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(12) United States Patent
Kim et al.**(10) Patent No.: US 10,038,146 B2****(45) Date of Patent: *Jul. 31, 2018****(54) ORGANIC LIGHT-EMITTING COMPOUND AND ORGANIC ELECTROLUMINESCENT DEVICE USING SAME***H01L 51/0085* (2013.01); *H01L 51/5016* (2013.01); *H01L 2251/308* (2013.01)**(71) Applicant: DOOSAN CORPORATION, Seoul (KR)****(58) Field of Classification Search**

None

See application file for complete search history.

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This patent is subject to a terminal disclaimer.

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(21) Appl. No.: 14/363,372**(22) PCT Filed: Dec. 7, 2012****(86) PCT No.: PCT/KR2012/010627**

§ 371 (c)(1),

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Sep. 21, 2012 (KR) 10-2012-0105048

(51) Int. Cl.**H01L 51/50** (2006.01)**H01L 51/00** (2006.01)**C09K 11/06** (2006.01)**C07D 471/04** (2006.01)**C07D 487/04** (2006.01)**(52) U.S. Cl.**CPC **H01L 51/0071** (2013.01); **C07D 471/04**(2013.01); **C07D 487/04** (2013.01); **C09K****11/06** (2013.01); **H01L 51/0067** (2013.01);**H01L 51/0072** (2013.01); **H01L 51/0074**(2013.01); **H01L 51/0094** (2013.01); **H01L****51/0052** (2013.01); **H01L 51/0081** (2013.01);

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Primary Examiner — Gregory D Clark*(74) Attorney, Agent, or Firm* — Sughrue Mion, PLLC**(57) ABSTRACT**

The present invention relates to a novel indole-based compound having superior hole injection and transport capabilities, light-emitting capabilities, and the like, and an organic electroluminescent device which comprises the indole-based compound in one or more organic layers thereof so as to thereby achieve improved characteristics, such as light-emitting efficiency, driving voltage, and lifespan characteristics.

9 Claims, No Drawings

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**ORGANIC LIGHT-EMITTING COMPOUND
AND ORGANIC ELECTROLUMINESCENT
DEVICE USING SAME**

CROSS REFERENCE TO RELATED
APPLICATIONS

This application is a National Stage of International Application No. PCT/KR2012/010627, filed on Dec. 7, 2012, which claims priority from Korean Patent Application Nos. 10-2011-0130547, filed on Dec. 7, 2011, and 10-2012-0105048, filed on Sep. 21, 2012, the contents of all of which are incorporated herein by reference in their entirety.

TECHNICAL FIELD

The present invention relates to a novel organic light-emitting compound and an organic electroluminescent device using the same, and more particularly, to a novel indole-based compound having superior hole injection and transport capabilities, light-emitting capabilities, and the like, and an organic electroluminescent device which comprises the indole-based compound in one or more organic layers thereof so as to thereby achieve improved characteristics, such as light-emitting efficiency, driving voltage, and lifespan characteristics.

BACKGROUND ART

In a study on an organic electroluminescent (EL) device (hereinafter, simply referred to as 'organic EL device'), which has continued from the start point of observation of an organic thin film light emission by Bernanose in the 1950s to blue electric light emission using an anthracene single crystal in 1965, an organic EL device having a lamination structure, which is divided into functional layers of a hole layer and a light emitting layer, was proposed by Tang in 1987, and the organic EL device has been developed in the form of introducing each characteristic organic layer into a device in order to manufacture the organic EL device having high efficiency and long lifespan, thereby leading to the development of specialized materials used therein.

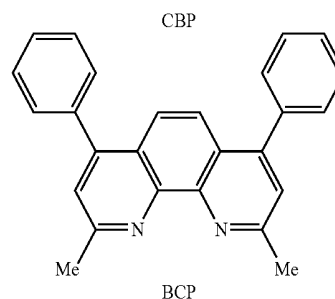
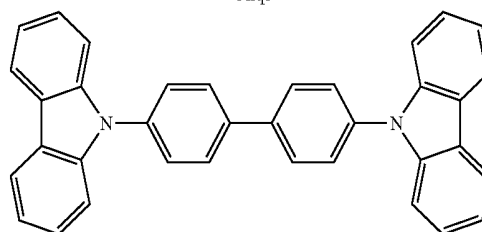
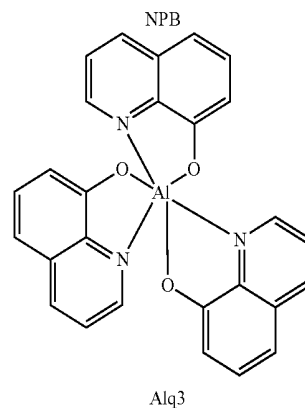
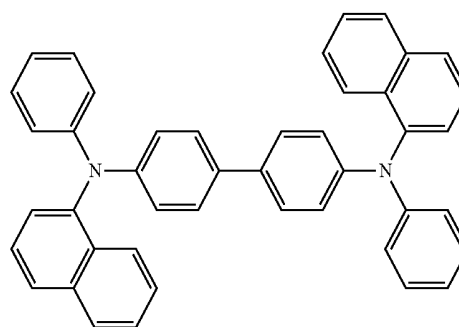
When voltage is applied between two electrodes of the organic EL device, holes are injected into the organic layer at the anode and electrons are injected into the organic layer at the cathode. When the injected holes and electrons meet each other, an exciton is formed, and the exciton falls down to a bottom state to emit light. Materials used as the organic layer may be classified into a light-emitting material, a hole injection material, a hole transporting material, an electron transporting material, an electron injection material, and the like according to the function.

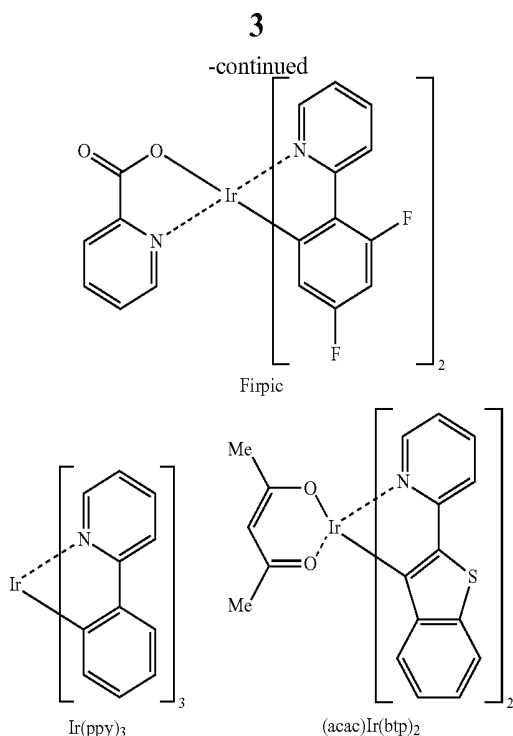
Materials for forming the light-emitting layer of the organic EL device may be divided into blue, green, and red light-emitting materials according to the light-emitting color. In addition, yellow and orange light-emitting materials are also used as a light-emitting material for implementing a much better natural color. Further, a host/dopant system may be used as a light-emitting material for the purpose of enhancing color purity and light-emitting efficiency through an energy transfer. Dopant materials may be

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divided into a fluorescent dopant using an organic material and a phosphorescent dopant in which a metal complex compound including heavy atoms such as Ir and Pt is used. Since the development of the phosphorescent material may theoretically enhance light-emitting efficiency by up to 4 times compared to the development of the fluorescent material, interests in not only phosphorescent dopant, but also phosphorescent host materials have been focused.

As the hole transporting layer, the hole blocking layer and the electron transporting layer, NPB, BCP, Alq₃ and the like represented by the following Formulae have been widely known until now, and for the light-emitting material, anthracene derivatives have been reported as a phosphorescent dopant/host material. In particular, for the phosphorescent material having a great advantage in terms of enhancing the efficiency, metal complex compounds including Ir, such as Firpic, Ir(ppy)₃ and (acac)Ir(btp)₂ are used as blue, green and red dopant materials. Until now, CBP exhibits excellent characteristics as a phosphorescent host material.





However, the existing materials are advantageous in terms of light emitting characteristics, but fall short of a level that sufficiently satisfies the lifespan in the organic EL device caused by the low glass transition temperature and very poor thermal stability.

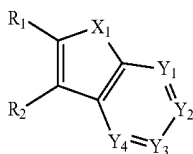
DISCLOSURE

Technical Problem

An object of the present invention is to provide an indole-based compound which may enhance driving voltage, light-emitting efficiency, and the like, and an organic EL device using the same.

Technical Solution

In order to achieve the above described object, the present invention provides a compound represented by the following Formula 1.



[Formula 1]

In the formula, R₁ and R₂ are each independently selected from the group consisting of hydrogen, deuterium, halogen, a cyano group, a nitro group, a C₁ to C₄₀ alkyl group, a C₃ to C₄₀ cycloalkyl group, a heterocycloalkyl group having 3 to 40 nuclear atoms, a C₆ to C₆₀ aryl group, a heteroaryl group having 5 to 60 nuclear atoms, a C₁ to C₄₀ alkoxy group, a C₆ to C₆₀ aryloxy group, a C₃ to C₄₀ alkylsilyl group, a C₆ to C₆₀ arylsilyl group, a C₂ to C₄₀ alkylboron group, a C₆ to C₆₀ arylboron group, a C₆ to C₆₀ arylphosphine group, a C₆ to C₆₀ arylphosphine oxide group and a C₆ to C₆₀ arylamine group,

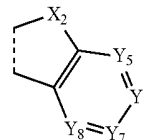
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Y₁ to Y₄ are each independently N or CR₃, and one of Y₁ and Y₂, Y₂ and Y₃, and Y₃ and Y₄ forms a fused ring represented by the following Formula 2,

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[Formula 2]



in the formula, Y₅ to Y₈ are each independently N or CR₄, and the dotted line means a site where fusion with the compound of Formula 1 occurs,

X₁ and X₂ are each independently selected from the group consisting of O, S, Se, N(Ar₁), C(Ar₂)(Ar₃) and Si(Ar₄)(Ar₅), and at least one of X₁ and X₂ is N(Ar₁).

R₃ and R₄ are each independently selected from the group consisting of hydrogen, deuterium, halogen, a cyano group, a nitro group, a C₁ to C₄₀ alkyl group, a C₃ to C₄₀ cycloalkyl group, a heterocycloalkyl group having 3 to 40 nuclear atoms, a C₆ to C₆₀ aryl group, a heteroaryl group having 5 to 60 nuclear atoms, a C₁ to C₄₀ alkoxy group, a C₆ to C₆₀ aryloxy group, a C₃ to C₄₀ alkylsilyl group, a C₆ to C₆₀ arylsilyl group, a C₂ to C₄₀ alkylboron group, a C₆ to C₆₀ aryl boron group, a C₆ to C₆₀ arylphosphine group, a C₆ to C₆₀ arylphosphine oxide group and a C₆ to C₆₀ arylamine group,

Ar₁ to Ar₅ are each independently selected from the group consisting of a C₁ to C₄₀ alkyl group, a C₃ to C₄₀ cycloalkyl group, a heterocycloalkyl group having 3 to 40 nuclear atoms, a C₆ to C₆₀ aryl group, a heteroaryl group having 5 to 60 nuclear atoms, a C₁ to C₄₀ alkoxy group, a C₆ to C₆₀ aryloxy group, a C₃ to C₄₀ alkylsilyl group, a C₆ to C₆₀ arylsilyl group, a C₂ to C₄₀ alkylboron group, a C₆ to C₆₀ aryl boron group, a C₆ to C₆₀ arylphosphine group, a C₆ to C₆₀ arylphosphine oxide group and a C₆ to C₆₀ arylamine group, and

the C₁ to C₄₀ alkyl group, the C₃ to C₄₀ cycloalkyl group, the heterocycloalkyl group having 3 to 40 nuclear atoms, the C₆ to C₆₀ aryl group, the heteroaryl group having 5 to 60 nuclear atoms, the C₁ to C₄₀ alkoxy group, the C₆ to C₆₀ aryloxy group, the C₃ to C₄₀ alkylsilyl group, the C₆ to C₆₀ arylsilyl group, the C₂ to C₄₀ alkylboron group, the C₆ to C₆₀ aryl boron group, the C₆ to C₆₀ arylphosphine group, the C₆ to C₆₀ arylphosphine oxide group and the C₆ to C₆₀ arylamine group of R₁ to R₄ and Ar₁ to Ar₅ may be each independently substituted with one or more substituents selected from the group consisting of deuterium, halogen, a cyano group, a nitro group, a C₁ to C₄₀ alkyl group, a C₃ to C₄₀ cycloalkyl group, a heterocycloalkyl group having 3 to 40 nuclear atoms, a C₆ to C₆₀ aryl group, a heteroaryl group having 5 to 60 nuclear atoms, a C₁ to C₄₀ alkoxy group, a C₆ to C₆₀ aryloxy group, a C₃ to C₄₀ alkylsilyl group, a C₆ to C₆₀ arylsilyl group, a C₂ to C₄₀ alkylboron group, a C₆ to C₆₀ aryl boron group, a C₆ to C₆₀ arylphosphine group, a C₆ to C₆₀ arylphosphine oxide group and a C₆ to C₆₀ arylamine group.

Herein, when Y₁ to Y₄ are all CR₃, R₃ may be the same as or different from each other, and adjacent R₃'s may combine with each other to form a fused ring. Further, when Y₅ to Y₈ are all CR₄, R₄ may also be the same as or different from each other, and adjacent R₄'s may combine with each other to form a fused ring.

In addition, when R_1 to R_4 and Ar_1 to Ar_5 are substituted with a plurality of substituents, the plurality of substituents may be the same as or different from each other.

The alkyl used in the present invention is a straight or branched saturated hydrocarbon having 1 to 40 carbon atoms, and examples thereof include methyl, ethyl, propyl, isobutyl, sec-butyl, pentyl, iso-amyl, hexyl, and the like.

Furthermore, the aryl used in the present invention means an aromatic part having 6 to 60 carbon atoms of a single ring or a combination of two or more rings, and the two or more rings may be simply pendant to each other or pendant to each other in a fused form. Examples of the aryl include phenyl, indenyl, naphthyl, anthracenyl, fluorenyl, phenanthryl, pyrenyl, chrysenyl, and the like.

Further, the heteroaryl used in the present invention means a monoheterocyclic or polyheterocyclic aromatic part having 5 to 60 nuclear atoms, and one or more carbons in the ring, preferably 1 to 3 carbons, are substituted with a hetero atom such as N, O, S, Si or Se. For the heteroaryl, it is interpreted that two or more rings may be simply pendant to each other or pendant to each other in a fused form, and furthermore, a form that is fused with an aryl group is also included. Examples of the heteroaryl include pyrazolyl, imidazolyl, oxazolyl, thiazolyl, triazolyl, tetrazolyl, oxadiazolyl, pyridinyl, pyrimidinyl, triazinyl, carbazolyl, indolyl, quinolinyl, isoquinolinyl, and the like.

The fused ring used in the present invention means a fused aliphatic ring, a fused aromatic ring, a fused heteroaliphatic ring, a fused heteroaromatic ring, or a combined form thereof.

Meanwhile, the present invention provides an organic electroluminescent device including (i) an anode, (ii) a cathode, and (iii) an organic layer having one or more layers interposed between the anode and the cathode, in which at least one in the organic layer having one or more layers includes the compound represented by Formula 1.

In this case, the organic layer including the compound represented by Formula 1 may be selected from the group consisting of a hole injection layer, a hole transporting layer, an electron transporting layer, an electron injection layer and a light-emitting layer.

Specifically, the organic layer including the compound represented by Formula 1 is a light-emitting layer, and the compound may be used as a phosphorescent host of the light-emitting layer.

BEST MODE

The present invention provides a novel indole-based compound having a molecular weight larger than that of a material for an organic electroluminescent device [for example: 4,4-dicarbazolybiphenyl (hereinafter, represented as CBP)] in the related art, and excellent driving voltage characteristics and efficiency. The indole-based compound of the present invention has a structure of a compound represented by the above Formula 1. In the organic electroluminescent device, a host molecule needs to have an energy level larger than that of a dopant molecule in order to have high light-emitting efficiency, and the compound of the present invention has a wide band gap (sky blue to red) because a fused carbon ring or a fused heterocyclic moiety, preferably a fused heterocyclic moiety is connected to an indole-based basic structure, and the energy level is controlled by various substituents. Accordingly, the compound of Formula 1 may minimize energy loss during the light-emitting process, thereby exhibiting an effect of improving light-emitting efficiency. Furthermore, these characteristics

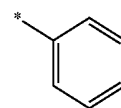
of the compound may improve hole injection and transport capabilities, light-emitting efficiency, driving voltage, lifespan characteristics, and the like as well as phosphorescent characteristics of the device. Further, the compound of Formula 1 may be applied to the hole transporting layer, the electron transporting layer, and the like as well as the light-emitting layer according to the type of substituent to be introduced.

In particular, due to the indole-based moiety, the compound of Formula 1 may exhibit excellent characteristics as a material for a light-emitting host (a material for a blue, green and/or red phosphorescent host, or a material for a fluorescent dopant) compared to the CBP in the related art. Further, the molecular weight of the compound is significantly increased in the indole-based basic structure due to various aromatic ring substituents, so that the glass transition temperature is enhanced, and accordingly, the compound of Formula 1 may have higher thermal stability than that of the CBP in the related art. Therefore, a device including the compound of the present invention may greatly enhance durability and lifespan characteristics.

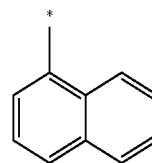
Herein, when a broad band-gap and thermal stability are considered, it is preferred that R_1 to R_4 of Formula 1 are each independently selected from the group consisting of hydrogen, a C_6 to C_{60} aryl group (for example: phenyl, naphthyl, and bisphenyl), a heteroaryl group having 5 to 60 nuclear atoms (for example: pyridine), and a C_6 to C_{60} arylamine group, and the C_6 to C_{60} aryl group, the heteroaryl group having 5 to 60 nuclear atoms, and the C_6 to C_{60} arylamine group of R_1 and R_2 may be substituted with one or more substituents selected from the group consisting of a C_1 to C_{40} alkyl group, a C_6 to C_{60} aryl group, and a heteroaryl group having 5 to 60 nuclear atoms.

In addition, when X_1 and/or X_2 of Formula 1 are(is) $N(Ar_1)$, $C(Ar_2)(Ar_3)$, or $Si(Ar_4)(Ar_5)$, it is preferred that Ar_1 to Ar_5 are each independently selected from the group consisting of a C_6 to C_{60} aryl group, a heteroaryl group having 5 to 60 nuclear atoms, and a C_6 to C_{60} arylamine group.

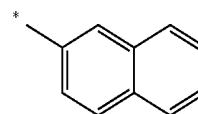
More preferably, R_1 to R_4 and Ar_1 to Ar_5 may be each independently selected from the group of the following substituents (Functional Groups S1 to S192).



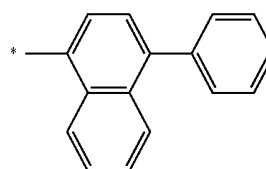
S1



S2



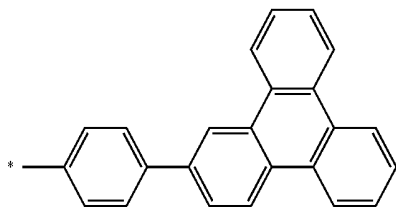
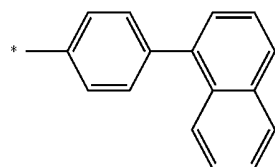
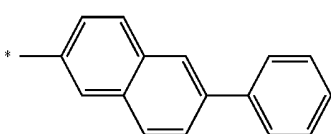
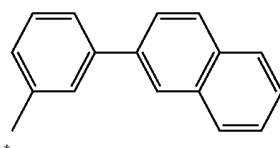
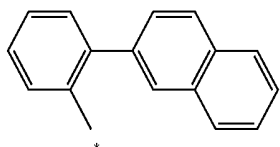
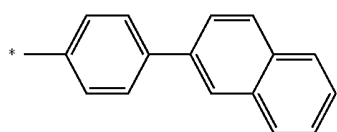
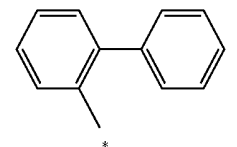
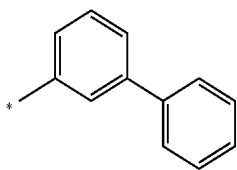
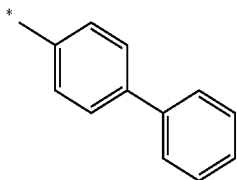
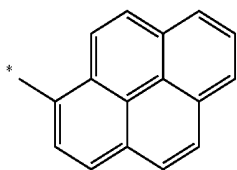
S3



S4

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S5

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S6

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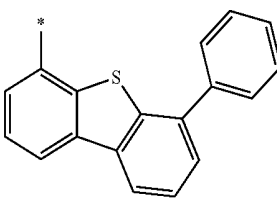
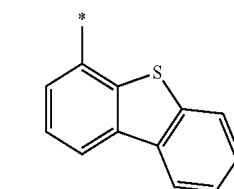
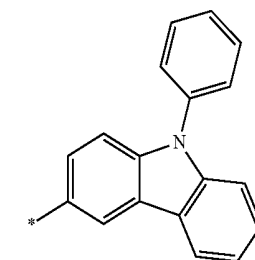
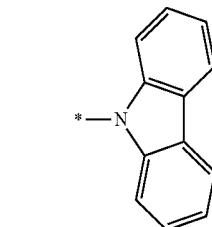
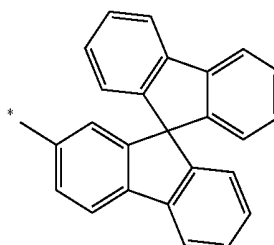
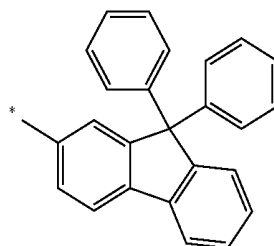
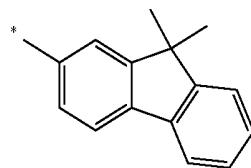
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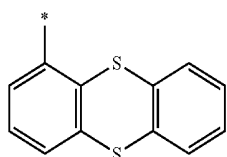
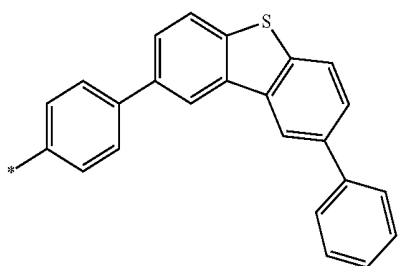
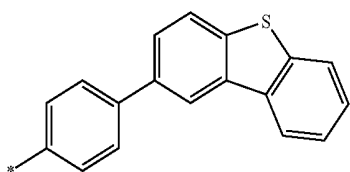
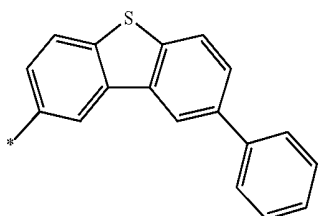
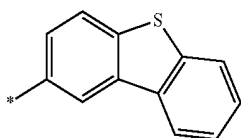
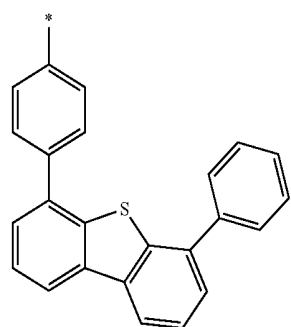
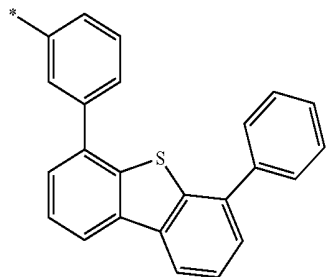
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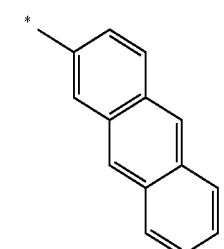
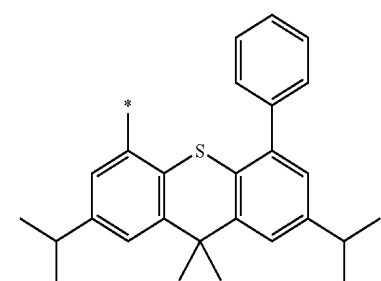
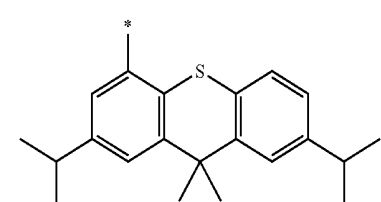
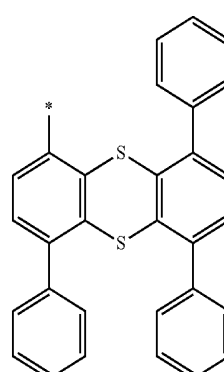
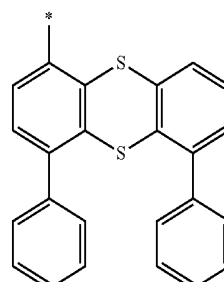
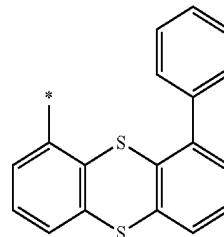
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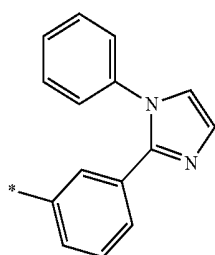
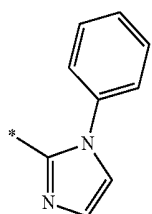
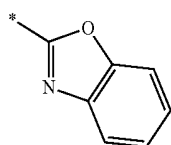
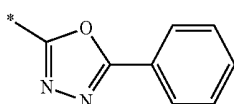
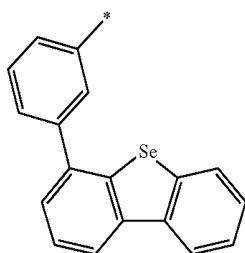
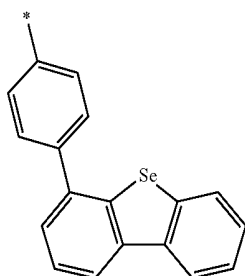
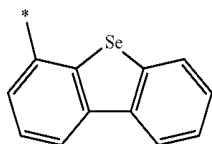
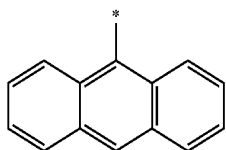
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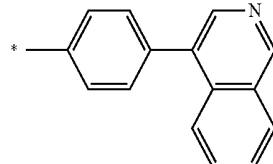
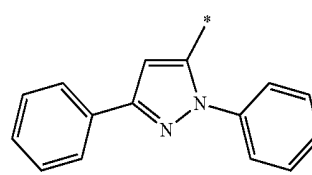
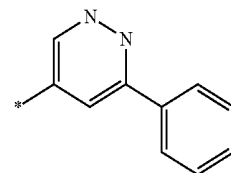
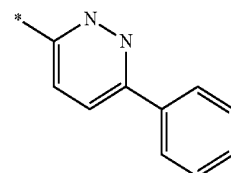
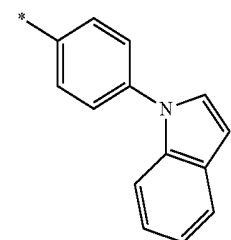
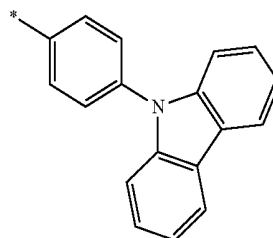
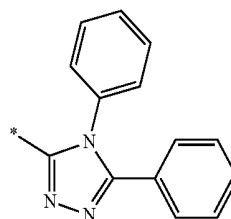
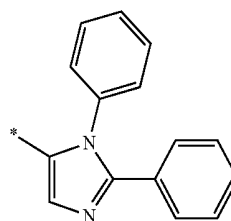
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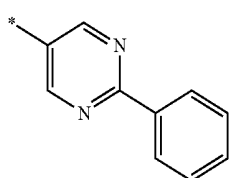
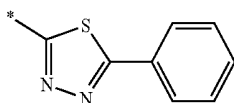
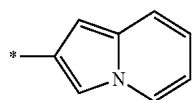
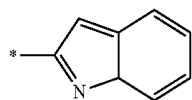
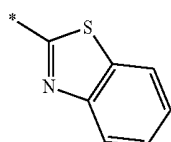
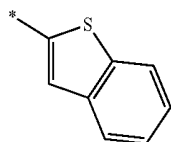
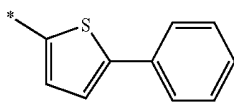
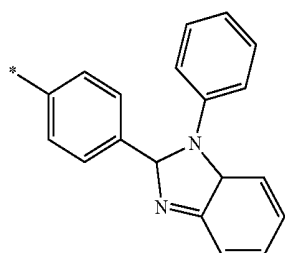
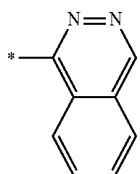
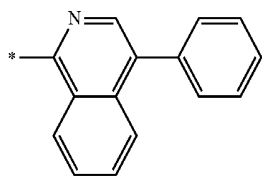
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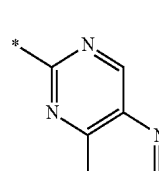
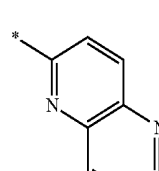
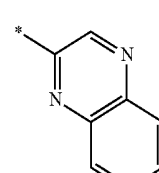
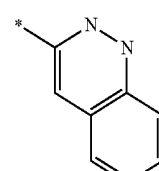
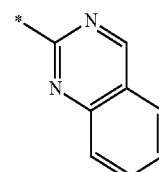
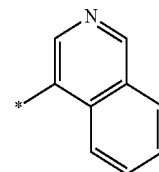
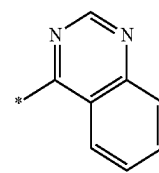
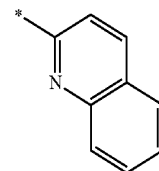
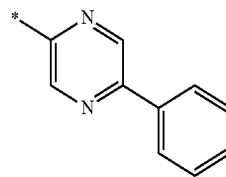
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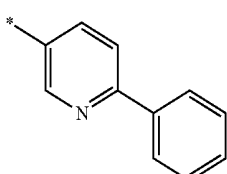
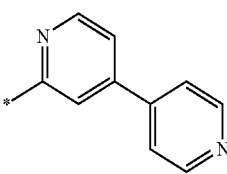
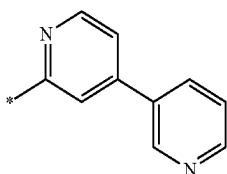
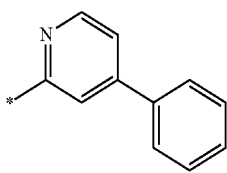
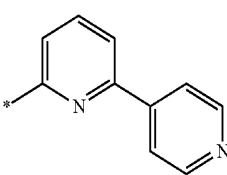
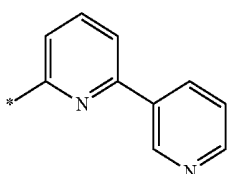
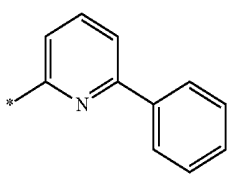
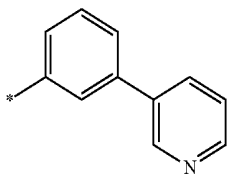
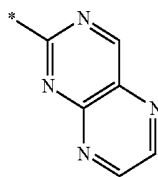
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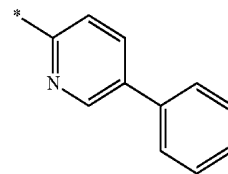


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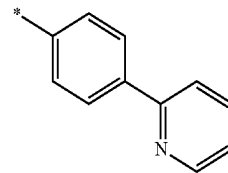
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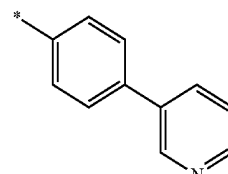


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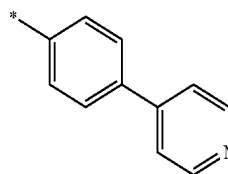
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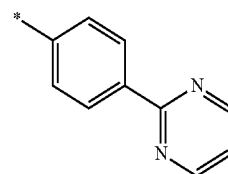


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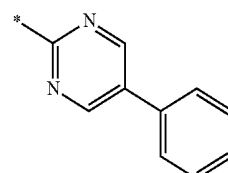
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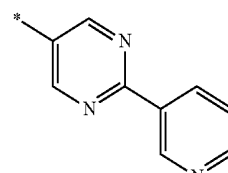
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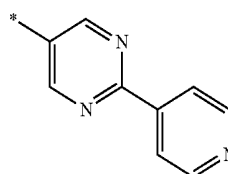


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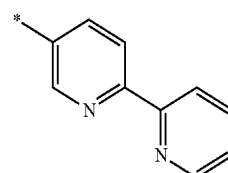
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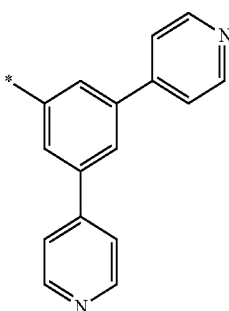
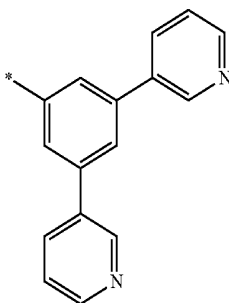
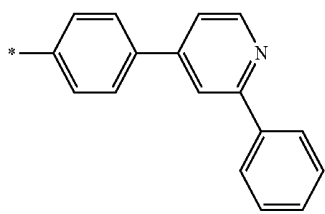
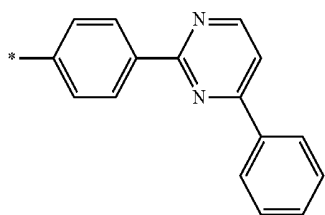
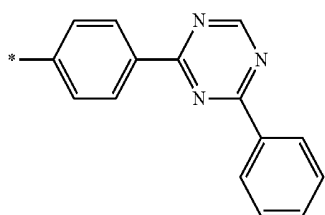
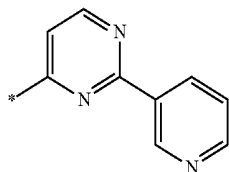
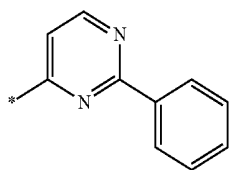


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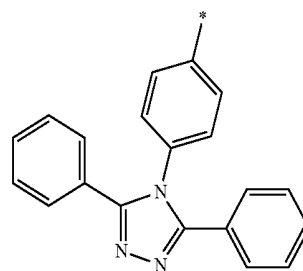


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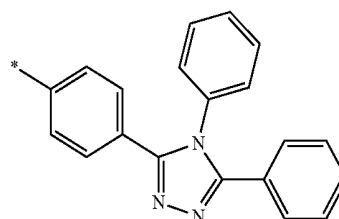
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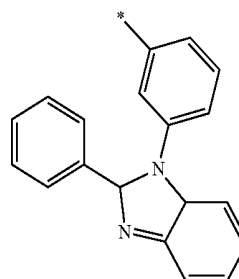
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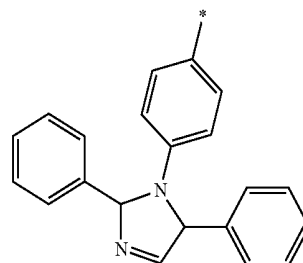
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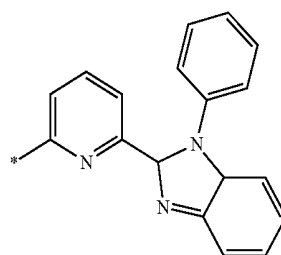
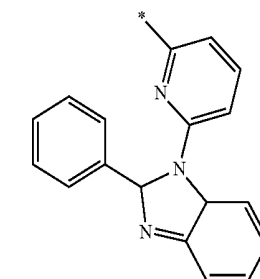


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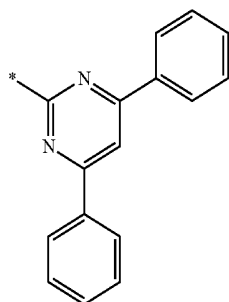
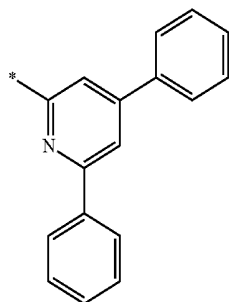
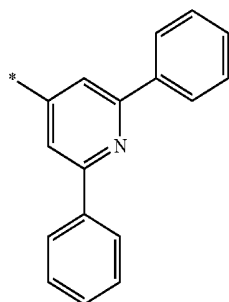
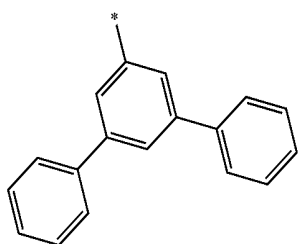
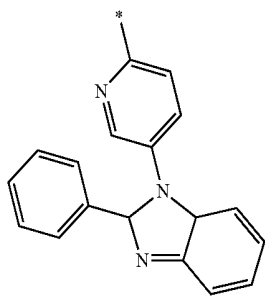
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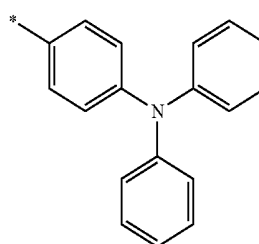
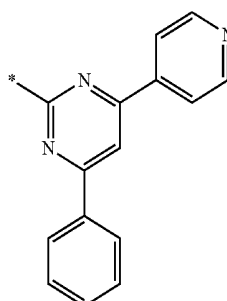
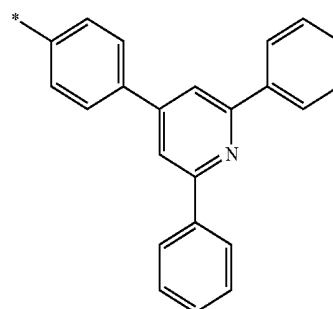
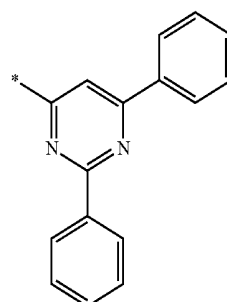
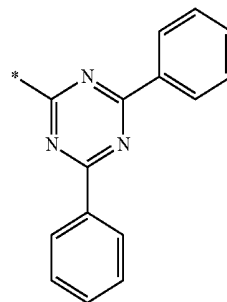
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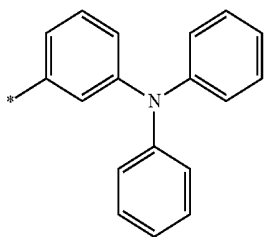
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S109

S110

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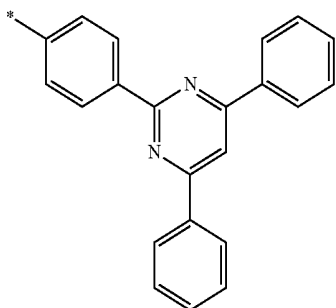
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S111

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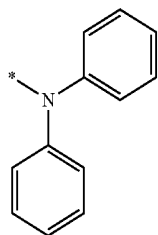
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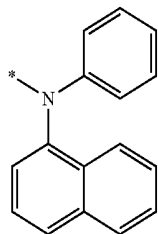
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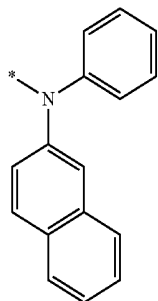
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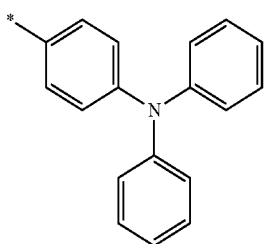
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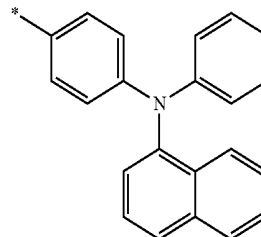
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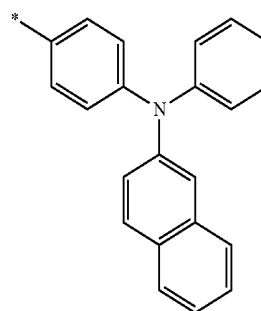


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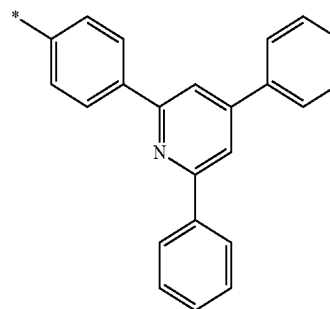
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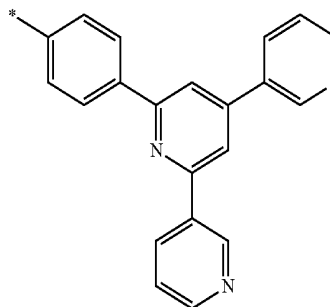
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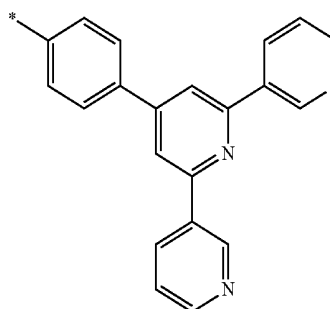
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S119



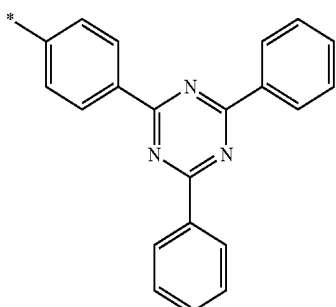
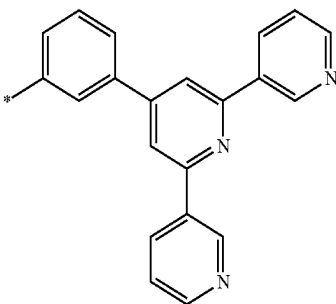
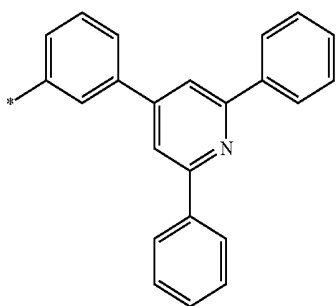
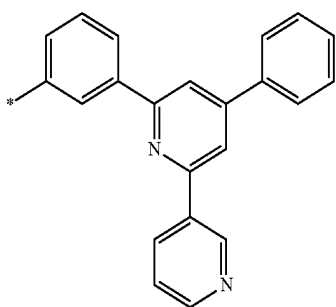
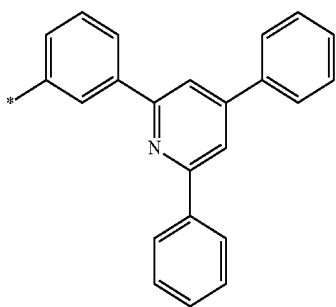
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S121

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S122

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S123

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S124

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S125

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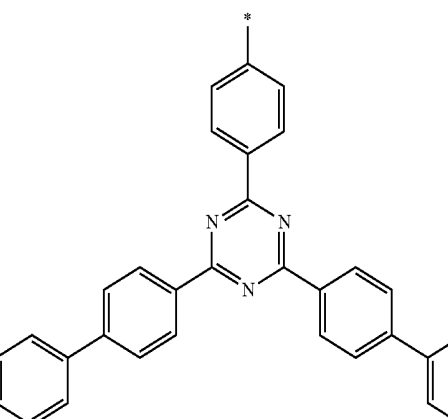
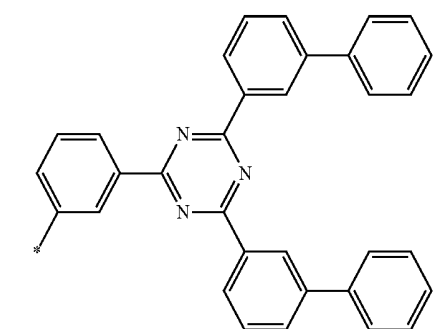
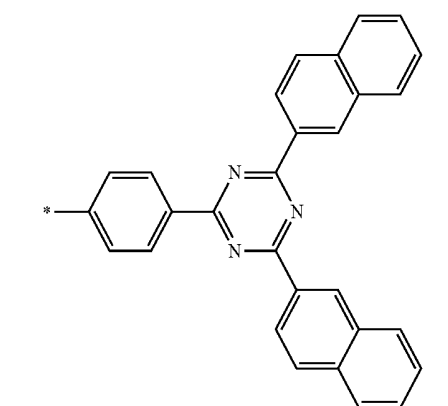
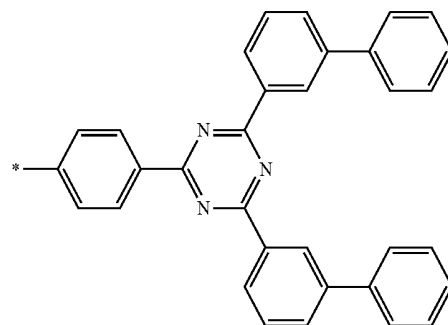
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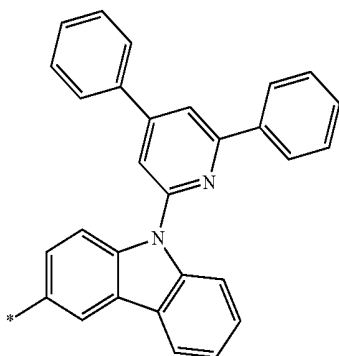
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S129

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S131

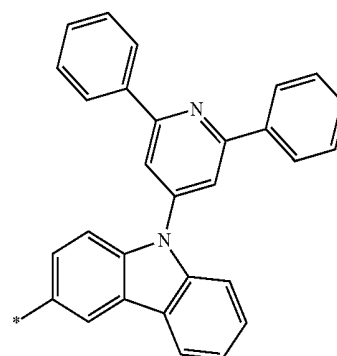
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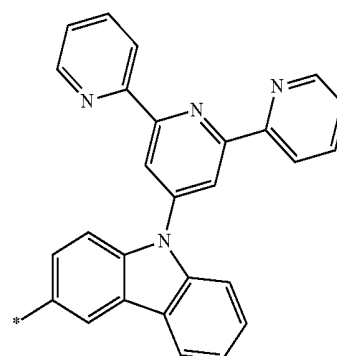
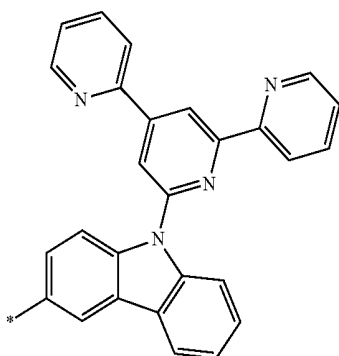
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S132

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S136

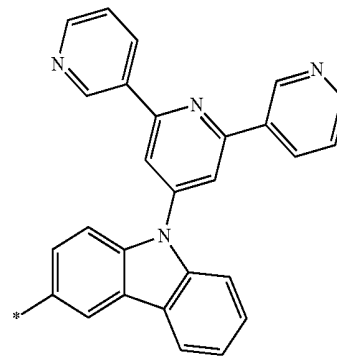
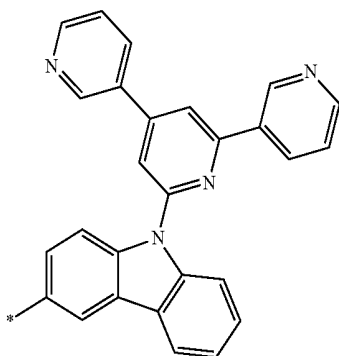
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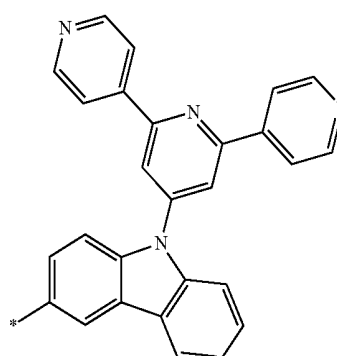
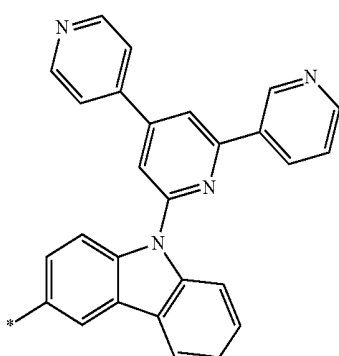
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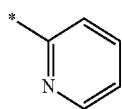
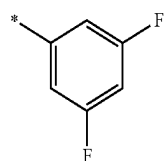
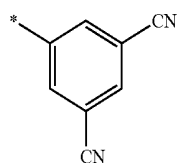
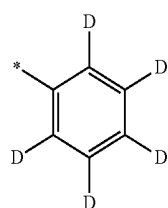
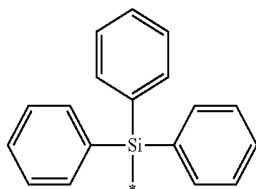
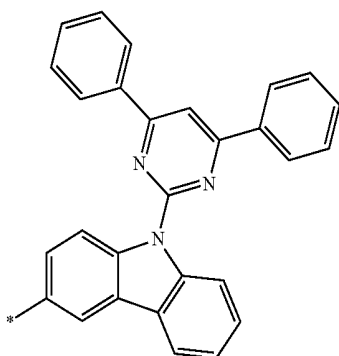
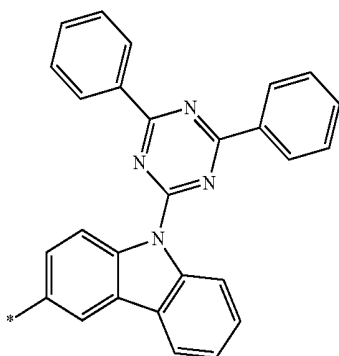
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S138

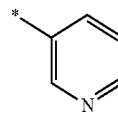
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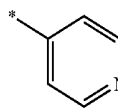
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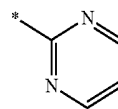
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S147

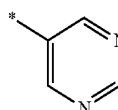
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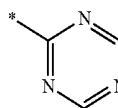
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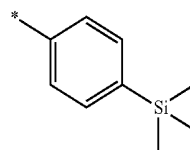
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S150

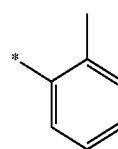
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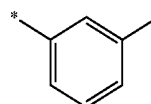
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S152

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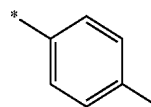
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S153

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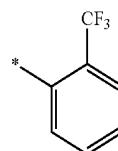
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S154

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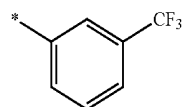
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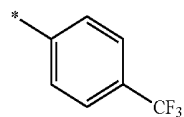
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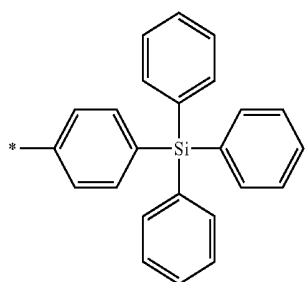
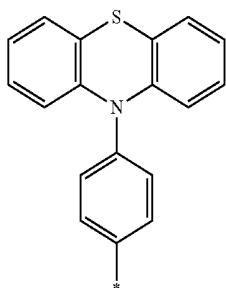
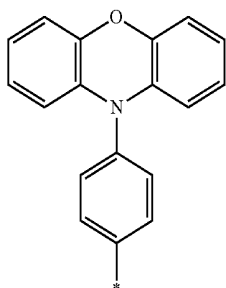
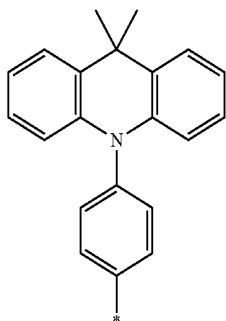
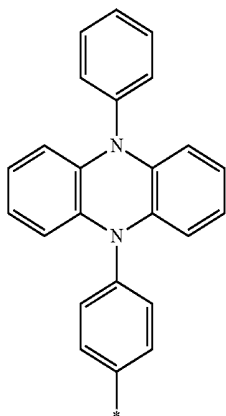
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S157

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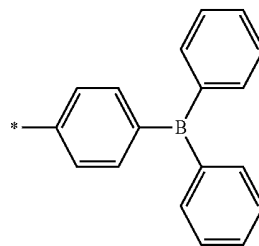


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S158

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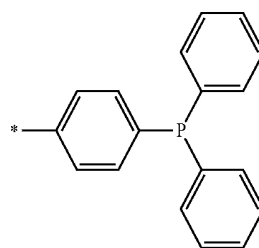


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S159

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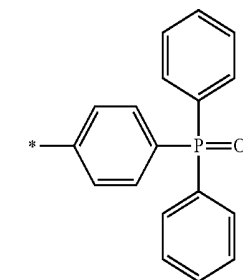


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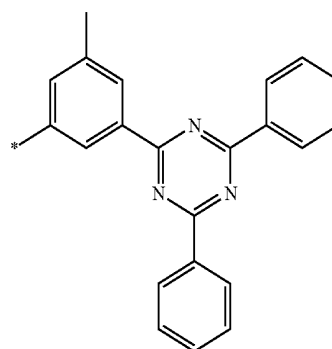
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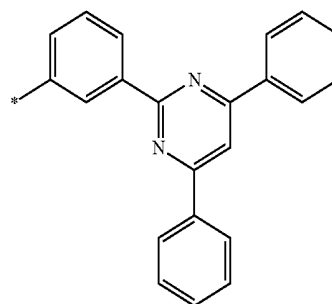


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S162

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S163

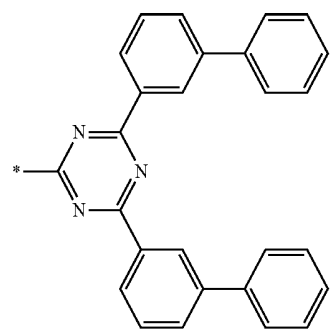
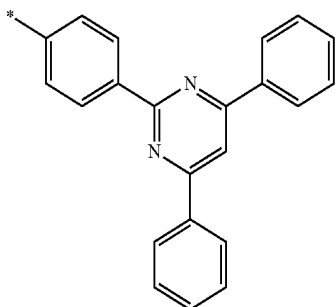
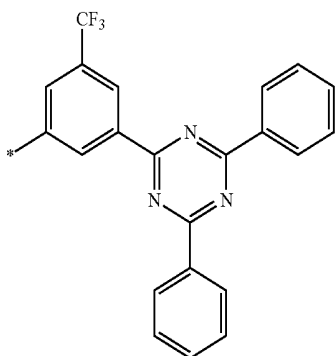
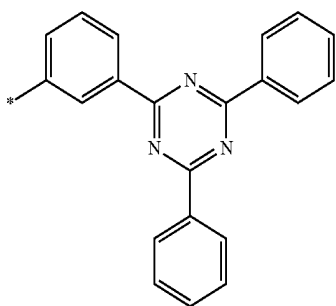
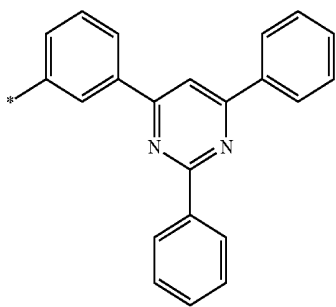
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S165

S166

S167

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S168

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S169

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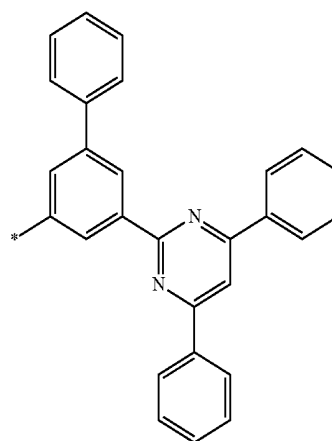
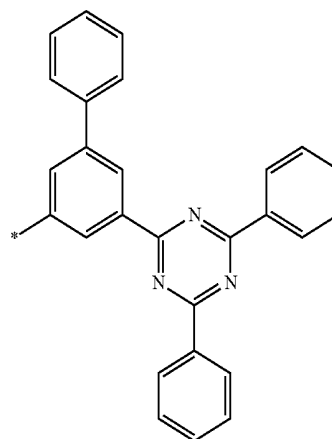
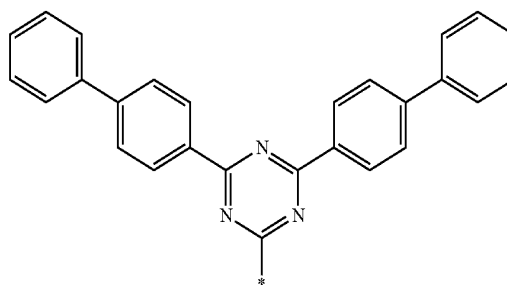
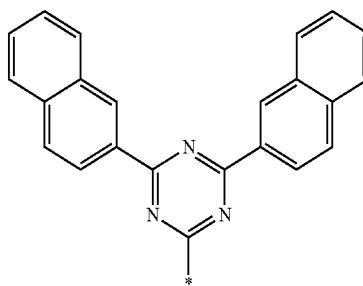
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S173

S174

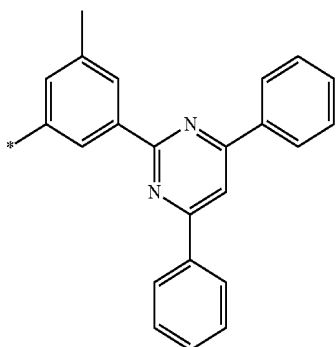
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S176



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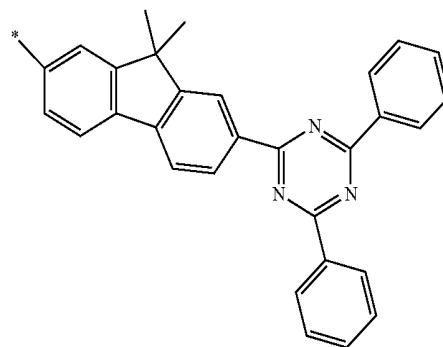


S177

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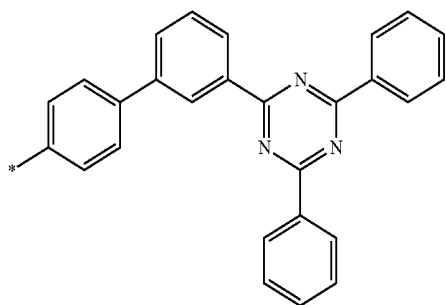


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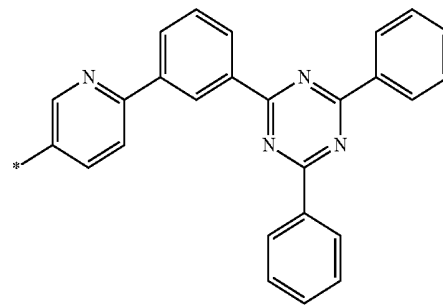
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S178

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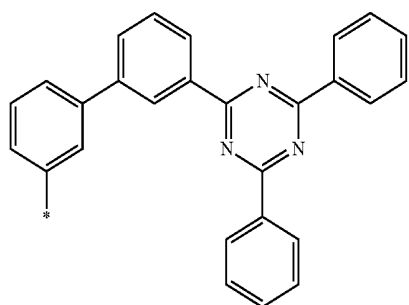


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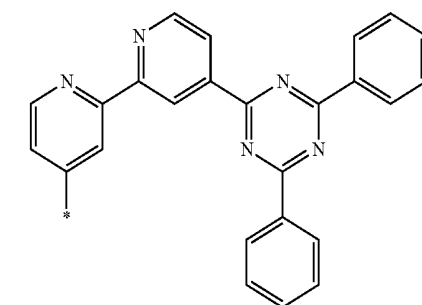
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S179

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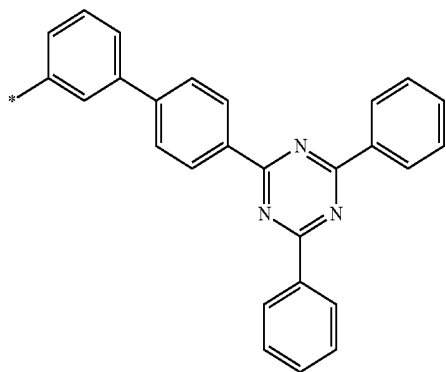
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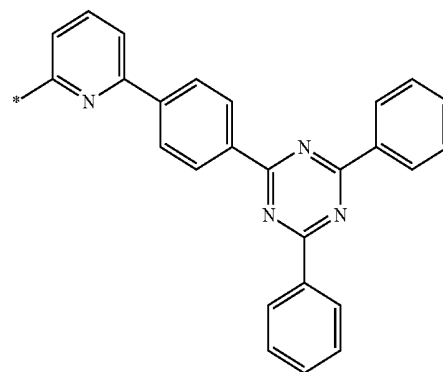
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S180

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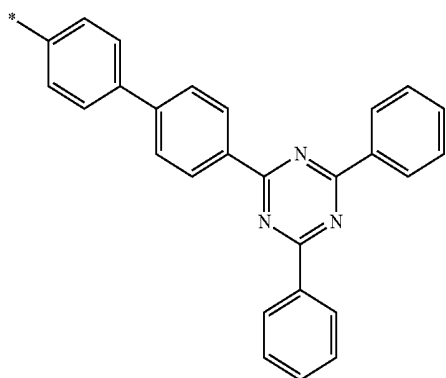


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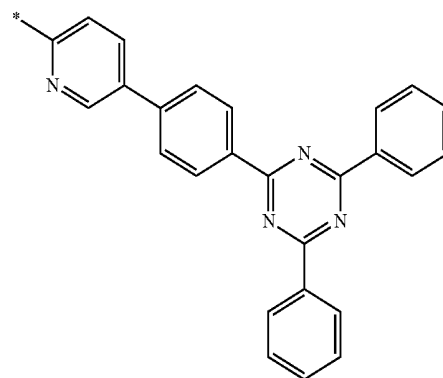
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S181

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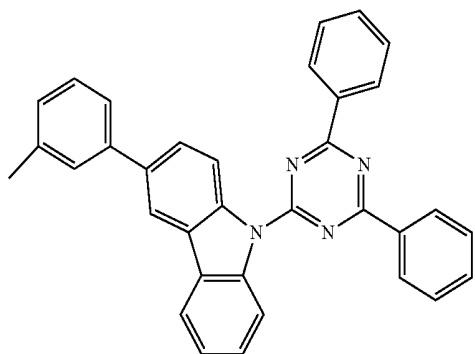


S186

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S187

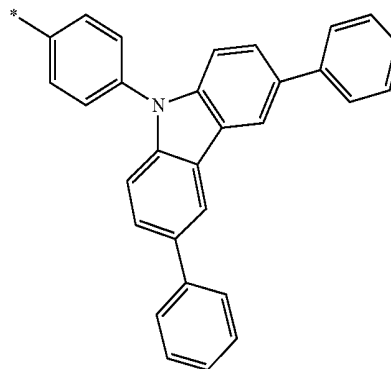
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S191

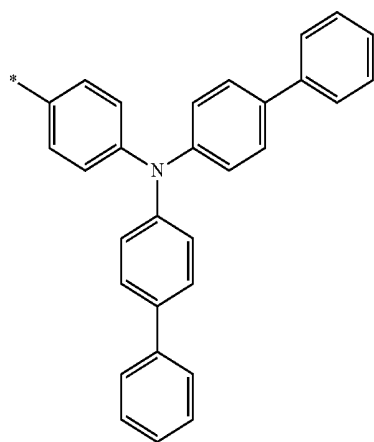
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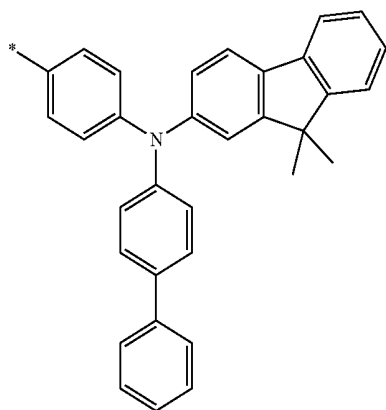
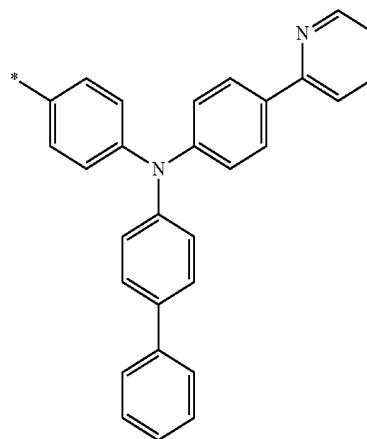
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S189 35



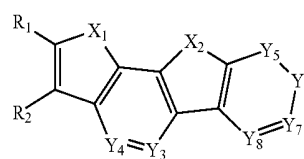
S192



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It is preferred that these compounds represented by Formula 1 according to the present invention are selected from the group consisting of the compounds represented by the following Formulae 1a to 1f.

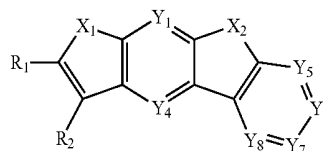
[Formula 1a]



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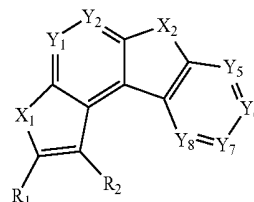
S190 50

[Formula 1b]

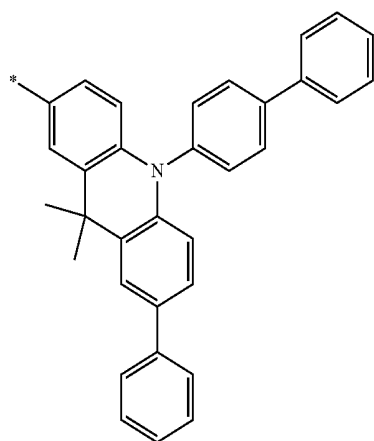


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[Formula 1c]

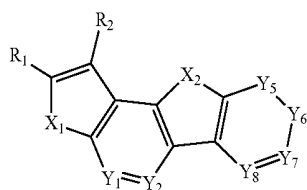


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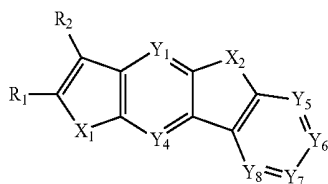


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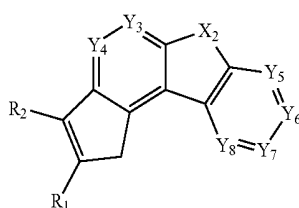
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[Formula 1d]



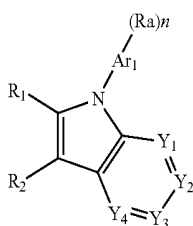
[Formula 1e]



[Formula 1f]

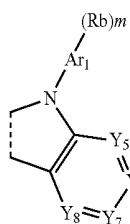
In Formulae 1a to 1f, R_1 , R_2 , X_1 , X_2 and Y_1 to Y_8 are the same as those defined above.

Furthermore, when the driving voltage and the current efficiency of the organic electroluminescent device are considered, it is preferred that in the compound represented by Formula 1 according to the present invention, both X_1 and X_2 are $N(Ar_1)$. Specifically, the compound represented by Formula 1 according to the present invention may be a compound represented by the following Formula 3.



[Formula 3]

In Formula 3, R_1 , R_2 , and Y_1 to Y_4 are the same as those defined above, and one of Y_1 and Y_2 , Y_2 and Y_3 , and Y_3 and Y_4 forms a fused ring represented by the following Formula 4,



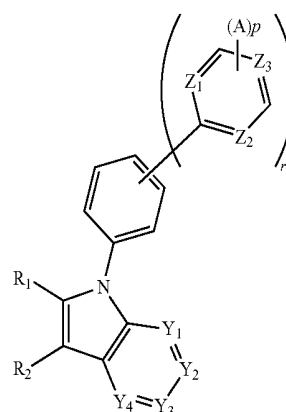
[Formula 4]

in Formula 4, Y_5 to Y_8 are the same as those defined above, the dotted line means a site where fusion with the compound of Formula 3 occurs, Ar_1 is a C_6 to C_{60} aryl group, or a heteroaryl group having 5 to 60 nuclear

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R_a and R_b are each independently selected from the group consisting of hydrogen, deuterium, halogen, a cyano group, a nitro group, a C_1 to C_{40} alkyl group, a C_3 to C_{40} cycloalkyl group, a heterocycloalkyl group having 3 to 40 nuclear atoms, a C_6 to C_{60} aryl group, a heteroaryl group having 5 to 60 nuclear atoms, a C_1 to C_{40} alkyloxy group, a C_6 to C_{60} aryloxy group, a C_3 to C_{40} alkylsilyl group, a C_6 to C_{60} arylsilyl group, a C_2 to C_{40} alkylboron group, a C_6 to C_{60} aryl boron group, a C_6 to C_{60} arylphosphine group, a C_6 to C_{60} arylphosphine oxide group and a C_6 to C_{60} arylamine group, and the C_1 to C_{40} alkyl group, the C_3 to C_{40} cycloalkyl group, the heterocycloalkyl group having 3 to 40 nuclear atoms, the C_6 to C_{60} aryl group, the heteroaryl group having 5 to 60 nuclear atoms, the C_1 to C_{40} alkyloxy group, the C_6 to C_{60} aryloxy group, the C_3 to C_{40} alkylsilyl group, the C_6 to C_{60} arylsilyl group, the C_2 to C_{40} alkylboron group, the C_6 to C_{60} aryl boron group, the C_6 to C_{60} arylphosphine group, the C_6 to C_{60} arylphosphine oxide group and the C_6 to C_{60} arylamine group of R_a and R_b may be each independently substituted with one or more substituents selected from the group consisting of deuterium, halogen, a cyano group, a nitro group, a C_1 to C_{40} alkyl group, a C_3 to C_{40} cycloalkyl group, a heterocycloalkyl group having 3 to 40 nuclear atoms, a C_6 to C_{60} aryl group, a heteroaryl group having 5 to 60 nuclear atoms, a C_1 to C_{40} alkyloxy group, a C_6 to C_{60} aryloxy group, a C_3 to C_{40} alkylsilyl group, a C_6 to C_{60} arylsilyl group, a C_2 to C_{40} alkylboron group, a C_6 to C_{60} aryl boron group, a C_6 to C_{60} arylphosphine group, a C_6 to C_{60} arylphosphine oxide group and a C_6 to C_{60} arylamine group, and n and m are each independently an integer of 0 to 5, provided that $n+m$ is at least 1 or more. Herein, when the structure of Formula 3 is reviewed, Ar_1 may also be interpreted to be a divalent functional group, such as a C_6 to C_{60} arylene group, or a heteroarylene group having 5 to 60 nuclear atoms.

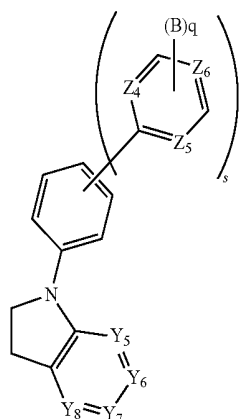
More preferably, the compound represented by Formula 1 according to the present invention may be a compound represented by the following Formula 5.



[Formula 5]

in Formula 5, R_1 , R_2 , and Y_1 to Y_4 are the same as those defined above, and one of Y_1 and Y_2 , Y_2 and Y_3 , and Y_3 and Y_4 forms a fused ring represented by the following Formula 6,

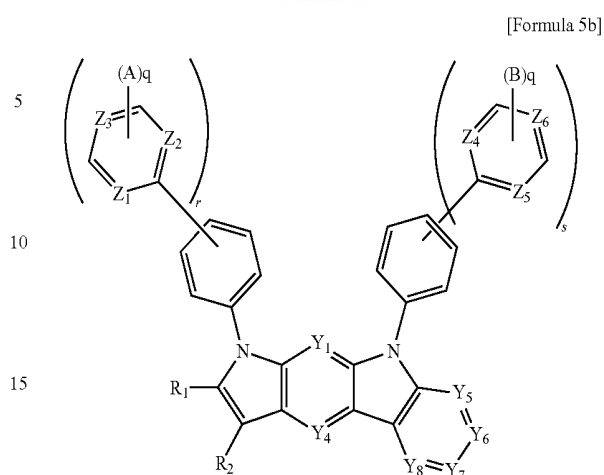
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[Formula 6]

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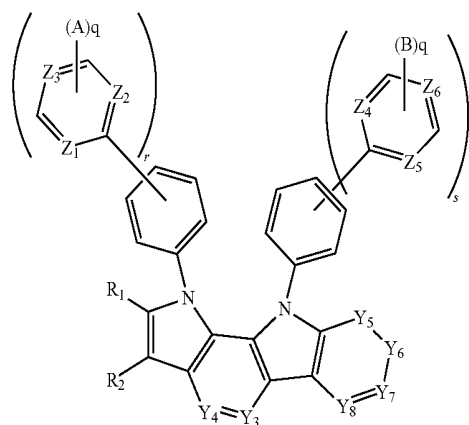
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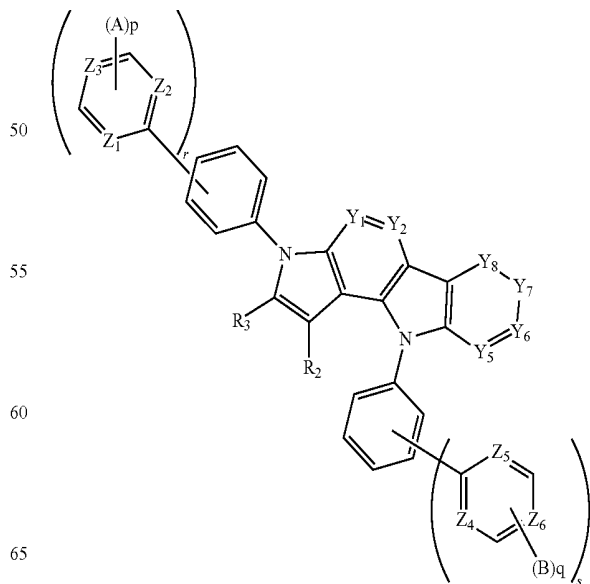
[Formula 5b]

in Formula 6, Y_5 to Y_8 are the same as those defined above, the dotted line means a site where fusion with the compound of Formula 5 occurs, Z_1 to Z_6 are each independently N or CAr_6 , and Ar_6 , A and B are each independently selected from the group consisting of a C_1 to C_{40} alkyl group, a C_3 to C_{40} cycloalkyl group, a heterocycloalkyl group having 3 to 40 nuclear atoms, a C_6 to C_{60} aryl group, a heteroaryl group having 5 to 60 nuclear atoms, a C_1 to C_{40} alkyloxy group, a C_6 to C_{60} aryloxy group, a C_3 to C_{40} alkylsilyl group, a C_6 to C_{60} arylsilyl group, a C_2 to C_{40} alkylboron group, a C_6 to C_{60} aryl boron group, a C_6 to C_{60} arylphosphine group, a C_6 to C_{60} arylphosphine oxide group and a C_6 to C_{60} arylamine group, r and s are each an integer of 0 to 5, provided that $r+s$ is at least 1 or more, and p and q are each an integer of 0 to 3.

In this case, the compound represented by Formula 5 may be selected from the group consisting of the compounds represented by the following Formulae 5a to 5f.



[Formula 5a]

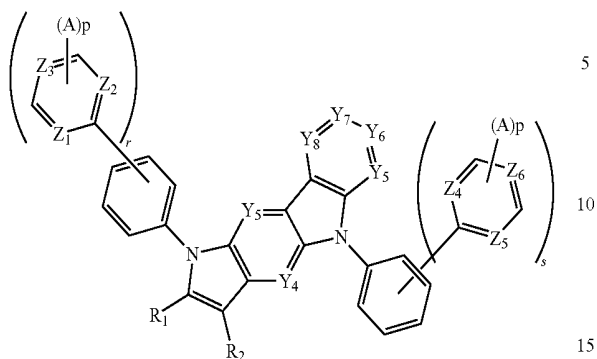


[Formula 5d]

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[Formula 5e]

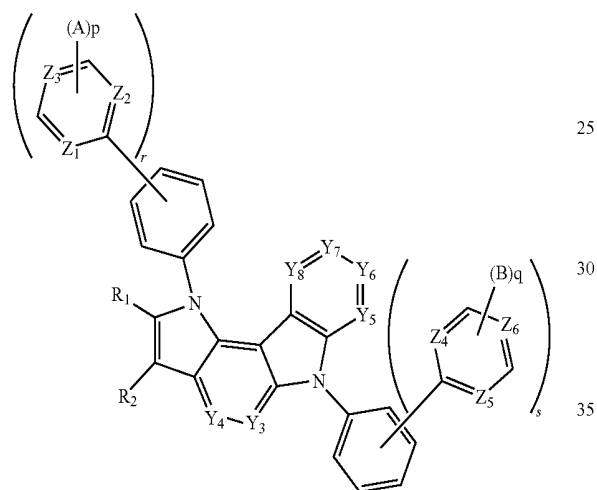


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[Formula 5f]



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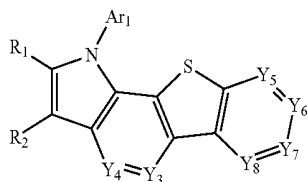
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In Formulae 5a to 5f, R_1 , R_2 , Y_1 to Y_8 , Z_1 to Z_6 , A, B, r, s, p and q are the same as those defined above.

Further, it is preferred that Ar_6 , A, and B of the compound represented by Formula 5 are each independently selected from the group consisting of a C_6 to C_{60} aryl group, a heteroaryl group having 5 to 60 nuclear atoms and a C_6 to C_{60} arylamine group.

Meanwhile, when the driving voltage and the current efficiency of the organic electroluminescent device are considered, it is preferred that in the compound represented by Formula 1 according to the present invention, X_2 is $N(Ar_1)$ when X_1 is S, and X_1 is N(Ar_1) when X_2 is S. Specifically, the compound represented by Formula 1 according to the present invention may be selected from the group consisting of the compounds represented by the following Formulae 6a to 6l.

[Formula 6a]

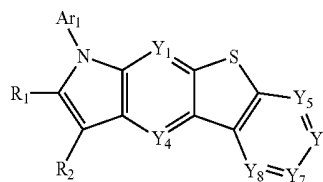


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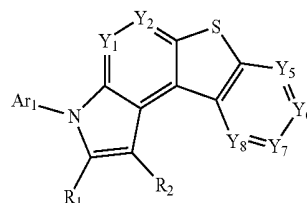
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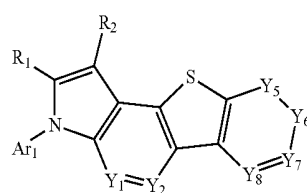
[Formula 6b]



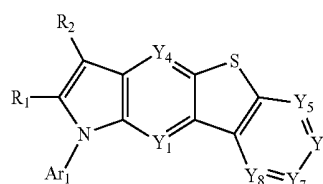
[Formula 6c]



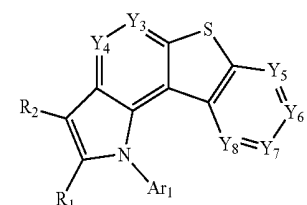
[Formula 6d]



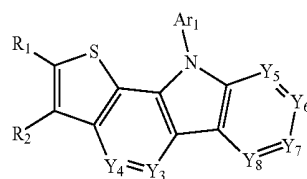
[Formula 6e]



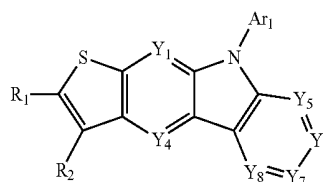
[Formula 6f]



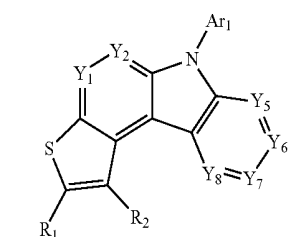
[Formula 6g]



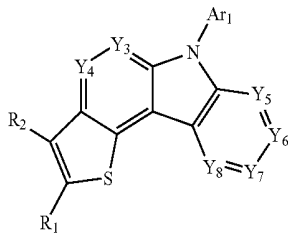
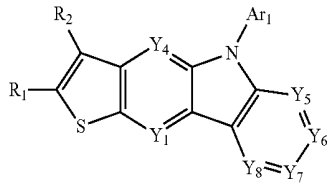
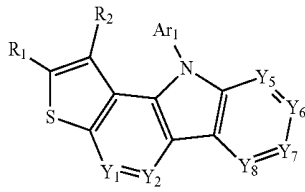
[Formula 6h]



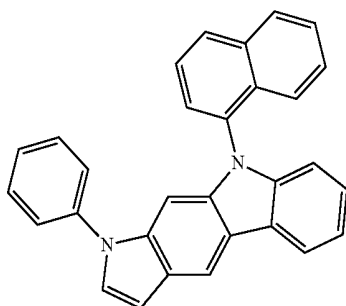
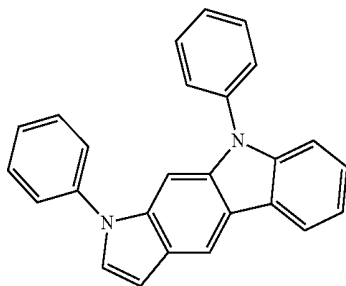
[Formula 6i]



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In the formulae, R_1 , R_2 , Y_1 to Y_8 , and Ar_1 are the same as those defined above. Specific examples of the aforementioned compound represented by Formula 1 according to the present invention include the following compounds (1 to 1583), but the compound of the present invention is not limited to the following compounds.



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[Formula 6j]

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[Formula 6k]

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[Formula 6l]

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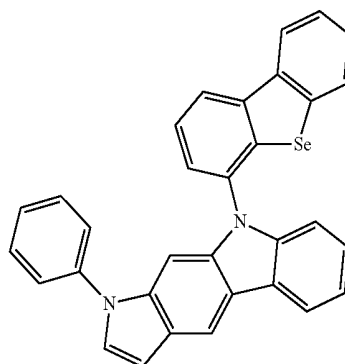
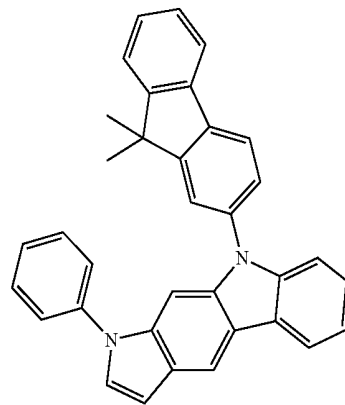
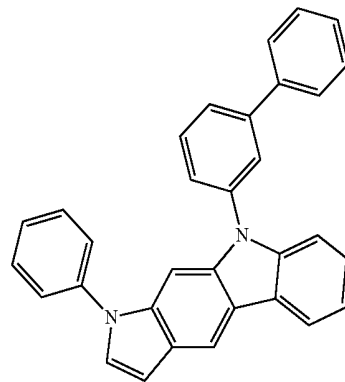
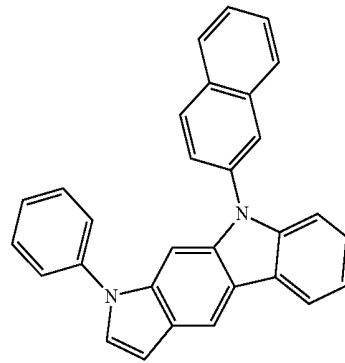
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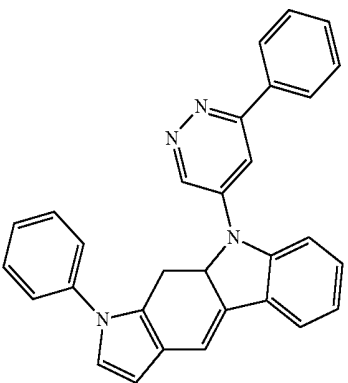
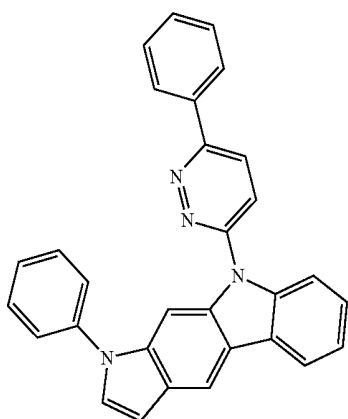
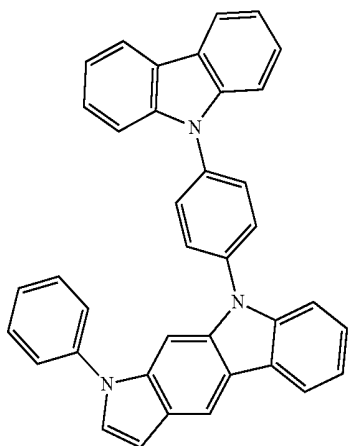
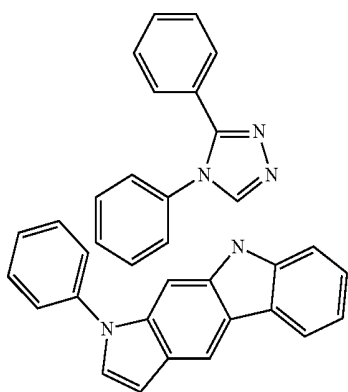
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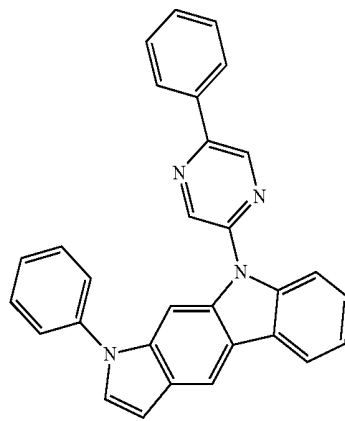
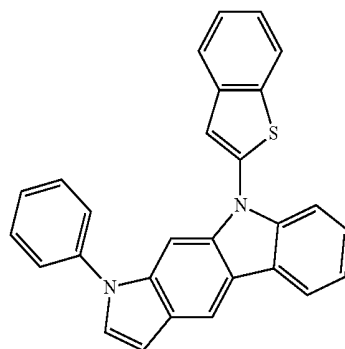
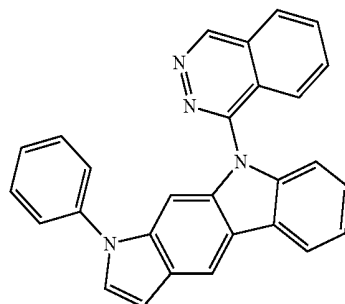
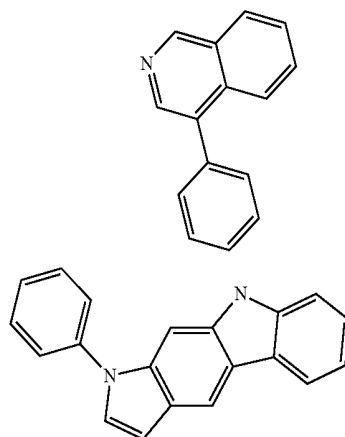
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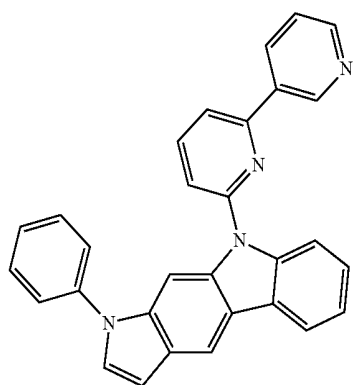
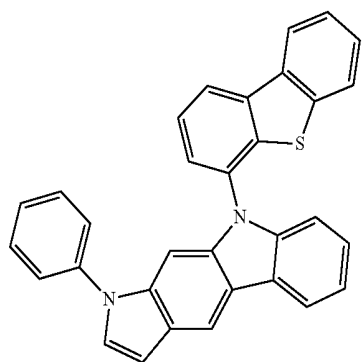
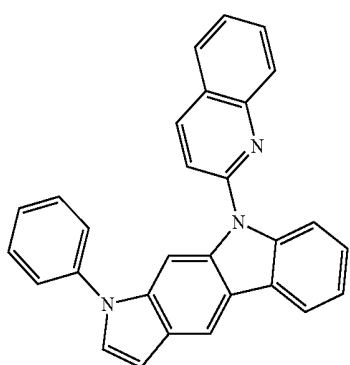
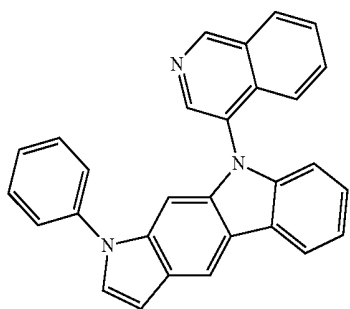
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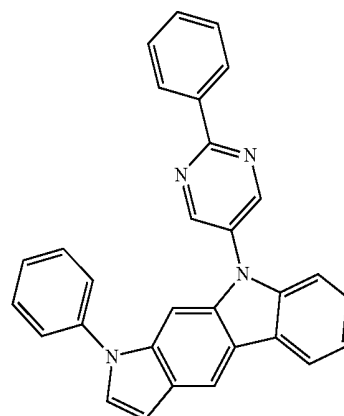


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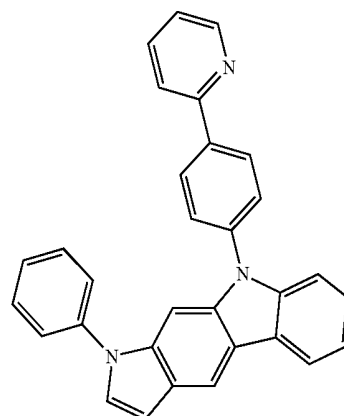
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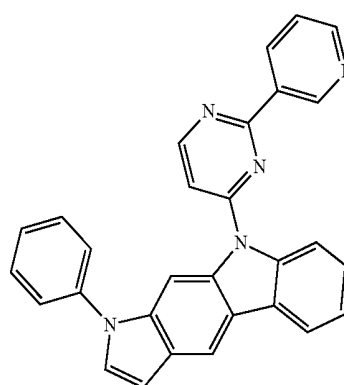
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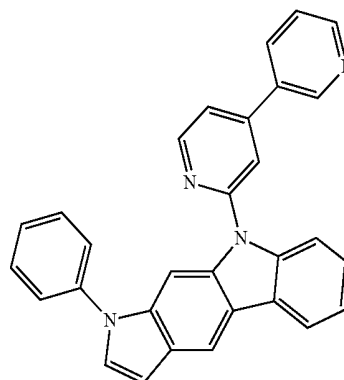


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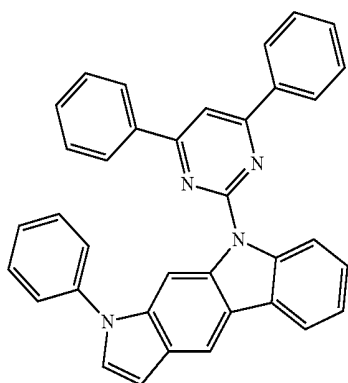
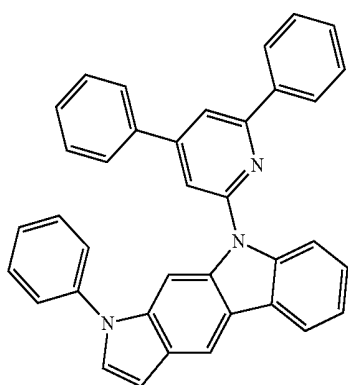
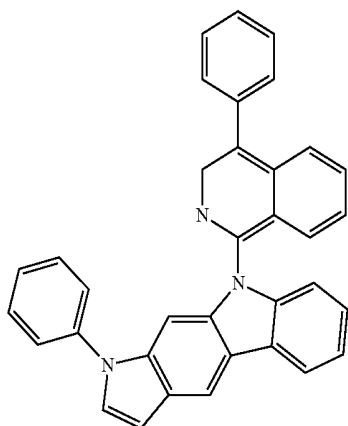
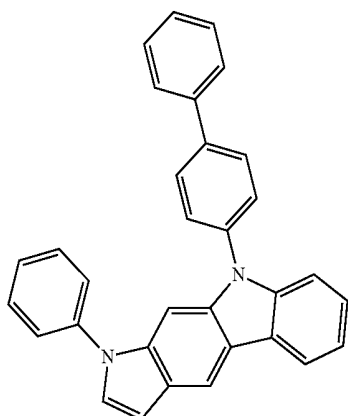


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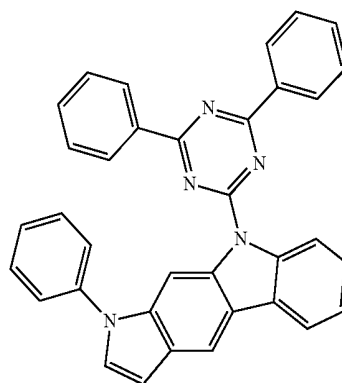
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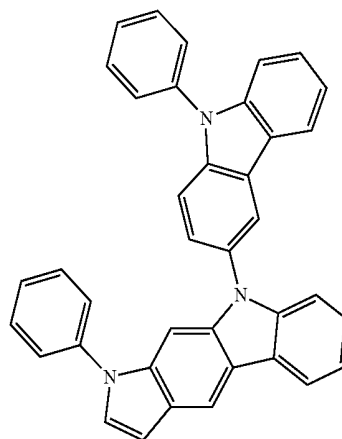
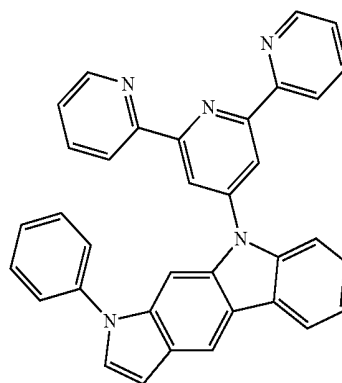
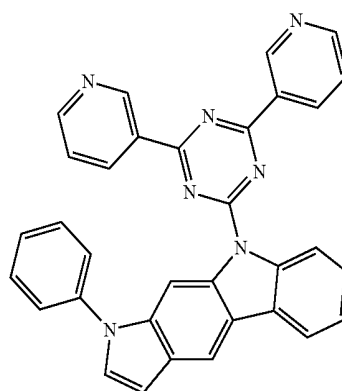
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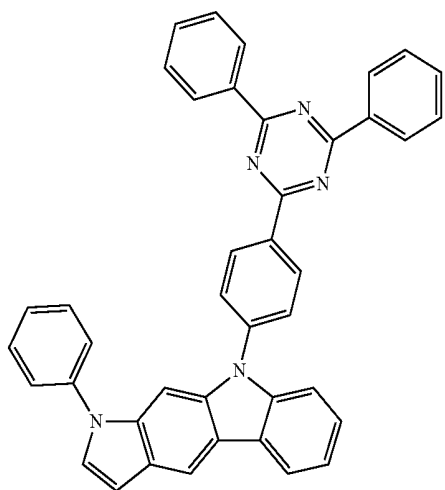
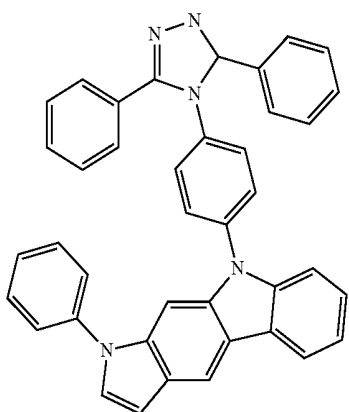
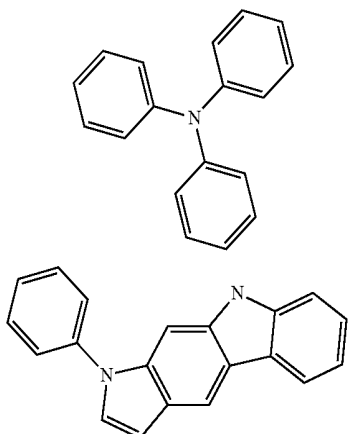
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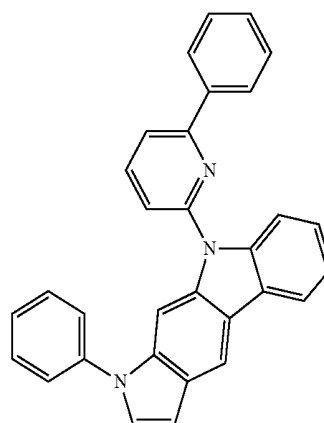
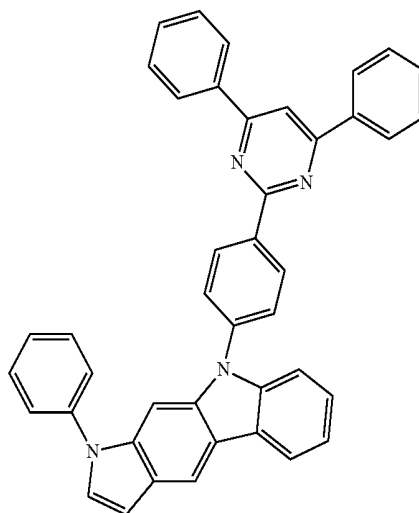
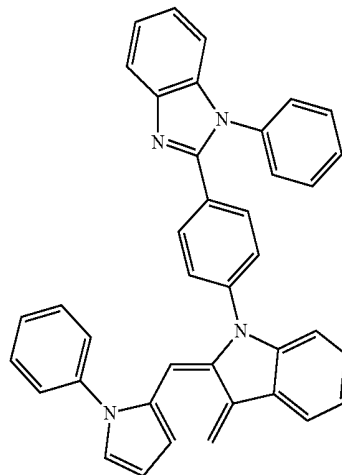
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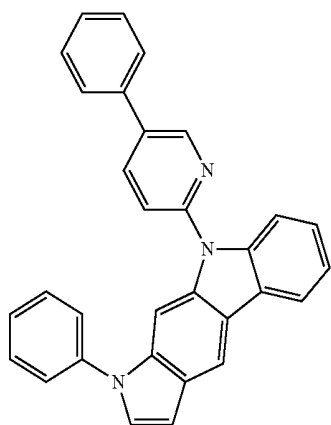
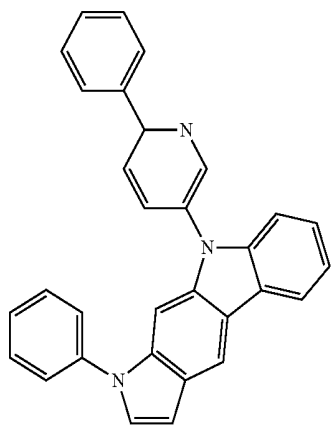
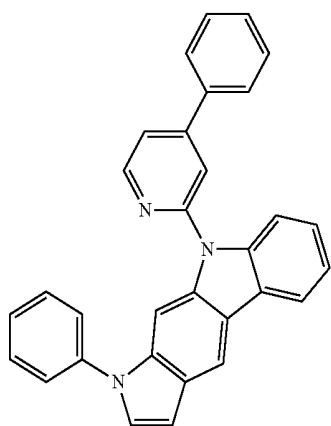
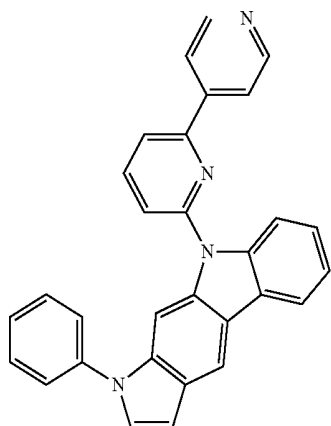
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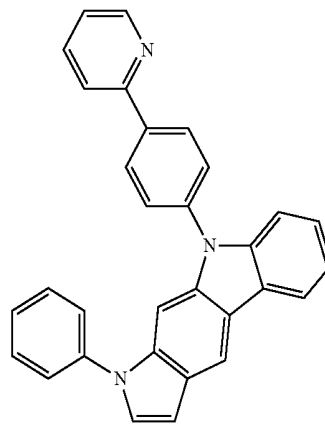
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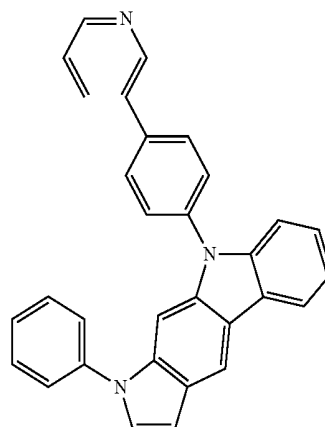
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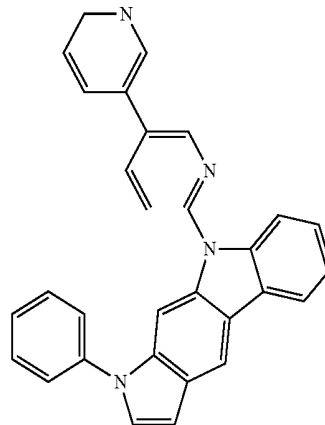
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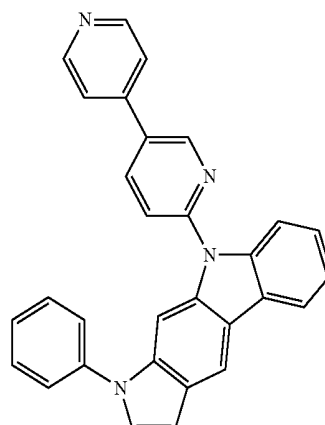
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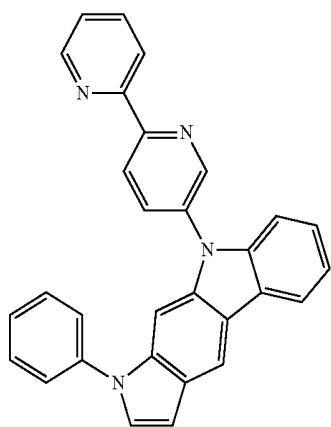
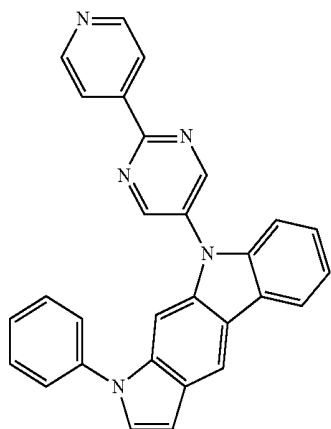
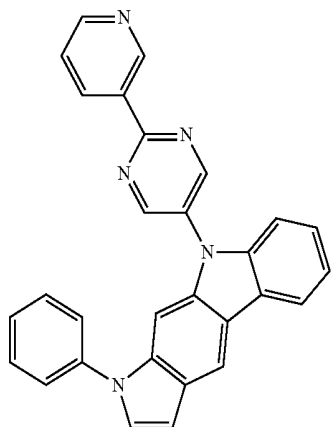
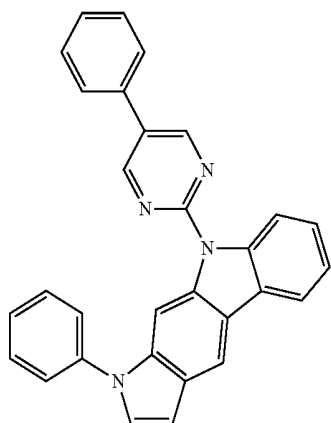
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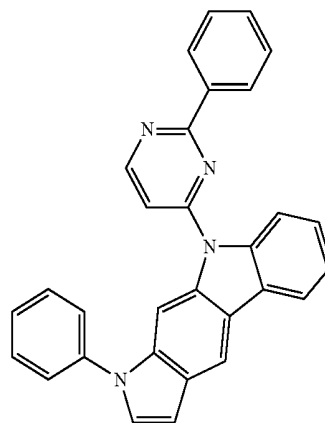
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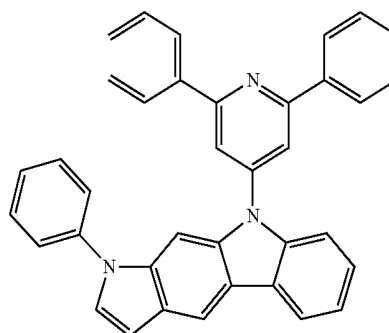
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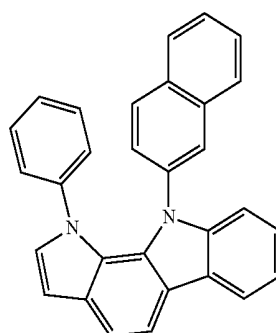
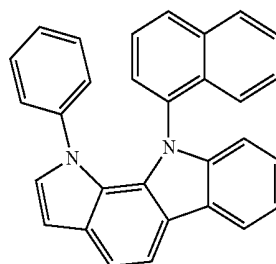
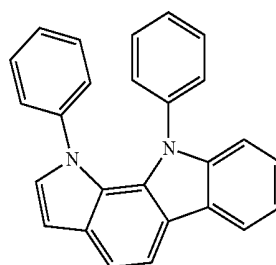
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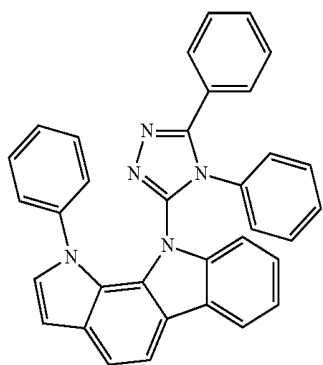
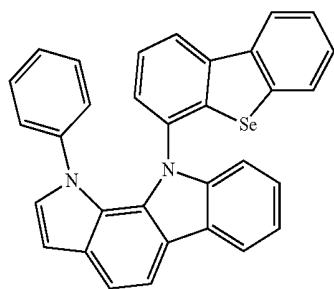
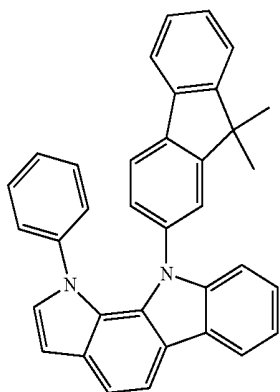
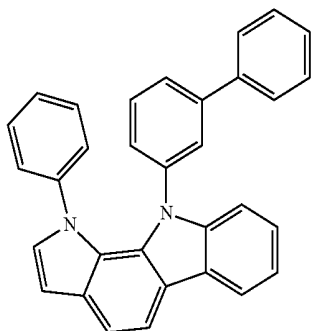
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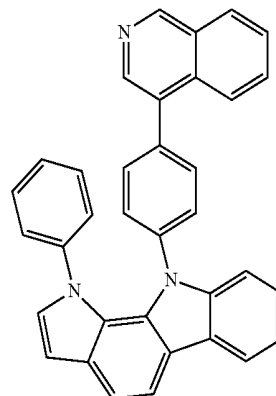
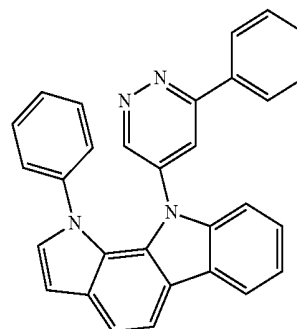
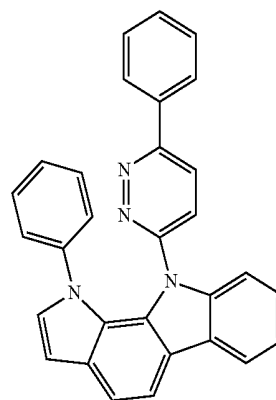
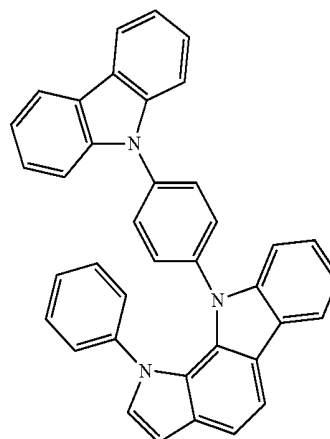
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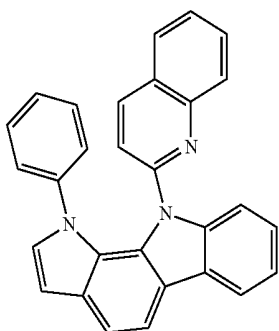
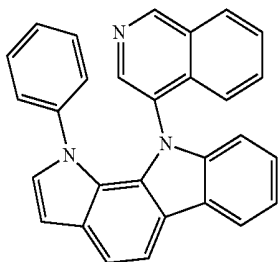
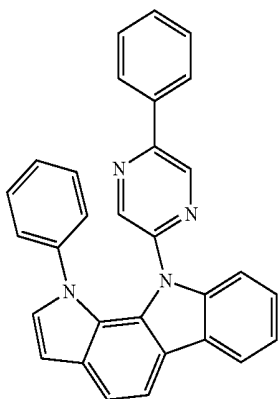
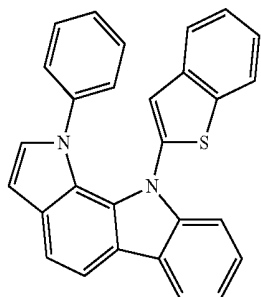
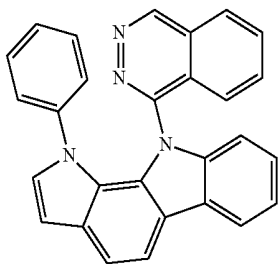
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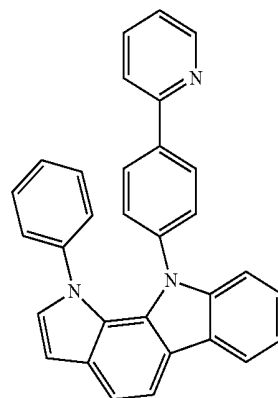
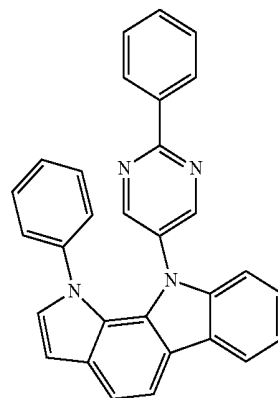
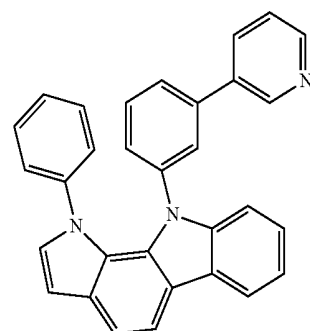
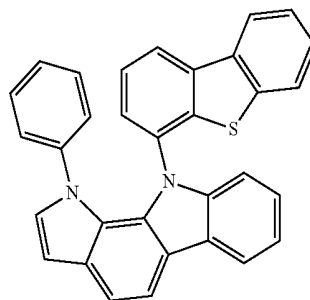
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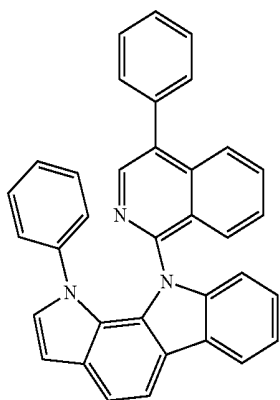
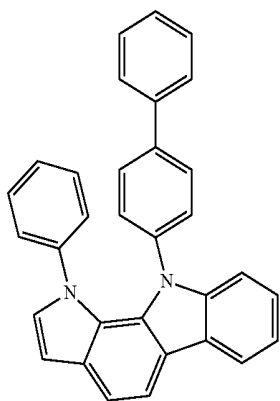
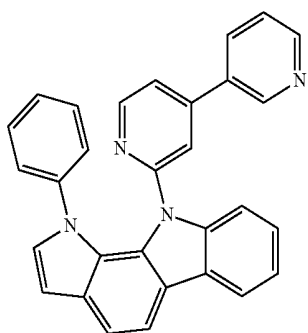
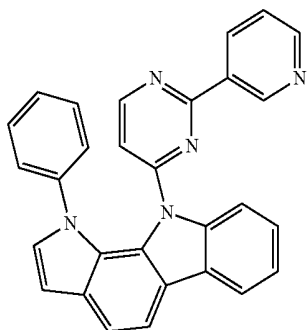


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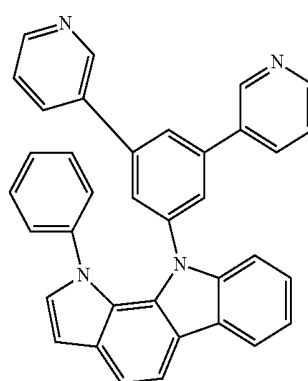
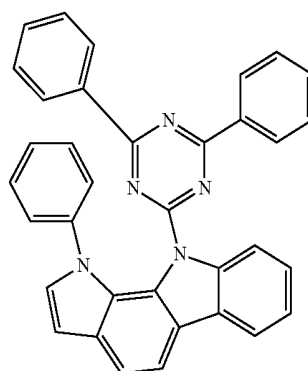
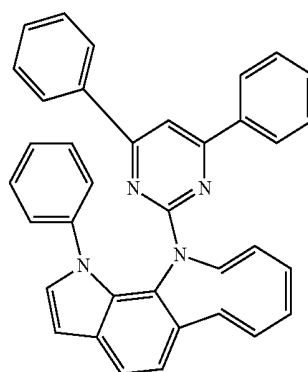
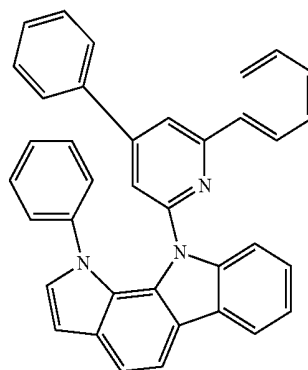
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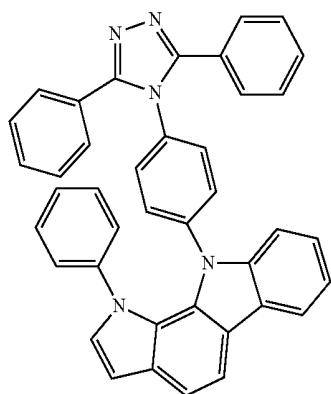
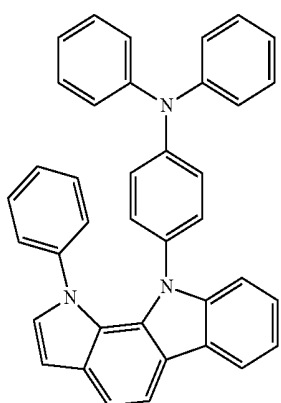
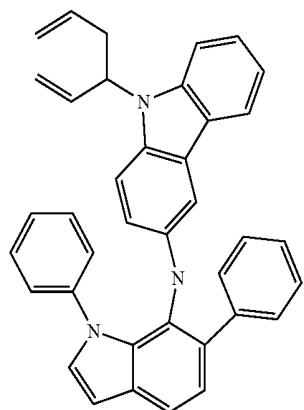
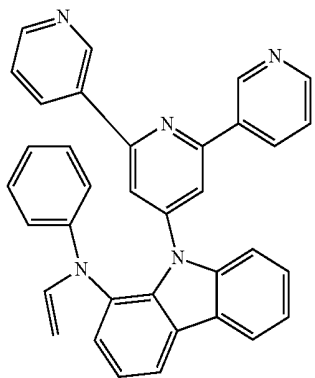
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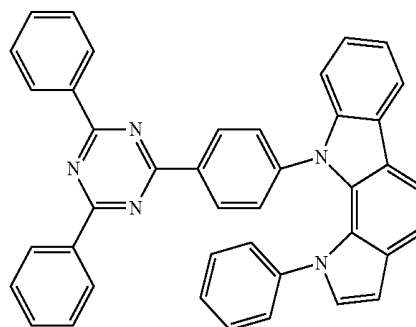
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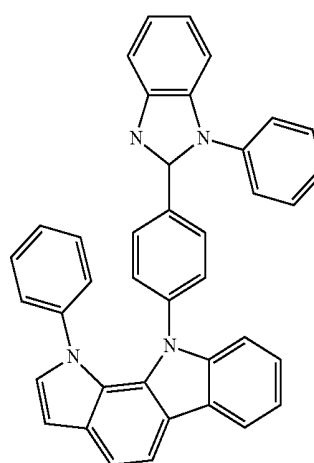
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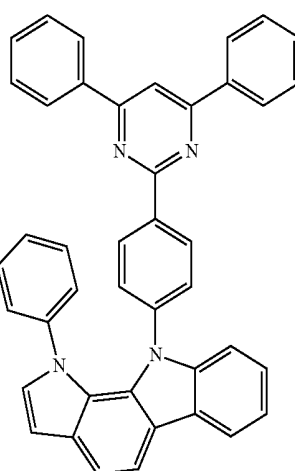
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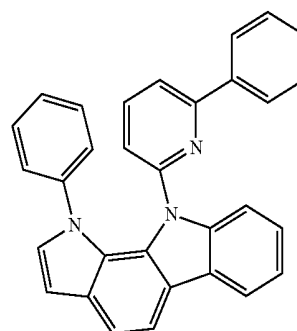
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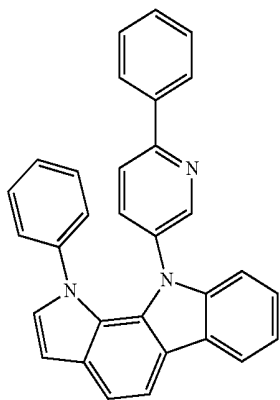
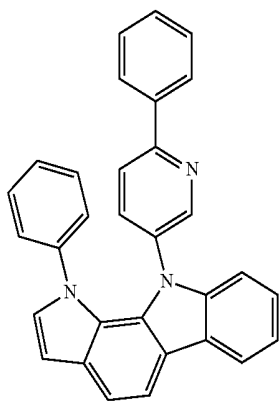
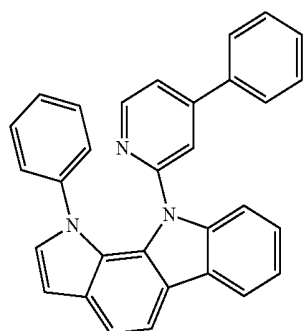
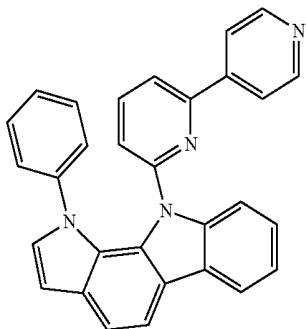


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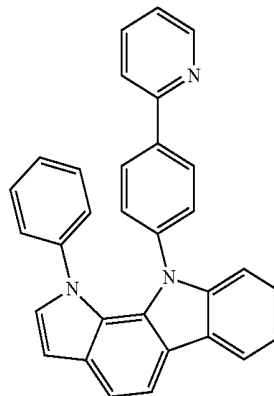
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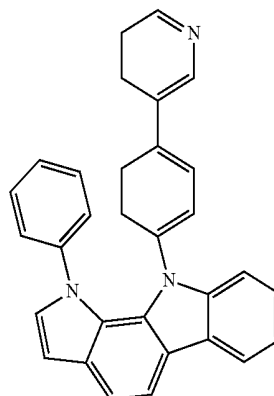
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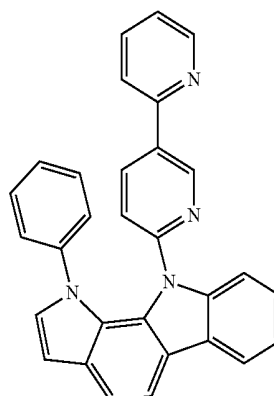
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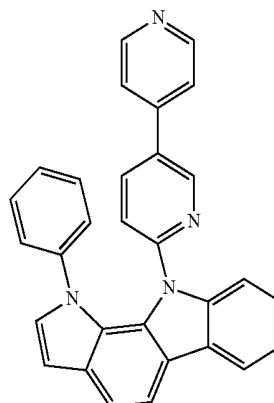
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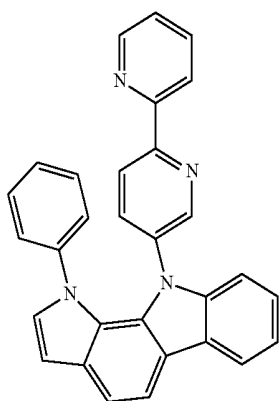
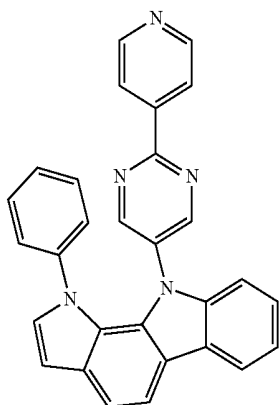
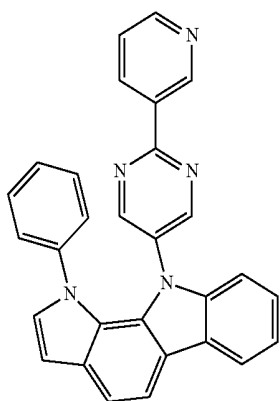
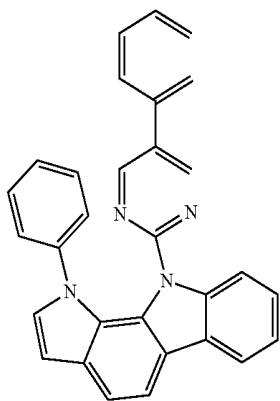
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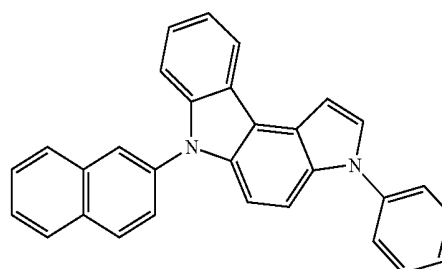
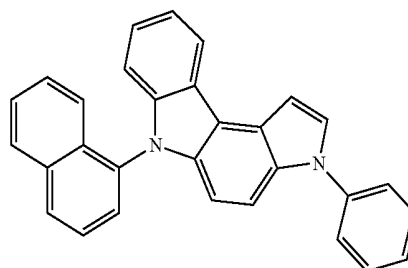
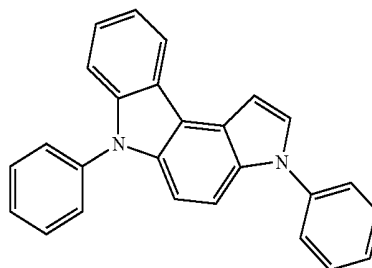
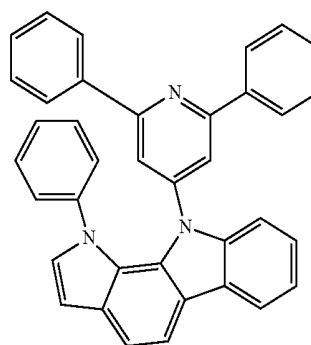
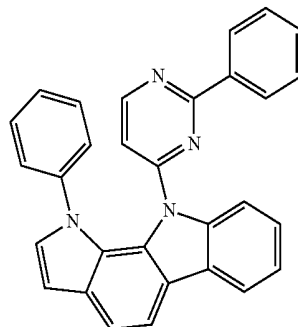
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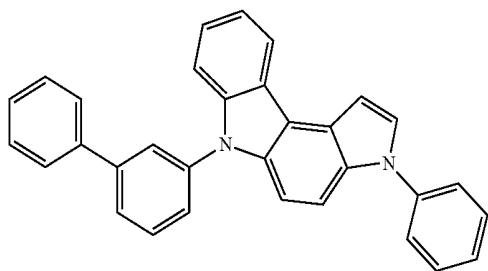
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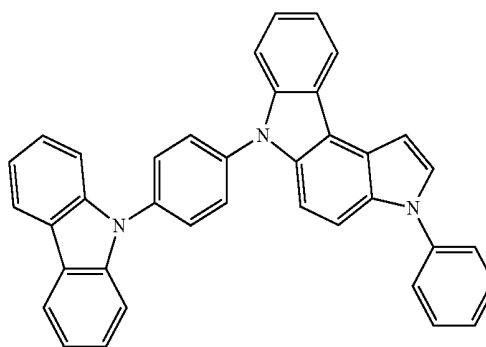
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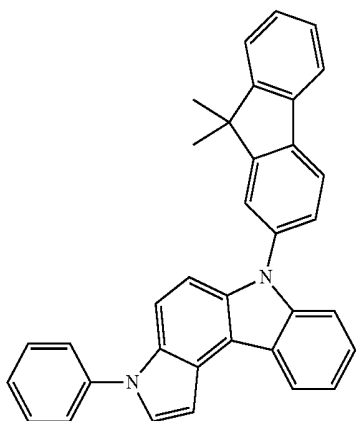
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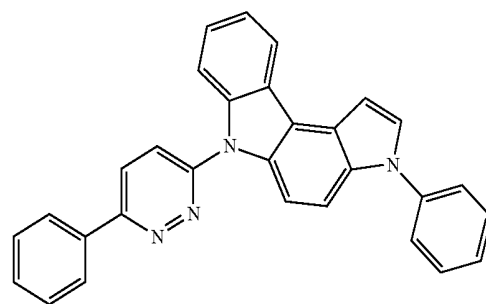
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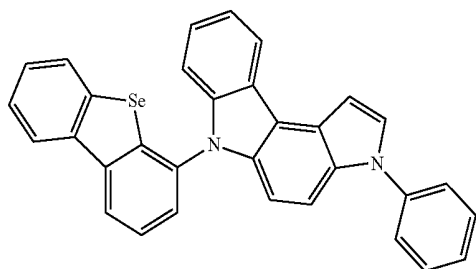
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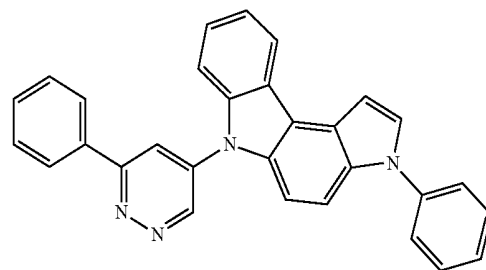
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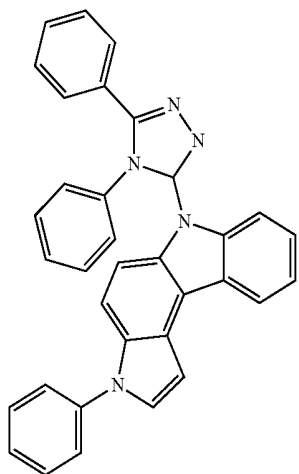
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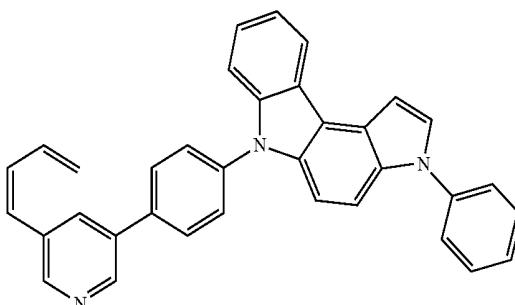


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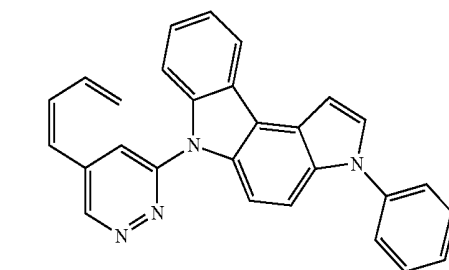
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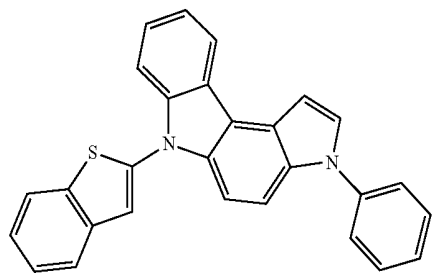
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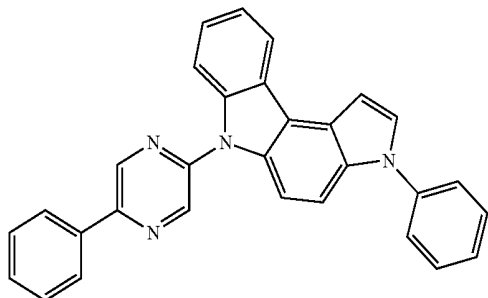
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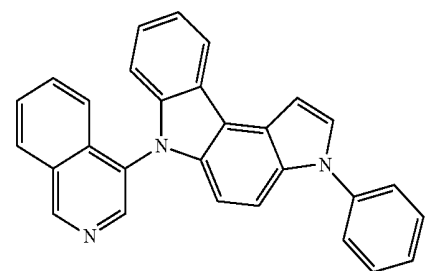
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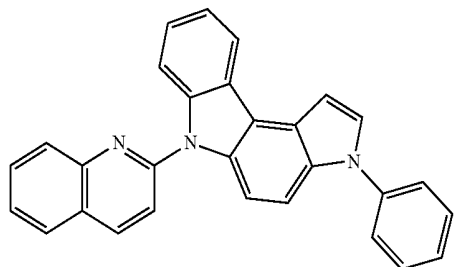
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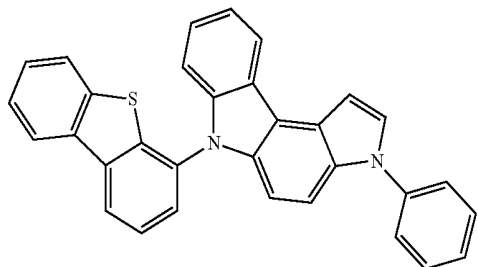
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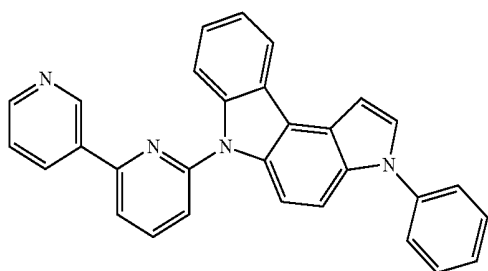
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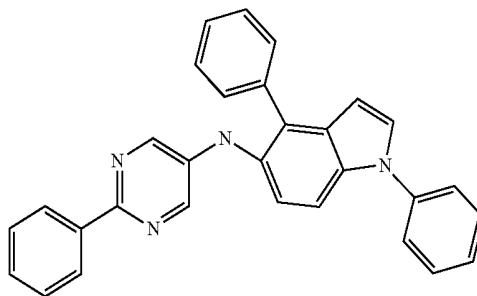


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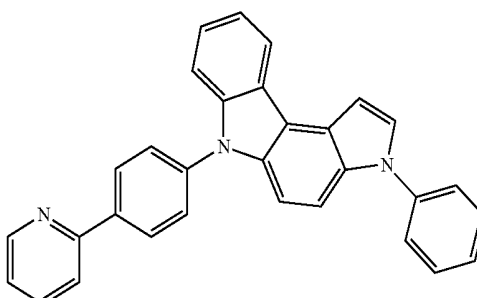
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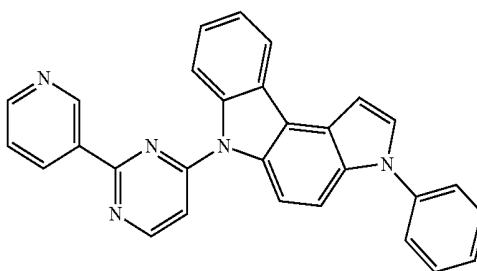
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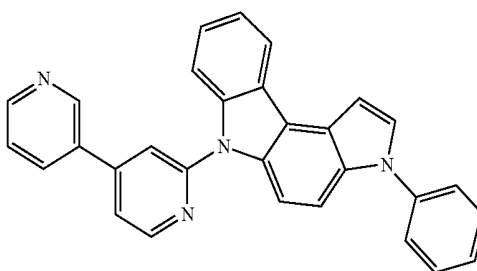
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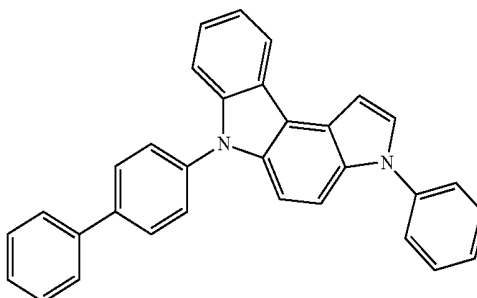
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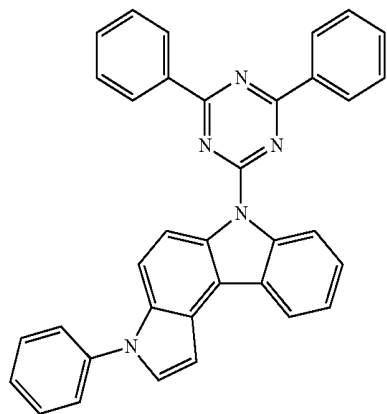
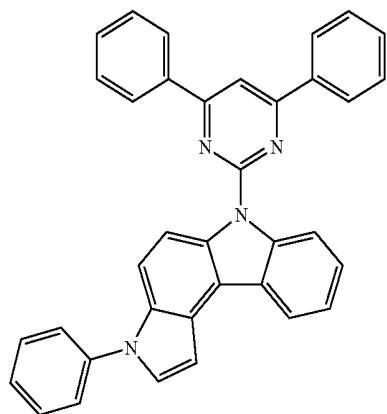
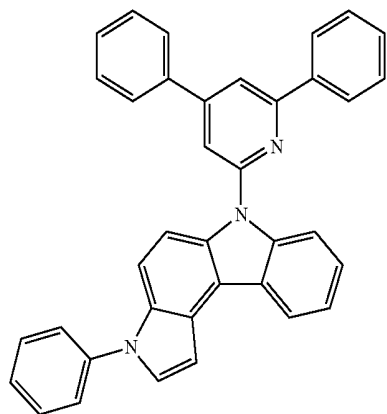
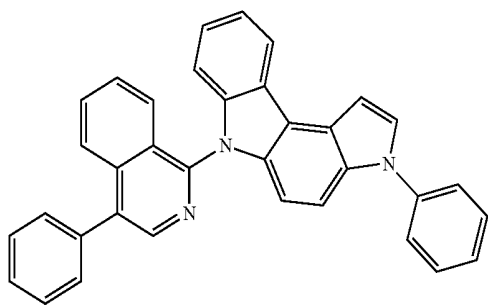


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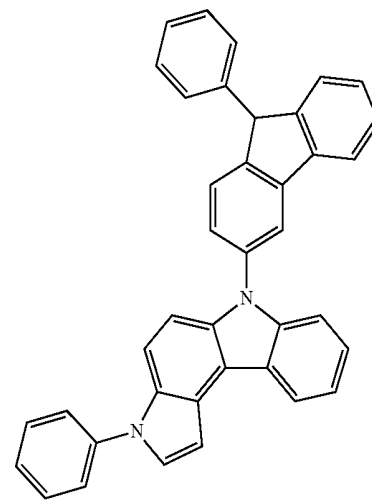
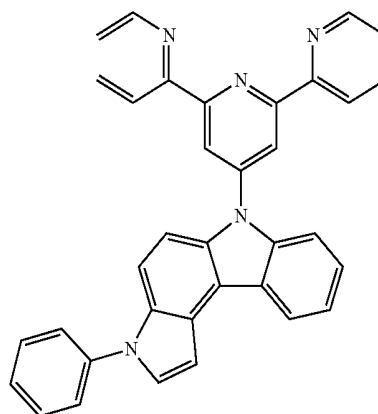
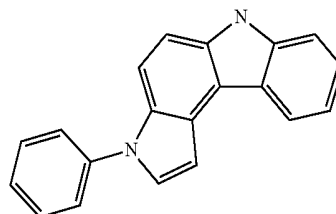
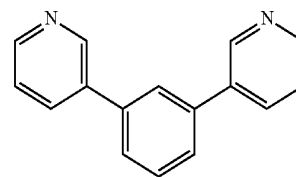


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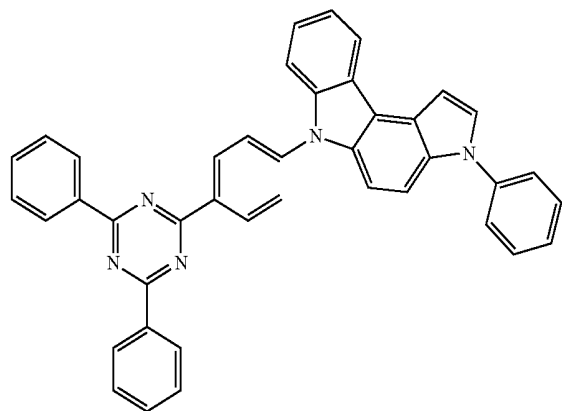
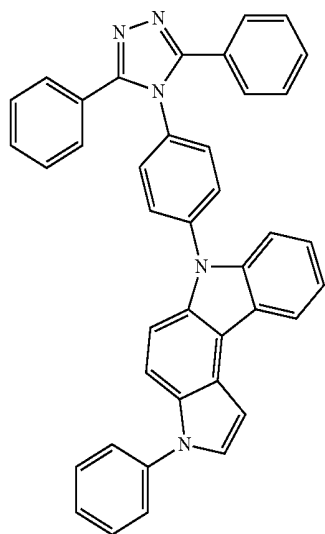
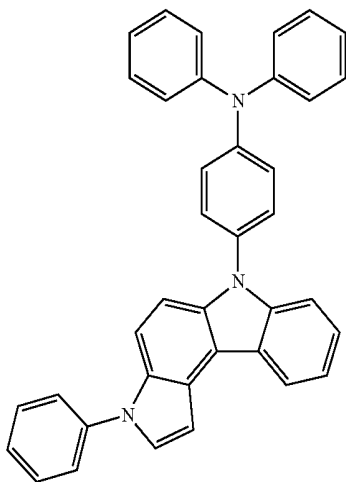
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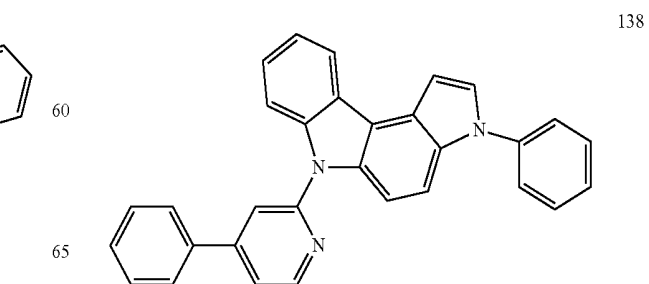
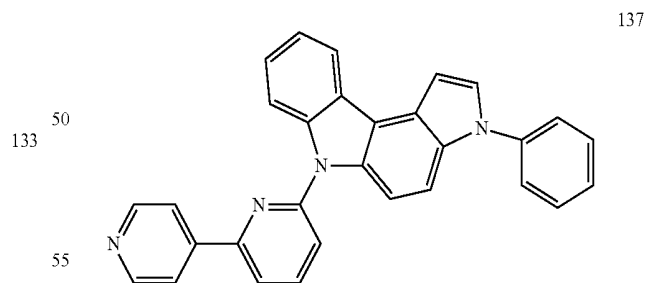
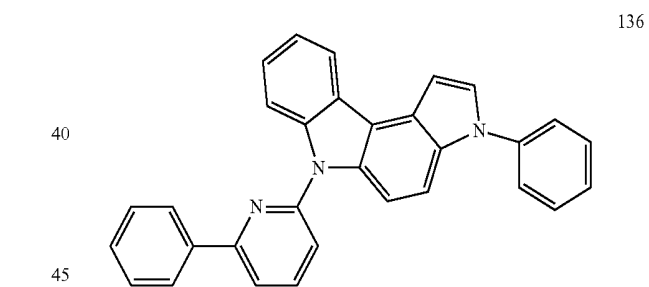
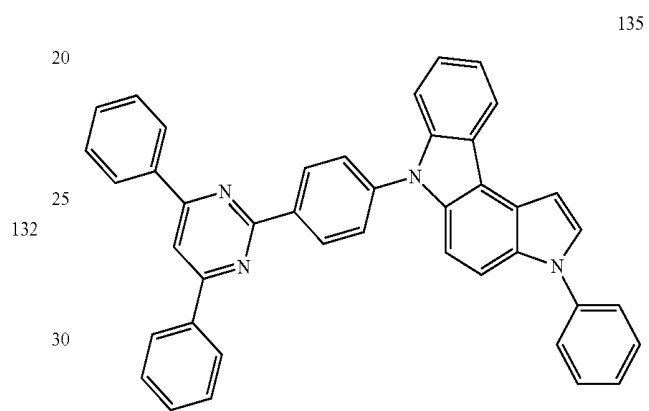
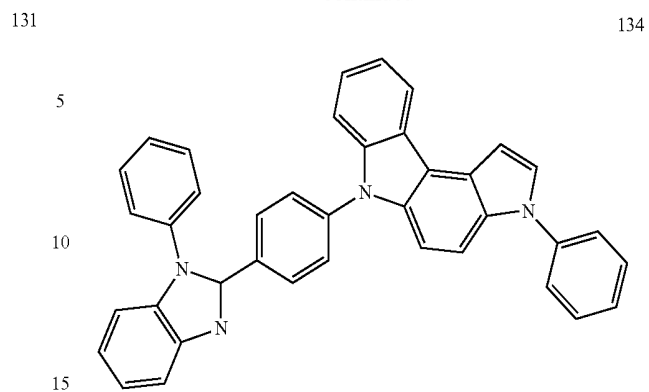
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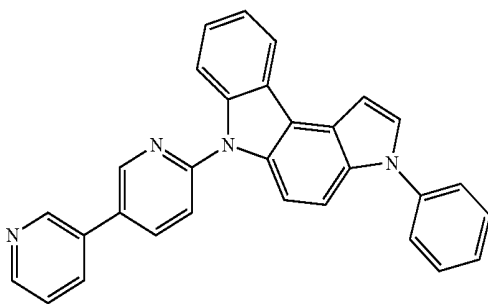
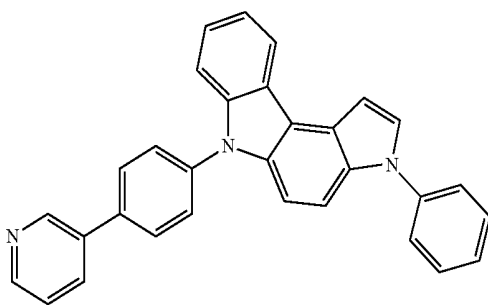
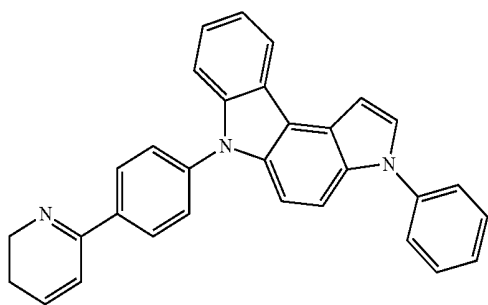
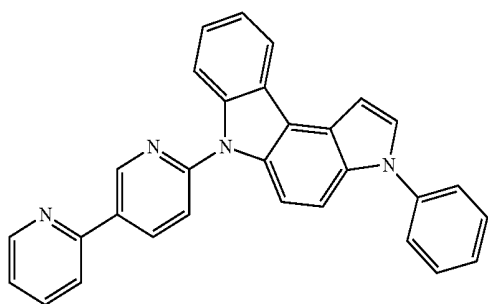
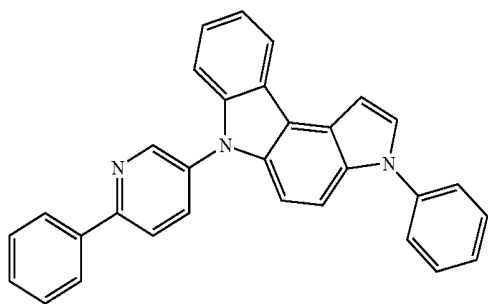
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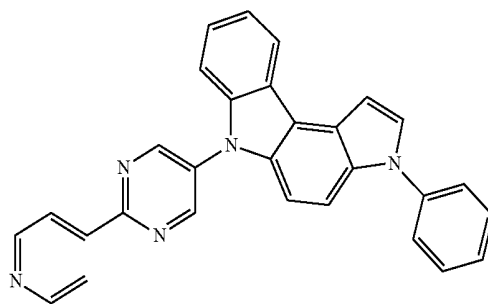
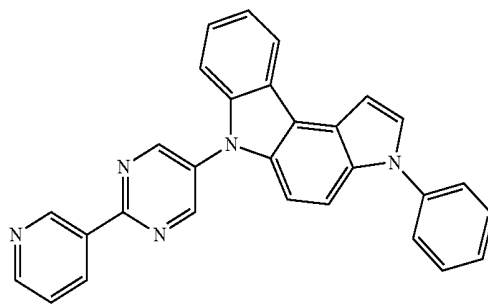
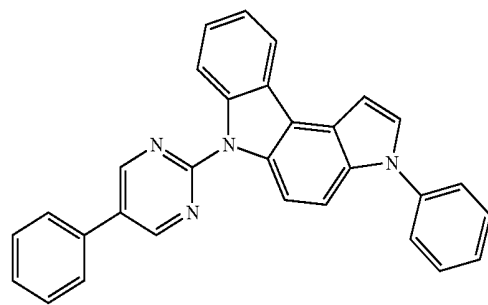
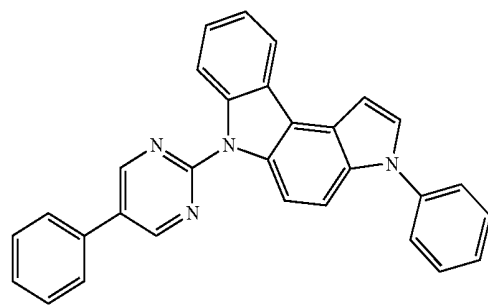
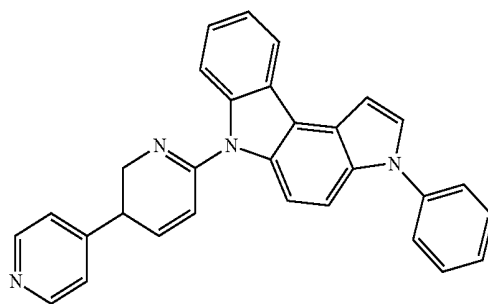
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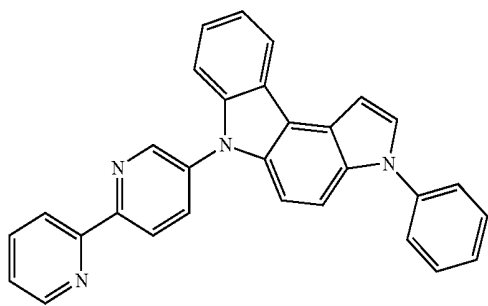


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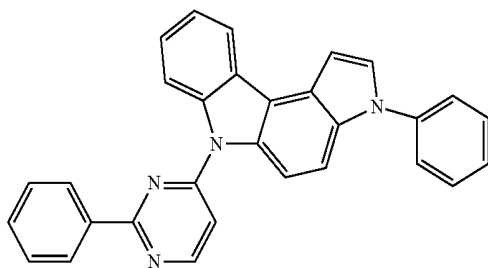


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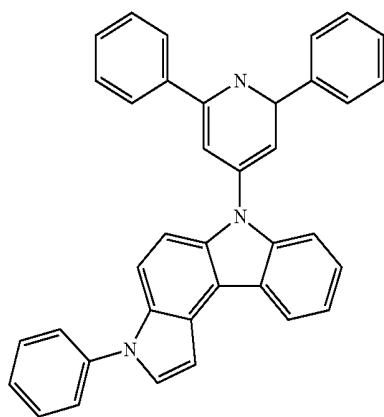


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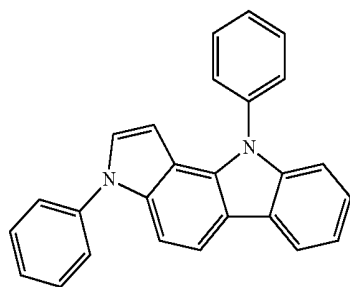
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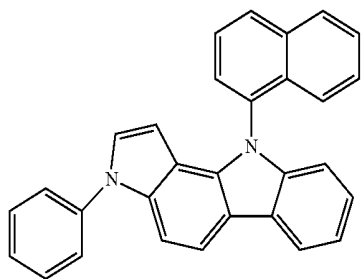


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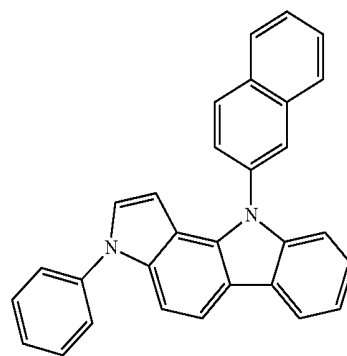
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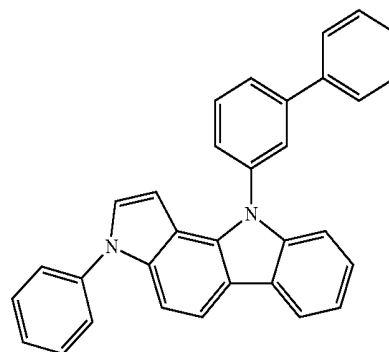
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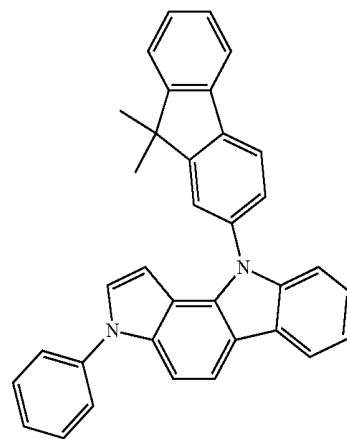


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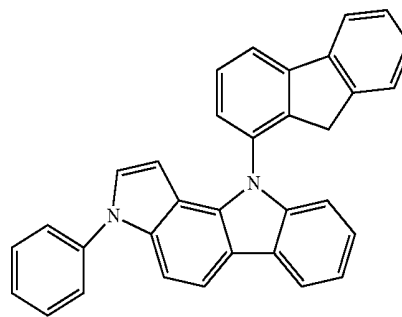
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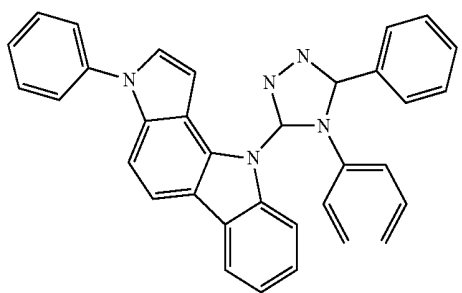


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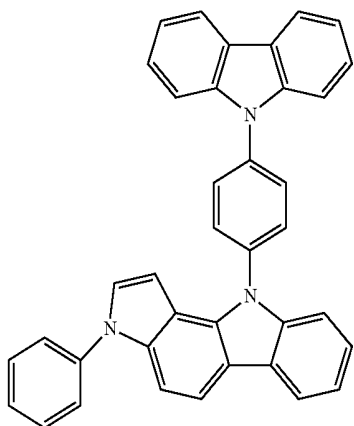
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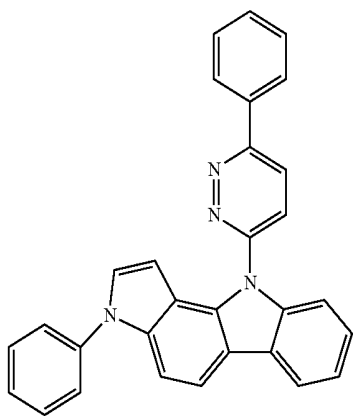
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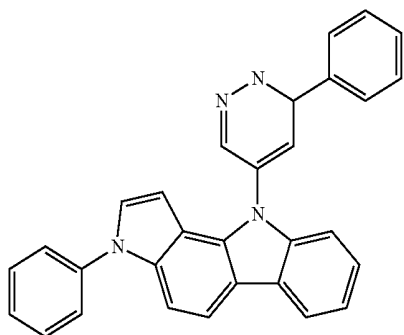
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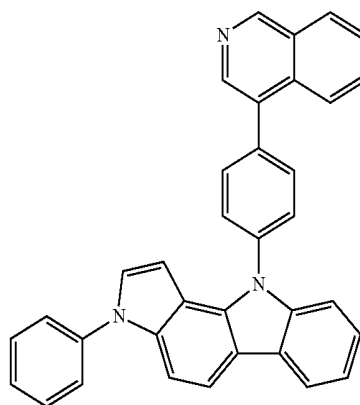


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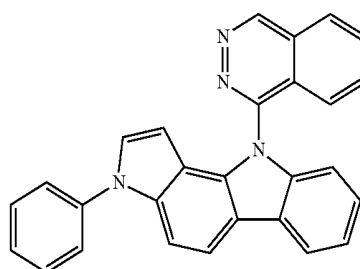
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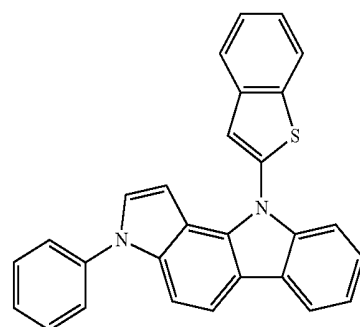
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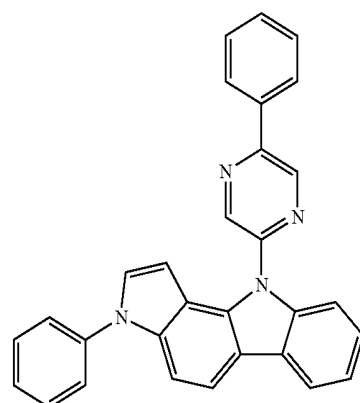
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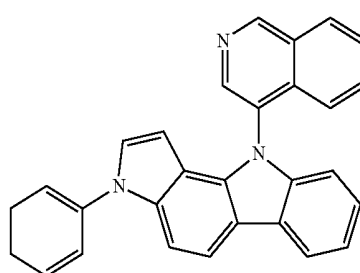
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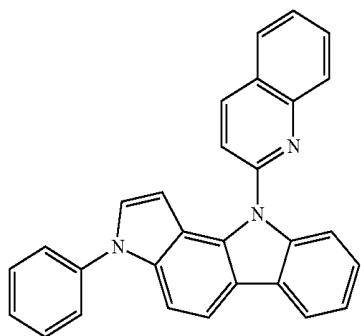
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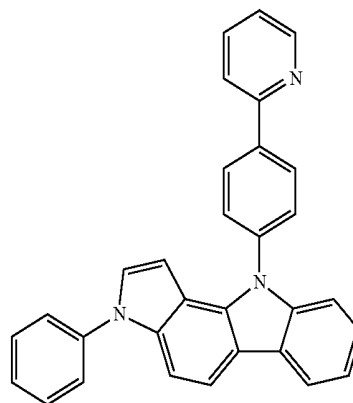
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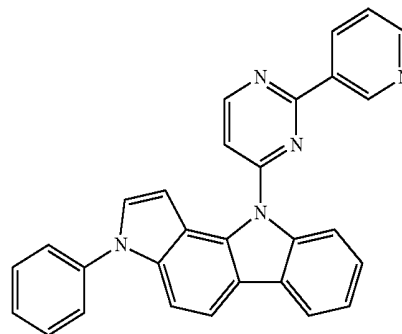
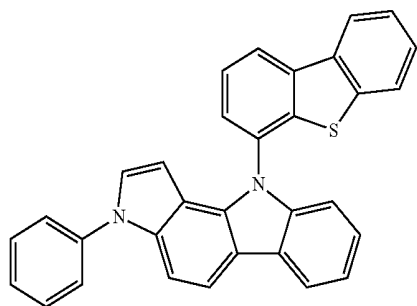
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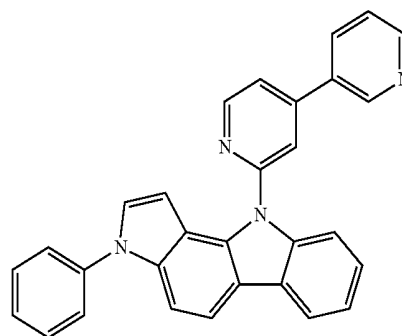
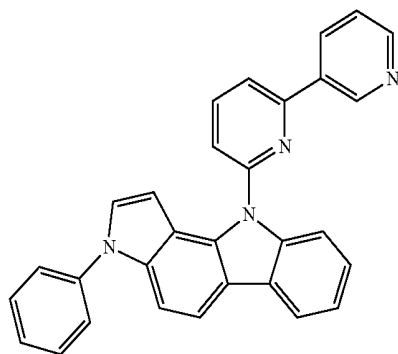
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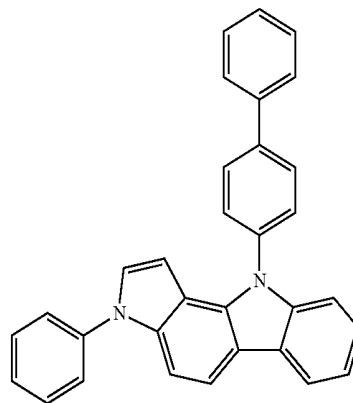
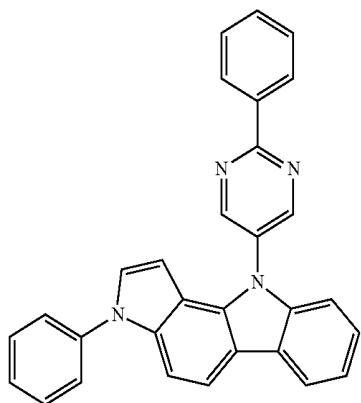
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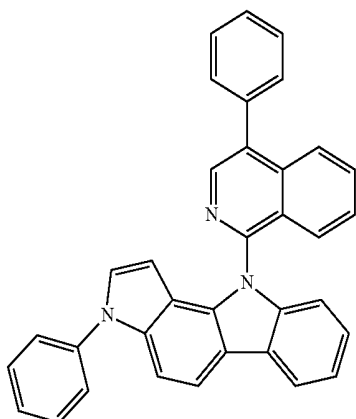
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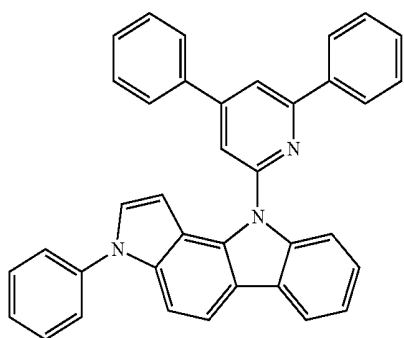


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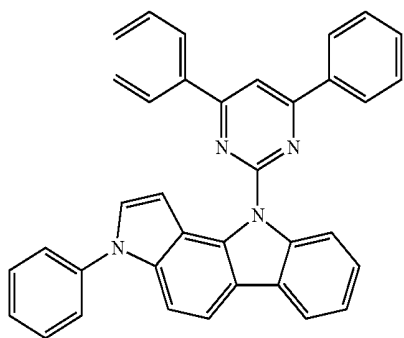
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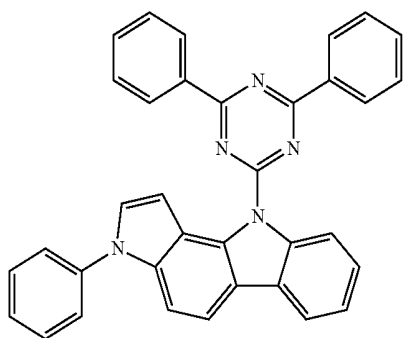


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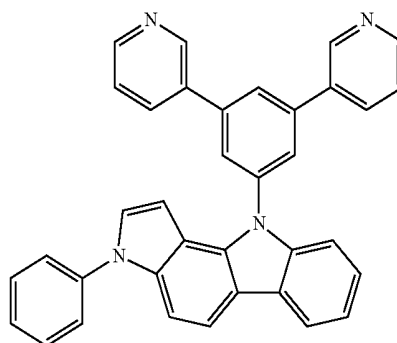
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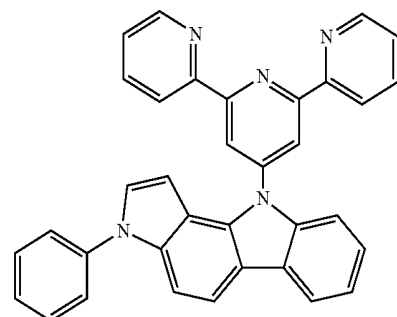
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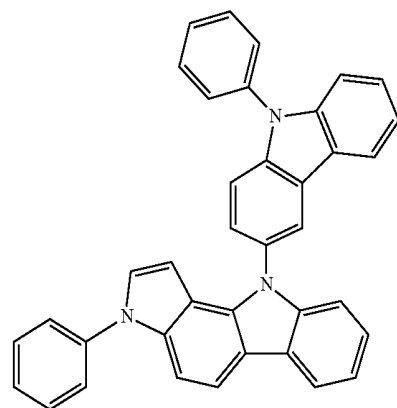
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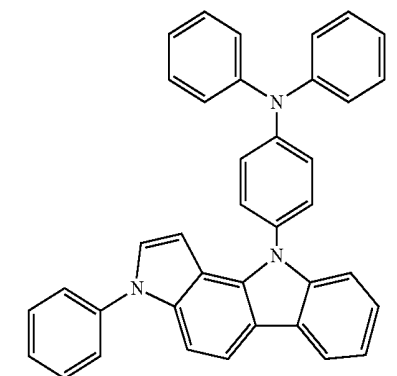
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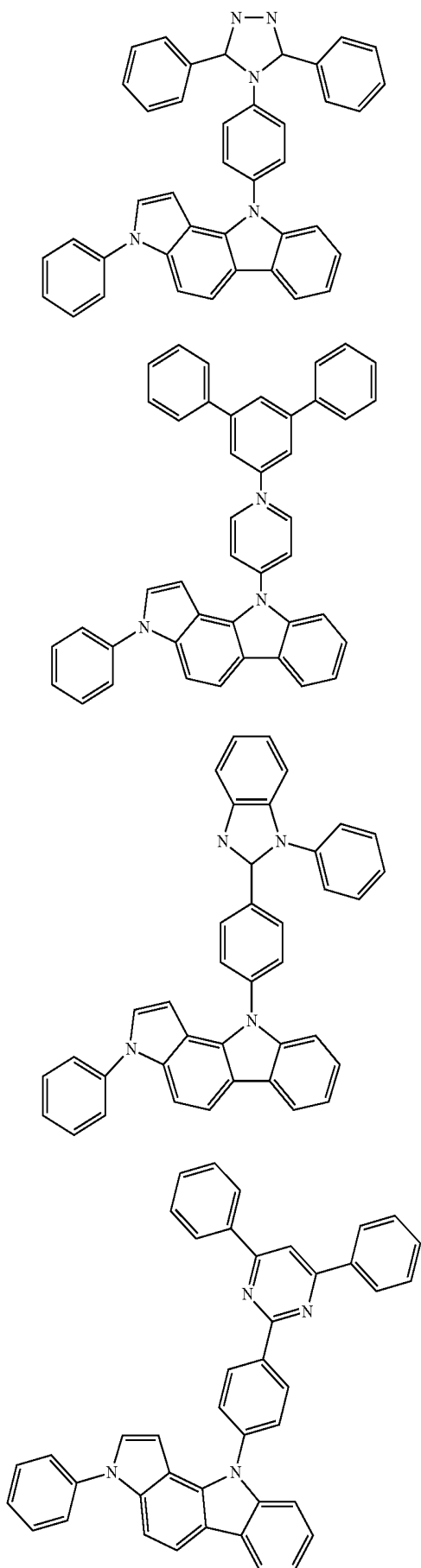
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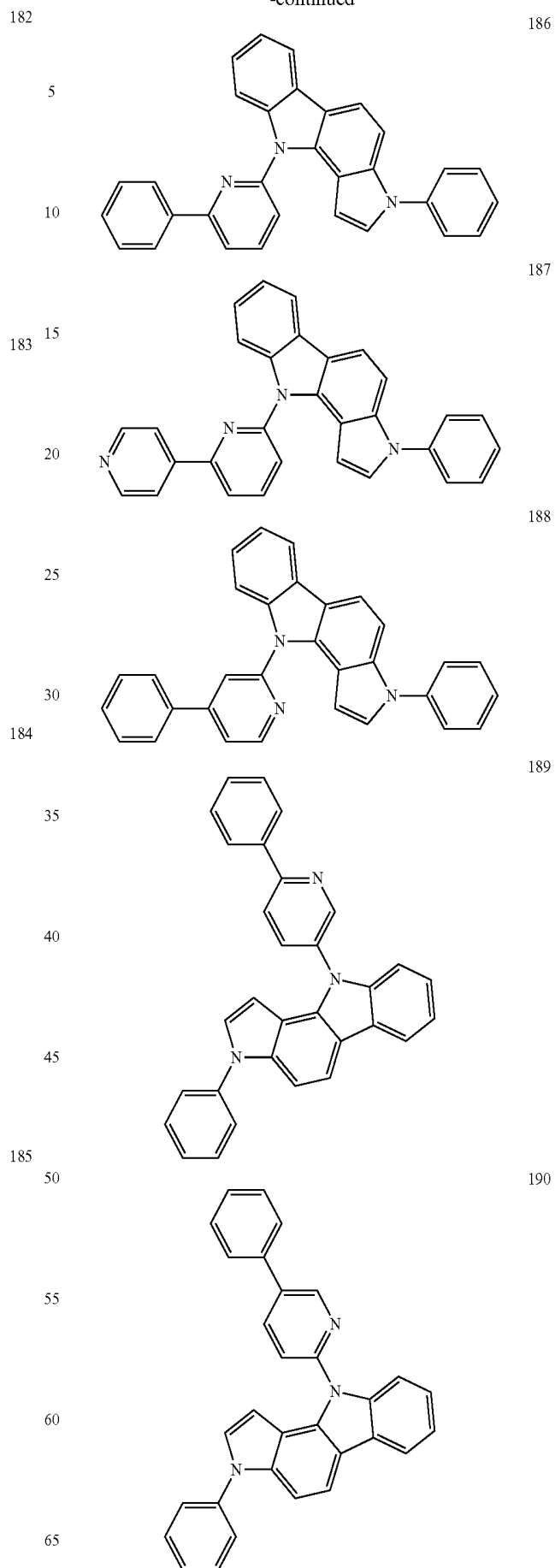
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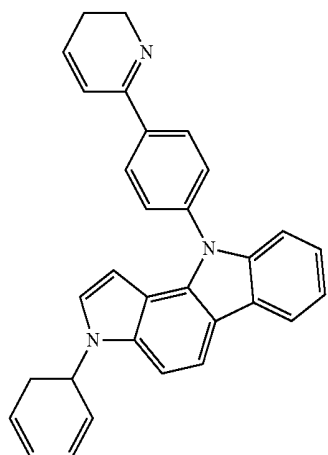
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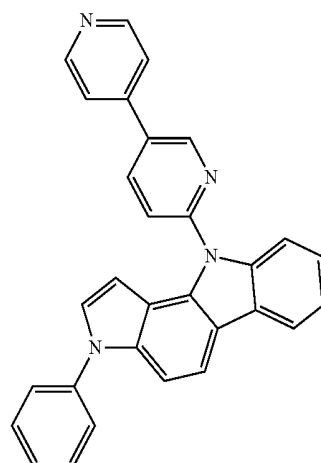
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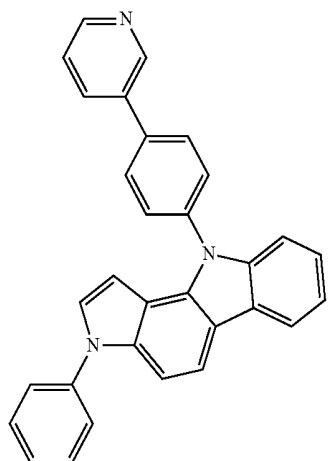
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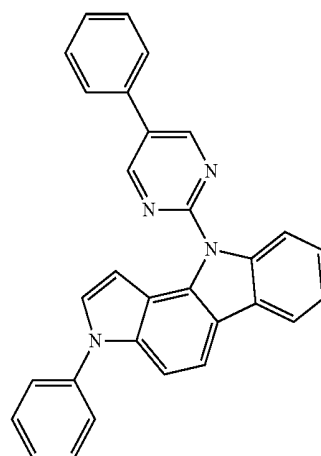
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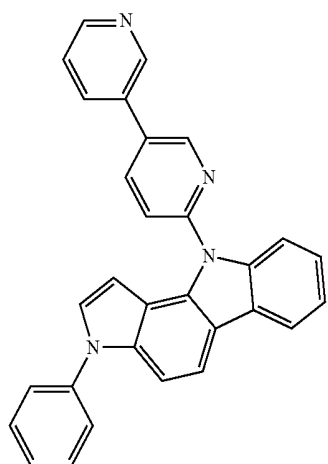


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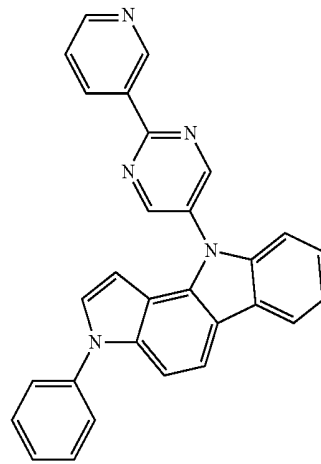
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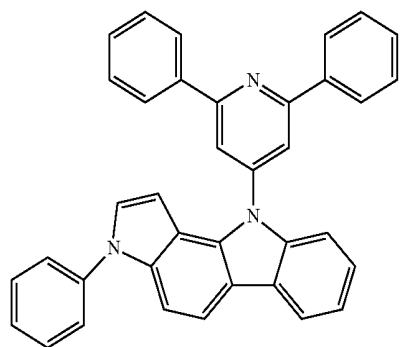
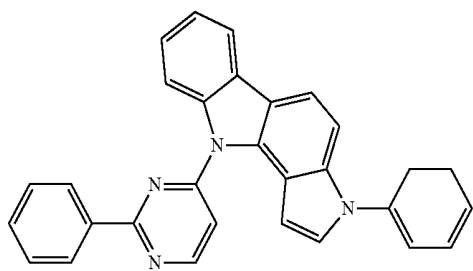
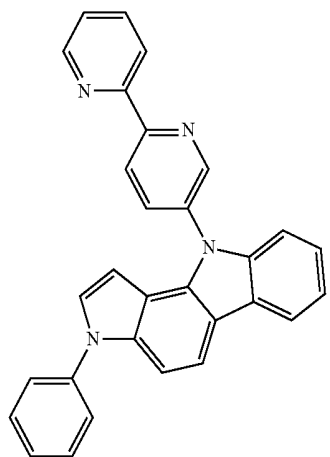
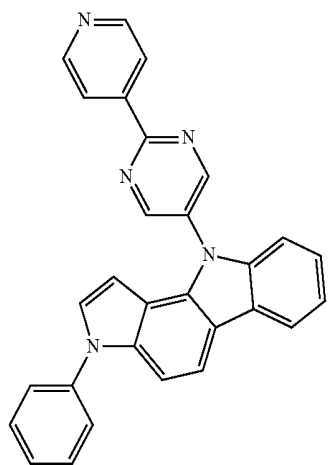


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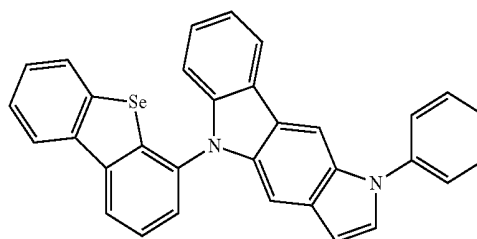
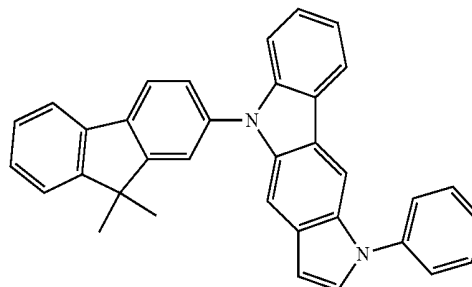
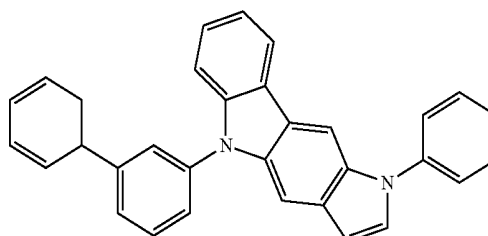
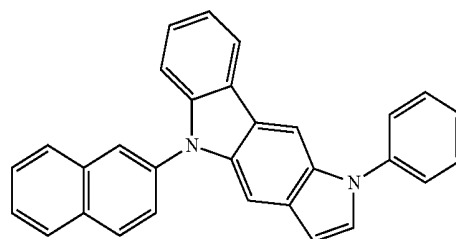
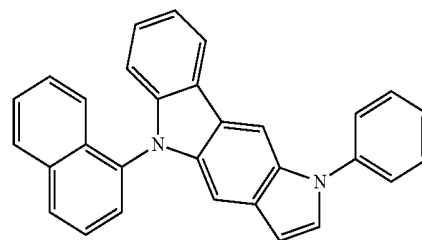
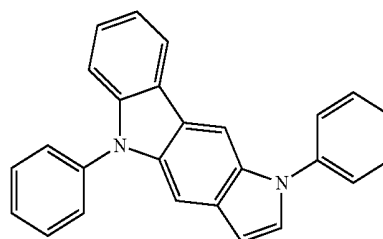
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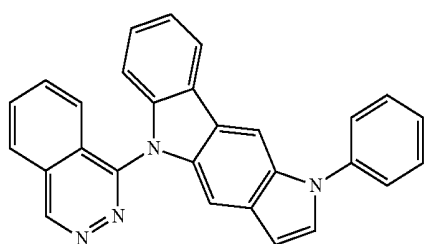
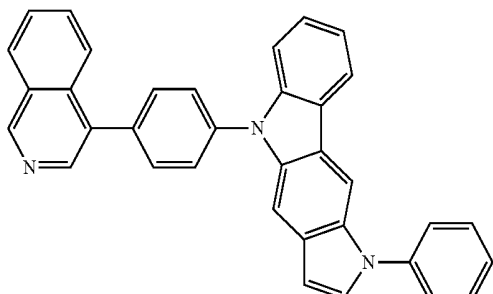
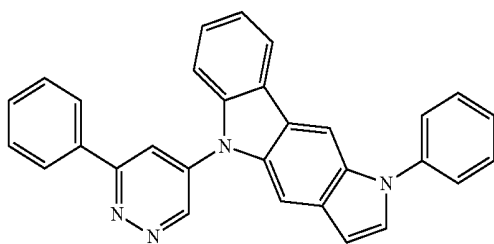
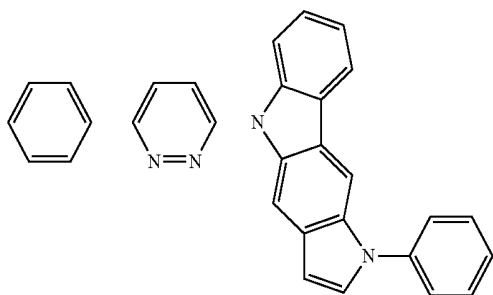
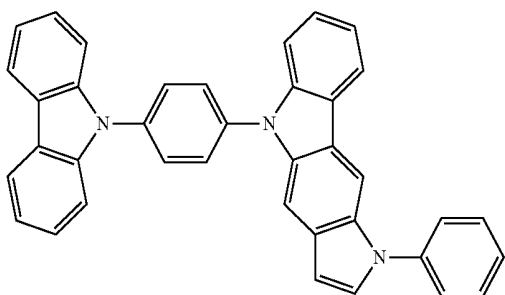
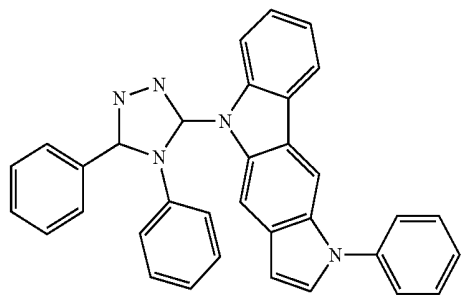
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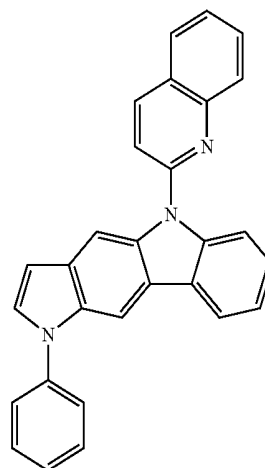
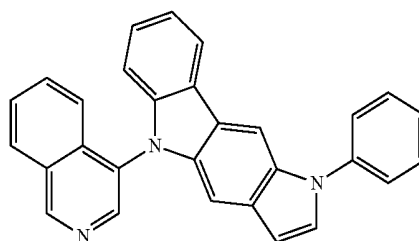
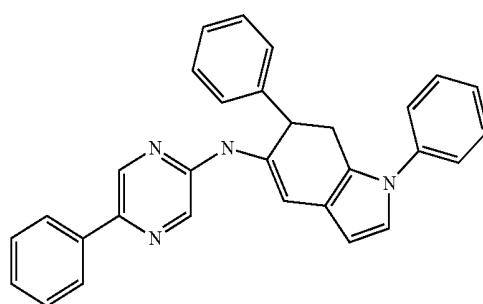
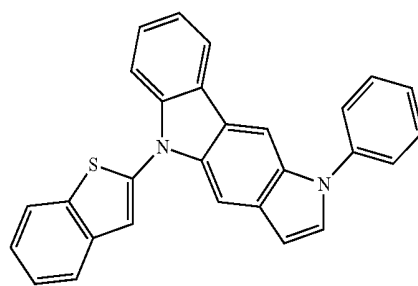
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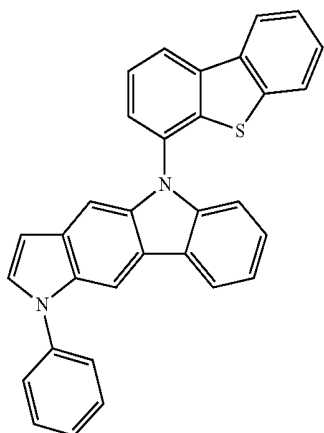
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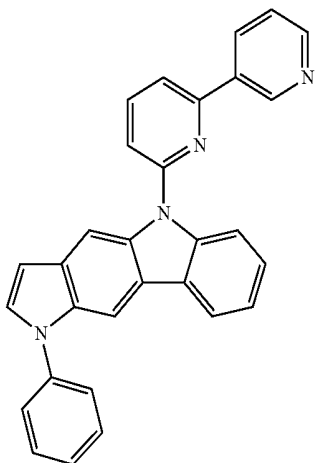
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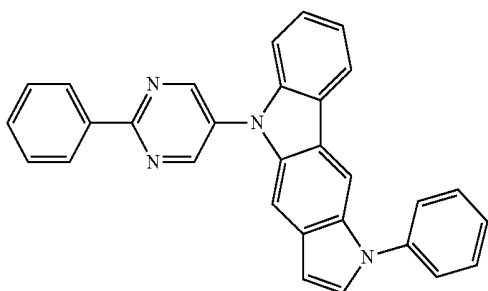
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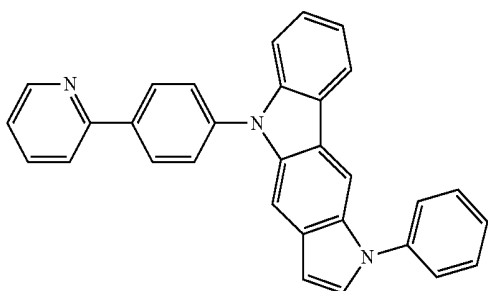


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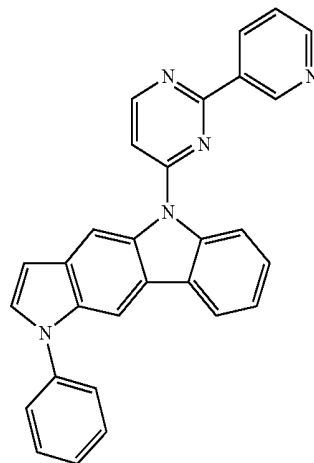
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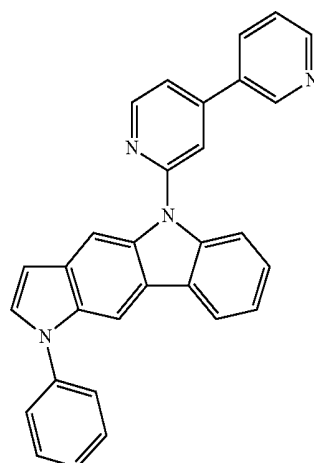
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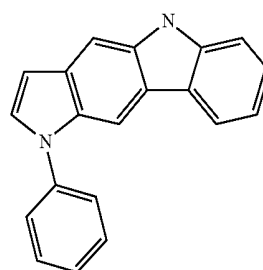
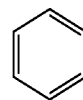
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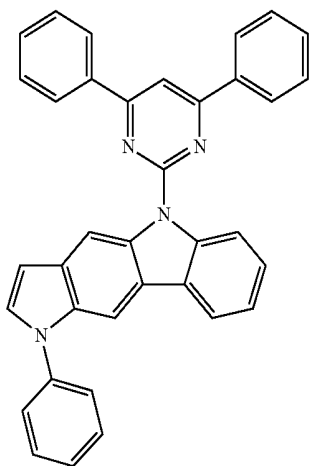
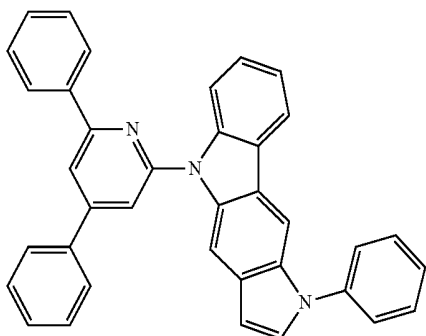
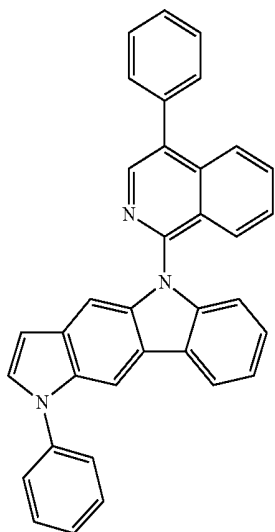
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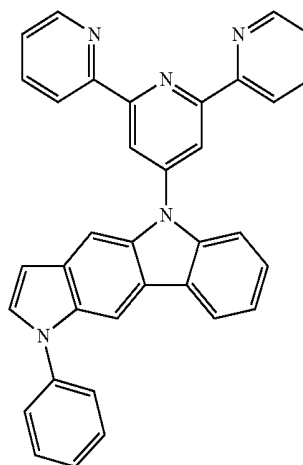
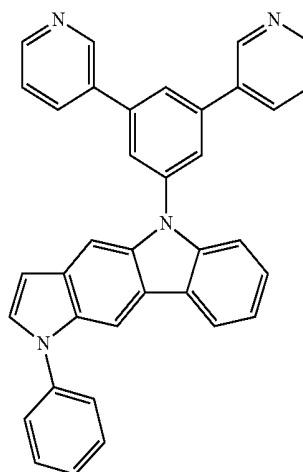
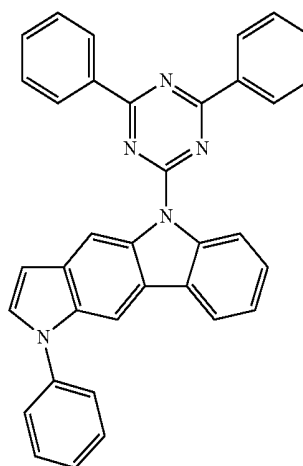
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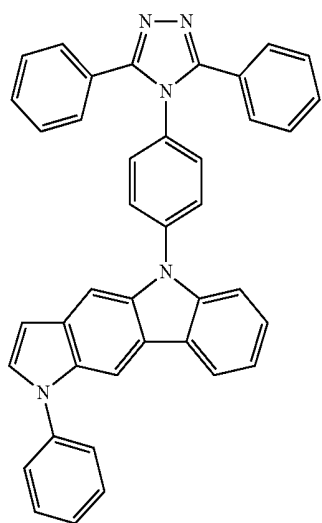
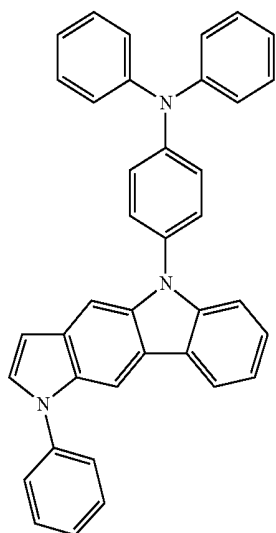
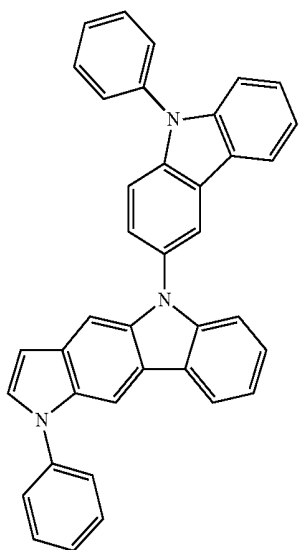
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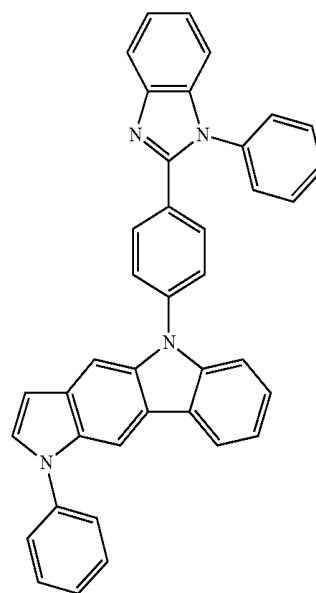
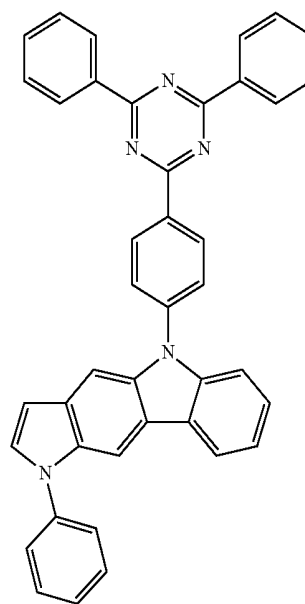
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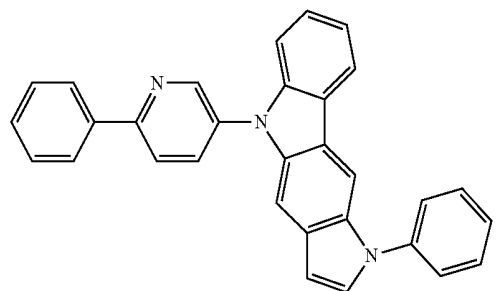
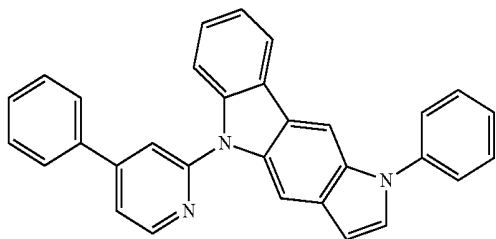
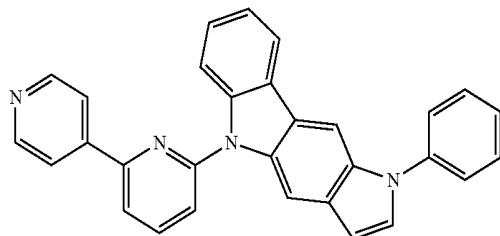
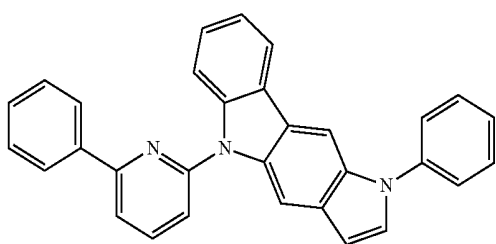
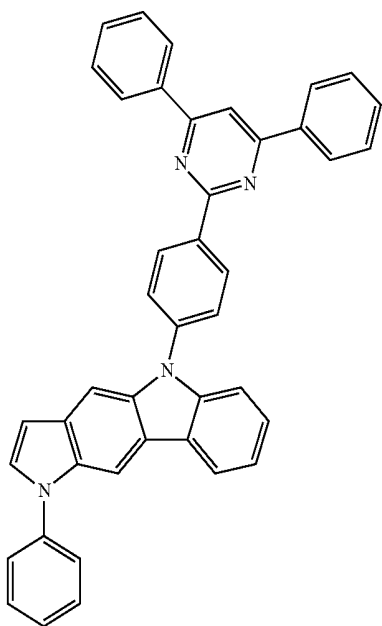
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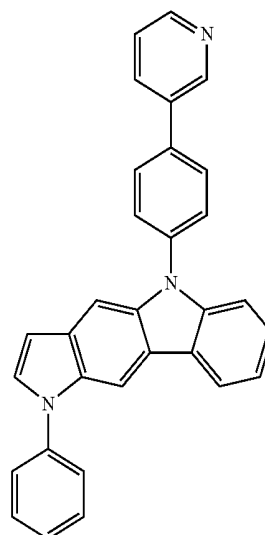
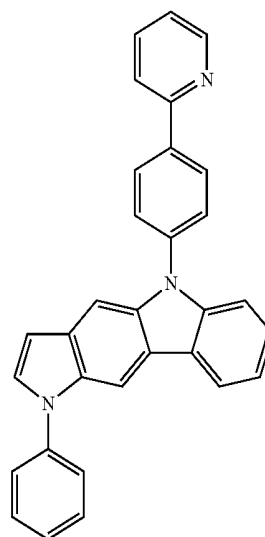
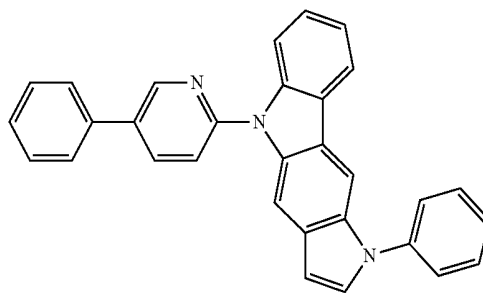
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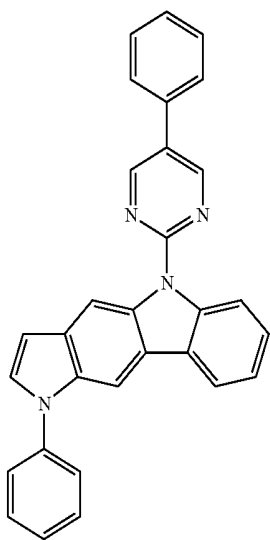
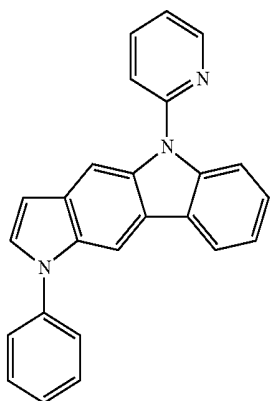
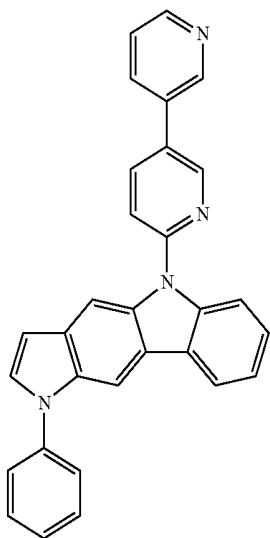
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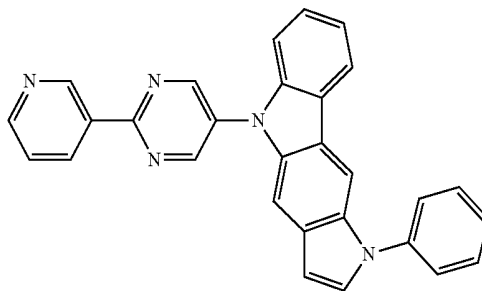


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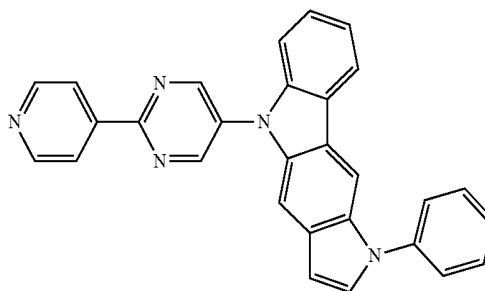


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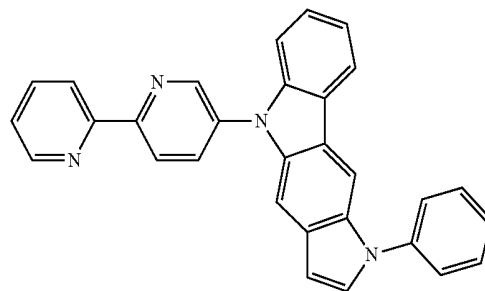


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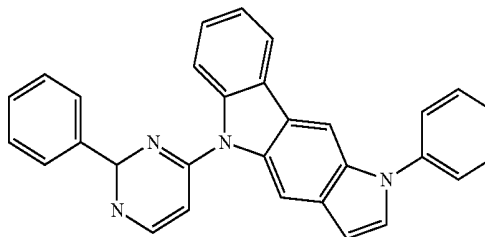
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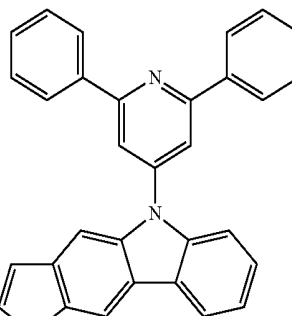
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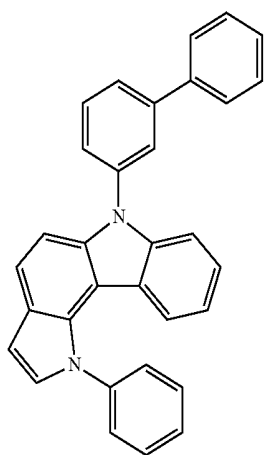
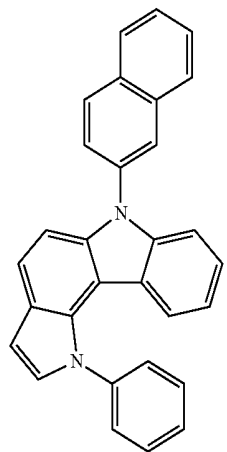
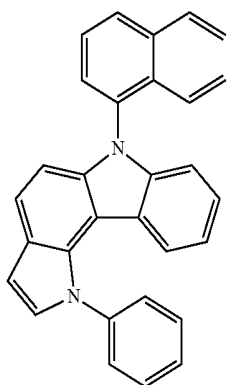
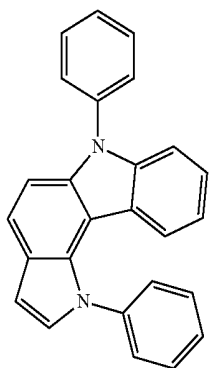


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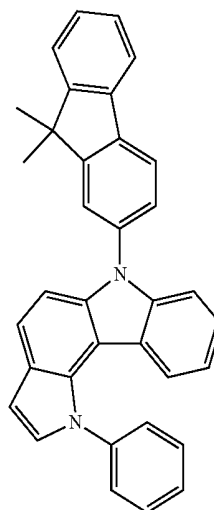
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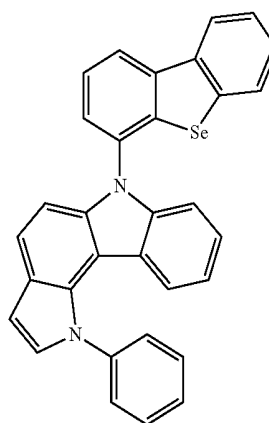
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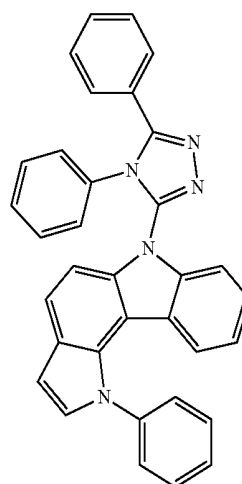
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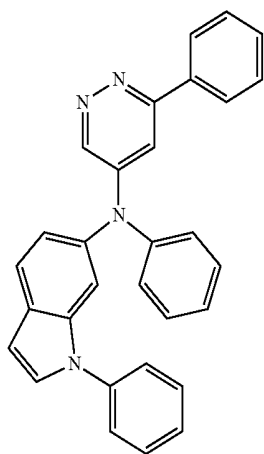
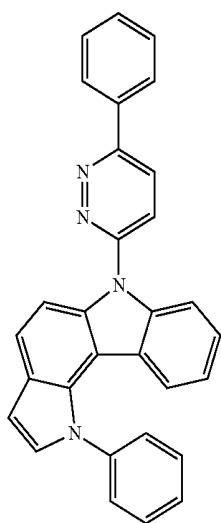
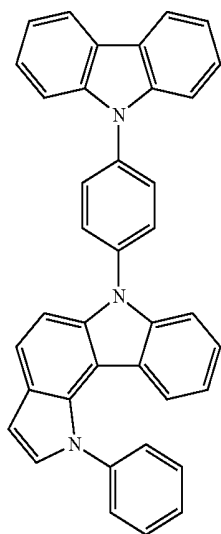
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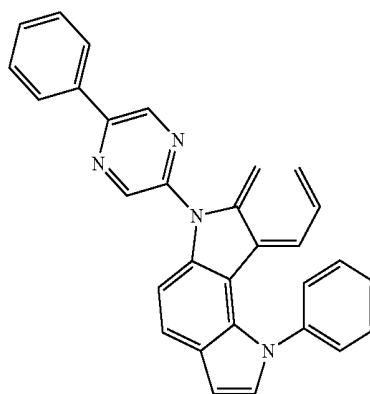
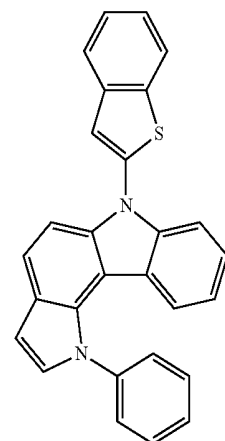
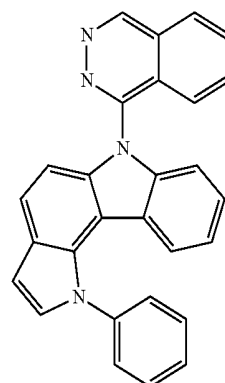
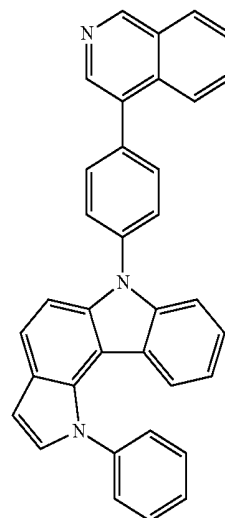
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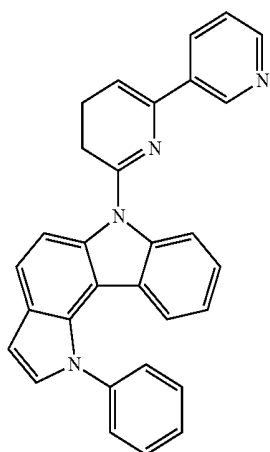
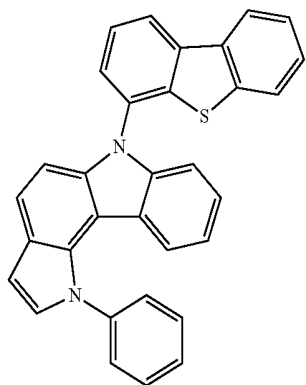
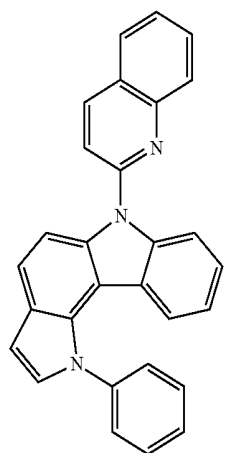
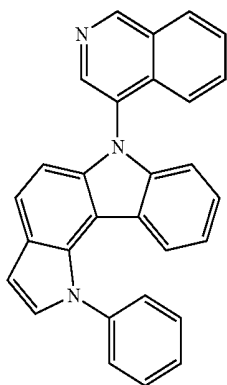


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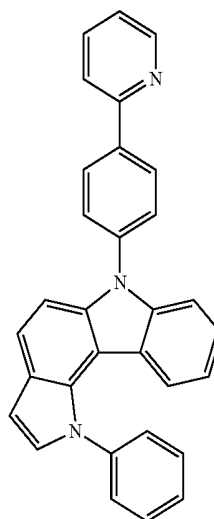
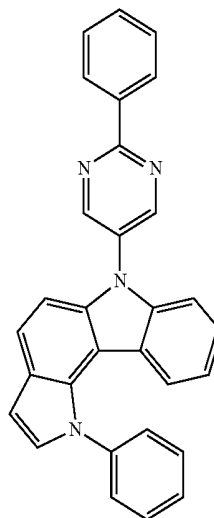
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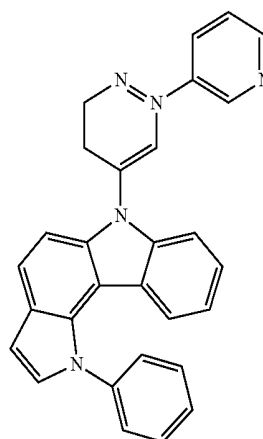
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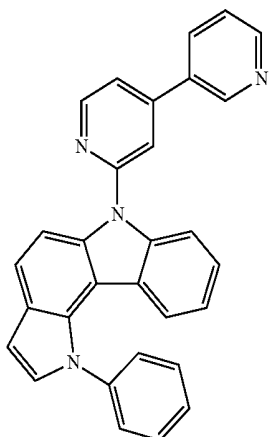
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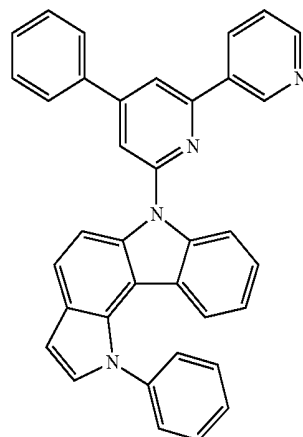
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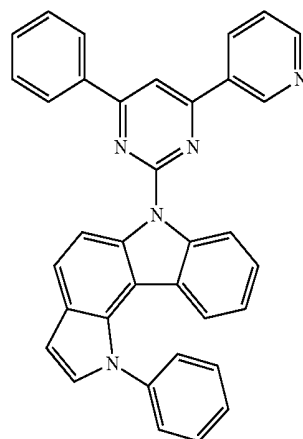
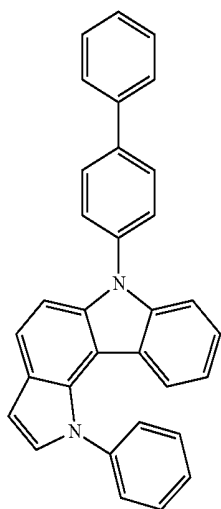
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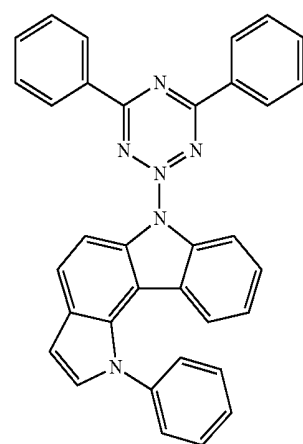
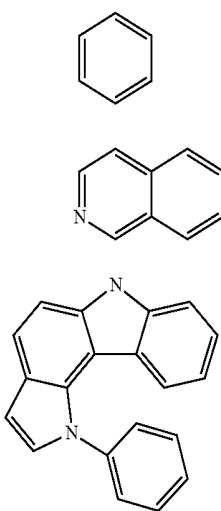
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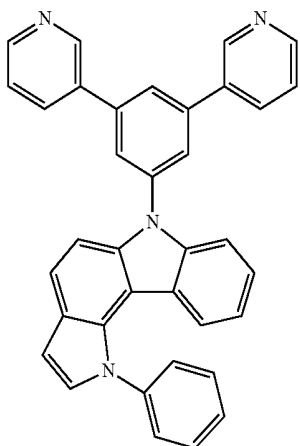
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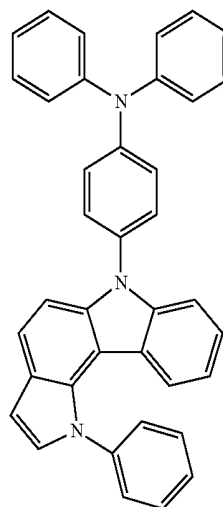
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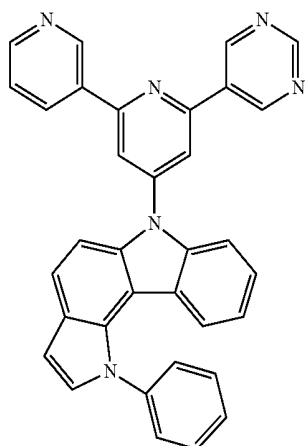
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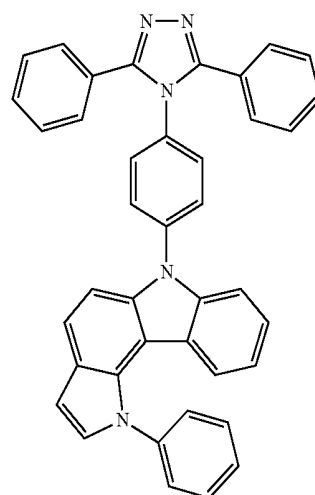
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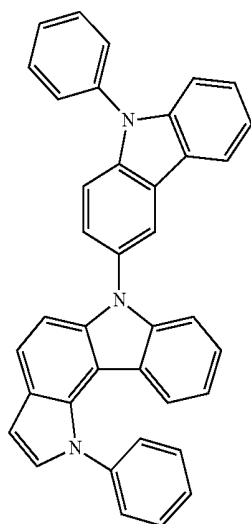
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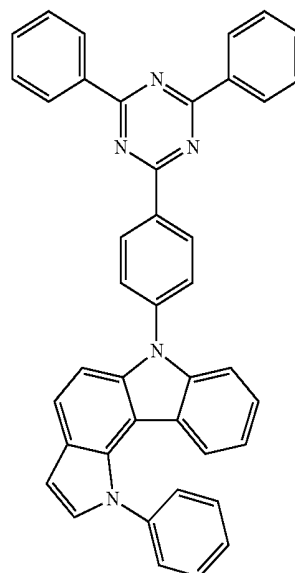
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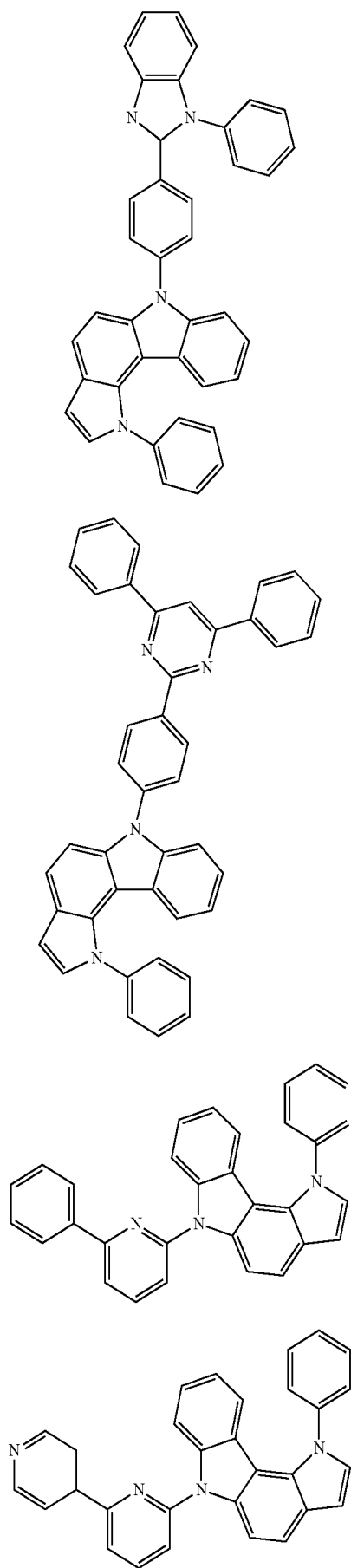
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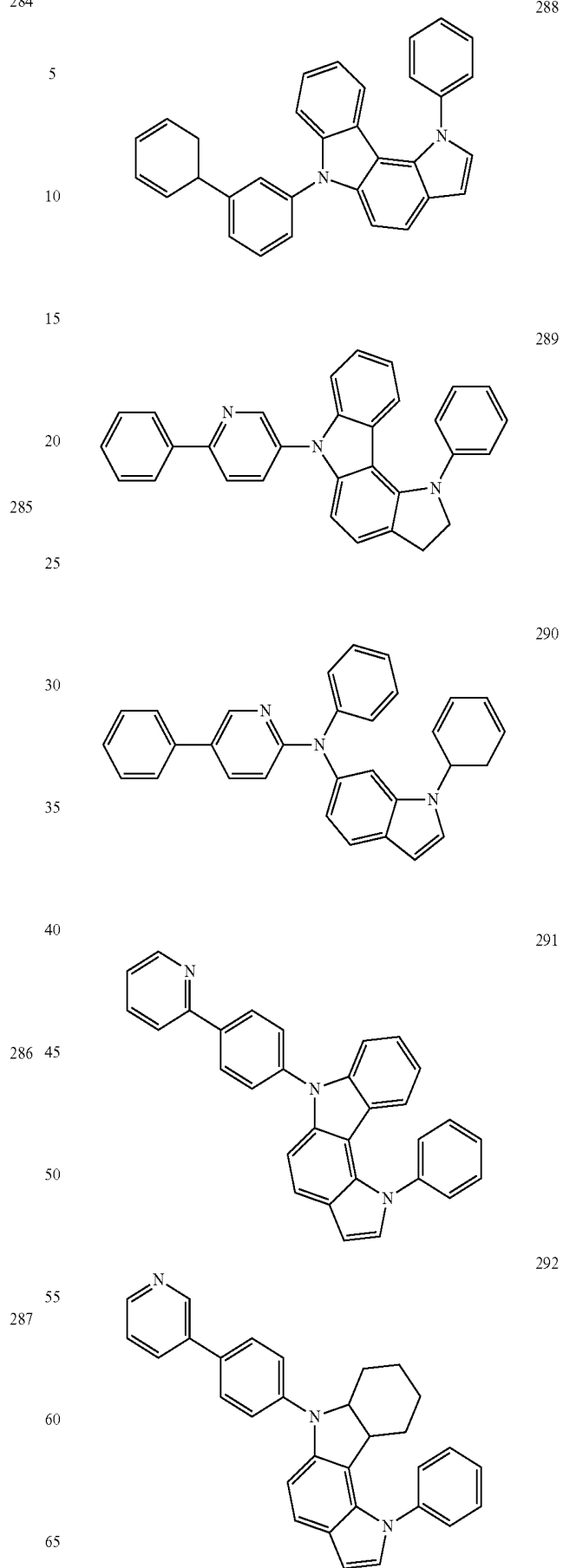
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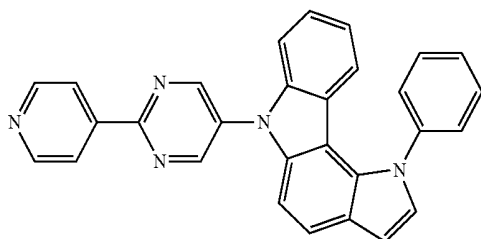
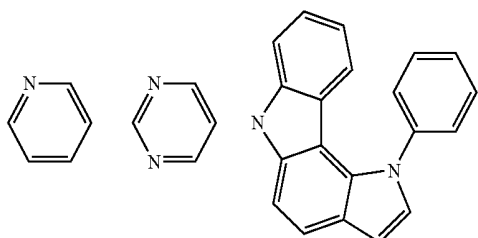
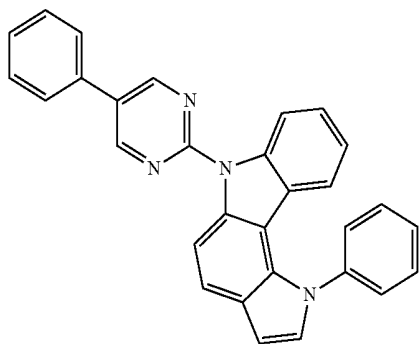
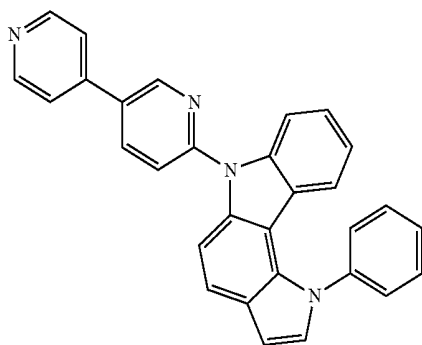
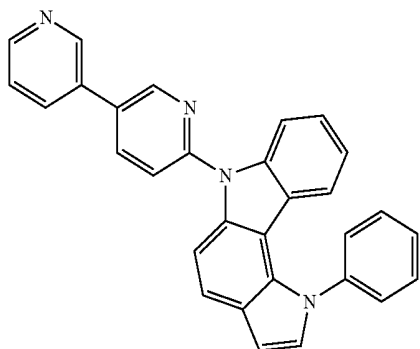
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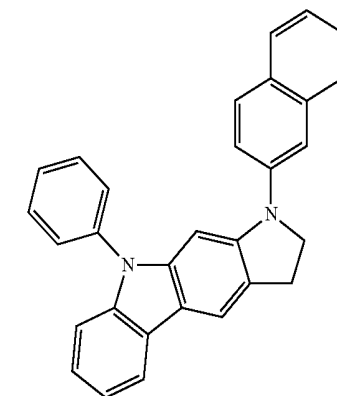
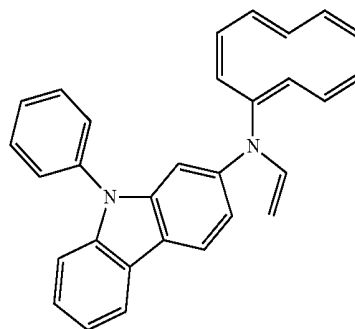
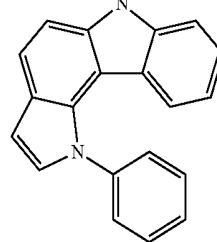
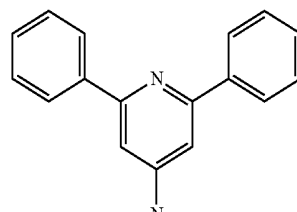
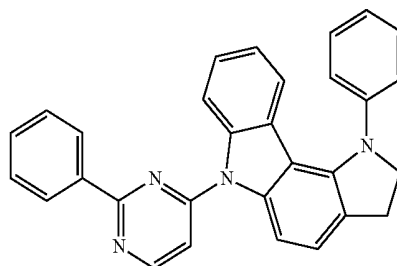
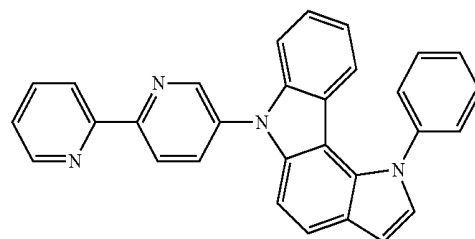
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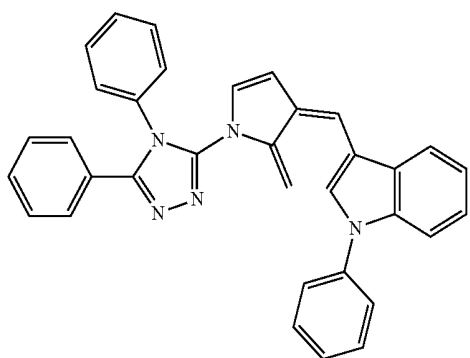
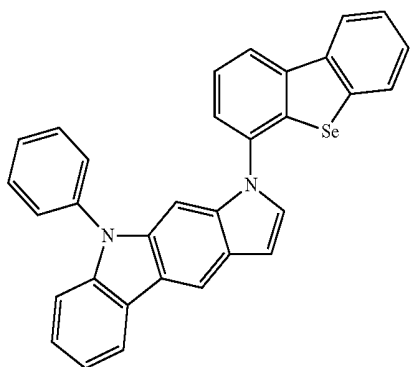
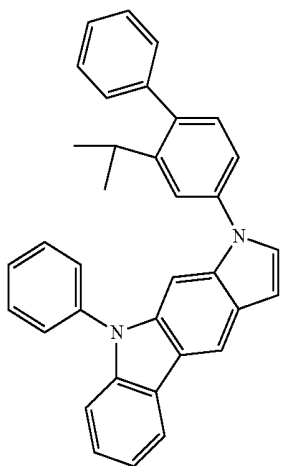
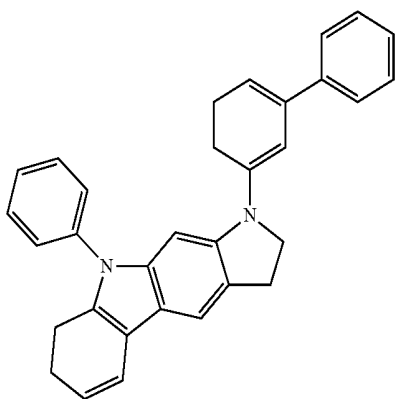
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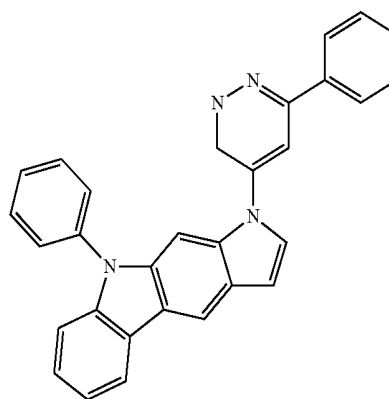
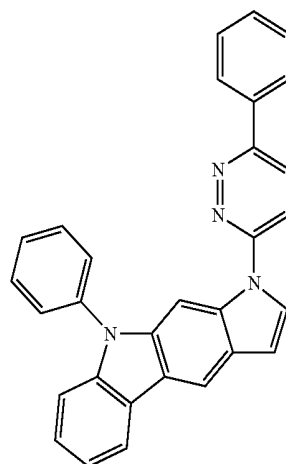
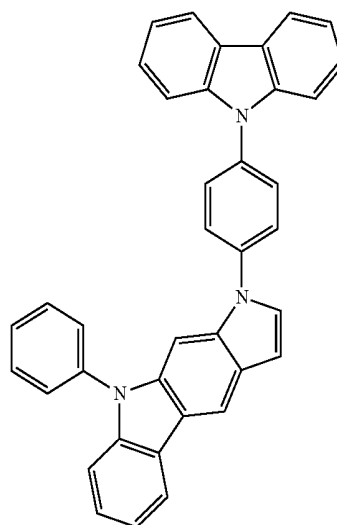
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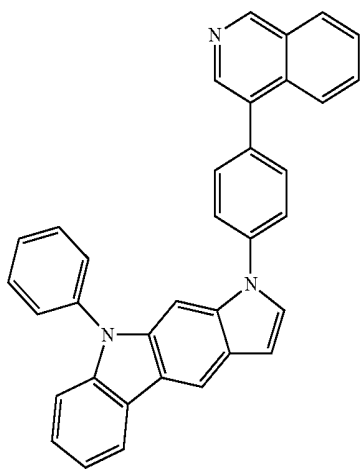


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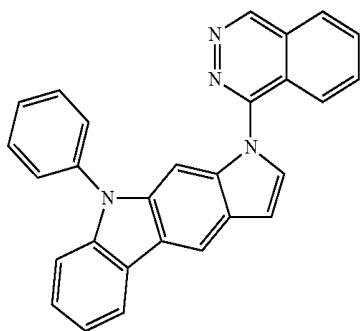
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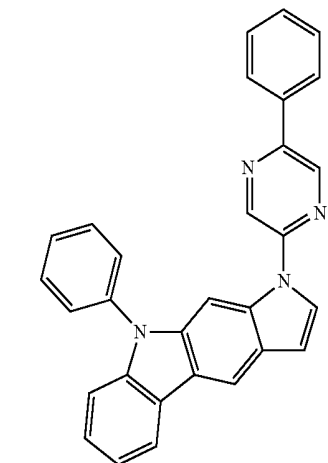
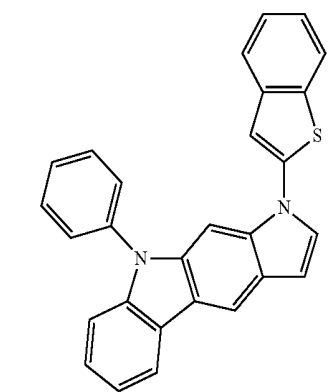
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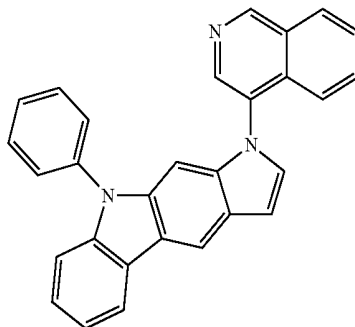
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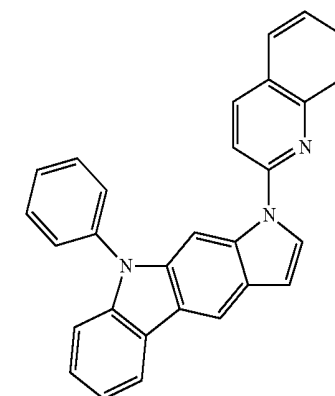
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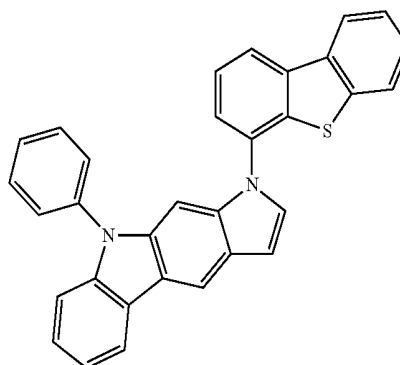
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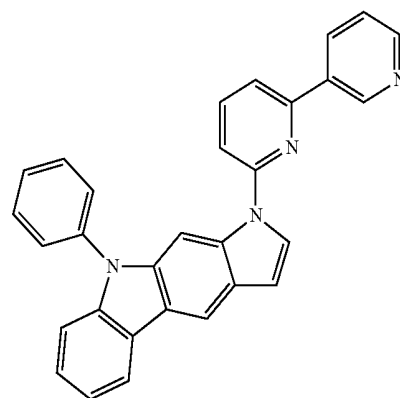
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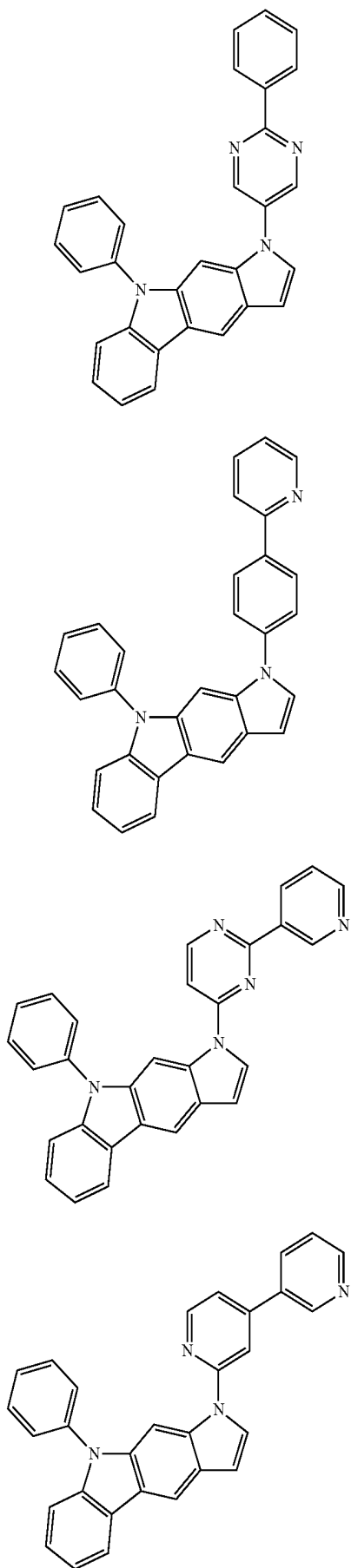
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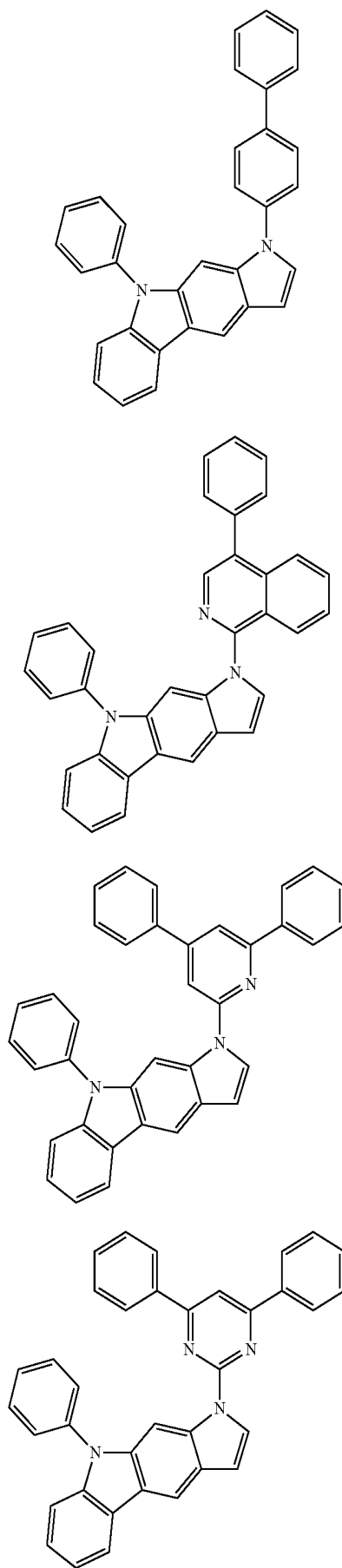
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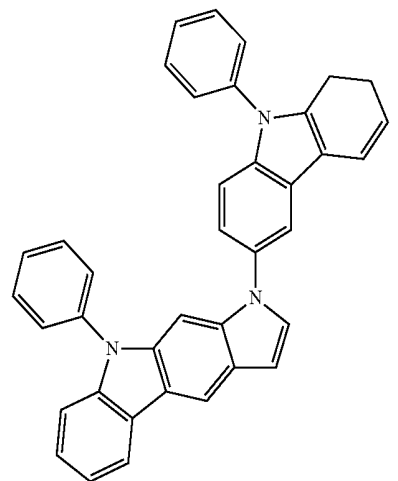
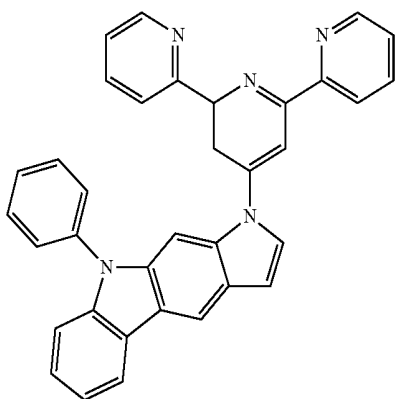
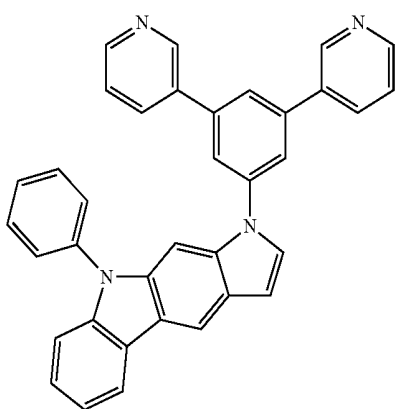
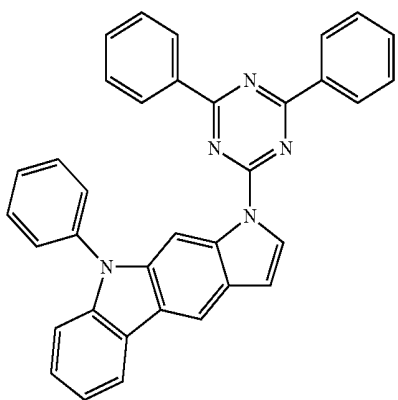
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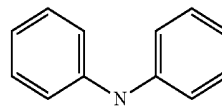
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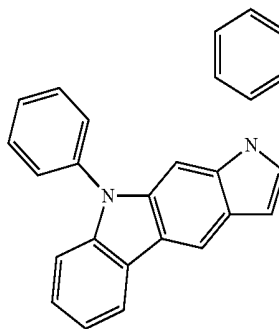


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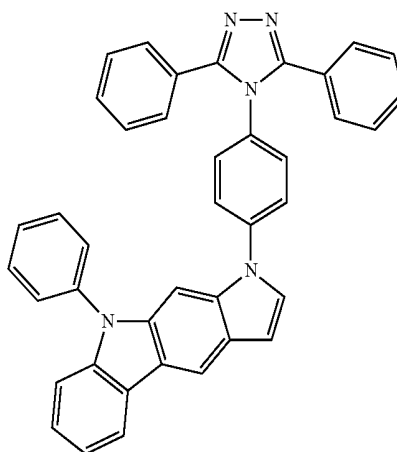
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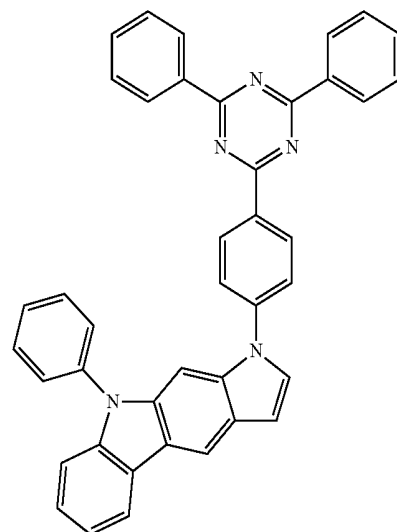
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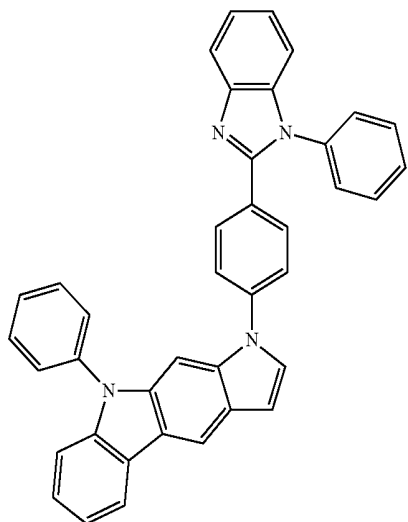
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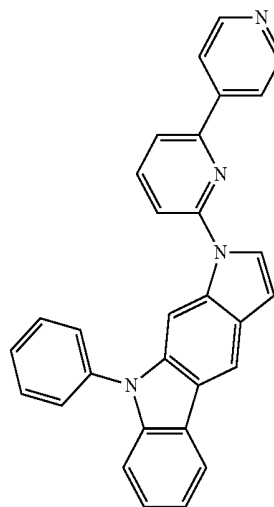
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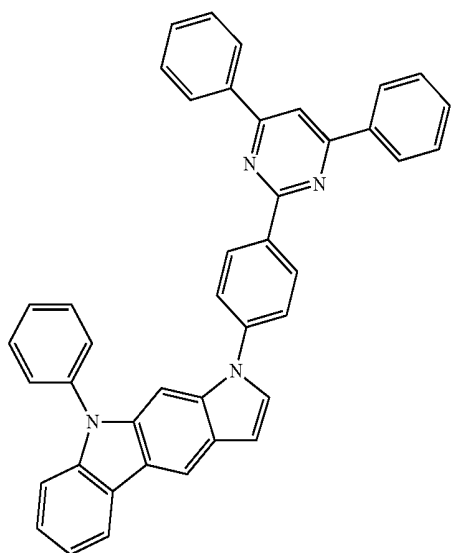
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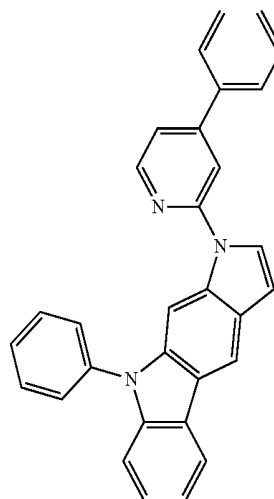
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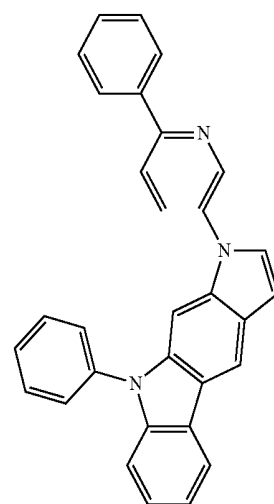
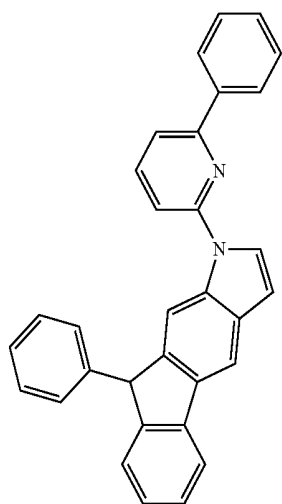
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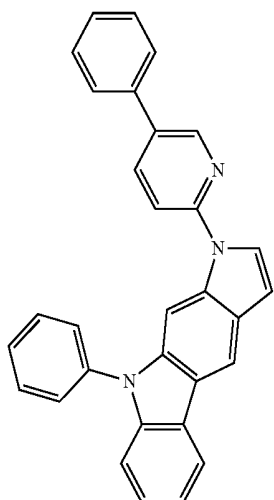
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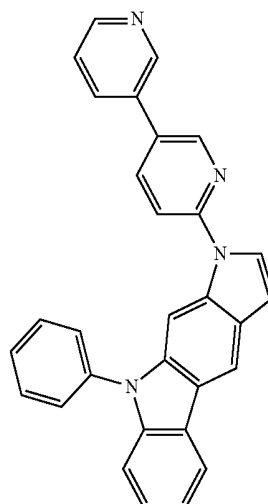
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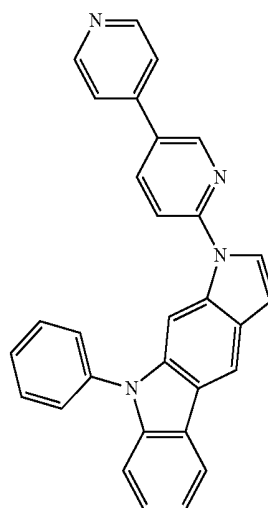
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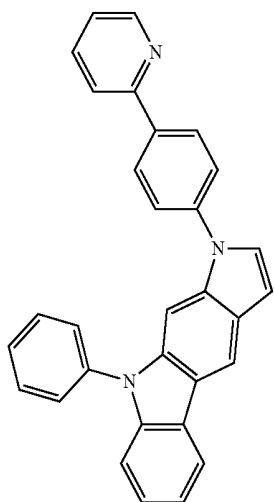
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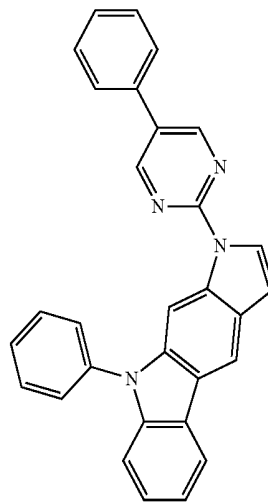
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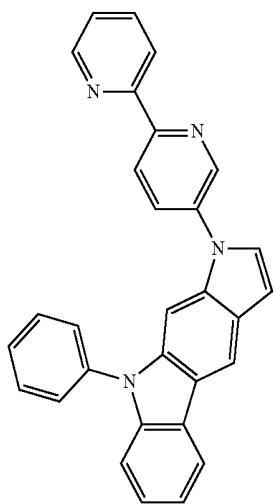
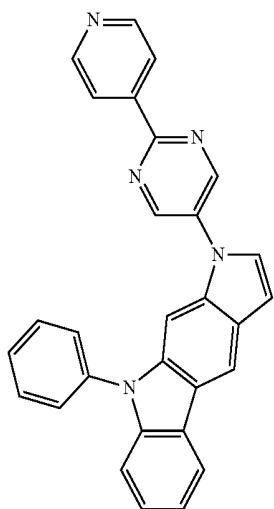
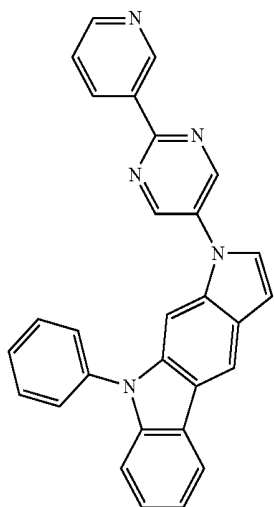


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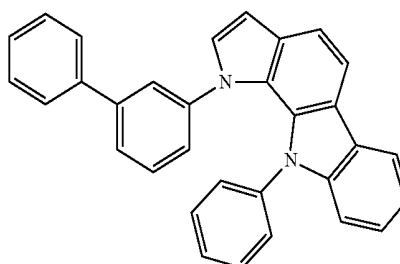
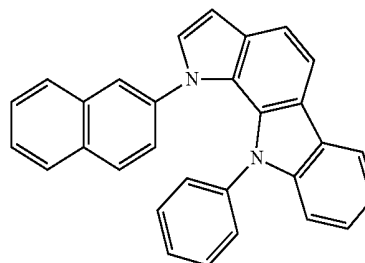
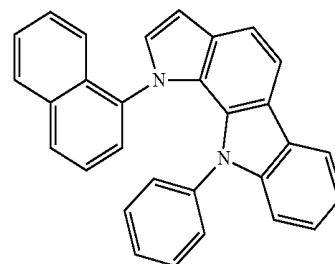
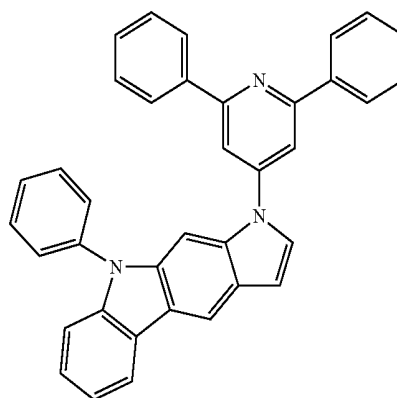
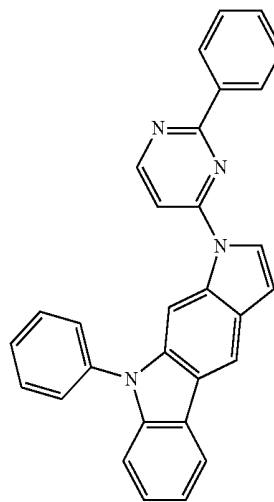
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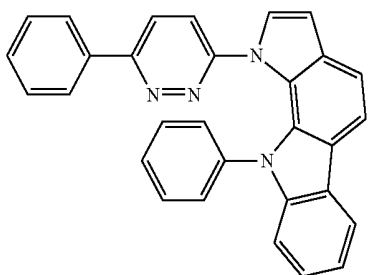
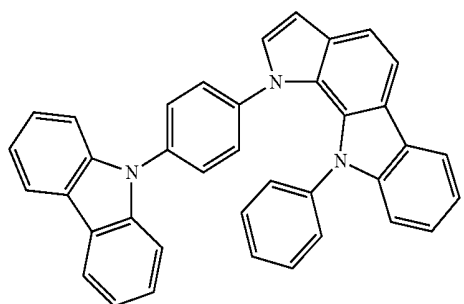
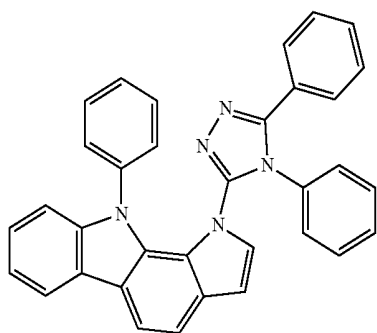
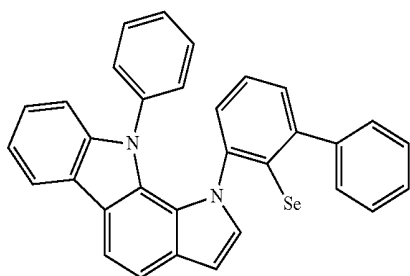
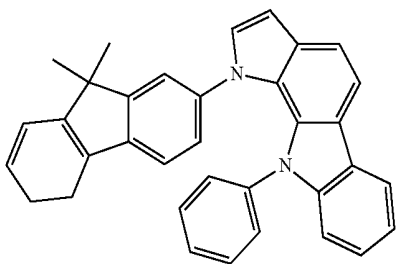
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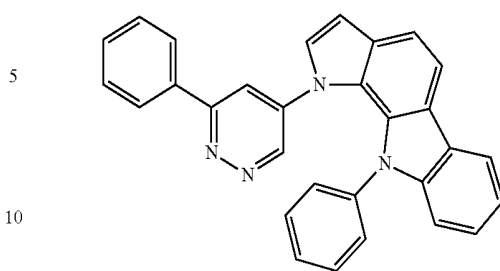
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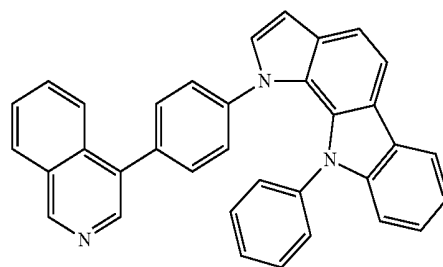
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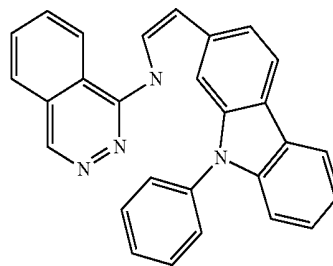
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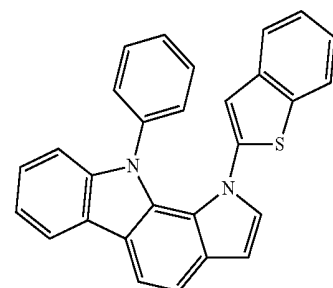


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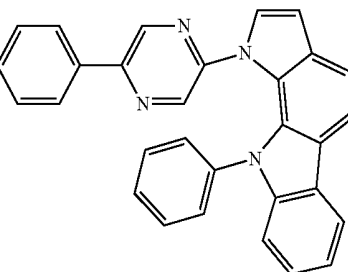
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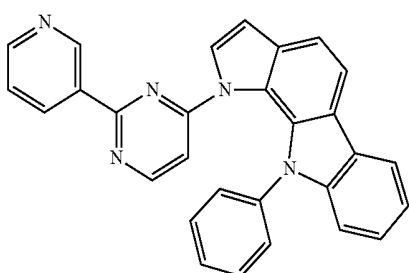
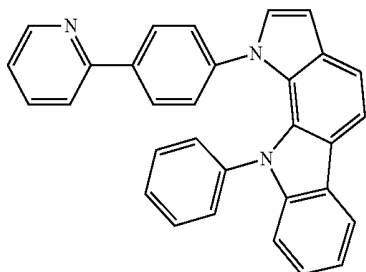
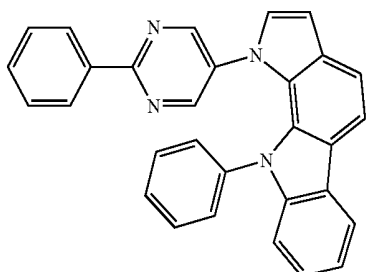
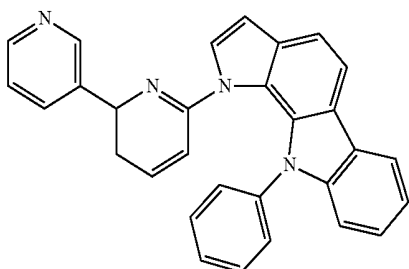
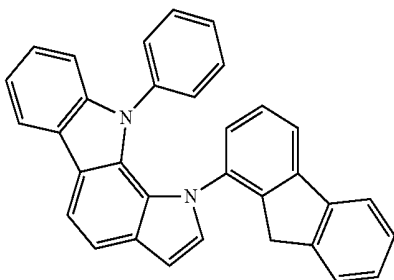
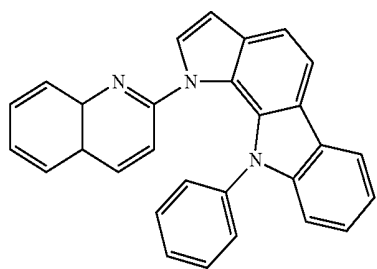
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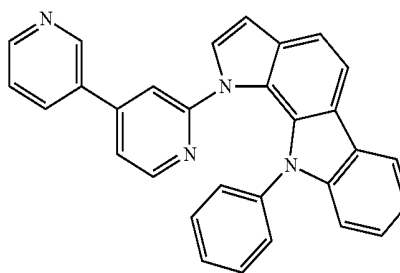
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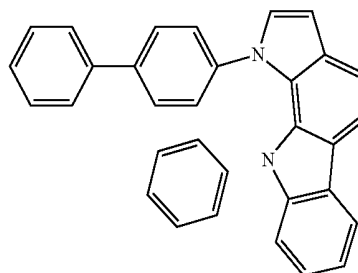


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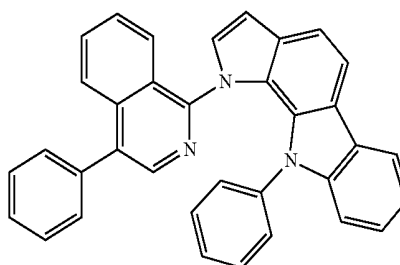
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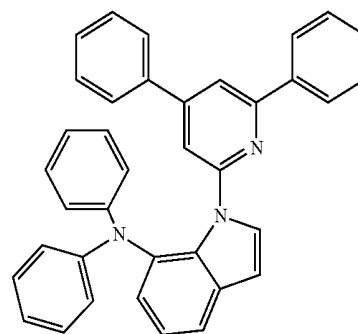
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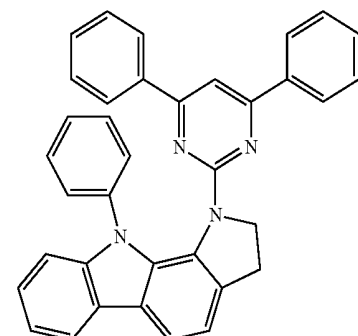


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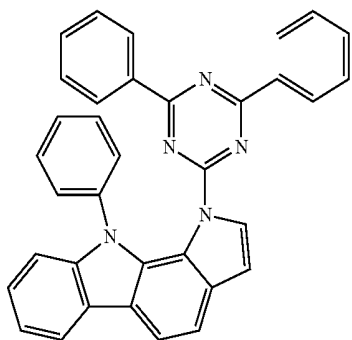
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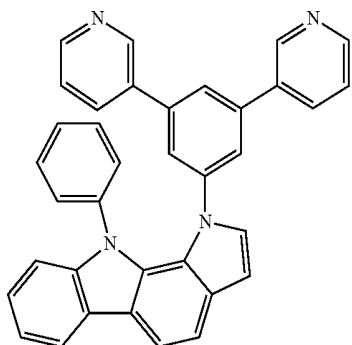
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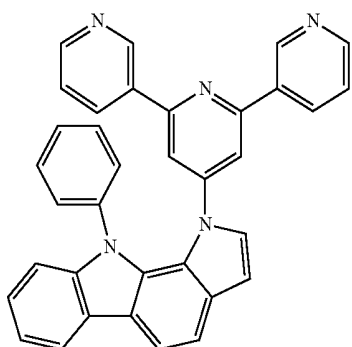
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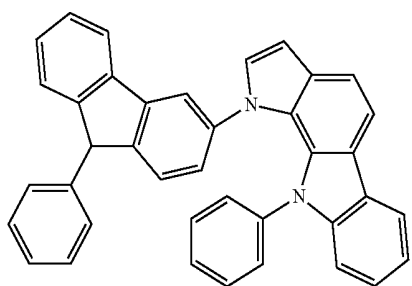
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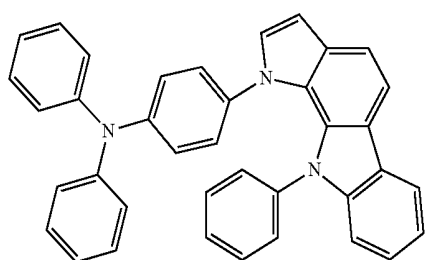
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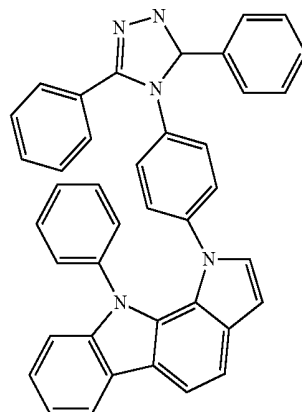


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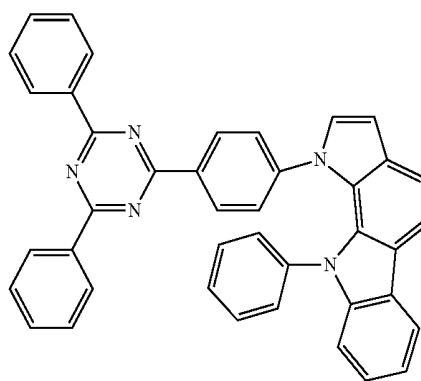


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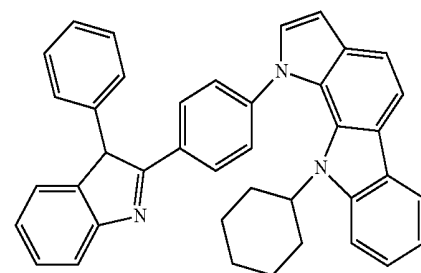
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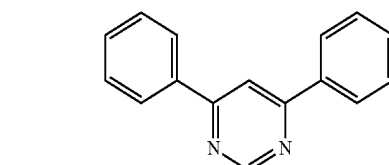
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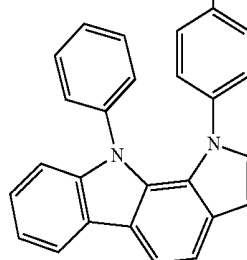
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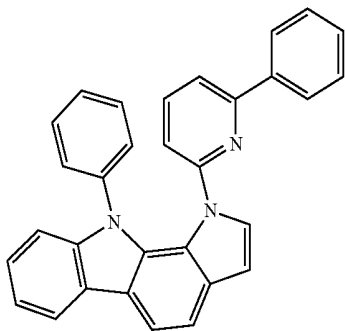


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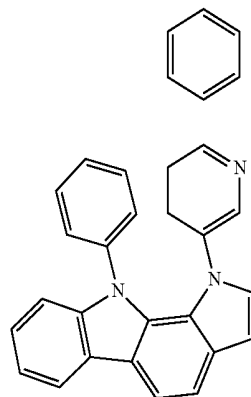
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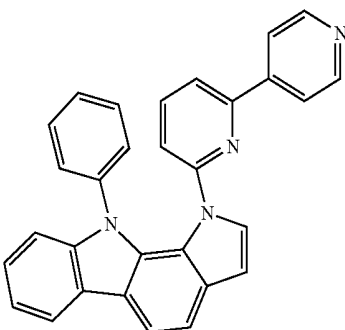
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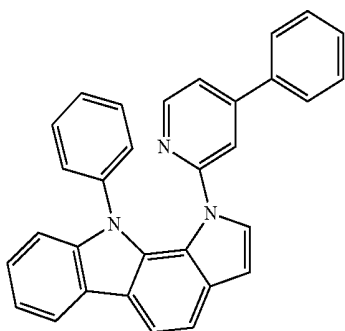
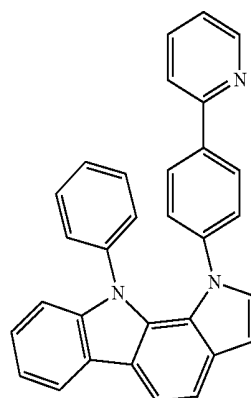
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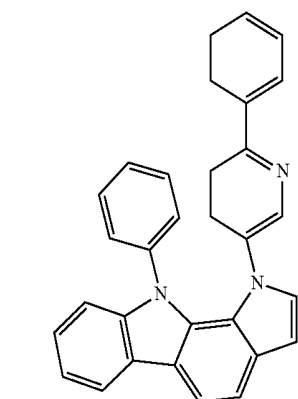
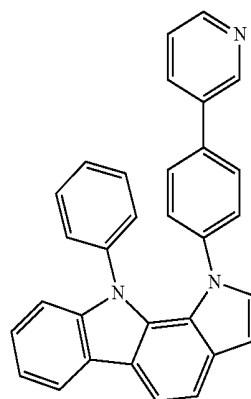
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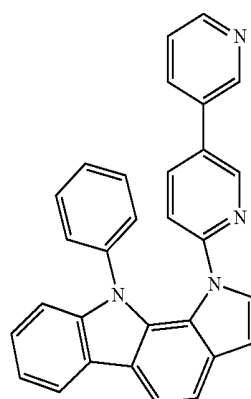
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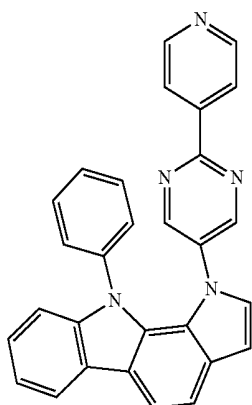
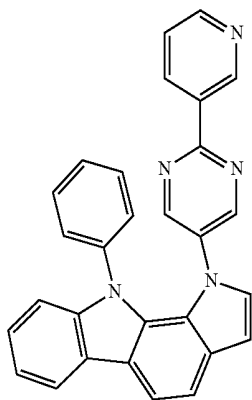
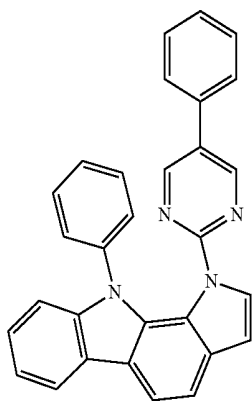
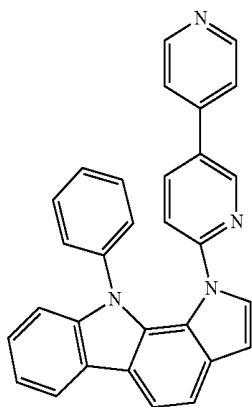


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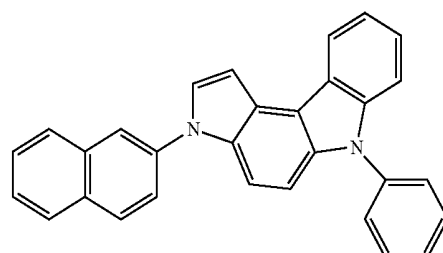
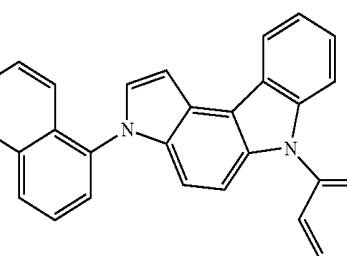
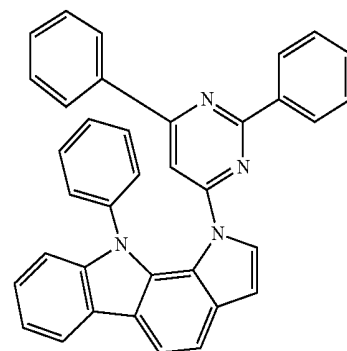
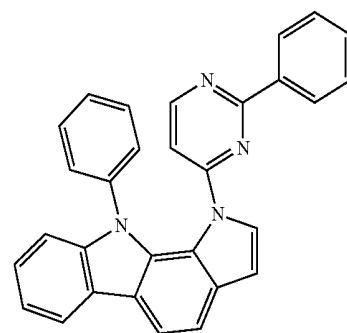
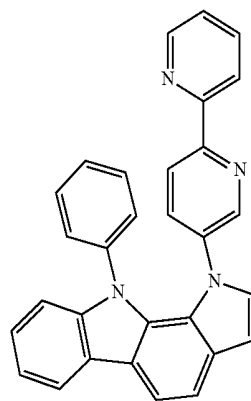
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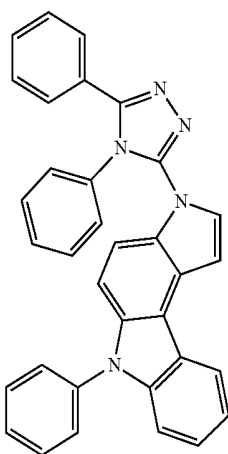
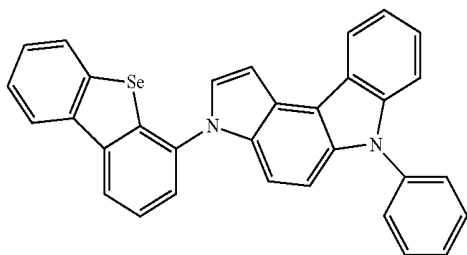
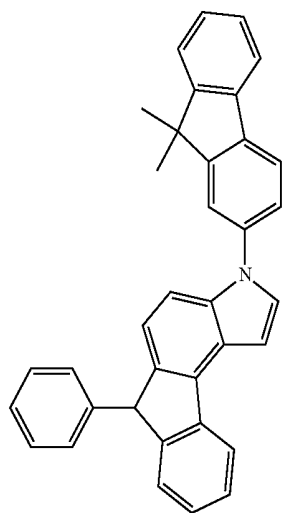
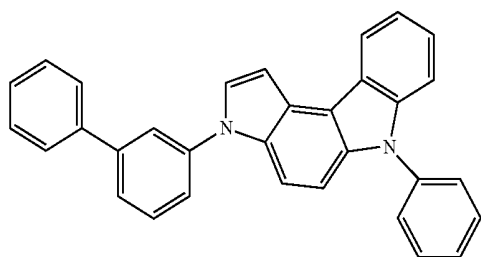
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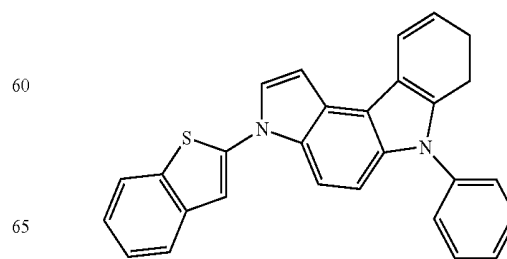
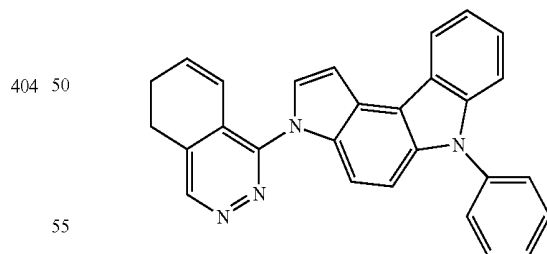
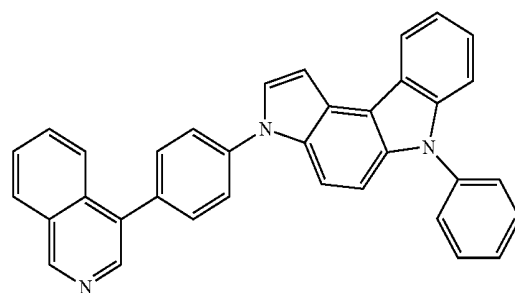
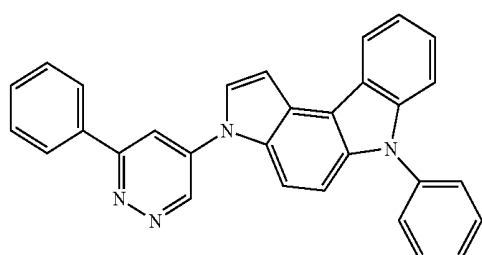
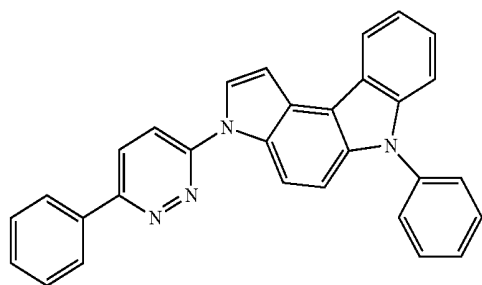
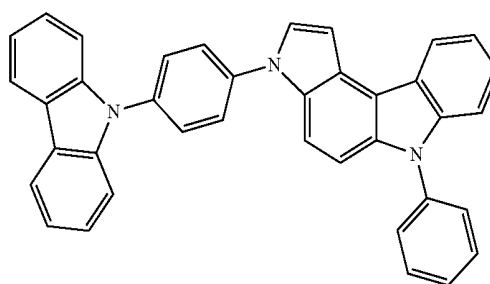
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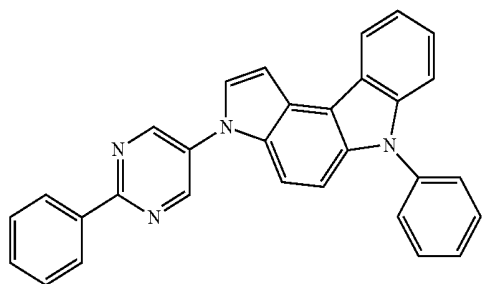
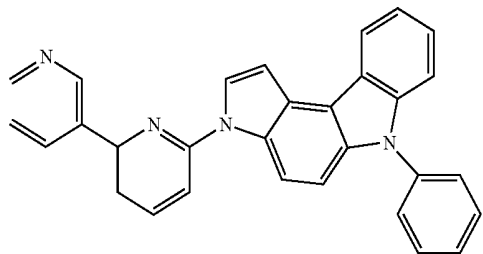
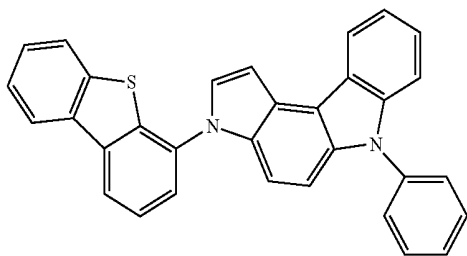
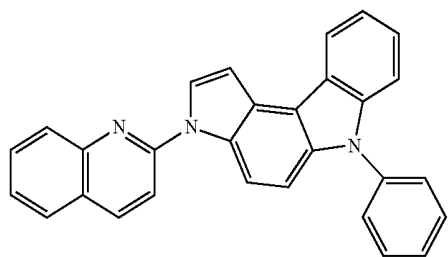
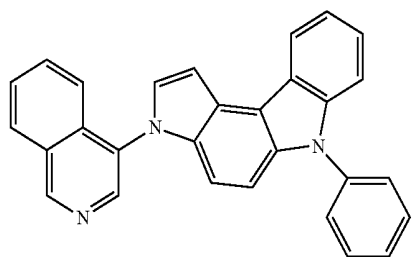
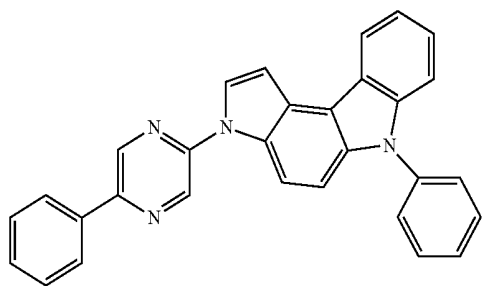


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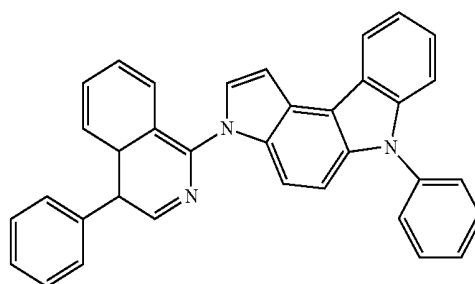
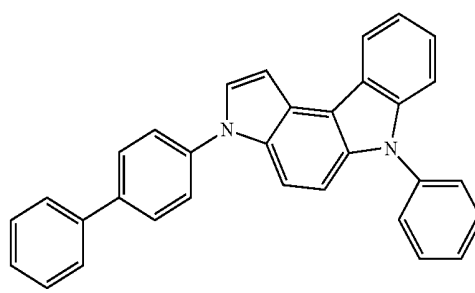
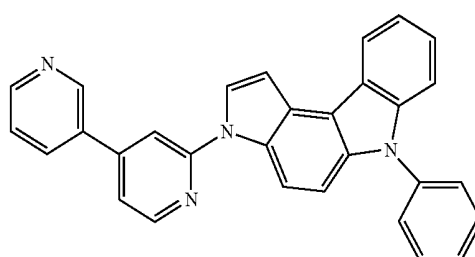
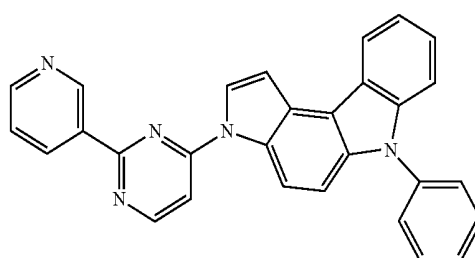
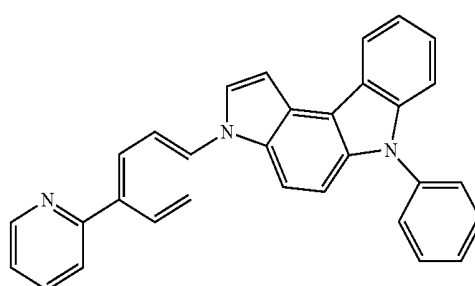
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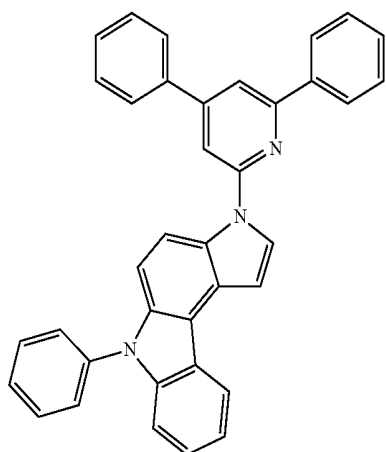


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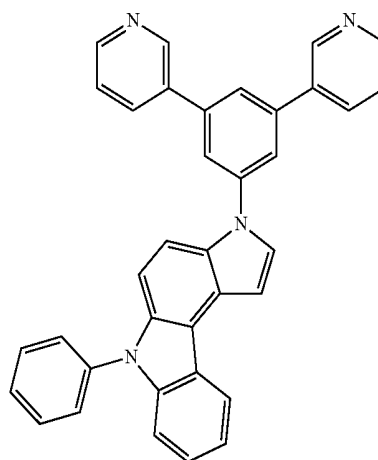
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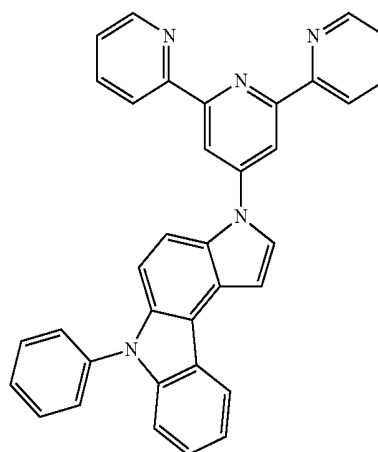
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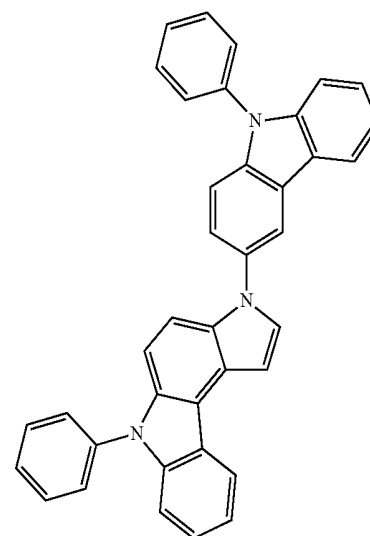
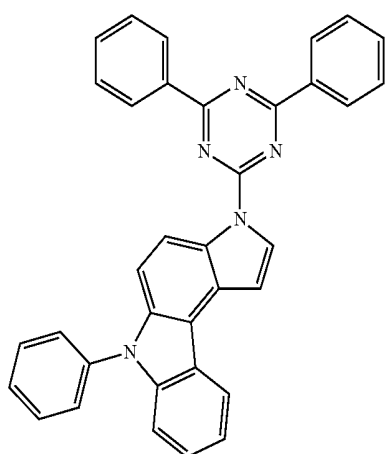
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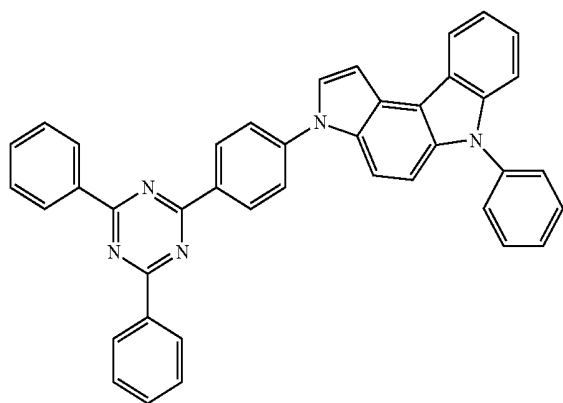
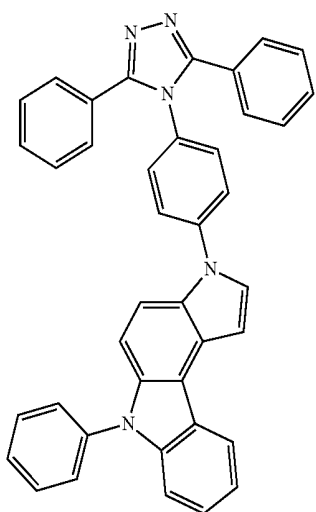
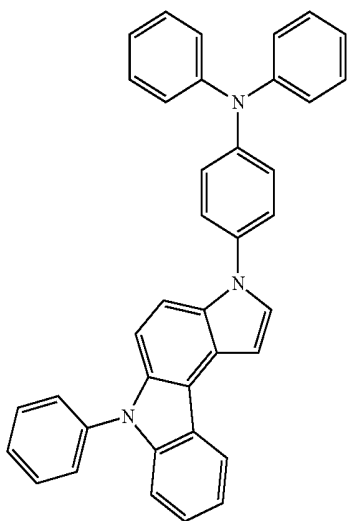
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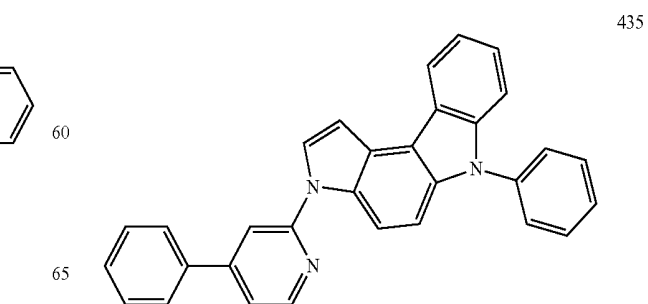
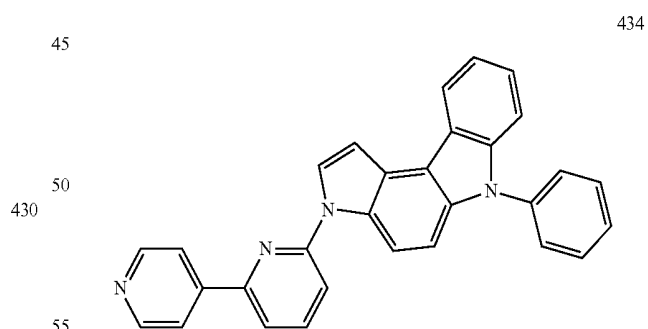
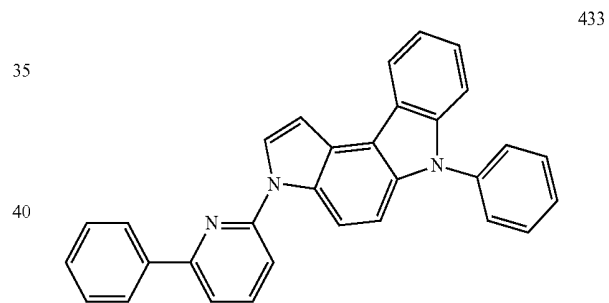
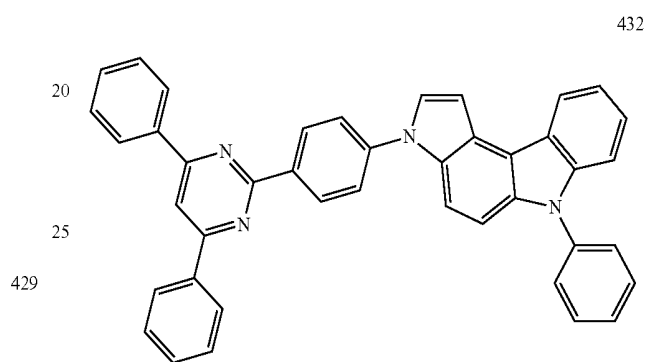
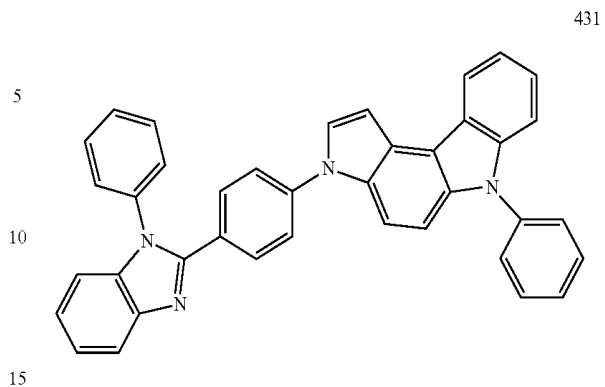
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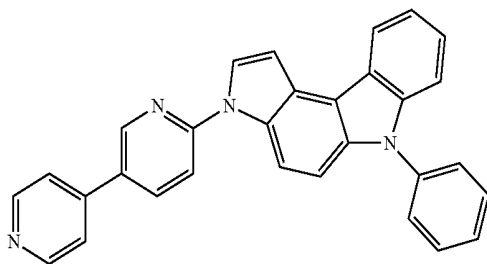
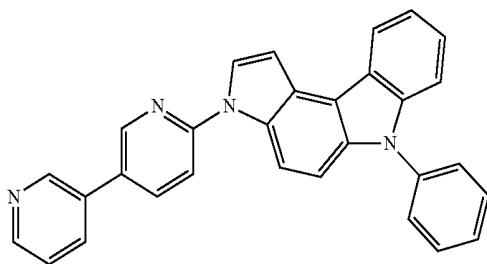
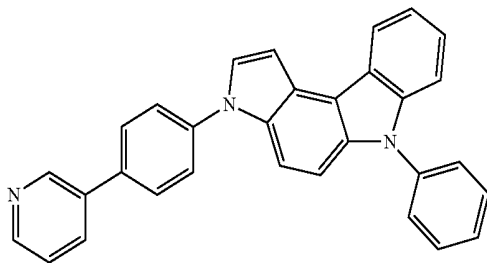
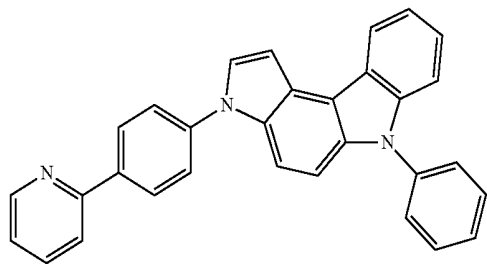
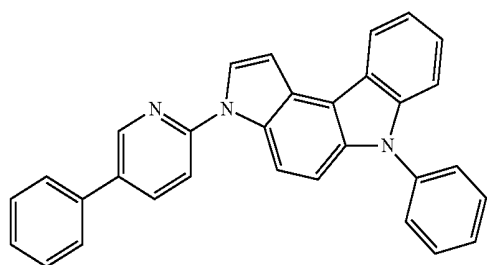
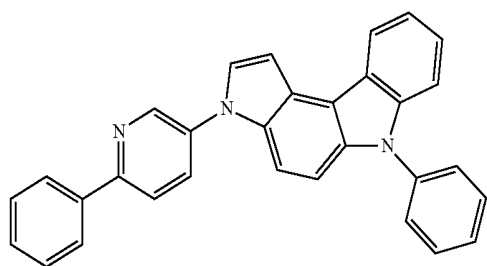


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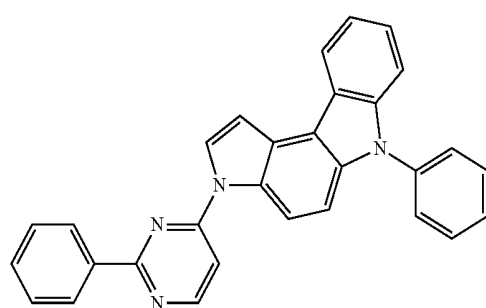
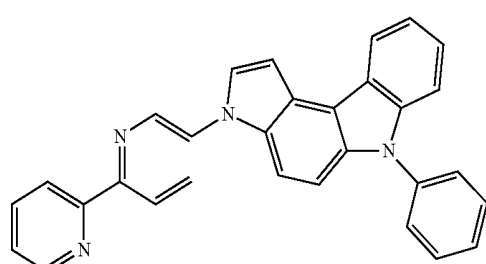
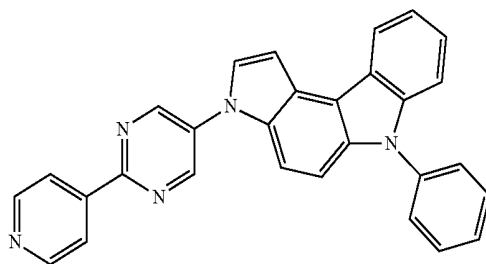
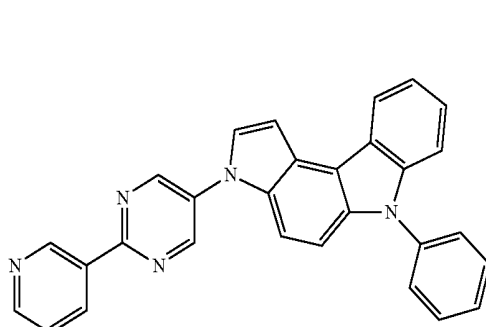
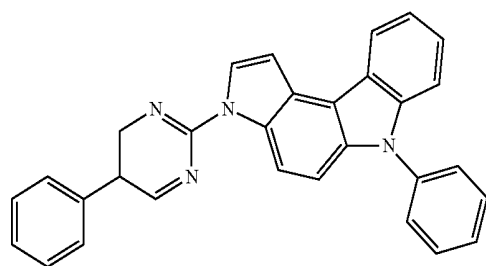
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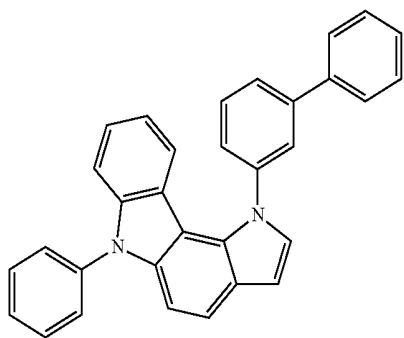
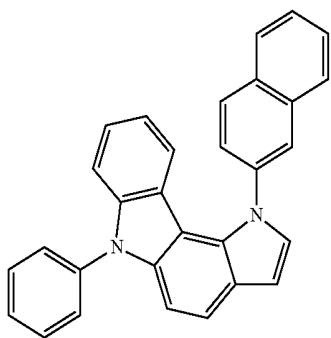
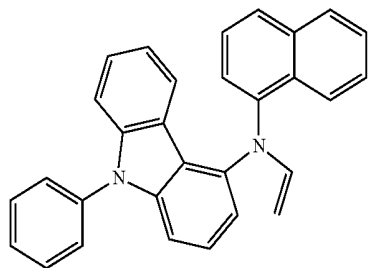
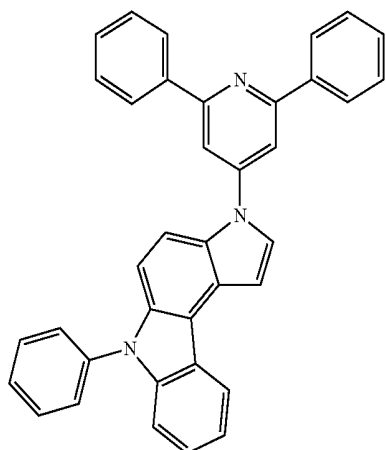


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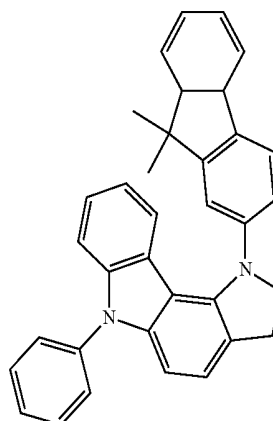
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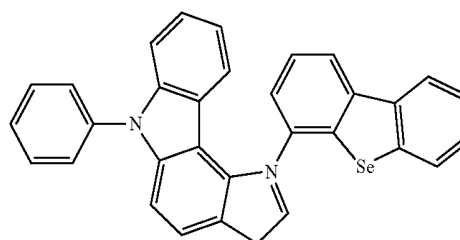


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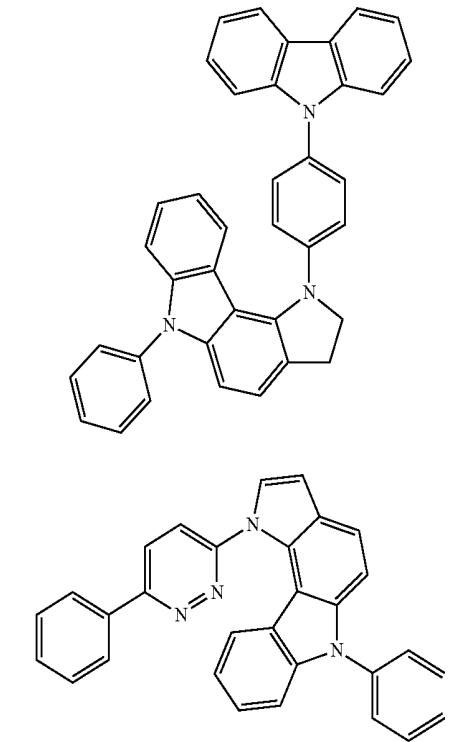
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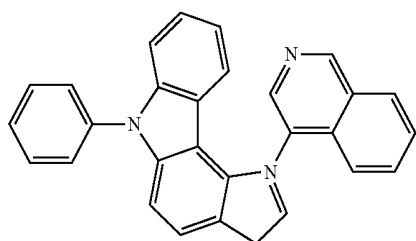
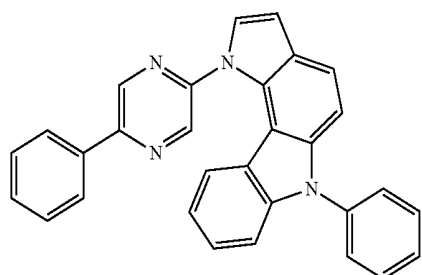
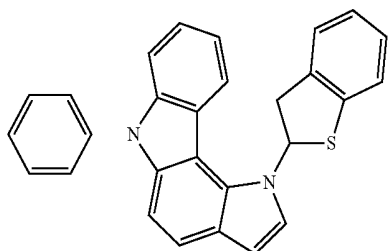
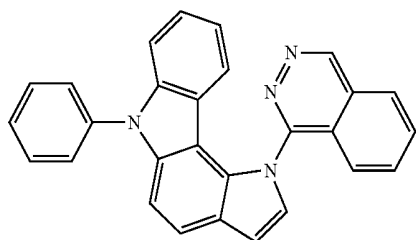
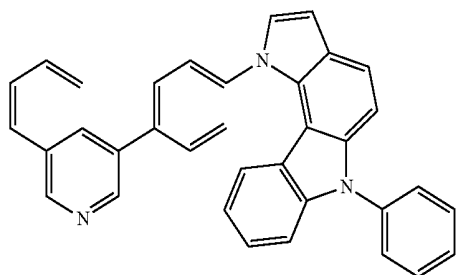
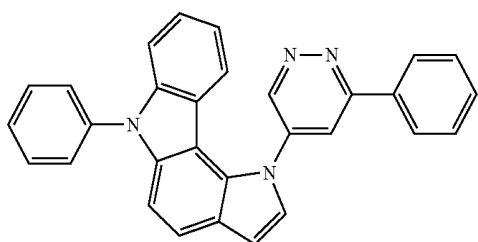
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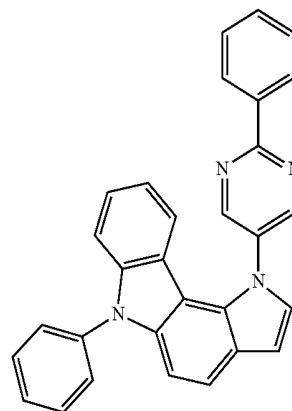
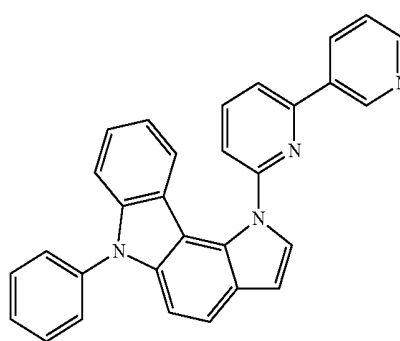
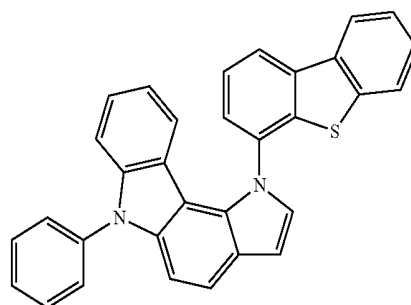
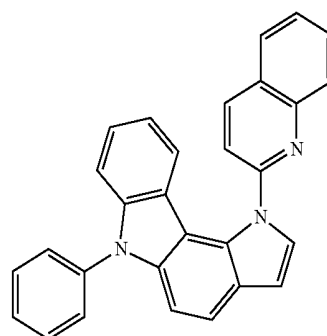
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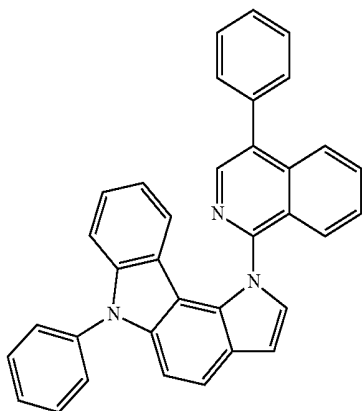
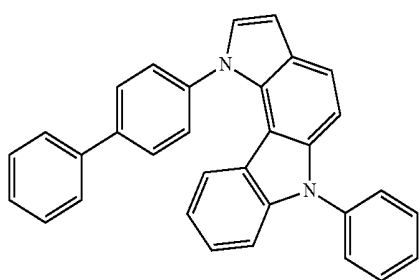
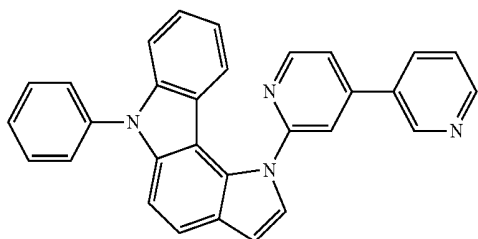
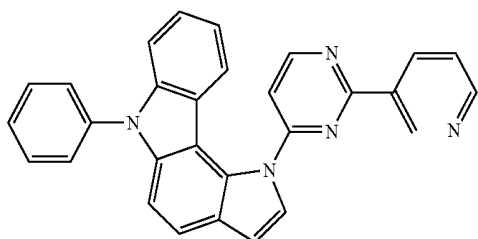
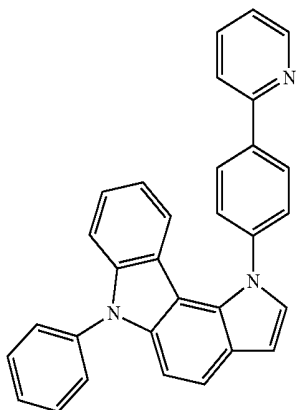
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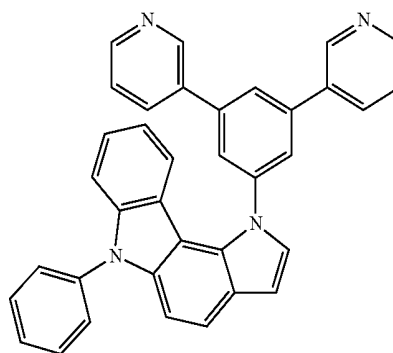
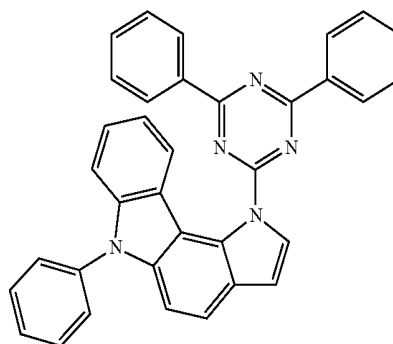
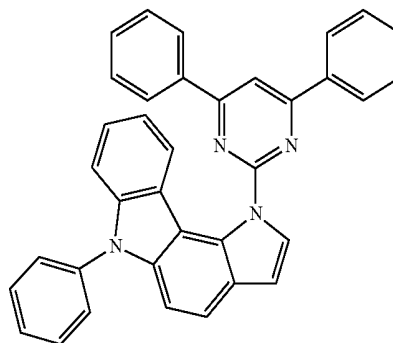
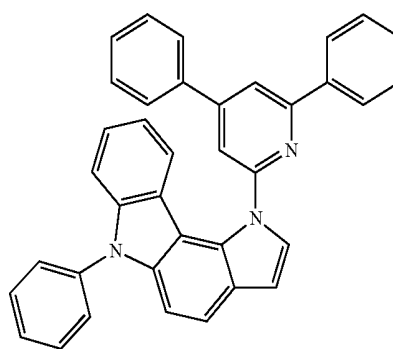
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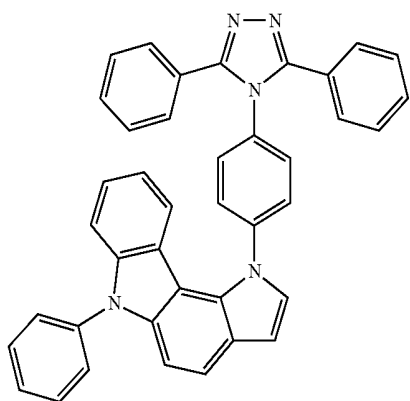
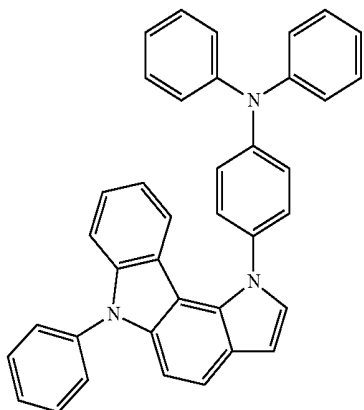
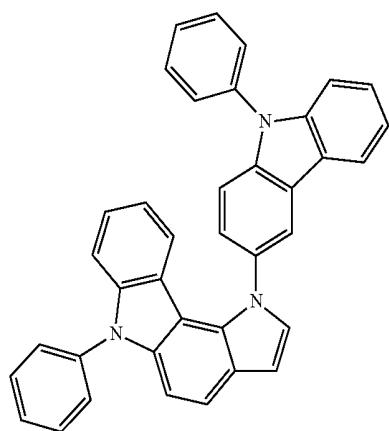
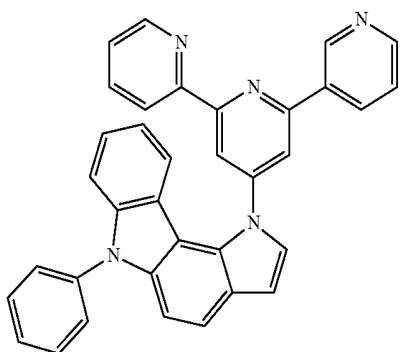


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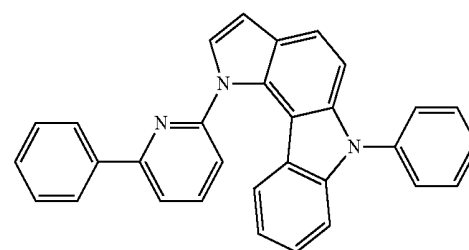
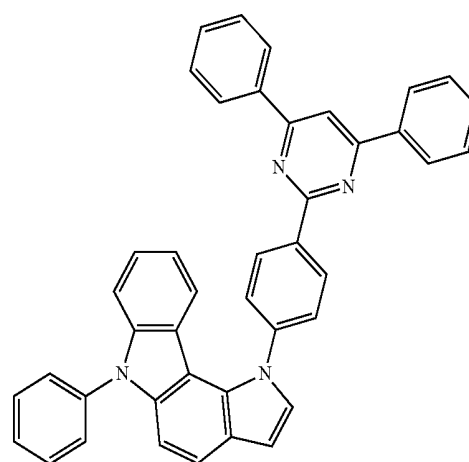
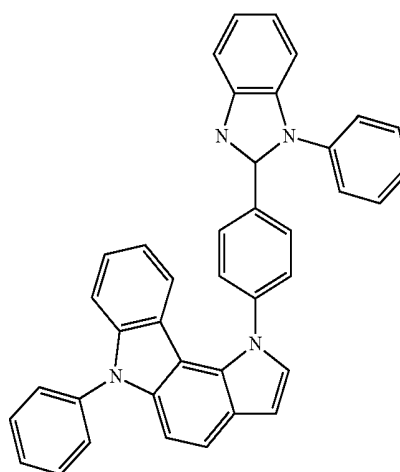
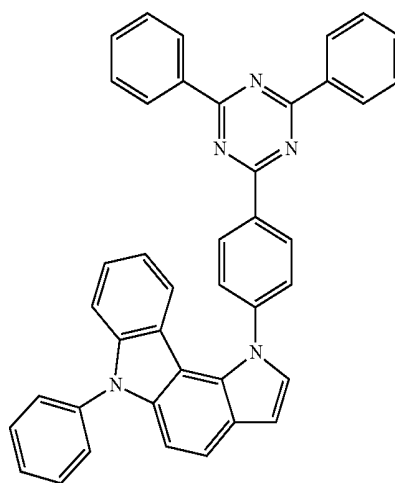
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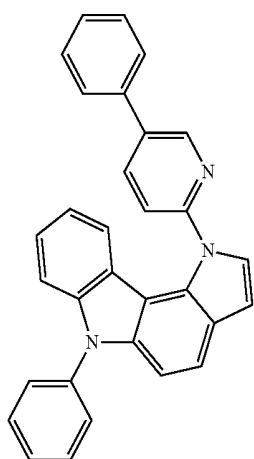
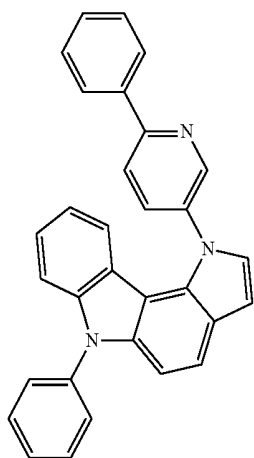
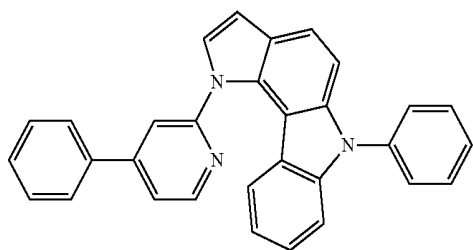
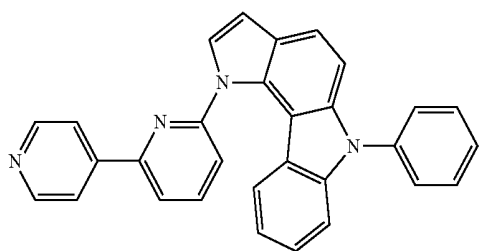
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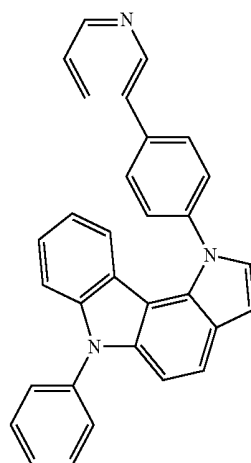
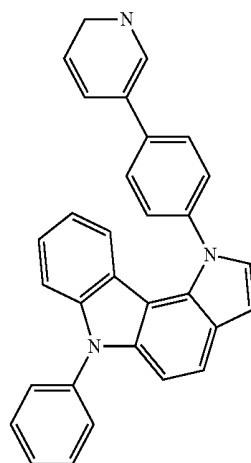
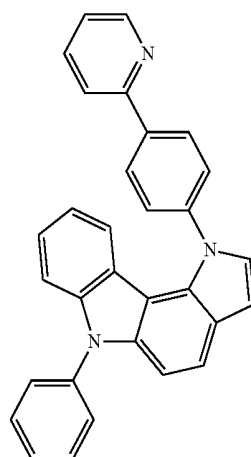
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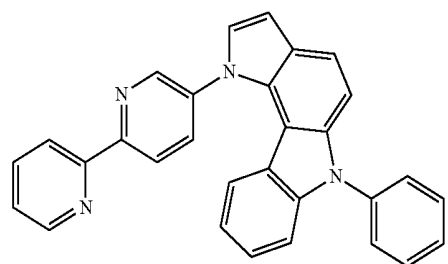
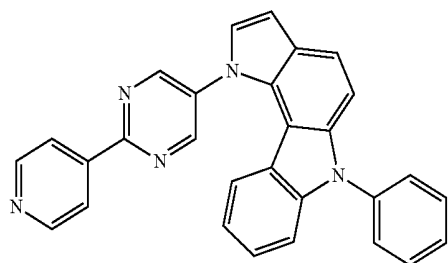
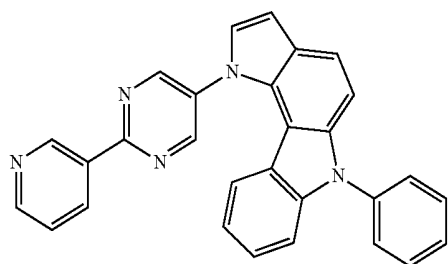
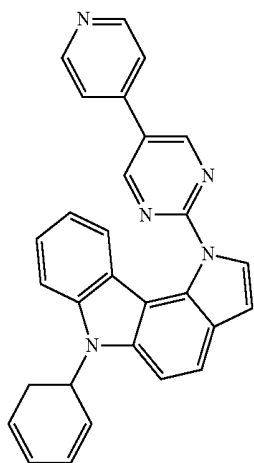
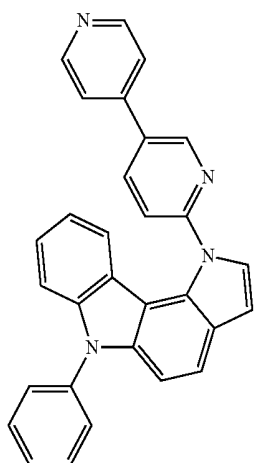


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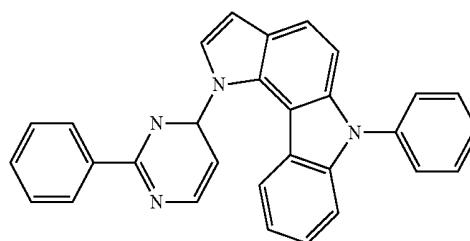
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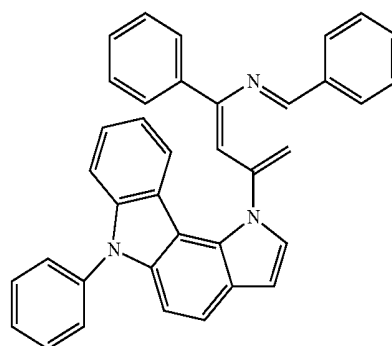
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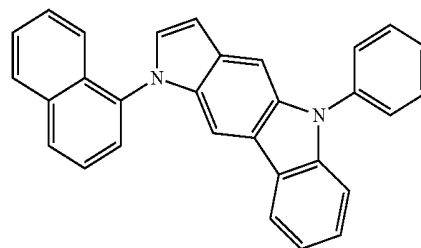
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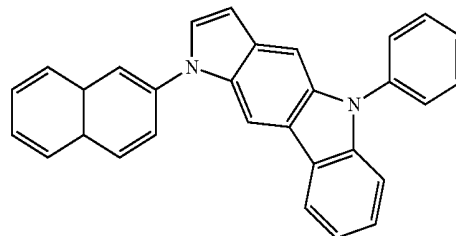


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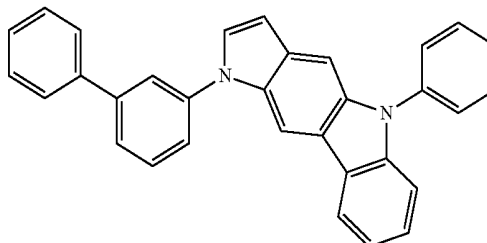


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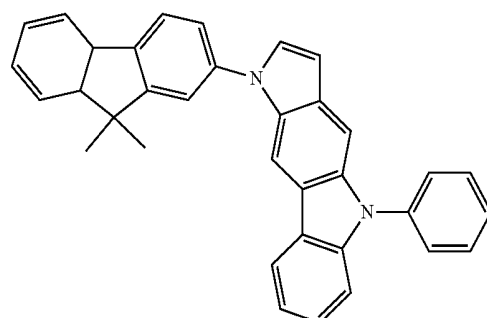


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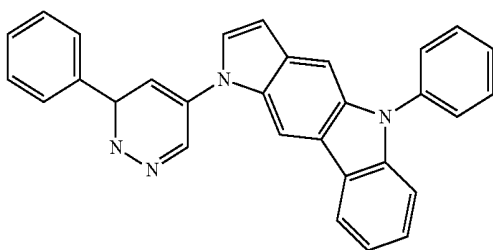
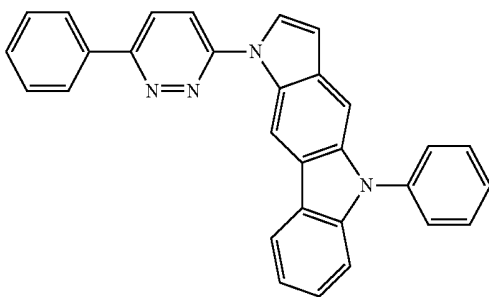
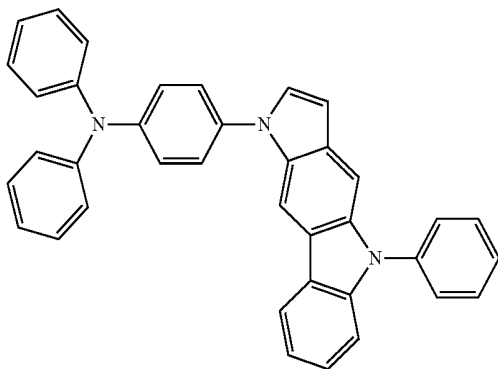
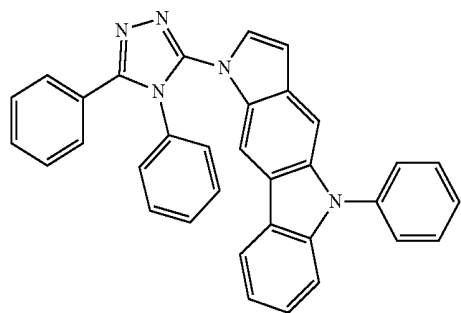
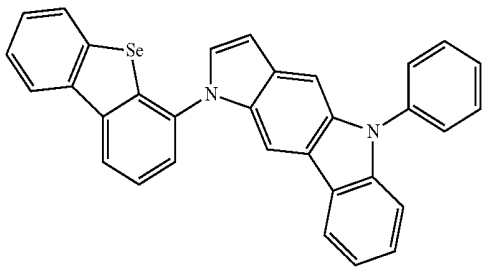
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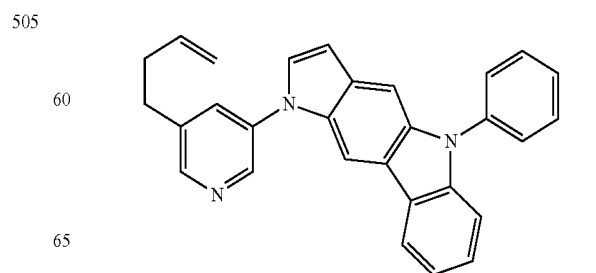
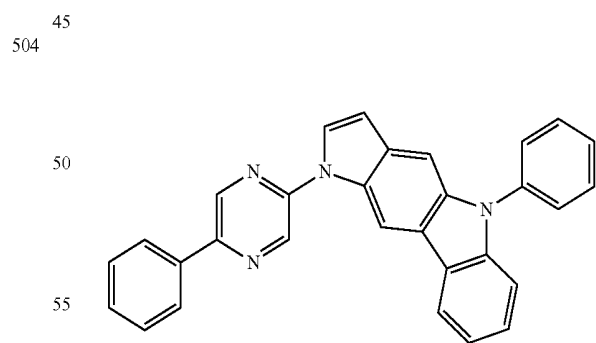
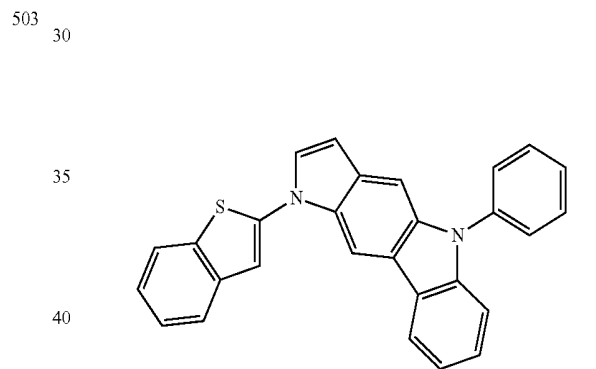
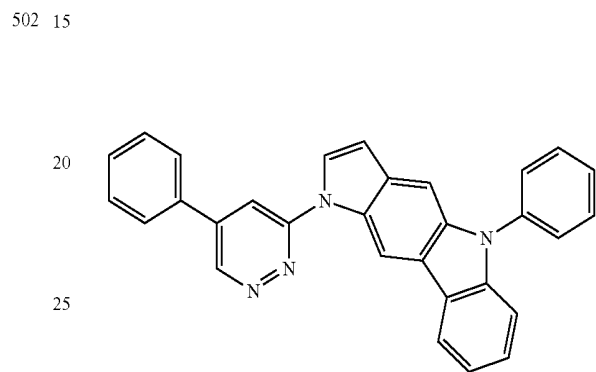
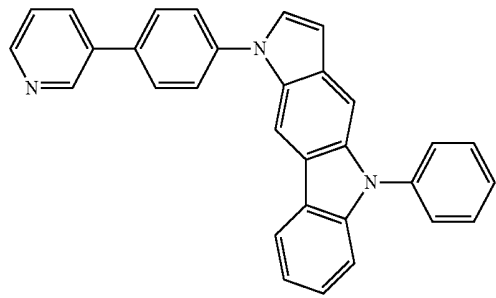


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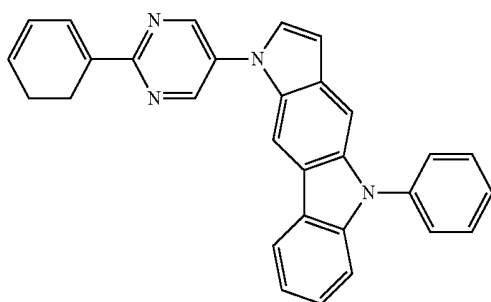
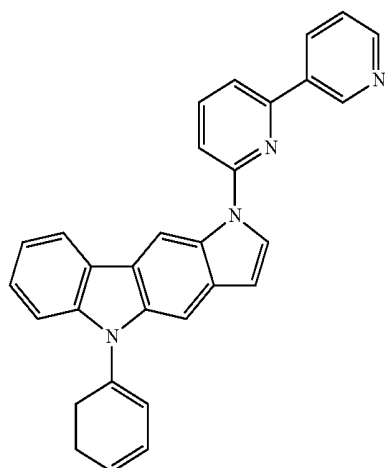
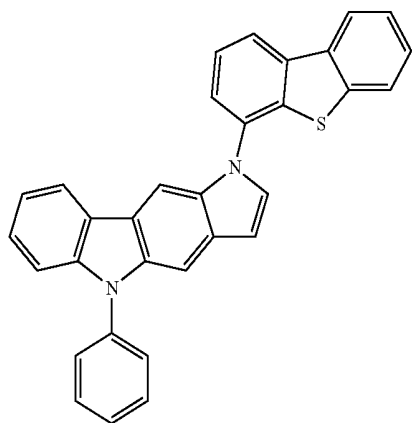
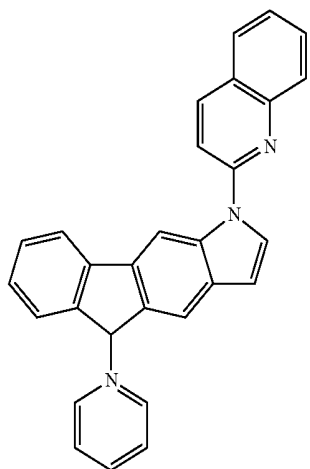
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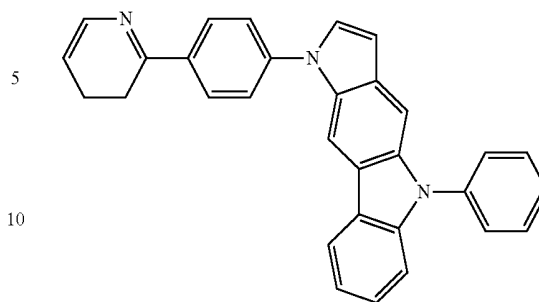


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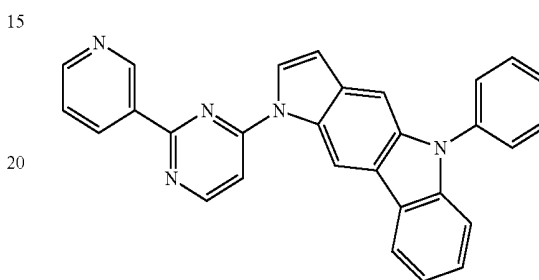


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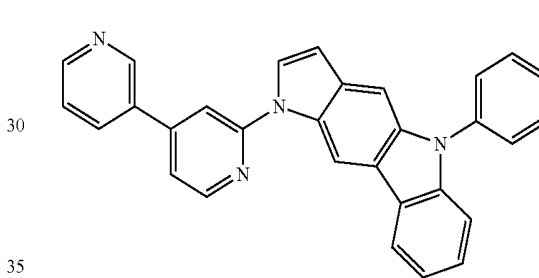


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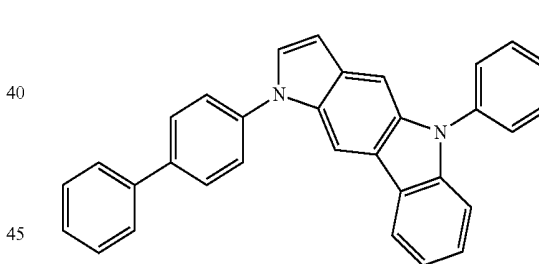


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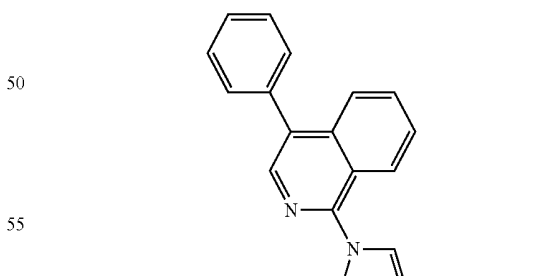


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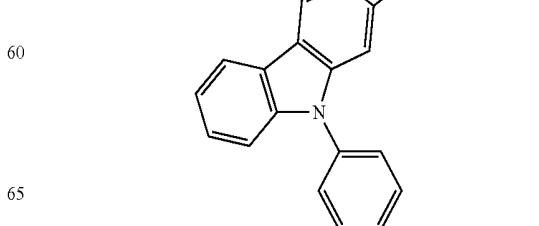


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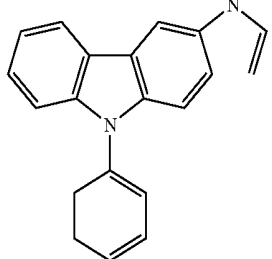
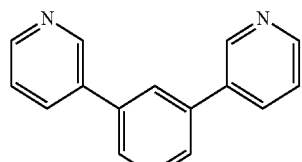
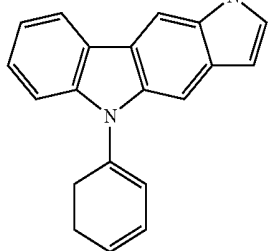
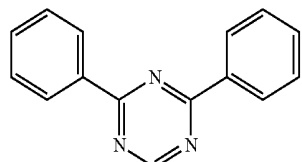
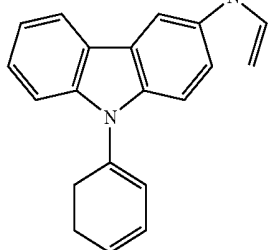
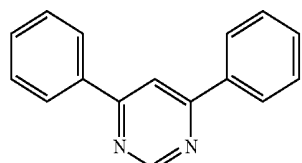
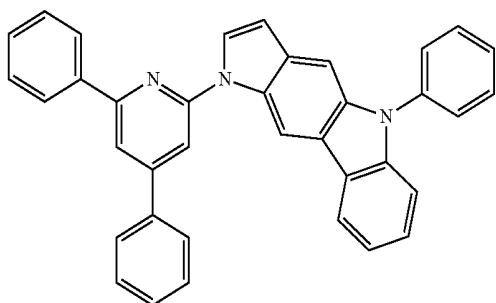
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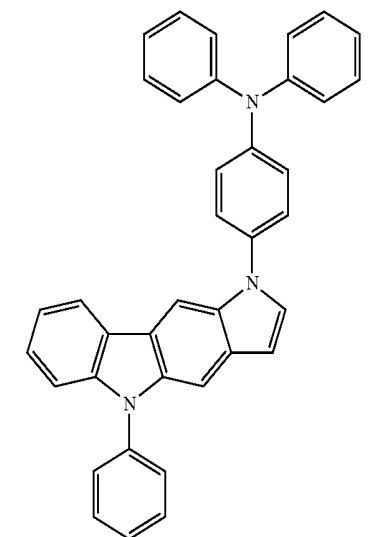
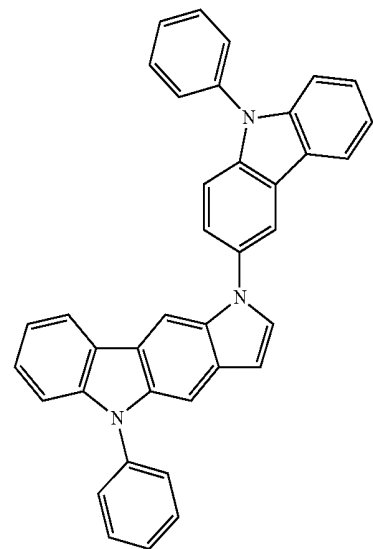
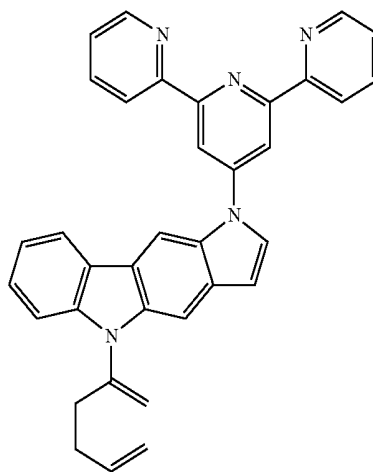
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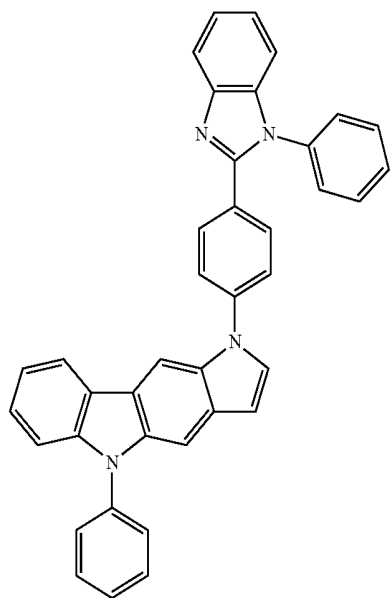
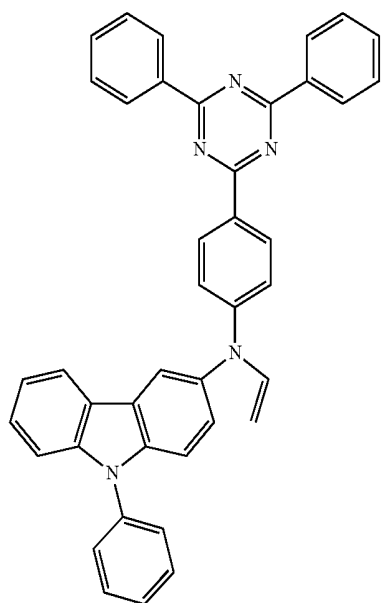
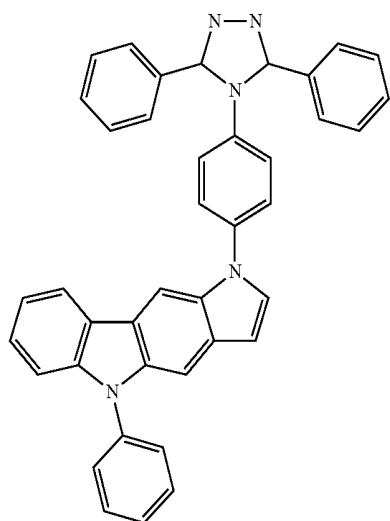


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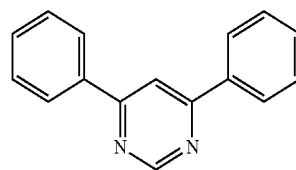
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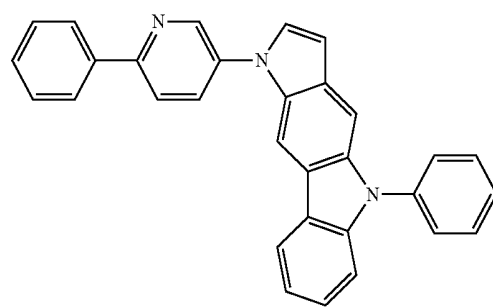
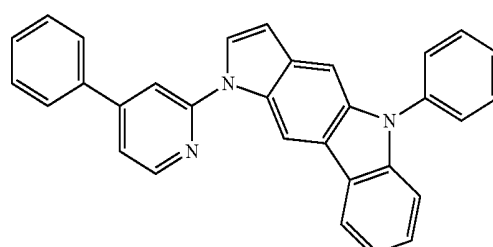
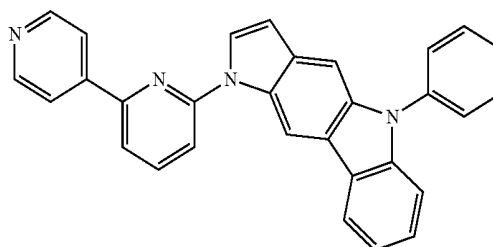
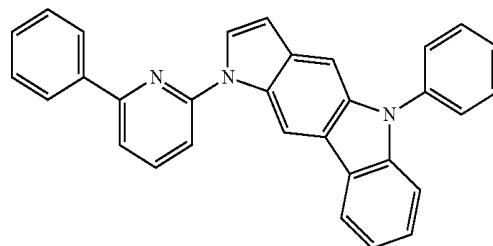
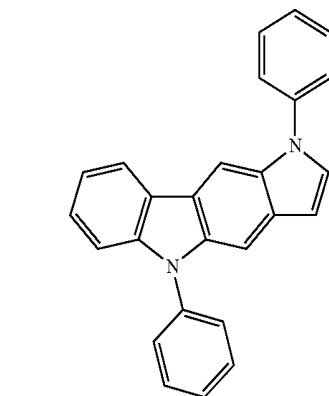
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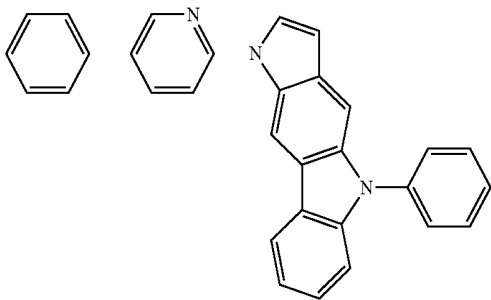
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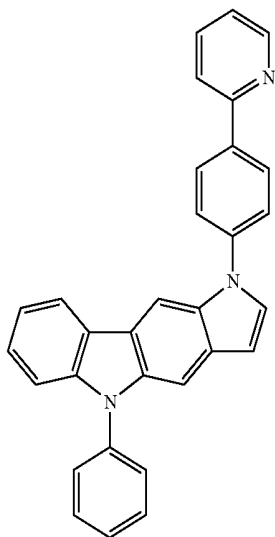
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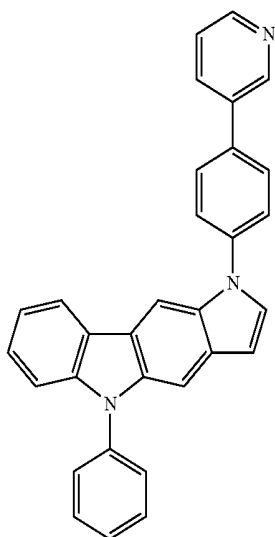
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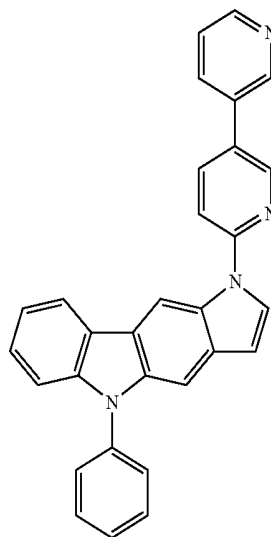
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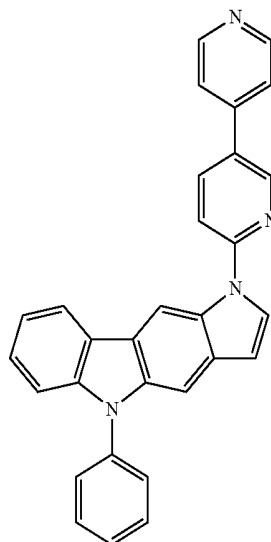
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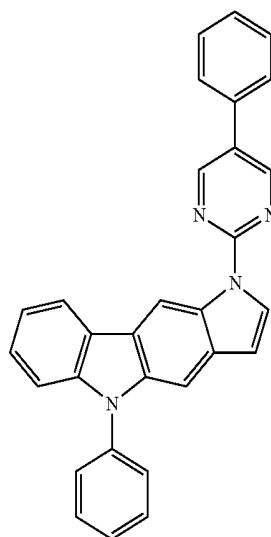
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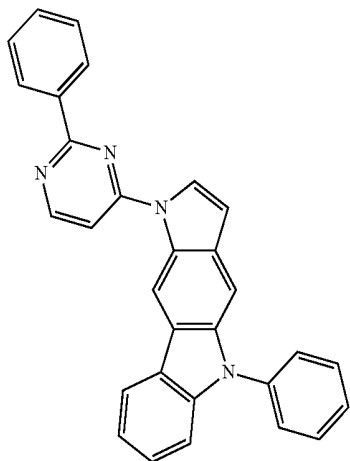
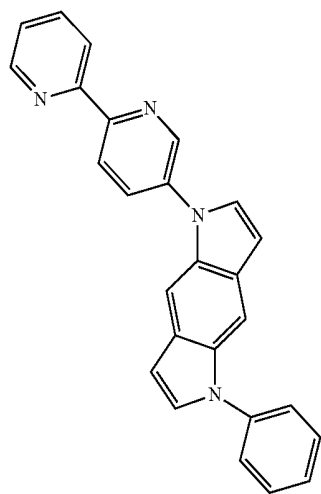
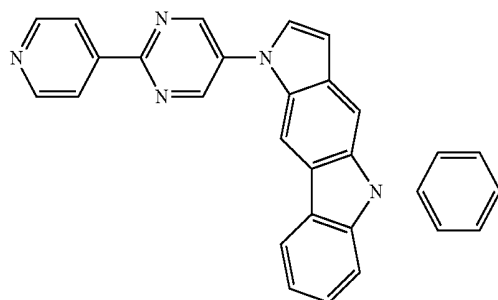
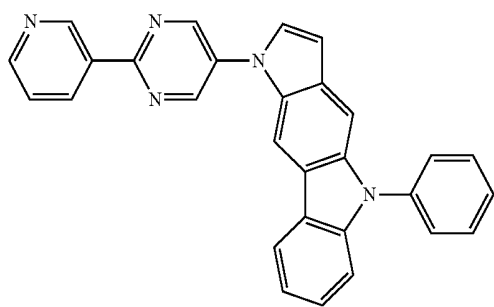
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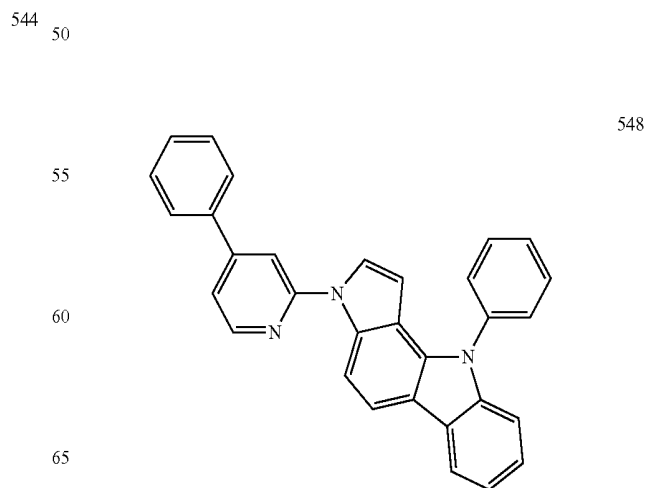
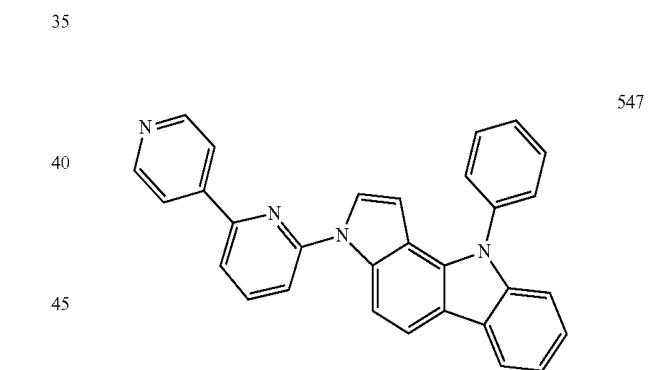
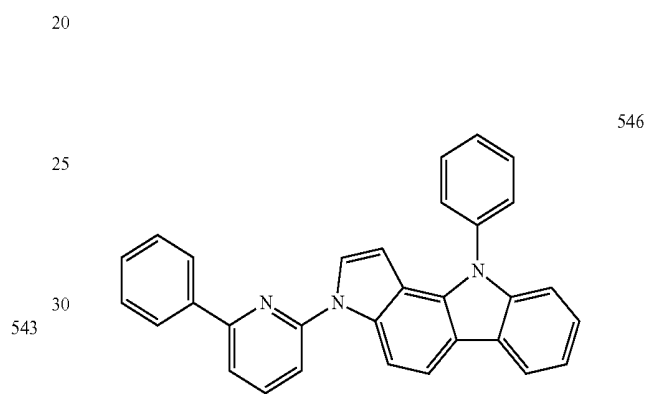
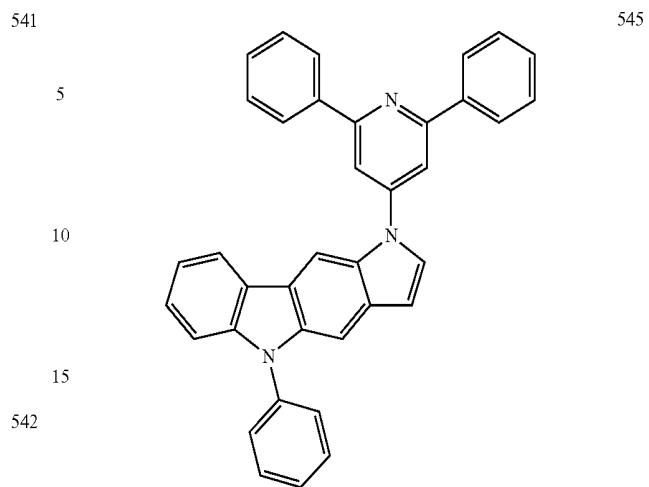
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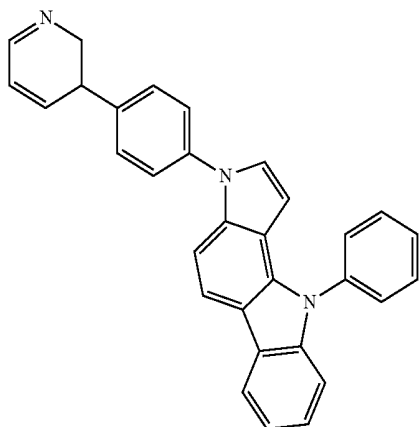
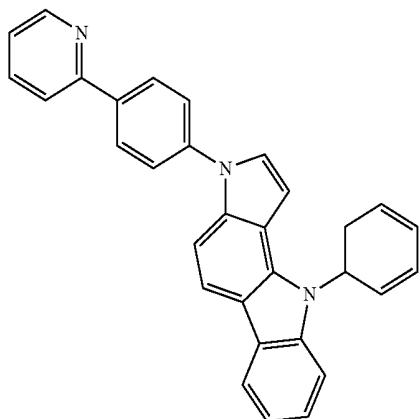
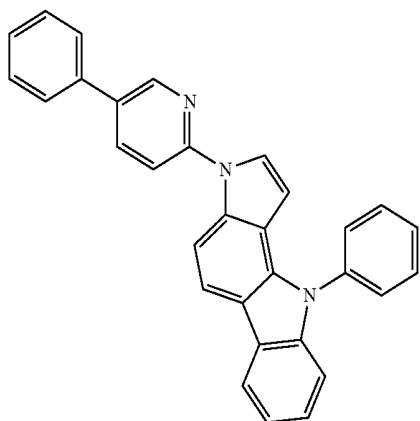
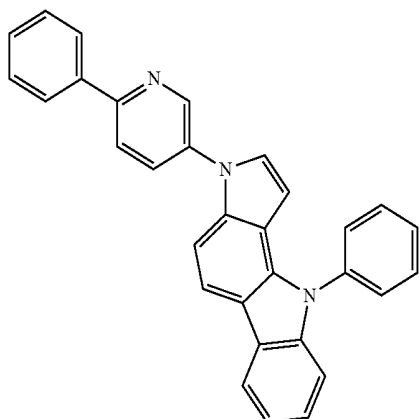
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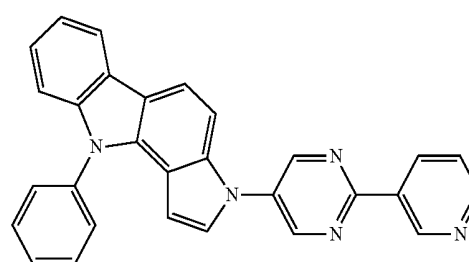
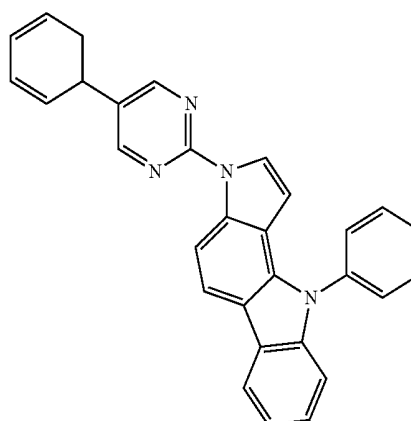
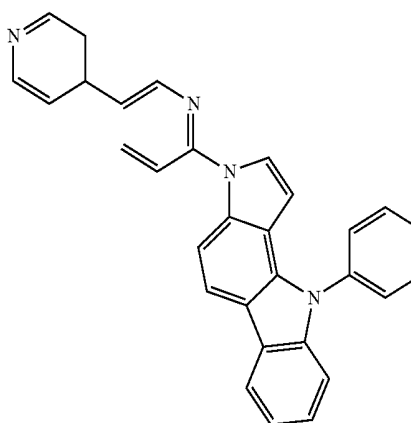
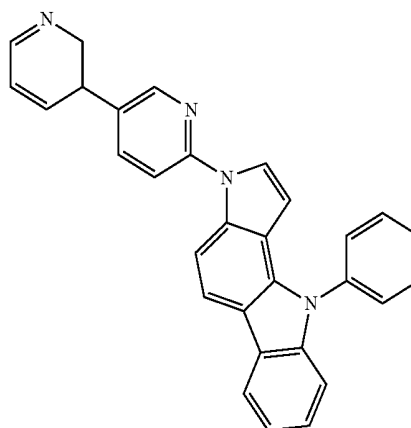
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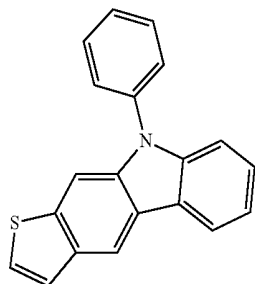
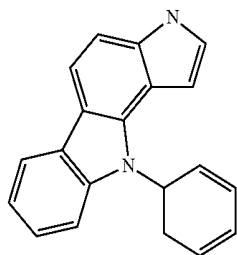
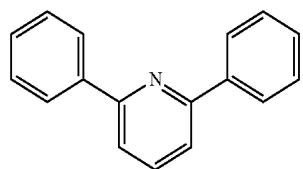
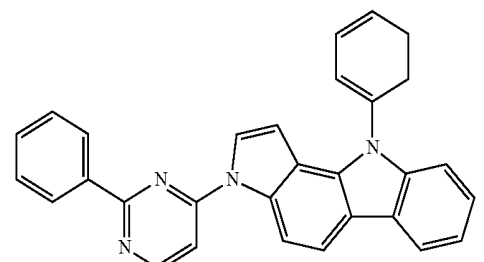
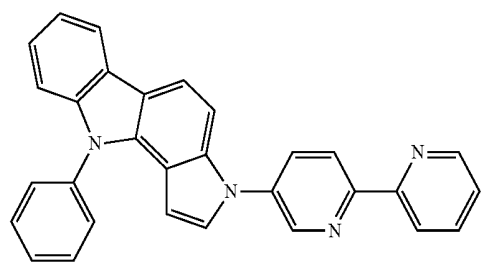
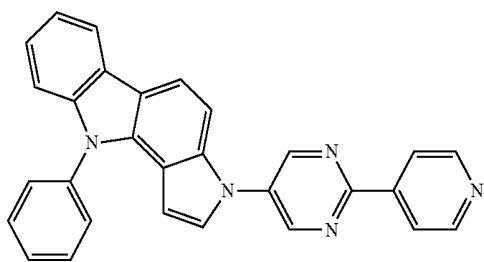
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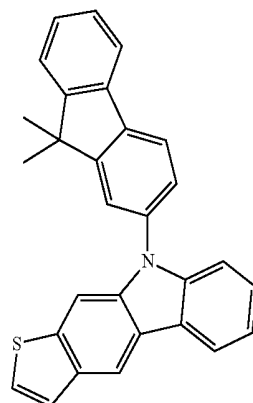
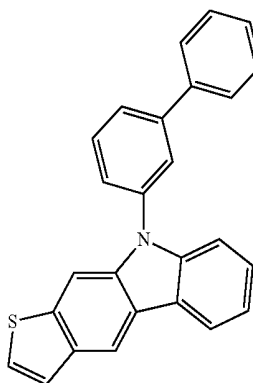
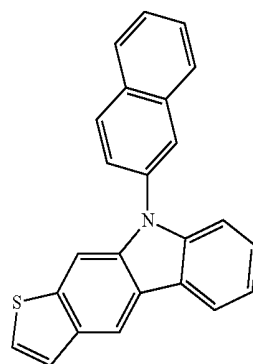
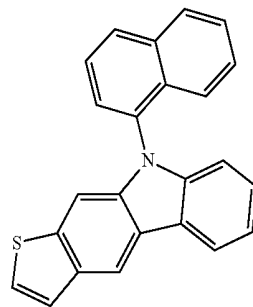
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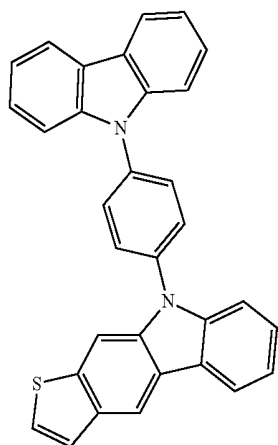
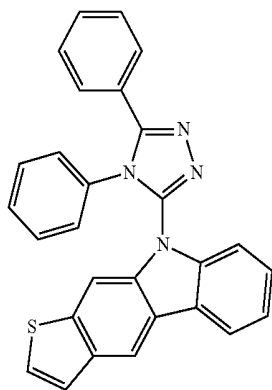
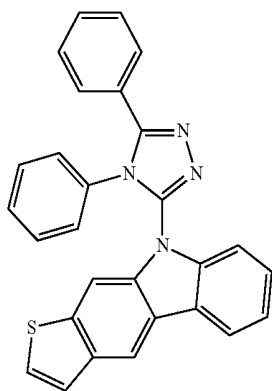
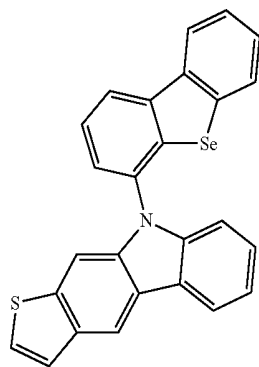
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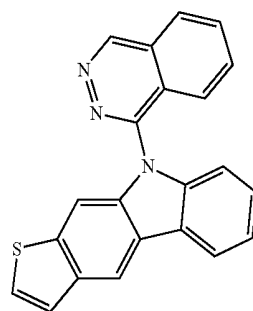
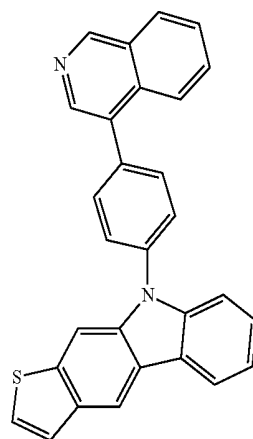
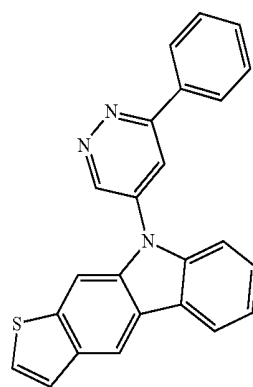
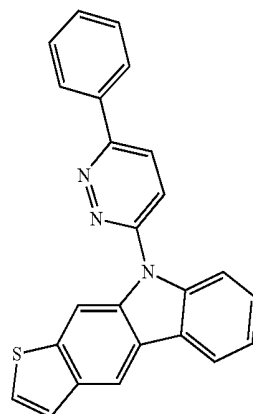
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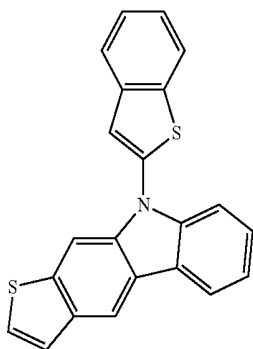
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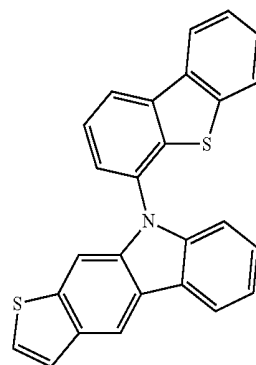
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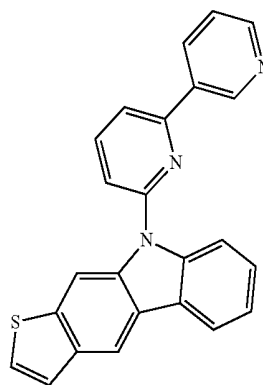
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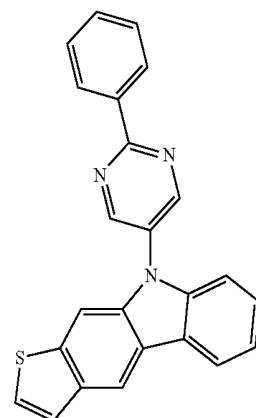
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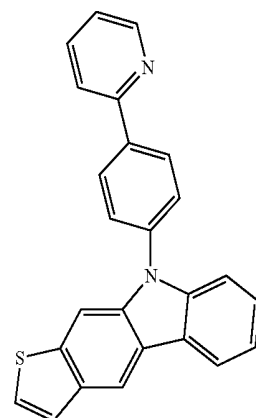
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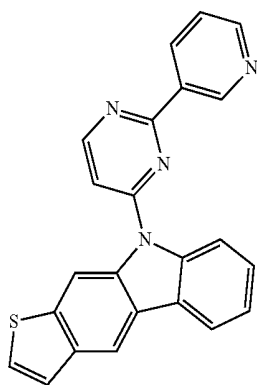
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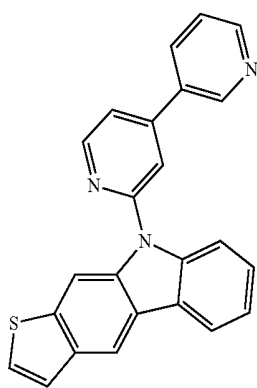


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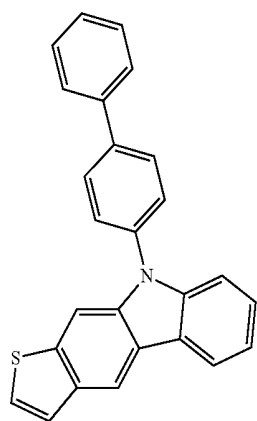


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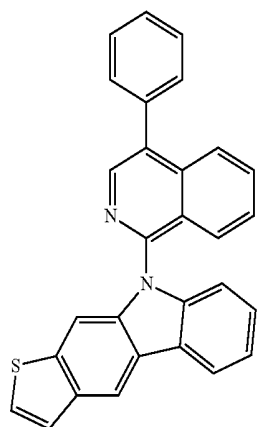
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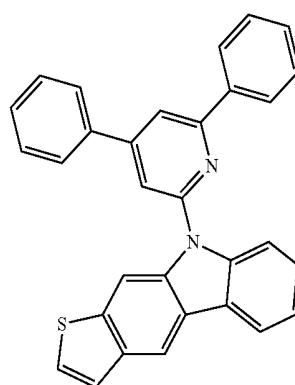
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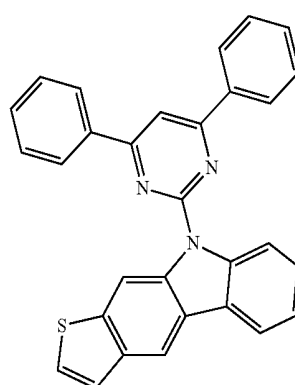
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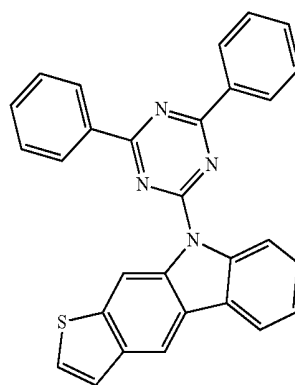
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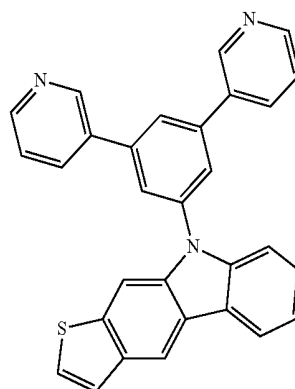
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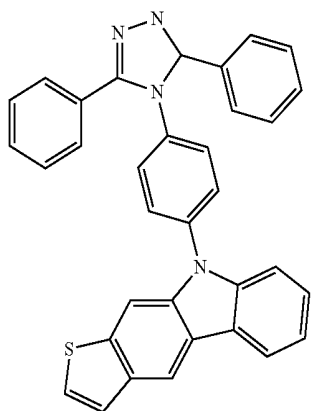
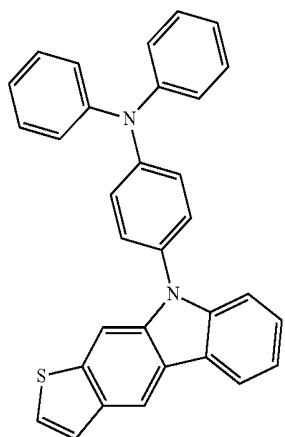
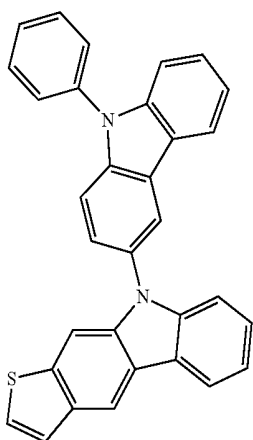
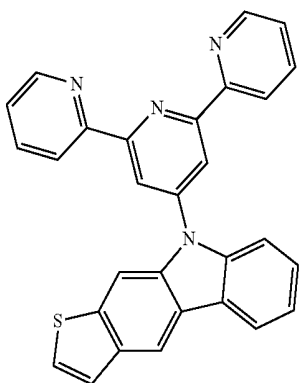


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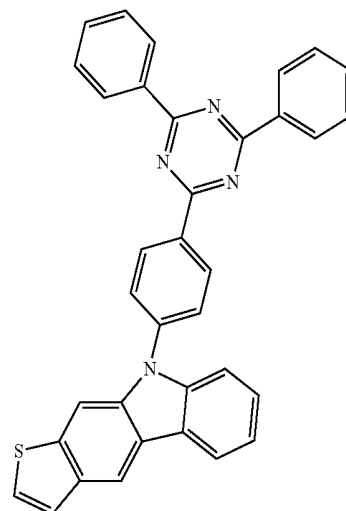
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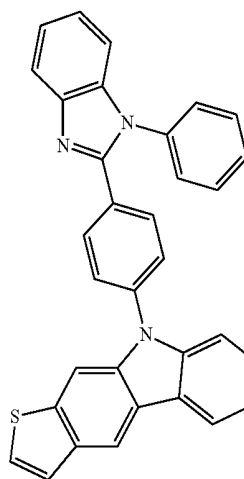
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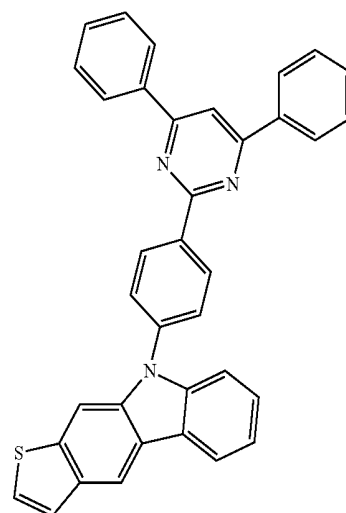
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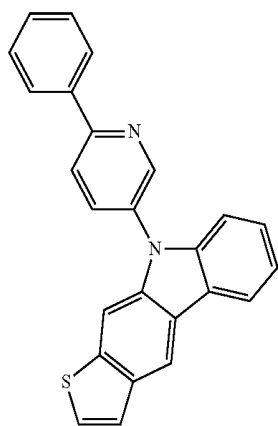
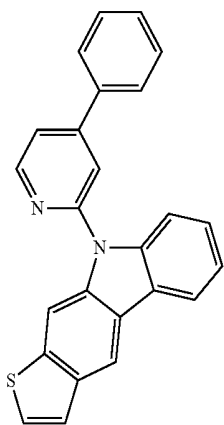
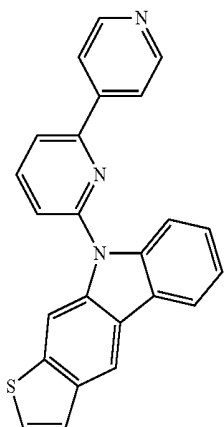
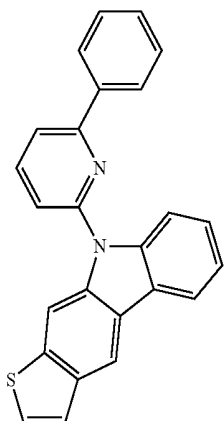


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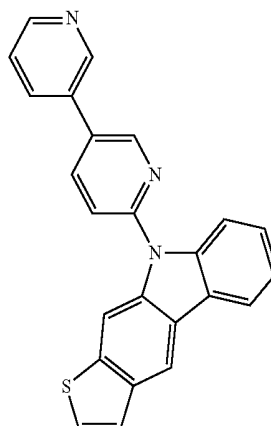
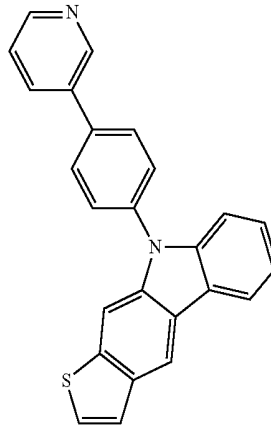
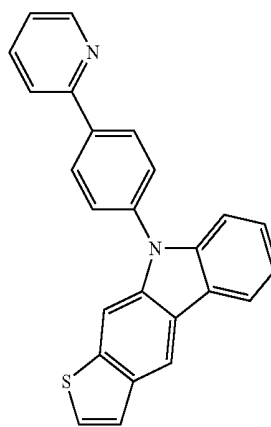
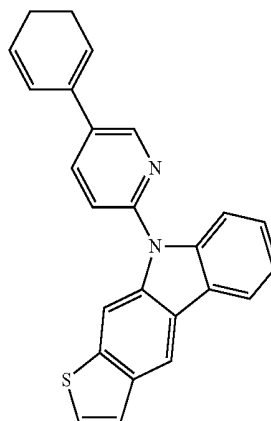
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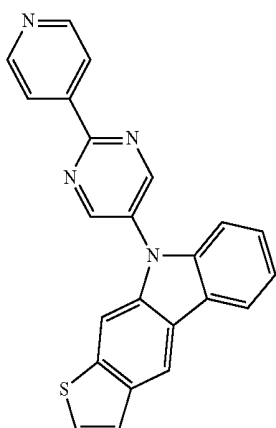
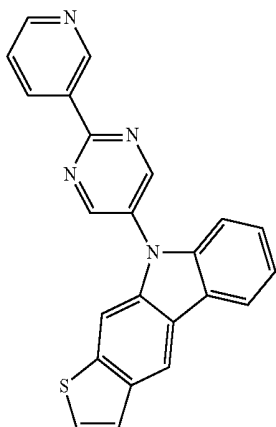
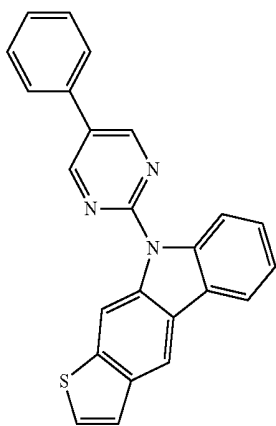
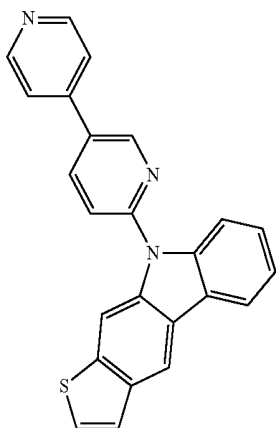
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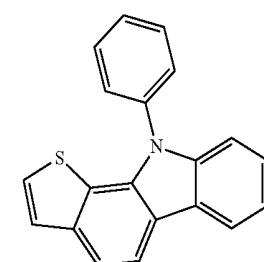
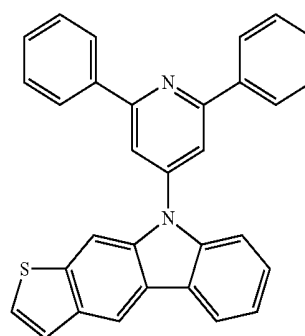
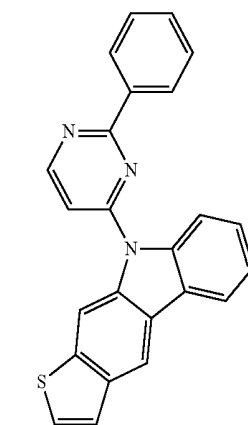
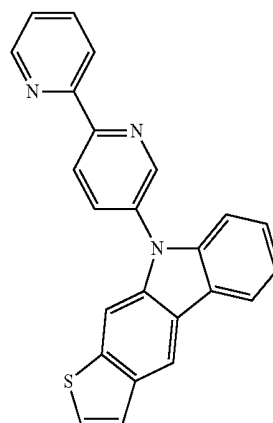
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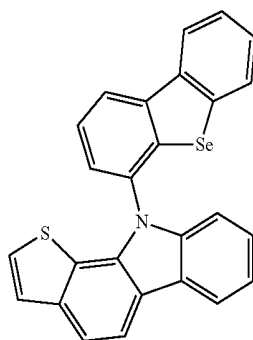
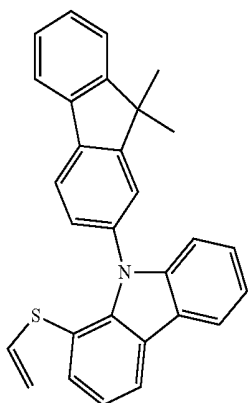
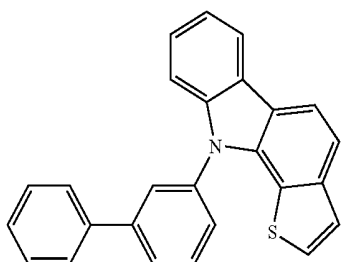
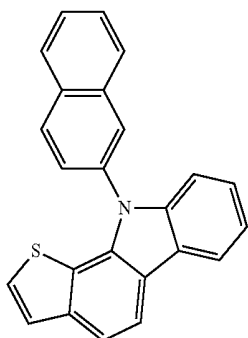
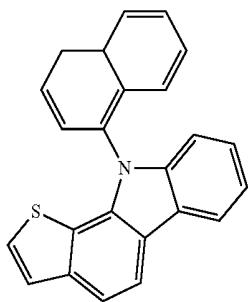
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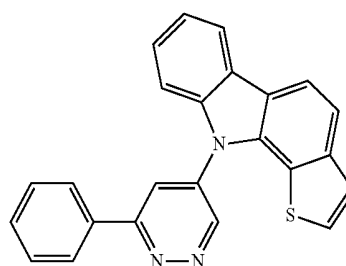
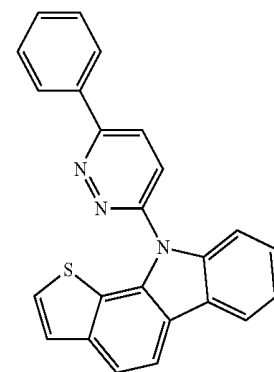
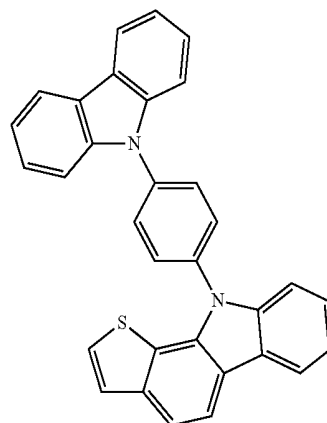
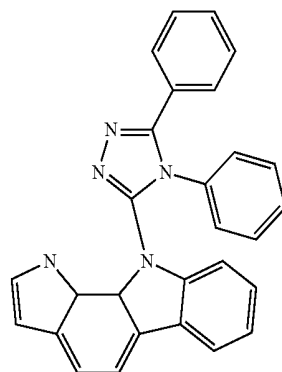
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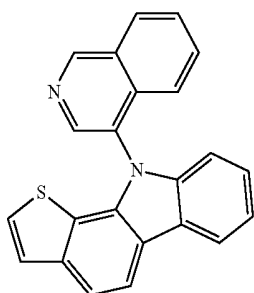
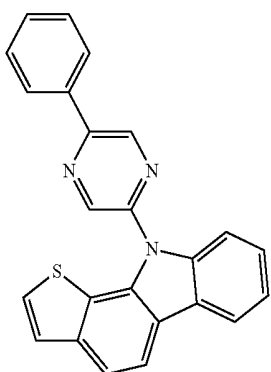
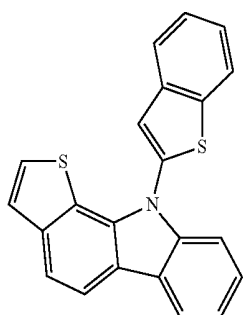
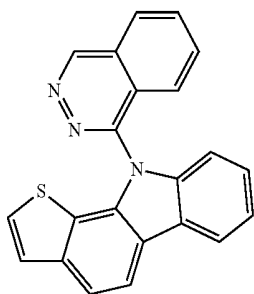
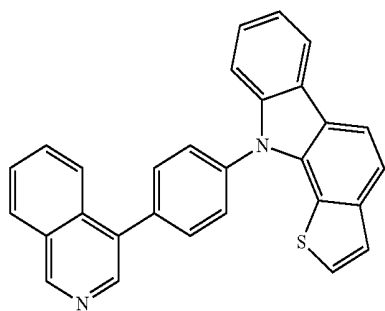


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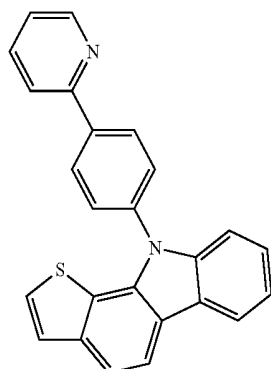
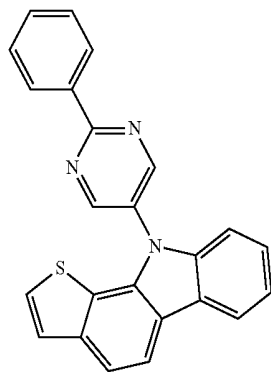
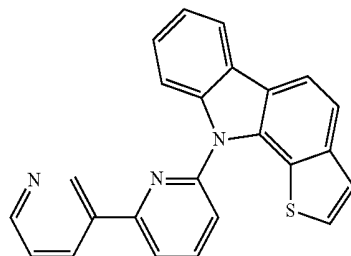
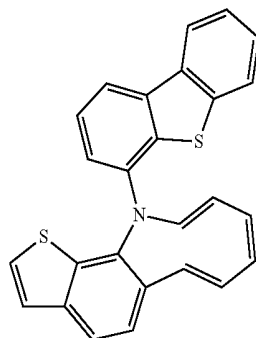
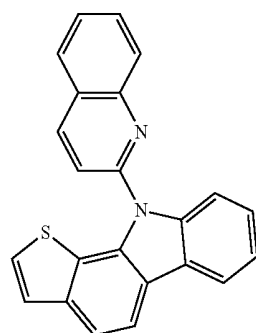
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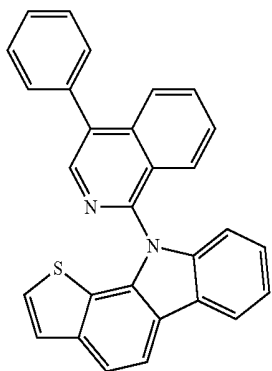
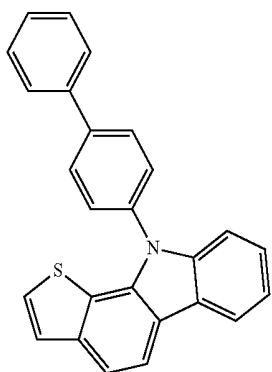
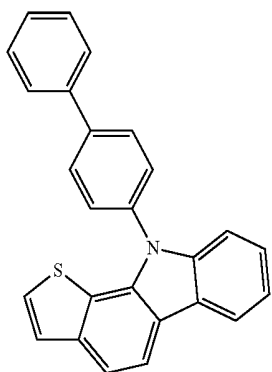
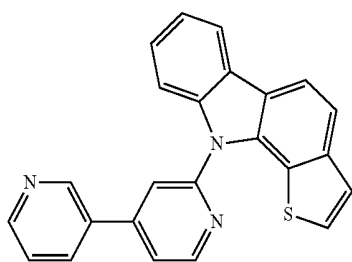
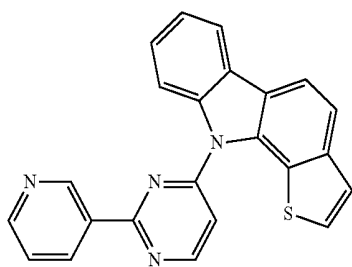
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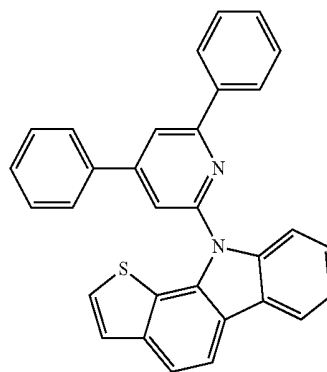
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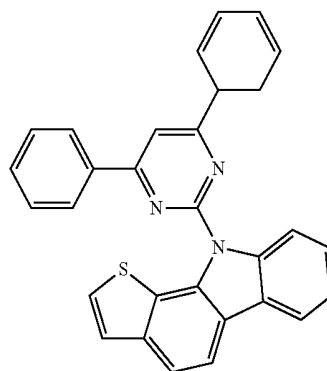


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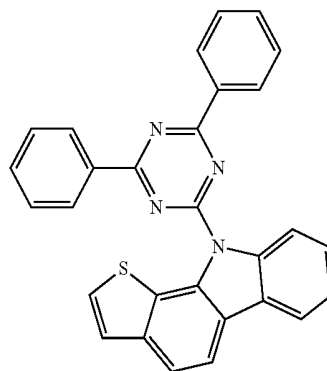
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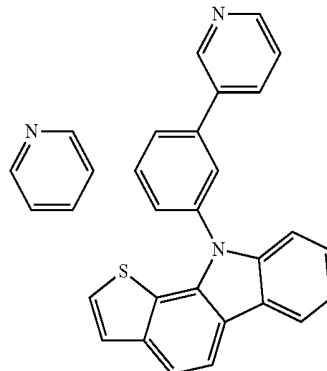
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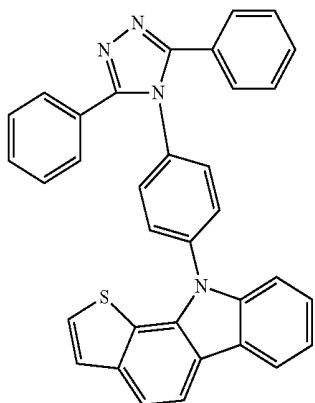
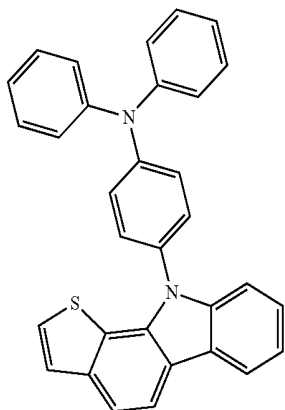
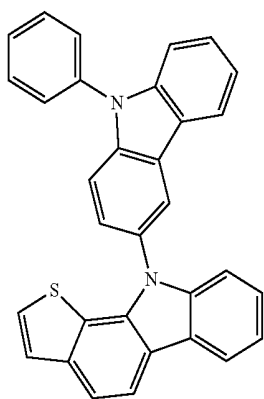
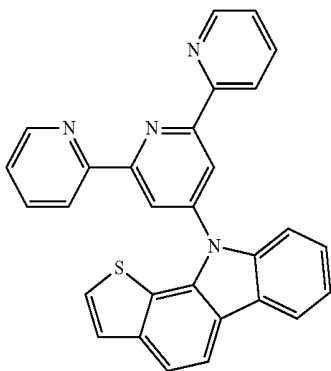
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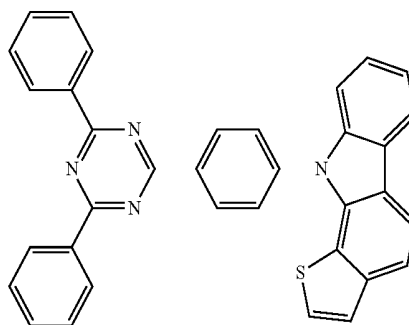
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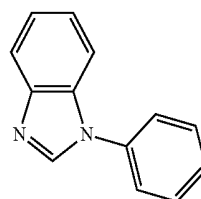
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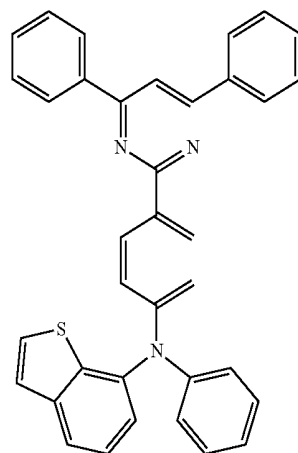
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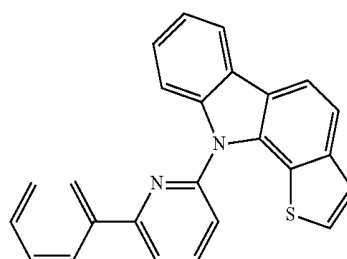
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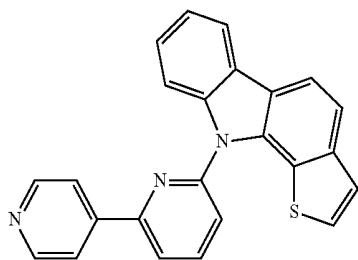


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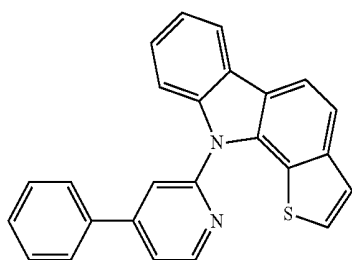


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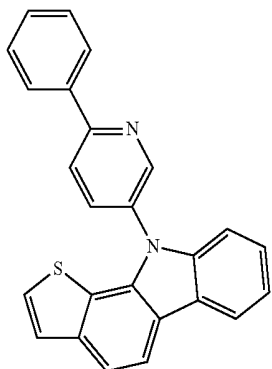
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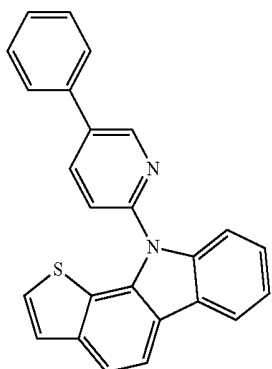
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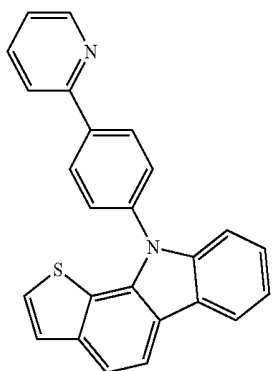


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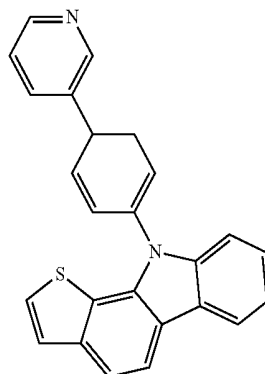
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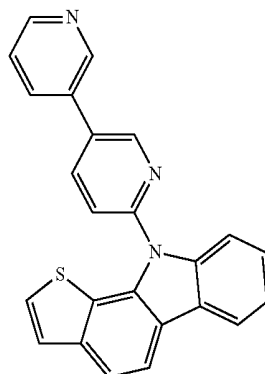
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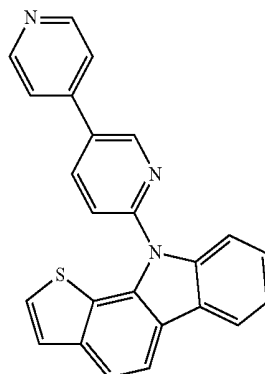


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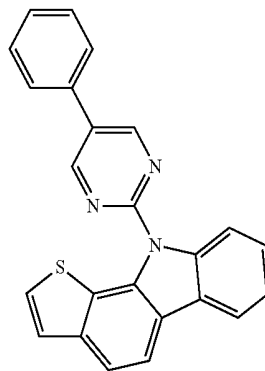
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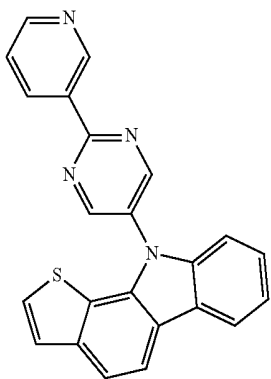


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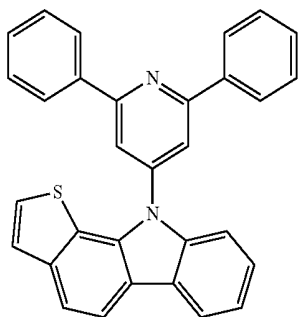
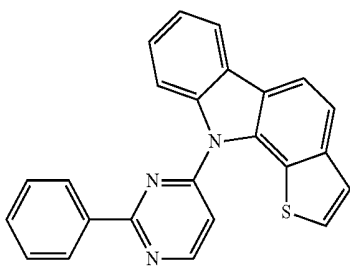
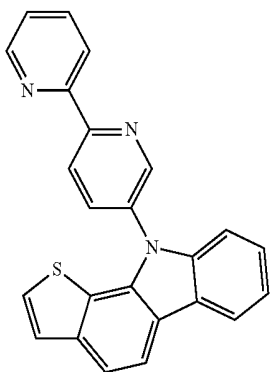
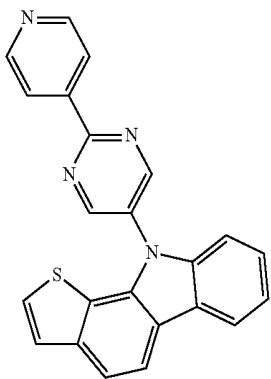
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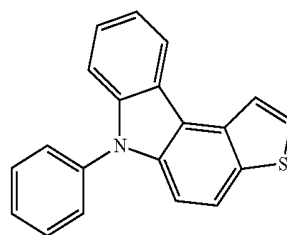
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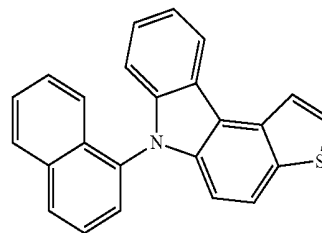


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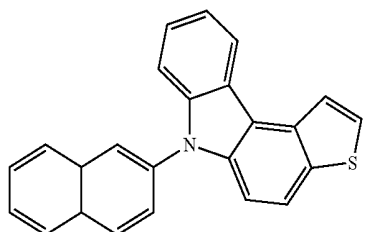
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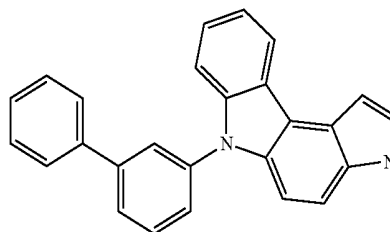
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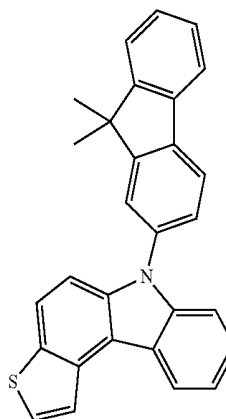
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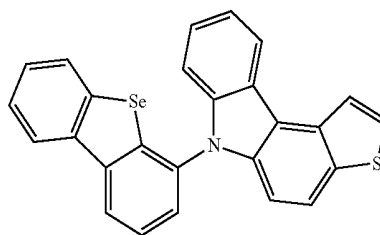
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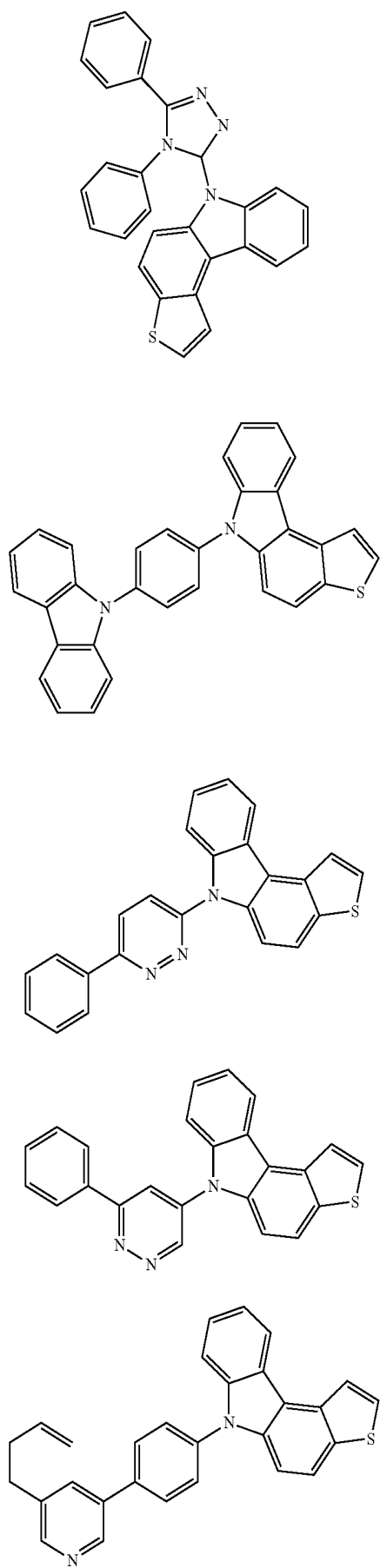


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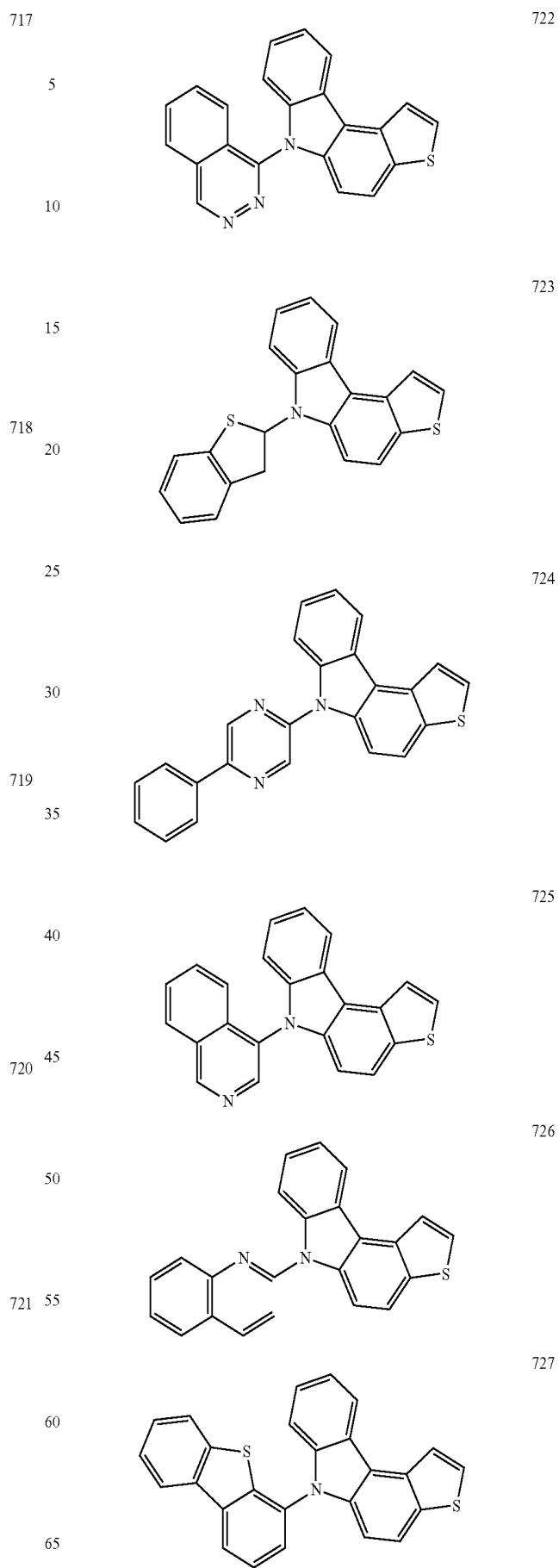


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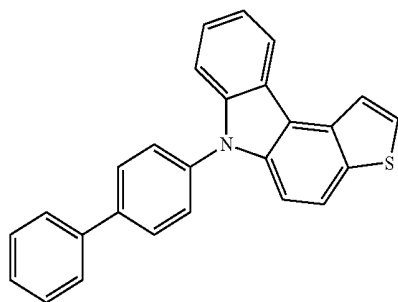
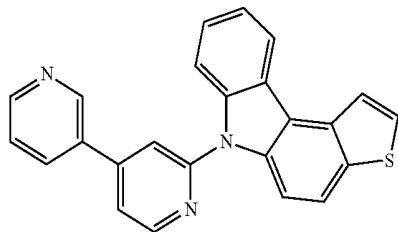
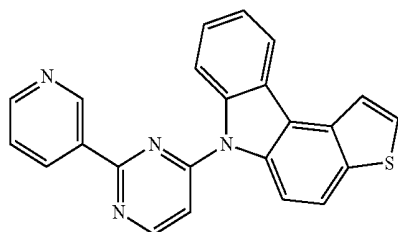
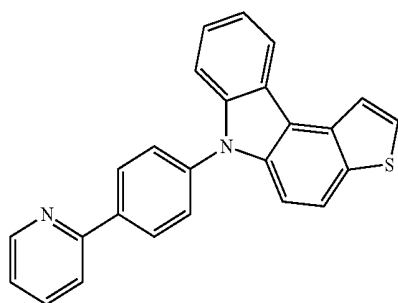
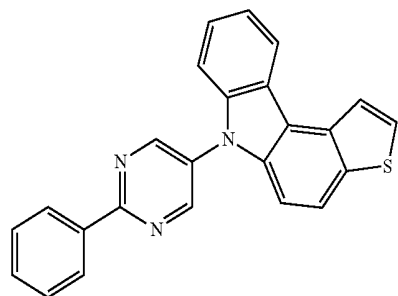
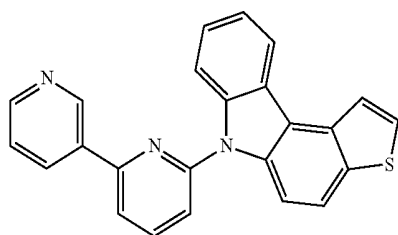
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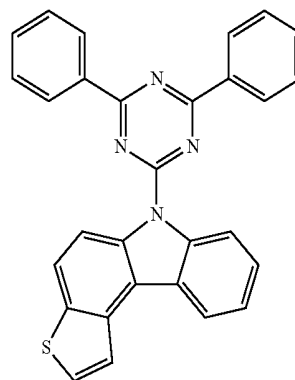
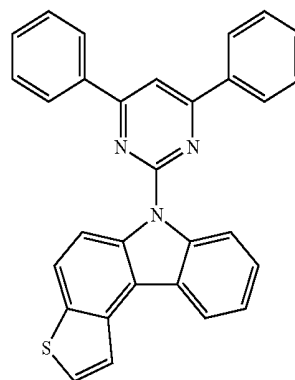
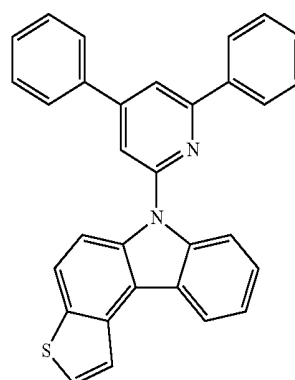
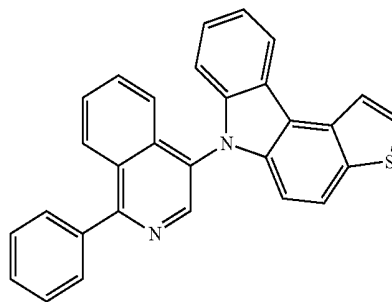
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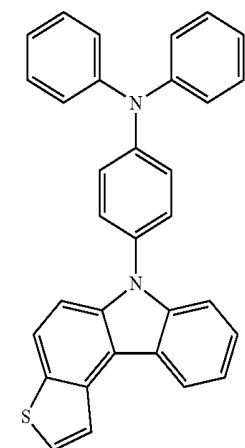
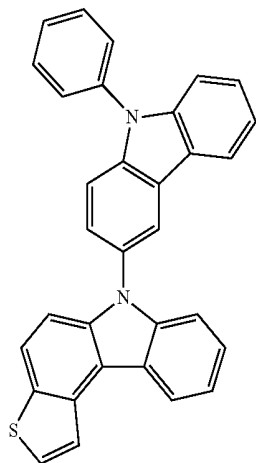
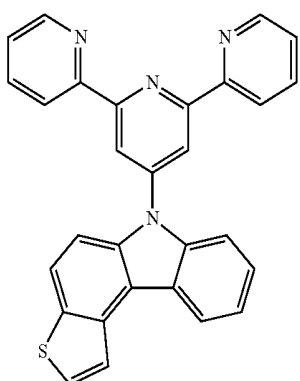
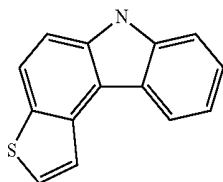
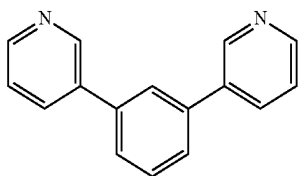
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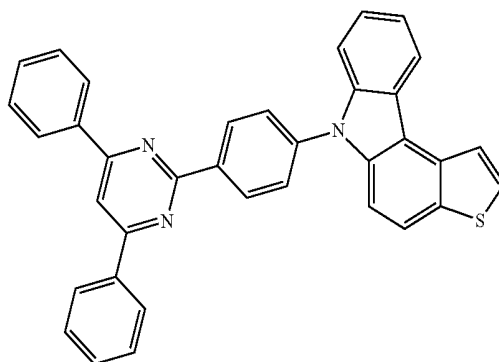
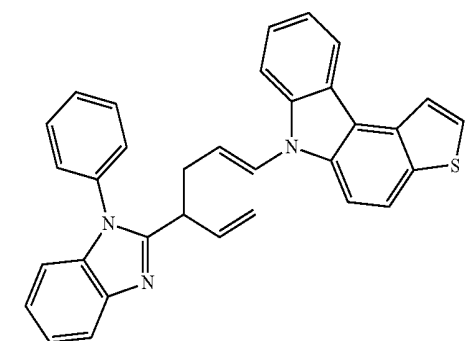
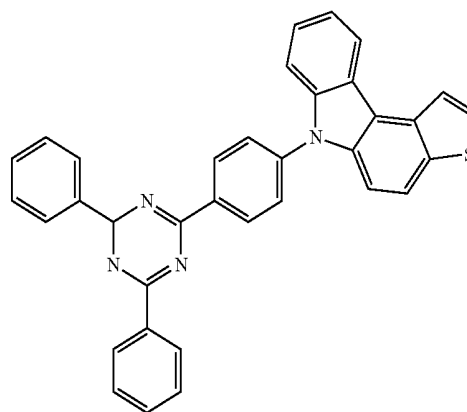
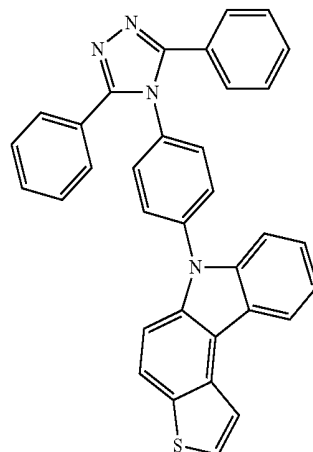
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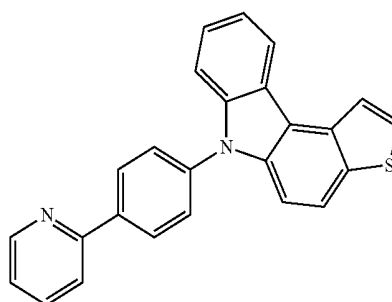
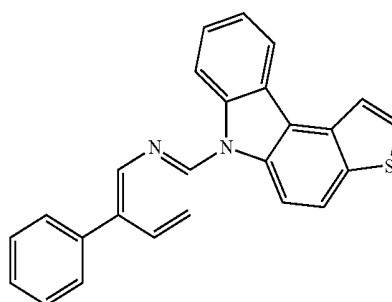
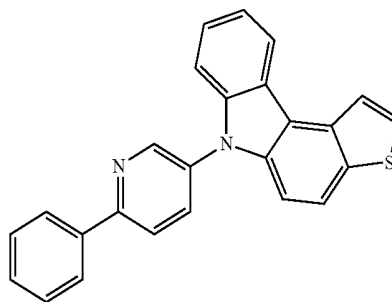
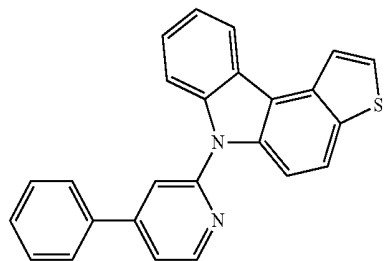
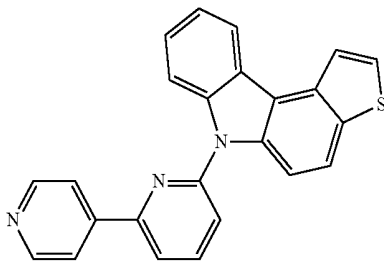
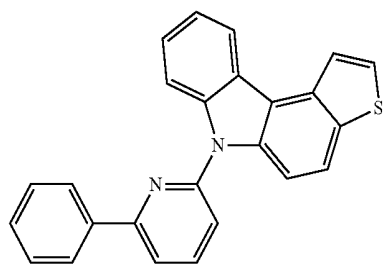
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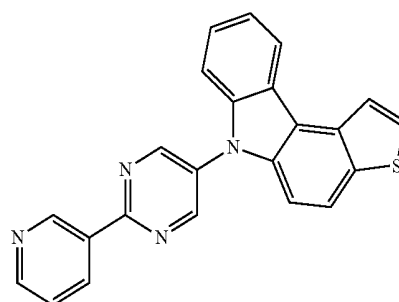
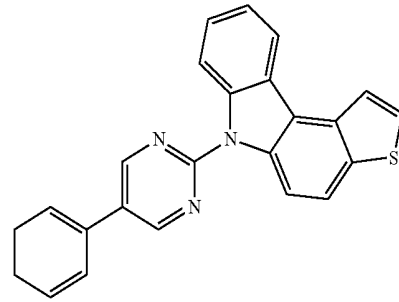
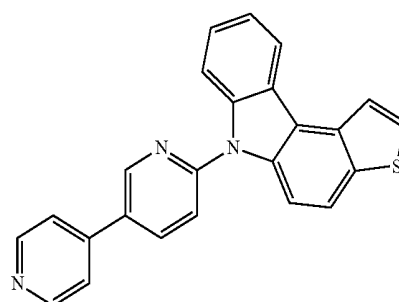
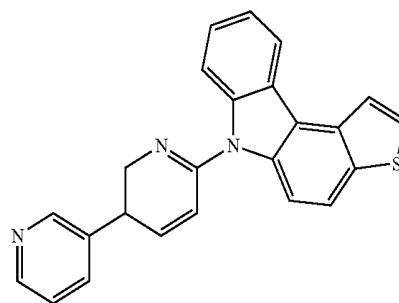
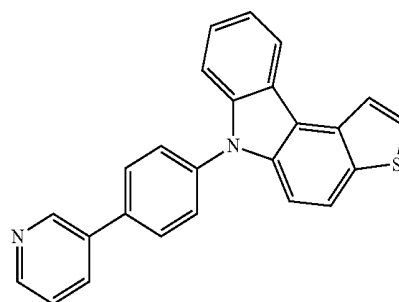
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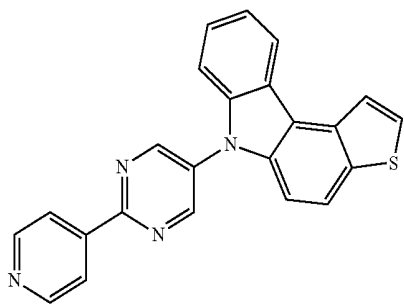
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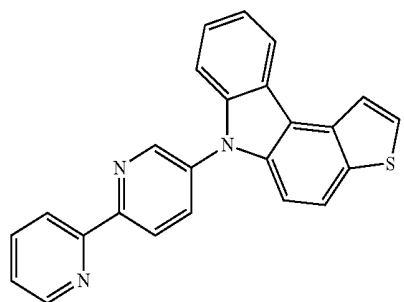
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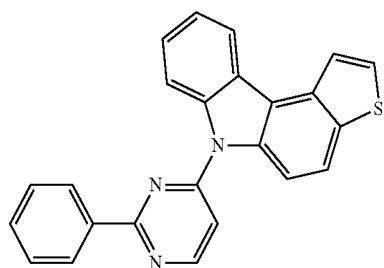
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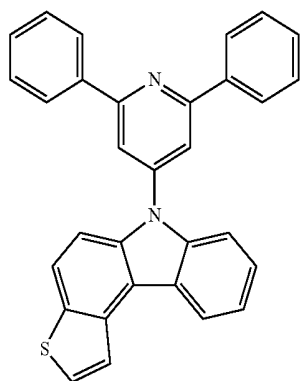
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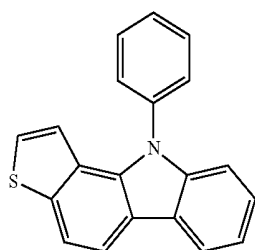
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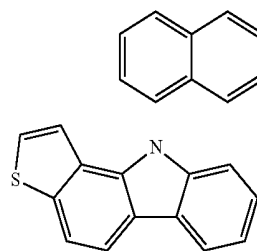
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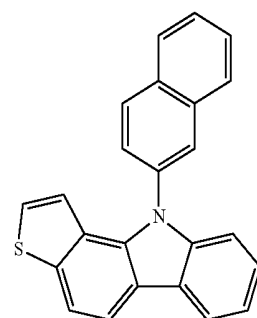
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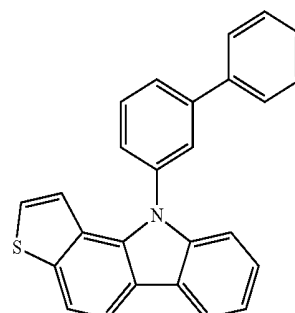
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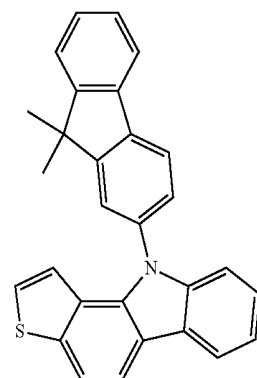
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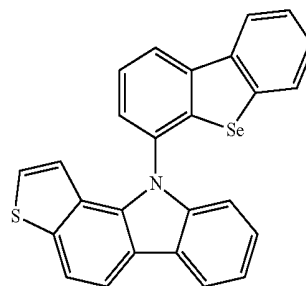
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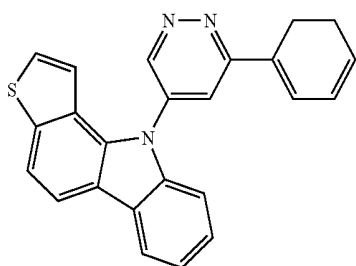
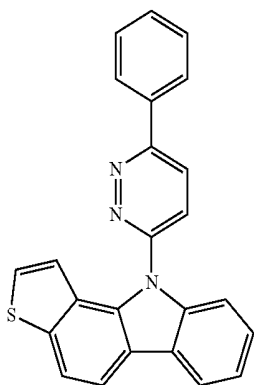
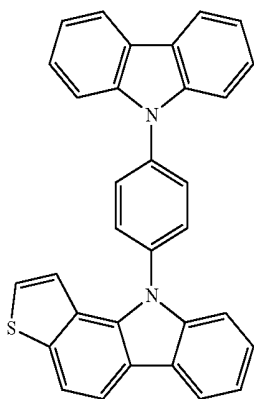
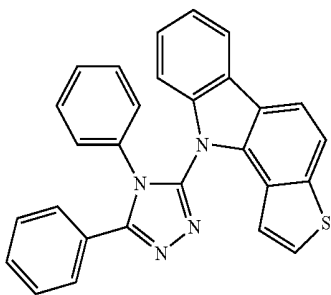


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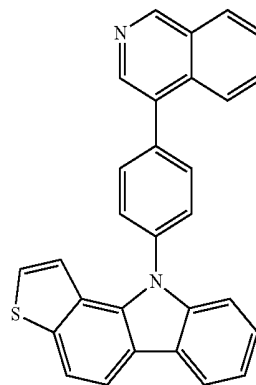
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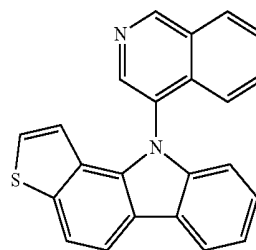
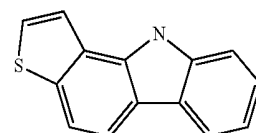
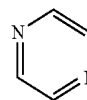
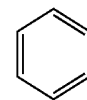
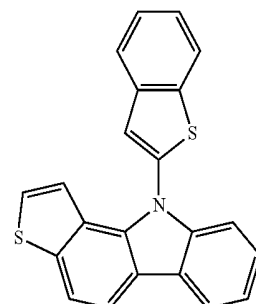
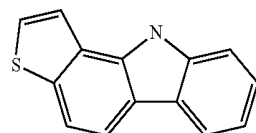
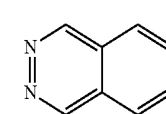
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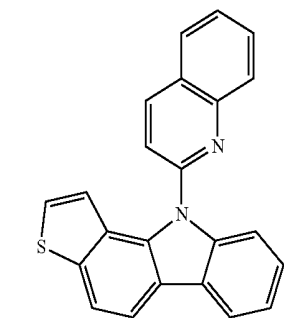
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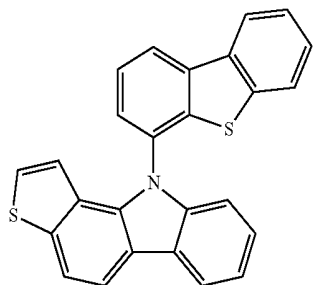
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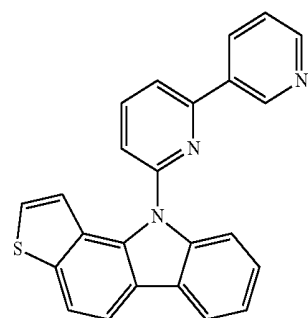
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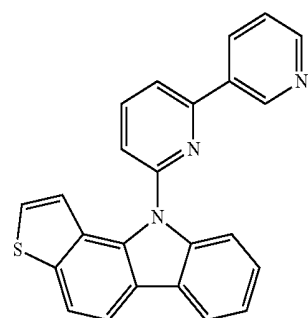
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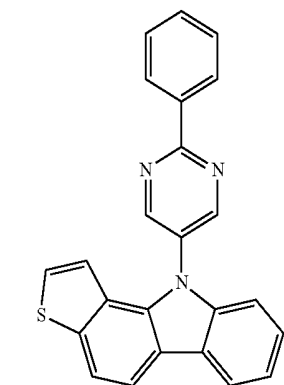
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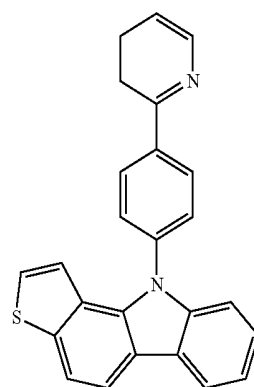
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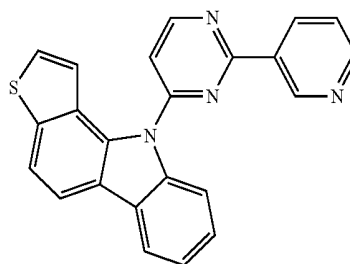
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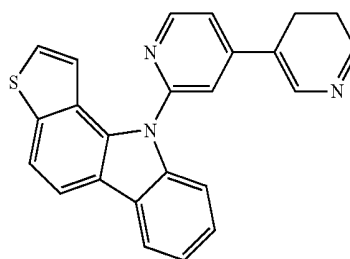
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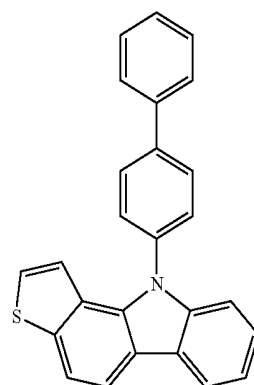


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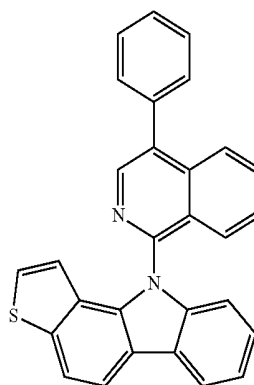


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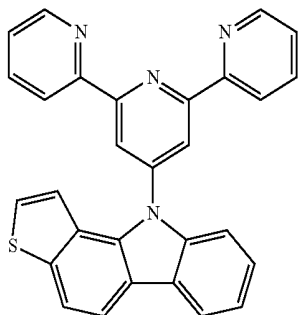
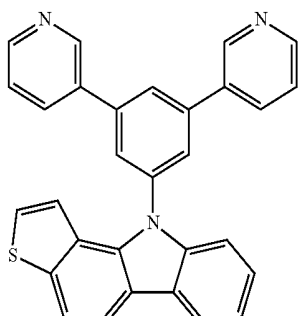
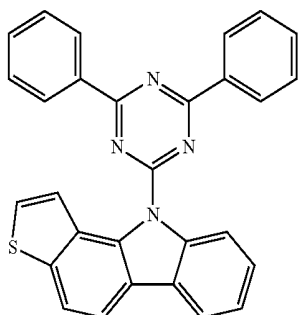
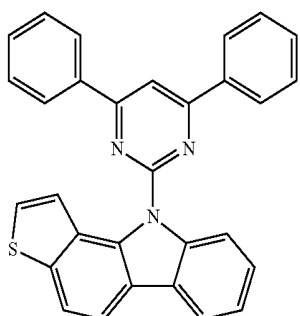
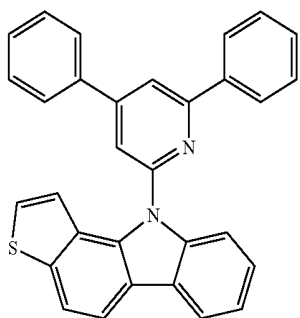
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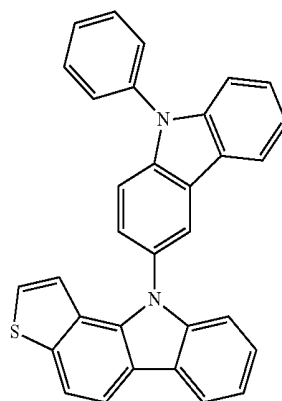


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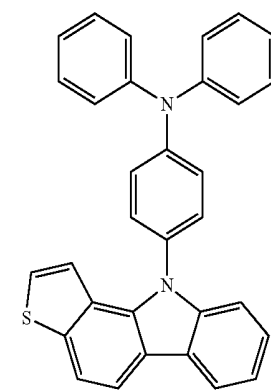
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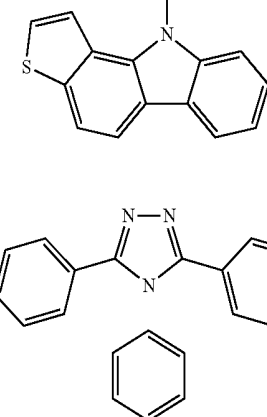
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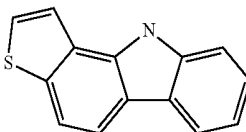
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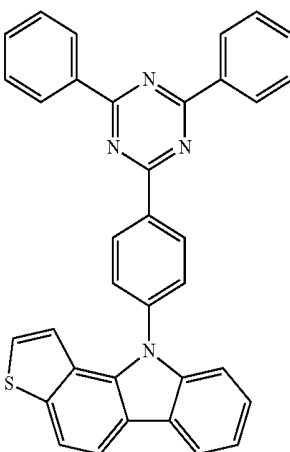
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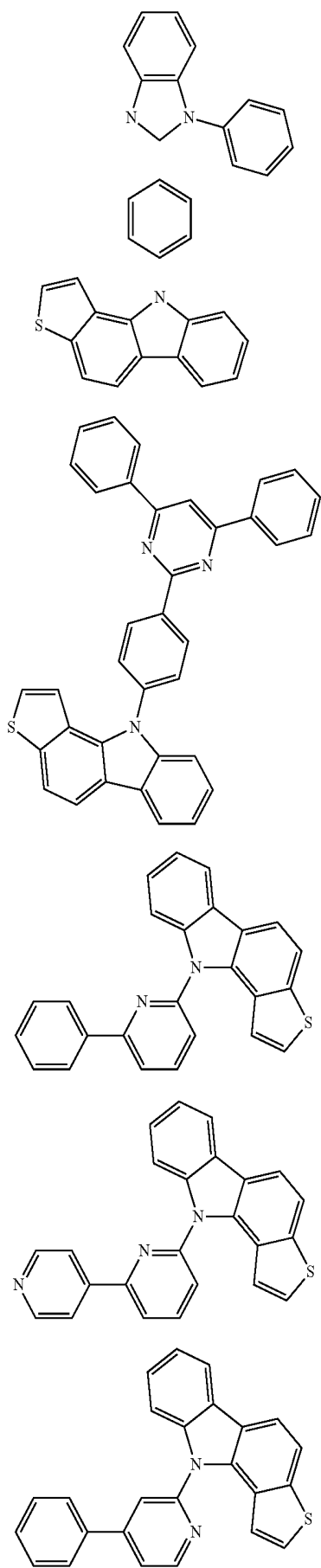
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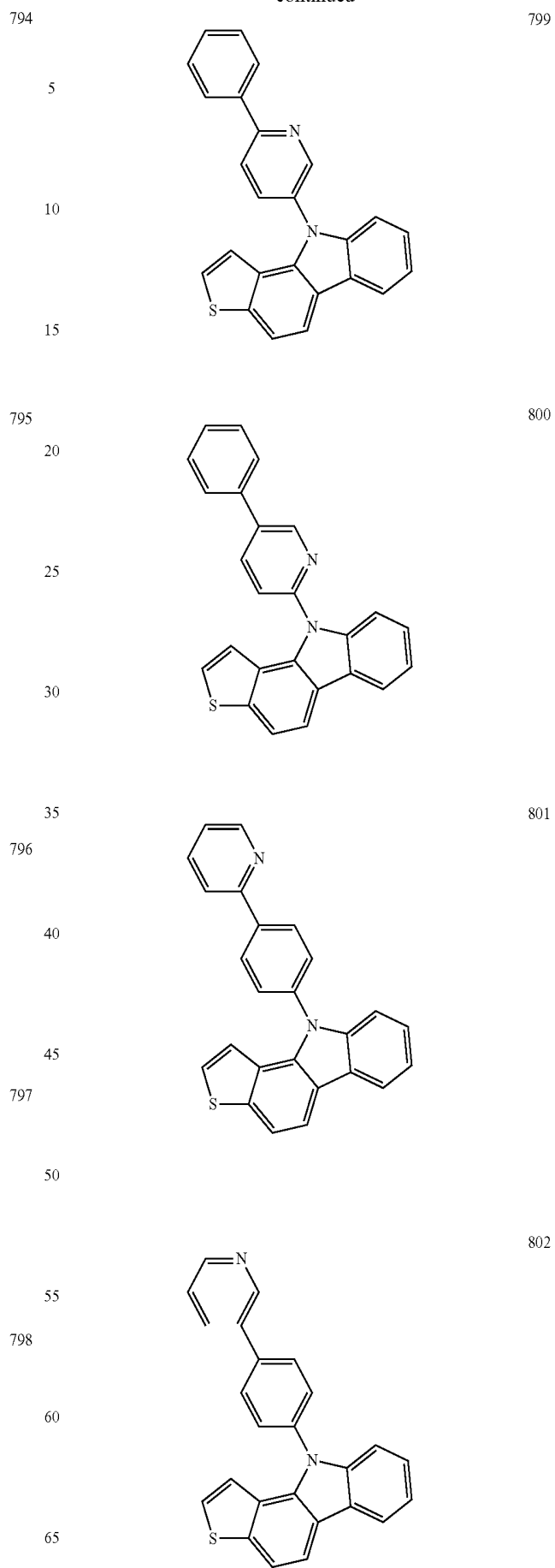
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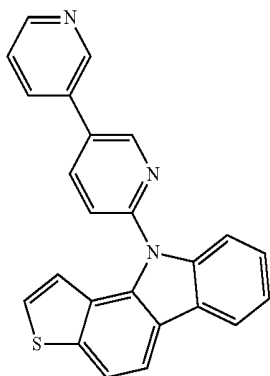
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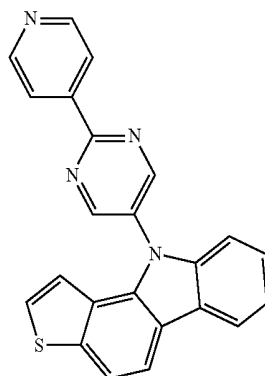
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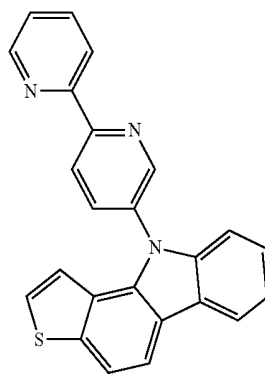
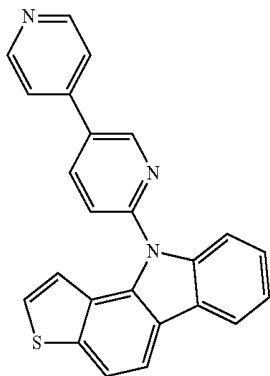
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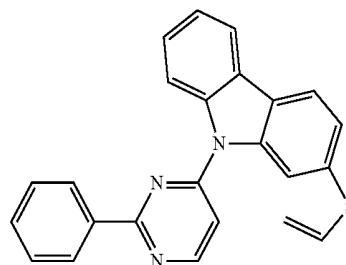
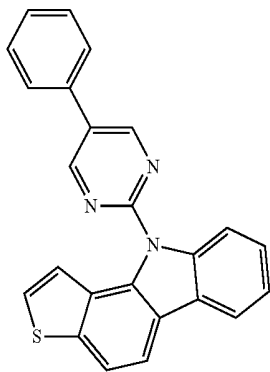
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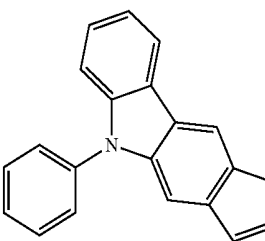
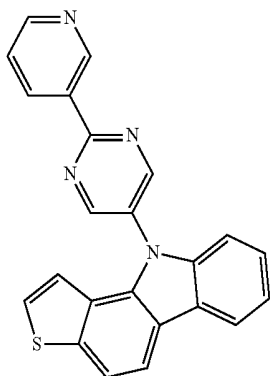
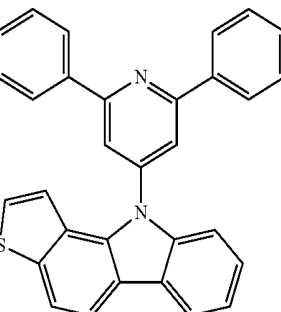
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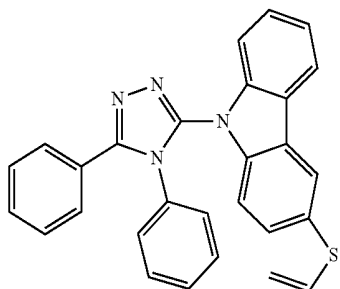
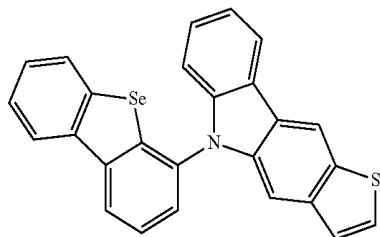
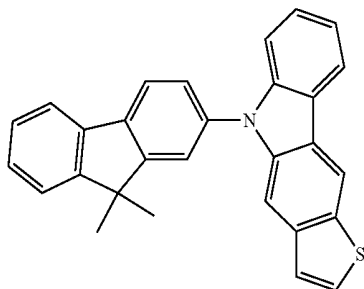
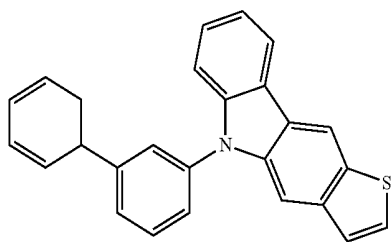
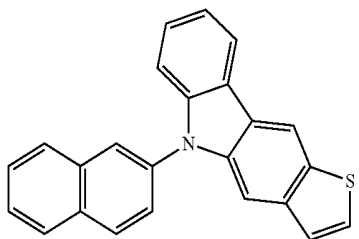
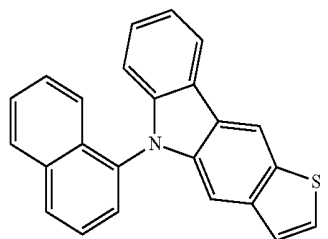
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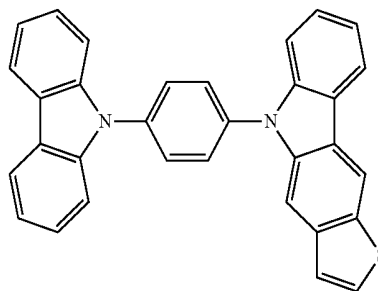
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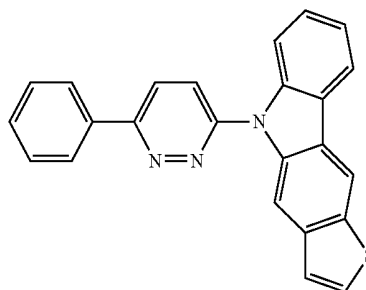
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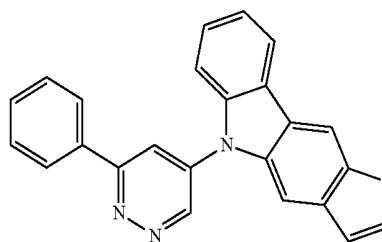
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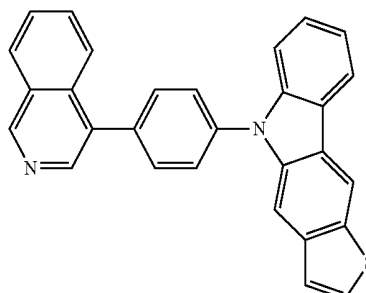
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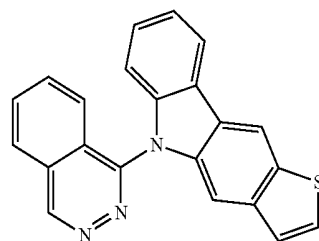


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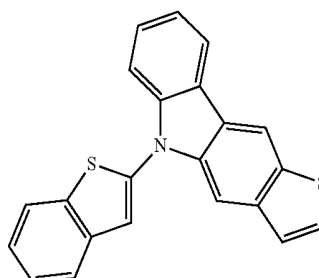
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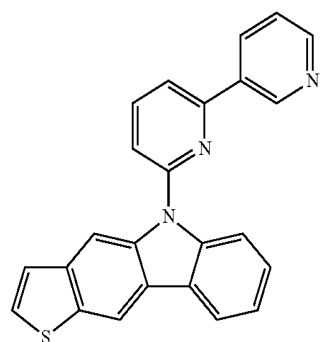
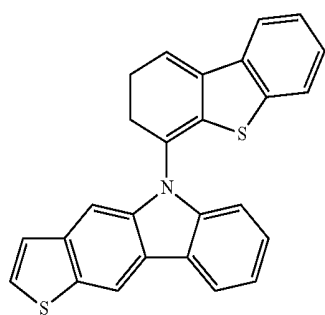
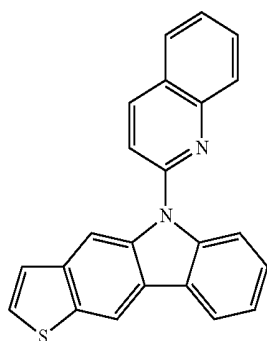
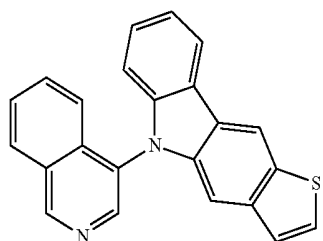
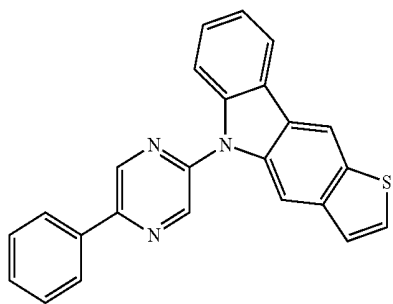
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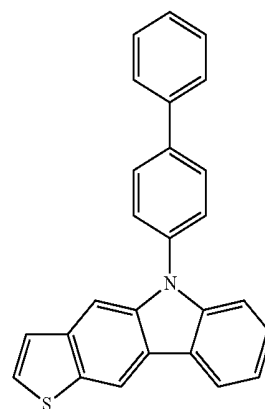
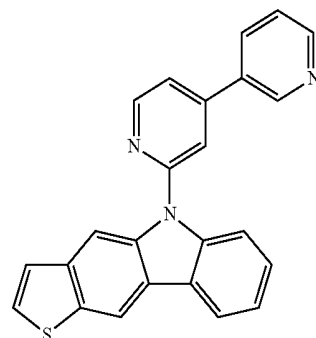
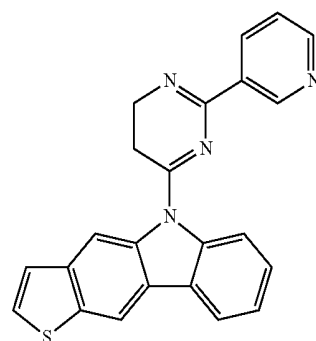
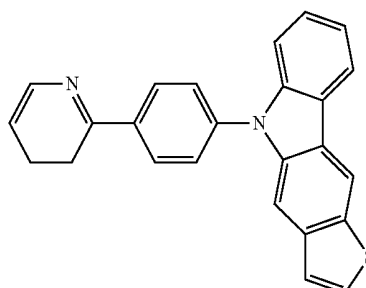
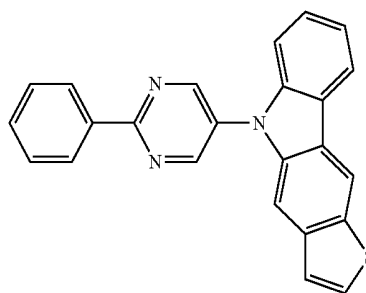
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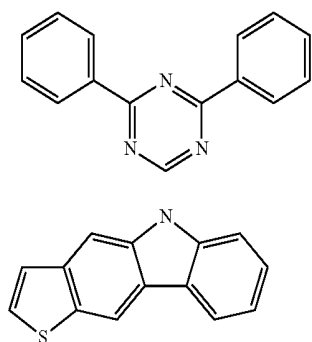
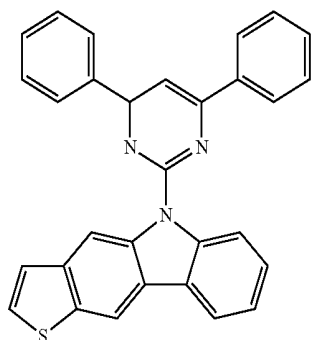
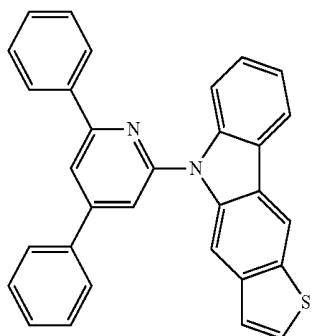
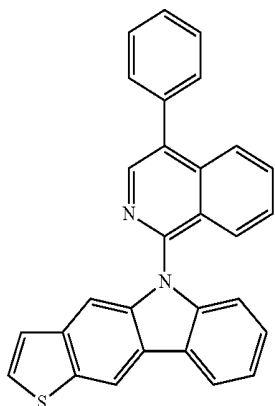
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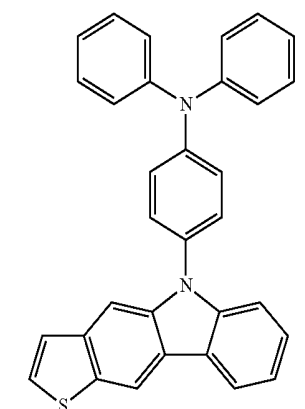
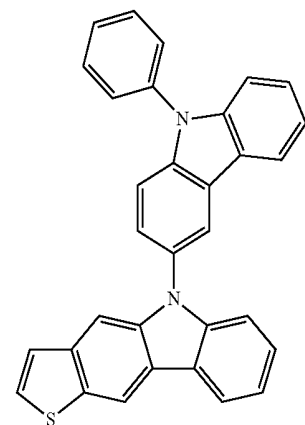
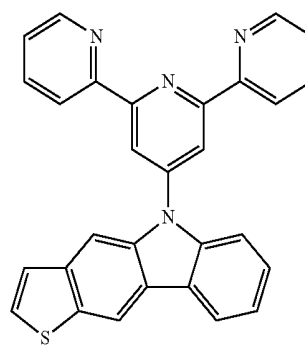
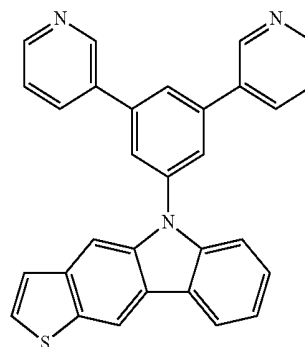
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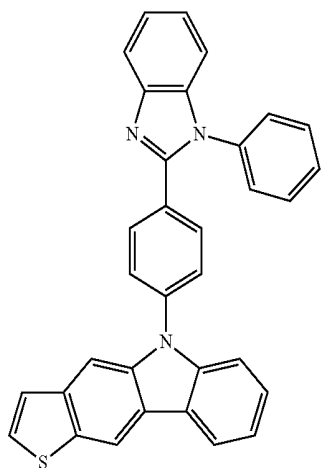
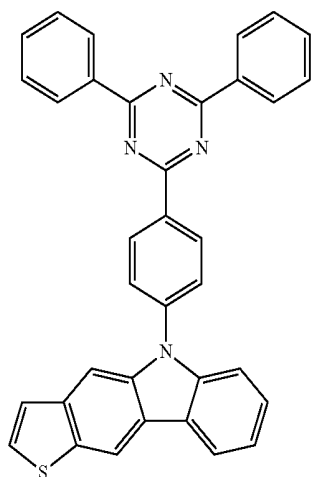
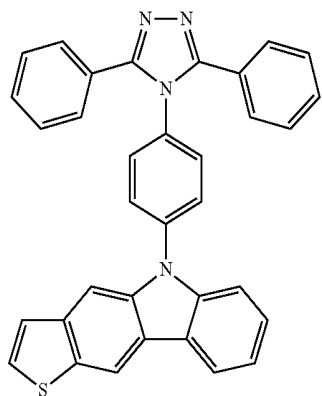


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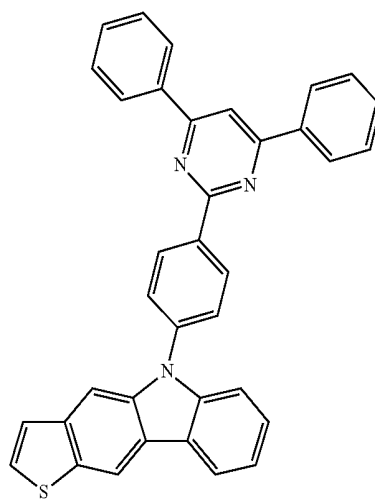
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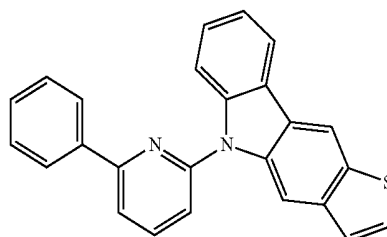
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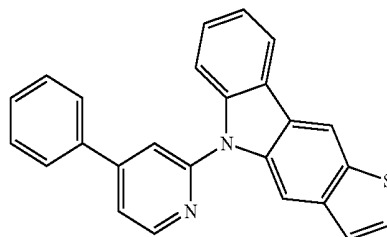
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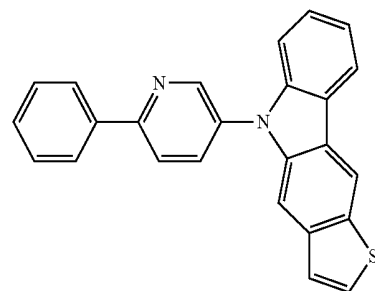
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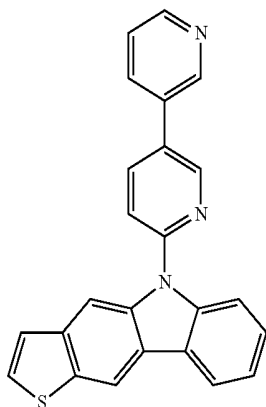
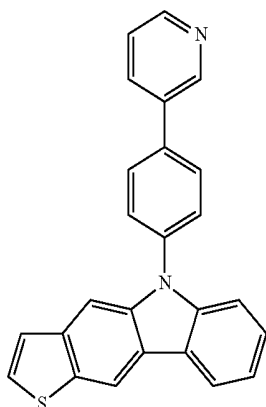
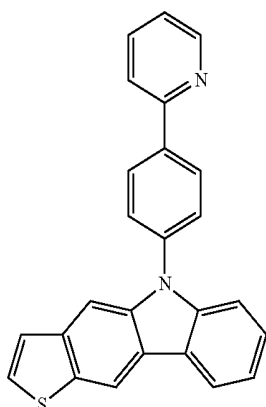
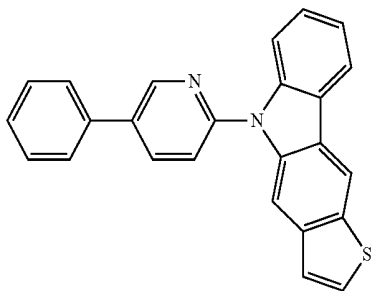
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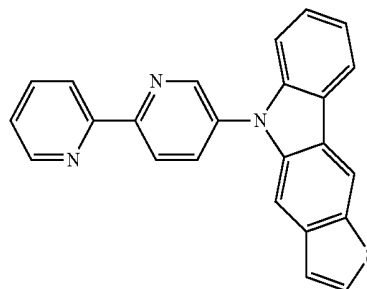
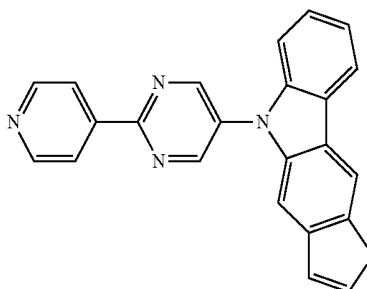
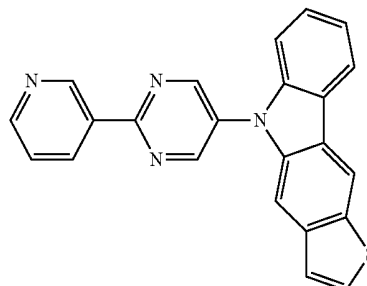
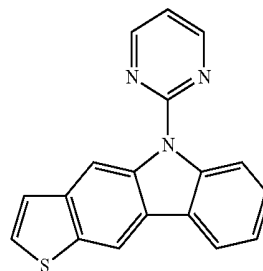
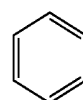
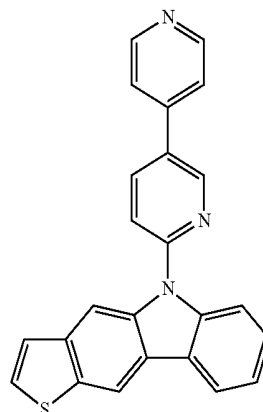
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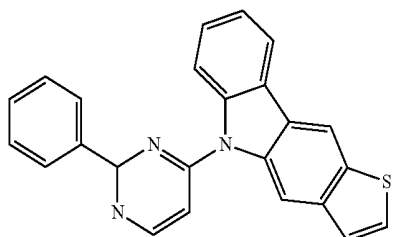
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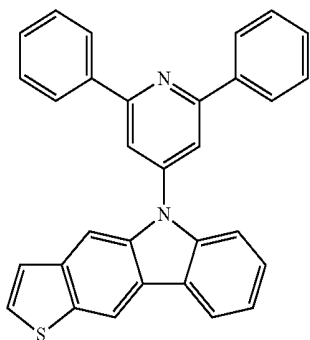


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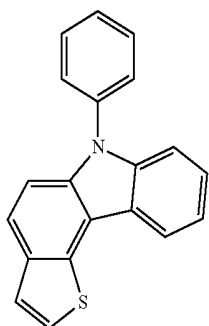
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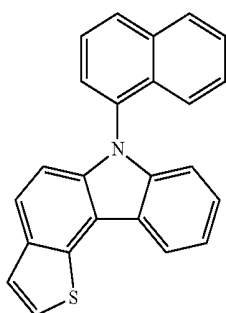


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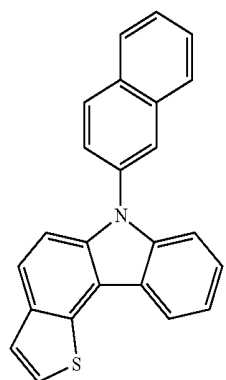


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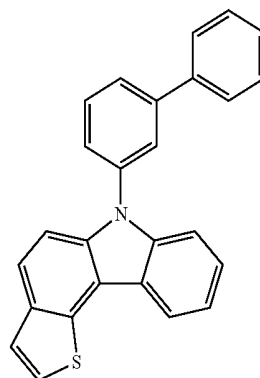
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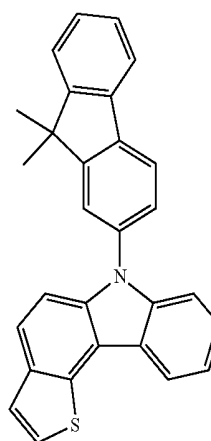
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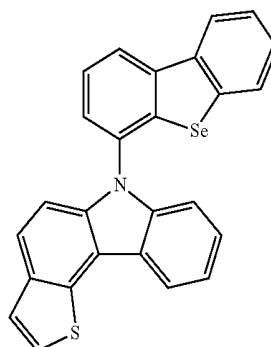


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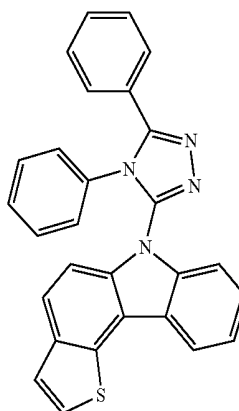


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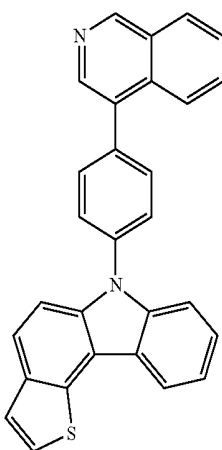
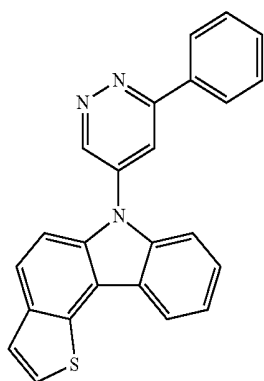
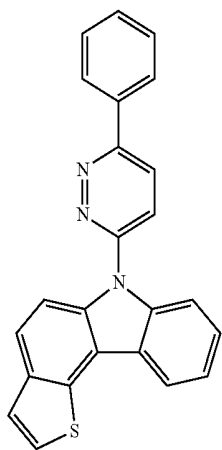
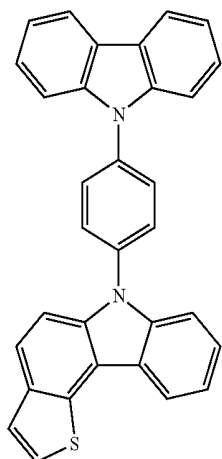
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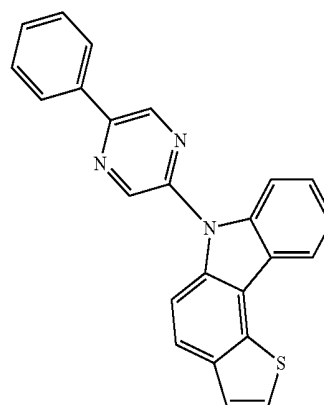
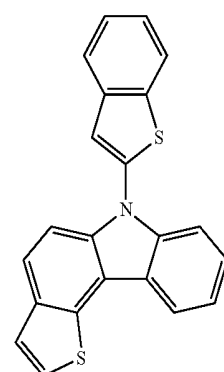
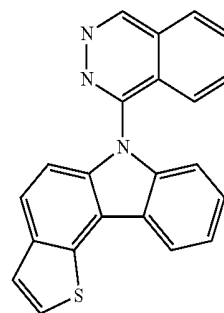
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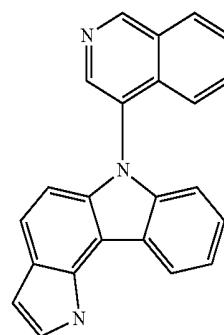
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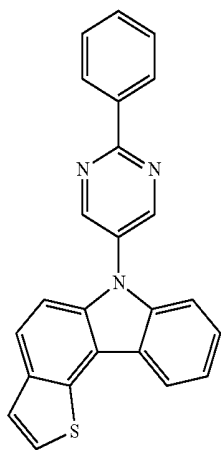
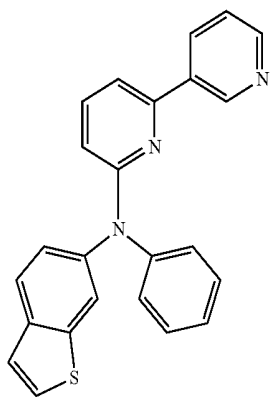
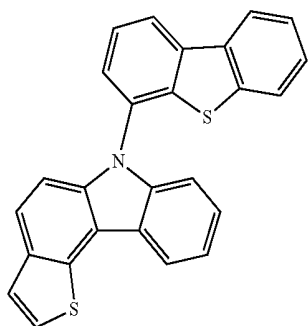
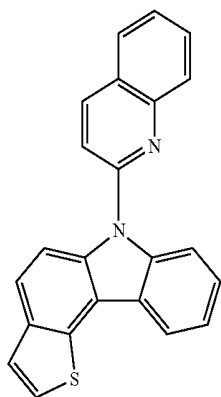
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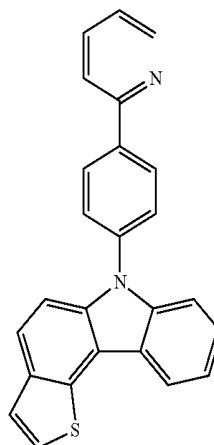
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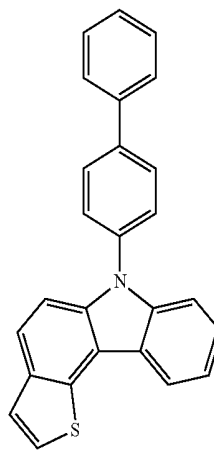
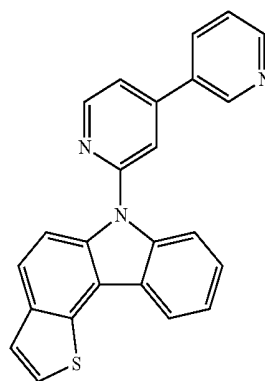
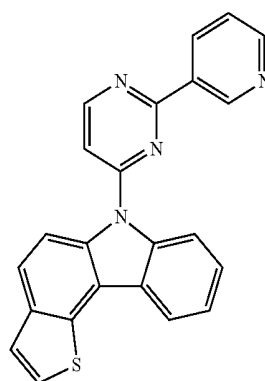
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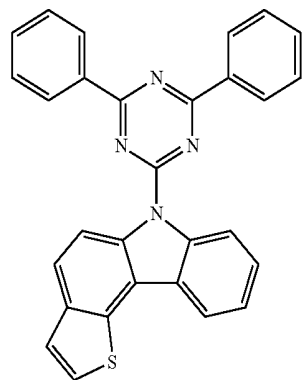
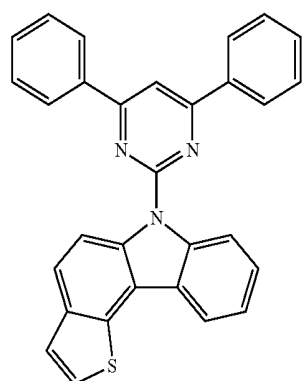
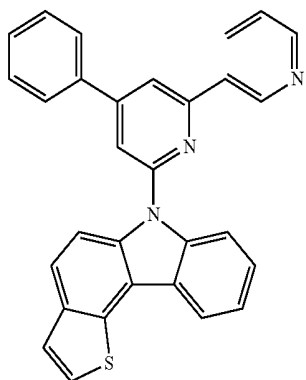
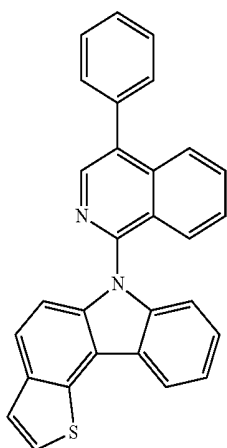
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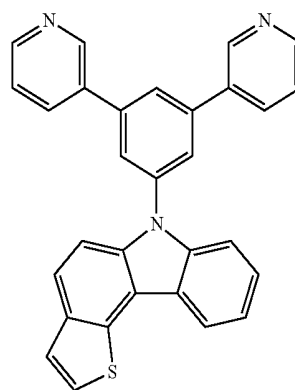
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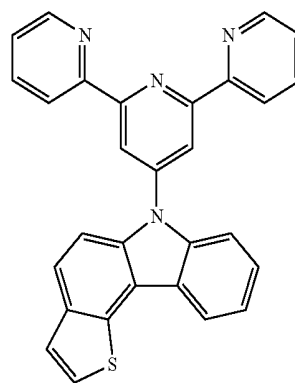
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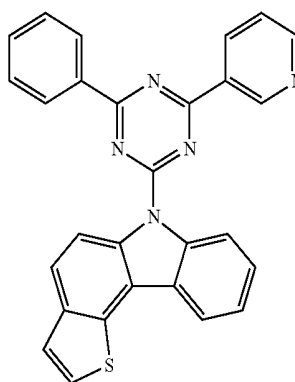


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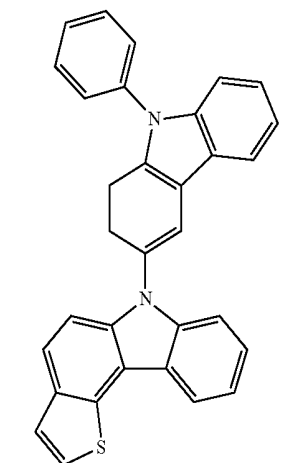


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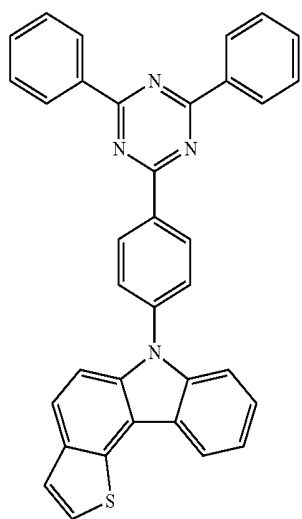
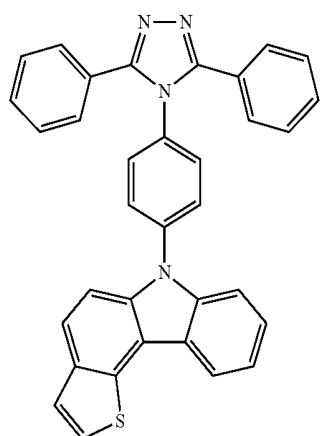
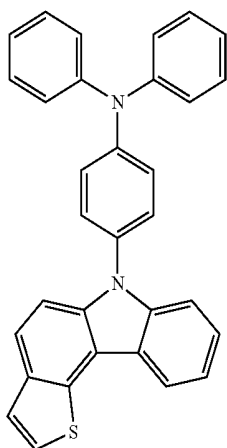
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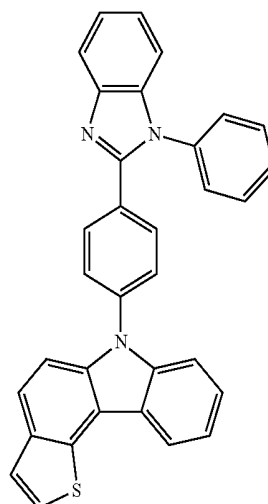
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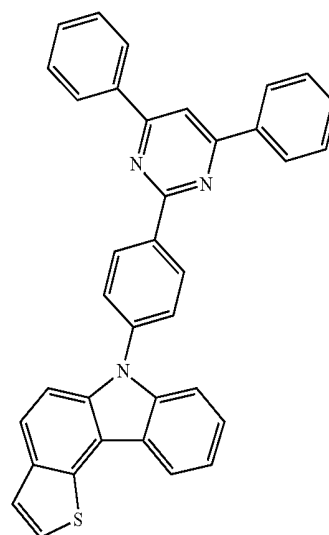
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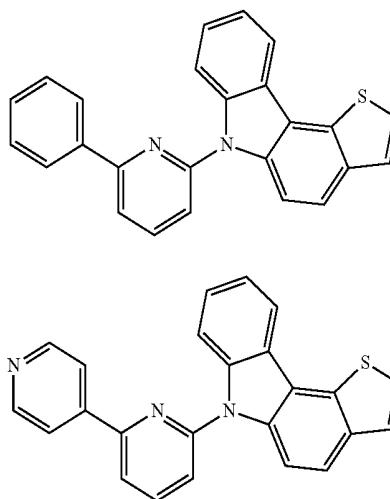
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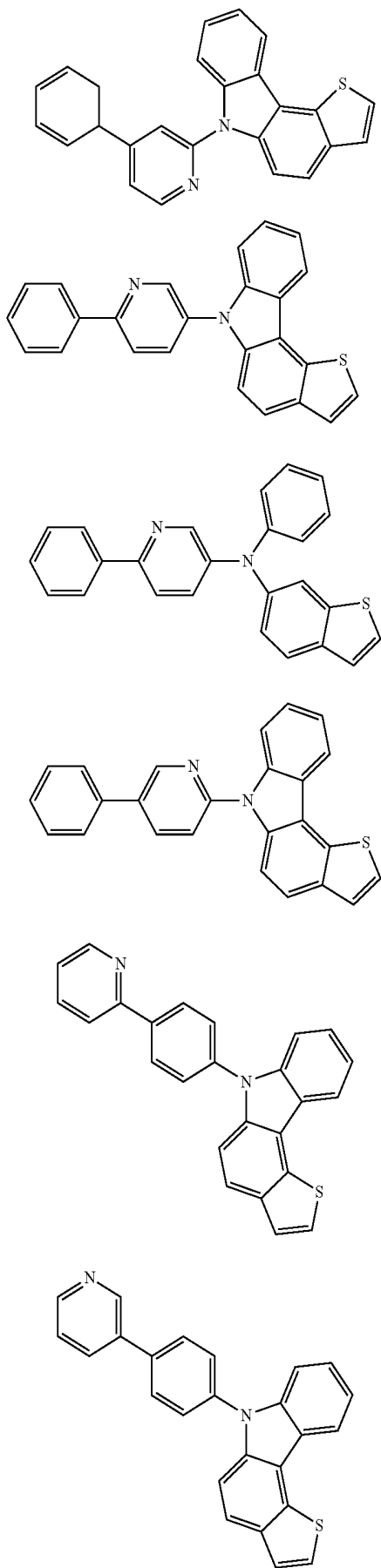
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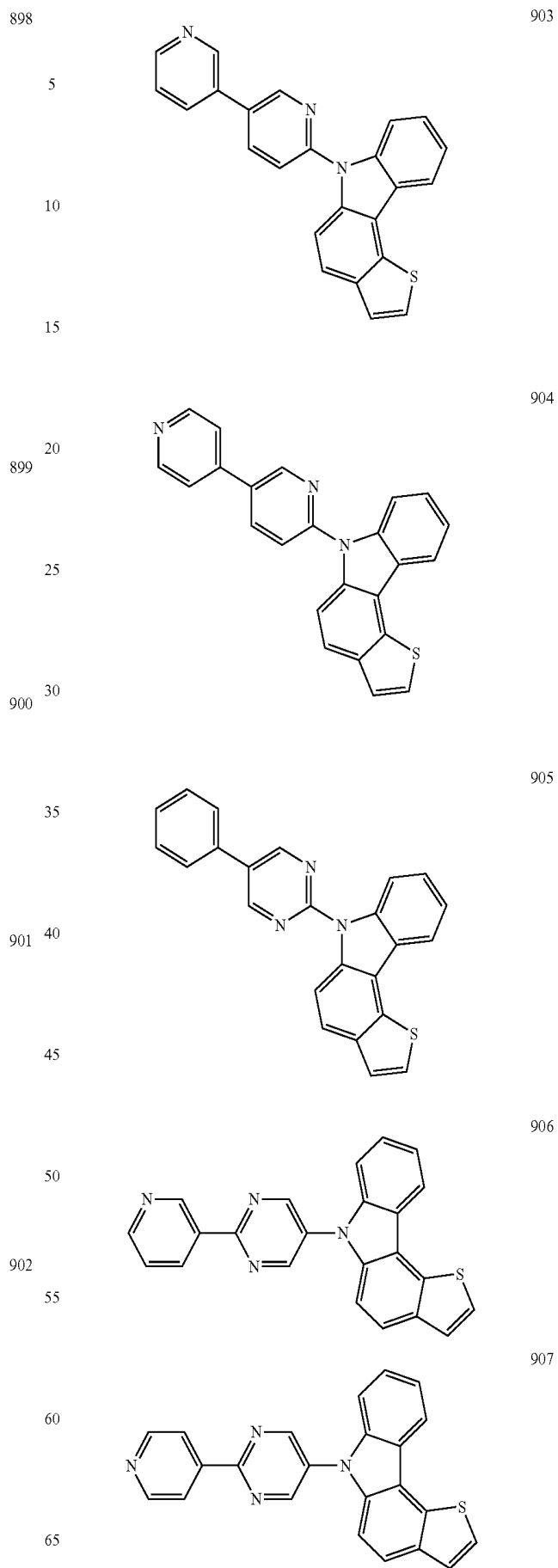
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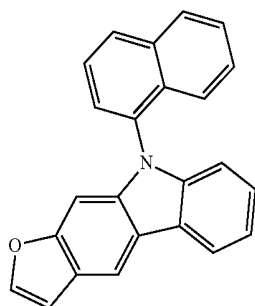
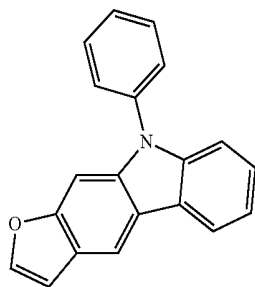
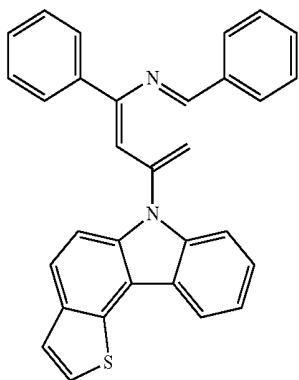
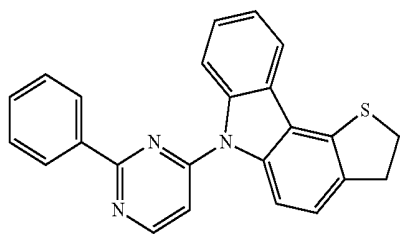
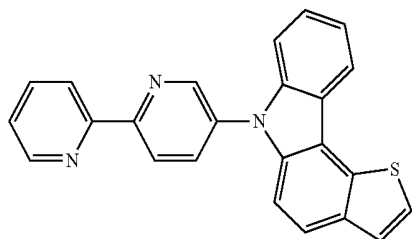
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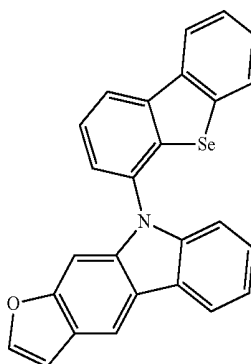
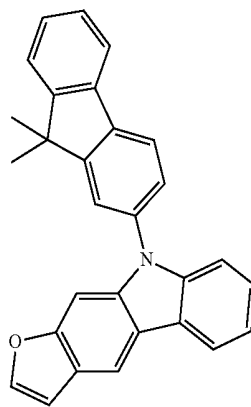
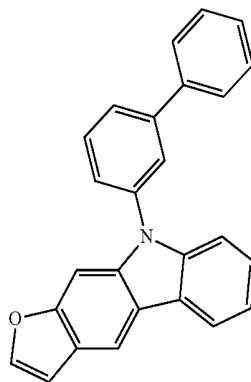
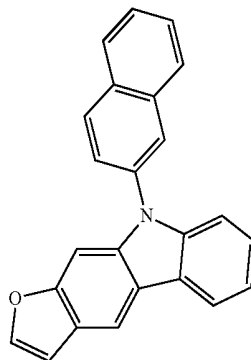
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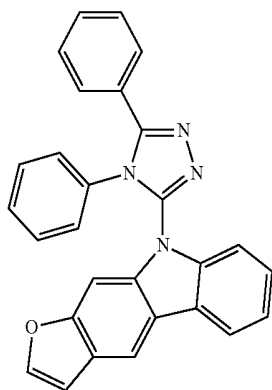
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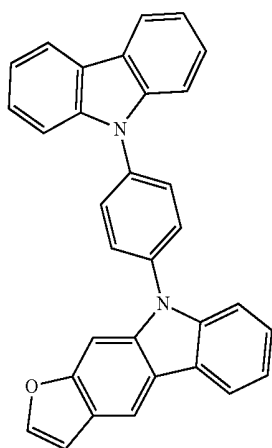
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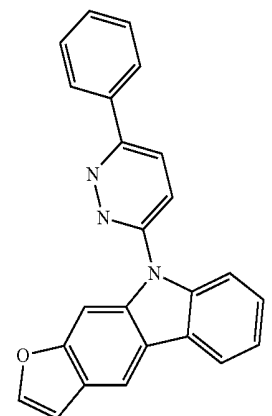


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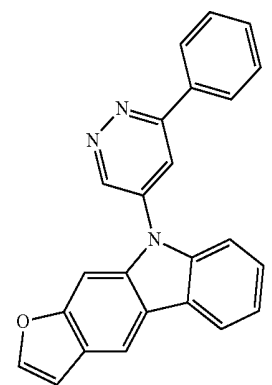


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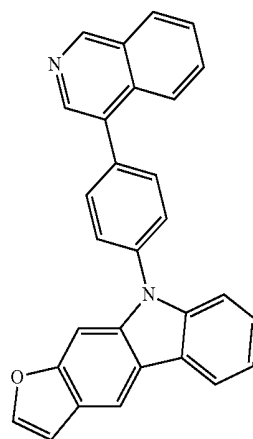
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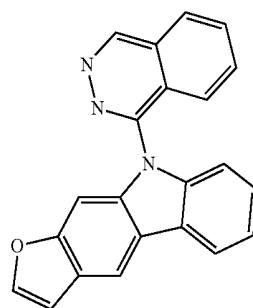
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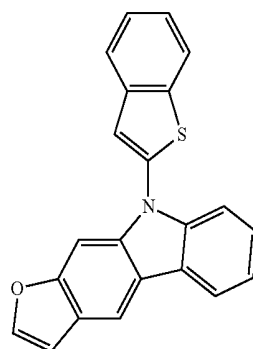
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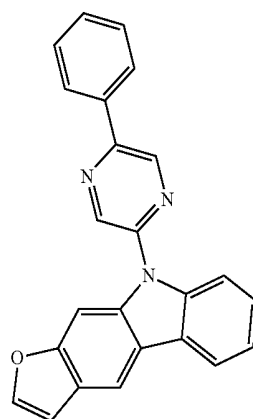
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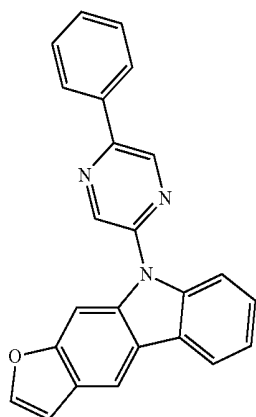
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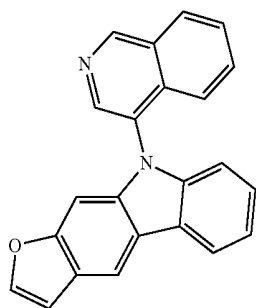


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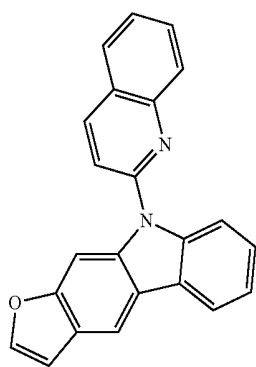
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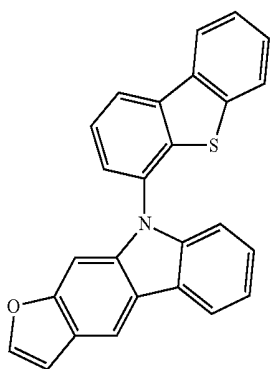


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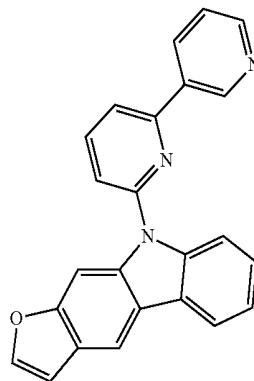
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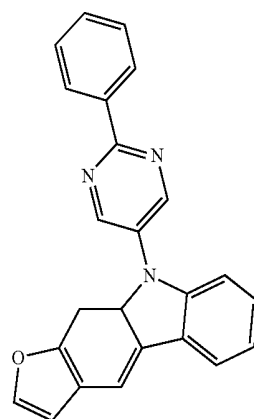
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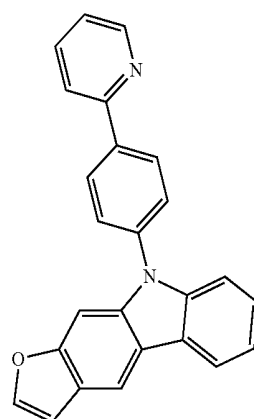
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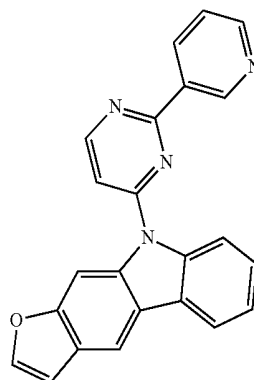
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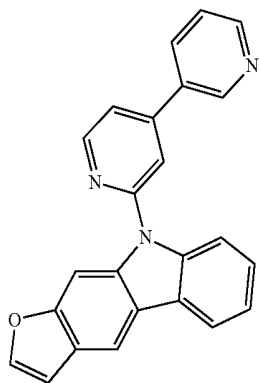
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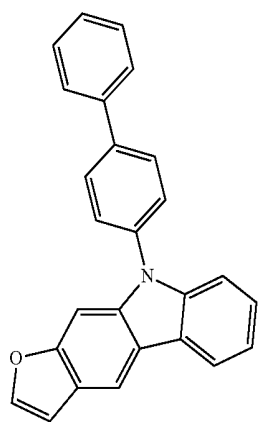


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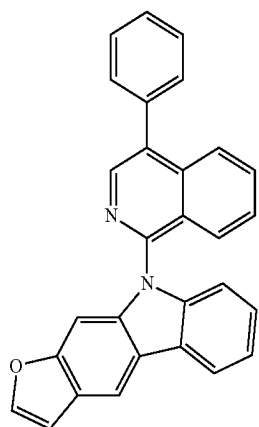


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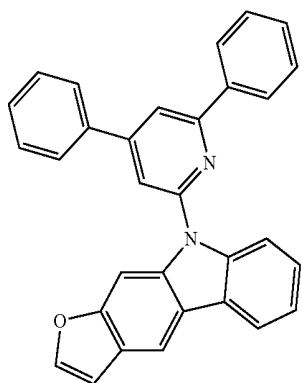


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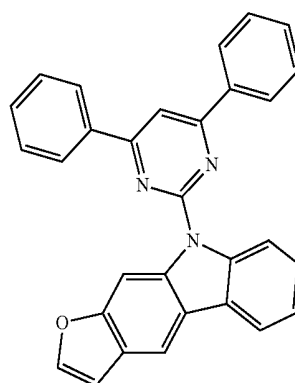
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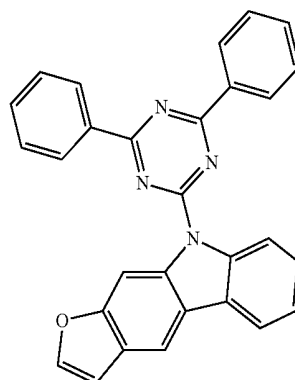
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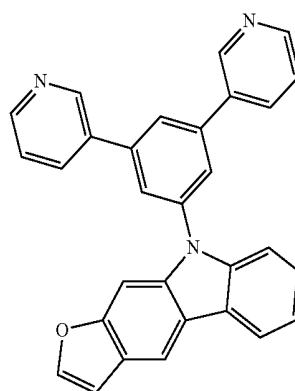
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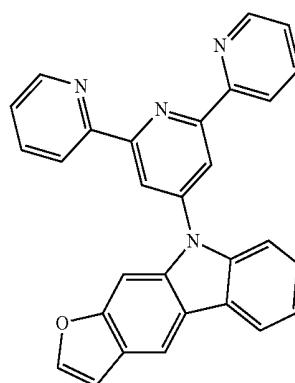
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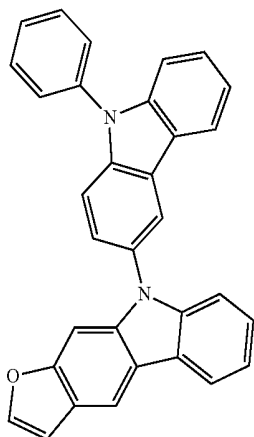
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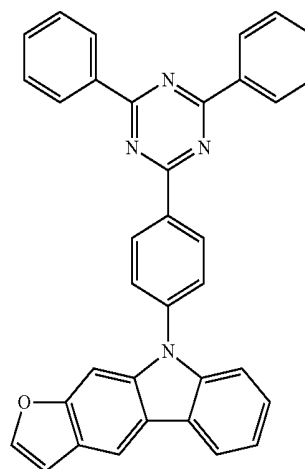
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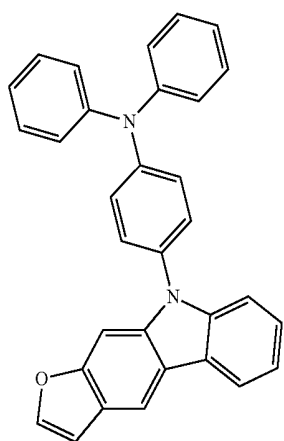
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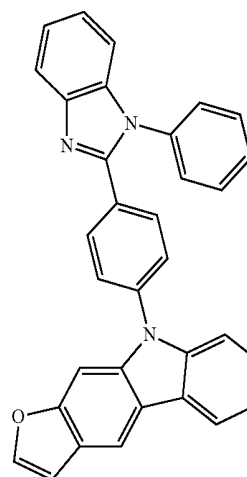
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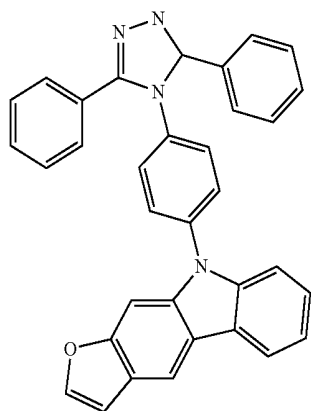
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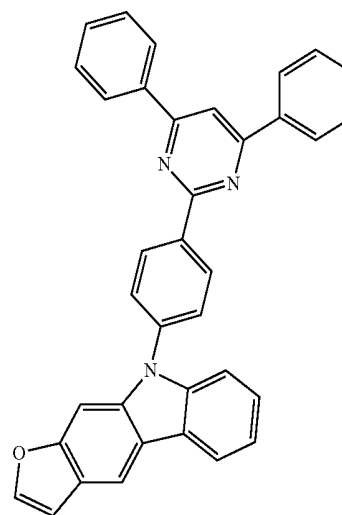
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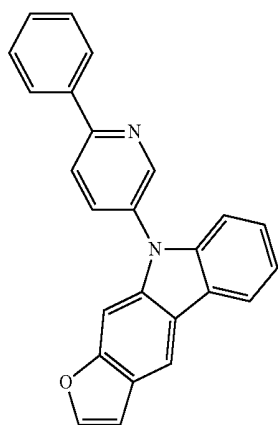
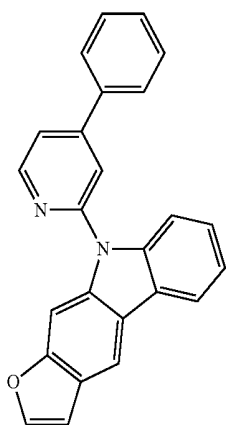
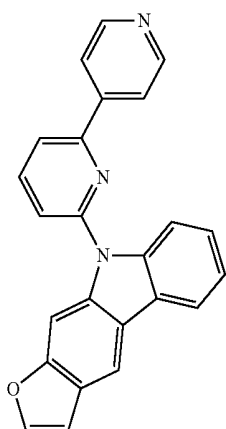
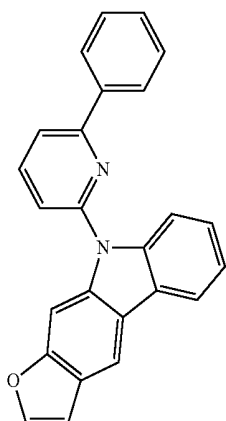


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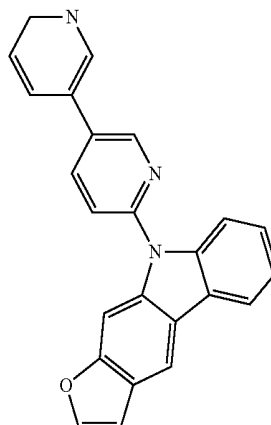
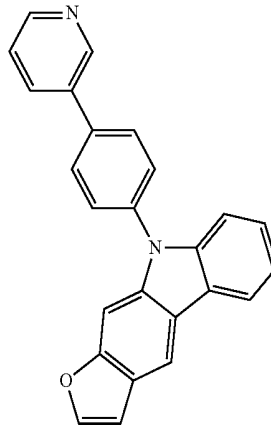
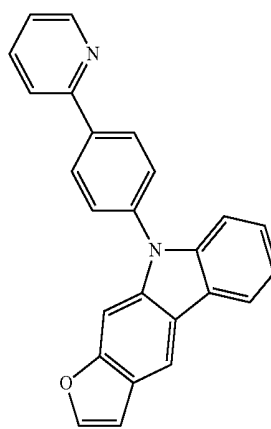
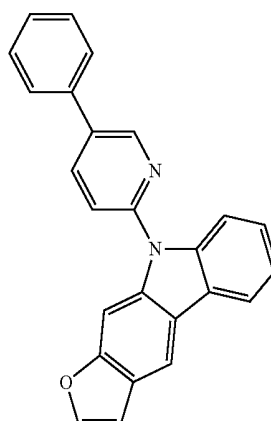
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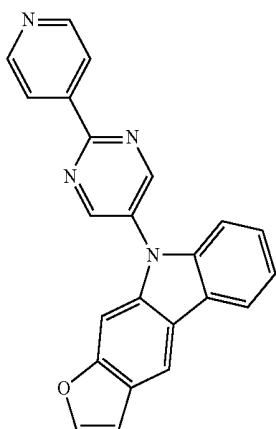
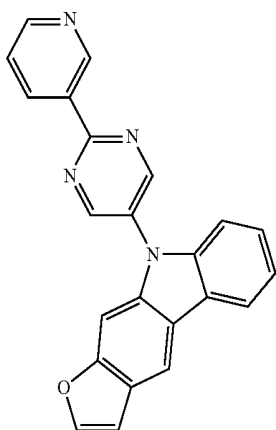
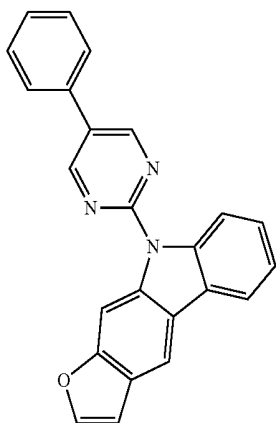
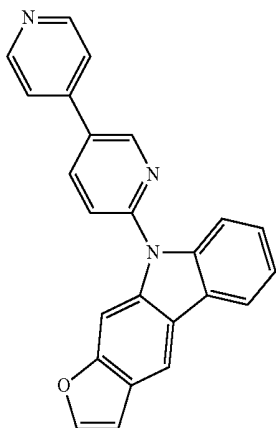
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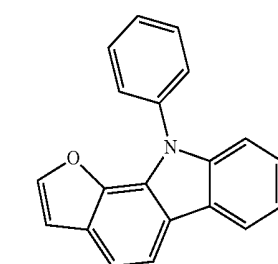
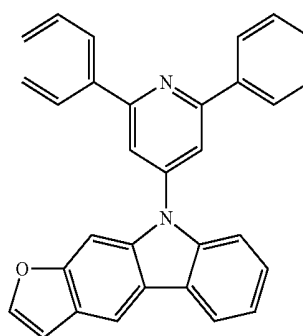
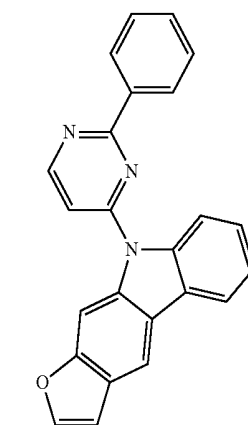
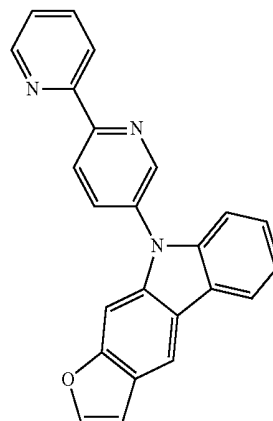
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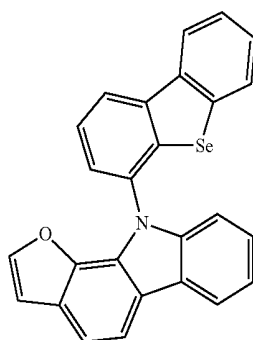
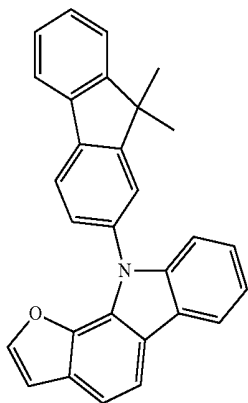
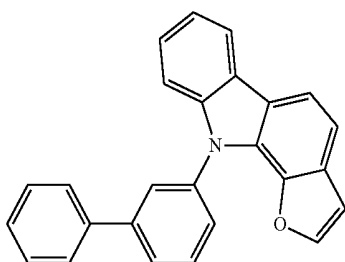
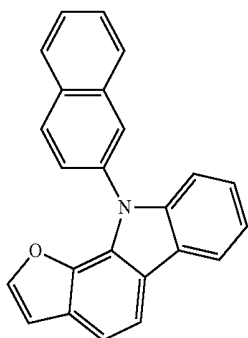
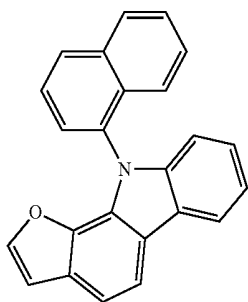
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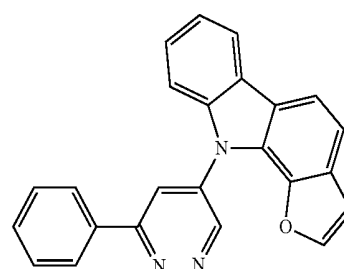
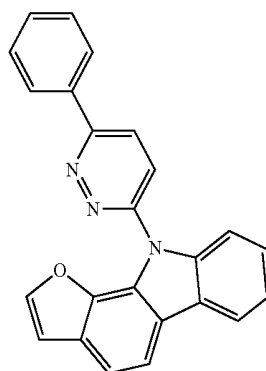
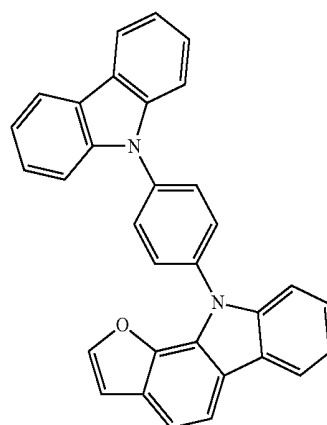
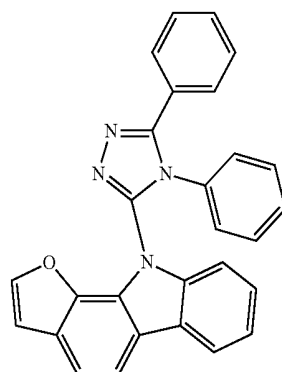
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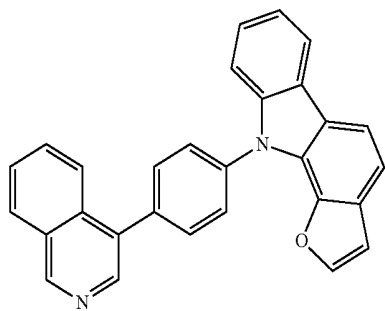
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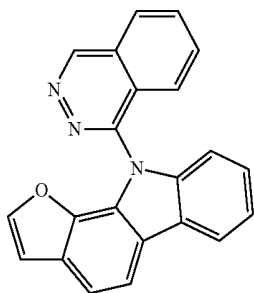


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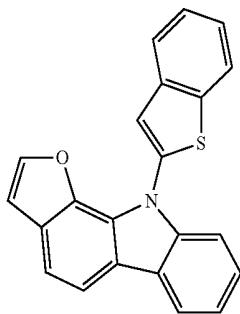
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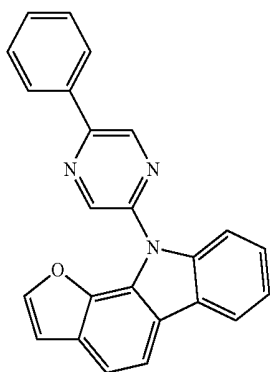
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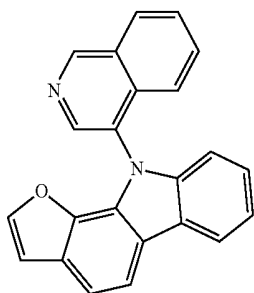
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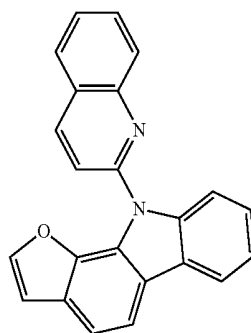


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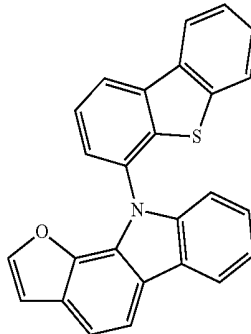
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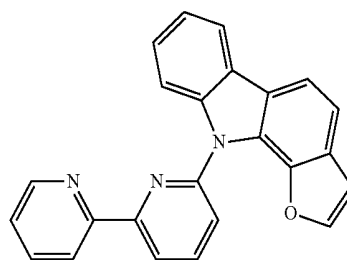
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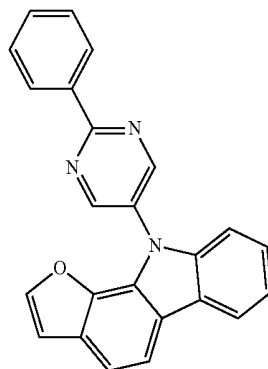
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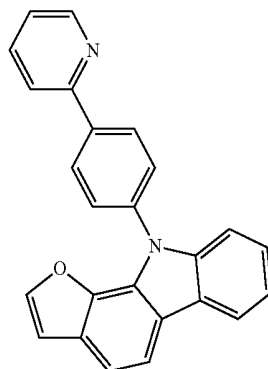


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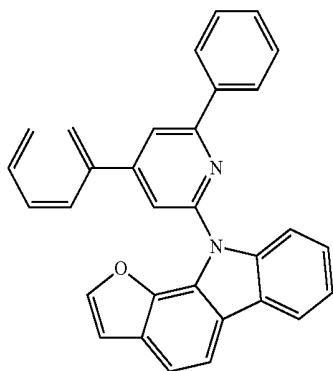
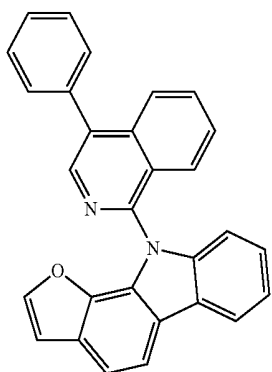
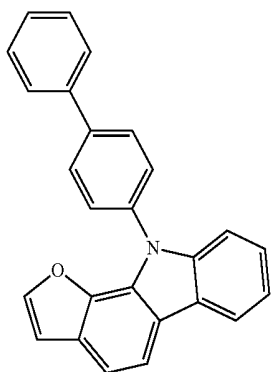
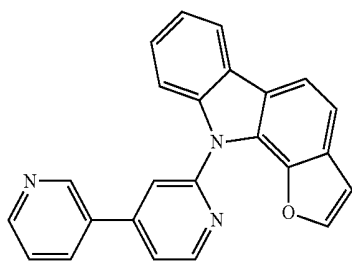
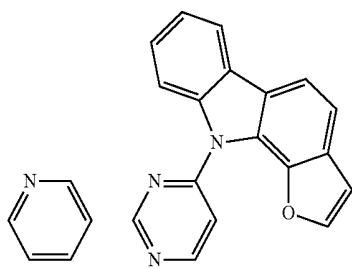
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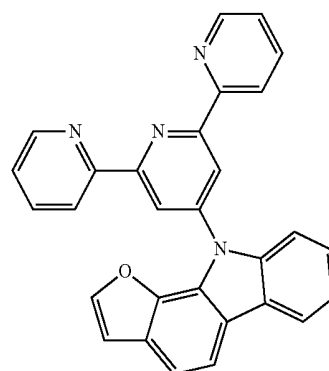
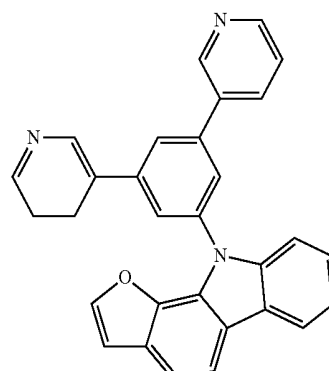
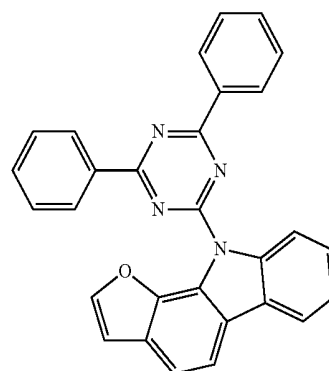
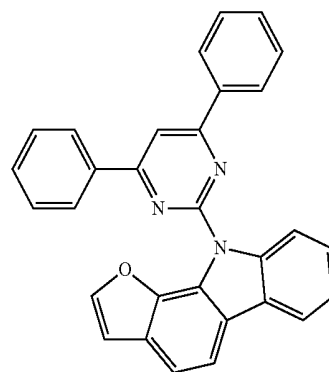
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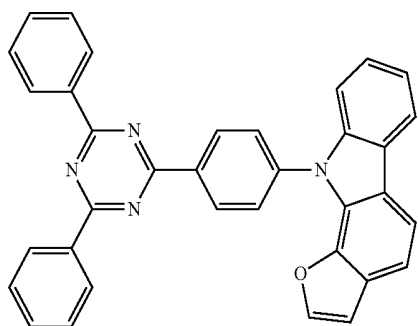
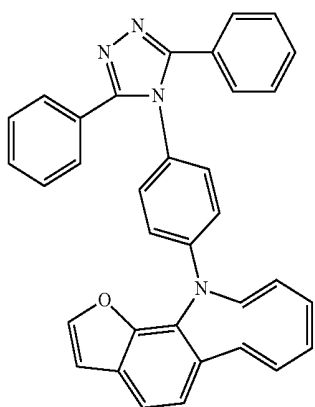
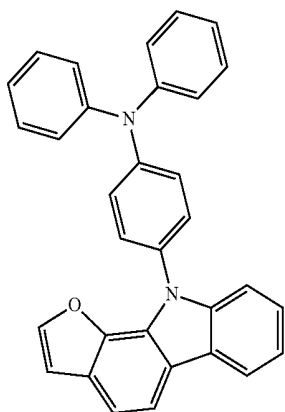
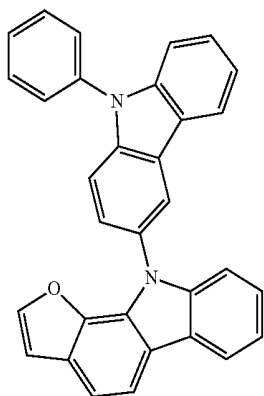


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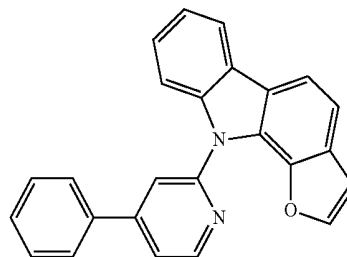
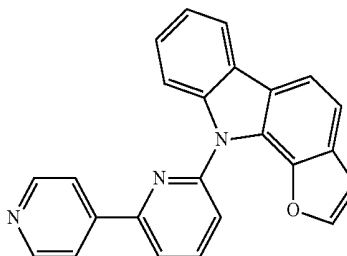
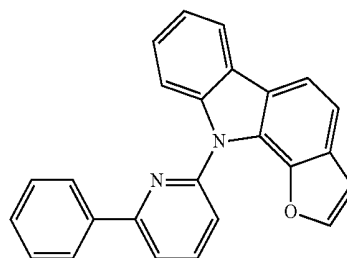
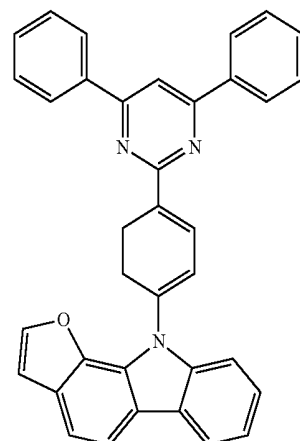
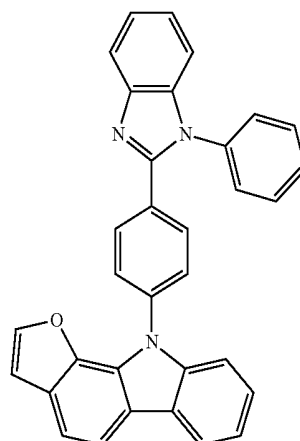
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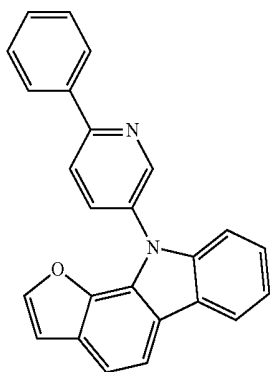
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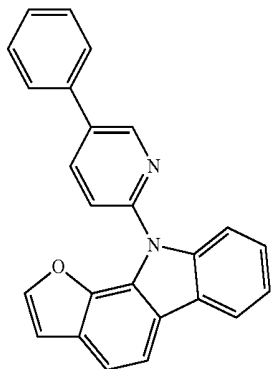


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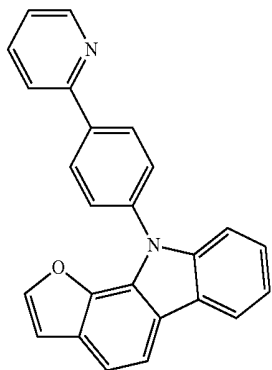


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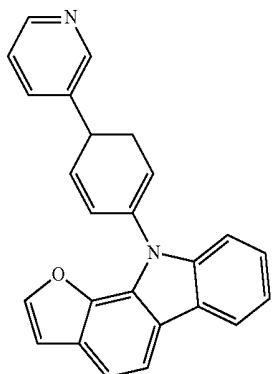


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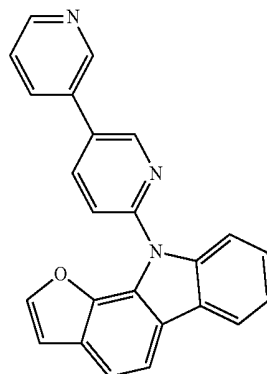
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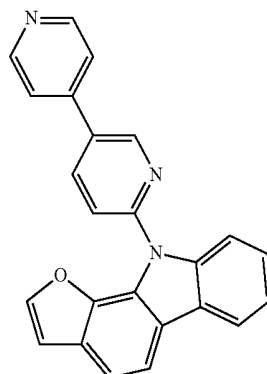
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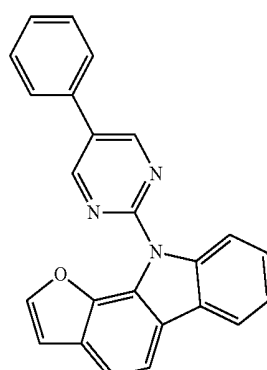
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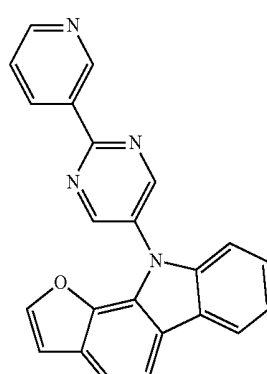
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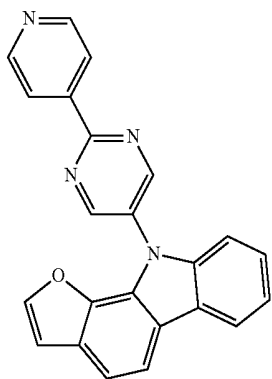


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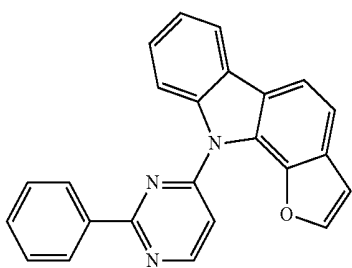
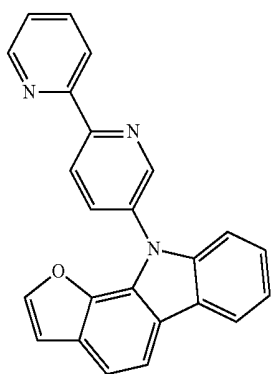
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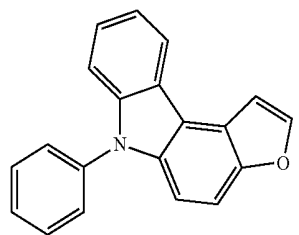
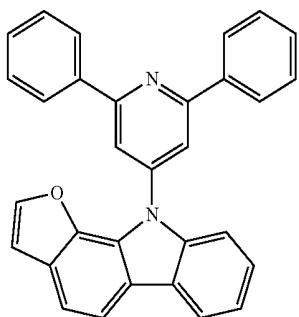
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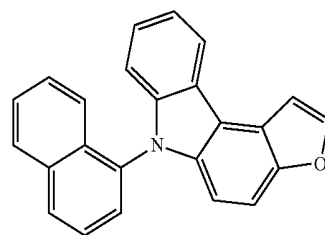
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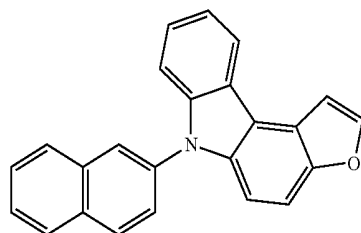
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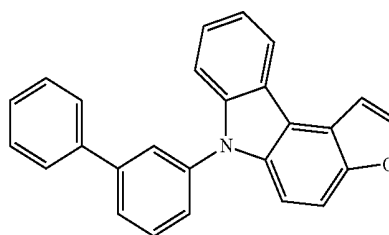
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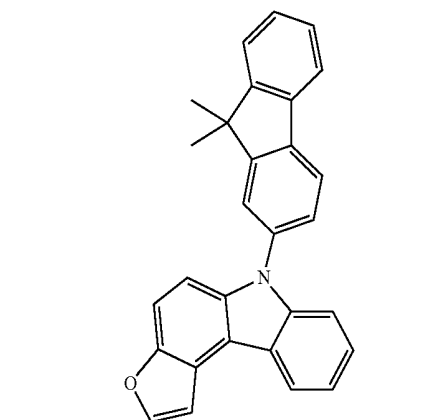
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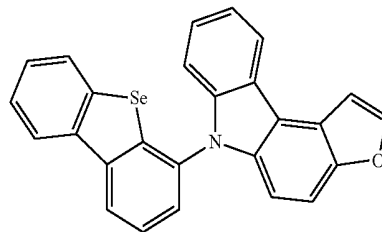
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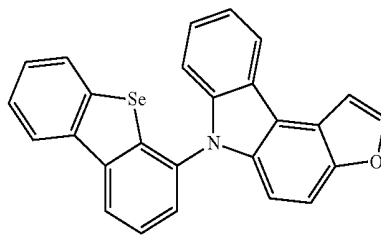
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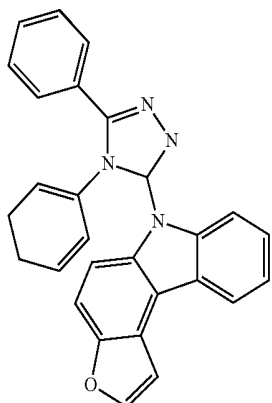
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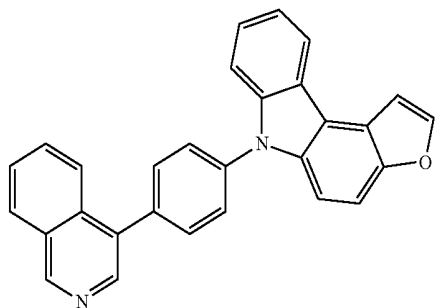
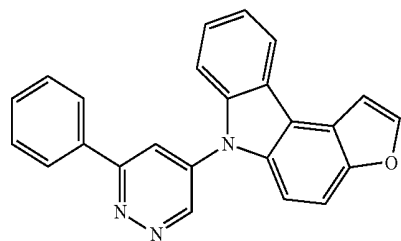
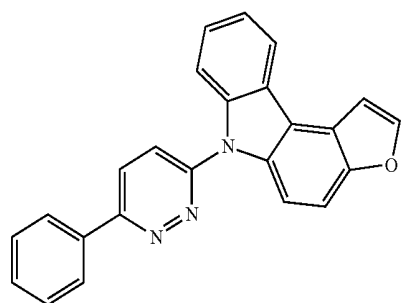
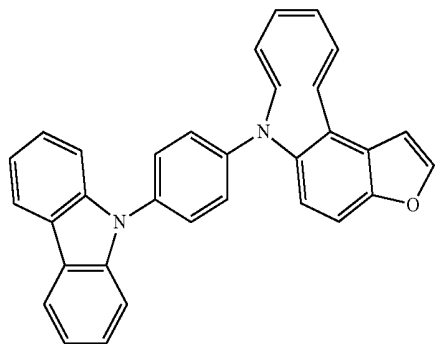
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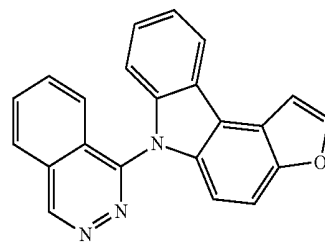
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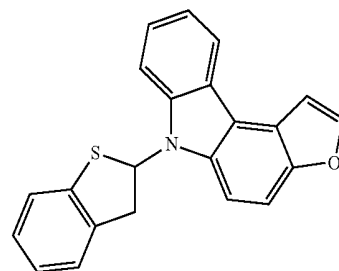
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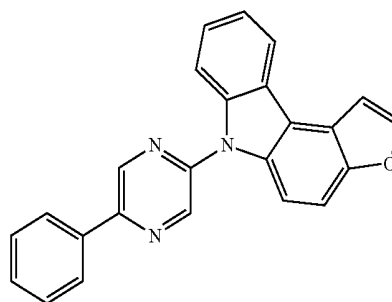
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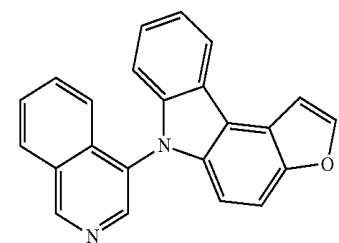
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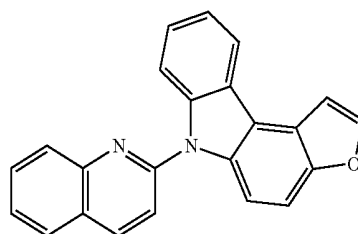
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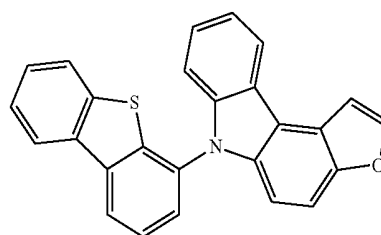
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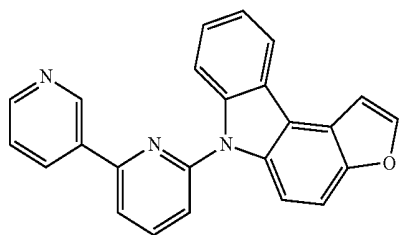


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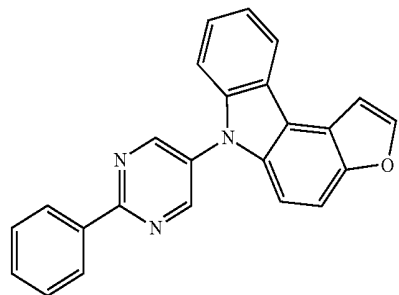
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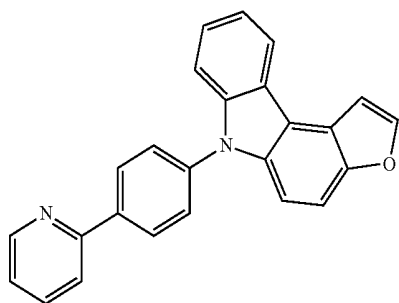
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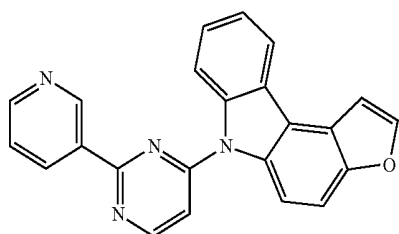
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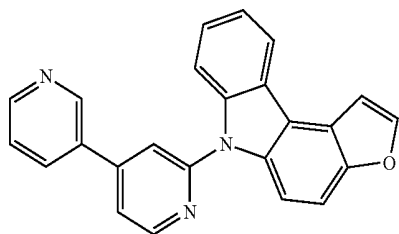
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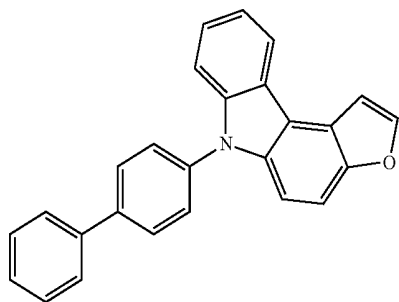
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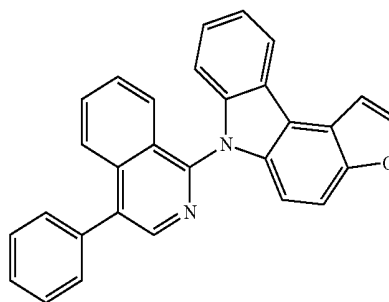
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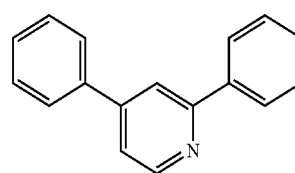
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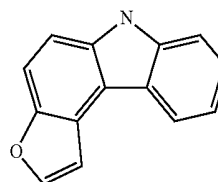


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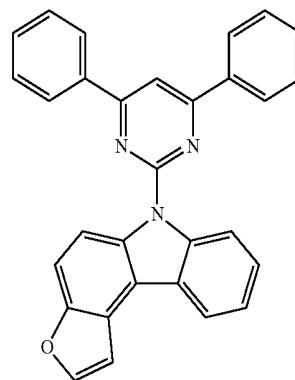
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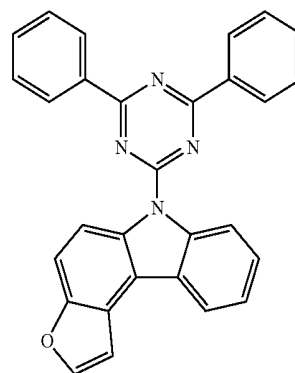
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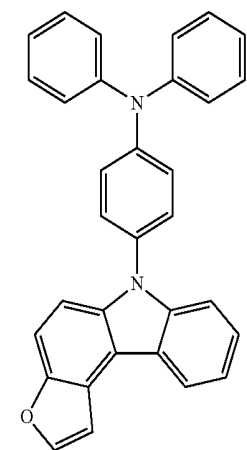
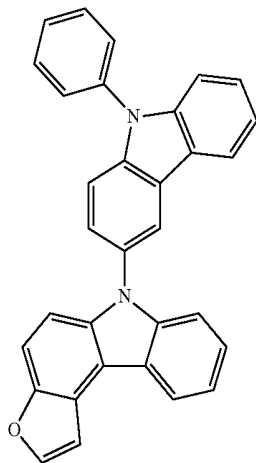
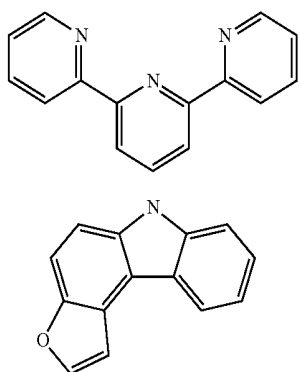
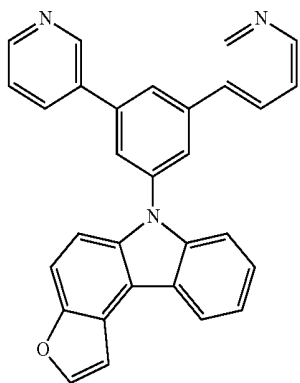
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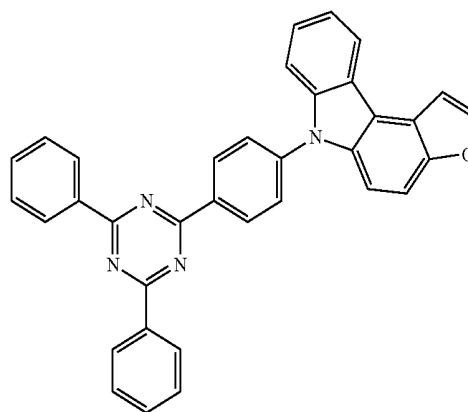
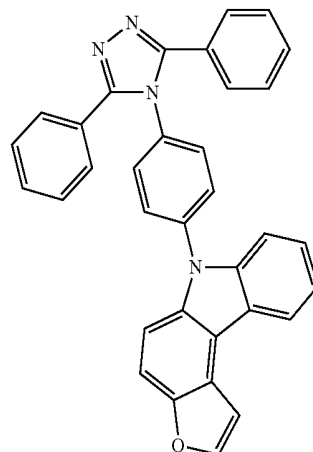
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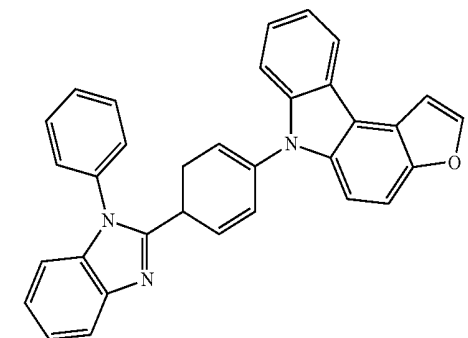
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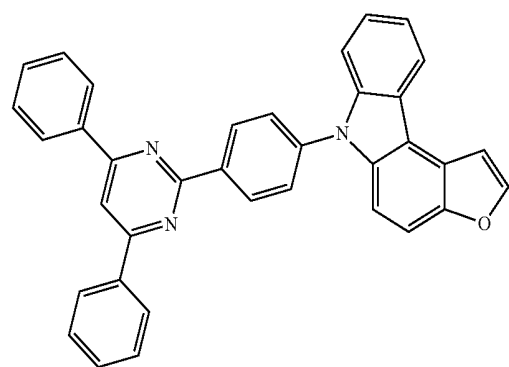
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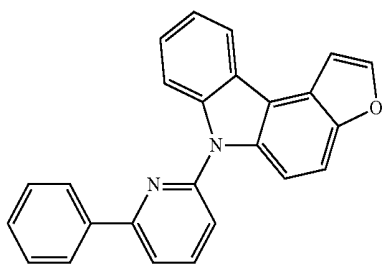
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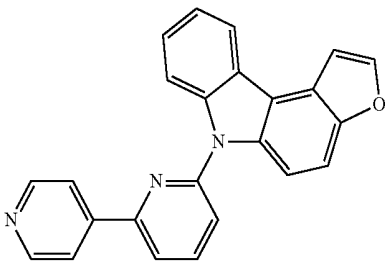
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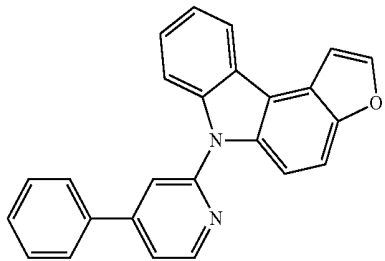
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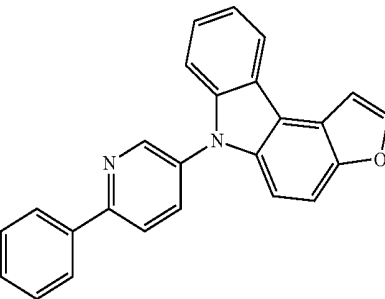
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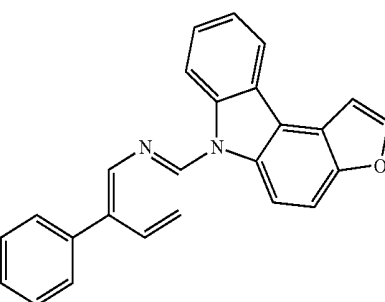
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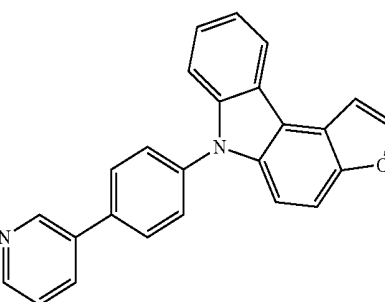
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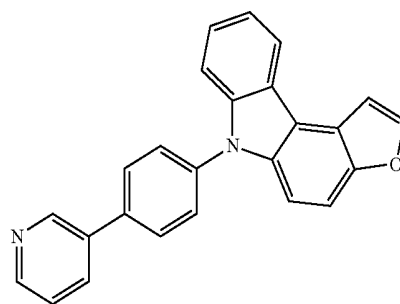


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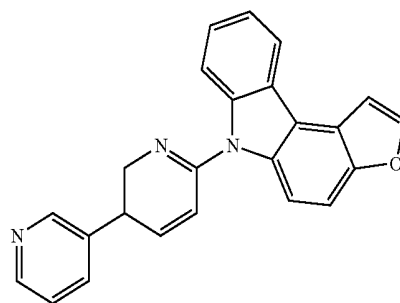
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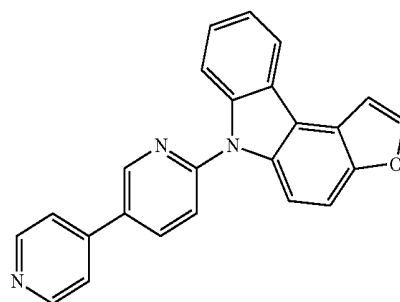
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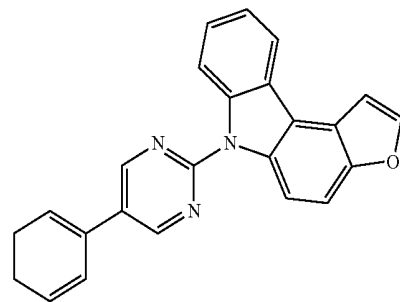
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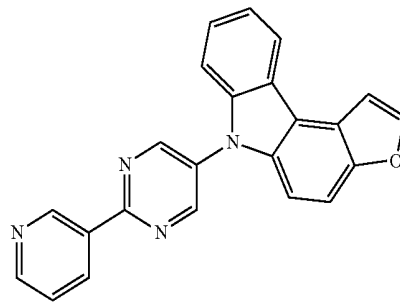
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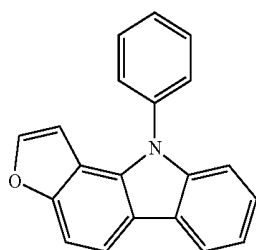
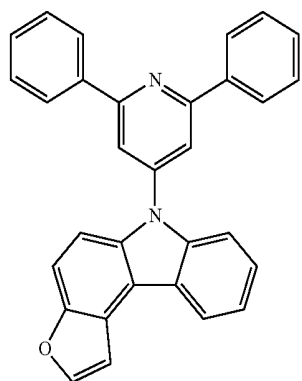
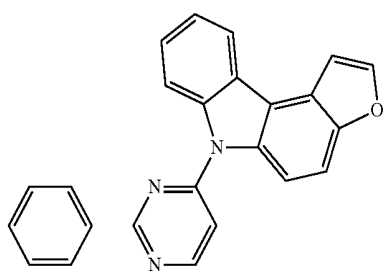
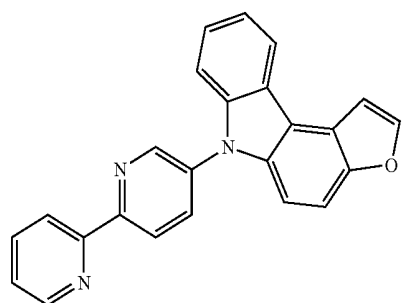
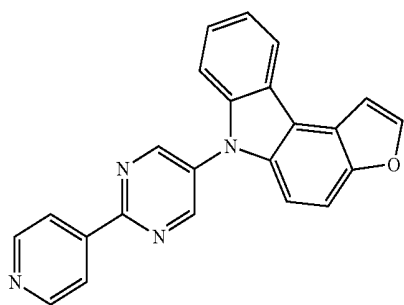
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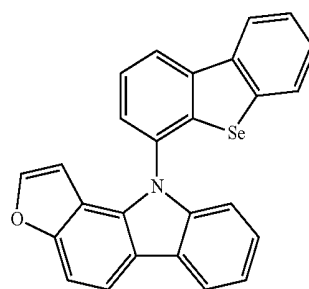
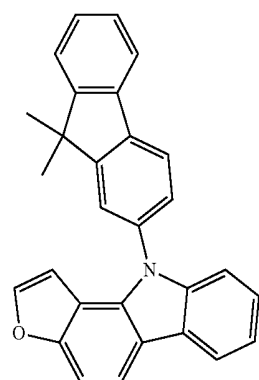
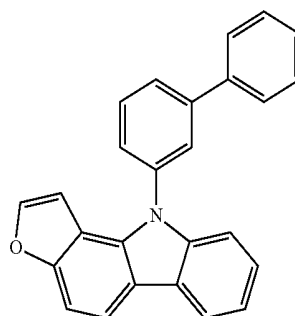
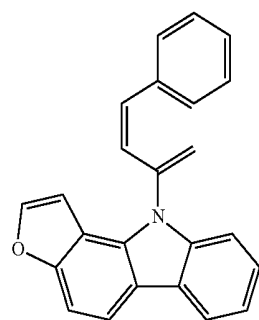
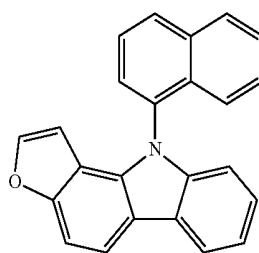
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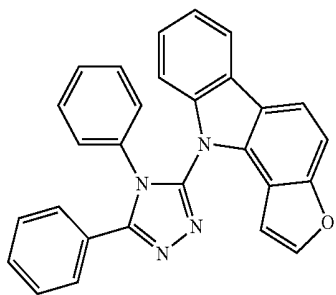
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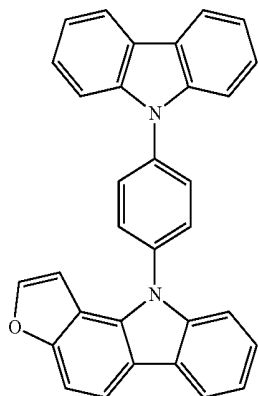
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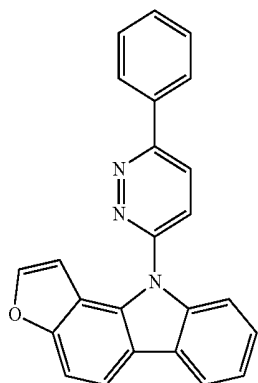
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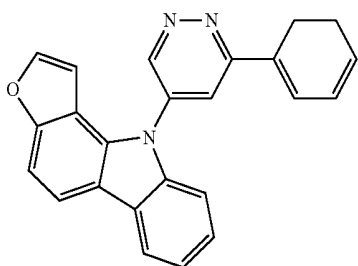
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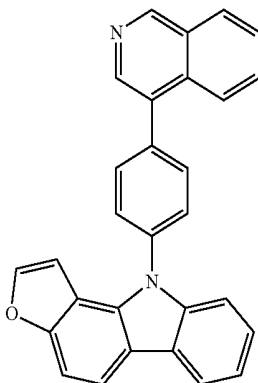
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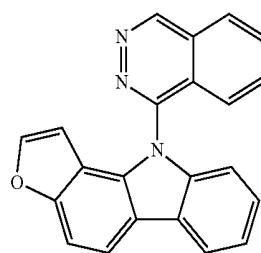


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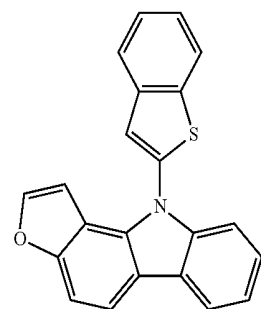
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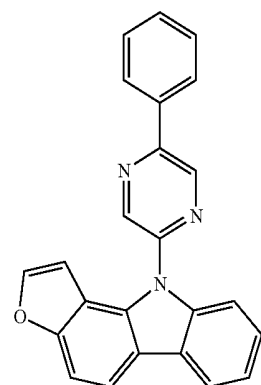
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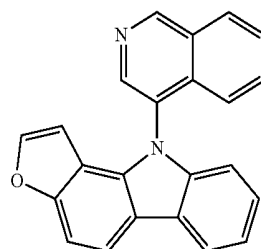
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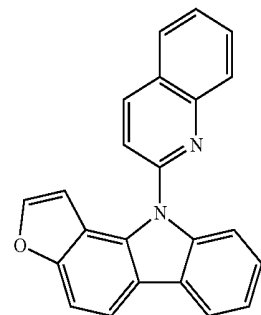
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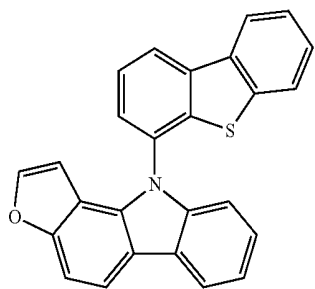
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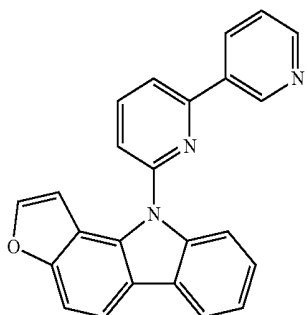
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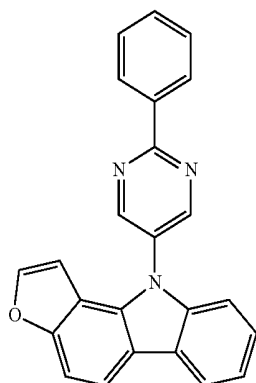
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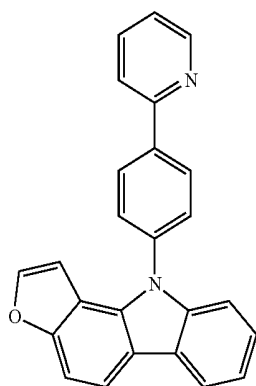
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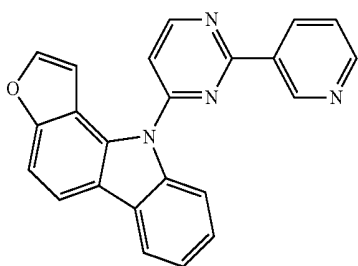
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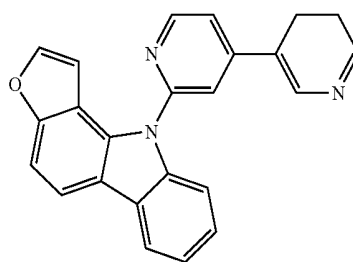
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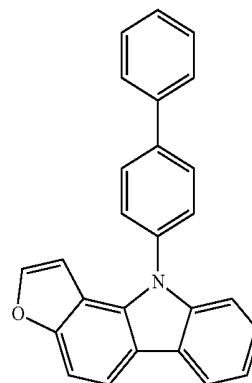
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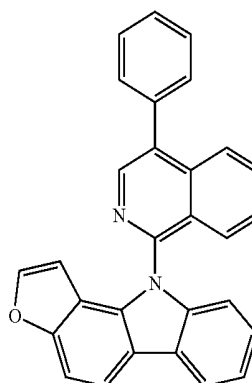
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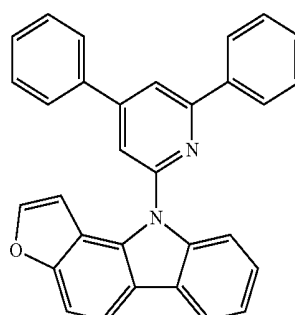
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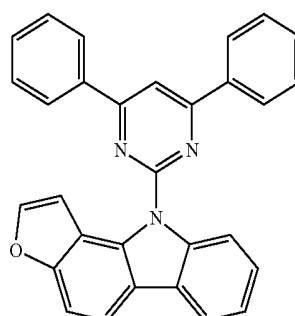
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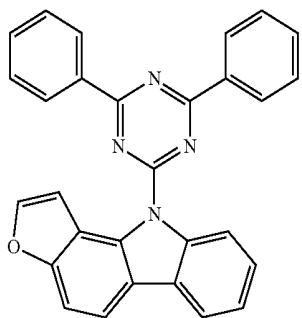
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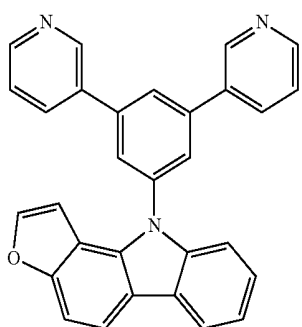


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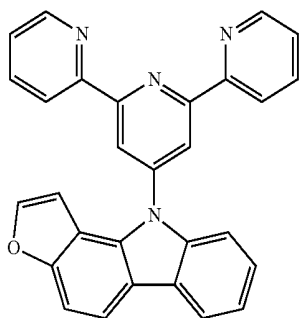


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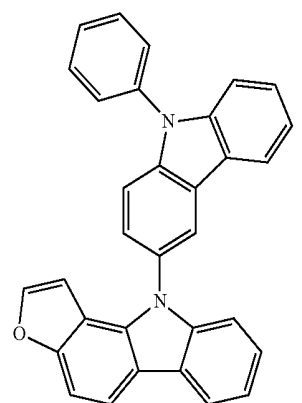


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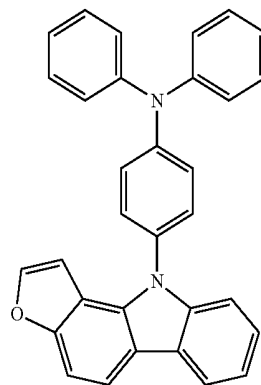
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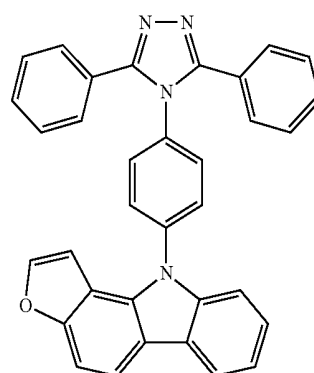
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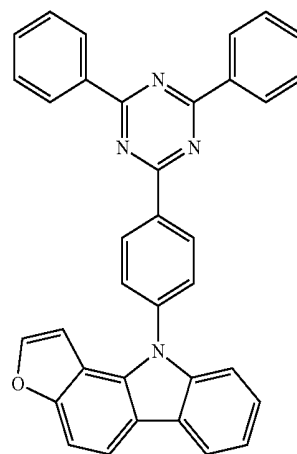
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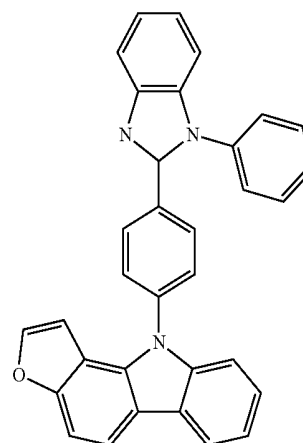
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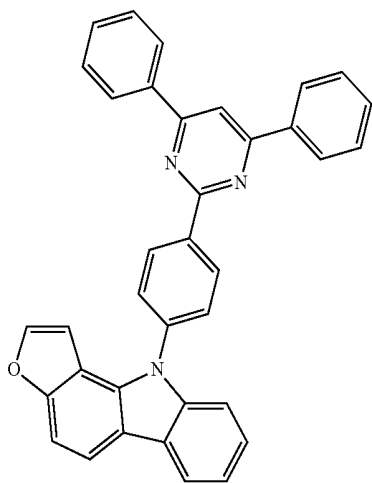
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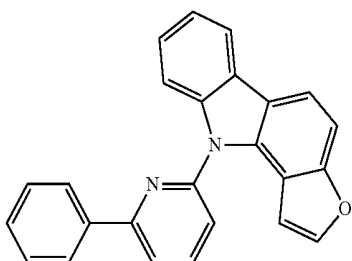
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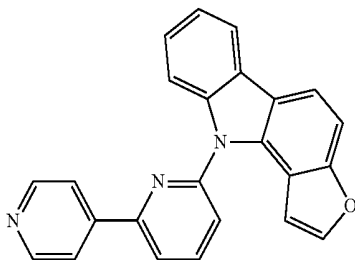


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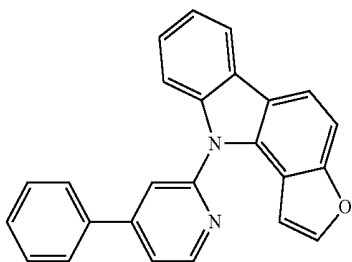
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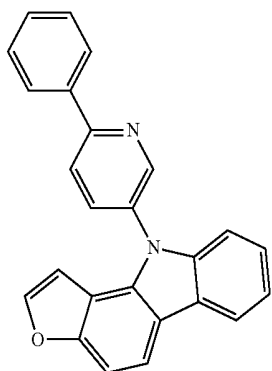
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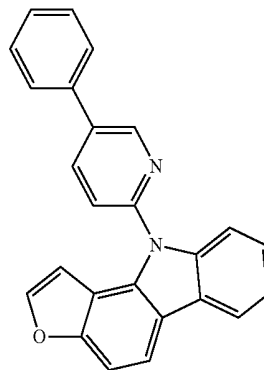


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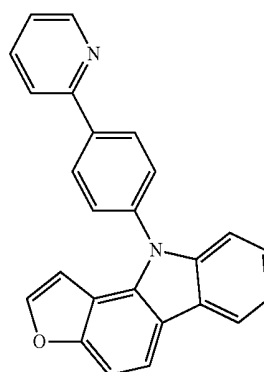
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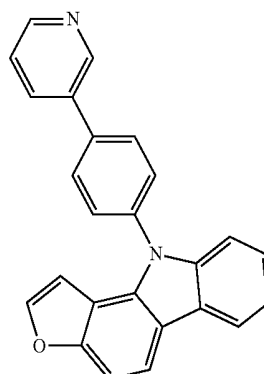


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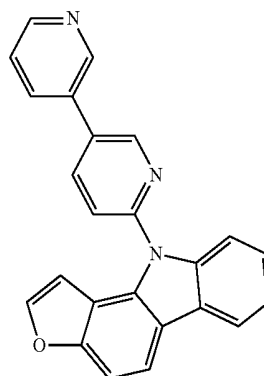
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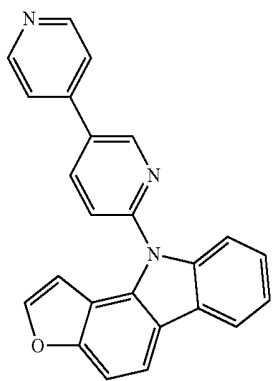
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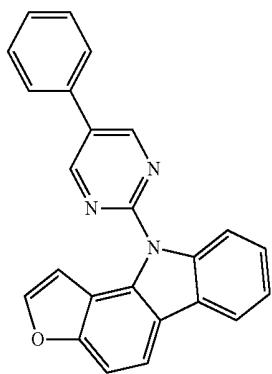


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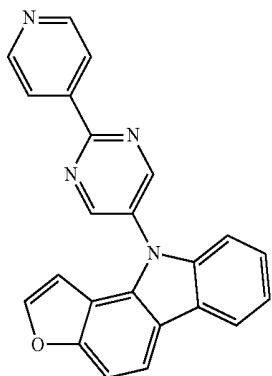
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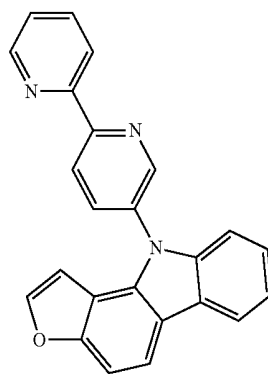
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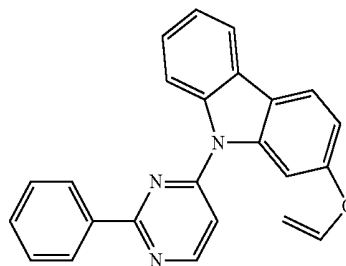
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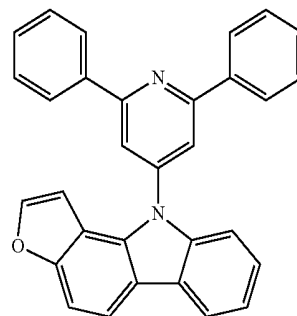
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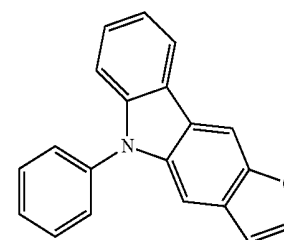
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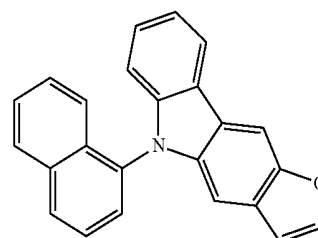
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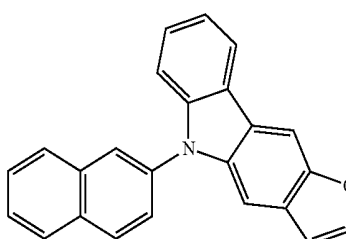
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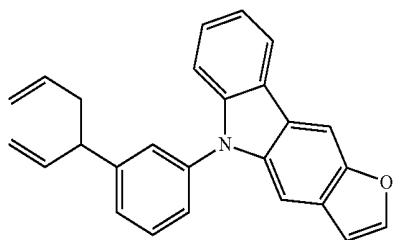


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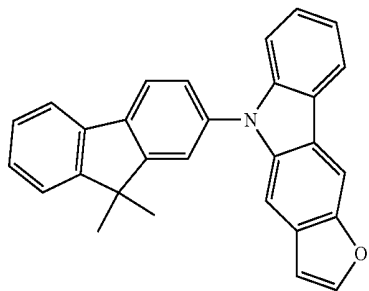
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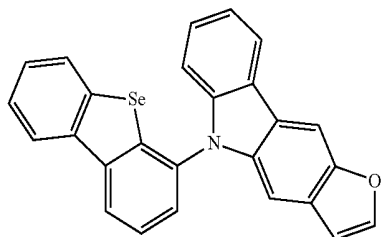
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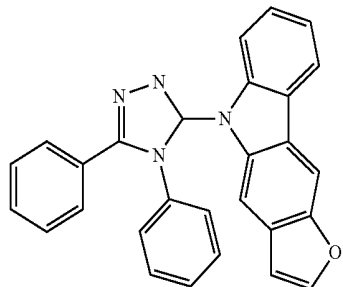
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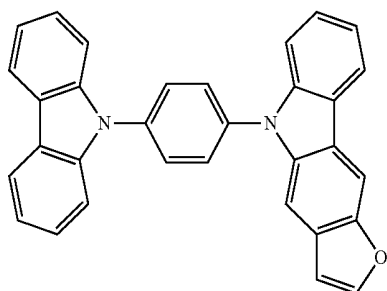
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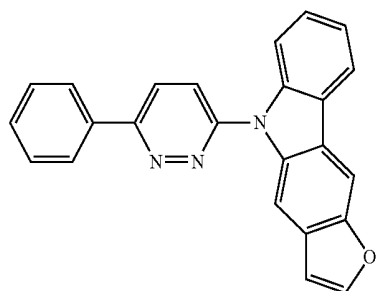
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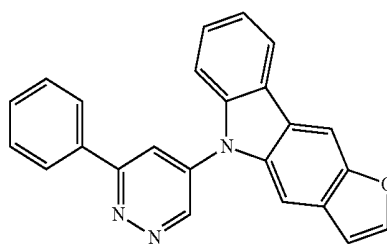


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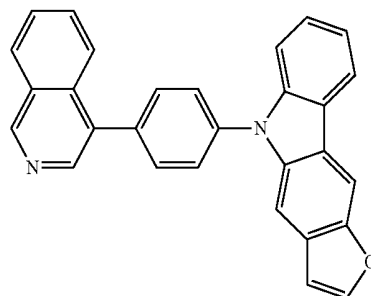
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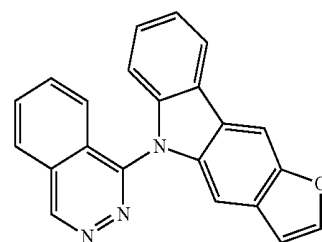
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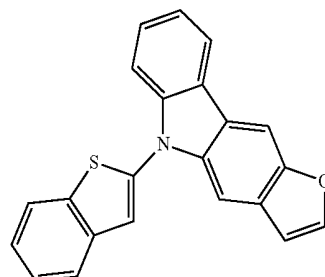
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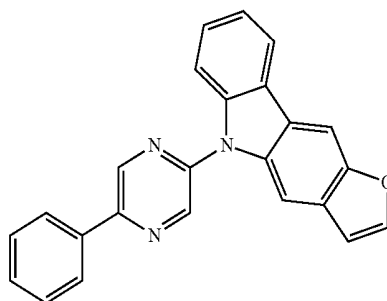
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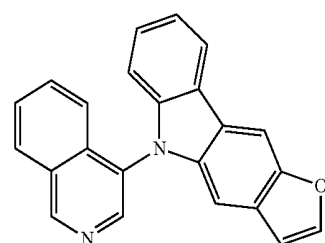
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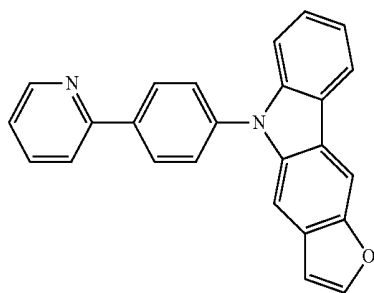
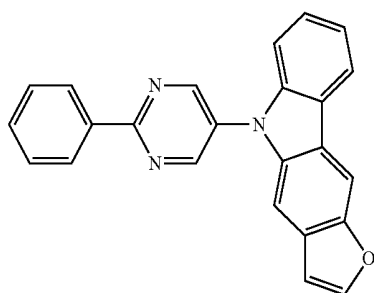
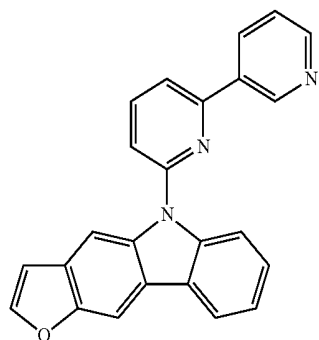
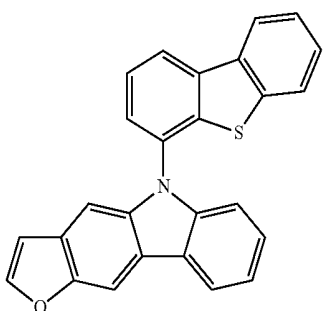
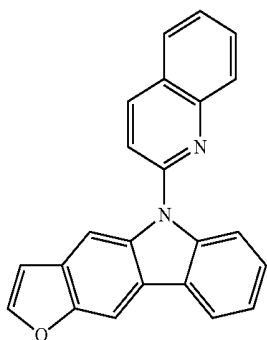


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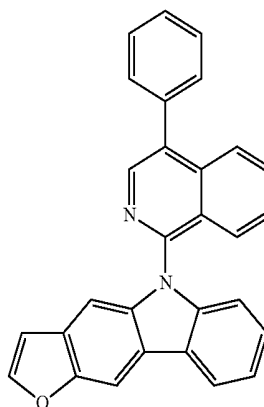
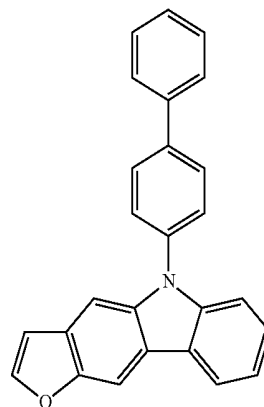
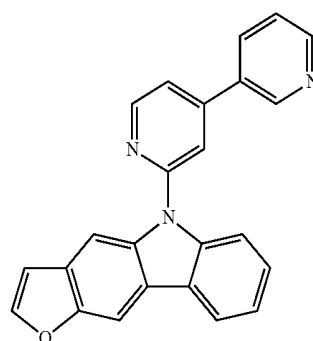
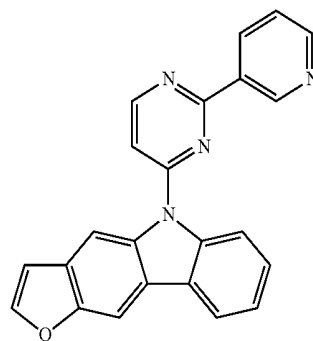


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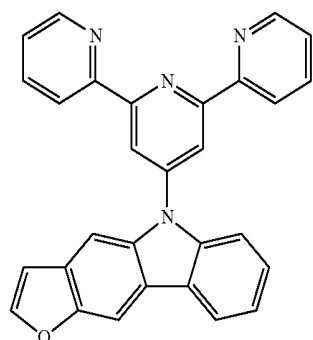
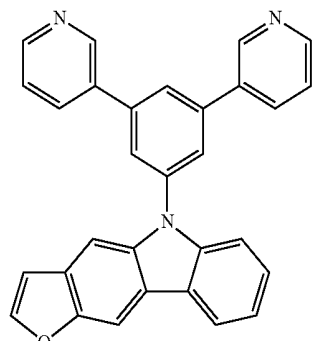
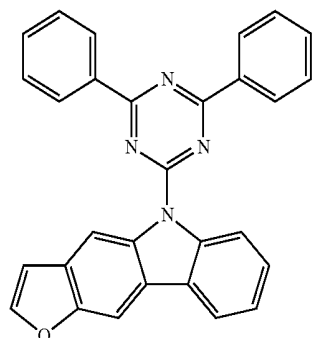
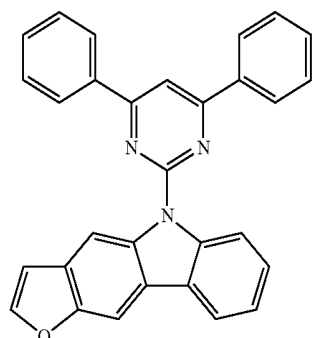
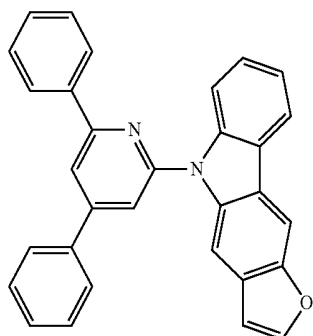
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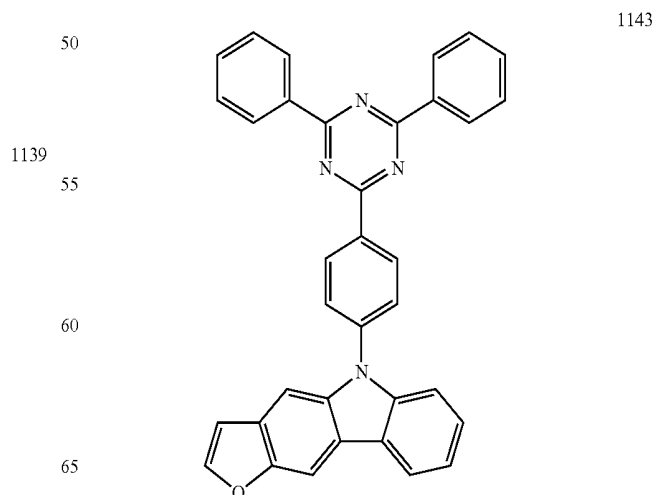
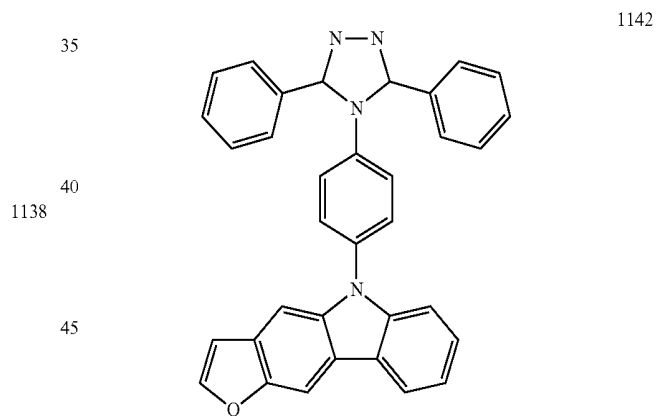
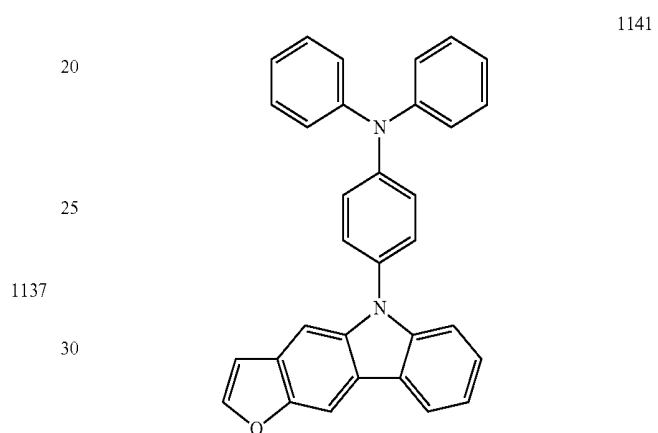
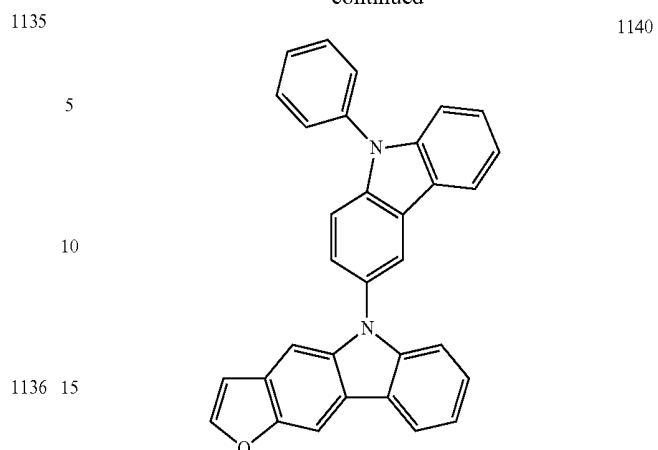
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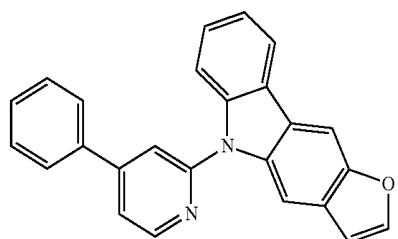
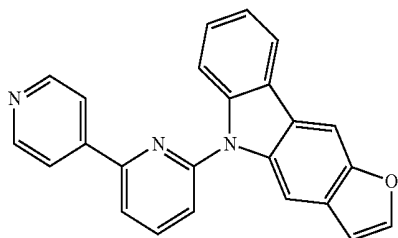
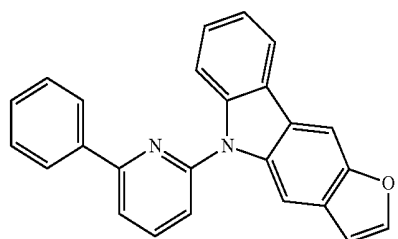
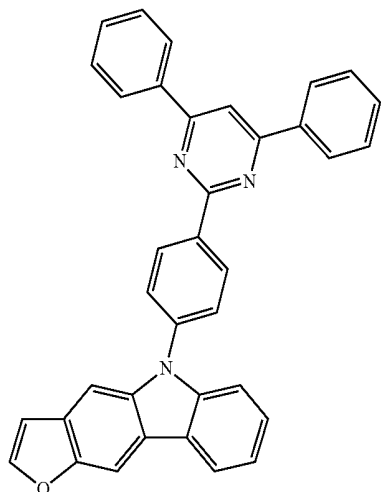
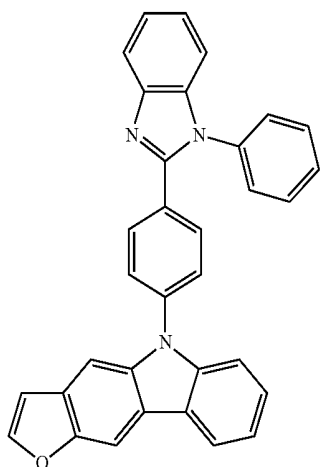


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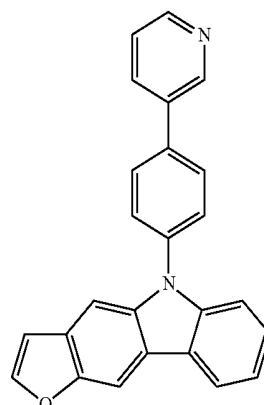
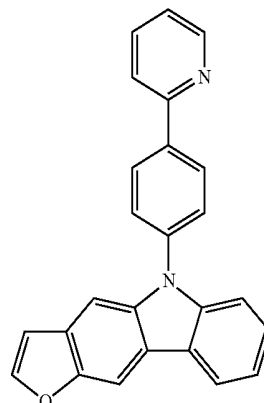
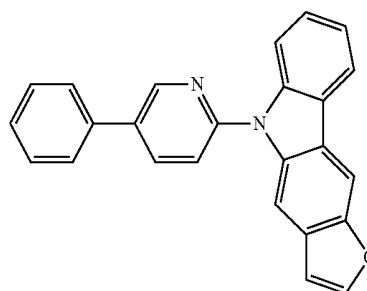
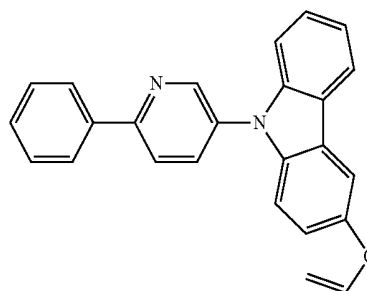
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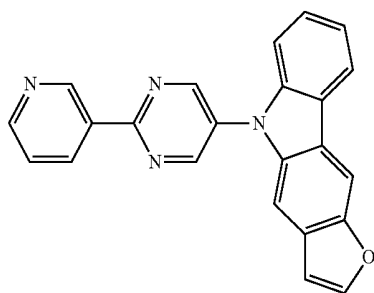
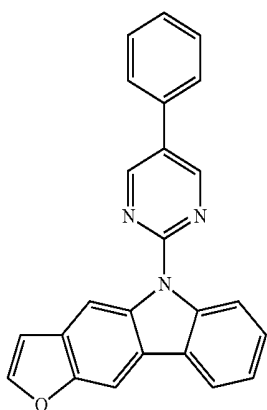
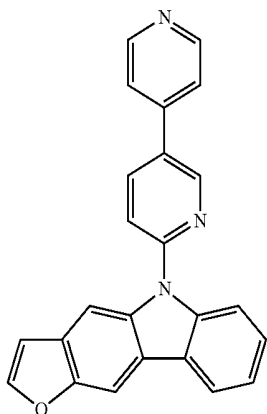
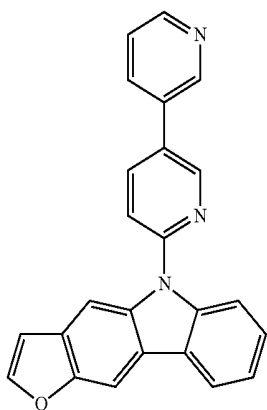


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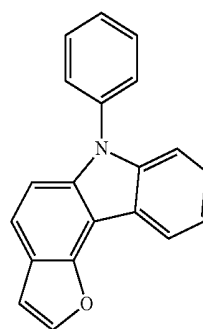
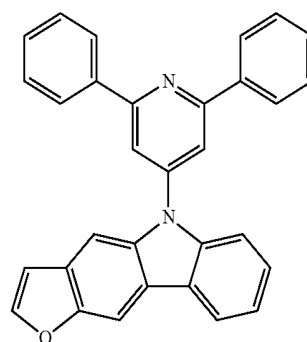
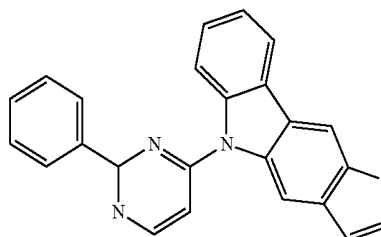
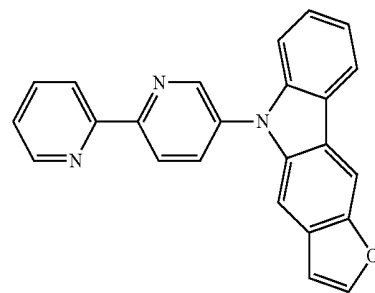
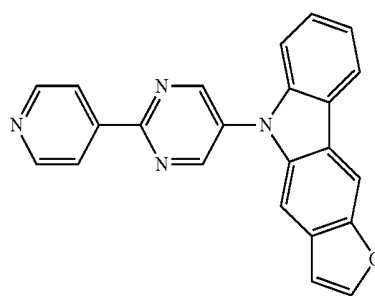
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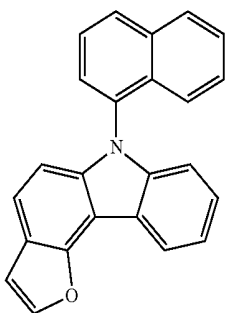


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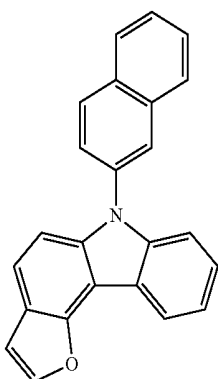
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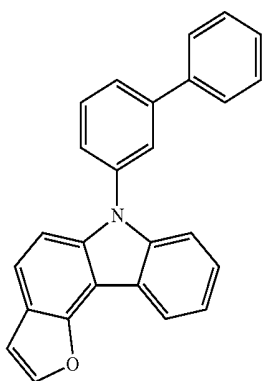


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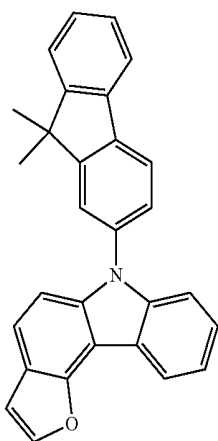


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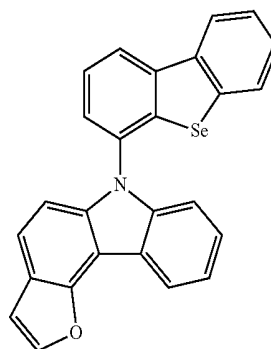
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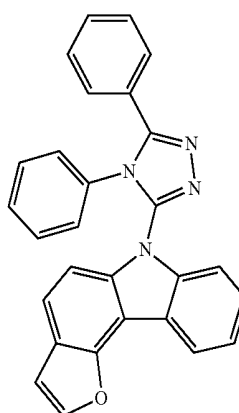
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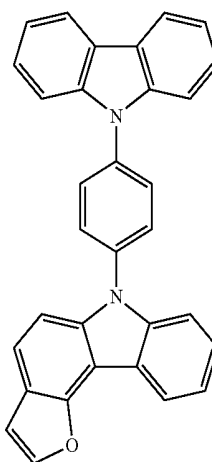
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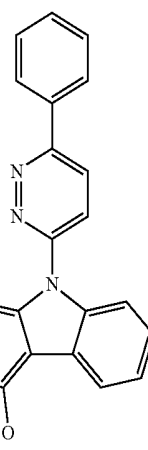
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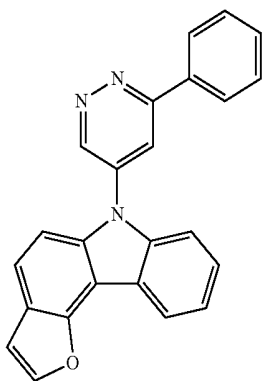


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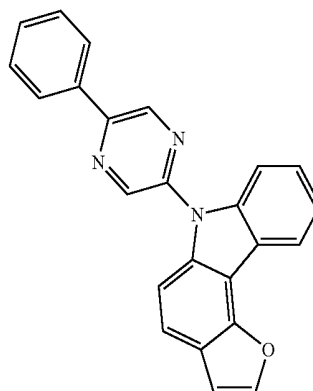
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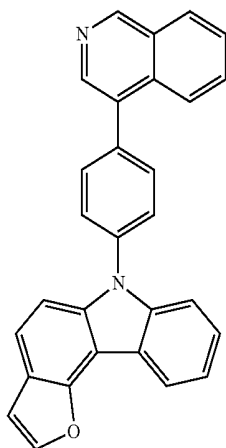
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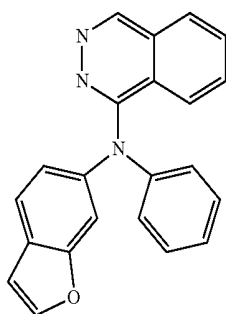
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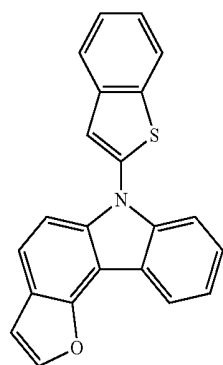
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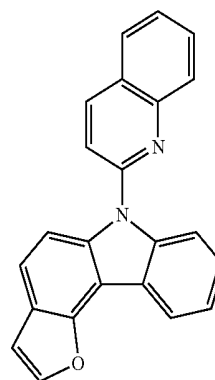
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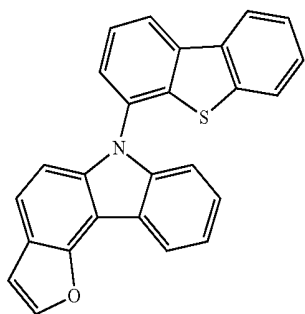


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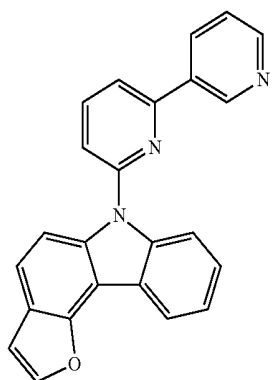
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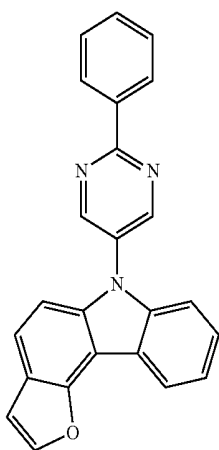


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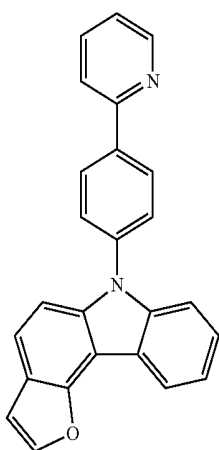


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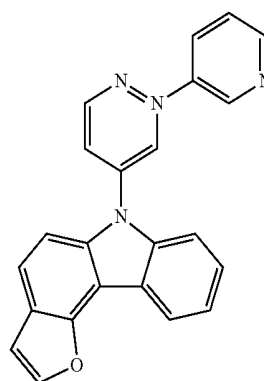
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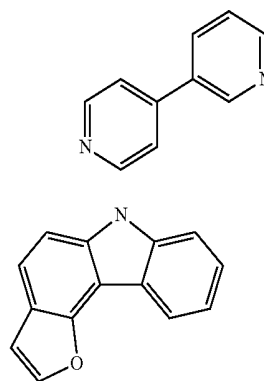
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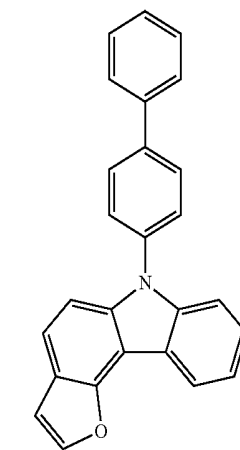
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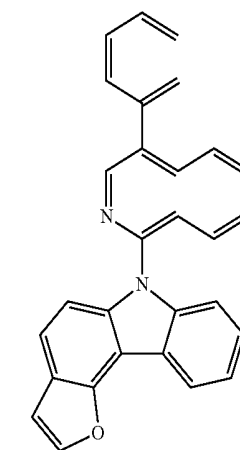
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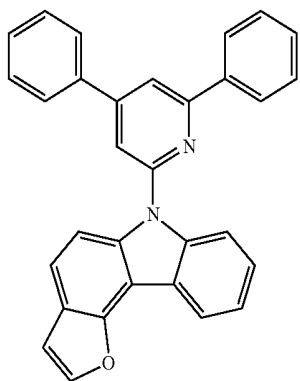


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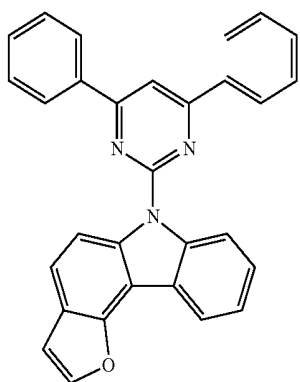


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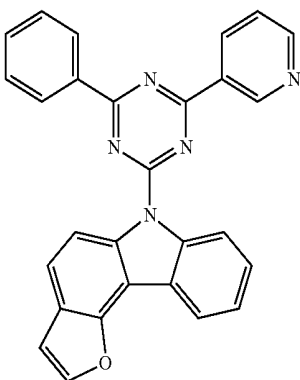


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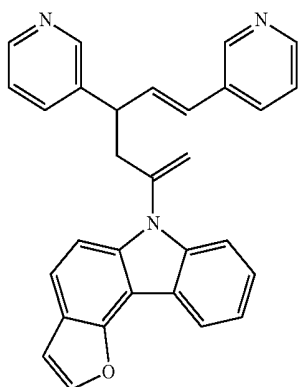
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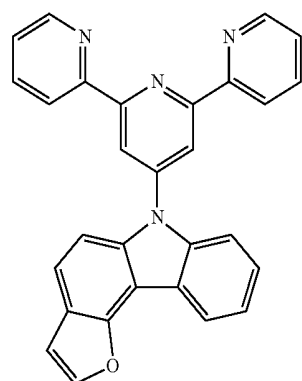
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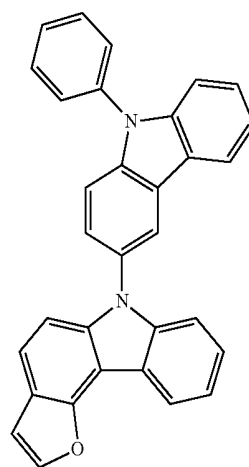
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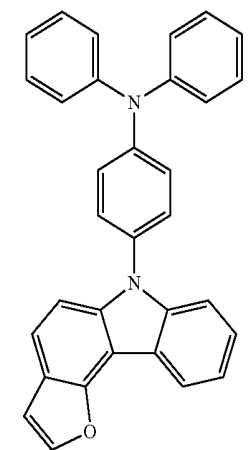
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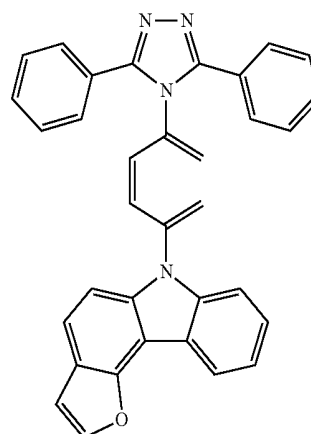
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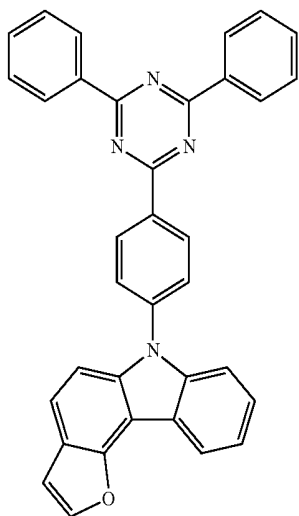


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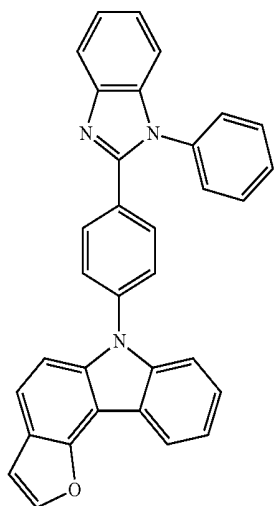
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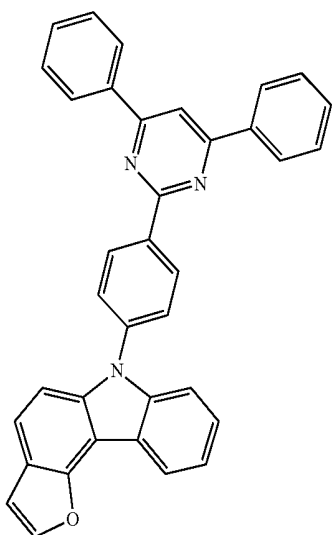
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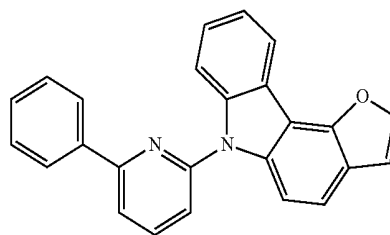


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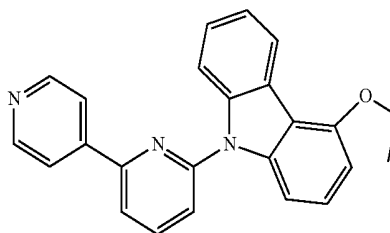
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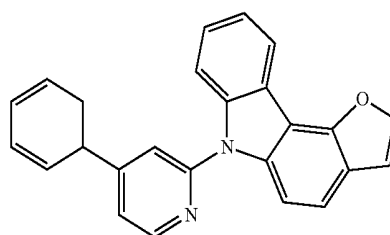
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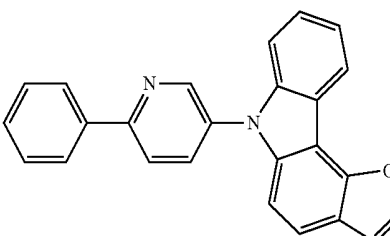
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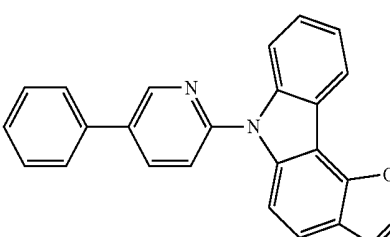
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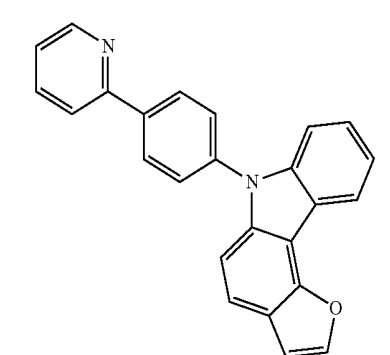
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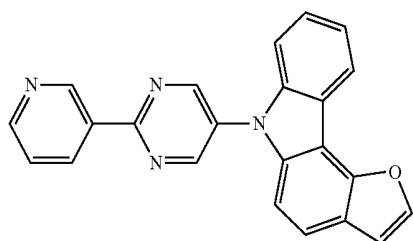
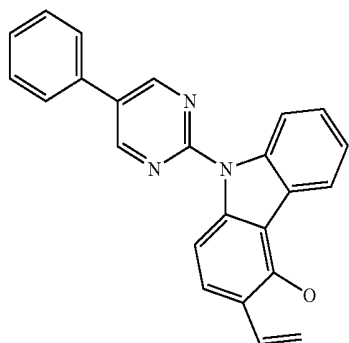
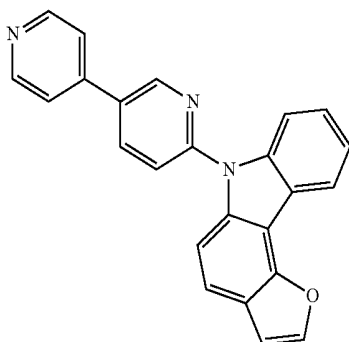
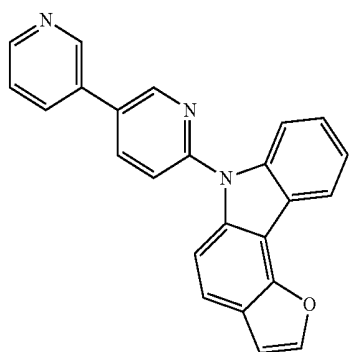
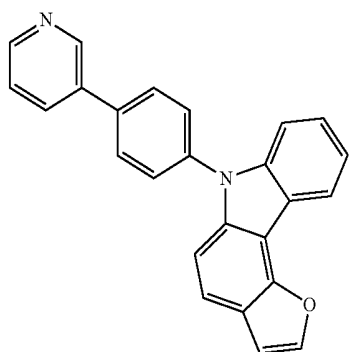


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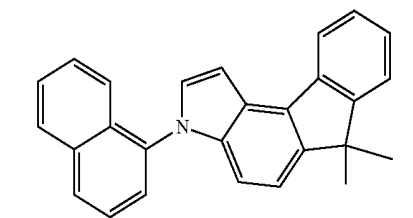
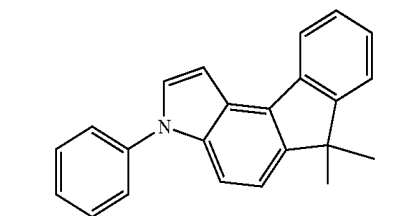
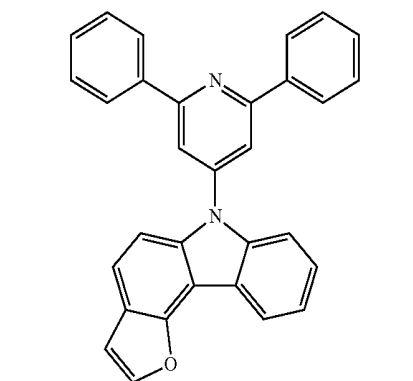
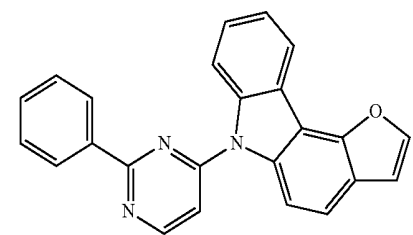
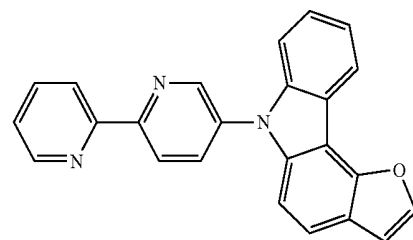
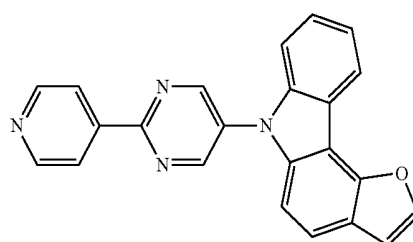


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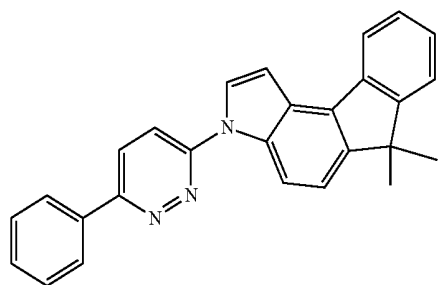
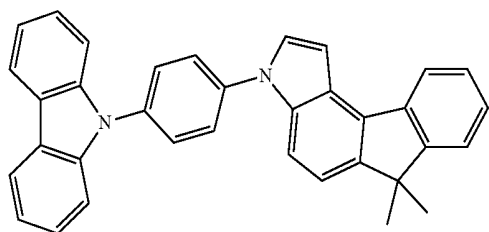
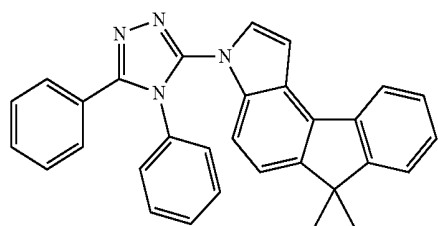
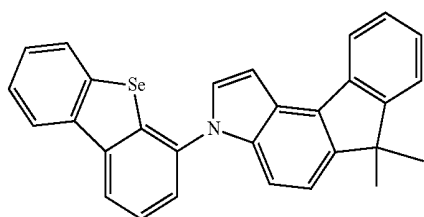
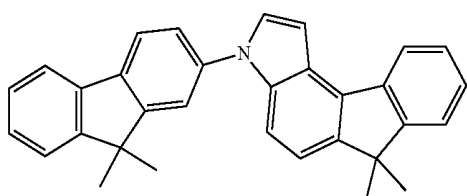
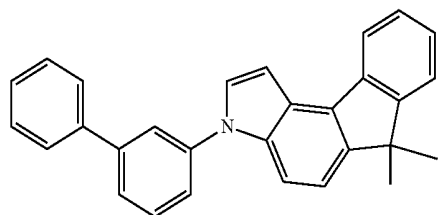
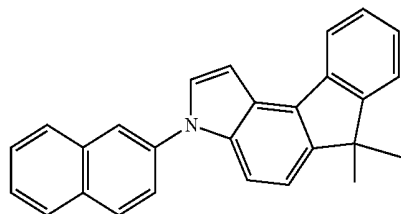
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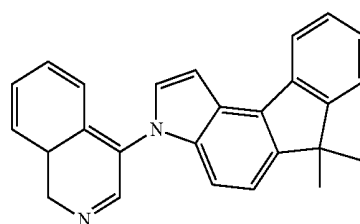
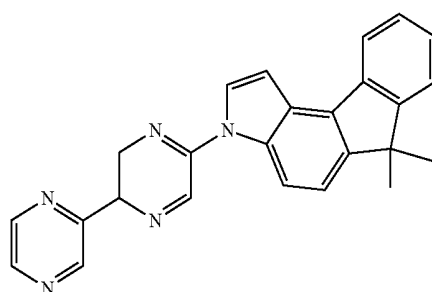
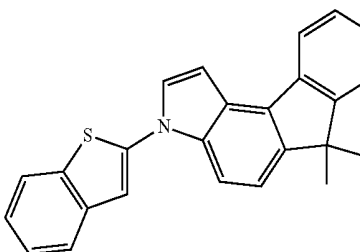
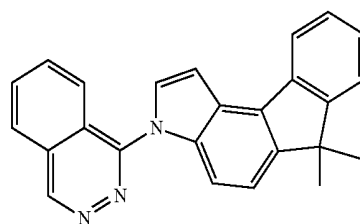
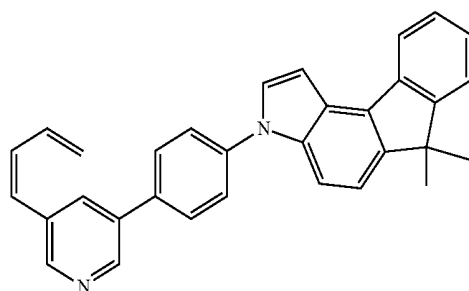
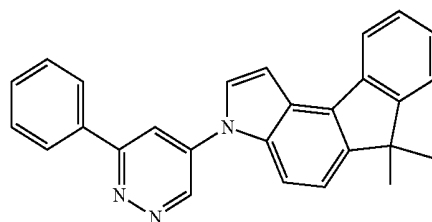
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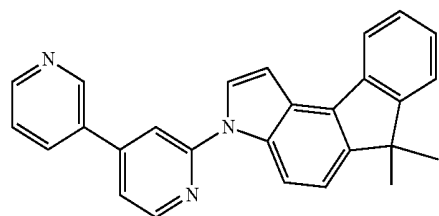
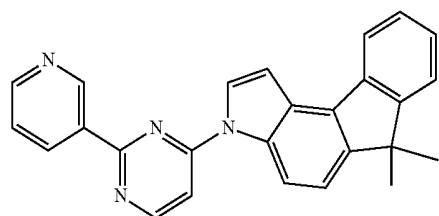
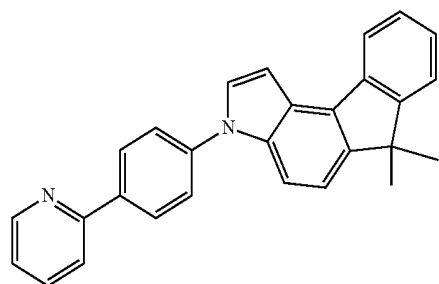
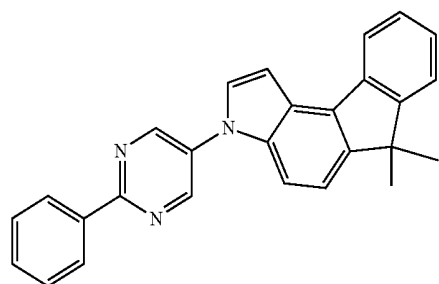
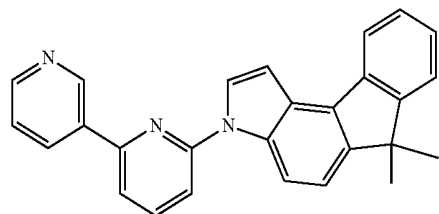
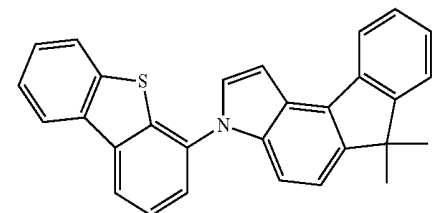
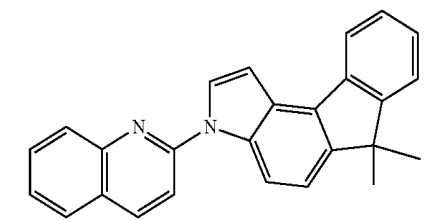


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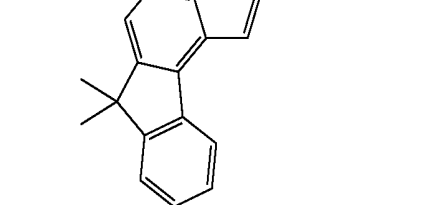
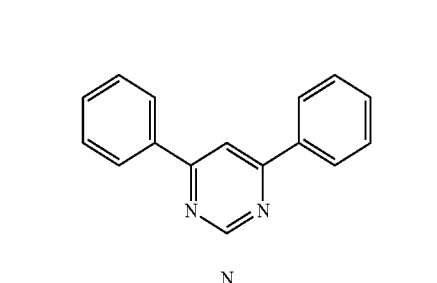
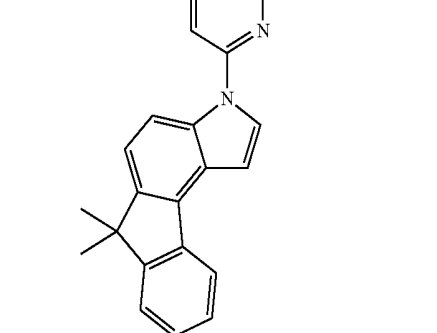
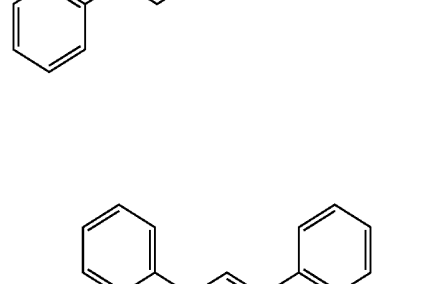
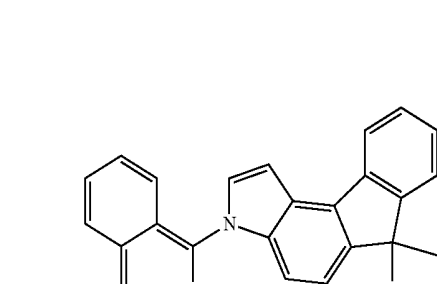
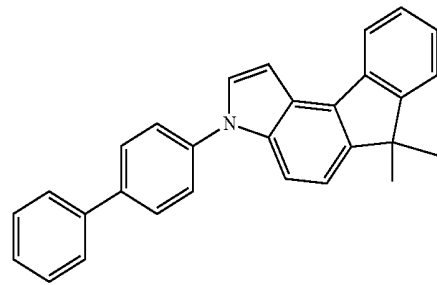


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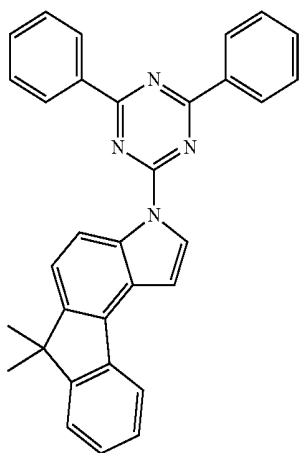
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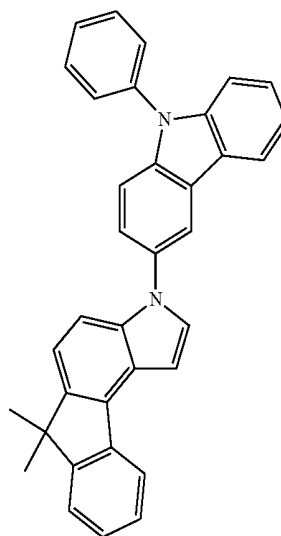
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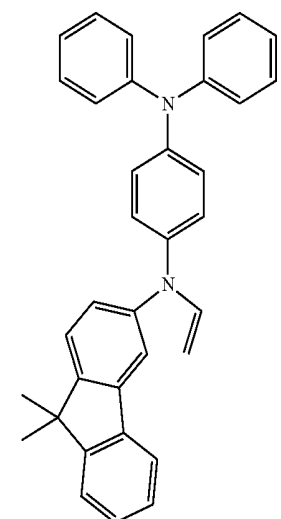
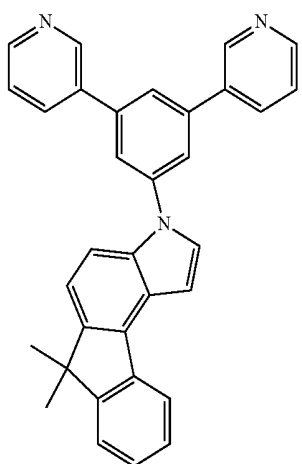
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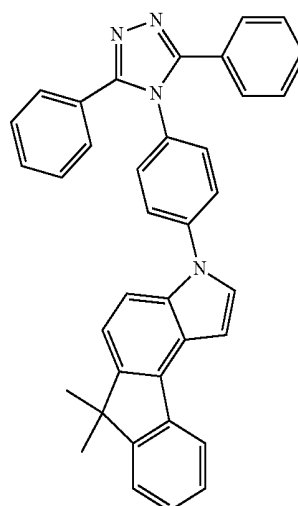
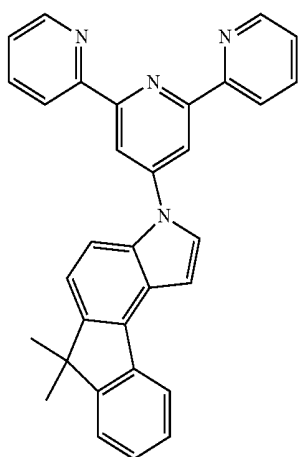
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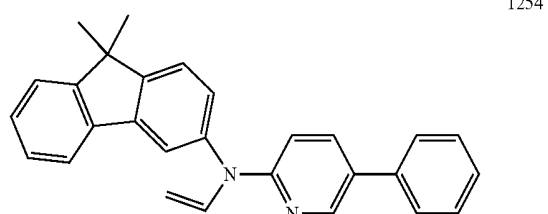
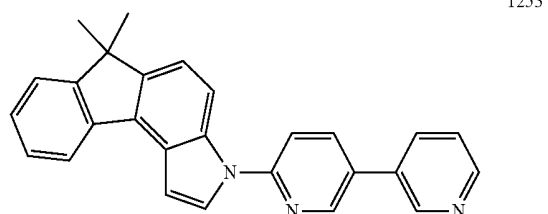
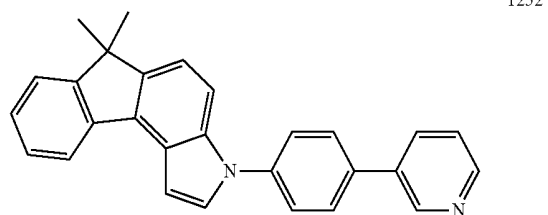
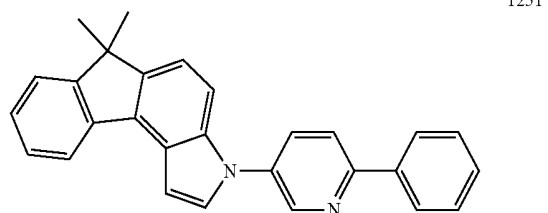
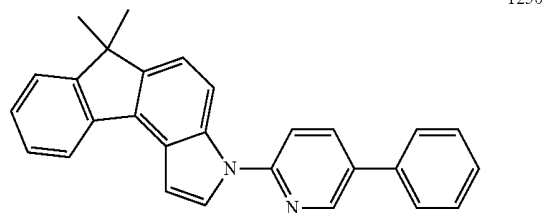
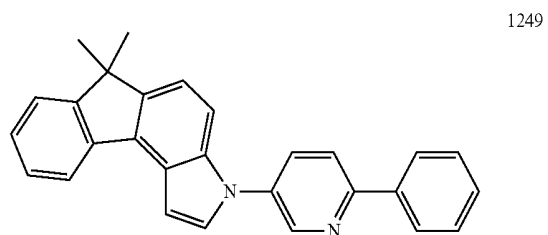
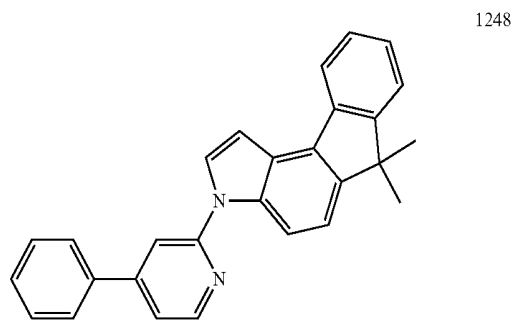
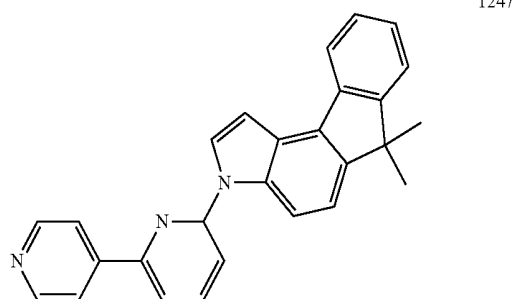
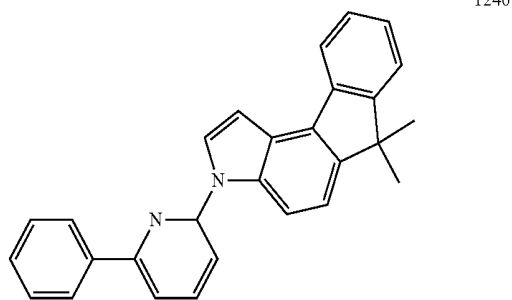
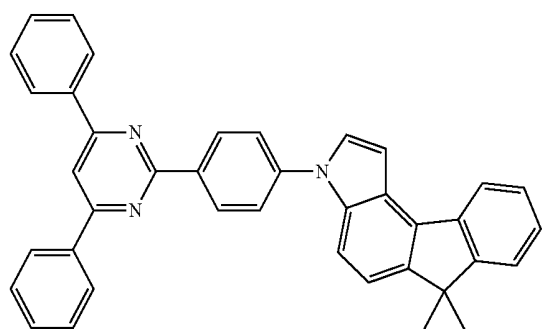
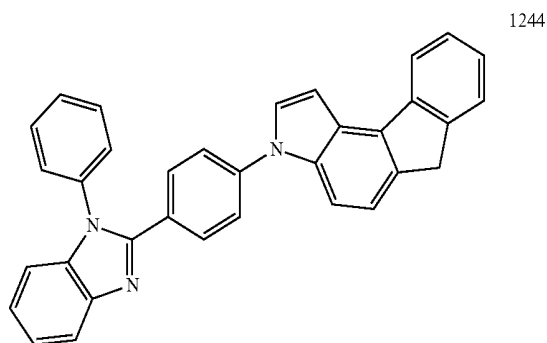
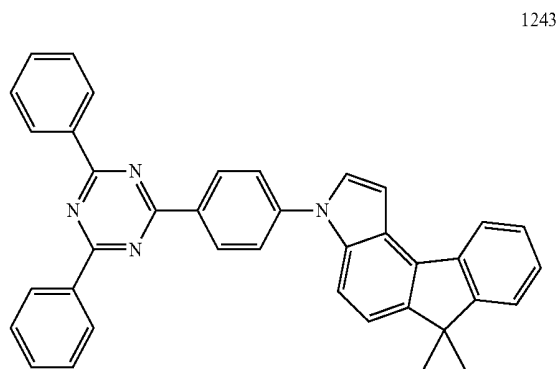
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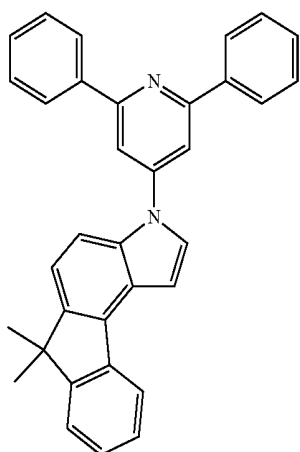
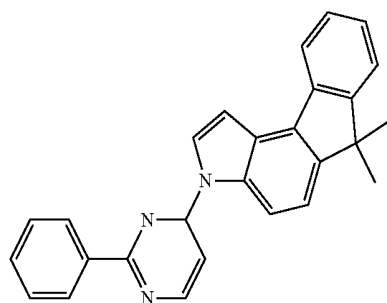
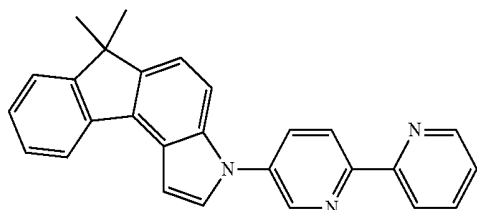
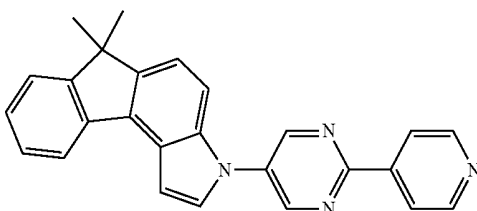
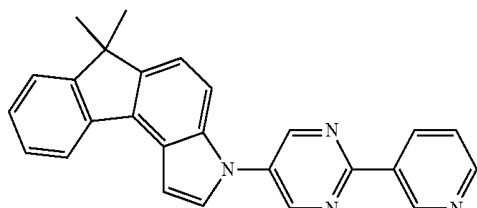
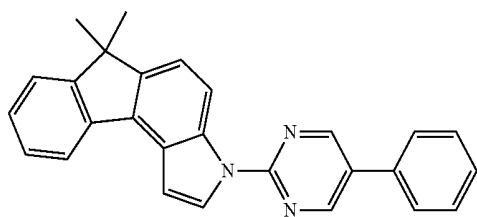
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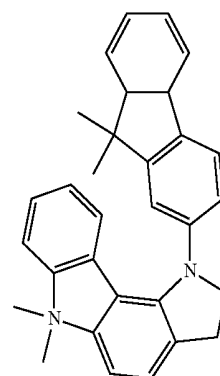
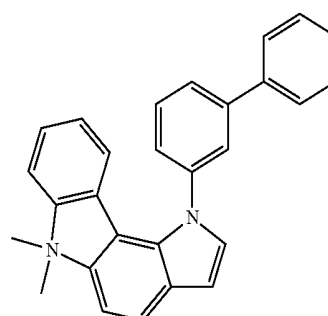
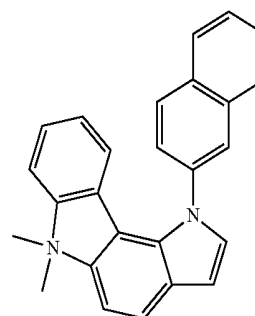
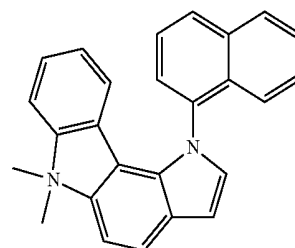
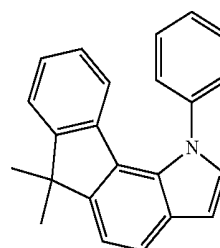
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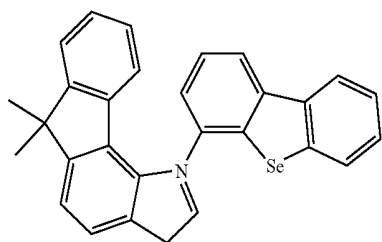
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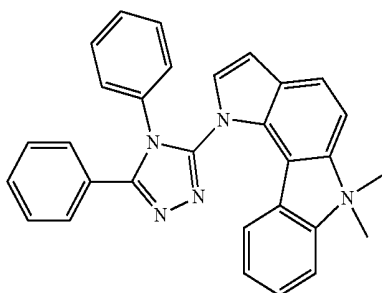
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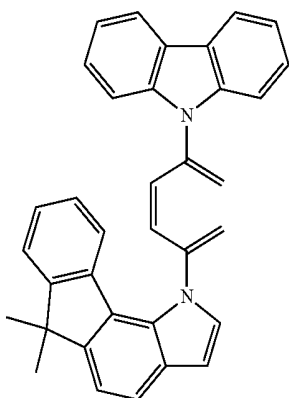
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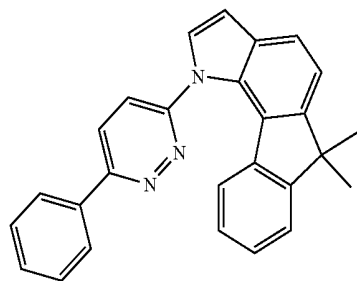
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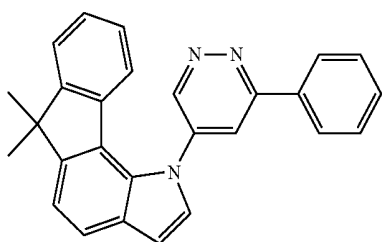
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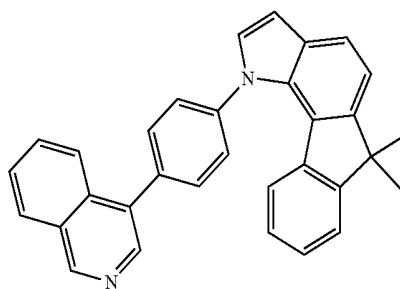


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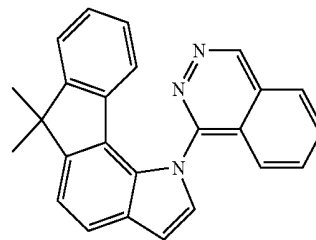
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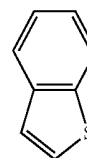


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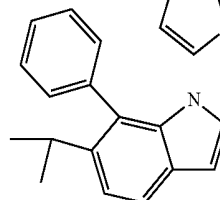
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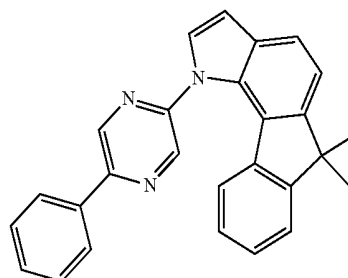


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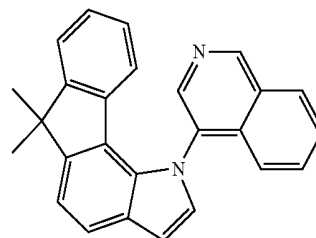
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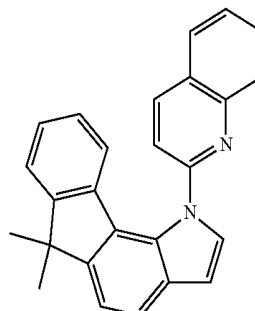
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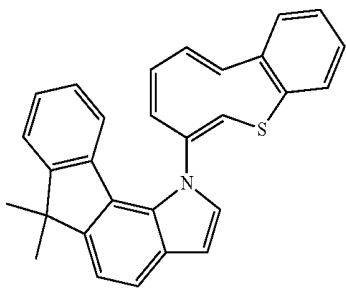


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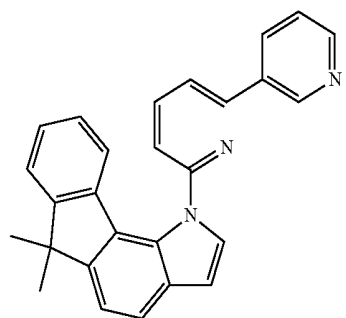
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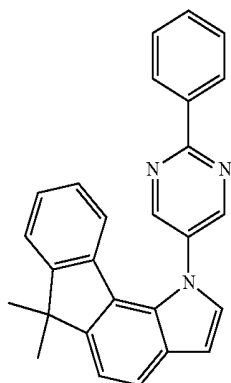


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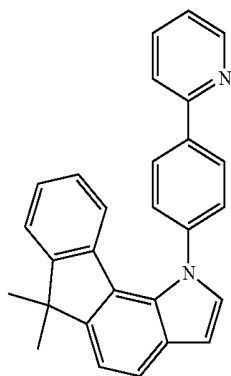


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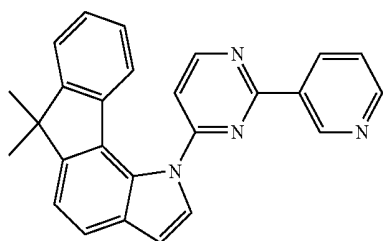


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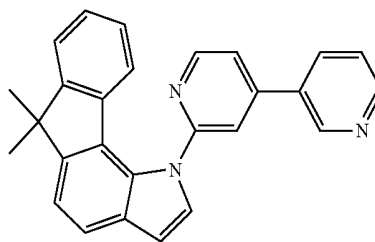


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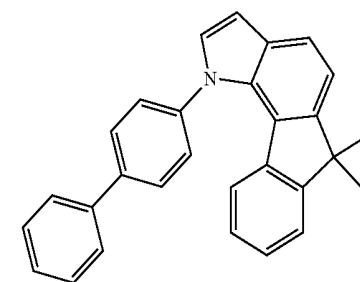
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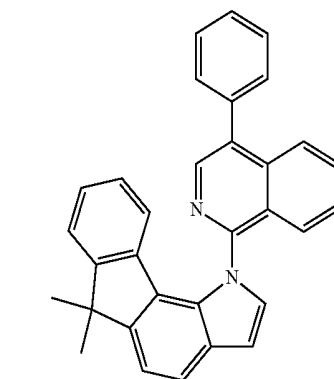
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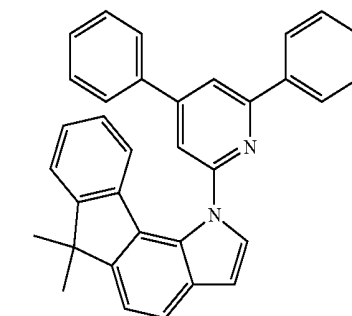
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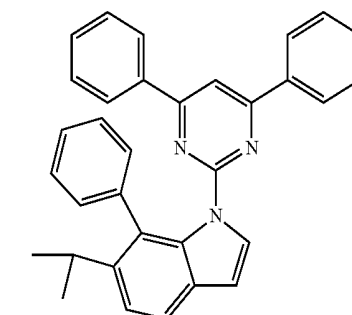
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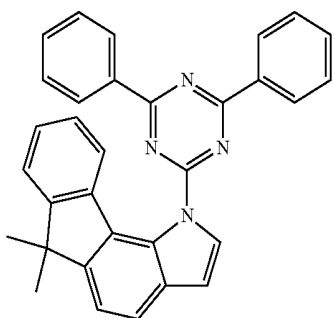


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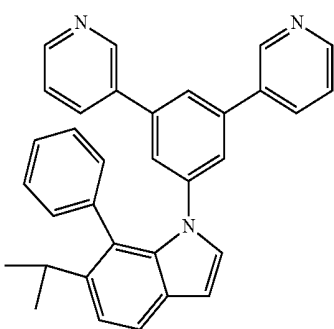


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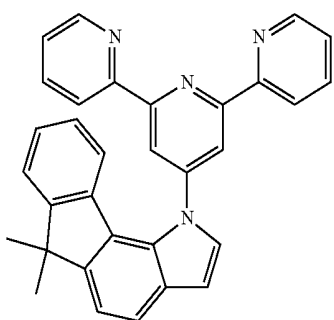


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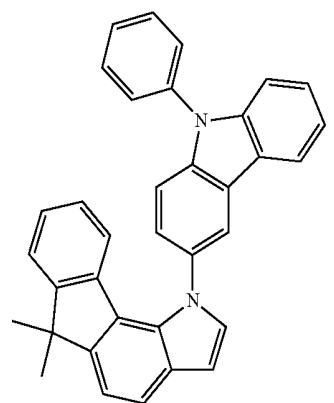
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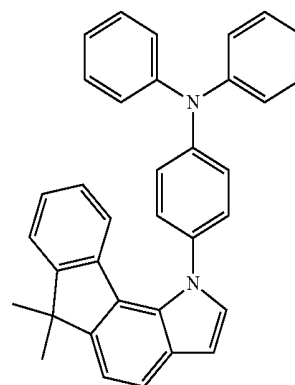
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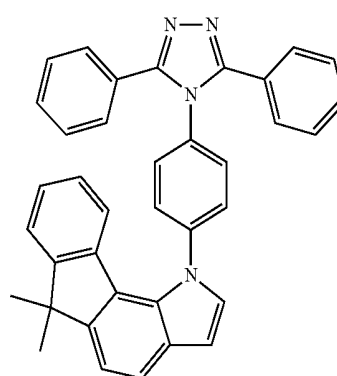
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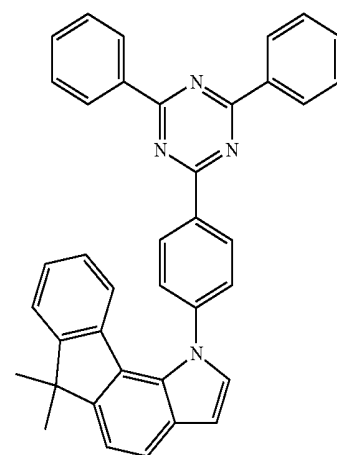
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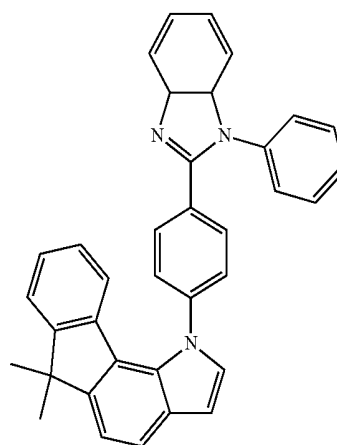
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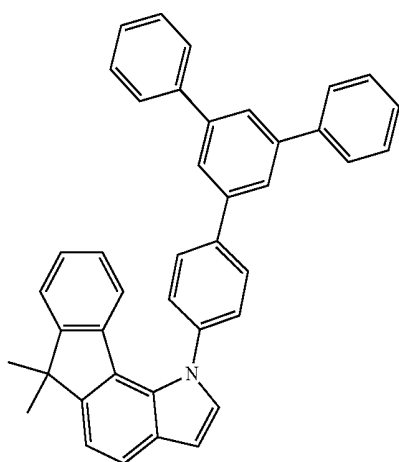


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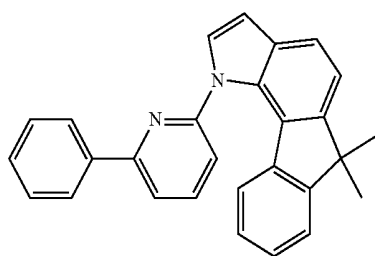
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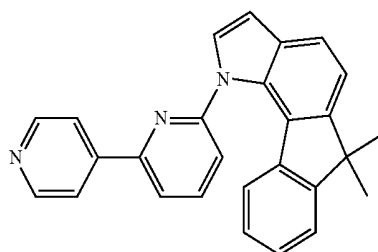
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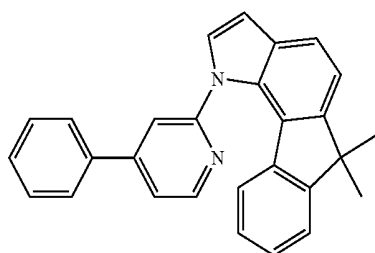
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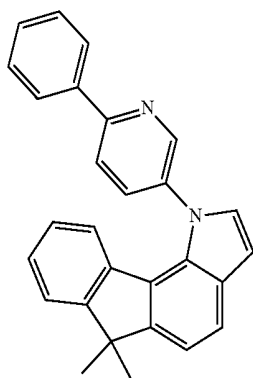
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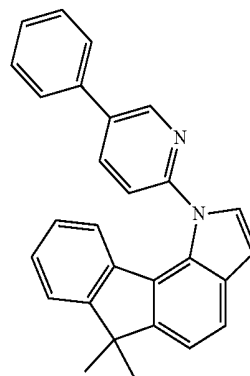


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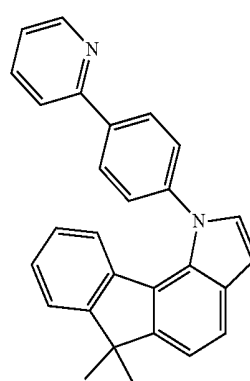
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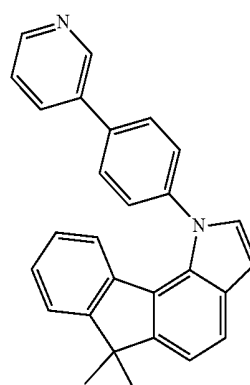


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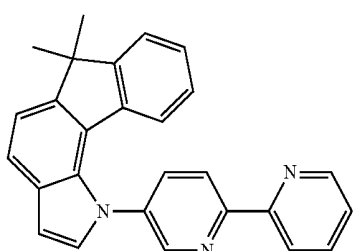
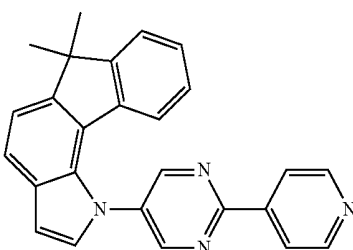
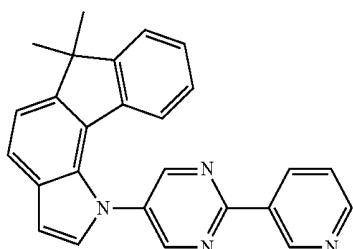
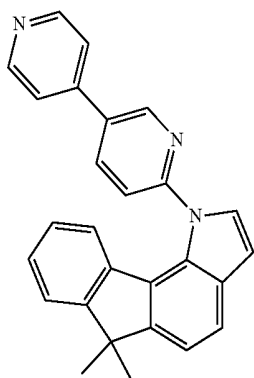
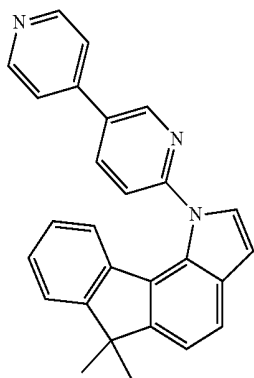


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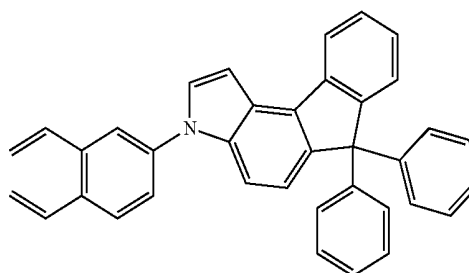
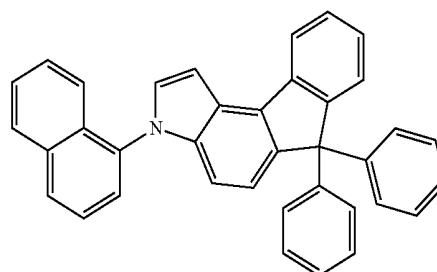
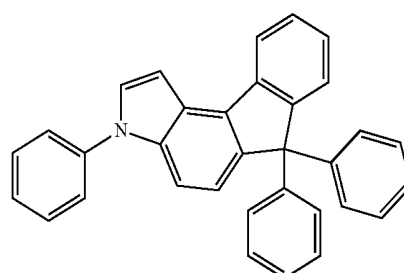
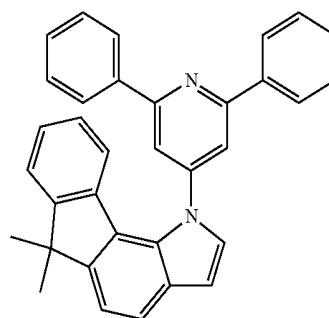
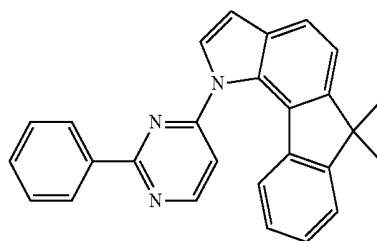
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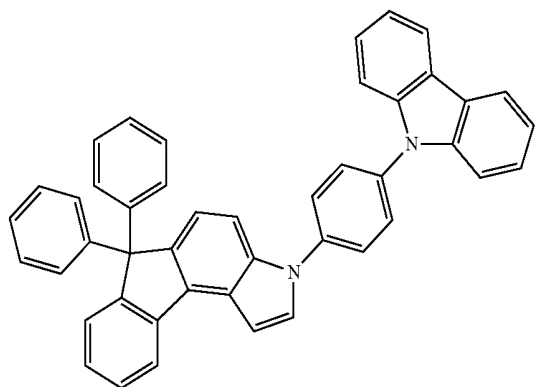
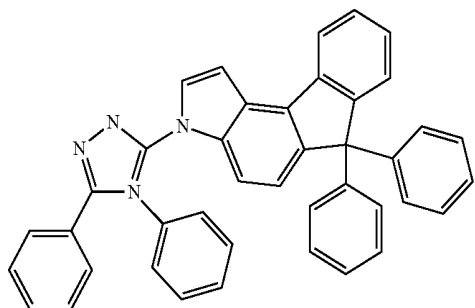
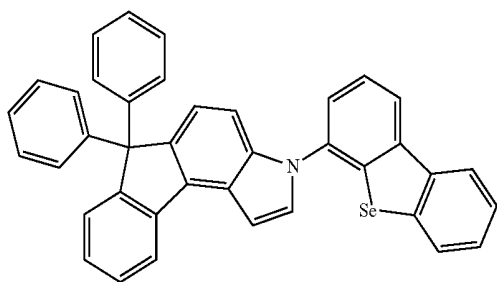
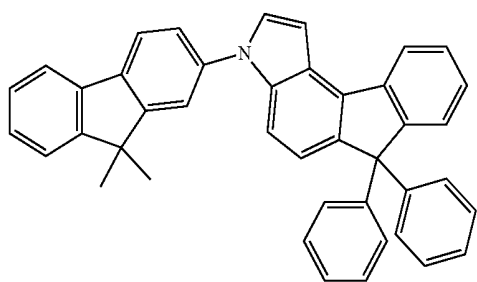
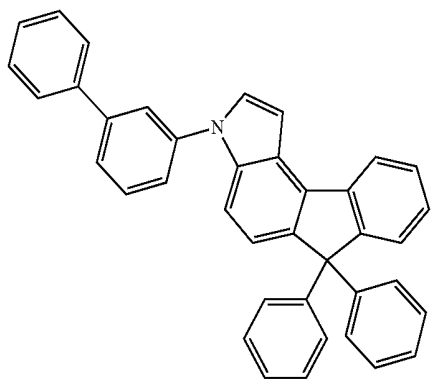
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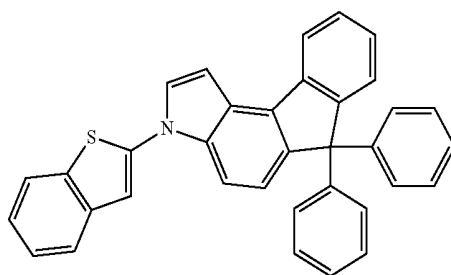
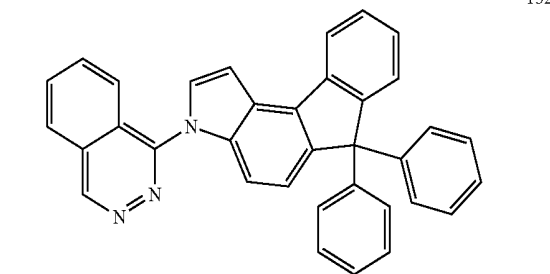
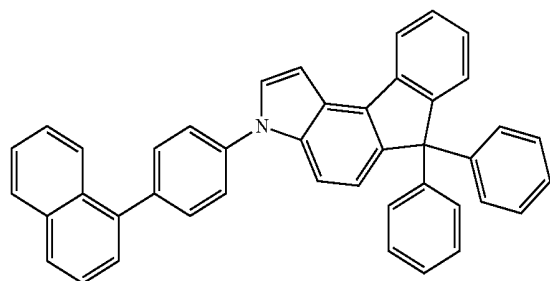
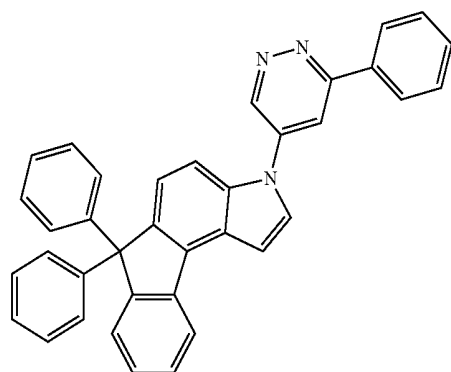
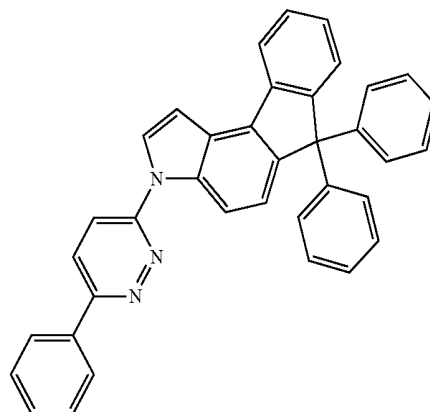
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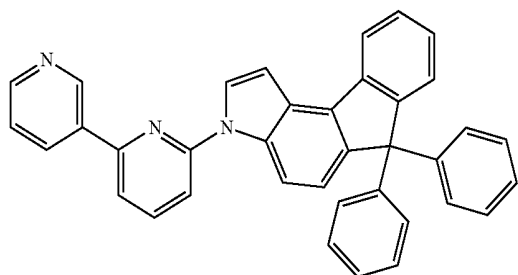
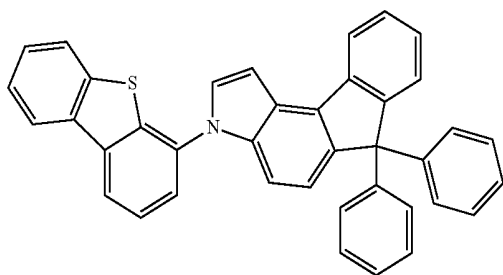
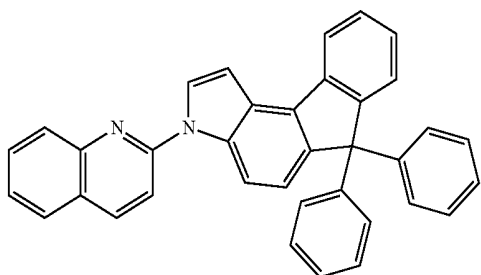
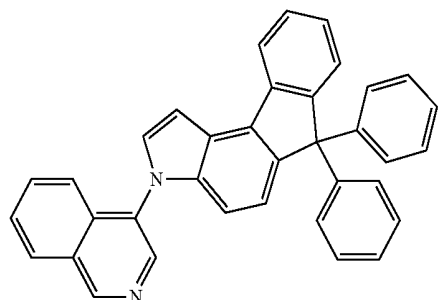
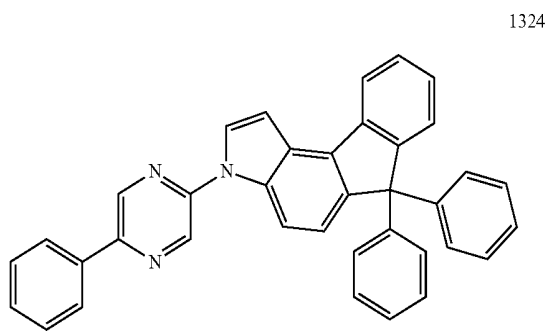
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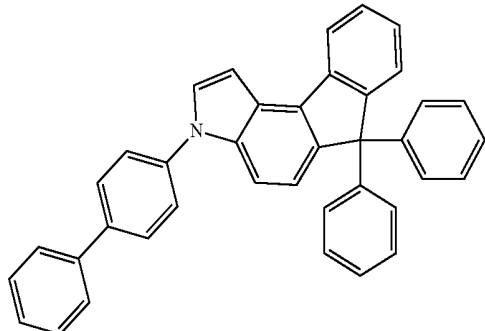
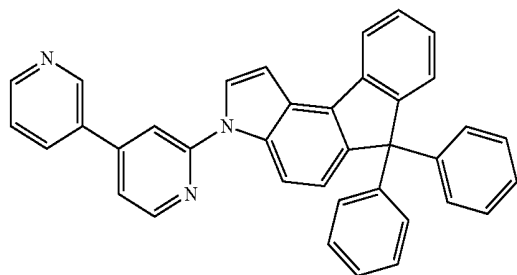
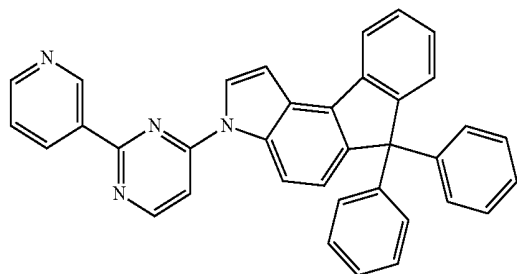
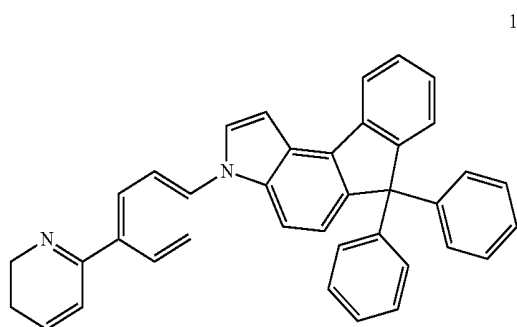
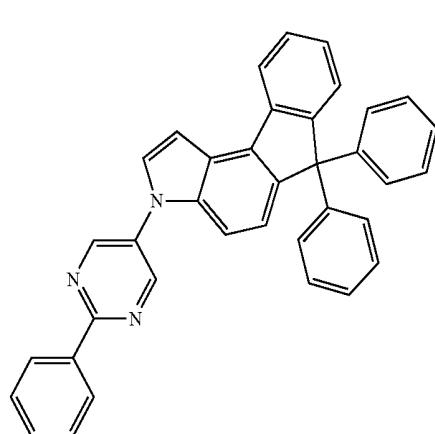


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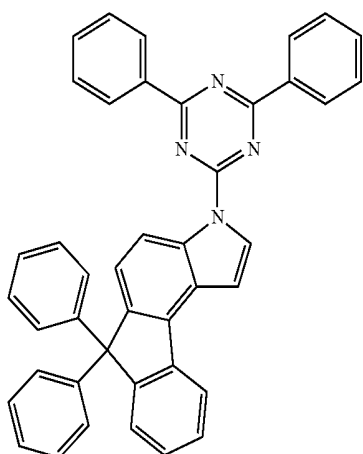
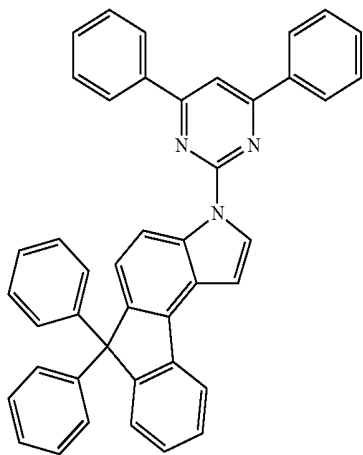
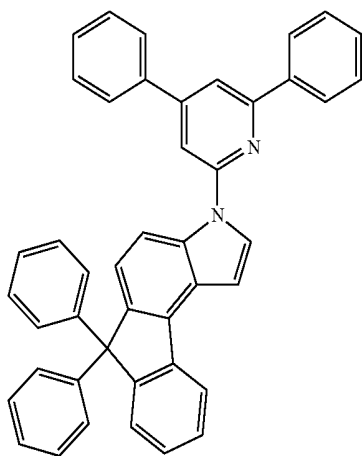
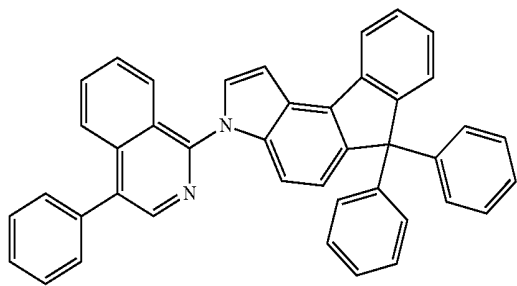
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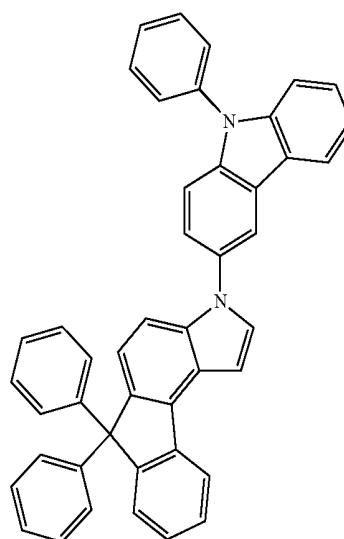
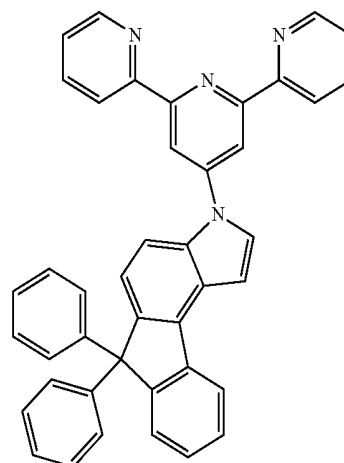
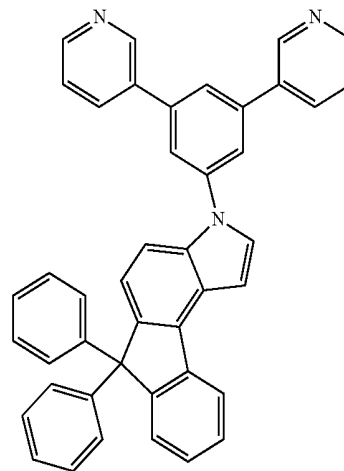
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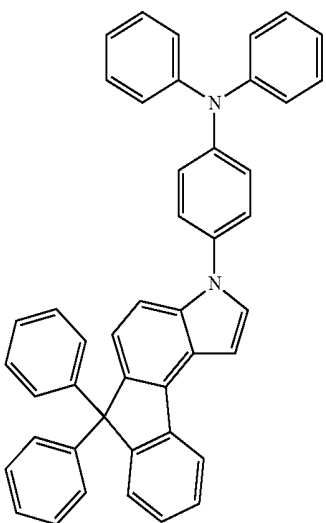
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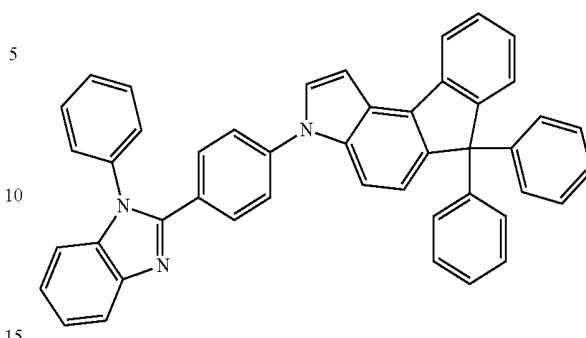


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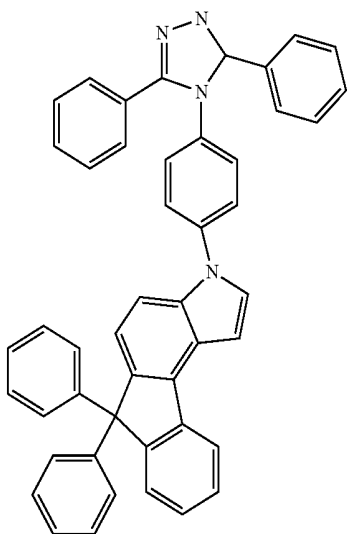
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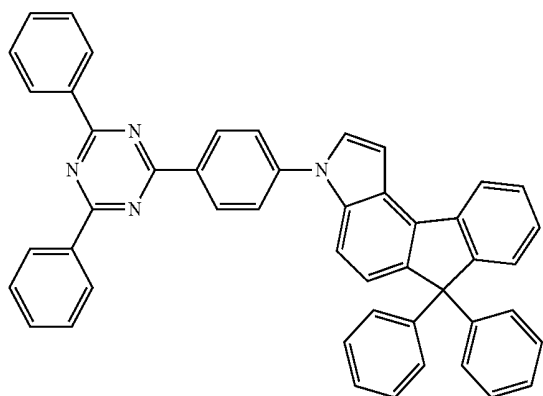
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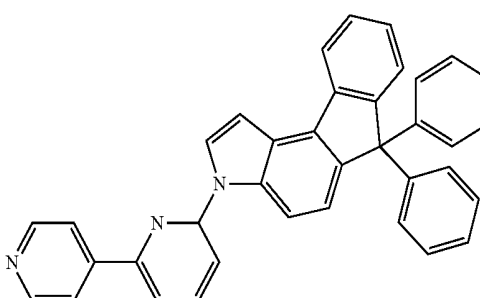
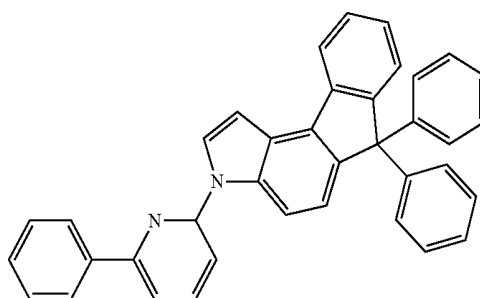
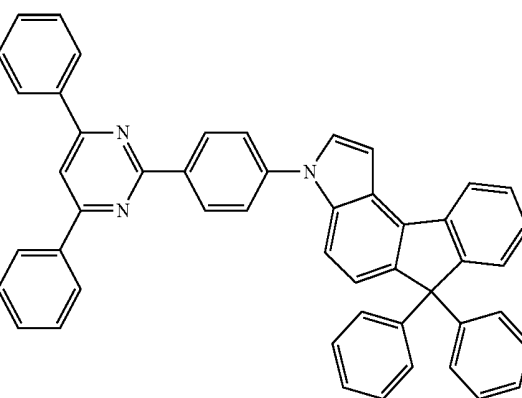
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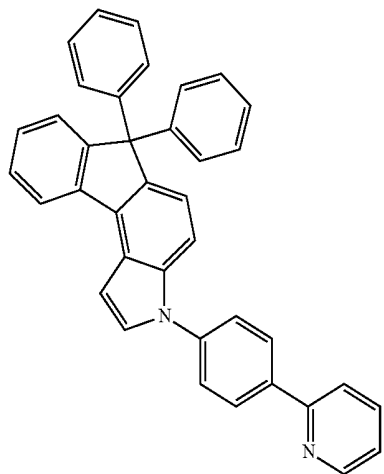
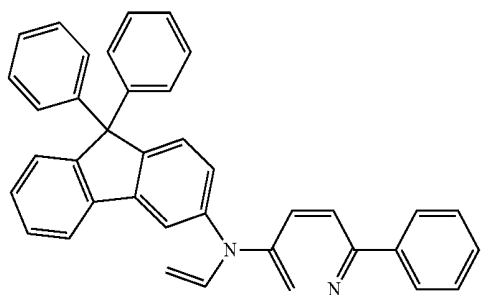
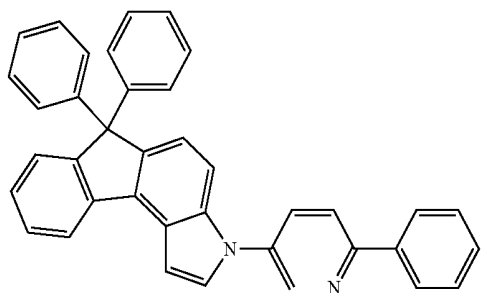
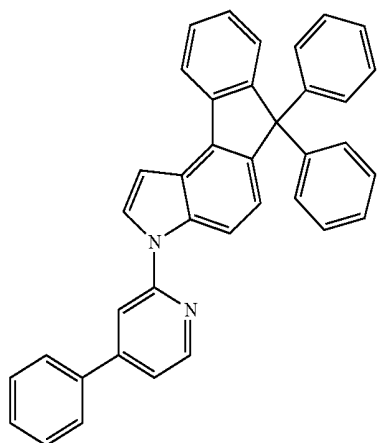


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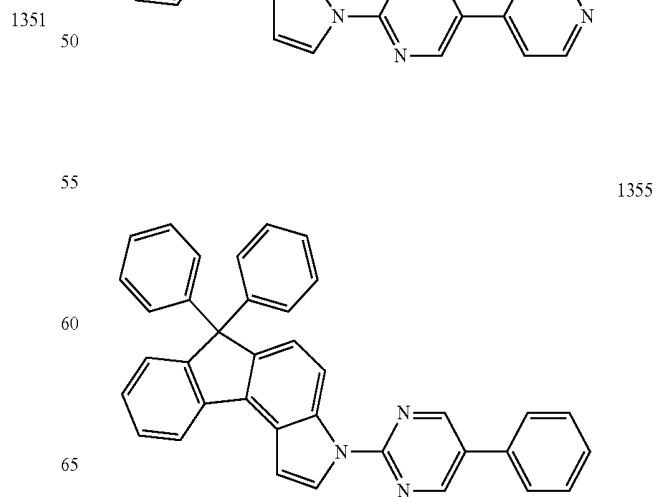
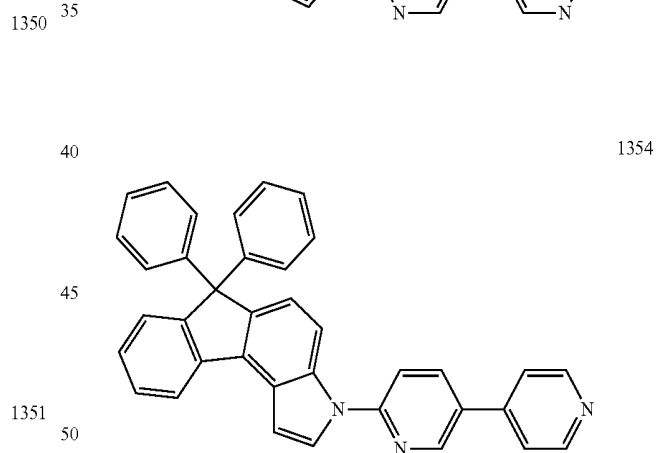
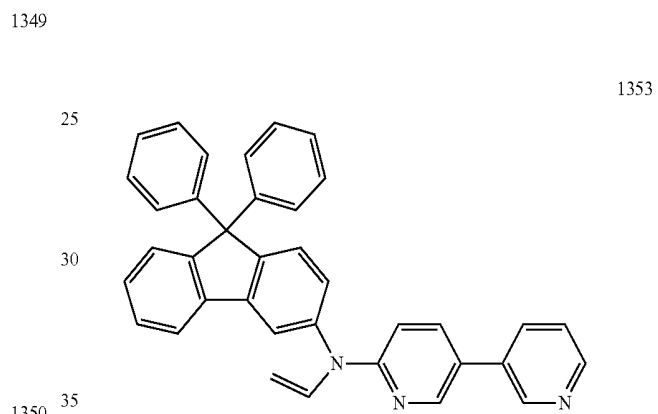
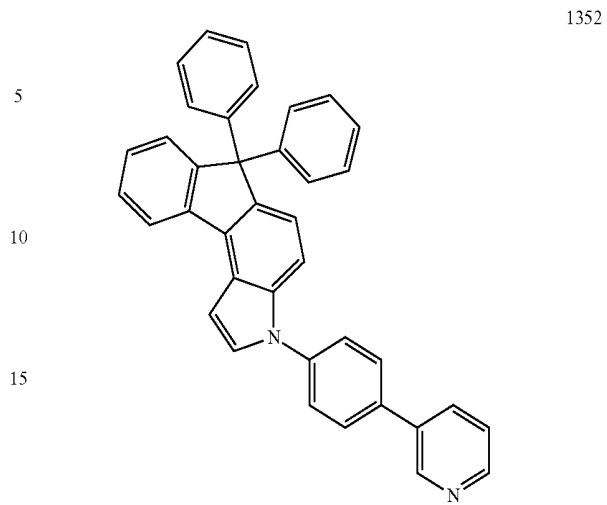
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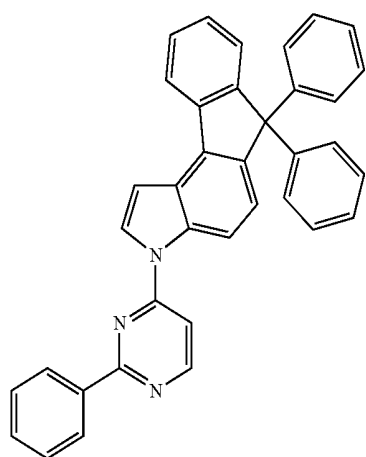
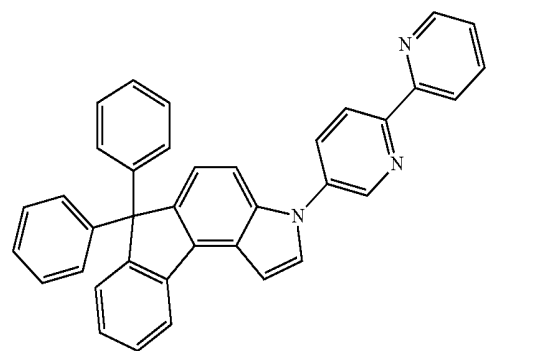
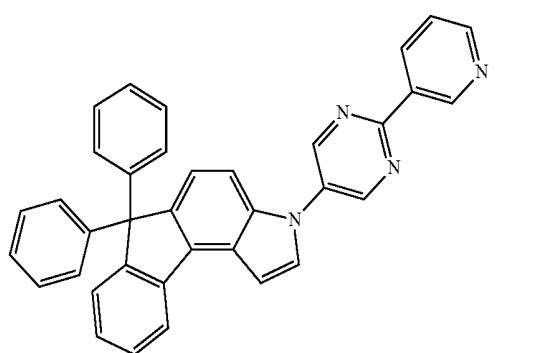
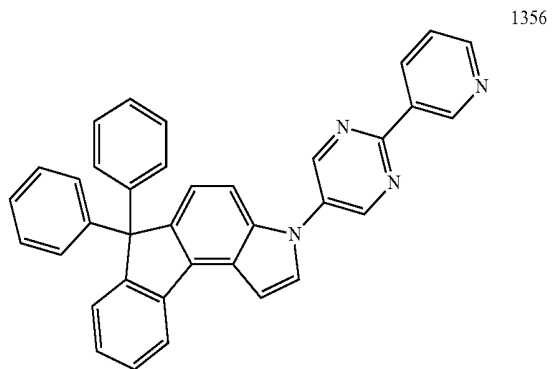
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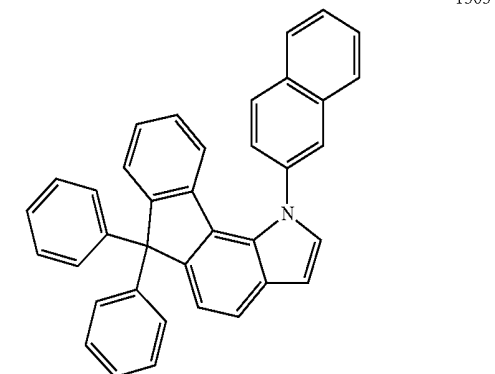
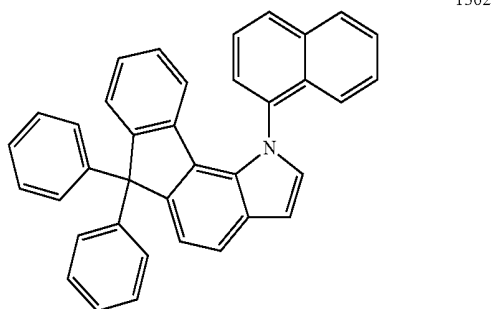
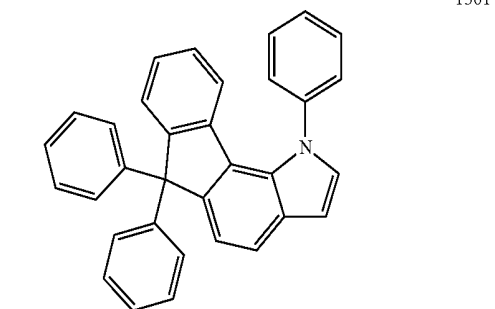
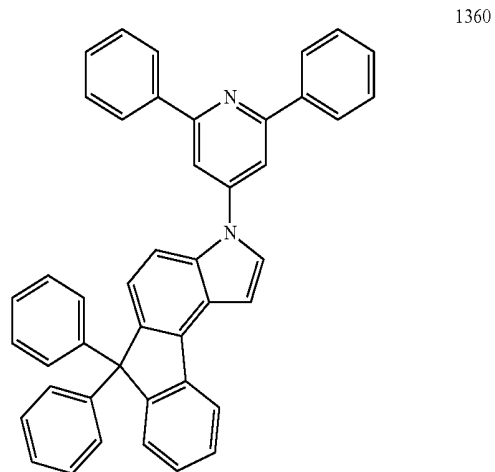
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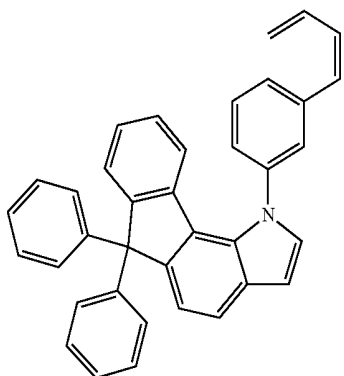
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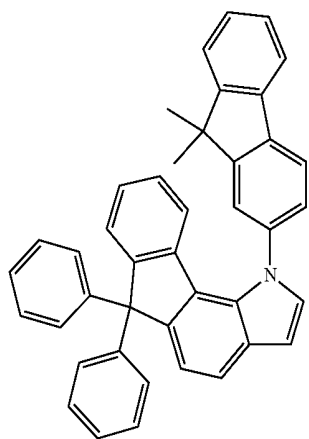


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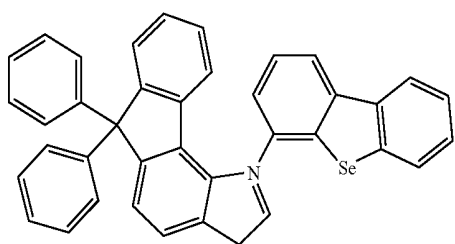


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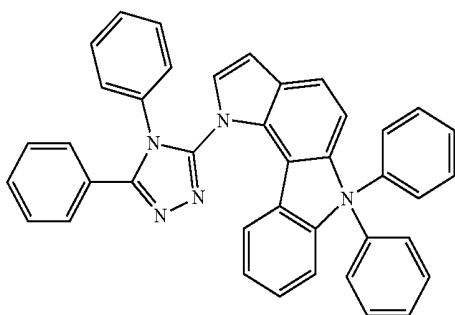
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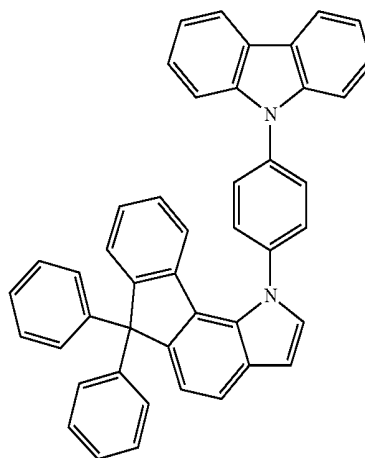


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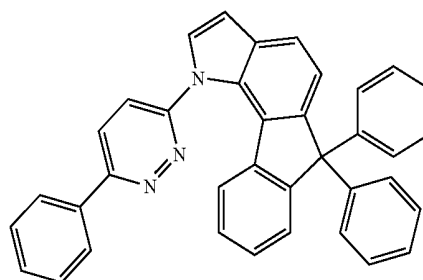
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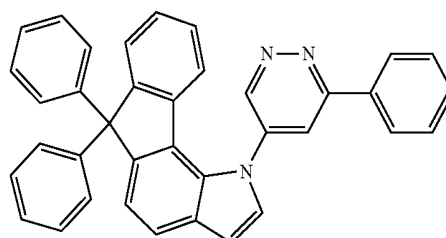
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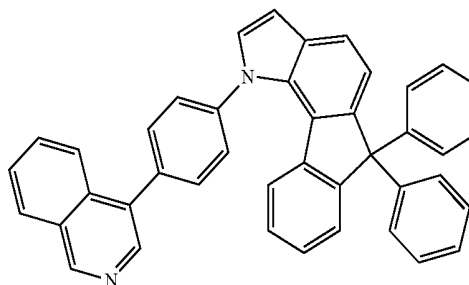
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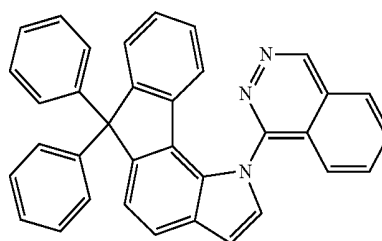
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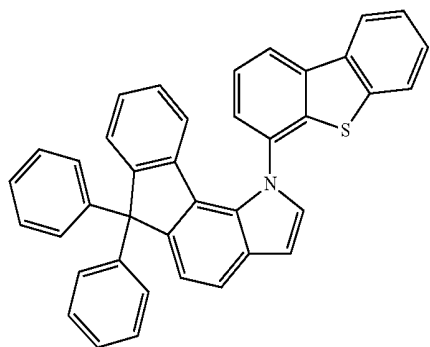
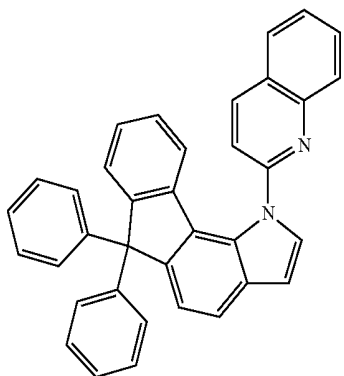
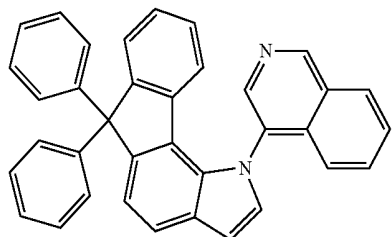
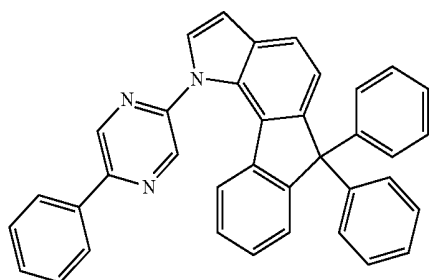
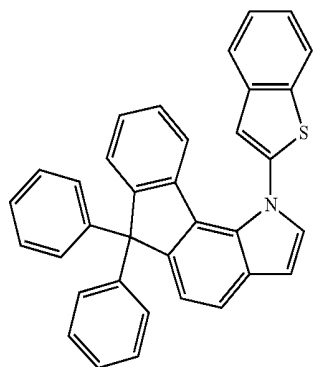


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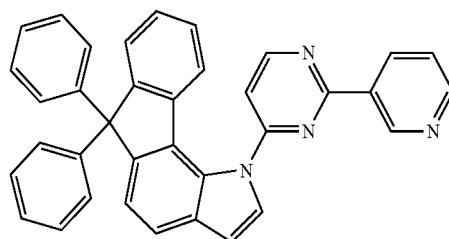
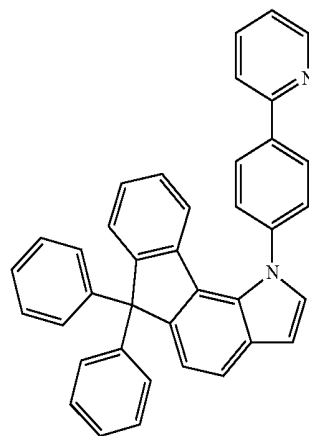
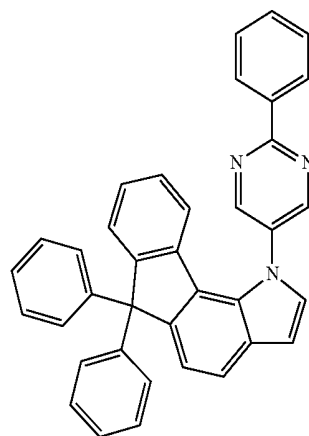
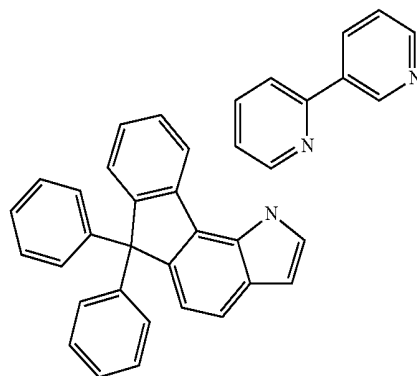


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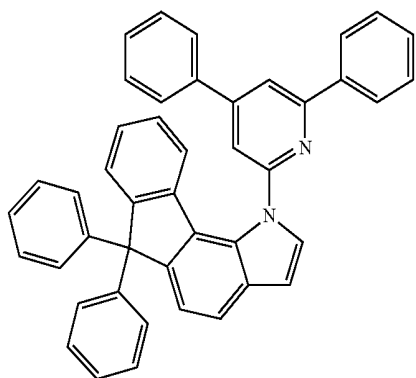
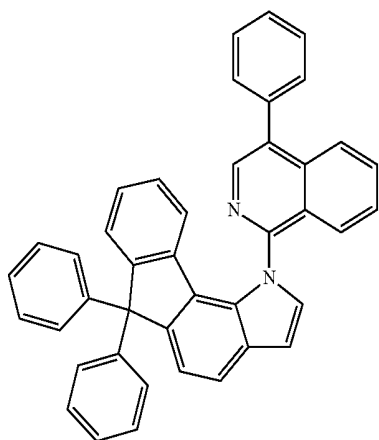
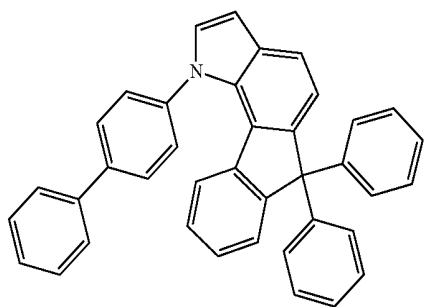
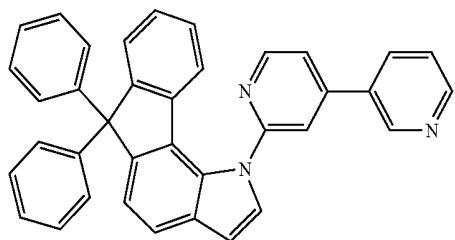
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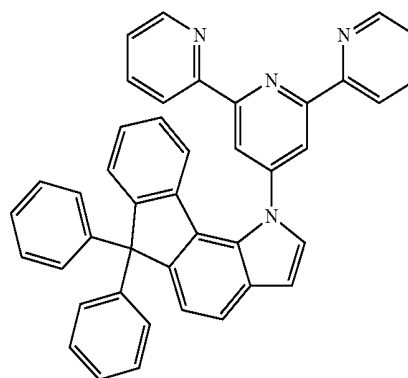
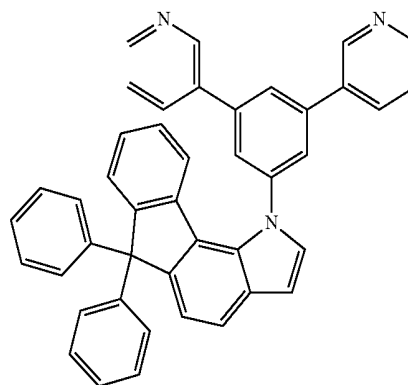
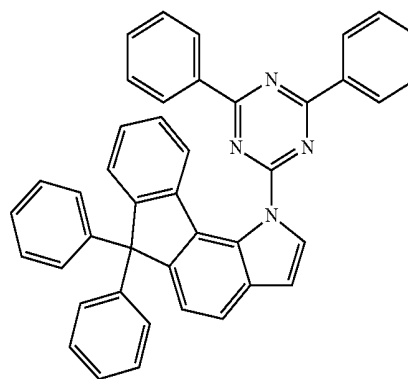
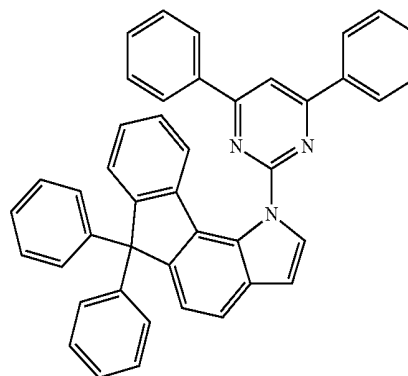
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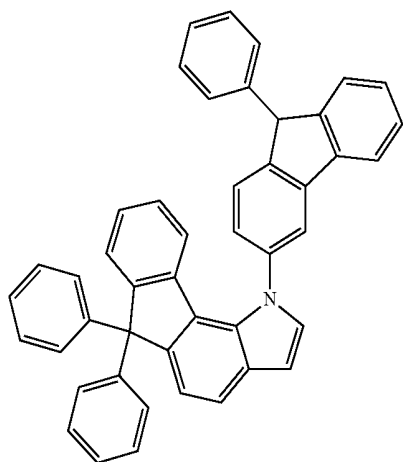
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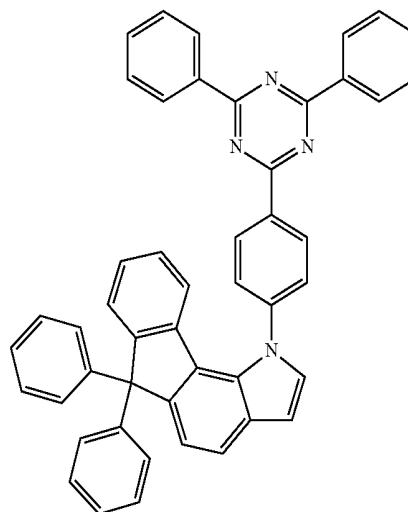
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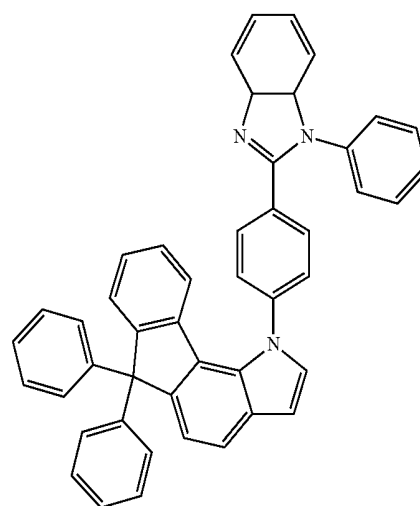
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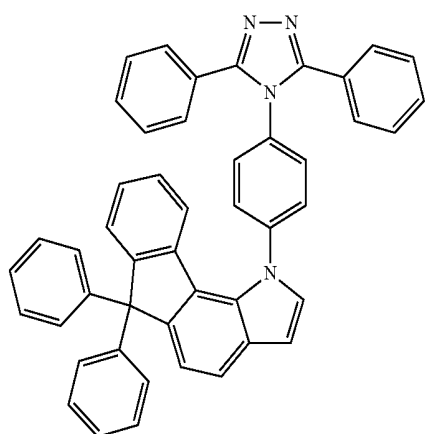
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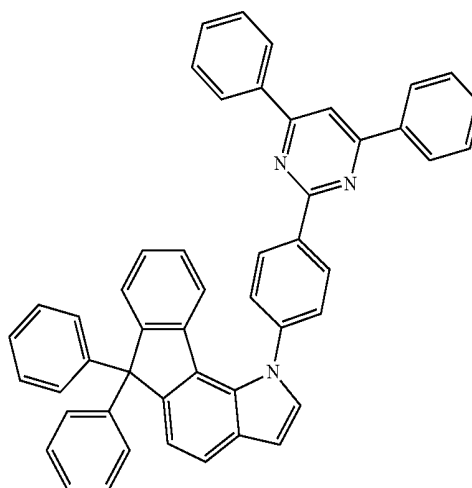
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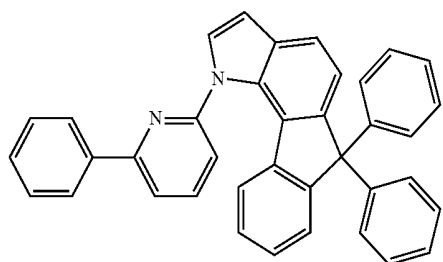


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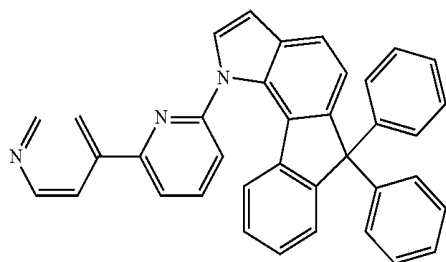


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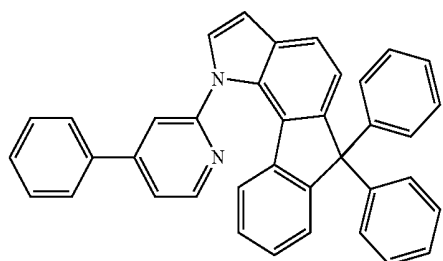
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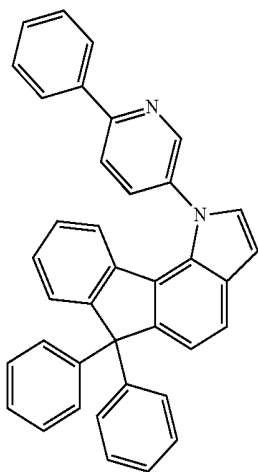
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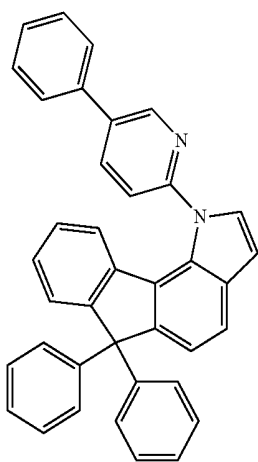
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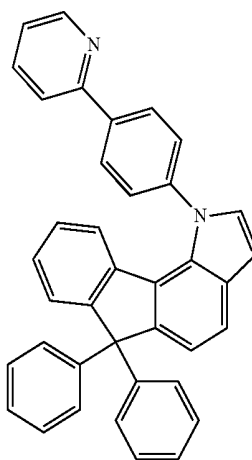
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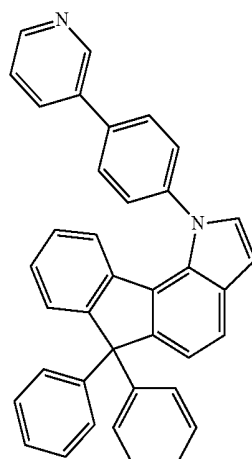
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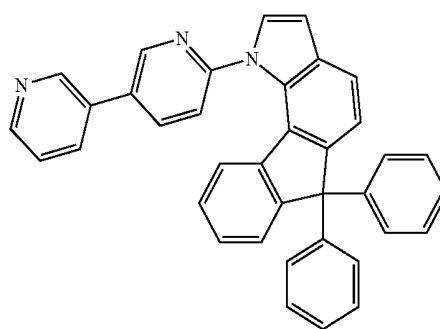
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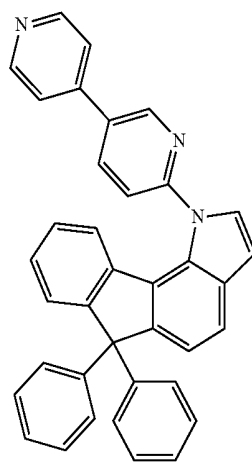
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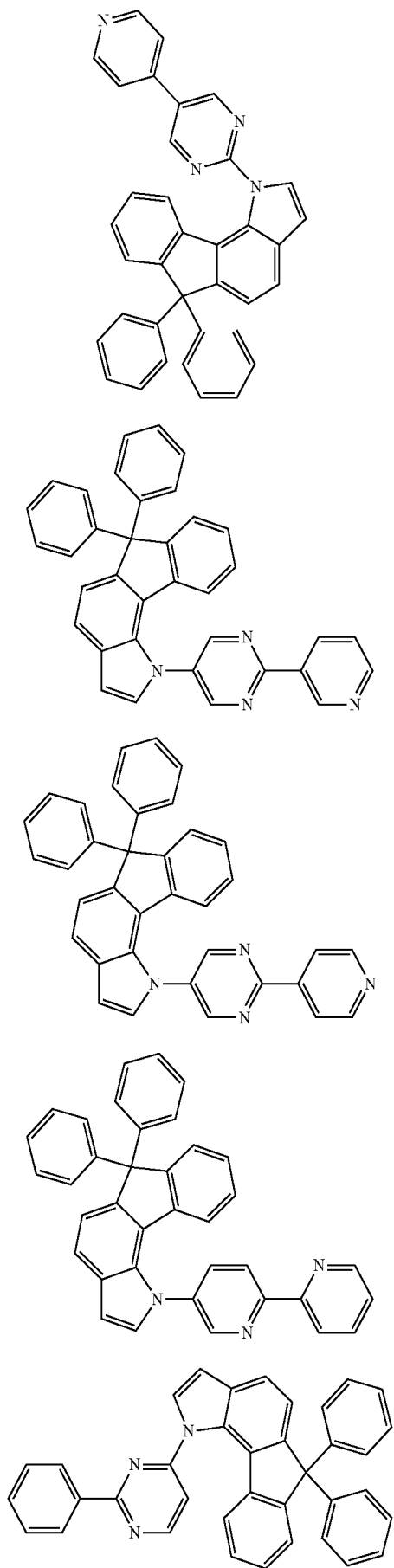
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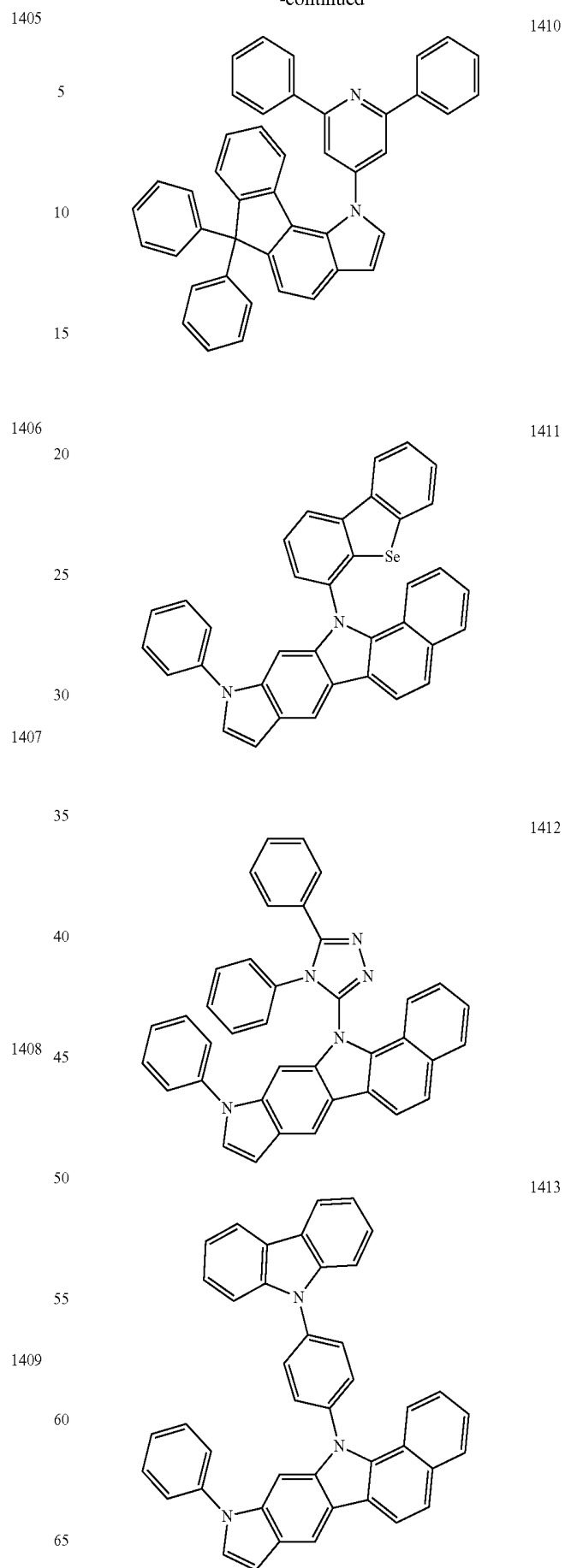
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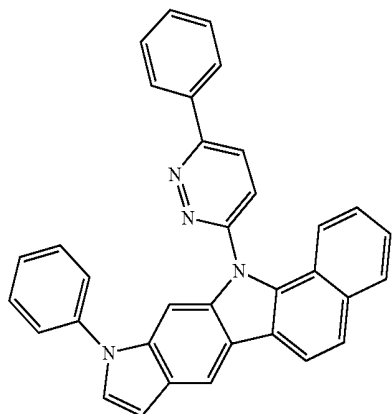


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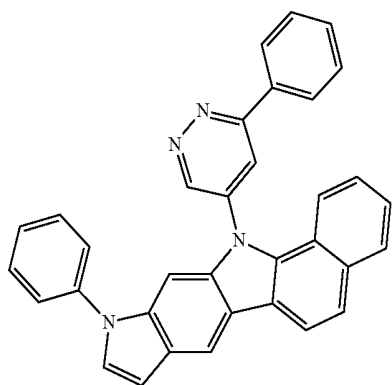
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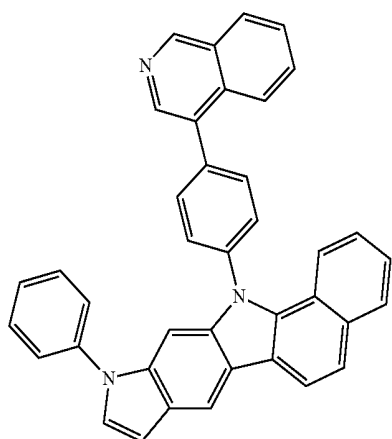
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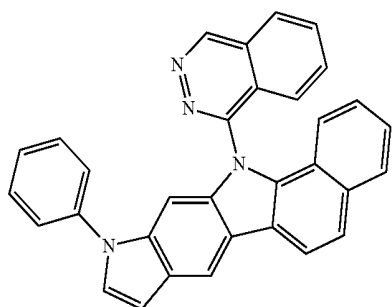


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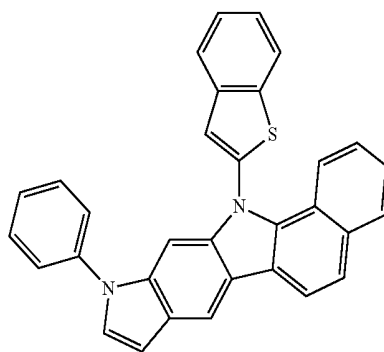
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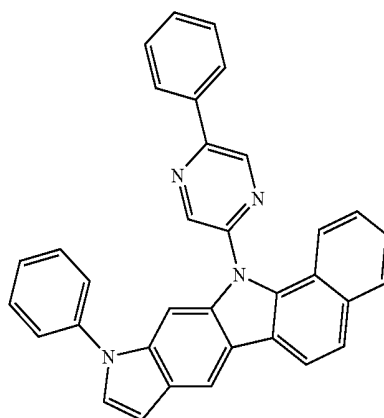
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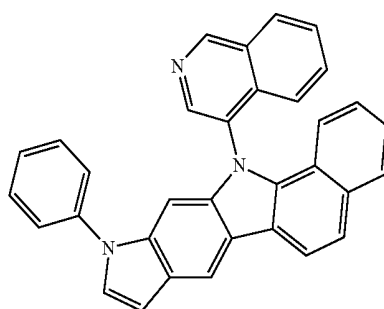
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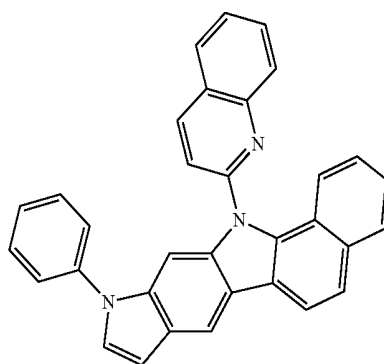
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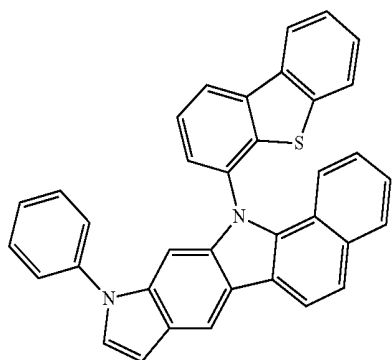


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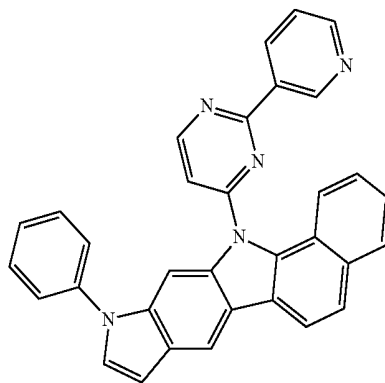
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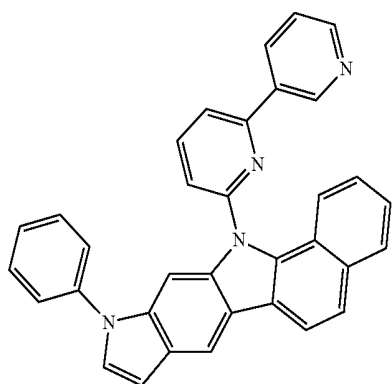
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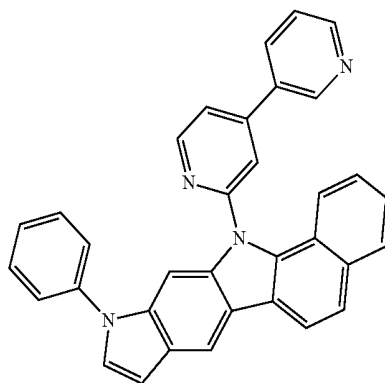
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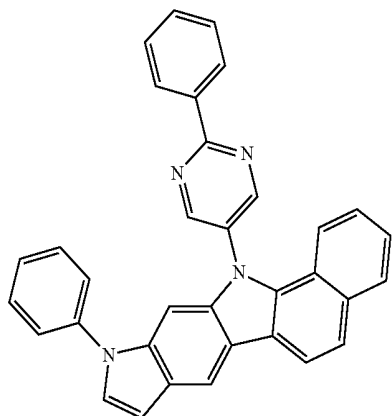
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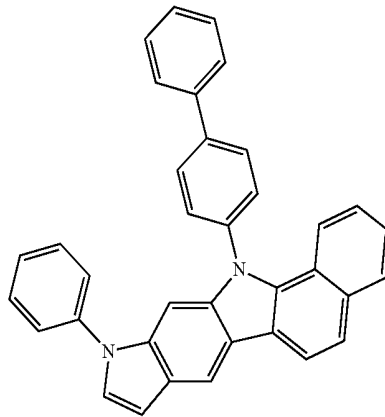
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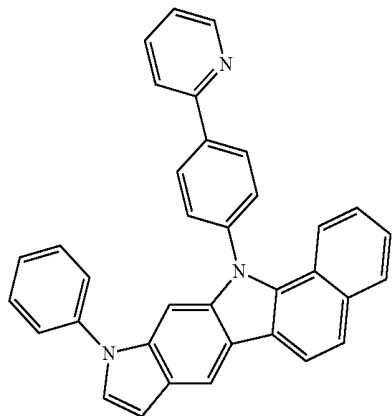


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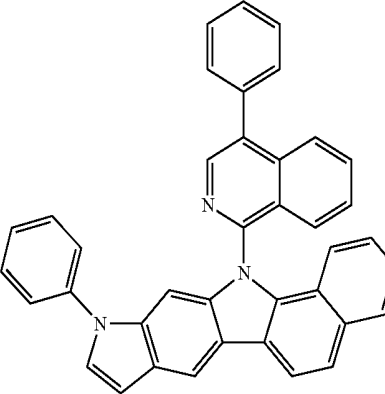
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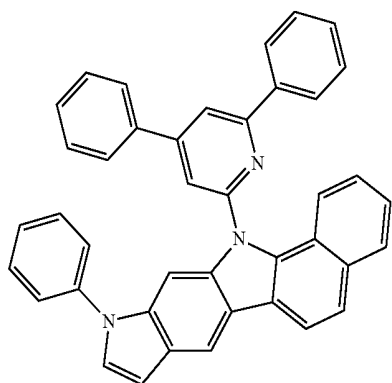
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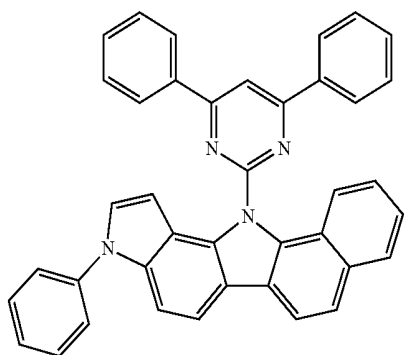


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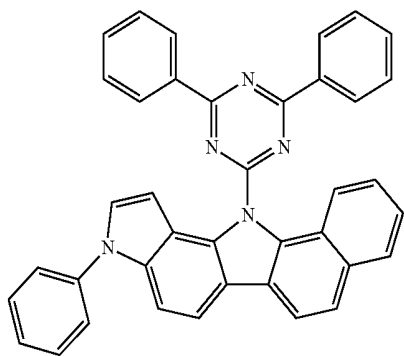


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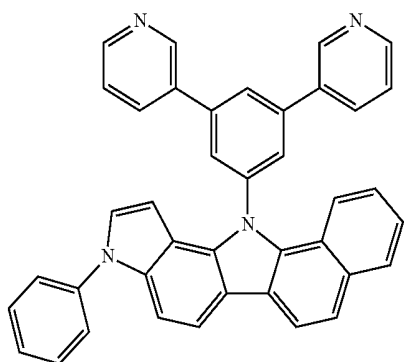


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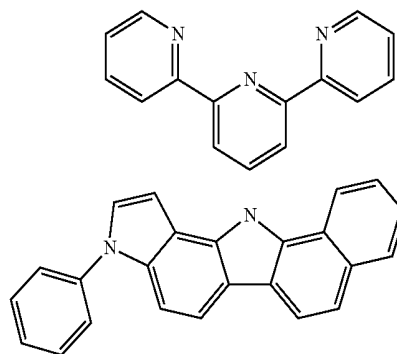
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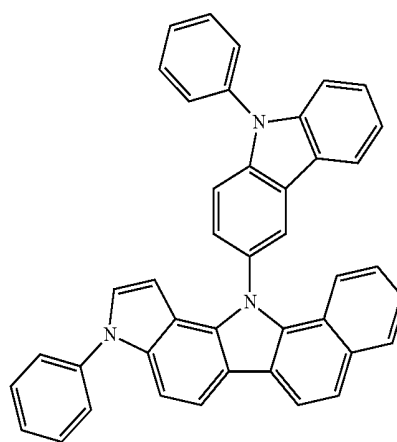
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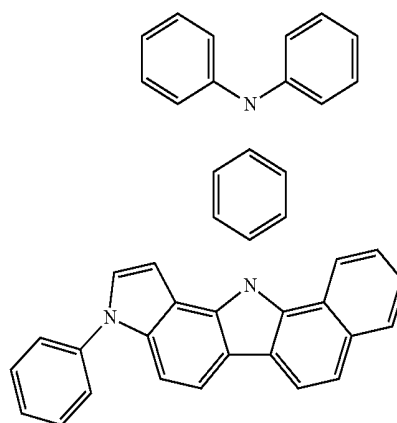
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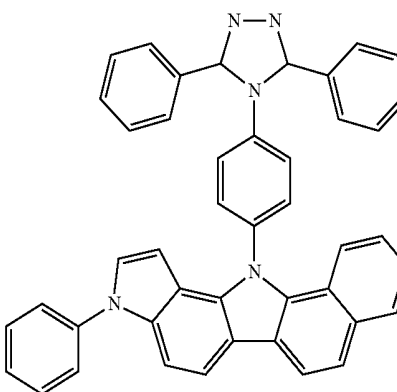
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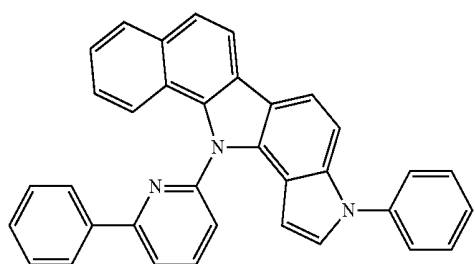
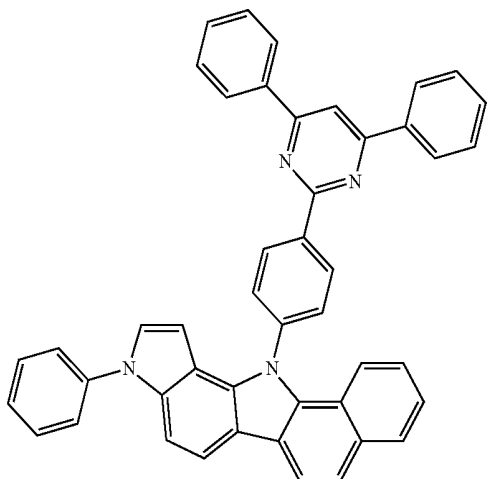
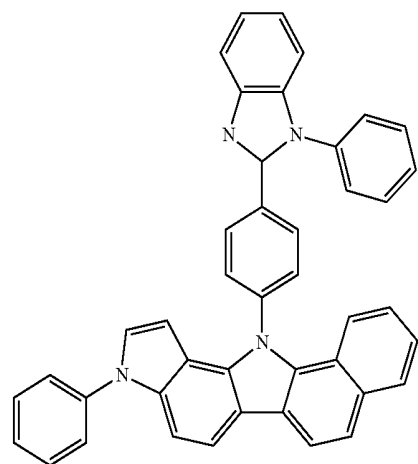
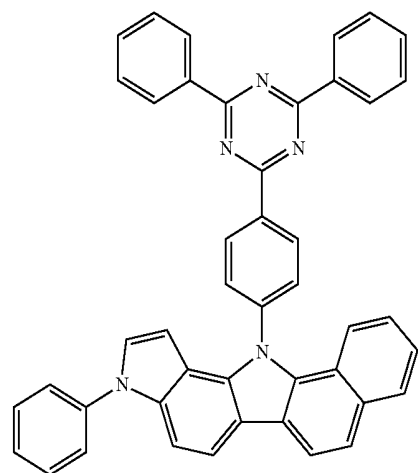
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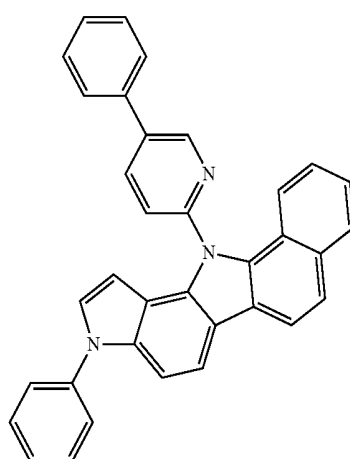
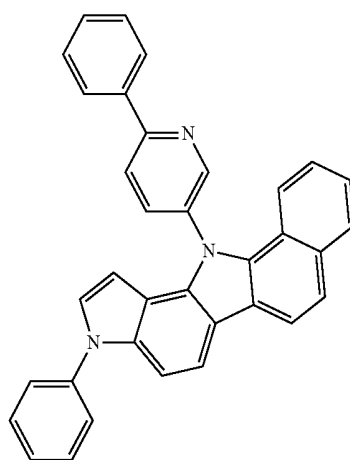
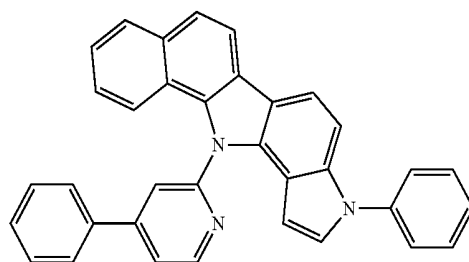
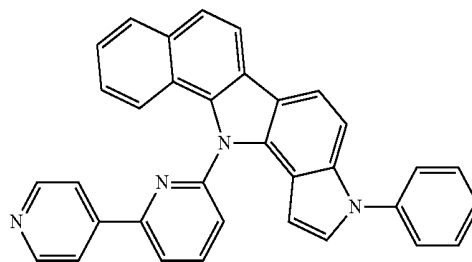
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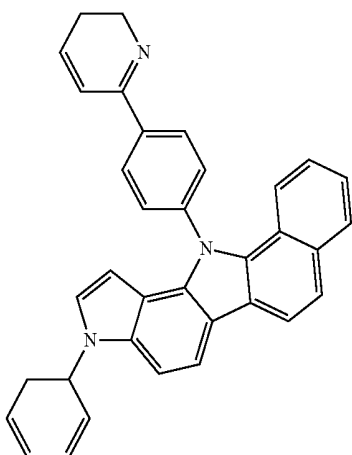
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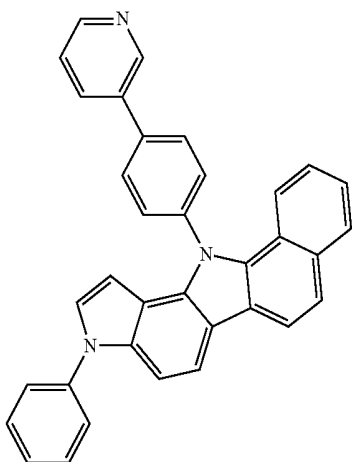
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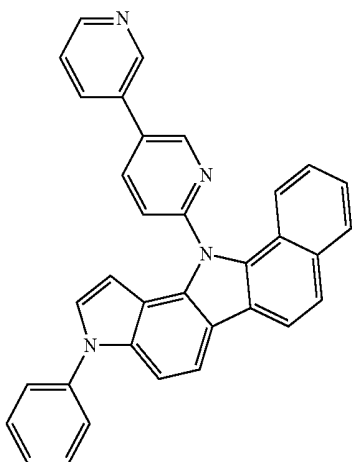
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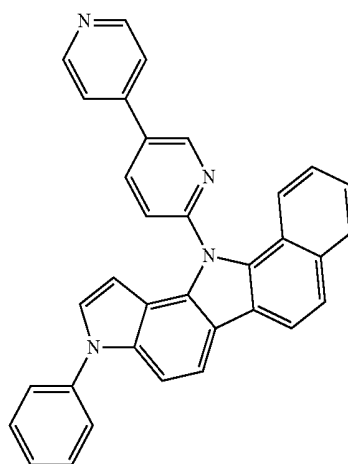
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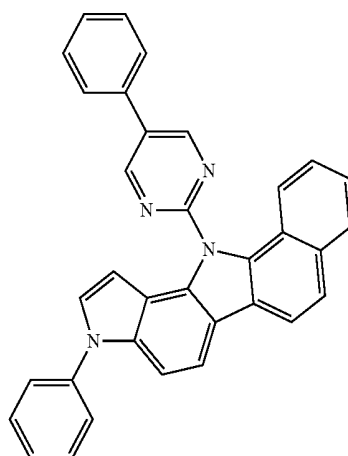
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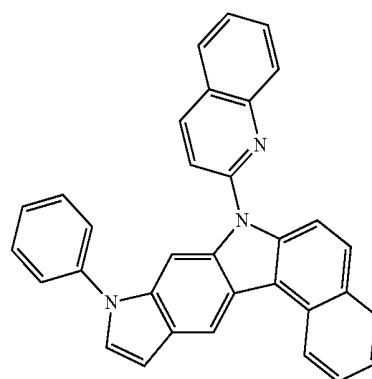
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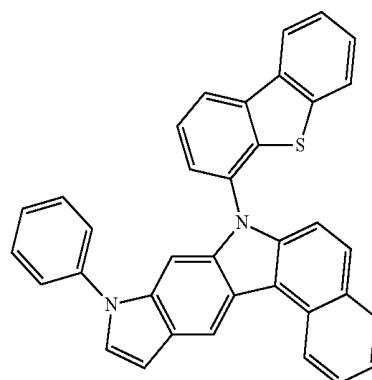
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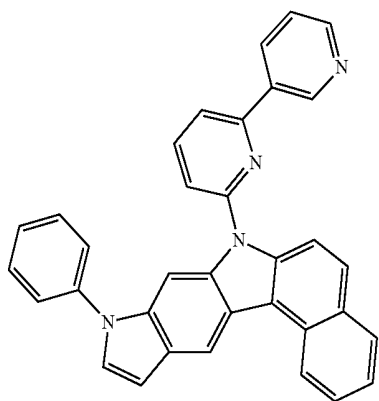


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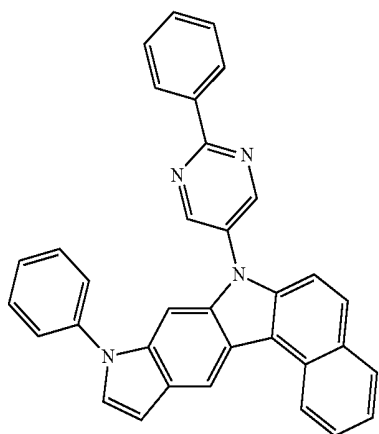


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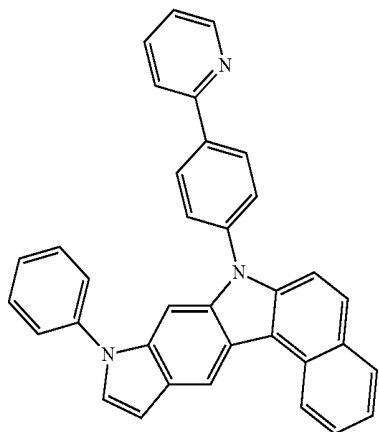
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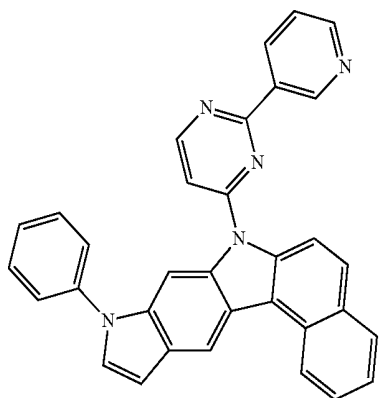
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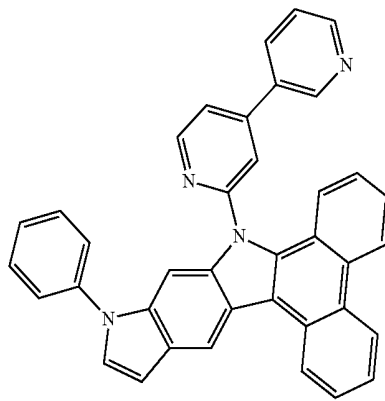
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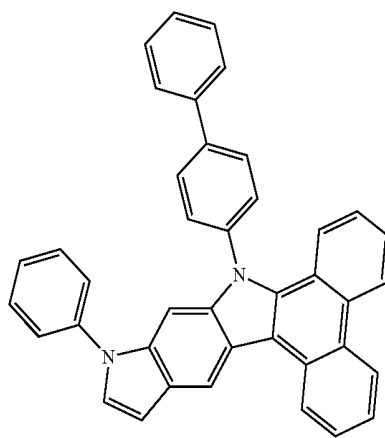
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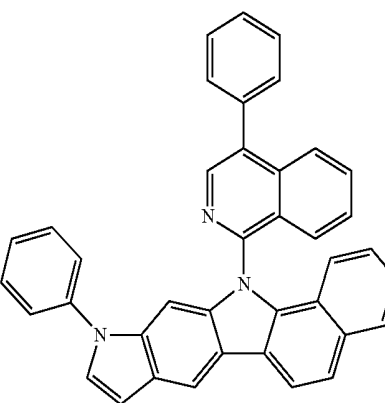
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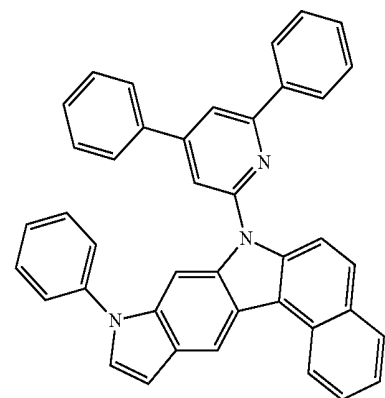
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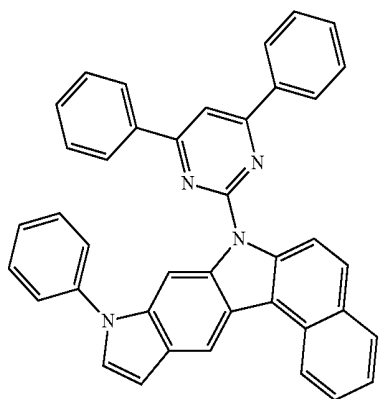


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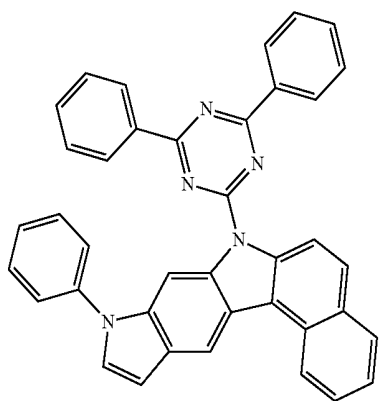
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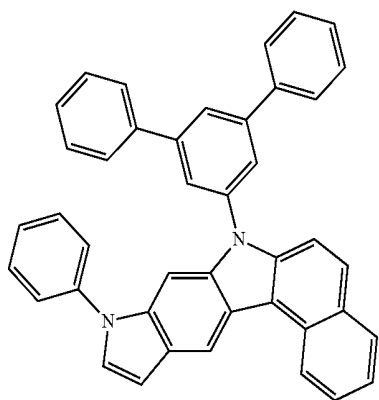
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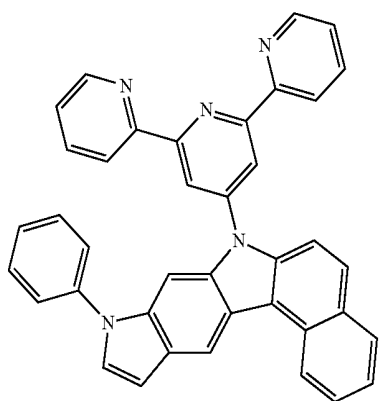
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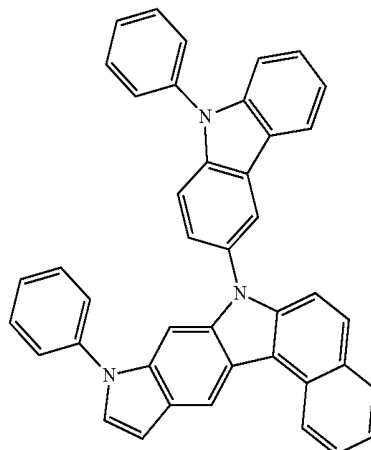
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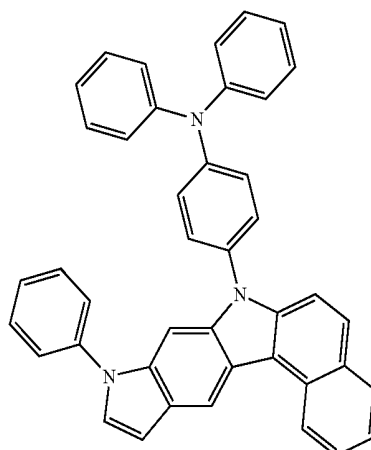
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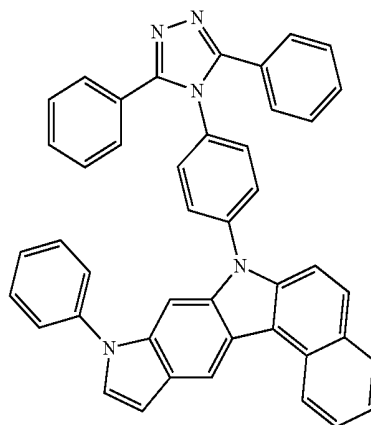
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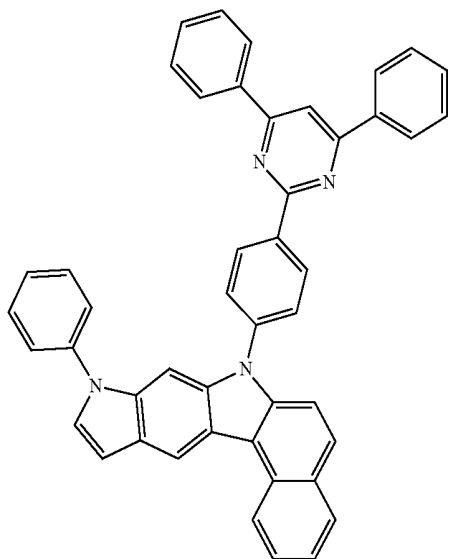
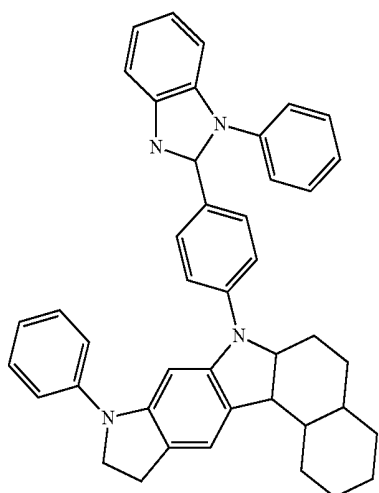
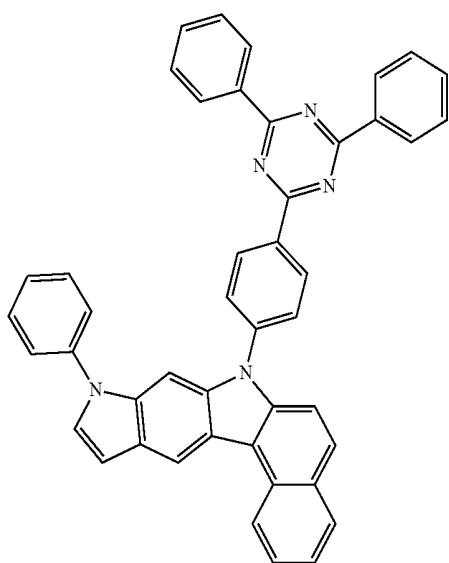
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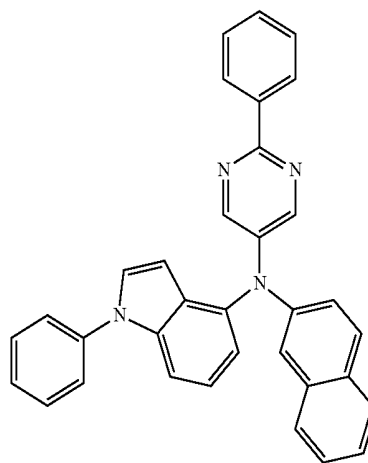
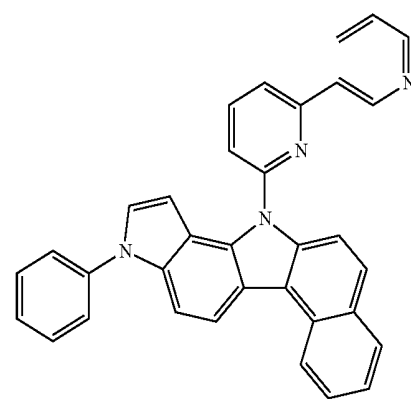
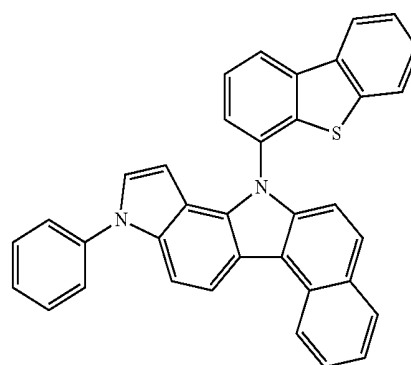
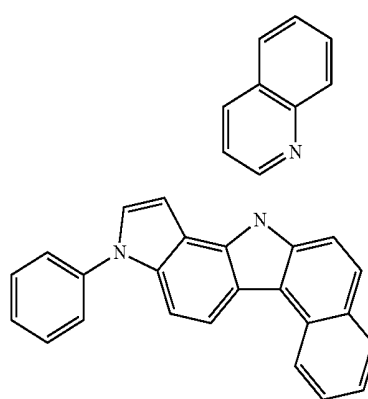
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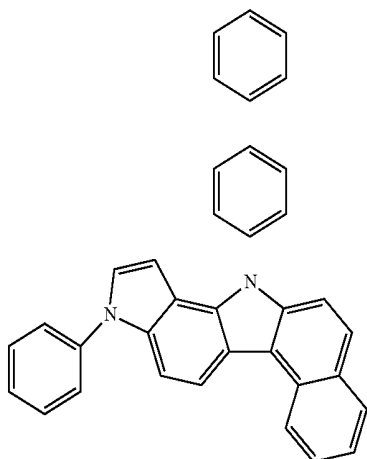
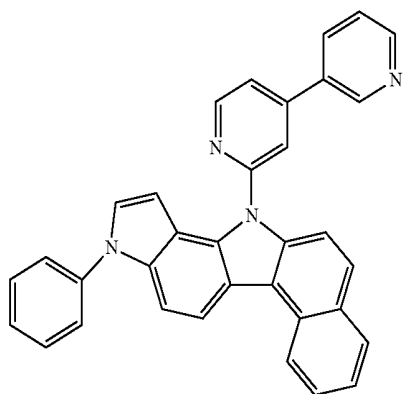
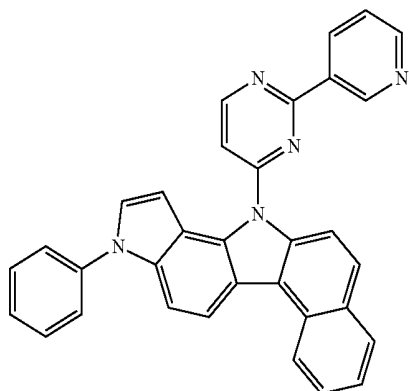
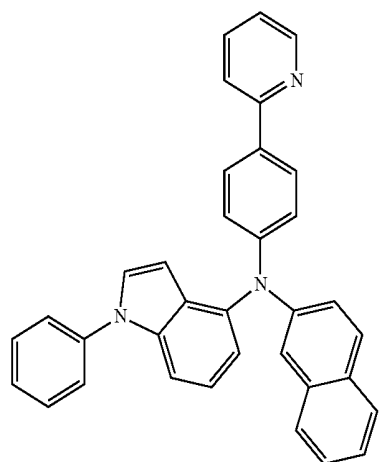


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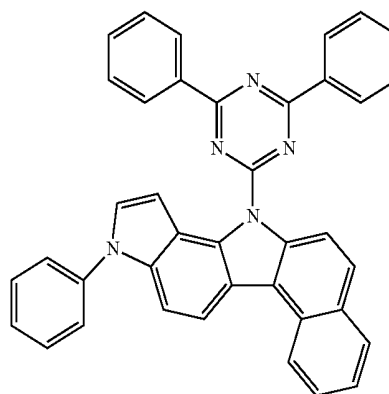
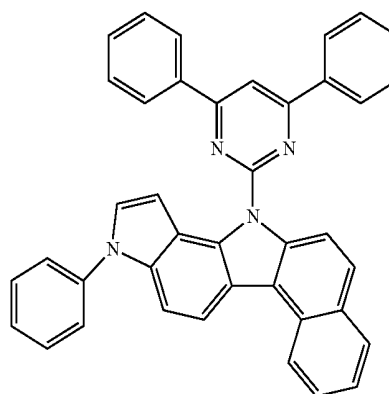
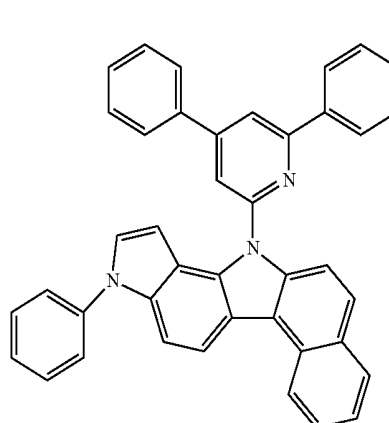
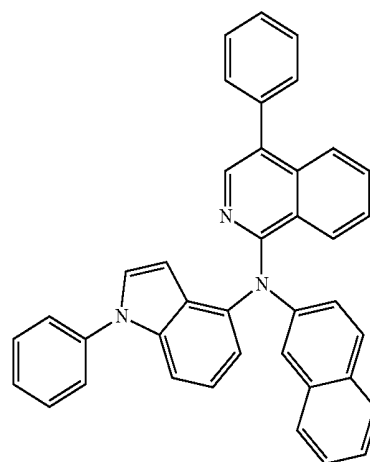
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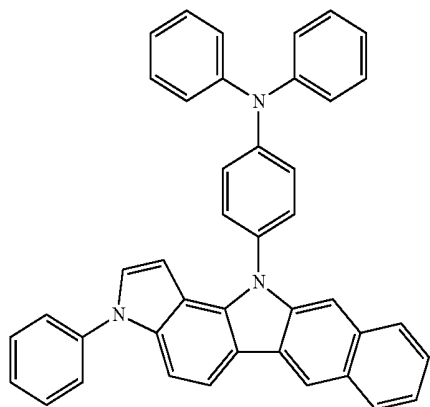
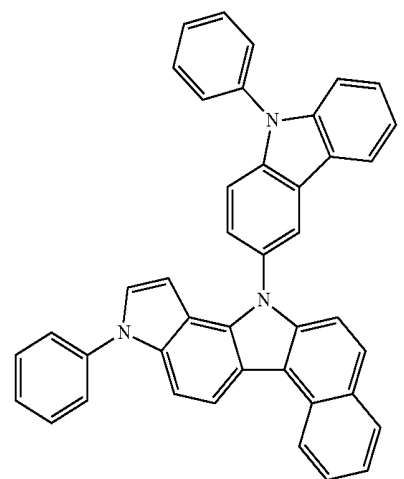
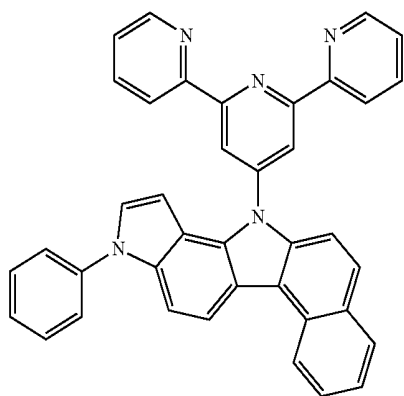
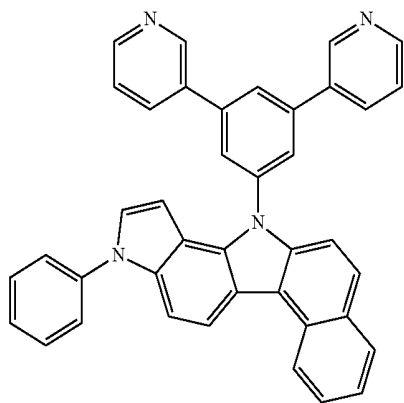


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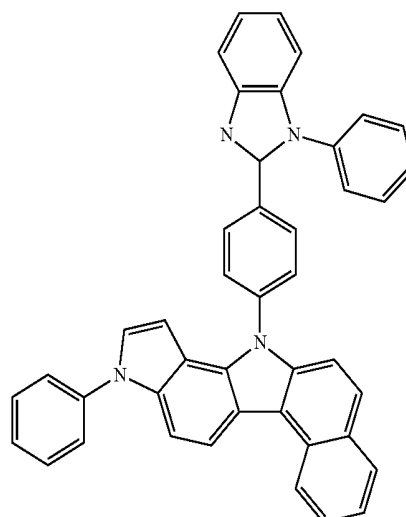
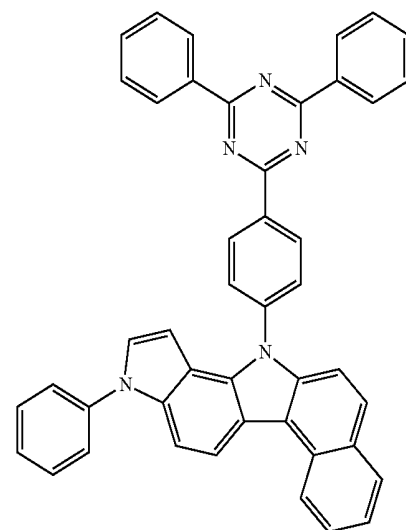
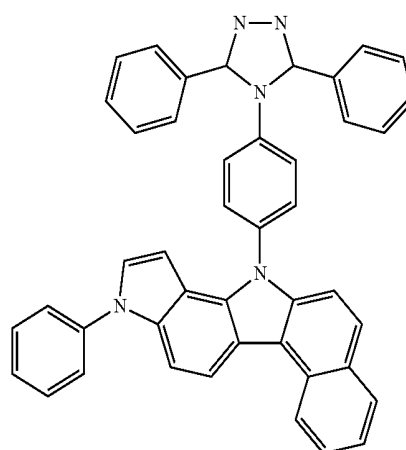
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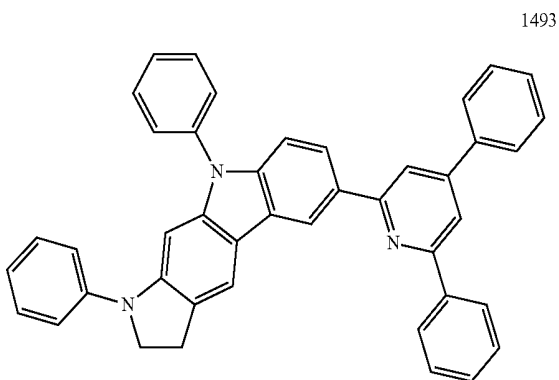
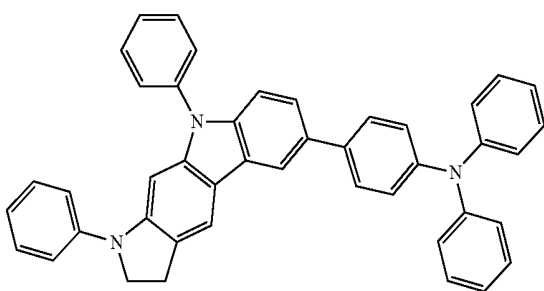
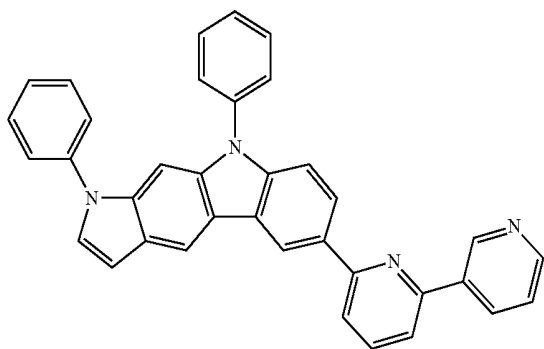
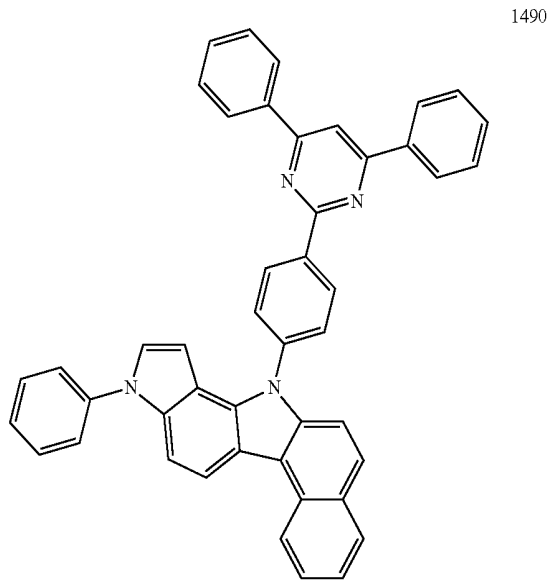


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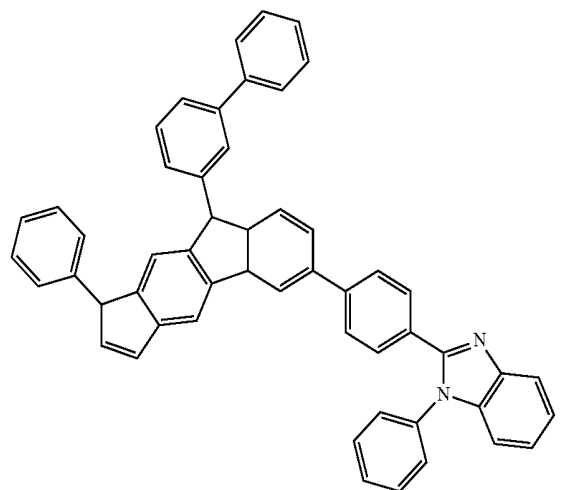
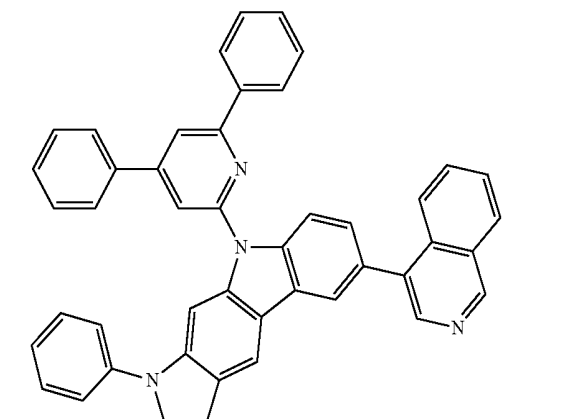
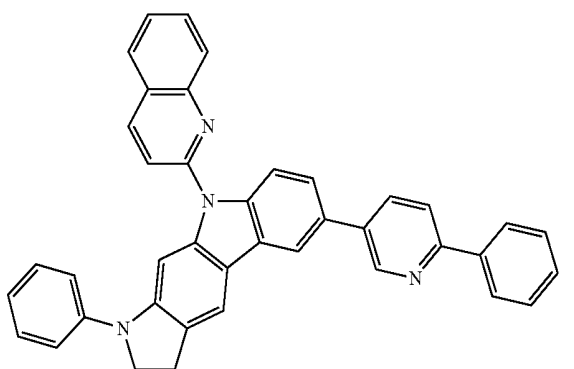
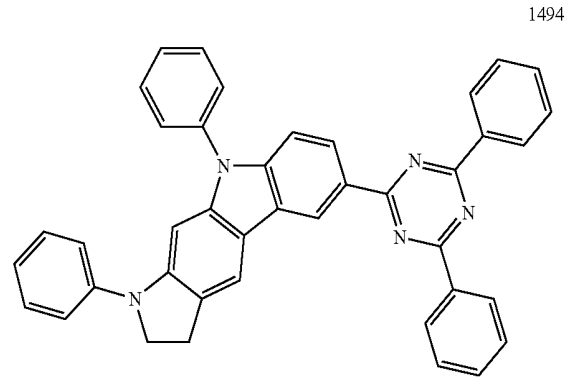
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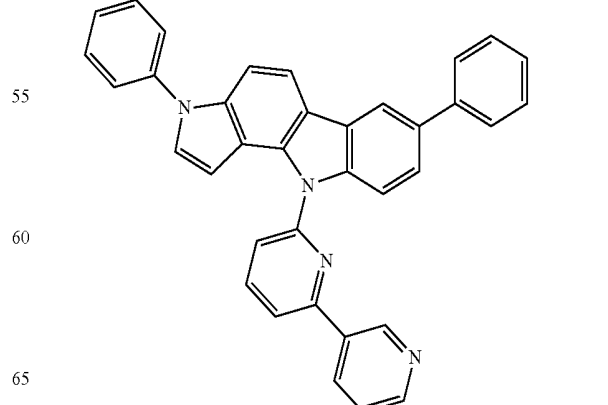
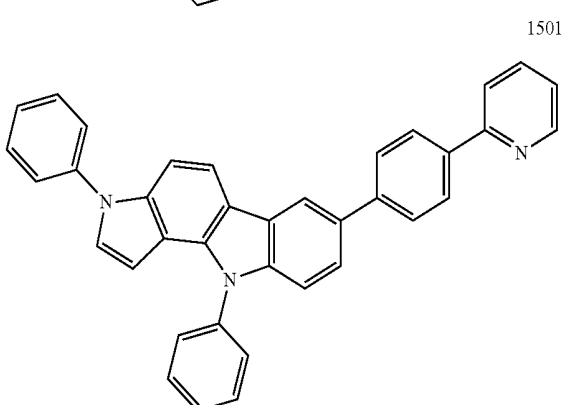
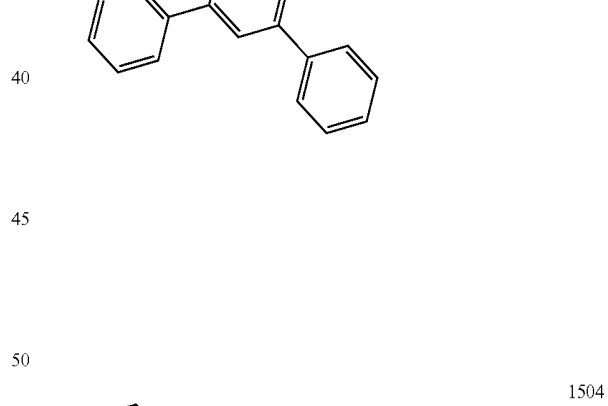
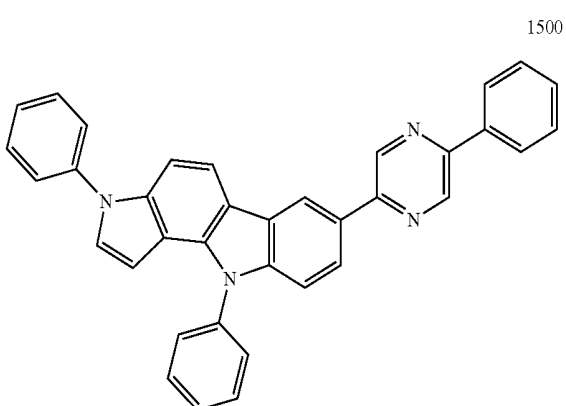
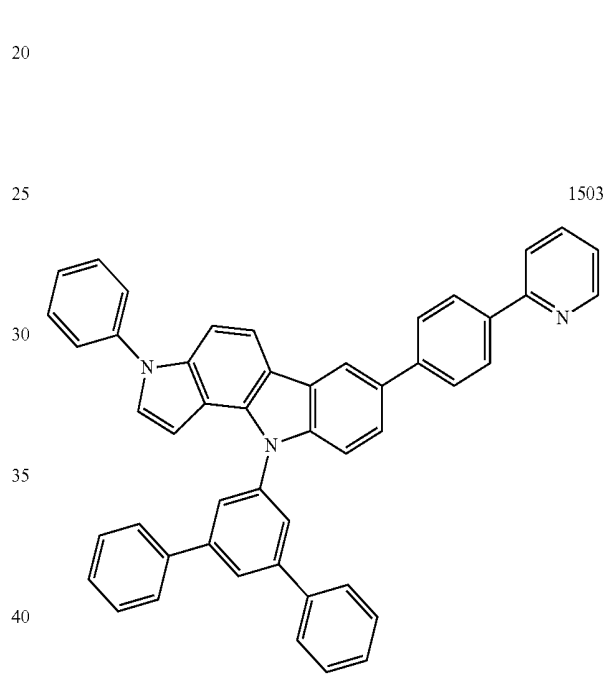
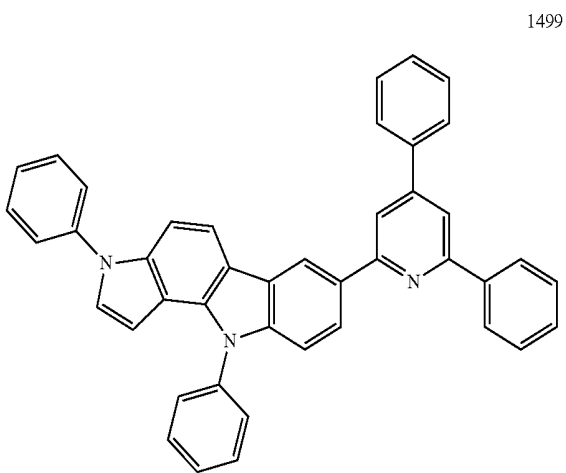
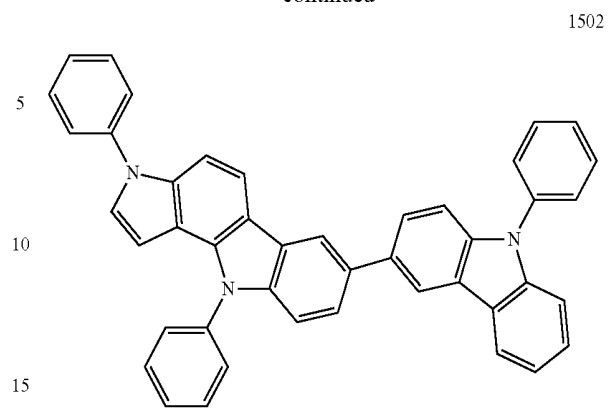
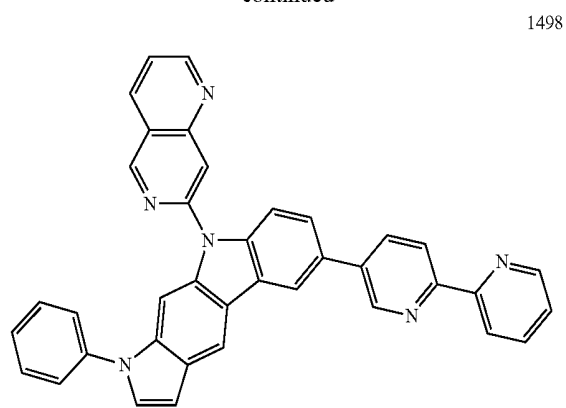


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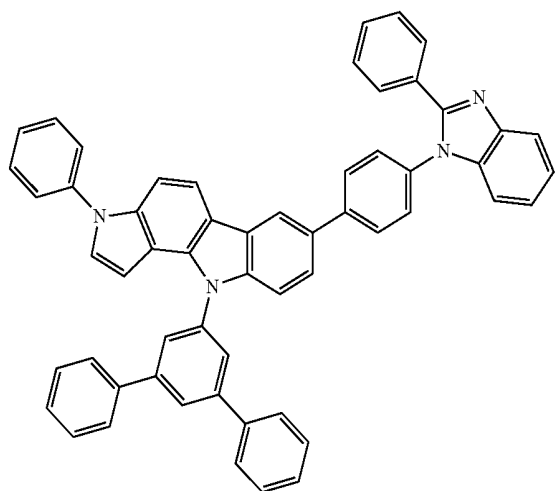
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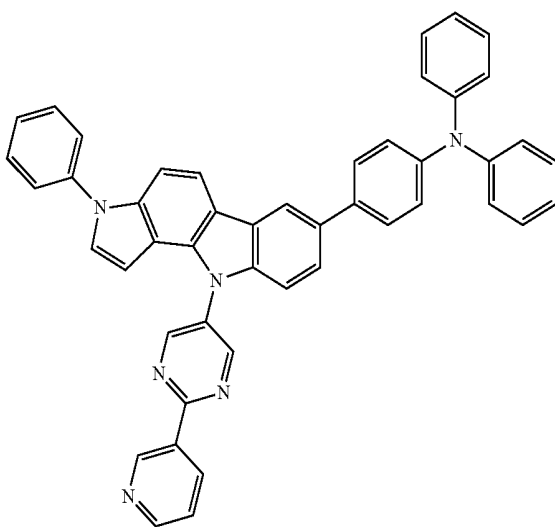
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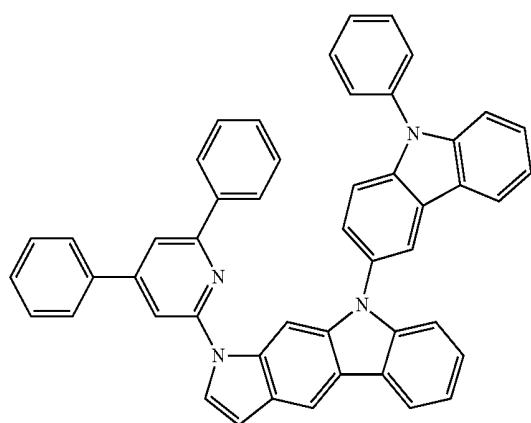
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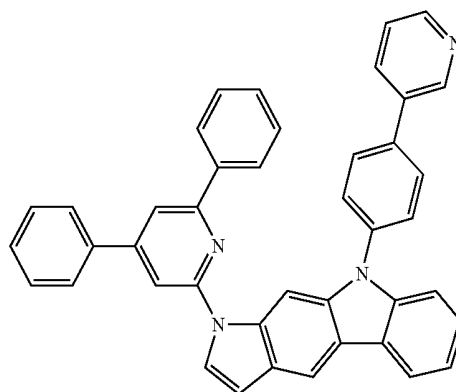
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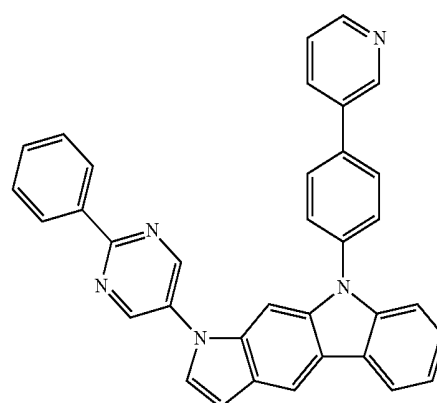
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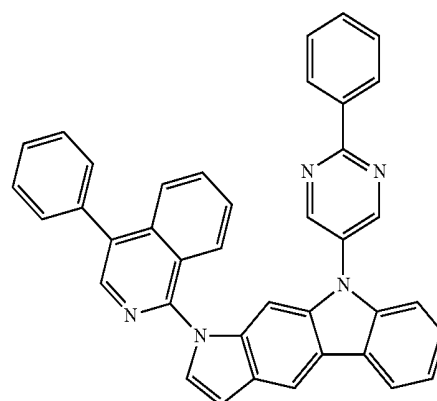
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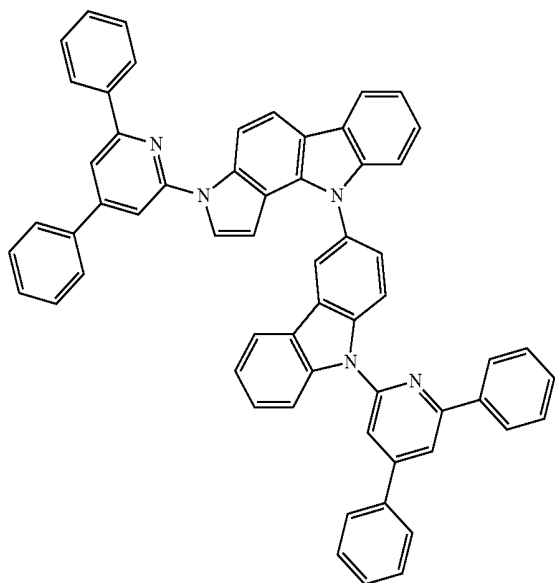


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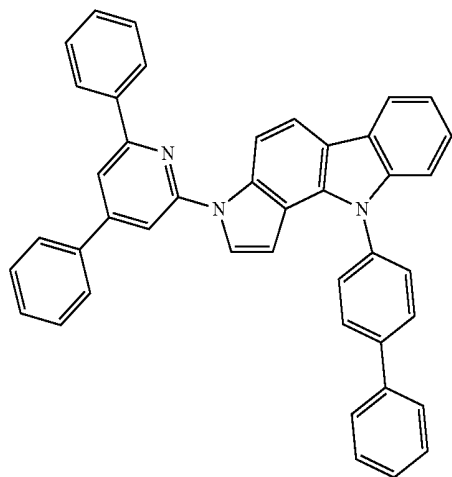
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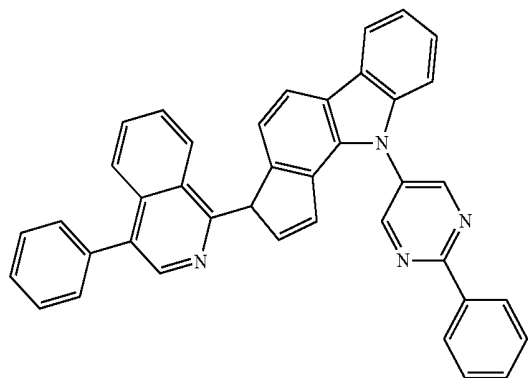
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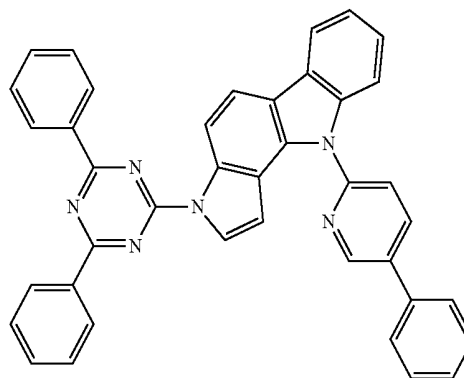
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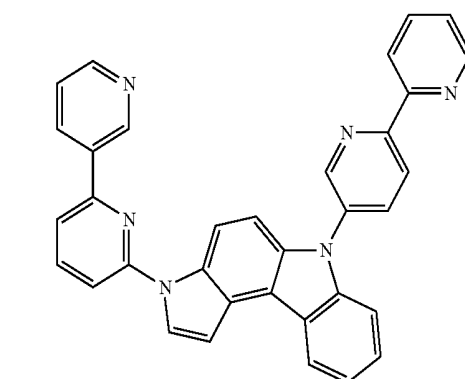
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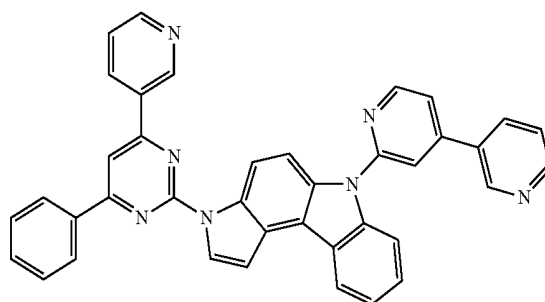
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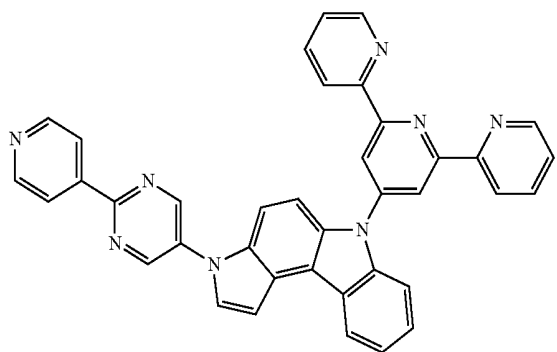
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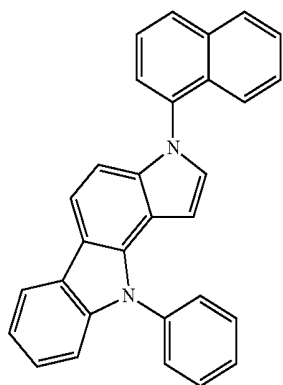
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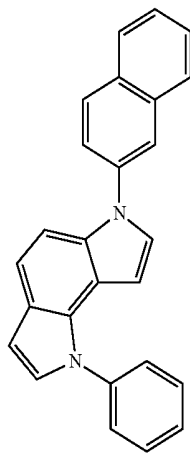
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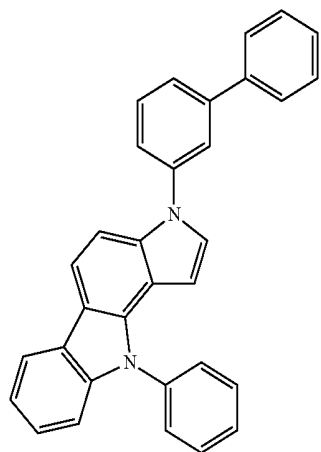


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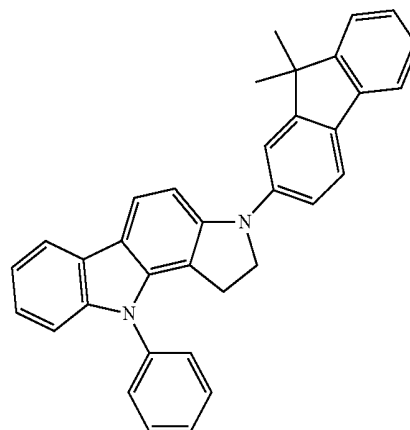
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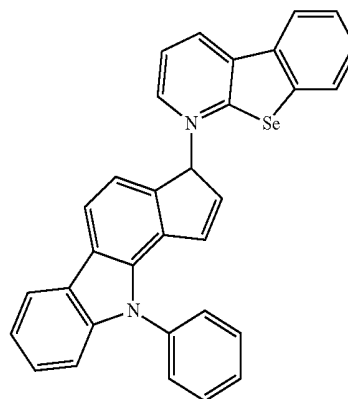
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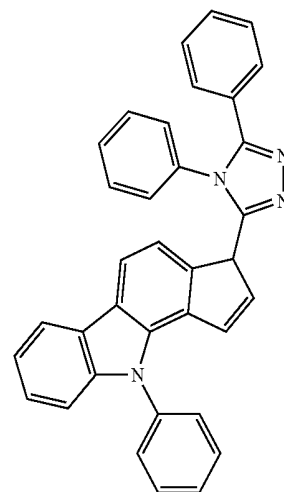


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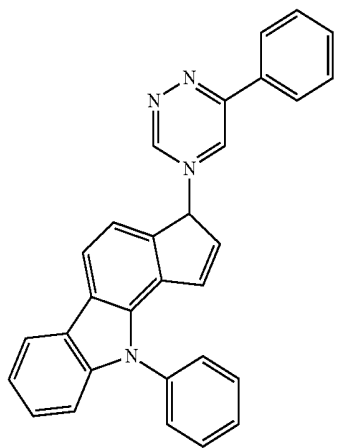
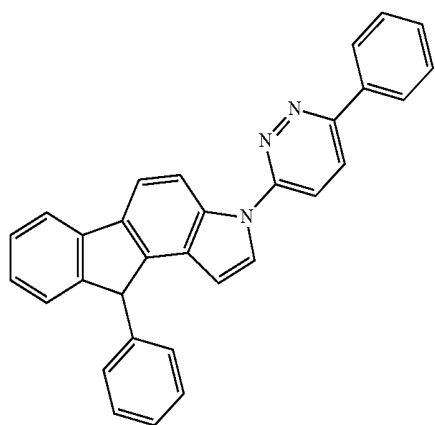
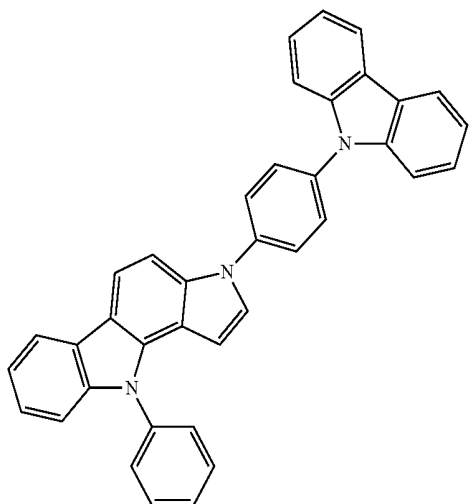


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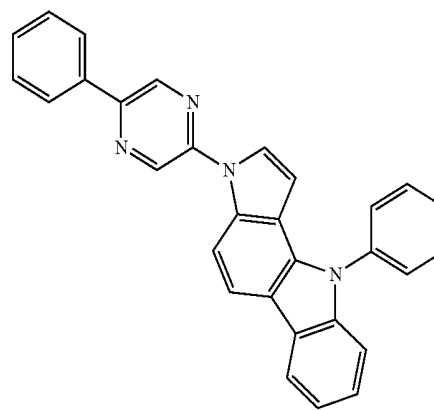
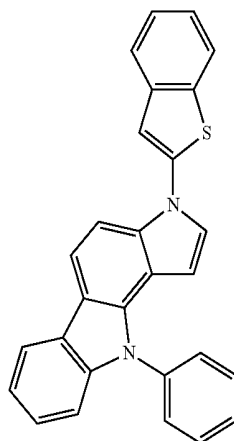
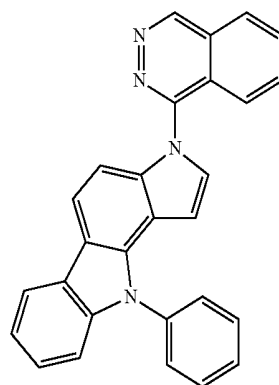
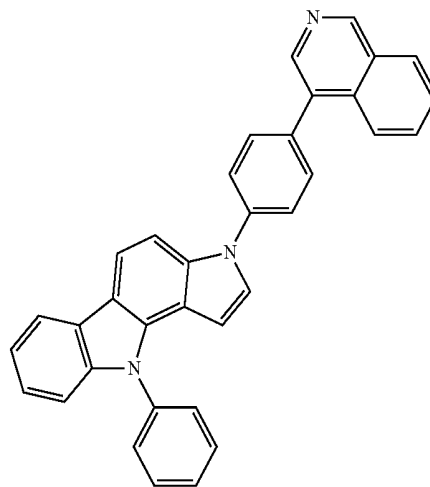
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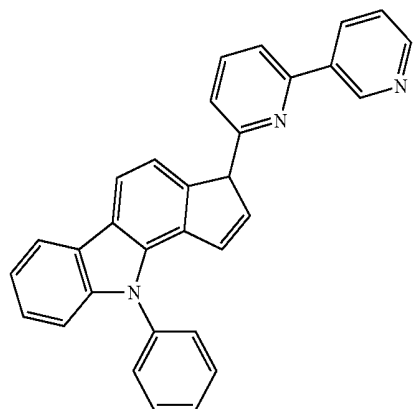
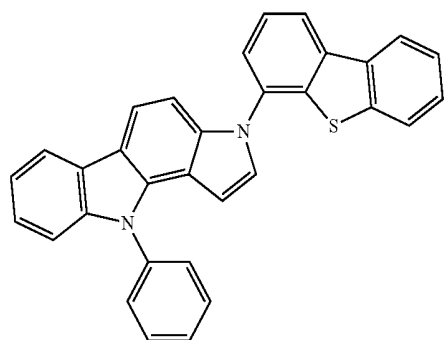
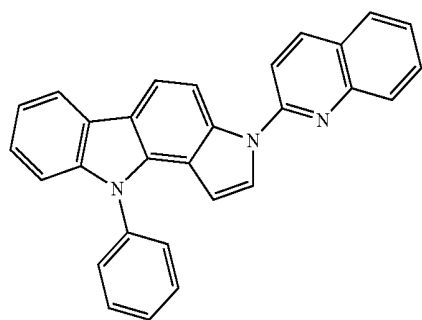
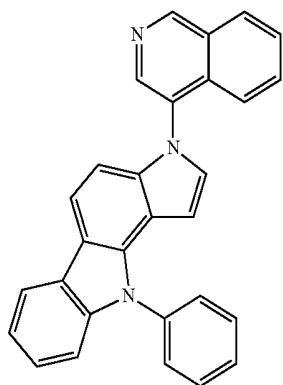


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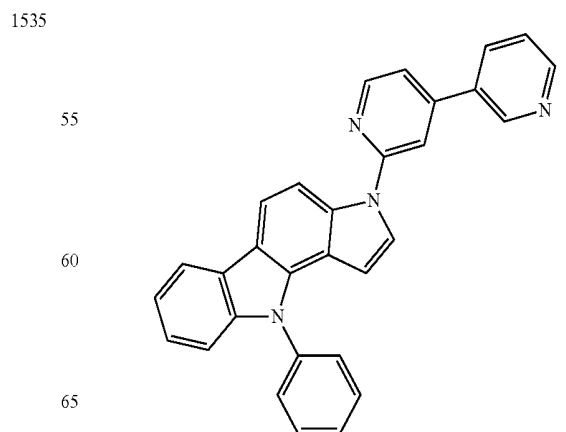
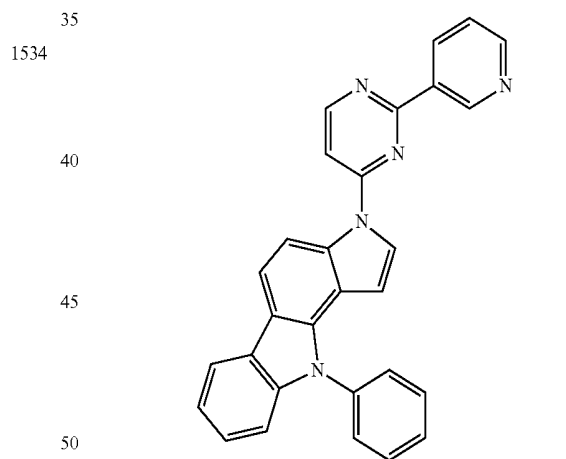
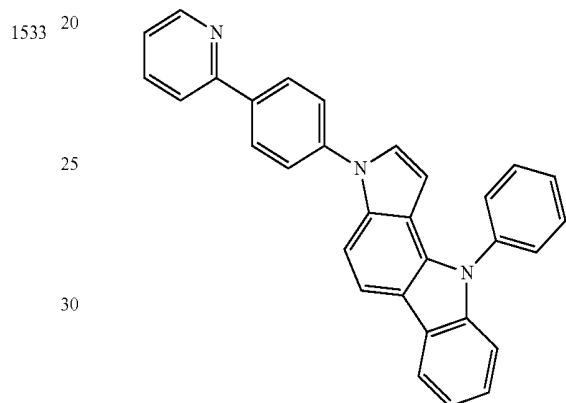
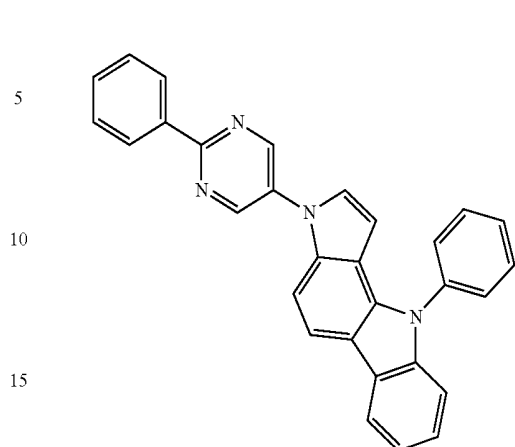
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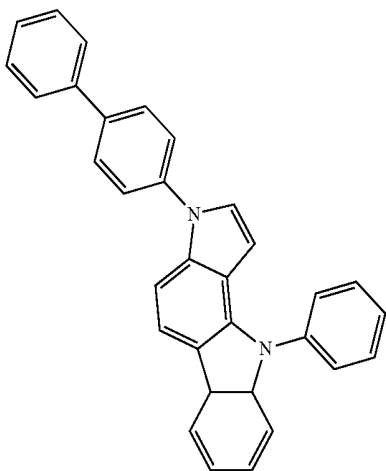
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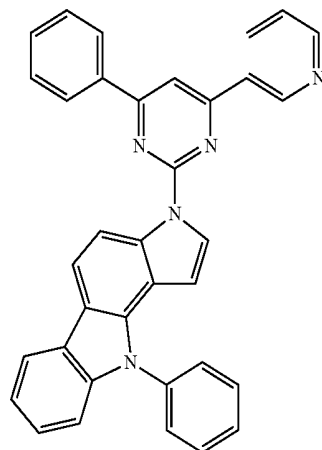


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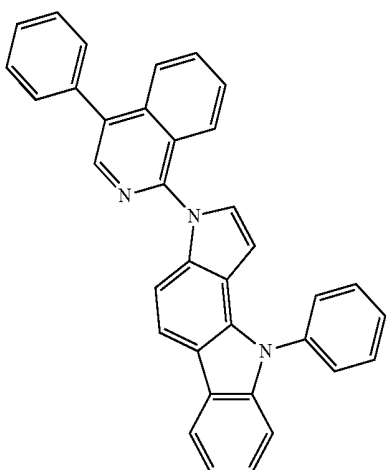
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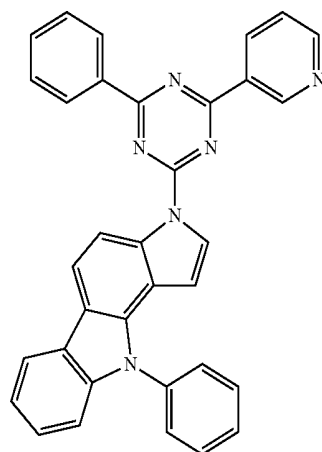


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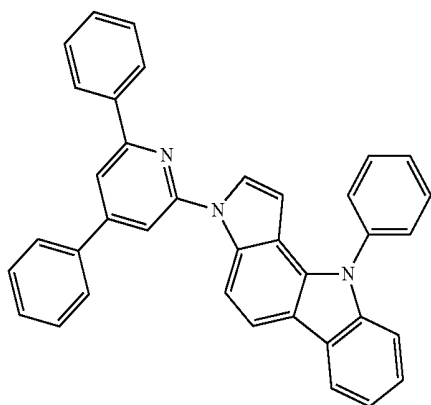
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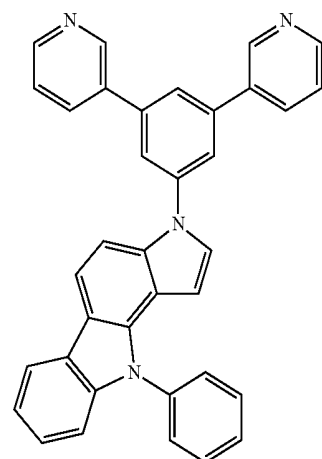
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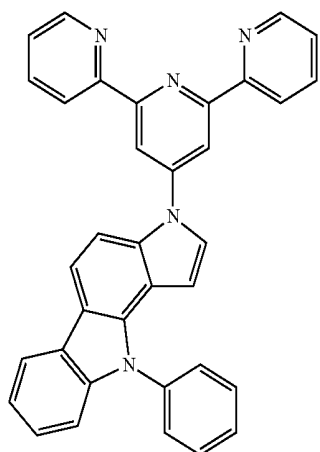
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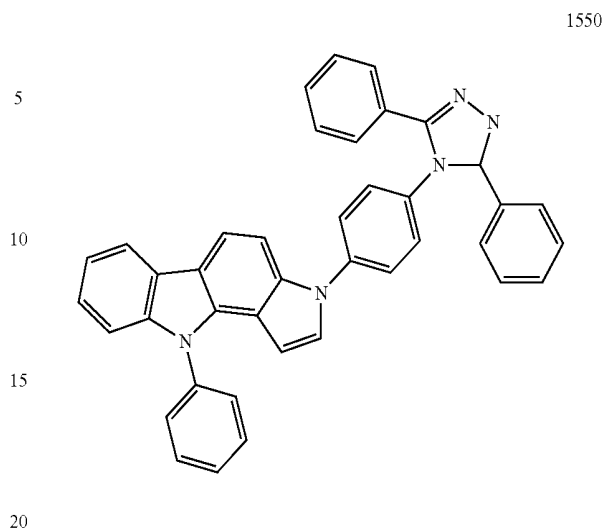


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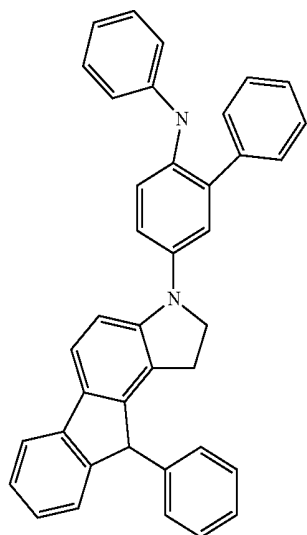
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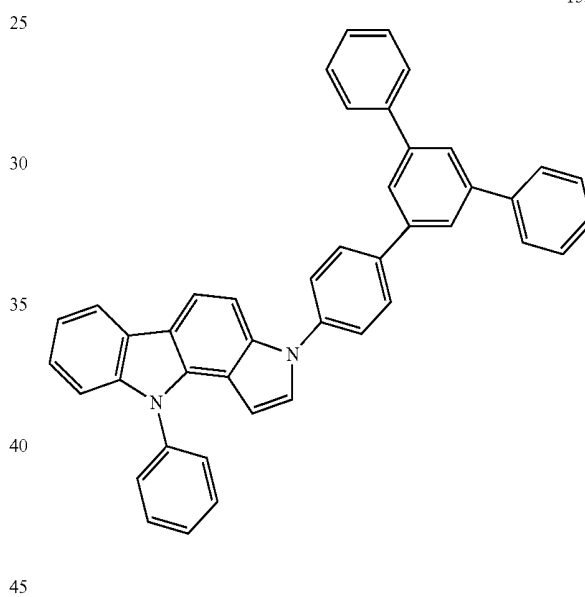
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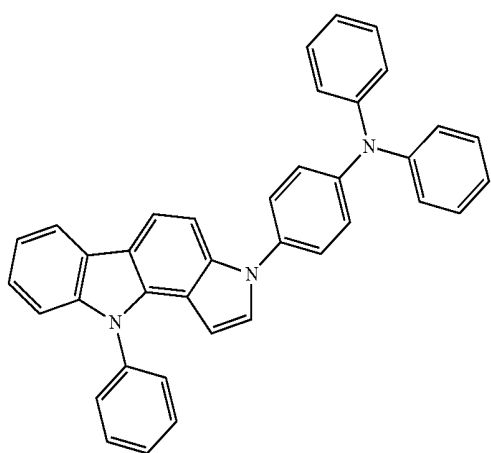
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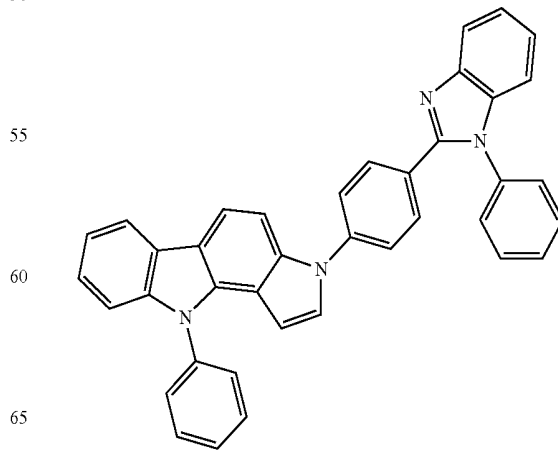
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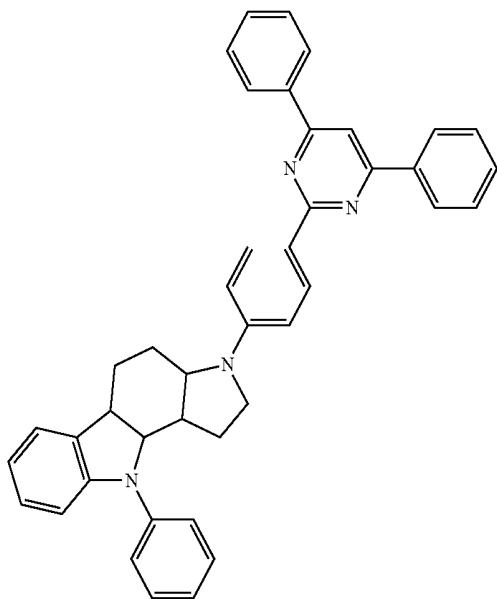
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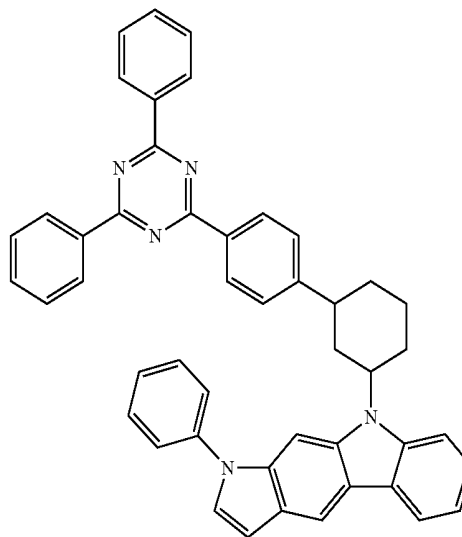
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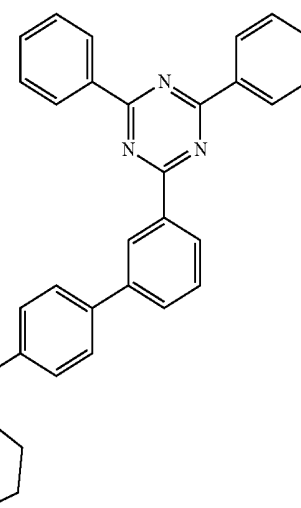
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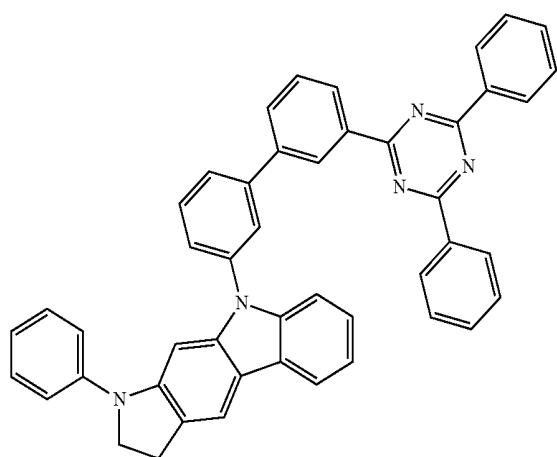
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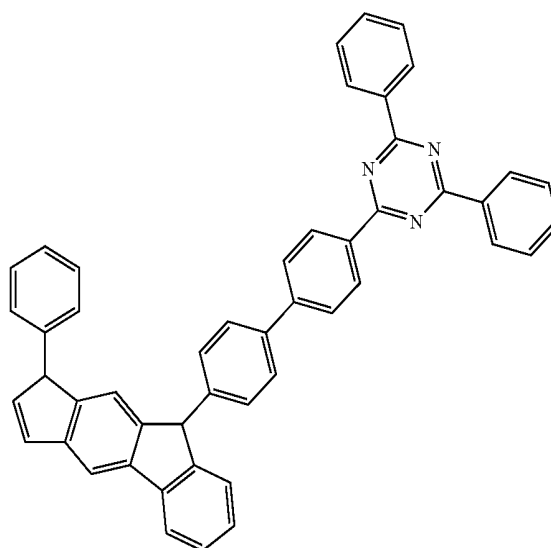
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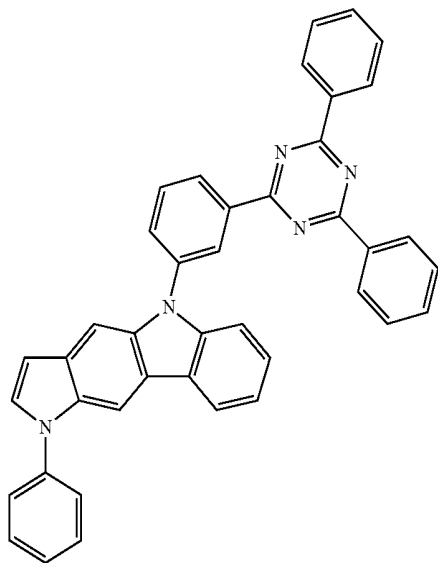
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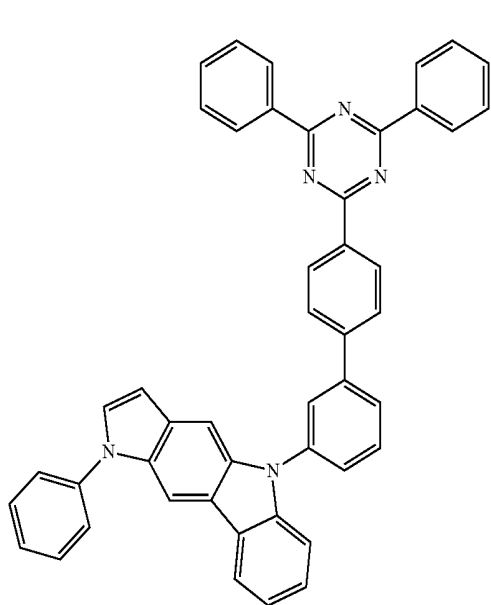
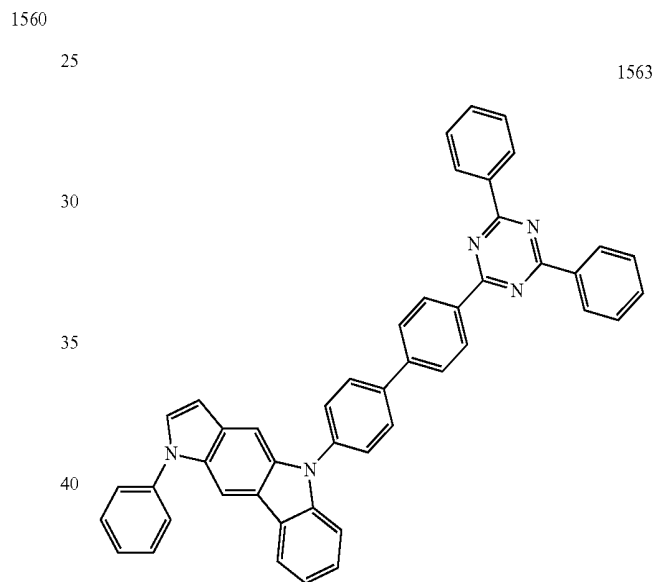
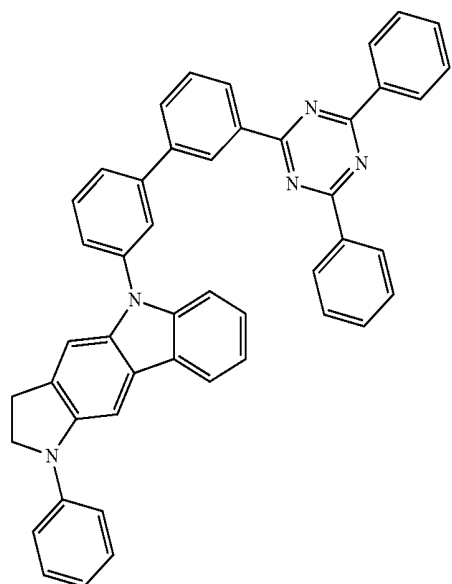
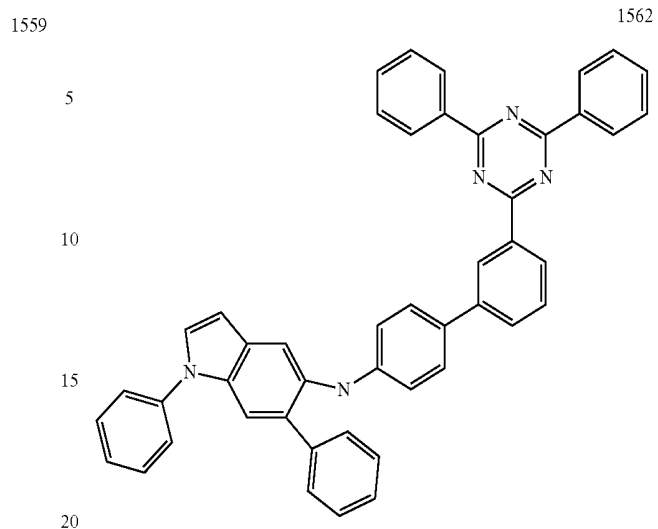
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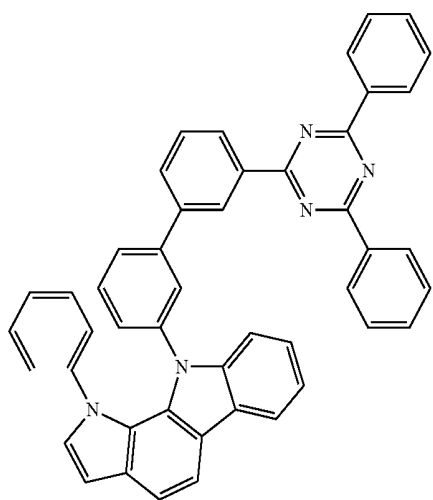
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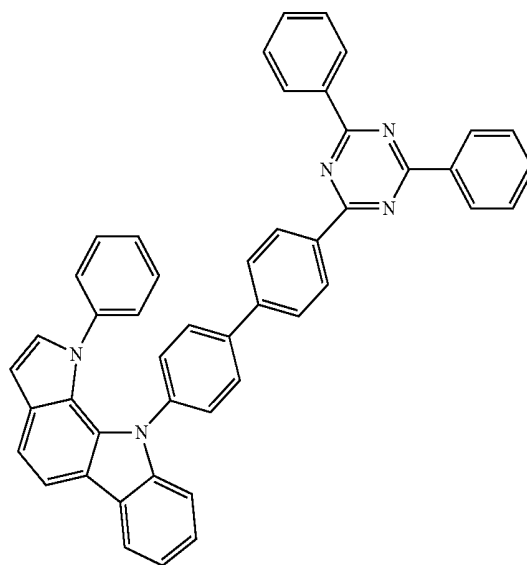


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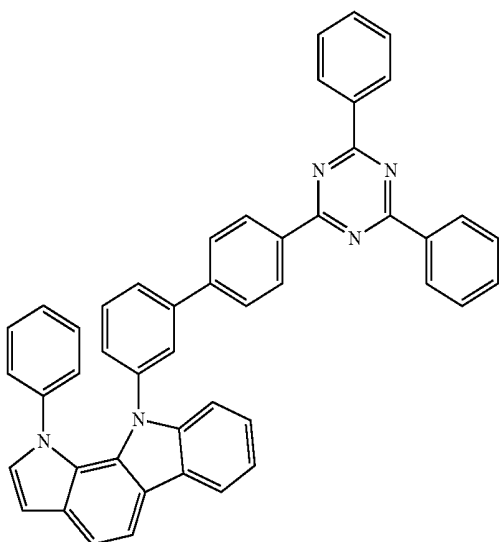
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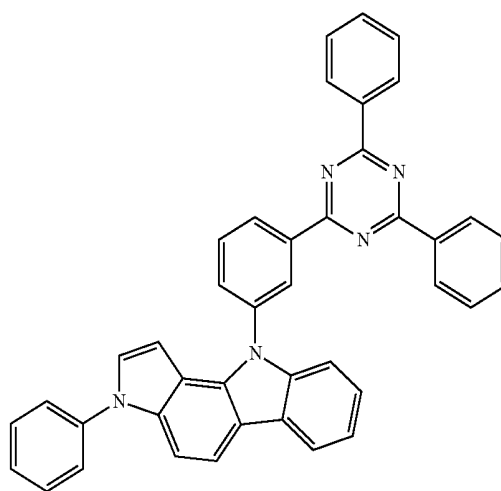
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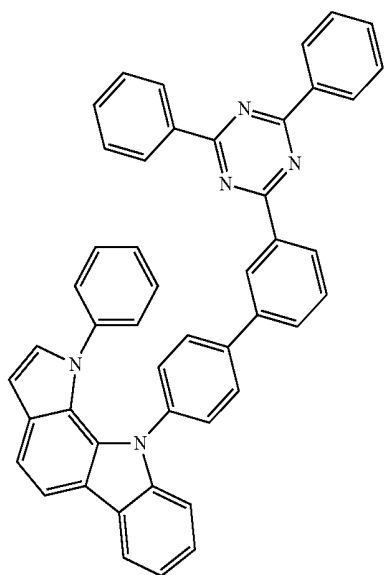
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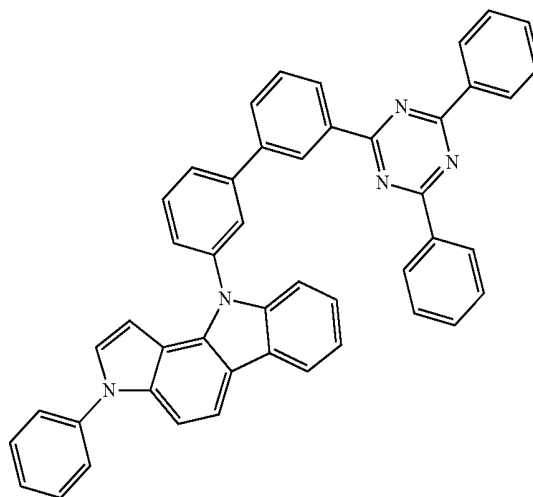
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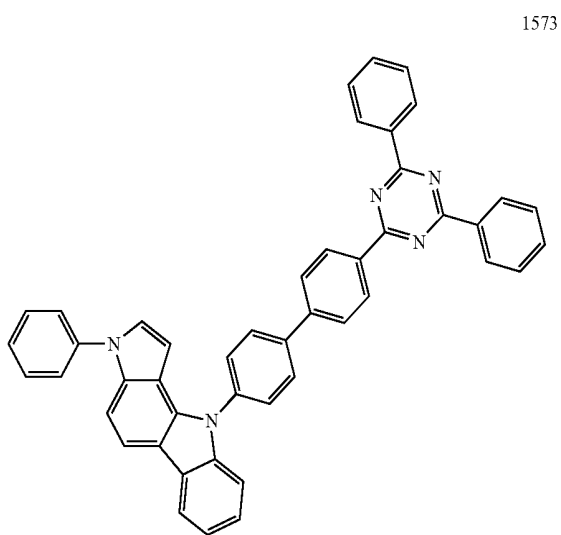
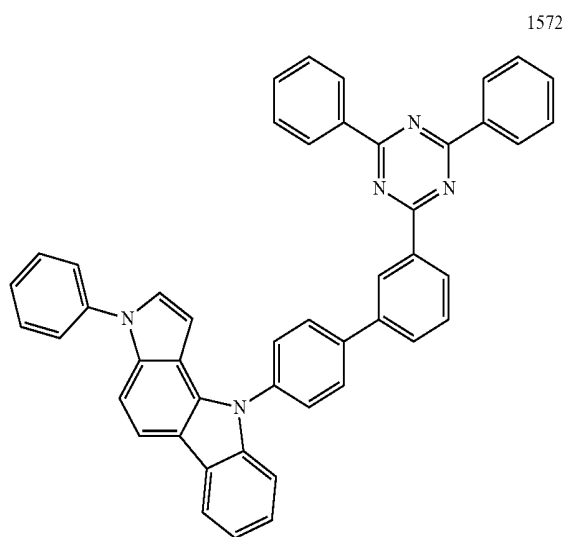
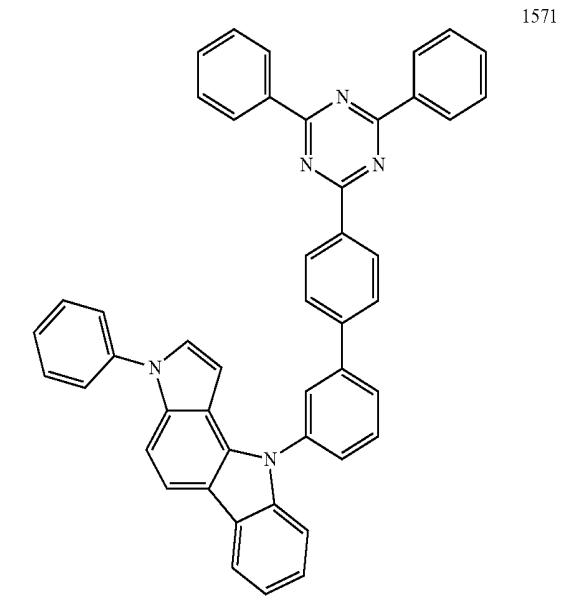


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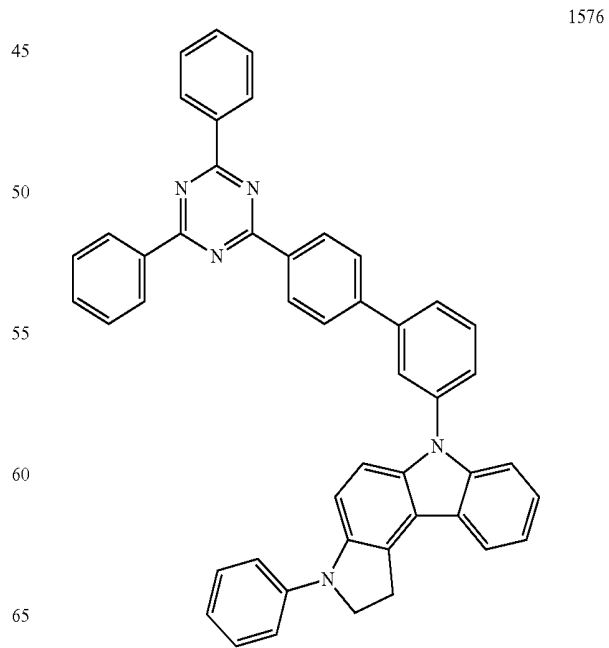
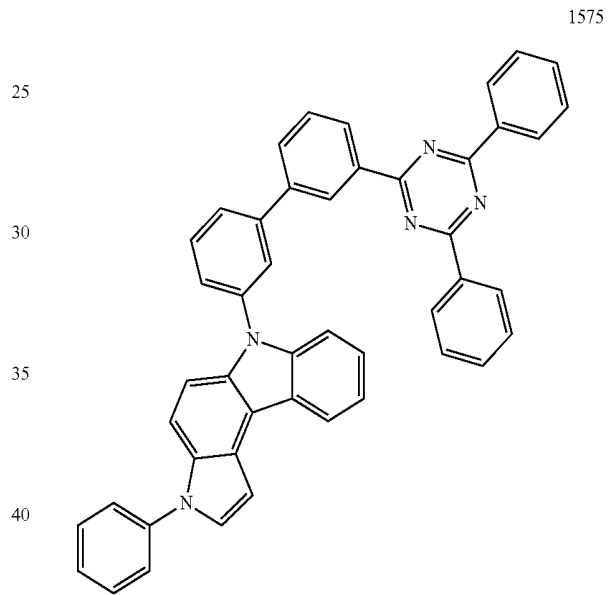
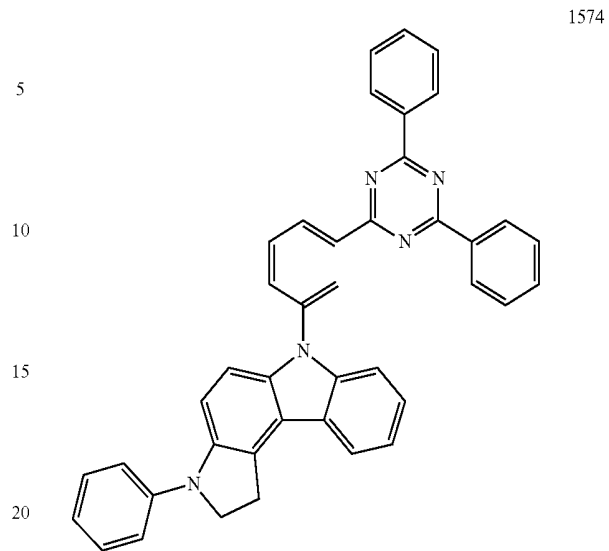
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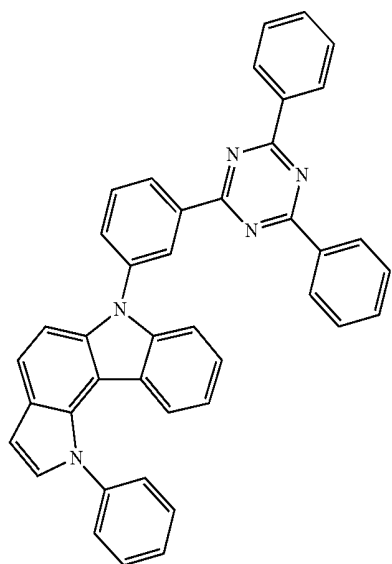
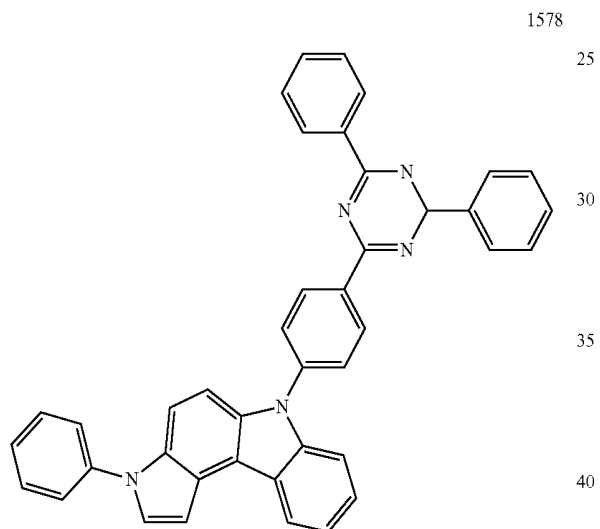
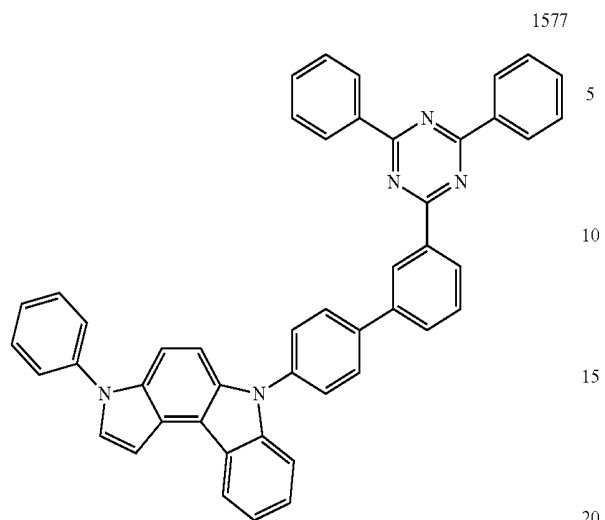


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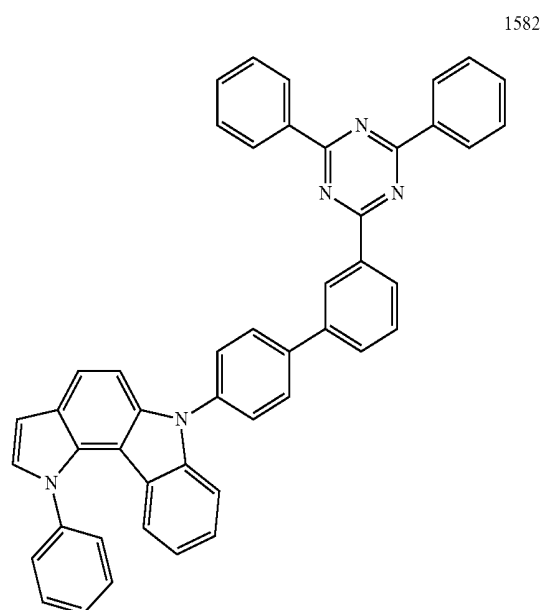
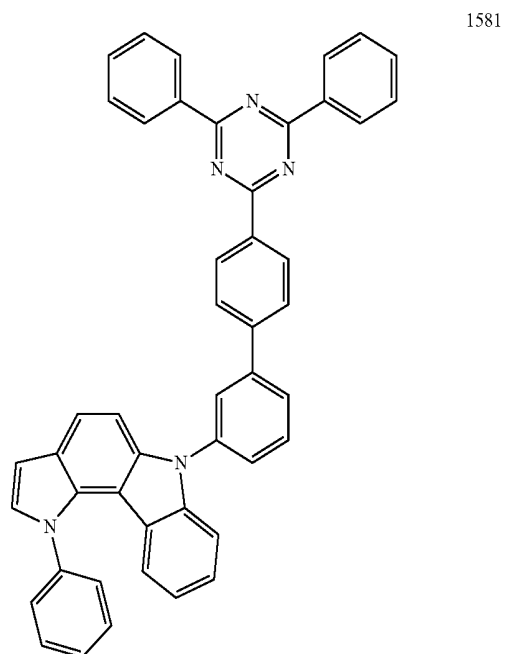
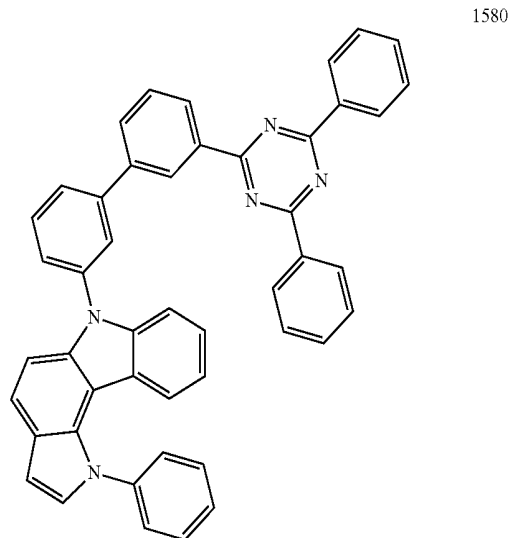
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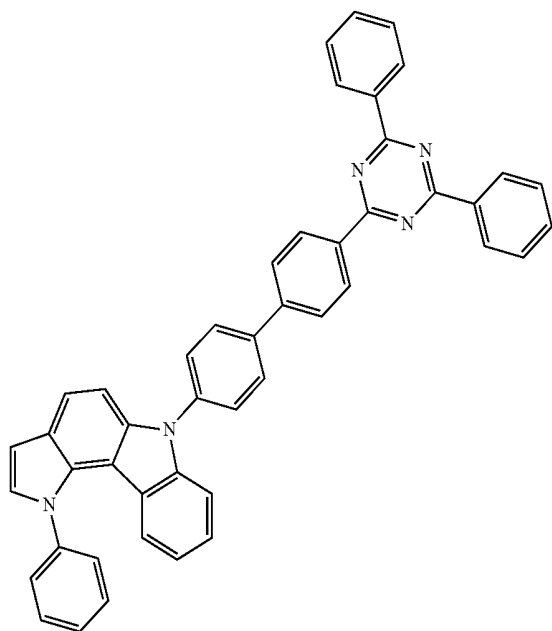
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The compound of Formula 1 according to the present invention may be synthesized by a general synthesis method. The detailed synthesis process of the compound of Formula 1 according to the present invention will be specifically described in Examples to be described below.

The present invention also provides an organic EL device including: (i) an anode; (ii) a cathode; and (iii) an organic layer having one or more layers interposed between the anode and the cathode, in which at least one in the organic layer having one or more layers includes one or more of the compounds represented by Formula 1.

A non-limiting example of the organic EL device structure according to the present invention may be a structure in which a substrate, an anode, a hole injection layer, a hole transporting layer, a light-emitting layer, an electron transporting layer, and a cathode are sequentially laminated. In this case, one or more of the hole injection layer, the hole transporting layer, the electron injection layer, the electron transporting layer, and the light-emitting layer may include one or more of the compound represented by Formula 1. Further, the compound represented by Formula 1 according to the present invention may be used as a phosphorescent host of the light-emitting layer. An electron injection layer may be positioned on the electron transporting layer.

In addition, the organic EL device according to the present invention may have not only the aforementioned structure in which an anode, an organic layer having one or more layers and a cathode are sequentially laminated, but also a structure in which an insulation layer or an adhesive layer may be inserted at the interface of the electrode and the organic layer.

In the organic EL device according to the present invention, the organic layer including the compound represented by Formula 1 may be formed by a vacuum deposition method or a solution coating method. Examples of the solution coating method include spin coating, dip coating, doctor blading, inkjet printing or heat transferring method and the like, but are not limited thereto.

The organic EL device according to the present invention may be manufactured by forming organic layers and elec-

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trodes using the materials and methods known in the art, except that one or more layers of the organic layers are formed so as to include the compound represented by Formula 1 according to the present invention.

For example, as the substrate, a silicon wafer, quartz or a glass plate, a metal plate, a plastic film, a plastic film or sheet or the like may be used.

Examples of an anode material include: a metal such as vanadium, chromium, copper, zinc and gold, or an alloy thereof; a metal oxide such as zinc oxide, indium oxide, indium tin oxide (ITO) and indium zinc oxide (IZO); a combination of a metal and an oxide, such as ZnO:Al or SnO₂:Sb; a conductive polymer such as polythiophene, poly(3-methylthiophene), poly[3,4-(ethylene-1,2-dioxy)thiophene] (PEDT), polypyrrole and polyaniline; or carbon black and the like, but are not limited thereto.

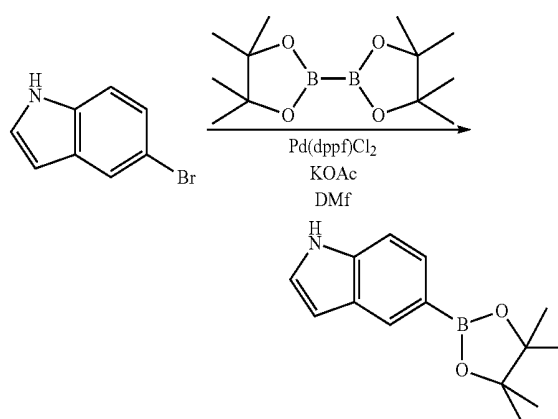
Examples of a cathode material include a metal such as magnesium, calcium, sodium, potassium, titanium, indium, yttrium, lithium, gadolinium, aluminum, silver, tin or lead or an alloy thereof; a multilayer structured material such as LiF/Al or LiO₂/Al, and the like, but are not limited thereto.

Furthermore, the hole injection layer, the hole transporting layer, the electron injection layer, and the electron transporting layer are not particularly limited, and a typical material known in the art may be used.

Hereinafter, the present invention will be described in detail through the Examples. However, the following Examples are only provided to illustrate the present invention, and the present invention is not limited by the following Examples.

[Preparation Example 1] Synthesis of IC-1a and IC-1b

<Step 1> Synthesis of 5-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole



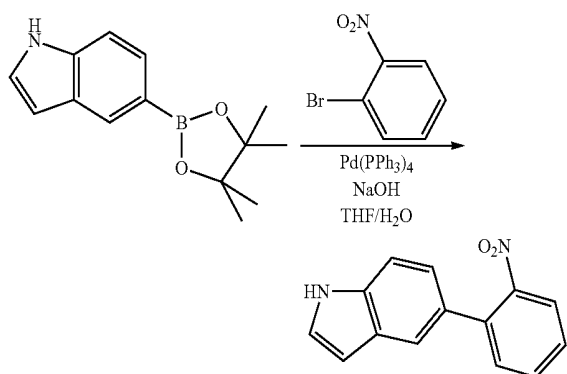
5-bromo-1H-indole (25 g, 0.128 mol), 4,4,4',4',5,5,5',5'-octamethyl-2,2'-bi(1,3,2-dioxaborolane) (48.58 g, 0.191 mol), Pd(dppf)Cl₂ (5.2 g, 5 mol), KOAc (37.55 g, 0.383 mol) and DMF (500 ml) were mixed under nitrogen flow, and the mixture was stirred at 130° C. for 12 hours.

After the reaction was completed, extraction was performed with ethyl acetate, moisture was removed with MgSO₄, and purification was performed by column chromatography (Hexane:EA=10:1 (v/v)), thereby obtaining 5-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole (12.43 g, yield 40%).

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¹H-NMR: δ 2.4 (s, 12H), 6.45 (d, 1H), 7.27 (d, 1H), 7.42 (d, 1H), 7.52 (d, 1H), 7.95 (s, 1H), 8.21 (s, 1H)

<Step 2> Synthesis of 5-(2-nitrophenyl)-1H-indole

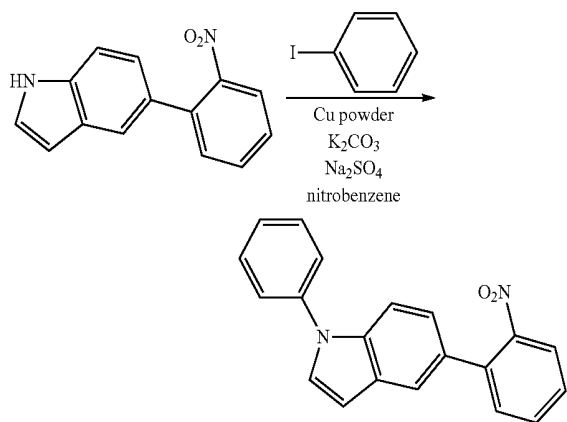


1-bromo-2-nitrobenzene (8 g, 39.6 mmol), 5-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole (11.55 g, 47.5 mmol) obtained in <Step 1>, NaOH (4.75 g, 118.8 mmol) and THF/H₂O (200 ml/100 ml) were mixed under nitrogen flow, then Pd(PPh₃)₄ (2.29 g, 5 mol) was added to the mixture at 40° C., and the resulting mixture was stirred at 80° C. for 12 hours.

After the reaction was completed, the mixture was extracted with methylene chloride, MgSO₄ was added thereto, and extraction was performed. After the solvent was removed from the organic layer obtained, the residue was purified by column chromatography (Hexane:EA=3:1 (v/v)), thereby obtaining 5-(2-nitrophenyl)-1H-indole (6.5 g, yield 69%).

¹H-NMR: δ 6.47 (d, 1H), 7.25 (d, 1H), 7.44 (d, 1H), 7.53 (d, 1H), 7.65 (t, 1H), 7.86 (t, 1H), 7.95 (s, 1H), 8.00 (d, 1H), 8.09 (t, 1H), 8.20 (s, 1H)

<Step 3> Synthesis of 5-(2-nitrophenyl)-1-phenyl-1H-indole



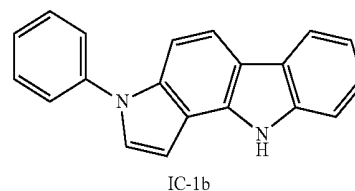
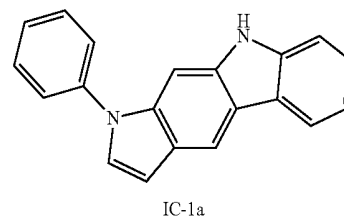
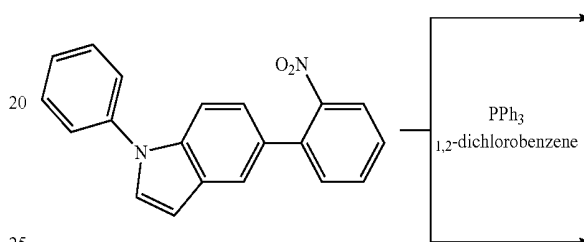
5-(2-nitrophenyl)-1H-indole (6.5 g, 27.28 mmol) obtained in <Step 2>, iodobenzene (8.35 g, 40.93 mmol), Cu powder (0.17 g, 2.73 mmol), K₂CO₃ (3.77 g, 27.28 mmol), Na₂SO₄ (3.88 g, 27.28 mmol), and nitrobenzene (100 ml) were mixed under nitrogen flow, and the mixture was stirred at 190° C. for 12 hours.

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After the reaction was completed, nitrobenzene was removed, the organic layer was separated with methylene chloride, and water was removed by using MgSO₄. After the solvent was removed from the organic layer in which water was removed, the residue was purified by column chromatography (Hexane:MC=3:1 (v/v)), thereby obtaining 5-(2-nitrophenyl)-1-phenyl-1H-indole (6.7 g, yield 78%).

¹H-NMR: δ 6.48 (d, 1H), 7.26 (d, 1H), 7.45 (m, 3H), 7.55 (m, 4H), 7.63 (t, 1H), 7.84 (t, 1H), 7.93 (s, 1H), 8.01 (d, 1H), 8.11 (t, 1H)

<Step 4> Synthesis of IC-1a and IC-1b



5-(2-nitrophenyl)-1-phenyl-1H-indole (6 g, 19.09 mmol) obtained in <Step 3>, triphenylphosphine (PPh₃) (12.52 g, 47.72 mmol) and 1,2-dichlorobenzene (50 ml) were mixed under nitrogen flow, and the mixture was stirred for 12 hours.

After the reaction was completed, 1,2-dichlorobenzene was removed, and extraction was performed with dichloromethane. For the organic layer obtained, water was removed with MgSO₄, and purification was performed by column chromatography (Hexane:MC=3:1 (v/v)), thereby obtaining IC-1a (2.32 g, yield 43%) and IC-1b (2.21 g, yield 41%).

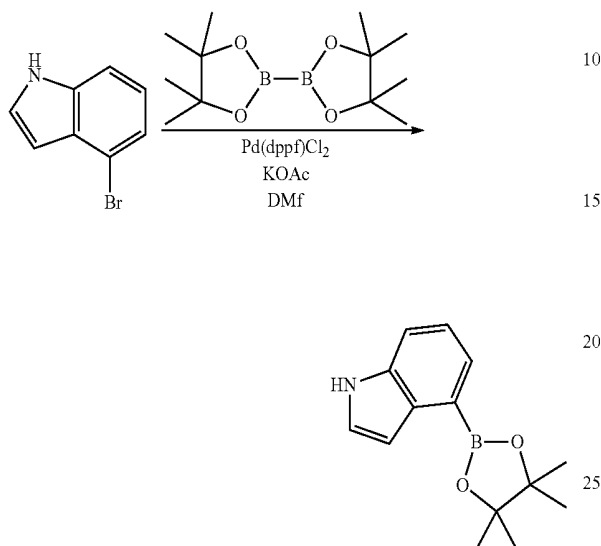
¹H-NMR for IC-1a: δ 6.51 (d, 1H), 7.28 (d, 1H), 7.46 (m, 3H), 7.51 (s, 1H), 7.56 (m, 3H), 7.64 (t, 1H), 7.85 (m, 2H), 8.08 (t, 1H), 8.24 (s, 1H)

¹H-NMR for IC-1b: δ 6.53 (d, 1H), 7.27 (d, 1H), 7.45 (m, 3H), 7.50 (d, 1H), 7.55 (m, 3H), 7.67 (t, 1H), 7.89 (m, 2H), 8.12 (t, 1H), 8.25 (s, 1H)

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[Preparation Example 2] Synthesis of IC-2

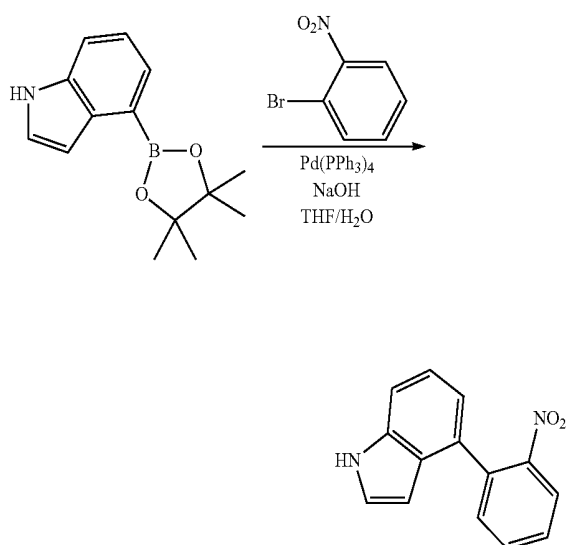
<Step 1> Synthesis of 4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole



4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole was obtained by performing the same procedure as in <Step 1> of Preparation Example 1, except that 4-bromo-1H-indole was used instead of 5-bromo-1H-indole.

$^1\text{H NMR}$: δ 1.26 (s, 12H), 6.43 (d, 1H), 7.26 (t, 1H), 7.48 (d, 1H), 7.74 (d, 1H), 7.85 (d, 1H), 8.23 (s, 1H)

<Step 2> Synthesis of 4-(2-nitrophenyl)-1H-indole

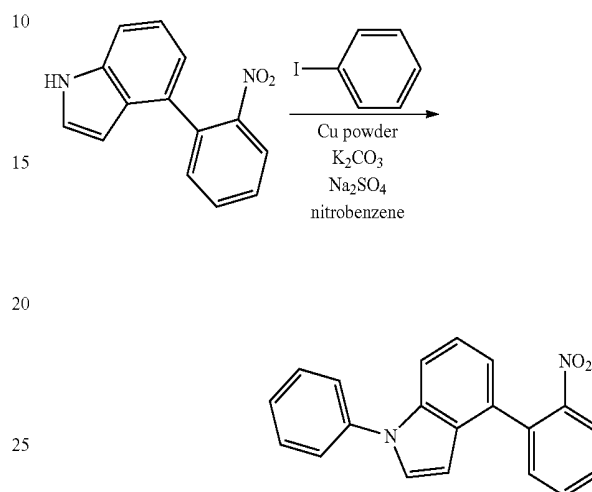


4-(2-nitrophenyl)-1H-indole was obtained by performing the same procedure as in <Step 2> of Preparation Example 1, except that 4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole obtained in <Step 1> was used instead of 5-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole.

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$^1\text{H NMR}$: δ 6.45 (d, 1H), 7.27 (t, 1H), 7.50 (d, 1H), 7.66 (t, 1H), 7.75 (d, 1H), 7.89 (m, 2H), 7.99 (d, 1H), 8.04 (d, 1H), 8.24 (s, 1H)

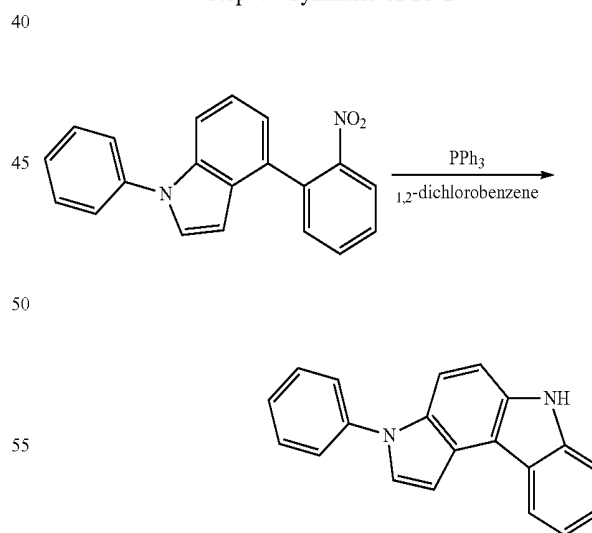
<Step 3> Synthesis of 4-(2-nitrophenyl)-1-phenyl-1H-indole



4-(2-nitrophenyl)-1-phenyl-1H-indole was obtained by performing the same procedure as in <Step 3> of Preparation Example 1, except that 4-(2-nitrophenyl)-1H-indole obtained in <Step 2> was used instead of 5-(2-nitrophenyl)-1H-indole.

$^1\text{H NMR}$: δ 6.47 (d, 1H), 7.28 (t, 1H), 7.47 (m, 2H), 7.52 (m, 2H), 7.60 (m, 2H), 7.67 (t, 1H), 7.75 (d, 1H), 7.89 (m, 2H), 8.00 (d, 1H), 8.06 (d, 1H)

<Step 4> Synthesis of IC-2



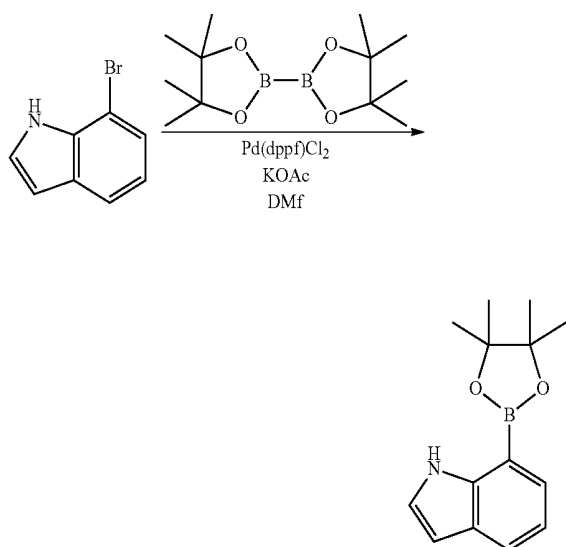
IC-2 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that 4-(2-nitrophenyl)-1-phenyl-1H-indole obtained in <Step 3> was used instead of 5-(2-nitrophenyl)-1-phenyl-1H-indole.

$^1\text{H NMR}$: δ 6.49 (d, 1H), 7.29 (t, 1H), 7.46 (m, 2H), 7.54 (m, 2H), 7.61 (d, 1H), 7.69 (t, 1H), 7.74 (d, 1H), 7.88 (m, 2H), 8.01 (d, 1H), 8.04 (d, 1H), 8.23 (s, 1H)

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[Preparation Example 3] Synthesis of IC-3

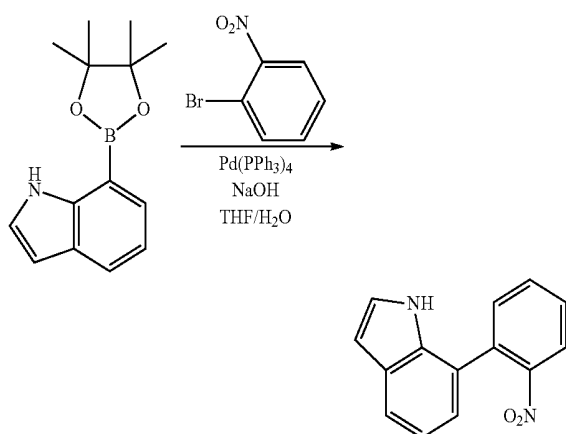
<Step 1> Synthesis of 7-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole



7-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole was obtained by performing the same procedure as in <Step 1> of Preparation Example 1, except that 7-bromo-1H-indole was used instead of 5-bromo-1H-indole.

$^1\text{H NMR}$: δ 1.25 (s, 12H), 6.43 (d, 1H), 7.25 (d, 1H), 7.45 (t, 1H), 7.56 (d, 1H), 7.71 (d, 1H), 8.22 (s, 1H)

<Step 2> Synthesis of 7-(2-nitrophenyl)-1H-indole

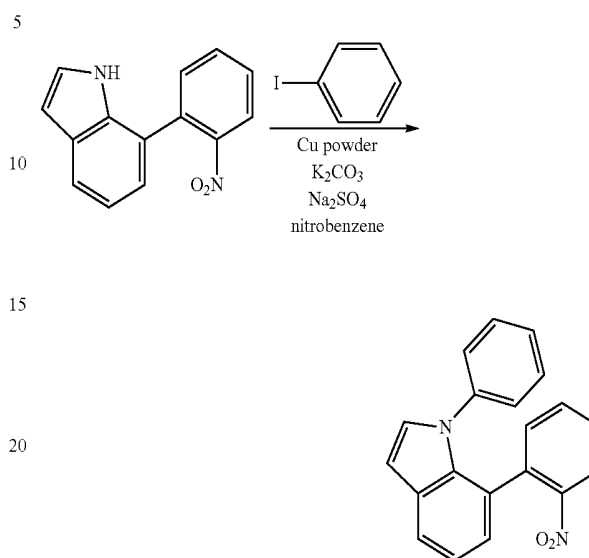


7-(2-nitrophenyl)-1H-indole was obtained by performing the same procedure as in <Step 2> of Preparation Example 1, except that 7-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole obtained in <Step 1> was used instead of 5-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole.

$^1\text{H NMR}$: δ 6.42 (d, 1H), 7.24 (d, 1H), 7.43 (t, 1H), 7.55 (d, 1H), 7.70 (m, 2H), 7.88 (t, 1H), 8.01 (d, 1H), 8.11 (d, 1H), 8.23 (s, 1H)

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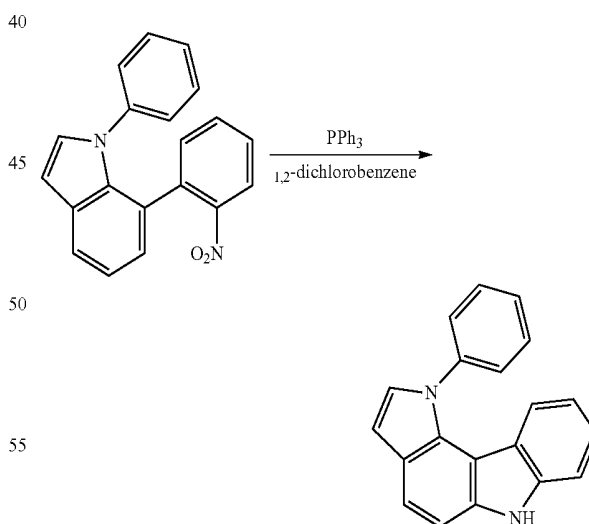
<Step 3> Synthesis of 7-(2-nitrophenyl)-1-phenyl-1H-indole



7-(2-nitrophenyl)-1-phenyl-1H-indole was obtained by performing the same procedure as in <Step 3> of Preparation Example 1, except that 7-(2-nitrophenyl)-1H-indole obtained in <Step 2> was used instead of 5-(2-nitrophenyl)-1H-indole.

$^1\text{H NMR}$: δ 6.43 (d, 1H), 7.26 (d, 1H), 7.44 (m, 3H), 7.56 (m, 4H), 7.71 (m, 2H), 7.89 (t, 1H), 8.02 (d, 1H), 8.10 (d, 1H)

<Step 4> Synthesis of IC-3



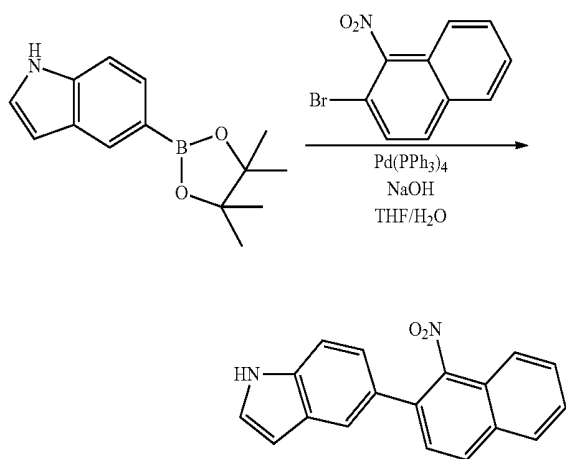
IC-3 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that 7-(2-nitrophenyl)-1-phenyl-1H-indole obtained in <Step 3> was used instead of 5-(2-nitrophenyl)-1-phenyl-1H-indole.

$^1\text{H NMR}$: δ 6.45 (d, 1H), 7.24 (d, 1H), 7.45 (m, 3H), 7.57 (m, 3H), 7.63 (d, 1H), 7.70 (d, 1H), 7.88 (t, 1H), 8.00 (d, 1H), 8.09 (d, 1H), 8.22 (s, 1H)

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[Preparation Example 4] Synthesis of IC-4a and IC-4-b

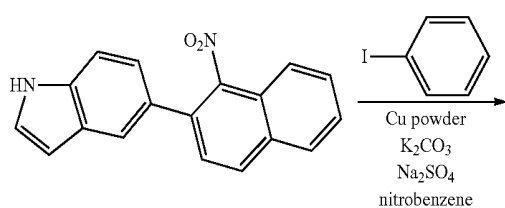
<Step 1> Synthesis of
5-(1-nitronaphthalen-2-yl)-1H-indole



5-(1-nitronaphthalen-2-yl)-1H-indole was obtained by performing the same procedure as in <Step 2> of Preparation Example 1, except that 2-bromo-1-nitronaphthalene was used instead of 1-bromo-2-nitrobenzene.

¹H NMR: δ 6.44 (d, 1H), 7.26 (d, 1H), 7.43 (d, 1H), 7.53 (d, 1H), 7.64 (m, 3H), 7.80 (m, 3H), 7.94 (s, 1H), 8.23 (s, 1H)

<Step 2> Synthesis of
5-(1-nitronaphthalen-2-yl)-1-phenyl-1H-indole

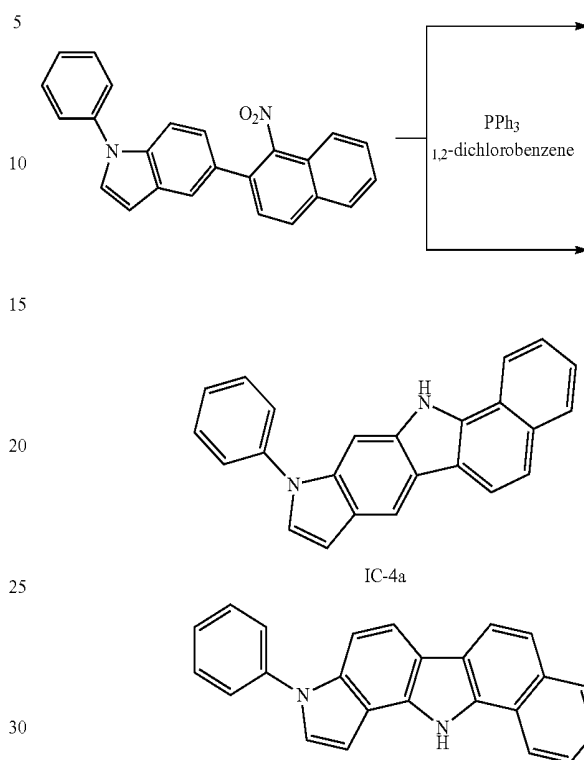


5-(1-nitronaphthalen-2-yl)-1-phenyl-1H-indole was obtained by performing the same procedure as in <Step 3> of Preparation Example 1, except that 5-(1-nitronaphthalen-2-yl)-1H-indole obtained in <Step 1> was used instead of 5-(2-nitrophenyl)-1H-indole.

¹H NMR: δ 6.44 (d, 1H), 7.26 (d, 1H), 7.43 (m, 3H), 7.53 (m, 4H), 7.64 (m, 3H), 7.80 (m, 3H), 7.94 (s, 1H)

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<Step 3> Synthesis of IC-4a and IC-4-b



IC-4a

IC-4b

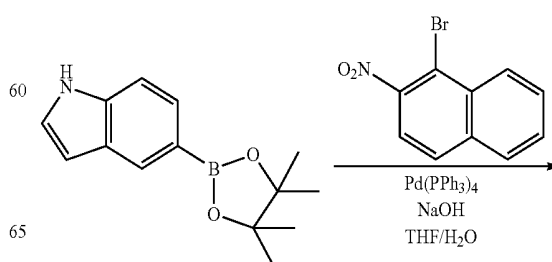
IC-4a and IC-4-b were obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that 5-(1-nitronaphthalen-2-yl)-1-phenyl-1H-indole obtained in <Step 2> was used instead of 5-(2-nitrophenyl)-1-phenyl-1H-indole.

¹H-NMR for IC-4-a: δ 6.44 (d, 1H), 7.26 (m, 2H), 7.43 (s, 1H), 7.53 (m, 4H), 7.64 (m, 3H), 7.71 (s, 1H), 7.80 (m, 3H), 8.20 (s, 1H)

¹H-NMR for IC-4-b: δ 6.43 (d, 1H), 7.27 (m, 2H), 7.42 (d, 1H), 7.55 (m, 4H), 7.65 (d, 1H), 7.72 (m, 3H), 7.82 (m, 3H), 8.20 (s, 1H)

[Preparation Example 5] Synthesis of IC-5a and IC-5b

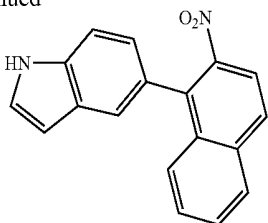
<Step 1> Synthesis of
5-(2-nitronaphthalen-1-yl)-1H-indole



¹H NMR: δ 6.44 (d, 1H), 7.26 (d, 1H), 7.43 (m, 3H), 7.53 (m, 4H), 7.64 (m, 3H), 7.80 (m, 3H), 7.94 (s, 1H)

417

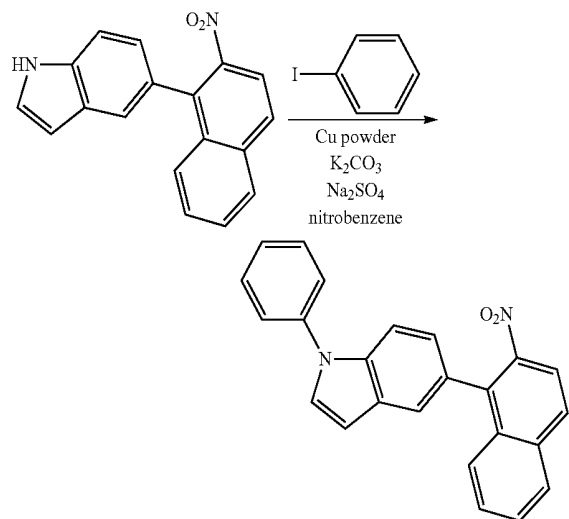
-continued



5-(2-nitronaphthalen-1-yl)-1-phenyl-1H-indole was obtained by performing the same procedure as in <Step 2> of Preparation Example 1, except that 1-bromo-2-nitrobenzene was used instead of 1-bromo-2-nitrobenzene.

$^1\text{H NMR}$: δ 6.43 (d, 1H), 7.25 (d, 1H), 7.44 (d, 1H), 7.55 (d, 1H), 7.67 (m, 2H), 7.81 (d, 1H), 7.96 (m, 2H), 8.00 (d, 1H), 8.05 (d, 1H), 8.23 (s, 1H)

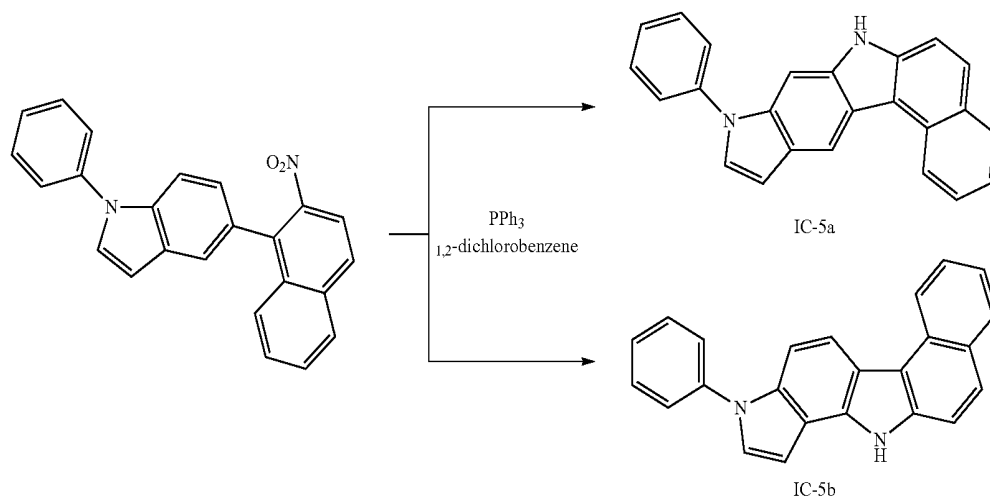
<Step 2> Synthesis of
5-(2-nitronaphthalen-1-yl)-1-phenyl-1H-indole



5-(2-nitronaphthalen-1-yl)-1-phenyl-1H-indole was obtained by performing the same procedure as in <Step 3> of Preparation Example 1, except that 5-(2-nitronaphthalen-1-yl)-1H-indole obtained in <Step 1> was used instead of 5-(2-nitrophenyl)-1H-indole.

$^1\text{H NMR}$: δ 6.45 (d, 1H), 7.26 (d, 1H), 7.45 (m, 2H), 7.54 (m, 2H), 7.66 (m, 3H), 7.80 (d, 1H), 7.96 (m, 2H), 8.01 (m, 2H), 8.06 (m, 2H)

<Step 3> Synthesis of IC-5a and IC-5b



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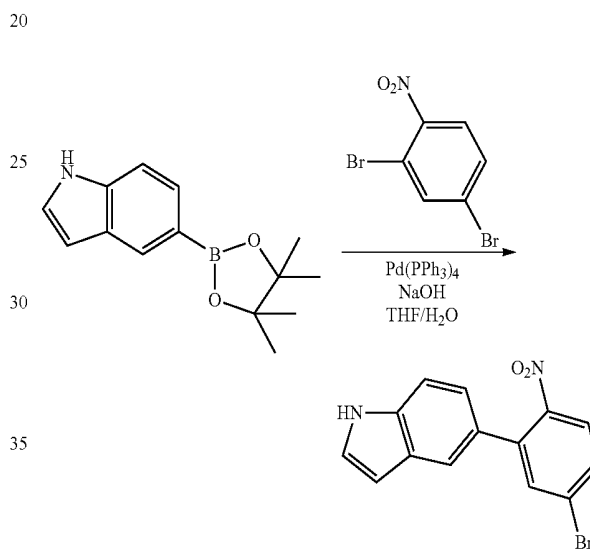
IC-5a and IC-56 were obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that 5-(2-nitronaphthalen-2-yl)-1-phenyl-1H-indole obtained in <Step 2> was used instead of 5-(2-nitrophenyl)-1-phenyl-1H-indole.

$^1\text{H NMR}$ for IC-5a: δ 6.45 (d, 1H), 7.26 (d, 1H), 7.45 (s, 1H), 7.54 (s, 1H), 7.66 (m, 2H), 7.80 (m, 3H), 7.96 (m, 2H), 8.01 (m, 2H), 8.06 (m, 2H), 8.21 (s, 1H)

$^1\text{H NMR}$ for IC-5b: δ 6.43 (d, 1H), 7.25 (d, 1H), 7.46 (d, 1H), 7.57 (d, 1H), 7.65 (m, 2H), 7.81 (m, 3H), 7.95 (m, 2H), 8.00 (m, 2H), 8.05 (m, 2H), 8.21 (s, 1H)

[Preparation Example 6] Synthesis of IC-6a and IC-6b

<Step 1> Synthesis of
5-(5-bromo-2-nitrophenyl)-1H-indole

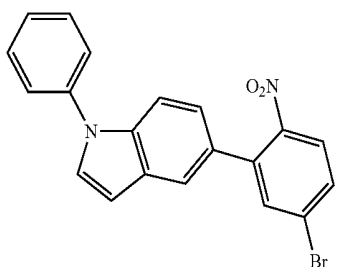
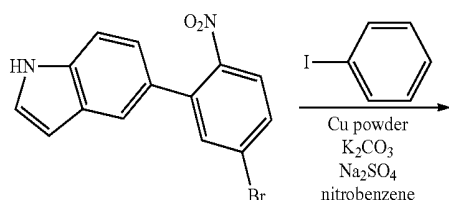


5-(5-bromo-2-nitrophenyl)-1H-indole was obtained by performing the same procedure as in <Step 2> of Preparation Example 1, except that 2,4-dibromo-1-nitrobenzene was used instead of 1-bromo-2-nitrobenzene.

$^1\text{H NMR}$: δ 6.45 (d, 1H), 7.26 (d, 1H), 7.45 (d, 1H), 7.55 (d, 1H), 7.64 (d, 1H), 7.85 (d, 1H), 7.96 (s, 1H), 8.13 (s, 1H), 8.21 (s, 1H)

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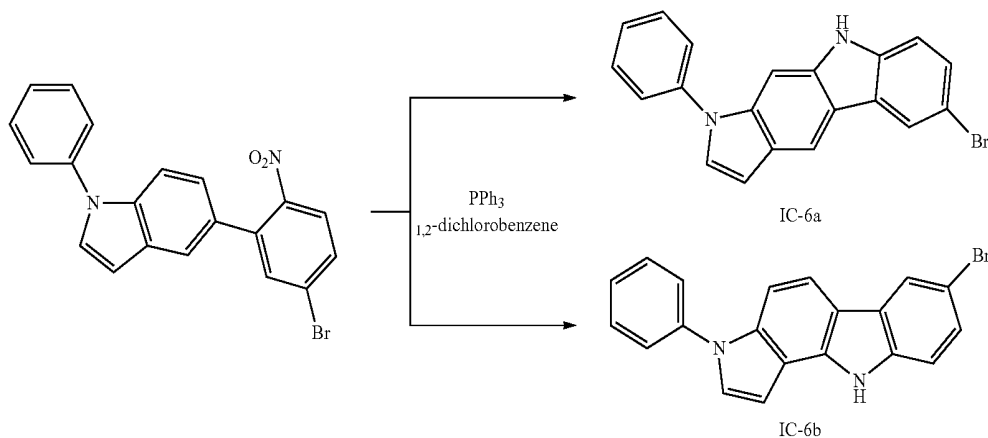
<Step 2> Synthesis of
5-(5-bromo-2-nitrophenyl)-1-phenyl-1H-indole



5-(5-bromo-2-nitrophenyl)-1-phenyl-1H-indole was obtained by performing the same procedure as in <Step 3> of Preparation Example 1, except that 5-(5-bromo-2-nitrophenyl)-1H-indole obtained in <Step 1> was used instead of 5-(2-nitrophenyl)-1H-indole.

¹H NMR: δ 6.44 (d, 1H), 7.25 (d, 1H), 7.46 (m, 3H), 7.56 (m, 4H), 7.65 (d, 1H), 7.86 (d, 1H), 7.95 (s, 1H), 8.11 (s, 1H)

<Step 3> Synthesis of IC-6a and IC-6b



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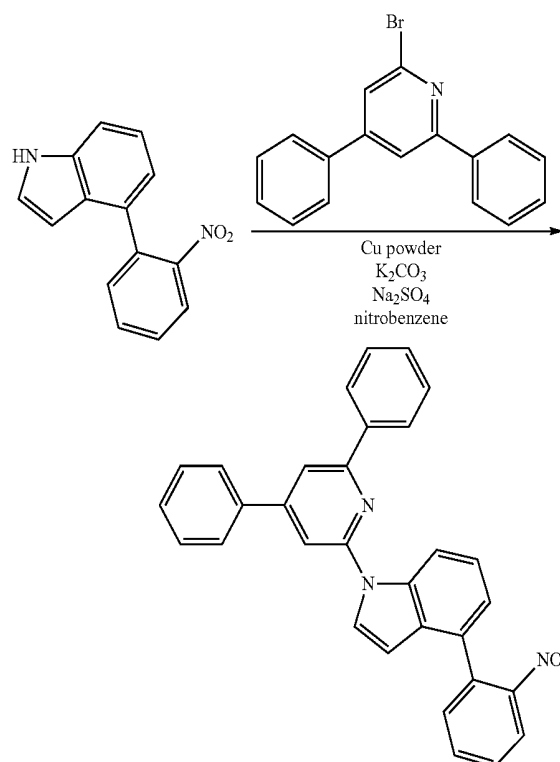
IC-6a and IC-6b were obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that 5-(5-bromo-2-nitrophenyl)-1-phenyl-1H-indole obtained in <Step 2> was used instead of 5-(2-nitrophenyl)-1-phenyl-1H-indole.

¹H-NMR for IC-6a: δ 6.44 (d, 1H), 7.25 (d, 1H), 7.39 (m, 2H), 7.46 (s, 1H), 7.50 (s, 1H), 7.58 (m, 3H), 7.65 (d, 1H), 7.86 (d, 1H), 8.11 (s, 1H), 8.22 (s, 1H)

¹H-NMR for IC-6b: δ 6.45 (d, 1H), 7.26 (d, 1H), 7.38 (m, 2H), 7.45 (d, 1H), 7.51 (d, 1H), 7.57 (m, 3H), 7.64 (d, 1H), 7.85 (d, 1H), 8.10 (s, 1H), 8.23 (s, 1H)

[Preparation Example 7] Synthesis of IC-7

<Step 1> Synthesis of 1-(4,6-diphenylpyridin-2-yl)-4-(2-nitrophenyl)-1H-indole



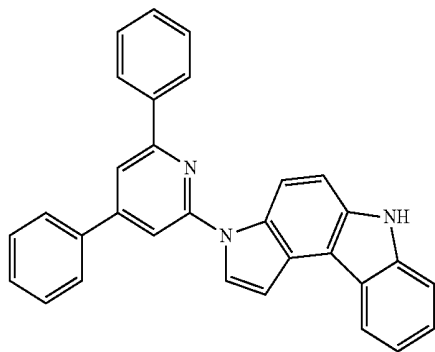
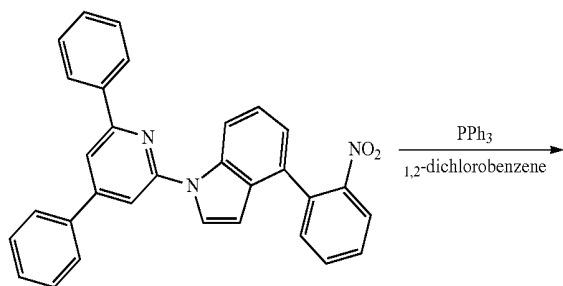
1-(4,6-diphenylpyridin-2-yl)-4-(2-nitrophenyl)-1H-indole was obtained by performing the same procedure as in

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<Step 3> of Preparation Example 1, except that 4-(2-nitrophenyl)-1H-indole was used instead of 5-(2-nitrophenyl)-1H-indole and 2-bromo-4,6-diphenylpyridine was used instead of iodobenzene.

GC-Mass (theoretical value: 467.16 g/mol, measured value: 467 g/mol).

<Step 2> Synthesis of IC-7

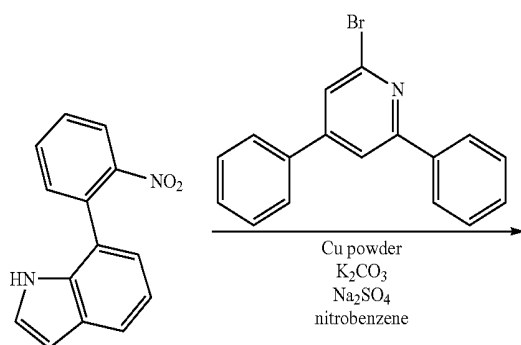


IC-7 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that 1-(4,6-diphenylpyridin-2-yl)-4-(2-nitrophenyl)-1H-indole obtained in <Step 1> was used instead of 5-(2-nitrophenyl)-1-phenyl-1H-indole.

GC-Mass (theoretical value: 435.17 g/mol, measured value: 435 g/mol)

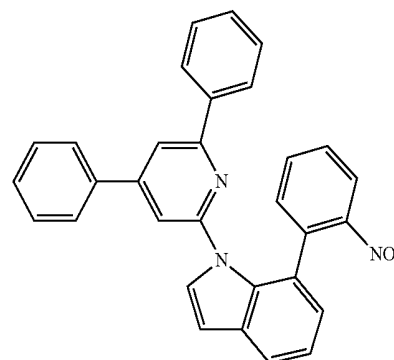
[Preparation Example 8] Synthesis of IC-8

<Step 1> Synthesis of 1-(4,6-diphenylpyridin-2-yl)-7-(2-nitrophenyl)-1H-indole



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-continued



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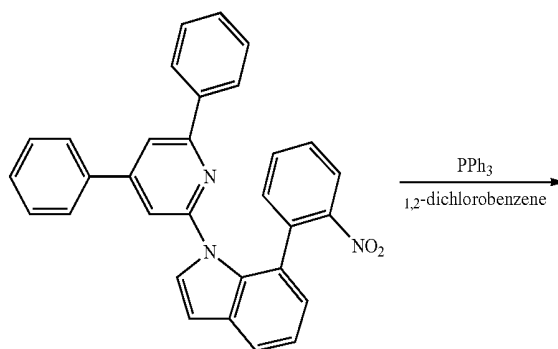
20

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1-(4,6-diphenylpyridin-2-yl)-7-(2-nitrophenyl)-1H-indole was obtained by performing the same procedure as in <Step 3> of Preparation Example 1, except that 7-(2-nitrophenyl)-1H-indole was used instead of 5-(2-nitrophenyl)-1H-indole and 2-bromo-4,6-diphenylpyridine was used instead of iodobenzene.

GC-Mass (theoretical value: 467.16 g/mol, measured value: 467 g/mol)

<Step 2> Synthesis of IC-8



30

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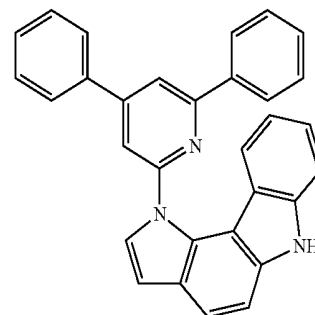
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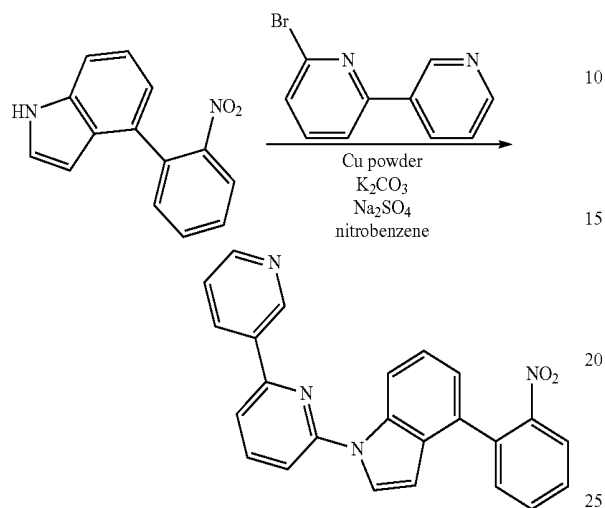
IC-8 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that 1-(4,6-diphenylpyridin-2-yl)-7-(2-nitrophenyl)-1H-indole obtained in <Step 1> was used instead of 5-(2-nitrophenyl)-1-phenyl-1H-indole.

GC-Mass (theoretical value: 435.17 g/mol, measured value: 435 g/mol)

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[Preparation Example 9] Synthesis of IC-9

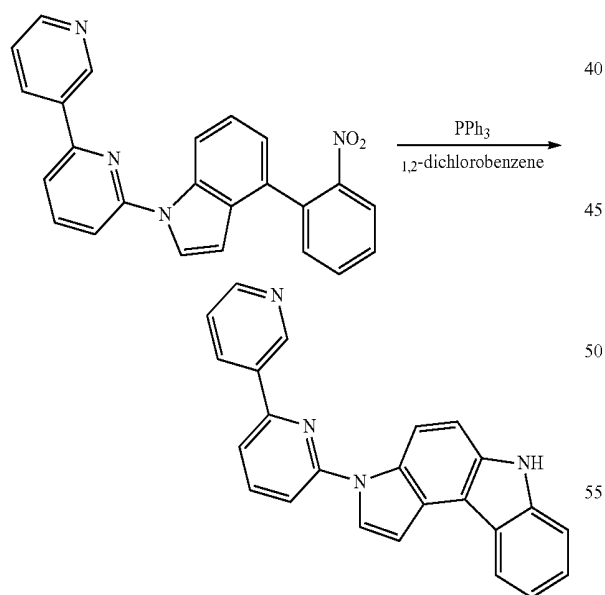
<Step 1> Synthesis of 1-(2,3'-bipyridin-6-yl)-4-(2-nitrophenyl)-1H-indole



1-(2,3'-bipyridin-6-yl)-4-(2-nitrophenyl)-1H-indole was obtained by performing the same procedure as in <Step 3> of Preparation Example 2, except that 6-bromo-2,3'-bipyridine was used instead of iodobenzene.

GC-Mass (theoretical value: 392.13 g/mol, measured value: 392 g/mol)<

<Step 2> Synthesis of IC-9



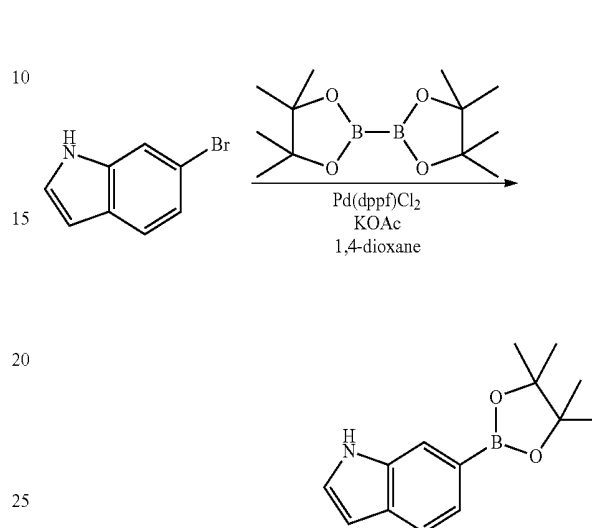
IC-9 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that 1-(2,3'-bipyridin-6-yl)-4-(2-nitrophenyl)-1H-indole obtained in <Step 1> was used instead of 5-(2-nitrophenyl)-1-phenyl-1H-indole.

GC-Mass (theoretical value: 360.14 g/mol, measured value: 360 g/mol)

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[Preparation Example 10] Synthesis of IC-10a and IC-10b

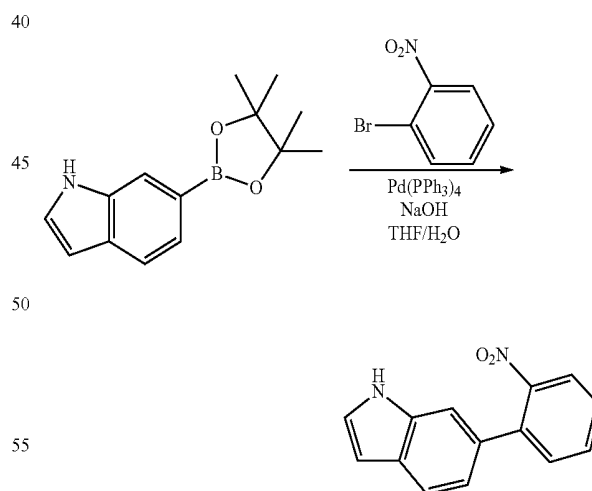
<Step 1> Synthesis of 6-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole



6-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole was obtained by performing the same procedure as in <Step 1> of Preparation Example 1, except that 6-bromo-1H-indole was used instead of 5-bromo-1H-indole.

¹H-NMR: δ 1.25 (s, 12H), 6.52 (d, 1H), 7.16 (d, 1H), 7.21 (d, 1H), 7.49 (d, 1H), 7.53 (s, 1H), 8.15 (s, 1H)

<Step 2> Synthesis of 6-(2-nitrophenyl)-1H-indole

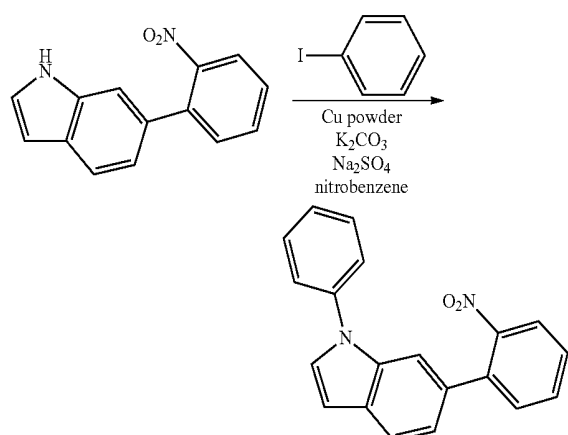


6-(2-nitrophenyl)-1H-indole was obtained by performing the same procedure as in <Step 2> of Preparation Example 1, except that 6-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole was used instead of 5-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole.

¹H-NMR: δ 6.57 (d, 1H), 7.07 (d, 1H), 7.24 (d, 1H), 7.35 (s, 1H), 7.43 (t, 1H), 7.50 (d, 1H), 7.58 (t, 1H), 7.66 (d, 1H), 7.78 (d, 1H), 8.19 (s, 1H)

425

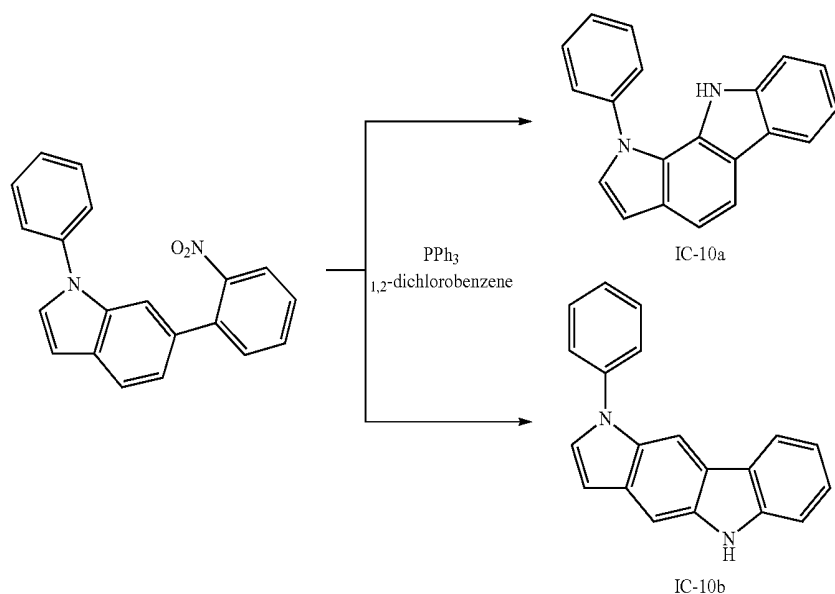
<Step 3> Synthesis of
6-(2-nitrophenyl)-1-phenyl-1H-indole



6-(2-nitrophenyl)-1-phenyl-1H-indole was obtained by performing the same procedure as in <Step 3> of Preparation Example 1, except that 6-(2-nitrophenyl)-1H-indole was used instead of 5-(2-nitrophenyl)-1H-indole.

$^1\text{H-NMR}$: δ 6.81 (d, 1H), 7.12 (t, 1H), 7.22 (t, 1H), 7.35 (s, 1H), 7.43 (d, 1H), 7.51 (m, 3H), 7.56 (m, 2H), 7.62 (m, 2H), 7.85 (d, 1H), 8.02 (d, 1H)

<Step 4> Synthesis of IC-10a and IC-10b



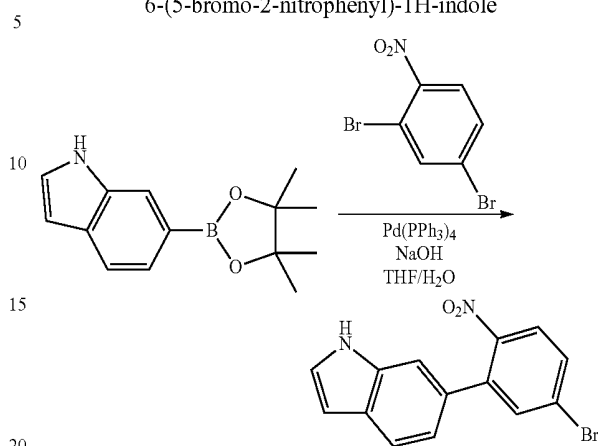
IC-10a and IC-10b were obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that 6-(2-nitrophenyl)-1-phenyl-1H-indole was used instead of 5-(2-nitrophenyl)-1-phenyl-1H-indole.

$^1\text{H-NMR}$: δ 6.80 (d, 1H), 7.11 (t, 1H), 7.23 (t, 1H), 7.42 (d, 1H), 7.50 (m, 3H), 7.57 (m, 2H), 7.63 (m, 2H), 7.86 (d, 1H), 8.03 (d, 1H), 9.81 (s, 1H)

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[Preparation Example 11] Synthesis of IC-11

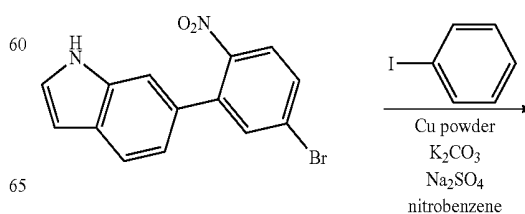
<Step 1> Synthesis of
6-(5-bromo-2-nitrophenyl)-1H-indole



6-(5-bromo-2-nitrophenyl)-1H-indole was obtained by performing the same procedure as in <Step 2> of Preparation Example 1, except that 2,4-dibromo-1-nitrobenzene and 6-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole were used instead of 1-bromo-2-nitrobenzene and 5-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole.

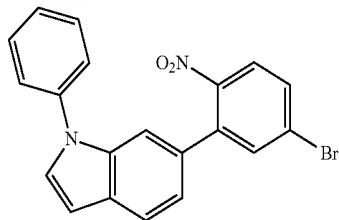
$^1\text{H NMR}$: δ 6.51 (d, 1H), 7.31 (d, 1H), 7.50 (d, 1H), 7.60 (d, 1H), 7.69 (d, 1H), 7.90 (d, 1H), 8.01 (s, 1H), 8.14 (s, 1H), 8.25 (s, 1H)

<Step 2> Synthesis of
6-(5-bromo-2-nitrophenyl)-1-phenyl-1H-indole



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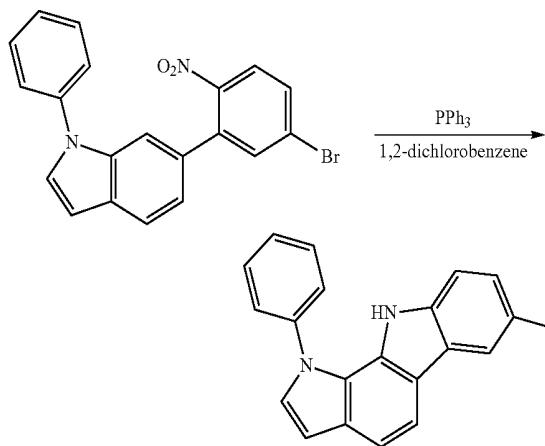
-continued



6-(5-bromo-2-nitrophenyl)-1-phenyl-1H-indole was obtained by performing the same procedure as in <Step 3> of Preparation Example 1, except that 6-(5-bromo-2-nitrophenyl)-1H-indole obtained in <Step 1> was used instead of 5-(2-nitrophenyl)-1H-indole.

¹H-NMR: δ 6.49 (d, 1H), 7.30 (d, 1H), 7.51 (m, 3H), 7.61 (m, 4H), 7.70 (d, 1H), 7.91 (d, 1H), 8.00 (s, 1H), 8.16 (s, 1H),

<Step 3> Synthesis of IC-11

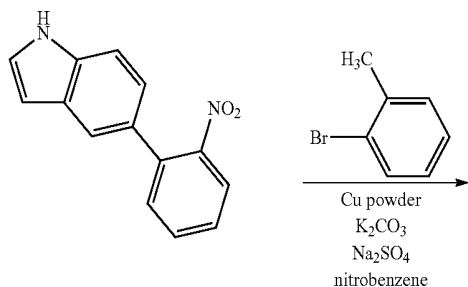


IC-11 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that 6-(5-bromo-2-nitrophenyl)-1-phenyl-1H-indole obtained in <Step 2> was used instead of 5-(2-nitrophenyl)-1-phenyl-1H-indole.

¹H-NMR: δ 6.47 (d, 1H), 7.28 (d, 1H), 7.40 (m, 2H), 7.47 (d, 1H), 7.53 (d, 1H), 7.59 (m, 3H), 7.66 (d, 1H), 7.87 (d, 1H), 8.12 (s, 1H), 8.25 (s, 1H)

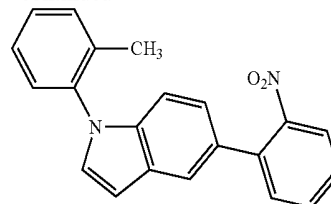
[Preparation Example 12] Synthesis of IC-12

<Step 1> Synthesis of 5-(2-nitrophenyl)-1-o-tolyl-1H-indole



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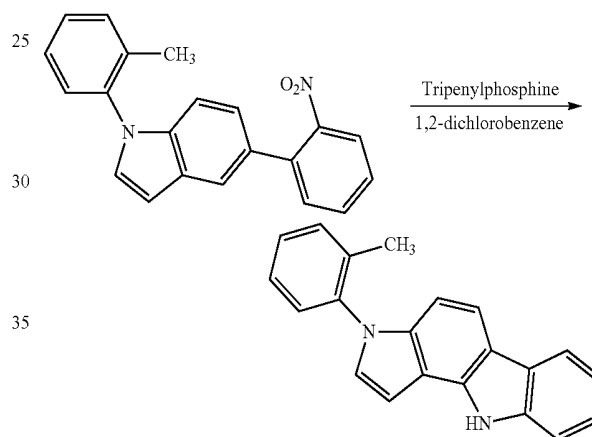
-continued



5-(2-nitrophenyl)-1-o-tolyl-1H-indole was obtained by performing the same procedure as in <Step 3> of Preparation Example 1, except that 1-bromo-2-methylbenzene was used instead of iodobenzene.

¹H-NMR: δ 1.92 (s, 3H), 6.47 (d, 1H), 7.25 (d, 1H), 7.46 (m, 3H), 7.56 (m, 3H), 7.64 (t, 1H), 7.85 (t, 1H), 7.94 (s, 1H), 8.00 (d, 1H), 8.12 (t, 1H)

<Step 2> Synthesis of IC-12

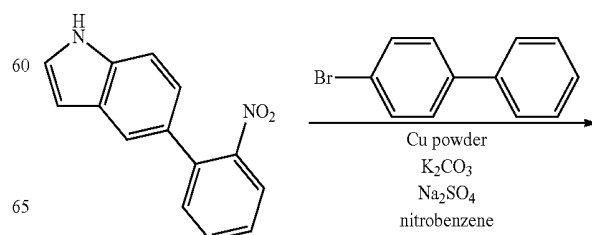


IC-12 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that 5-(2-nitrophenyl)-1-o-tolyl-1H-indole obtained in <Step 1> was used instead of 5-(2-nitrophenyl)-1-phenyl-1H-indole.

¹H-NMR: δ 1.93 (s, 3H), 6.98 (d, 1H), 7.11 (t, 1H), 7.28 (t, 1H), 7.31 (d, 1H), 7.42 (t, 1H), 7.51 (d, 1H), 7.61 (m, 4H), 7.86 (d, 1H), 8.01 (d, 1H), 10.58 (s, 1H)

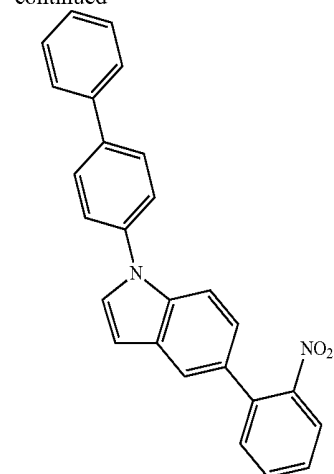
[Preparation Example 13] Synthesis of IC-13

<Step 1> Synthesis of 1-(biphenyl-4-yl)-5-(2-nitrophenyl)-1H-indole



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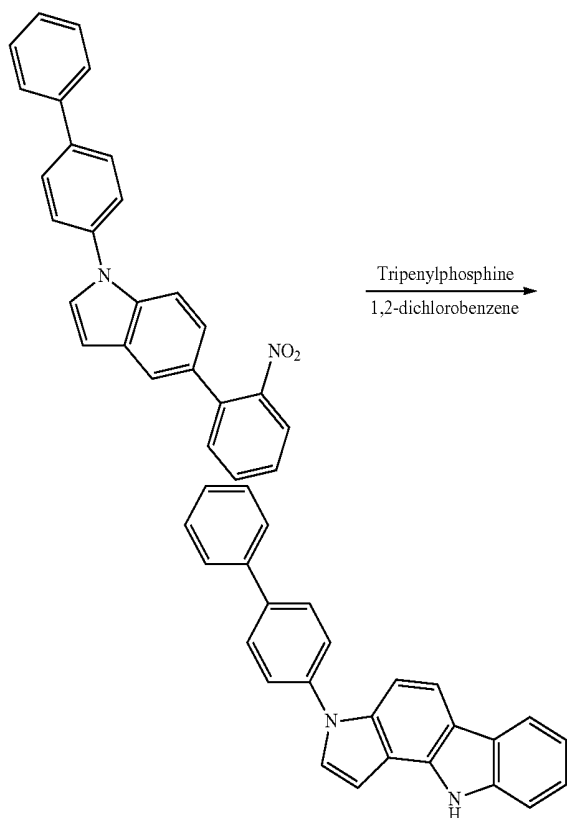
-continued



1-(biphenyl-4-yl)-5-(2-nitrophenyl)-1H-indole was obtained by performing the same procedure as in <Step 3> of Preparation Example 1, except that 4-bromobiphenyl was used instead of iodobenzene.

$^1\text{H-NMR}$: δ 6.73 (d, 1H), 7.18 (d, 1H), 7.39 (m, 2H), 7.47 (m, 3H), 7.54 (d, 1H), 7.59 (m, 3H), 7.64 (m, 4H), 7.75 (d, 2H), 7.82 (d, 1H)

<Step 2> Synthesis of IC-13



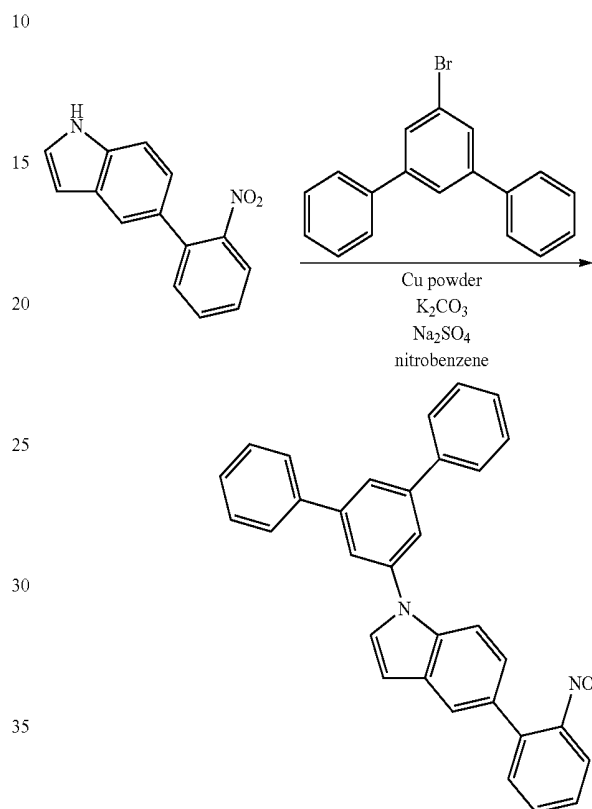
IC-13 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that 1-(biphenyl-4-yl)-5-(2-nitrophenyl)-1H-indole obtained in <Step 1> was used instead of 5-(2-nitrophenyl)-1-phenyl-1H-indole.

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$^1\text{H-NMR}$: δ 6.75 (d, 1H), 7.20 (d, 1H), 7.42 (m, 2H), 7.51 (m, 3H), 7.56 (d, 1H), 7.62 (m, 3H), 7.68 (m, 3H), 7.76 (d, 2H), 7.85 (d, 1H), 10.45 (s, 1H)

5 [Preparation Example 14] Synthesis of IC-14

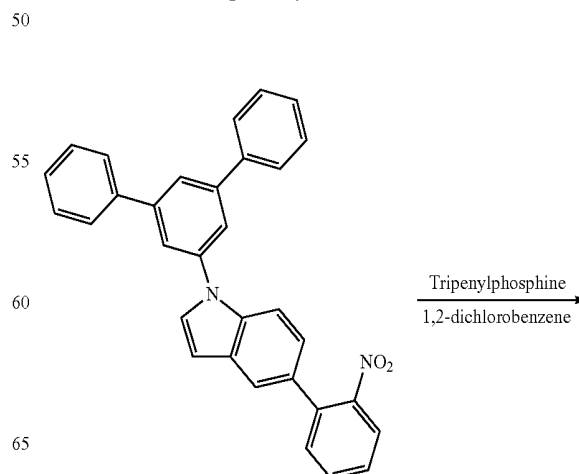
<Step 2> Synthesis of IC-14-1



IC-14-1 was obtained by performing the same procedure as in <Step 3> of Preparation Example 1, except that 1-bromo-3,5-diphenylbenzene was used instead of iodobenzene.

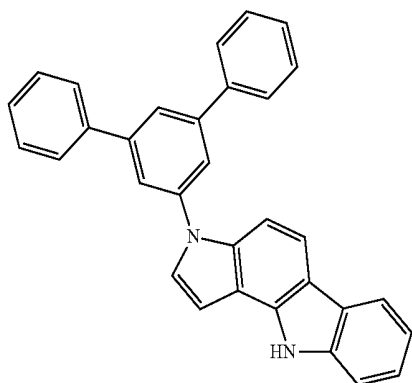
$^1\text{H-NMR}$: δ 6.98 (d, 1H), 7.11 (t, 1H), 7.24 (t, 1H), 7.38 (t, 2H), 7.46 (m, 6H), 7.58 (d, 1H), 7.81 (d, 4H), 7.87 (m, 4H), 7.93 (d, 1H), 7.99 (d, 1H)

<Step 2> Synthesis of IC-14



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-continued

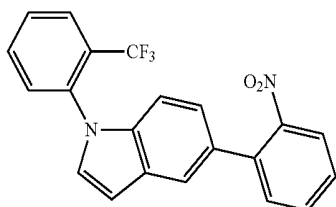
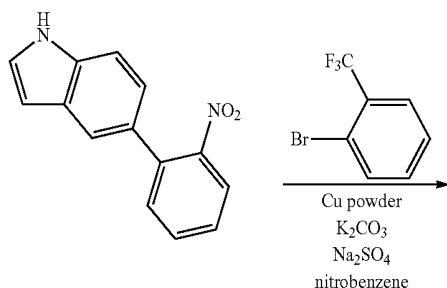


IC-14 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that IC-11-1 obtained in <Step 1> was used instead of 5-(2-nitrophenyl)-1-phenyl-1H-indole.

¹H-NMR: δ 6.97 (d, 1H), 7.10 (t, 1H), 7.23 (t, 1H), 7.37 (t, 2H), 7.45 (m, 6H), 7.58 (d, 1H), 7.80 (d, 4H), 7.86 (m, 3H), 7.92 (d, 1H), 7.98 (d, 1H), 10.60 (s, 1H)

[Preparation Example 15] Synthesis of IC-15

<Step 1> Synthesis of 5-(2-nitrophenyl)-1-(2-(trifluoromethyl)phenyl)-1H-indole

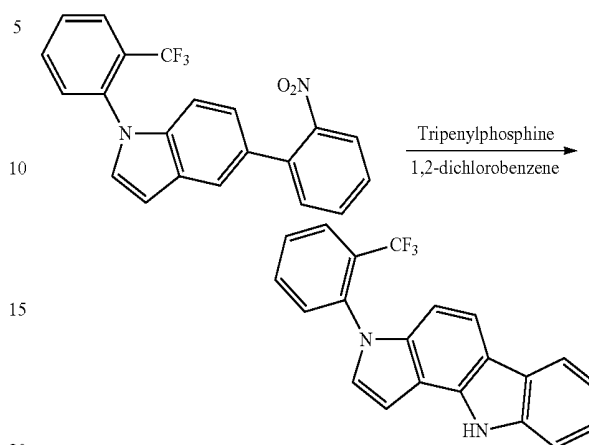


5-(2-nitrophenyl)-1-(2-(trifluoromethyl)phenyl)-1H-indole was obtained by performing the same procedure as in <Step 3> of Preparation Example 1, except that 1-bromo-2-(trifluoromethyl)benzene was used instead of iodobenzene.

¹H-NMR: δ 6.48 (d, 1H), 7.26 (d, 1H), 7.47 (m, 3H), 7.57 (m, 3H), 7.63 (t, 1H), 7.84 (t, 1H), 7.95 (s, 1H), 8.01 (d, 1H), 8.13 (t, 1H)

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<Step 2> Synthesis of IC-15

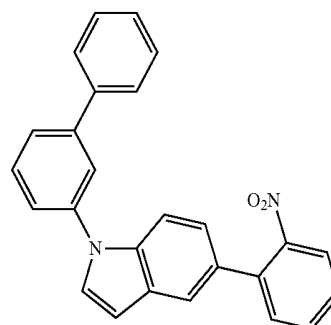
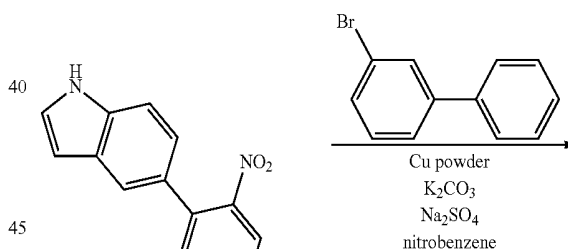


IC-15 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that 5-(2-nitrophenyl)-1-(2-(trifluoromethyl)phenyl)-1H-indole obtained in <Step 1> was used instead of 5-(2-nitrophenyl)-1-phenyl-1H-indole.

¹H-NMR: δ 6.97 (d, 1H), 7.12 (t, 1H), 7.29 (t, 1H), 7.32 (d, 1H), 7.41 (t, 1H), 7.52 (d, 1H), 7.60 (m, 4H), 7.85 (d, 1H), 8.01 (d, 1H), 10.57 (s, 1H)

[Preparation Example 16] Synthesis of IC-16

<Step 1> Synthesis of 1-(biphenyl-3-yl)-5-(2-nitrophenyl)-1H-indole

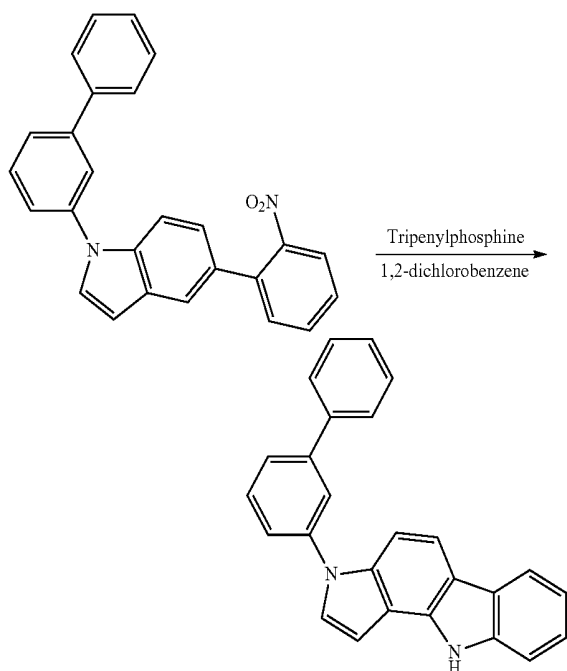


1-(biphenyl-3-yl)-5-(2-nitrophenyl)-1H-indole was obtained by performing the same procedure as in <Step 3> of Preparation Example 1, except that 3-bromobiphenyl was used instead of iodobenzene.

¹H-NMR: δ 6.75 (d, 1H), 7.19 (d, 1H), 7.38 (m, 2H), 7.48 (m, 3H), 7.52 (d, 1H), 7.58 (m, 3H), 7.65 (m, 4H), 7.76 (m, 2H), 7.85 (d, 1H)

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<Step 2> Synthesis of IC-16

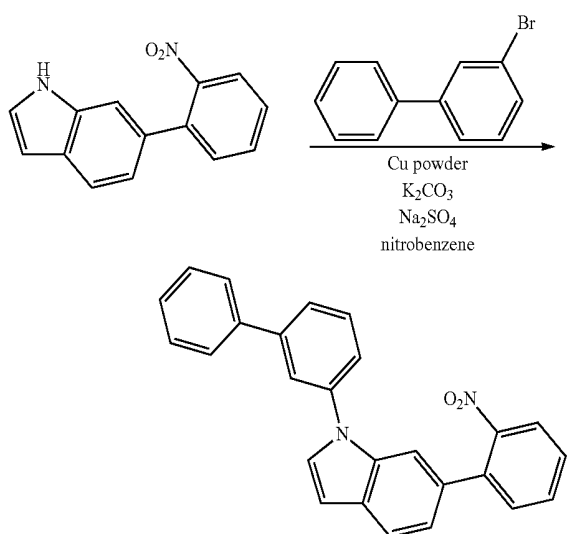


IC-16 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that 1-(biphenyl-3-yl)-5-(2-nitrophenyl)-1H-indole obtained in <Step 1> was used instead of 5-(2-nitrophenyl)-1-phenyl-1H-indole.

$^1\text{H-NMR}$: δ 6.74 (d, 1H), 7.21 (d, 1H), 7.41 (m, 2H), 7.52 (m, 3H), 7.56 (d, 1H), 7.61 (m, 3H), 7.69 (m, 3H), 7.77 (m, 2H), 7.86 (d, 1H), 10.44 (s, 1H)

[Preparation Example 17] Synthesis of IC-17

<Step 1> Synthesis of 1-(biphenyl-3-yl)-6-(2-nitrophenyl)-1H-indole



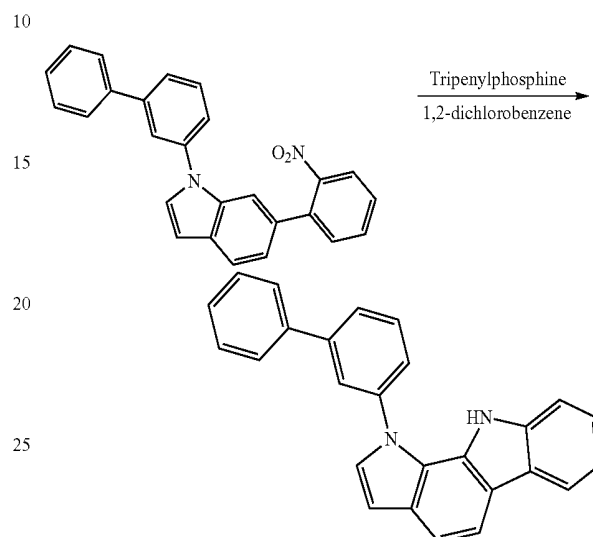
1-(biphenyl-3-yl)-6-(2-nitrophenyl)-1H-indole was obtained by performing the same procedure as in <Step 3>

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of Preparation Example 1, except that 6-(2-nitrophenyl)-1H-indole and 3-bromobiphenyl were used instead of instead of 5-(2-nitrophenyl)-1H-indole and Iodobenzene.

$^1\text{H-NMR}$: δ 6.76 (d, 1H), 7.18 (d, 1H), 7.37 (m, 2H), 7.47 (m, 3H), 7.51 (d, 1H), 7.57 (m, 3H), 7.64 (m, 4H), 7.75 (m, 2H), 7.86 (d, 1H)

<Step 2> Synthesis of IC-17

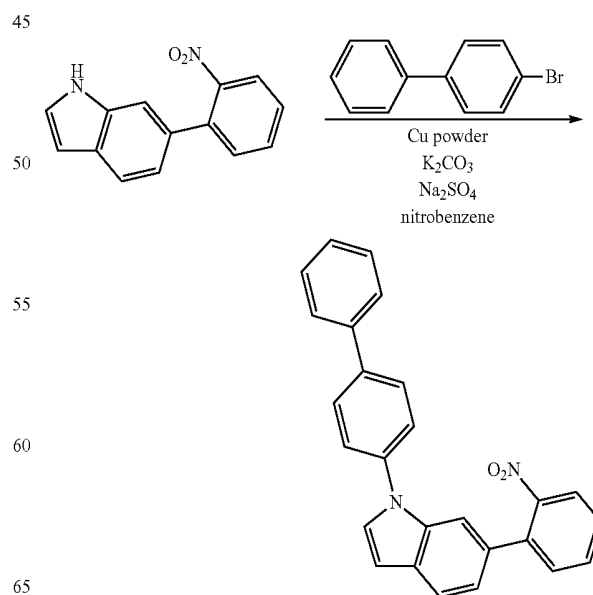


IC-17 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that 1-(biphenyl-3-yl)-6-(2-nitrophenyl)-1H-indole obtained in <Step 1> was used instead of 5-(2-nitrophenyl)-1-phenyl-1H-indole.

$^1\text{H-NMR}$: δ 6.75 (d, 1H), 7.20 (d, 1H), 7.40 (m, 2H), 7.51 (m, 3H), 7.57 (d, 1H), 7.62 (m, 3H), 7.70 (m, 3H), 7.76 (m, 2H), 7.85 (d, 1H), 10.43 (s, 1H)

[Preparation Example 18] Synthesis of IC-18

<Step 1> Synthesis of 1-(biphenyl-4-yl)-6-(2-nitrophenyl)-1H-indole

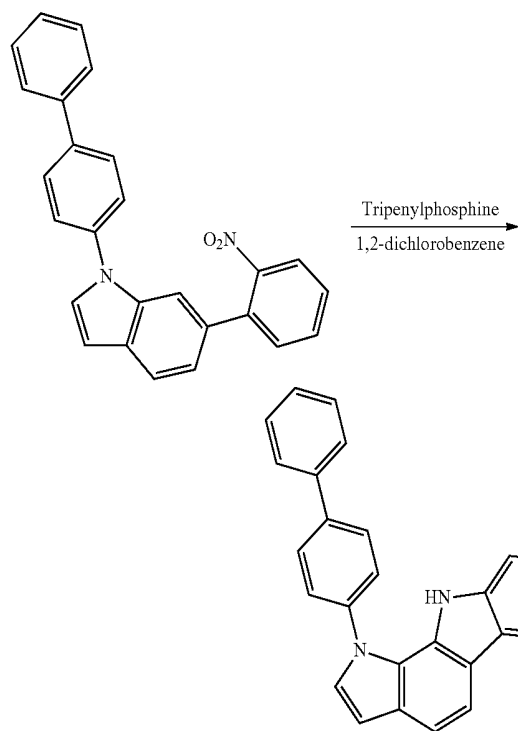


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1-(biphenyl-4-yl)-6-(2-nitrophenyl)-1H-indole was obtained by performing the same procedure as in <Step 3> of Preparation Example 1, except that 6-(2-nitrophenyl)-1H-indole and 4-bromobiphenyl were used instead of 5-(2-nitrophenyl)-1H-indole and iodobenzene.

$^1\text{H-NMR}$: δ 6.74 (d, 1H), 7.19 (d, 1H), 7.40 (m, 2H), 7.46 (m, 3H), 7.55 (d, 1H), 7.58 (m, 3H), 7.63 (m, 4H), 7.75 (d, 2H), 7.83 (d, 1H)

<Step 2> Synthesis of IC-18

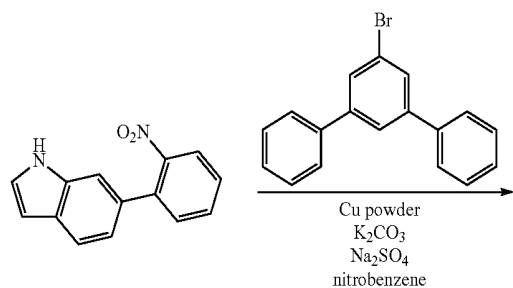


IC-18 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that 1-(biphenyl-4-yl)-6-(2-nitrophenyl)-1H-indole obtained in <Step 1> was used instead of 5-(2-nitrophenyl)-1-phenyl-1H-indole.

$^1\text{H-NMR}$: δ 6.74 (d, 1H), 7.19 (d, 1H), 7.43 (m, 2H), 7.52 (m, 3H), 7.57 (d, 1H), 7.63 (m, 3H), 7.69 (m, 3H), 7.75 (d, 2H), 7.86 (d, 1H), 10.46 (s, 1H)

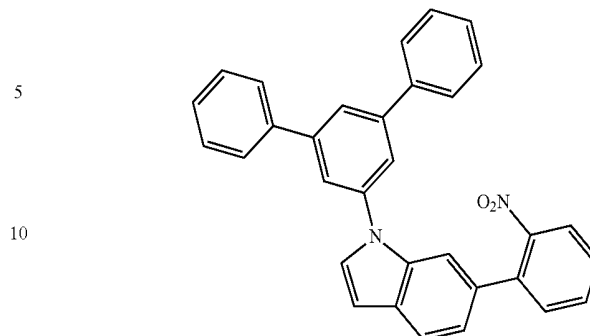
[Preparation Example 19] Synthesis of IC-19

<Step 1> Synthesis of IC-19-1



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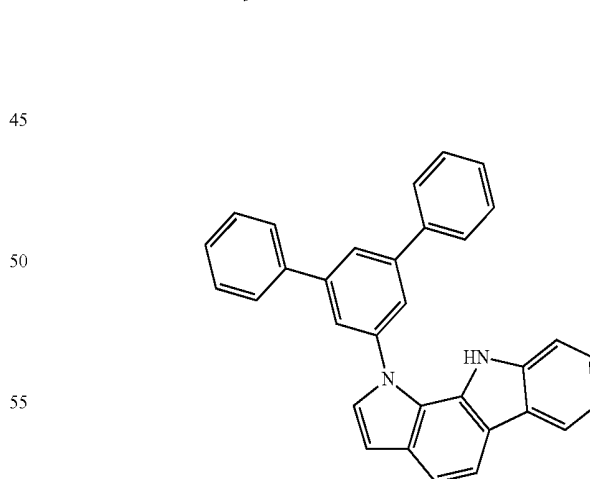
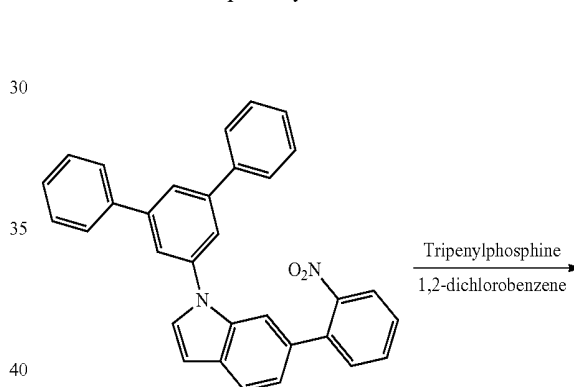
-continued



IC-19-1 was obtained by performing the same procedure as in <Step 3> of Preparation Example 1, except that 6-(2-nitrophenyl)-1H-indole and 1-bromo-3,5-diphenyl benzene were used instead of 5-(2-nitrophenyl)-1-phenyl-1H-indole and iodobenzene.

$^1\text{H-NMR}$: δ 6.98 (d, 1H), 7.11 (t, 1H), 7.24 (t, 1H), 7.38 (m, 2H), 7.45 (m, 6H), 7.57 (d, 1H), 7.80 (d, 4H), 7.86 (m, 4H), 7.92 (d, 1H), 7.98 (d, 1H)

<Step 2> Synthesis of IC-19



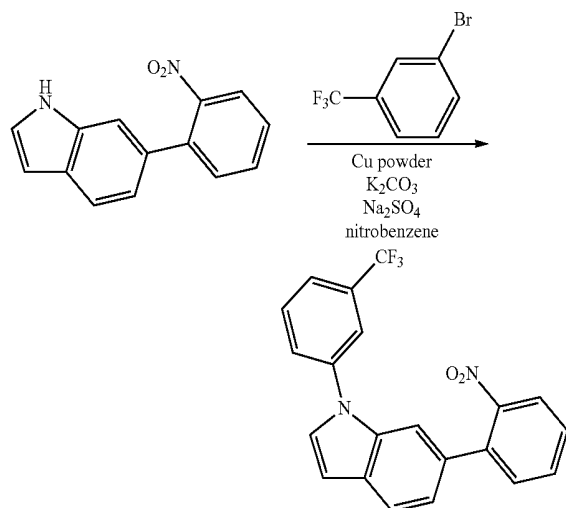
IC-19 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that IC-19-1 obtained in <Step 1> was used instead of 5-(2-nitrophenyl)-1-phenyl-1H-indole.

$^1\text{H-NMR}$: δ 6.97 (d, 1H), 7.10 (t, 1H), 7.23 (t, 1H), 7.37 (t, 2H), 7.45 (m, 6H), 7.58 (d, 1H), 7.80 (d, 4H), 7.86 (m, 3H), 7.92 (d, 1H), 7.98 (d, 1H), 10.59 (s, 1H)

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[Preparation Example 20] Synthesis of IC-20

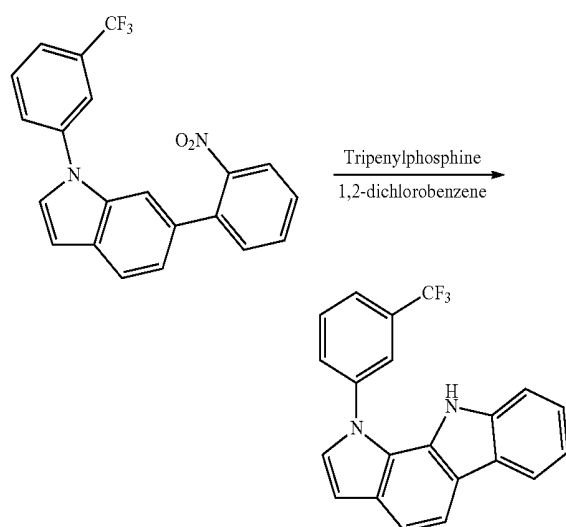
<Step 1> Synthesis of 6-(2-nitrophenyl)-1-(3-(trifluoromethyl)phenyl)-1H-indole



6-(2-nitrophenyl)-1-(3-(trifluoromethyl)phenyl)-1H-indole was obtained by performing the same procedure as in <Step 3> of Preparation Example 1, except that 6-(2-nitrophenyl)-1H-indole and 1-bromo-3-(trifluoromethyl)benzene were used instead of 5-(2-nitrophenyl)-1-phenyl-1H-indole and iodobenzene.

¹H-NMR: δ 6.80 (d, 1H), 7.11 (t, 1H), 7.21 (t, 1H), 7.36 (s, 1H), 7.42 (s, 1H), 7.50 (m, 2H), 7.55 (m, 2H), 7.63 (m, 2H), 7.86 (d, 1H), 8.01 (d, 1H)

<Step 2> Synthesis of IC-20



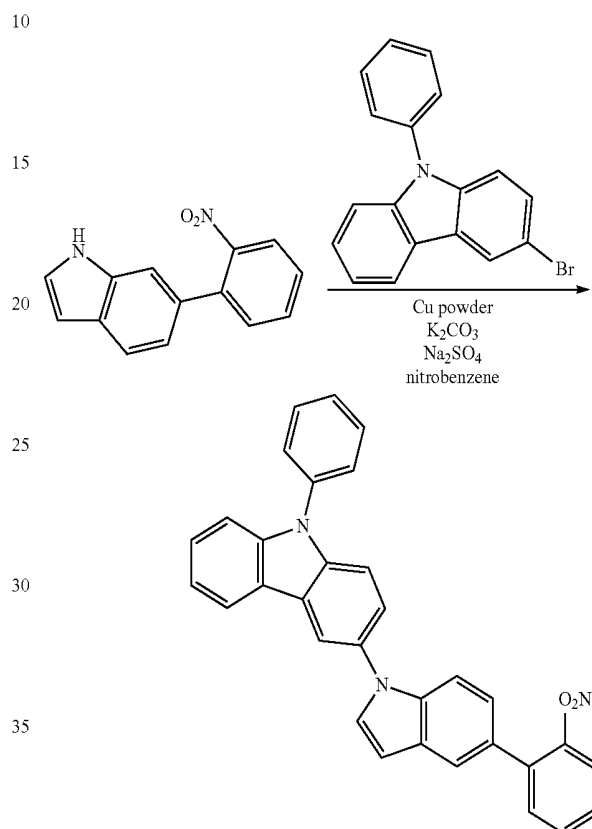
IC-20 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that 6-(2-nitrophenyl)-1-(3-(trifluoromethyl)phenyl)-1H-indole obtained in <Step 1> was used instead of 5-(2-nitrophenyl)-1-phenyl-1H-indole.

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¹H-NMR: δ 6.81 (d, 1H), 7.12 (t, 1H), 7.24 (t, 1H), 7.43 (d, 1H), 7.51 (m, 2H), 7.58 (m, 2H), 7.64 (m, 2H), 7.85 (d, 1H), 8.02 (d, 1H), 9.82 (s, 1H)

[Preparation Example 21] Synthesis of IC-21

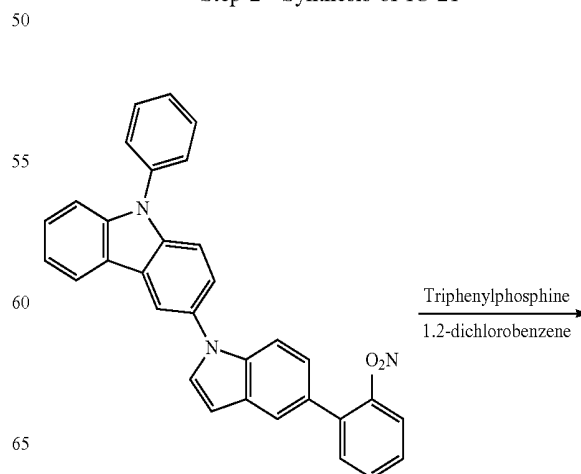
Step 1> Synthesis of 3-(5-(2-nitrophenyl)-1H-indol-1-yl)-9-phenyl-9H-carbazole



3-(5-(2-nitrophenyl)-1H-indol-1-yl)-9-phenyl-9H-carbazole was obtained by performing the same procedure as in <Step 3> of Preparation Example 1, except that 6-(2-nitrophenyl)-1H-indole and 3-bromo-9-phenyl-9H-carbazole were used instead of 5-(2-nitrophenyl)-1-phenyl-1H-indole and iodobenzene.

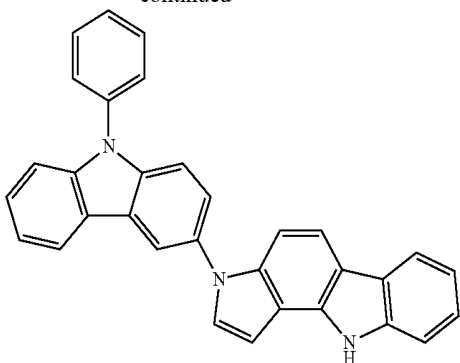
GC-Mass (theoretical value: 479.16 g/mol, measured value: 479 g/mol)

<Step 2> Synthesis of IC-21

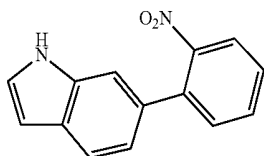


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-continued



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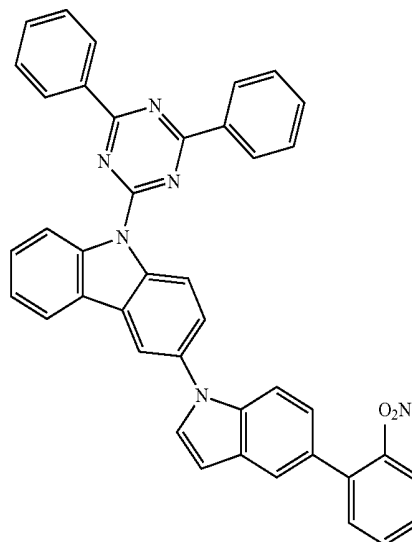
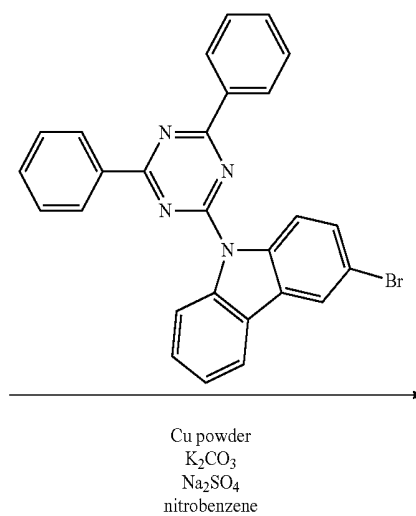
IC-21 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that 3-(5-(2-nitrophenyl)-1H-indol-1-yl)-9-phenyl-9H-carbazole obtained in <Step 1> was used instead of 5-(2-nitrophenyl)-1-phenyl-1H-indole.

GC-Mass (theoretical value: 447.17 g/mol, measured value: 447 g/mol)

[Preparation Example 22] Synthesis of IC-22

<Step 1> Synthesis of

9-(4,6-diphenyl-1,3,5-triazin-2-yl)-3-(5-(2-nitrophenyl)-1H-indol-1-yl)-9H-carbazole

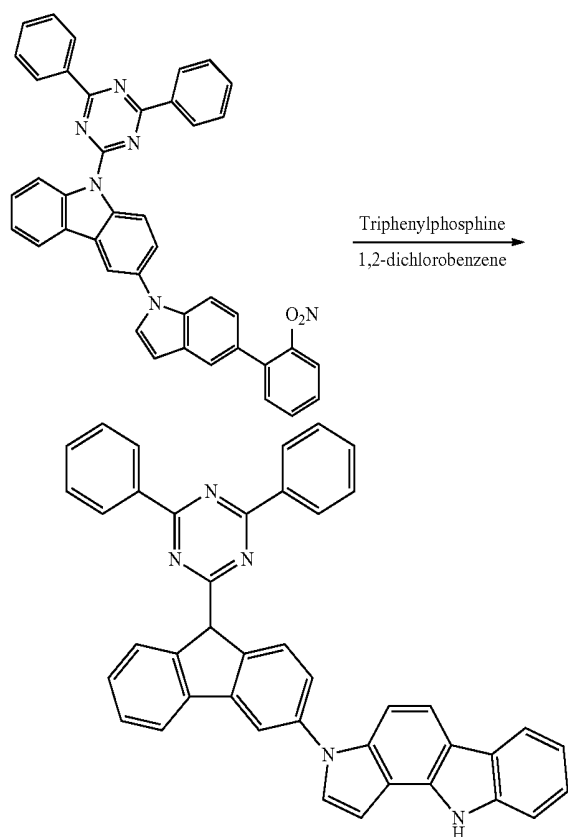


441

9-(4,6-diphenyl-1,3,5-triazin-2-yl)-3-(5-(2-nitrophenyl)-1H-indol-1-yl)-9H-carbazole was obtained by performing the same procedure as in <Step 3> of Preparation Example 1, except that 6-(2-nitrophenyl)-1H-indole and 3-bromo-9-(4,6-diphenyl-1,3,5-triazin-2-yl)-9H-carbazole were used instead of 5-(2-nitrophenyl)-1H-indole and iodobenzene.

GC-Mass (theoretical value: 634.21 g/mol, measured value: 634 g/mol)

<Step 2> Synthesis of IC-22

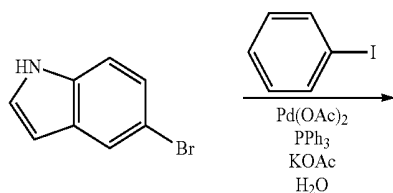


IC-22 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that 9-(4,6-diphenyl-1,3,5-triazin-2-yl)-3-(5-(2-nitrophenyl)-1H-indol-1-yl)-9H-carbazole obtained in <Step 1> was used instead of 5-(2-nitrophenyl)-1-phenyl-1H-indole.

GC-Mass (theoretical value: 602.22 g/mol, measured value: 602 g/mol)

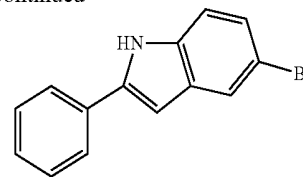
[Preparation Example 23] Synthesis of IC-23

<Step 1> Synthesis of 5-bromo-2-phenyl-1H-indole



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-continued

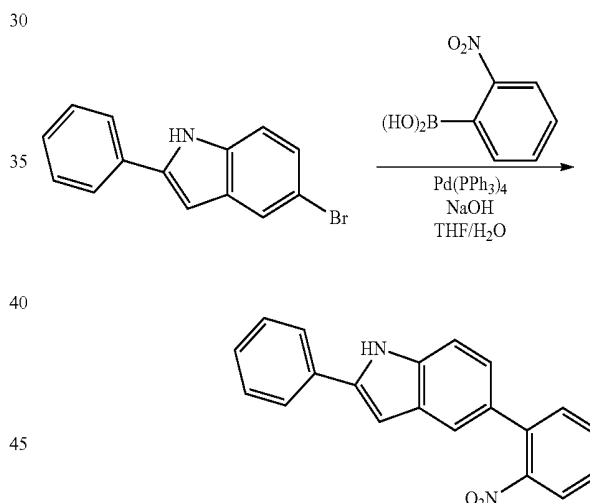


5-bromo-1H-indole (25 g, 0.13 mol), iodobenzene (31.22 g, 0.15 mol), Pd(OAc)₂ (1.43 g, 5 mol %), triphenylphosphine (1.67 g, 5 mol %), KOAc (37.55 g, 0.38 mol), and H₂O (300 ml) were mixed under nitrogen flow, and the mixture was stirred at 110° C. for 24 hours.

After the reaction was completed, extraction was performed with ethyl acetate, moisture was removed with MgSO₄, and purification was performed by column chromatography (Hexane:EA=10:1 (v/v)), thereby obtaining 5-bromo-2-phenyl-1H-indole (16.66 g, yield 48%).

¹H-NMR: δ 6.89 (dd, 1H), 7.20 (dd, 1H), 7.34 (m, 1H), 7.36 (d, 1H), 7.47 (t, 2H), 7.71 (d, 1H), 7.86 (dd, 2H), 11.74 (s, 1H)

<Step 2> Synthesis of 5-(2-nitrophenyl)-2-phenyl-1H-indole



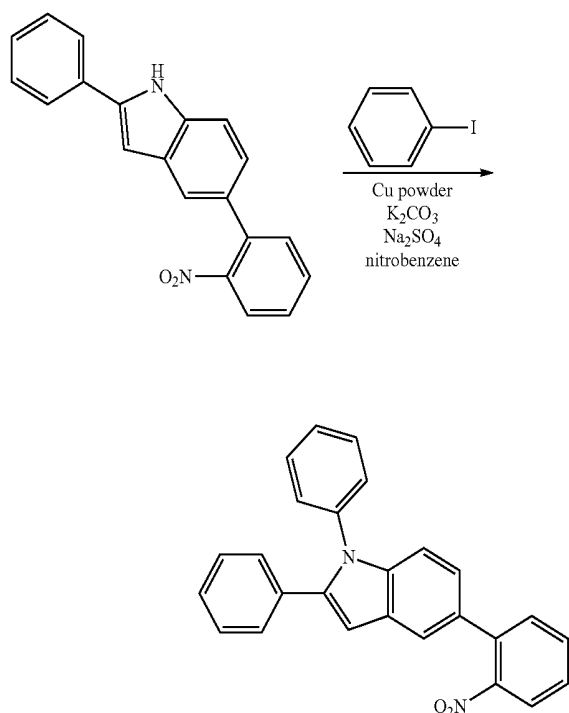
2-nitrophenylboronic acid (11.04 g, 66.14 mmol), 5-bromo-2-phenyl-1H-indole (15 g, 55.12 mmol) obtained in <Step 1>, NaOH (6.61 g, 165.36 mmol) and THF/H₂O (200 ml/100 ml) were mixed under nitrogen flow, then Pd(PPh₃)₄ (3.18 g, 5 mol) was added to the mixture at 40° C., and the resulting mixture was stirred at 80° C. for 12 hours.

After the reaction was completed, extraction was performed with methylene chloride, MgSO₄ was added thereto, and the mixture was filtered. After the solvent was removed from the organic layer obtained, the residue was purified by column chromatography (Hexane:EA=5:1 (v/v)), thereby obtaining 5-(2-nitrophenyl)-2-phenyl-1H-indole (10.74 g, yield 62%).

¹H-NMR: δ 6.88 (dd, 1H), 7.21 (d, 1H), 7.32 (m, 1H), 7.34 (d, 1H), 7.46 (m, 3H), 7.64 (m, 2H), 7.77 (d, 2H), 8.02 (d, 2H), 11.73 (s, 1H)

443

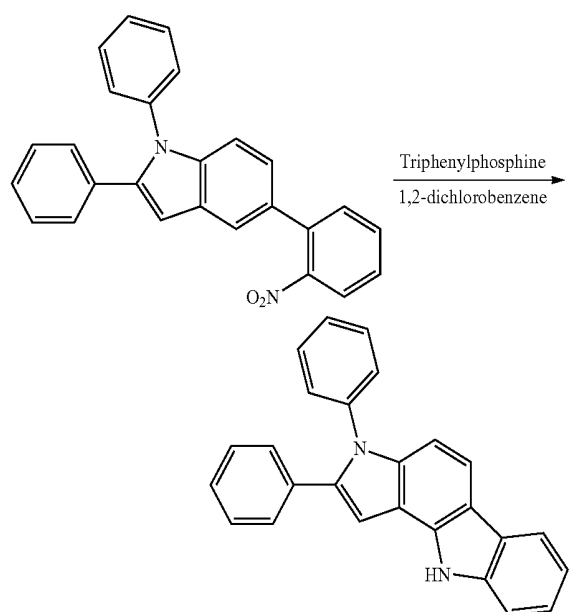
<Step 3> Synthesis of
5-(2-nitrophenyl)-1,2-diphenyl-1H-indole



5-(2-nitrophenyl)-1,2-diphenyl-1H-indole was obtained by performing the same procedure as in <Step 3> of Preparation Example 1, except that 5-(2-nitrophenyl)-2-phenyl-1H-indole obtained in <Step 2> was used instead of 5-(2-nitrophenyl)-1H-indole.

GC-Mass (theoretical value: 390.14 g/mol, measured value: 390 g/mol)

<Step 3> Synthesis of IC-23



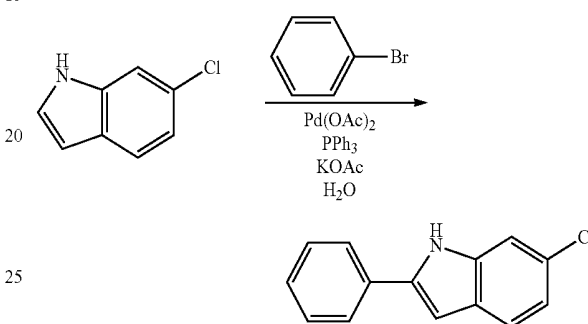
444

IC-23 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that 5-(2-nitrophenyl)-1,2-diphenyl-1H-indole obtained in <Step 3> was used instead of 5-(2-nitrophenyl)-1-phenyl-1H-indole.

GC-Mass (theoretical value: 358.15 g/mol, measured value: 358 g/mol)

[Preparation Example 24] Synthesis of IC-24

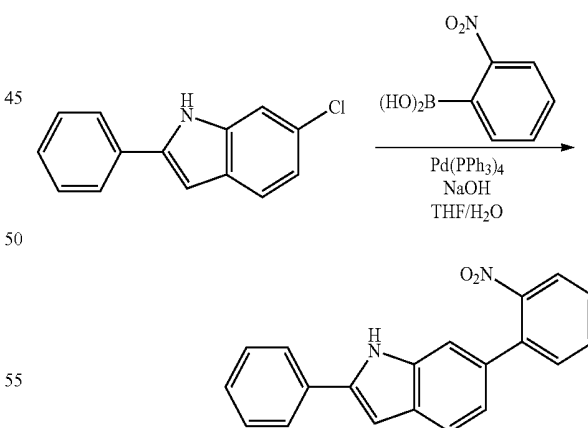
<Step 1> Synthesis of 6-chloro-2-phenyl-1H-indole



6-chloro-2-phenyl-1H-indole was obtained by performing the same procedure as in <Step 1> of Preparation Example 23, except that 6-chloro-1H-indole and bromobenzene were used instead of 5-bromo-1H-indole and iodobenzene.

¹H-NMR: δ 6.92 (d, 1H), 7.02 (dd, 1H), 7.33 (t, 1H), 7.41 (s, 1H), 7.47 (t, 2H), 7.54 (d, 1H), 7.85 (d, 2H), 11.68 (s, 1H)

<Step 2> Synthesis of
6-(2-nitrophenyl)-2-phenyl-1H-indole

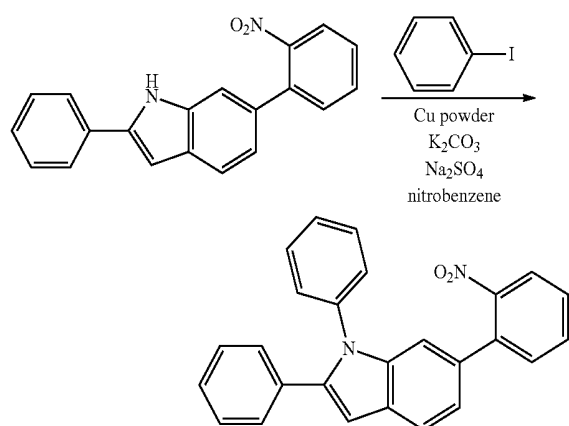


6-(2-nitrophenyl)-2-phenyl-1H-indole was obtained by performing the same procedure as in <Step 2> of Preparation Example 23, except that 6-chloro-2-phenyl-1H-indole obtained in <Step 1> was used instead of 5-bromo-2-phenyl-1H-indole.

¹H-NMR: δ 6.91 (d, 1H), 7.03 (d, 1H), 7.31 (t, 1H), 7.42 (s, 1H), 7.48 (m, 3H), 7.53 (d, 1H), 7.76 (m, 3H), 8.01 (d, 2H), 11.66 (s, 1H)

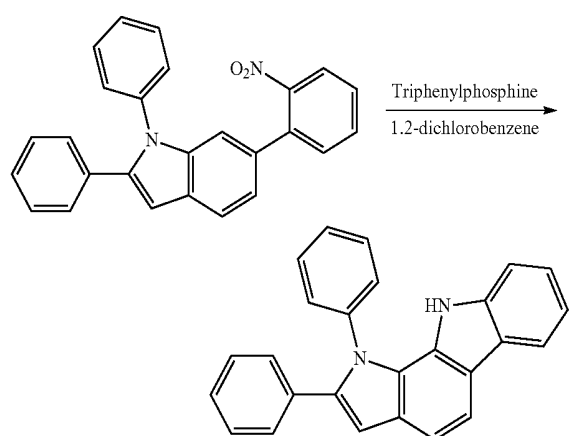
445

<Step 3> Synthesis of
6-(2-nitrophenyl)-1,2-diphenyl-1H-indole



6-(2-nitrophenyl)-1,2-diphenyl-1H-indole was obtained by performing the same procedure as in <Step 3> of Preparation Example 1, except that 6-(2-nitrophenyl)-2-phenyl-1H-indole obtained in <Step 2> was used instead of 5-(2-nitrophenyl)-1-phenyl-1H-indole.

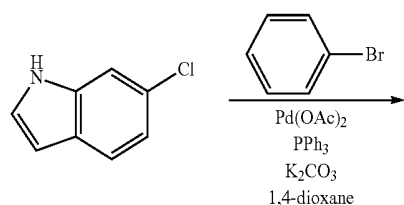
GC-Mass (theoretical value: 390.14 g/mol, measured value: 390 g/mol)



IC-24 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that 6-(2-nitrophenyl)-1,2-diphenyl-1H-indole obtained in <Step 2> was used instead of 5-(2-nitrophenyl)-1-phenyl-1H-indole. GC-Mass (theoretical value: 358.15 g/mol, measured value: 358 g/mol)

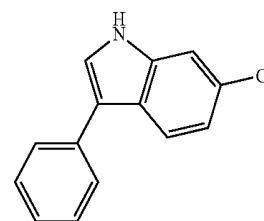
[Preparation Example 25] Synthesis of IC-25

<Step 1> Synthesis of 6-chloro-3-phenyl-1H-indole



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-continued

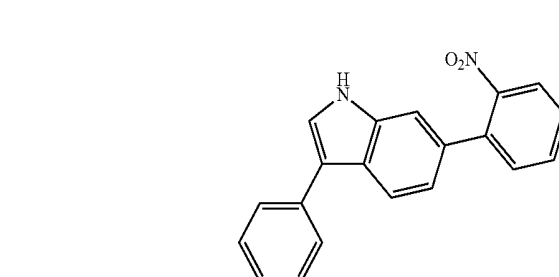
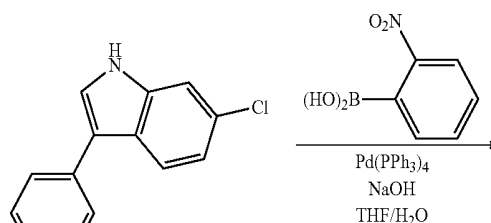


6-chloro-1H-indole (25 g, 0.17 mol), bromobenzene (31.19 g, 0.20 mol), Pd(OAc)₂ (1.86 g, 5 mol %), triphenylphosphine (2.17 g, 5 mol %), K₂CO₃ (68.64 g, 0.50 mol), and 1,4-dioxane (300 ml) were mixed under nitrogen flow, and the mixture was stirred at 130° C. for 18 hours.

After the reaction was completed, extraction was performed with ethyl acetate, moisture was removed with MgSO₄, and purification was performed by column chromatography (Hexane:EA=10:1 (v/v)), thereby obtaining 6-chloro-3-phenyl-1H-indole (24.5 g, yield 65%).

¹H-NMR: δ 7.10 (dd, 1H), 7.25 (m, 1H), 7.43 (t, 2H), 7.49 (d, 1H), 7.67 (dd, 2H), 7.73 (d, 1H), 7.85 (d, 1H), 11.49 (s, 1H)

<Step 2> Synthesis of
6-(2-nitrophenyl)-3-phenyl-1H-indole

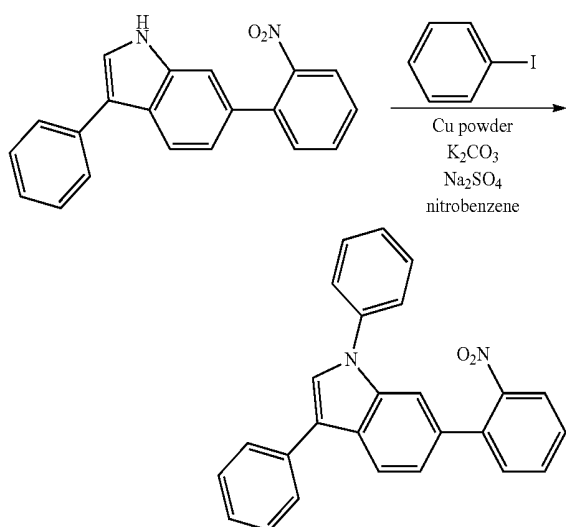


6-(2-nitrophenyl)-3-phenyl-1H-indole was obtained by performing the same procedure as in <Step 2> of Preparation Example 23, except that 6-chloro-3-phenyl-1H-indole obtained in <Step 1> was used instead of 5-bromo-2-phenyl-1H-indole.

¹H-NMR: δ 7.11 (d, 1H), 7.26 (m, 1H), 7.44 (t, 2H), 7.48 (m, 2H), 7.55 (m, 3H), 7.61 (d, 1H), 7.73 (d, 1H), 8.00 (d, 2H), 11.48 (s, 1H)

447

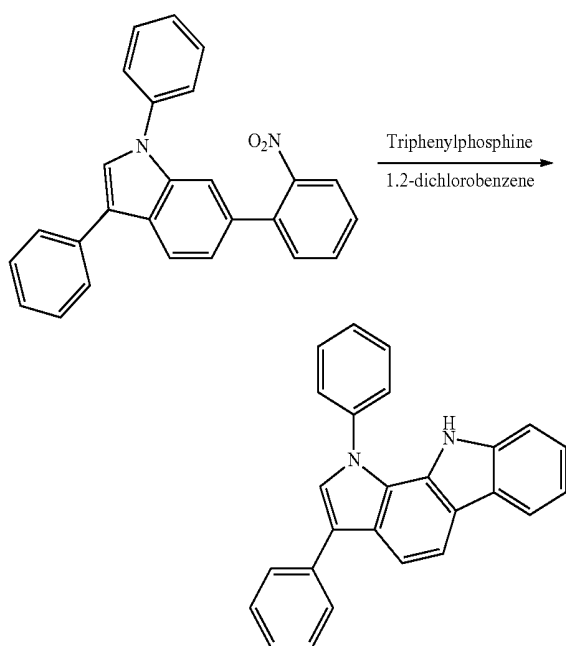
<Step 3> Synthesis of
6-(2-nitrophenyl)-1,3-diphenyl-1H-indole



6-(2-nitrophenyl)-1,3-diphenyl-1H-indole was obtained by performing the same procedure as in <Step 3> of Preparation Example 1, except that 6-(2-nitrophenyl)-3-phenyl-1H-indole obtained in <Step 2> was used instead of 5-(2-nitrophenyl)-1-phenyl-1H-indole.

GC-Mass (theoretical value: 390.14 g/mol, measured value: 390 g/mol)<

<Step 4> Synthesis of IC-25



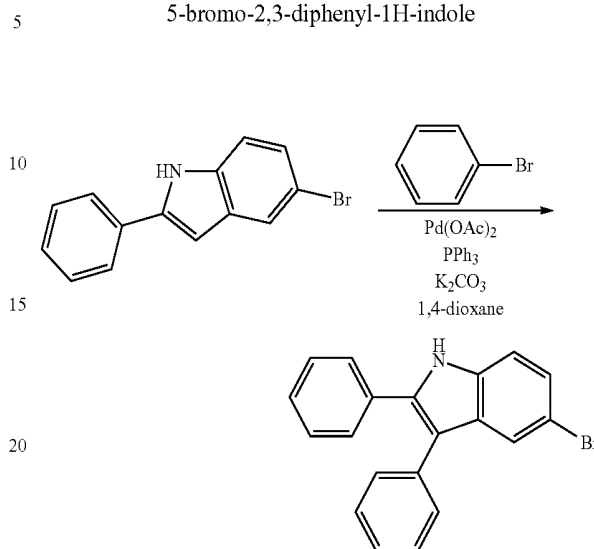
IC-25 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that 6-(2-nitrophenyl)-1,3-diphenyl-1H-indole obtained in <Step 3> was used instead of 5-(2-nitrophenyl)-1-phenyl-1H-indole.

GC-Mass (theoretical value: 358.15 g/mol, measured value: 358 g/mol)

448

[Preparation Example 26] Synthesis of IC-26

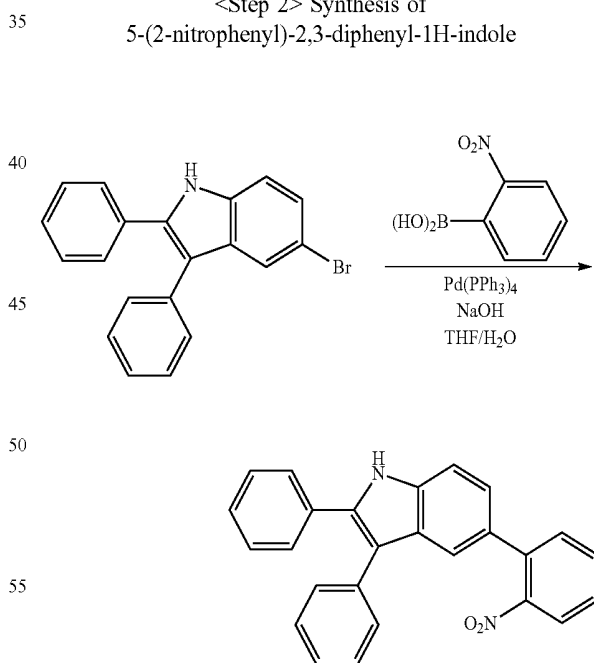
<Step 1> Synthesis of
5-bromo-2,3-diphenyl-1H-indole



5-bromo-2,3-diphenyl-1H-indole was obtained by performing the same procedure as in <Step 1> of Preparation Example 25, except that 5-bromo-2-phenyl-1H-indole was used instead of 6-chloro-1H-indole.

¹H-NMR: δ 7.23 (d, 1H), 7.31 (t, 2H), 7.43 (m, 6H), 7.67 (d, 1H), 7.71 (d, 1H), 7.84 (d, 2H), 11.34 (s, 1H)

<Step 2> Synthesis of
5-(2-nitrophenyl)-2,3-diphenyl-1H-indole

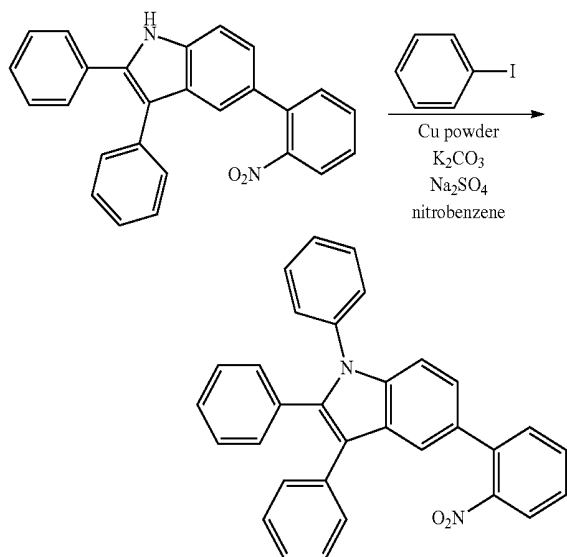


5-(2-nitrophenyl)-2,3-diphenyl-1H-indole was obtained by performing the same procedure as in <Step 2> of Preparation Example 23, except that 5-bromo-2,3-diphenyl-1H-indole obtained in <Step 1> was used instead of 5-bromo-2-phenyl-1H-indole.

GC-Mass (theoretical value: 390.14 g/mol, measured value: 390 g/mol)<

449

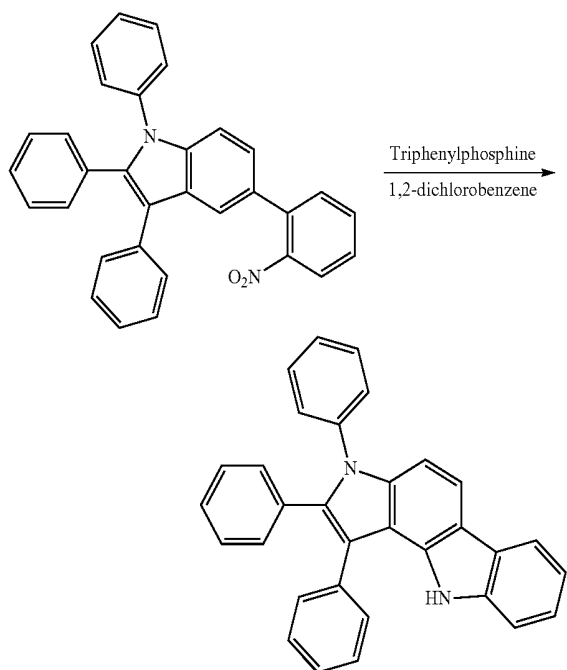
<Step 3> Synthesis of
5-(2-nitrophenyl)-2,3-diphenyl-1H-indole



5-(2-nitrophenyl)-1,2,3-triphenyl-1H-indole was obtained by performing the same procedure as in <Step 3> of Preparation Example 1, except that 5-(2-nitrophenyl)-2,3-diphenyl-1H-indole obtained in <Step 2> was used instead of 5-(2-nitrophenyl)-1H-indole.

GC-Mass (theoretical value: 466.17 g/mol, measured value: 466 g/mol)<

<Step 4> Synthesis of IC-26



IC-23 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that 5-(2-

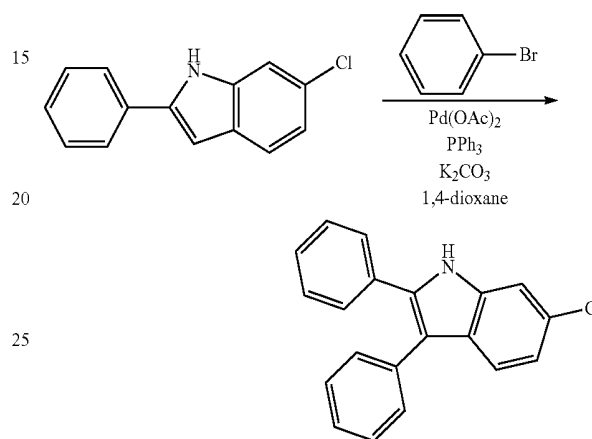
450

nitrophenyl)-1,2,3-triphenyl-1H-indole obtained in <Step 3> was used instead of 5-(2-nitrophenyl)-1-phenyl-1H-indole.

GC-Mass (theoretical value: 434.18 g/mol, measured value: 434 g/mol)

[Preparation Example 27] Synthesis of IC-27

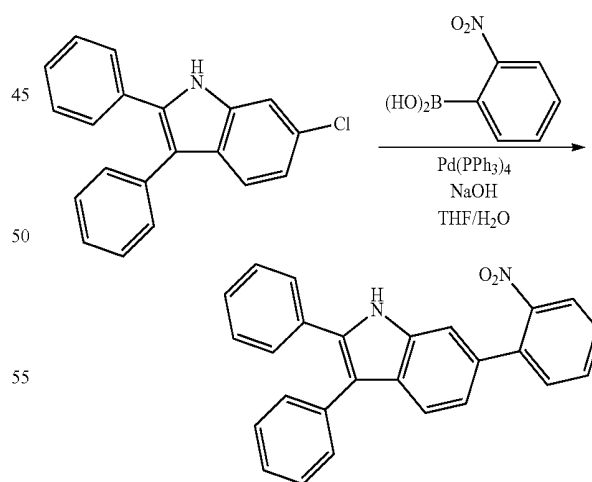
<Step 1> Synthesis of
6-chloro-2,3-diphenyl-1H-indole



6-chloro-2,3-diphenyl-1H-indole was obtained by performing the same procedure as in <Step 1> of Preparation Example 25, except that 6-chloro-2-phenyl-1H-indole was used instead of 6-chloro-1H-indole.

¹H-NMR: δ 7.18 (d, 1H), 7.29 (t, 2H), 7.50 (m, 6H), 7.62 (d, 1H), 7.75 (d, 1H), 7.89 (d, 2H), 11.35 (s, 1H)

<Step 2> Synthesis of
6-(2-nitrophenyl)-2,3-diphenyl-1H-indole

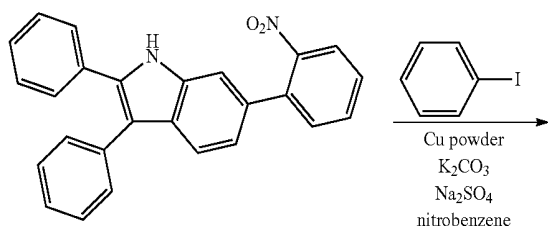


6-(2-nitrophenyl)-2,3-diphenyl-1H-indole was obtained by performing the same procedure as in <Step 2> of Preparation Example 23, except that 6-chloro-2,3-diphenyl-1H-indole obtained in <Step 1> was used instead of 5-bromo-2-phenyl-1H-indole.

GC-Mass (theoretical value: 390.14 g/mol, measured value: 390 g/mol)<

451

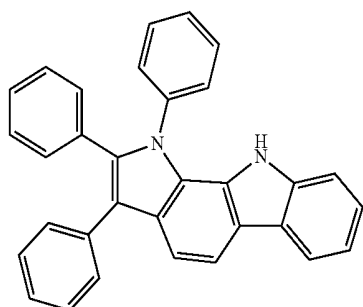
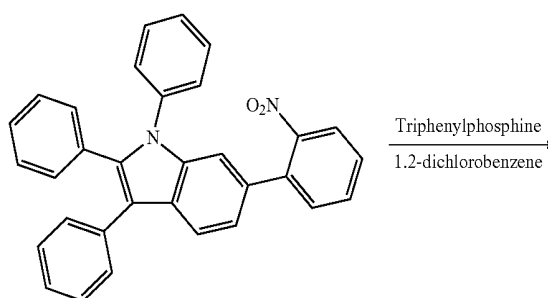
<Step 3> Synthesis of
6-(2-nitrophenyl)-1,2,3-triphenyl-1H-indole



6-(2-nitrophenyl)-1,2,3-triphenyl-1H-indole was obtained by performing the same procedure as in <Step 3> of Preparation Example 1, except that 6-(2-nitrophenyl)-2,3-diphenyl-1H-indole obtained in <Step 2> was used instead of 5-(2-nitrophenyl)-1H-indole.

GC-Mass (theoretical value: 466.17 g/mol, measured value: 466 g/mol)<

<Step 4> Synthesis of IC-27



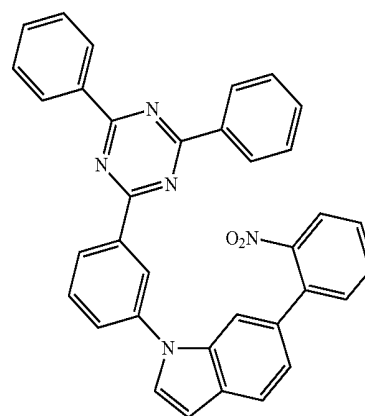
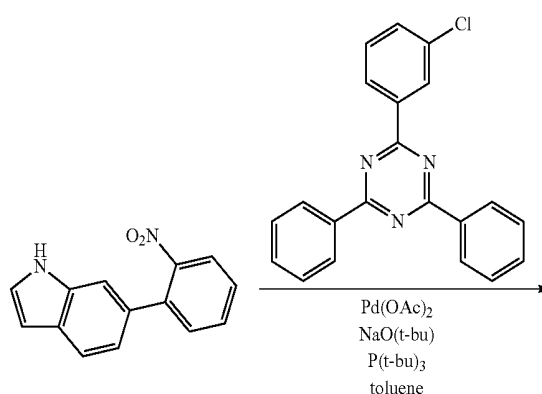
452

IC-27 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that 6-(2-nitrophenyl)-1,2,3-triphenyl-1H-indole obtained in <Step 3> was used instead of 5-(2-nitrophenyl)-1-phenyl-1H-indole.

GC-Mass (theoretical value: 434.18 g/mol, measured value: 434 g/mol)

[Preparation Example 28] Synthesis of IC-28

<Step 1> Synthesis of 1-(3-(4,6-diphenyl-1,3,5-triazin-2-yl)phenyl)-6-(2-nitrophenyl)-1H-indole



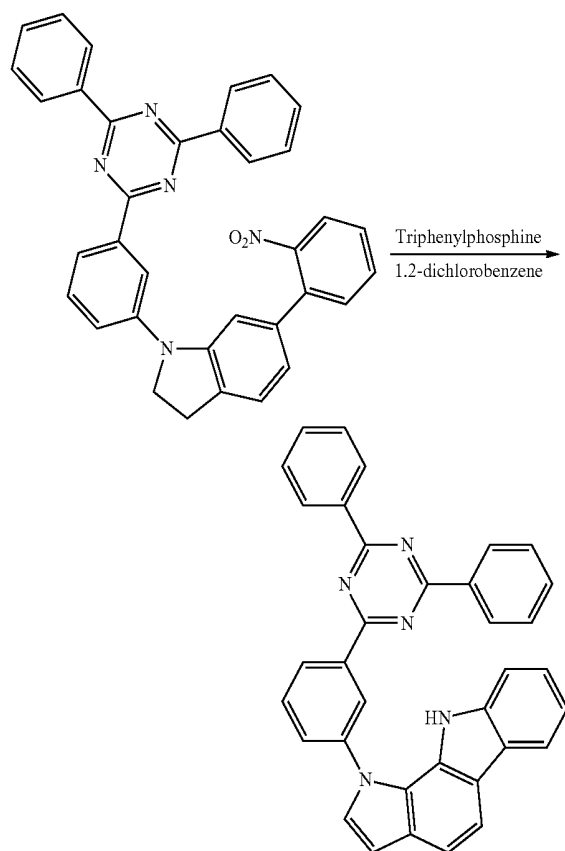
6-(2-nitrophenyl)-1H-indole (10 g, 41.97 mmol), 2-(3-chlorophenyl)-4,6-diphenyl-1,3,5-triazine (17.32 g, 50.37 mmol), Pd(OAc)₂ (0.47 g, 5 mol %), NaO(t-bu) (8.07 g, 83.95 mmol), P(t-bu)₃ (0.85 g, 4.19 mmol) and toluene (100 ml) were mixed under nitrogen flow, and the mixture was stirred at 110° C. for 12 hours.

After the reaction was completed, the extraction was performed with ethyl acetate, moisture was removed with MgSO₄, and purification was performed by column chromatography (Hexane:EA=3:1 (v/v)), thereby obtaining 1-(3-(4,6-diphenyl-1,3,5-triazin-2-yl)phenyl)-6-(2-nitrophenyl)-1H-indole (15.8 g, yield 69%).

GC-Mass (theoretical value: 545.19 g/mol, measured value: 545 g/mol)<

453

<Step 2> Synthesis of IC-28

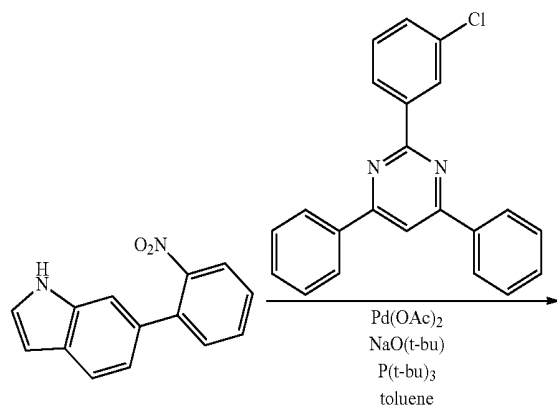


IC-28 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that 1-(3-(4,6-diphenyl-1,3,5-triazin-2-yl)phenyl)-6-(2-nitrophenyl)-1H-indole obtained in <Step 1> was used instead of 5-(2-nitrophenyl)-1-phenyl-1H-indole.

GC-Mass (theoretical value: 513.20 g/mol, measured value: 513 g/mol)

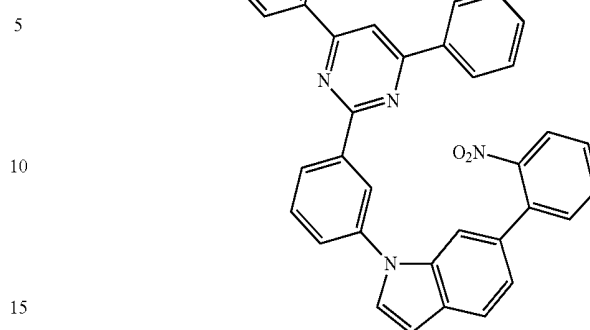
[Preparation Example 29] Synthesis of IC-29

<Step 1> Synthesis of 1-(3-(4,6-diphenylpyrimidin-2-yl)phenyl)-6-(2-nitrophenyl)-1H-indole



454

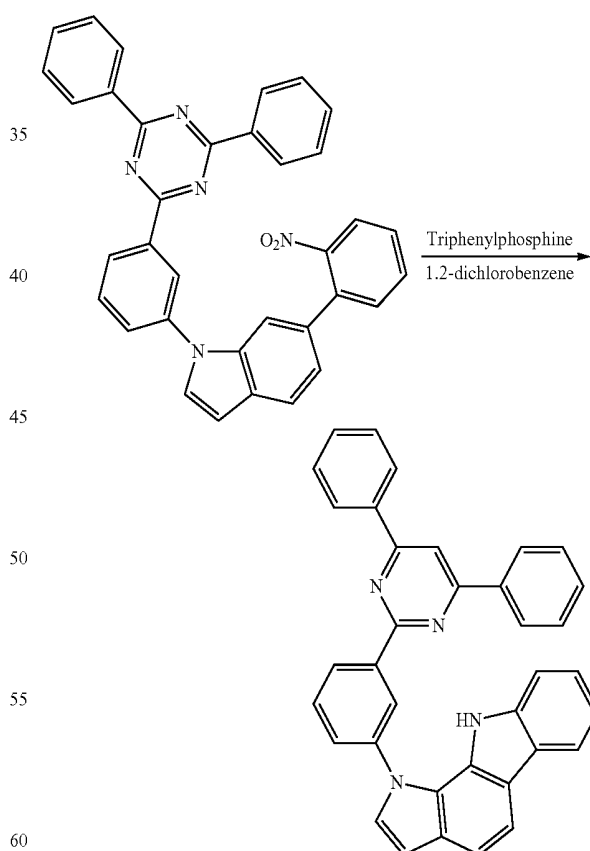
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1-(3-(4,6-diphenylpyrimidin-2-yl)phenyl)-6-(2-nitrophenyl)-1H-indole was obtained by performing the same procedure as in <Step 1> of Preparation Example 28, except that 2-(3-chlorophenyl)-4,6-diphenylpyrimidine was used instead of 2-(3-chlorophenyl)-4,6-diphenyl-1,3,5-triazine.

GC-Mass (theoretical value: 544.19 g/mol, measured value: 544 g/mol)<

<Step 2> Synthesis of IC-29



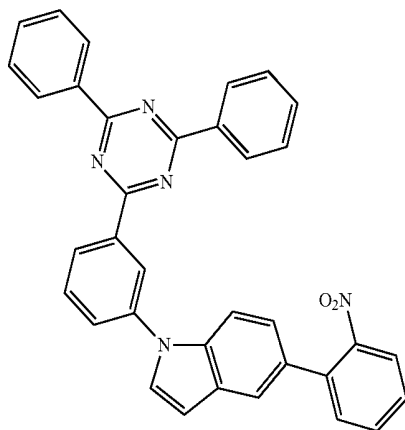
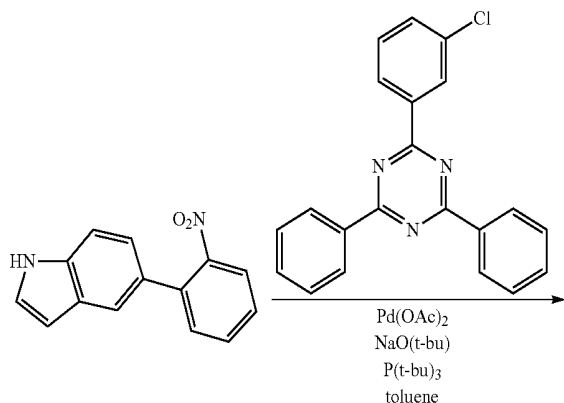
IC-29 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that 1-(3-(4,6-diphenylpyrimidin-2-yl)phenyl)-6-(2-nitrophenyl)-1H-indole obtained in <Step 1> was used instead of 5-(2-nitrophenyl)-1-phenyl-1H-indole.

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GC-Mass (theoretical value: 512.20 g/mol, measured value: 512 g/mol)

[Preparation Example 30] Synthesis of IC-30

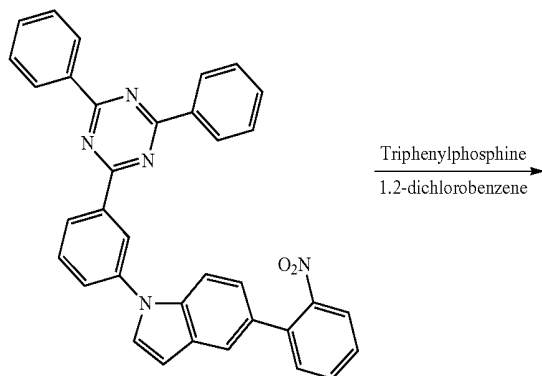
<Step 1> Synthesis of 1-(3-(4,6-diphenyl-1,3,5-triazin-2-yl)phenyl)-5-(2-nitrophenyl)-1H-indole



11-(3-(4,6-diphenyl-1,3,5-triazin-2-yl)phenyl)-5-(2-nitrophenyl)-1H-indole was obtained by performing the same procedure as in <Step 1> of Preparation Example 28, except that 5-(2-nitrophenyl)-1H-indole was used instead of 6-(2-nitrophenyl)-1H-indole.

GC-Mass (theoretical value: 545.19 g/mol, measured value: 545 g/mol)<

<Step 2> Synthesis of IC-30



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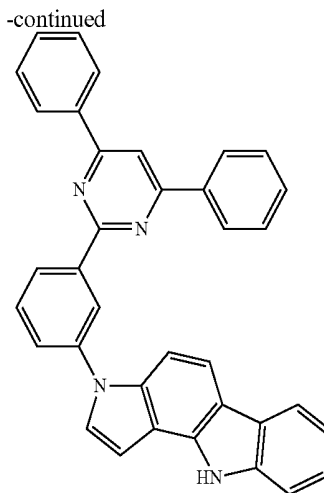
45

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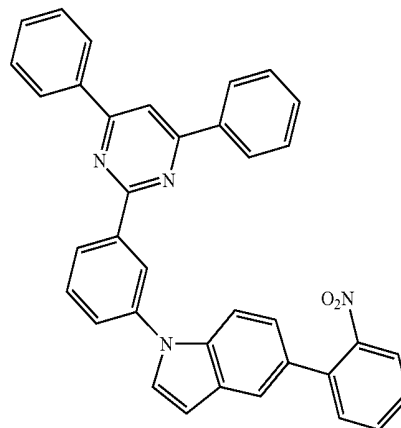
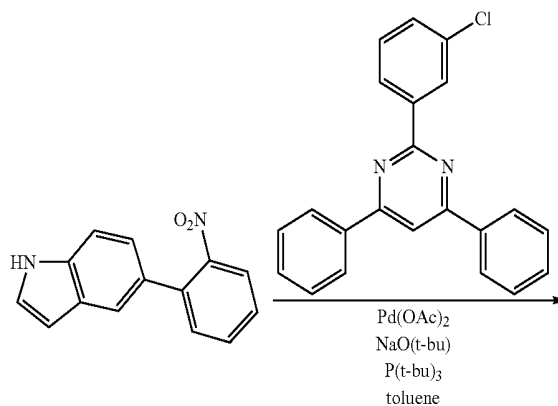


IC-30 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that 11-(3-(4,6-diphenyl-1,3,5-triazin-2-yl)phenyl)-5-(2-nitrophenyl)-1H-indole obtained in <Step 1> was used instead of 5-(2-nitrophenyl)-1-phenyl-1H-indole.

GC-Mass (theoretical value: 513.20 g/mol, measured value: 513 g/mol)

[Preparation Example 31] Synthesis of IC-31

<Step 1> Synthesis of 1-(3-[4,6-diphenylpyrimidin-2-yl]phenyl)-5-(2-nitrophenyl)-1H-indole



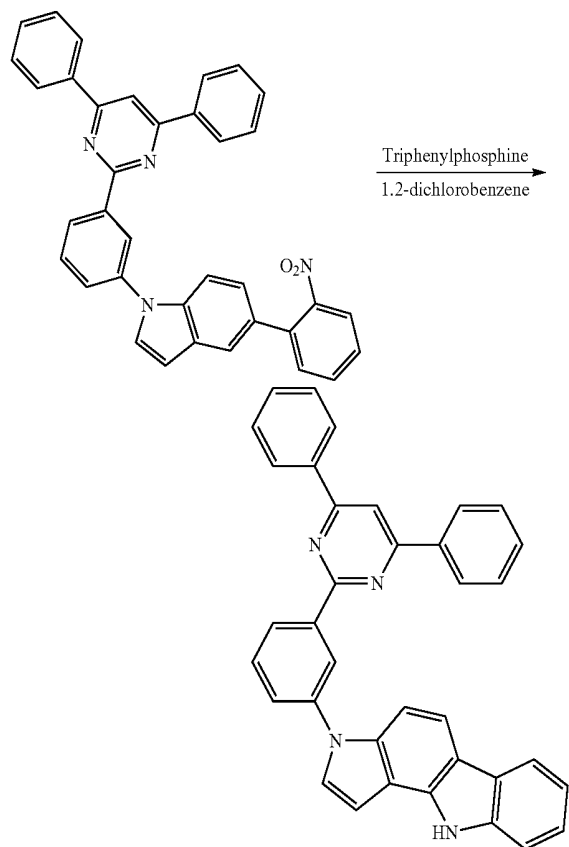
1-(3-(4,6-diphenylpyrimidin-2-yl)phenyl)-5-(2-nitrophenyl)-1H-indole was obtained by performing the same pro-

457

cedure as in <Step 1> of Preparation Example 28, except that 5-(2-nitrophenyl)-1H-indole and 2-(3-chloro phenyl)-4,6-diphenylpyrimidine were used instead of 6-(2-nitrophenyl)-1H-indole and 2-(3-chlorophenyl)-4,6-diphenyl-1,3,5-triazine.

GC-Mass (theoretical value: 544.19 g/mol, measured value: 544 g/mol)

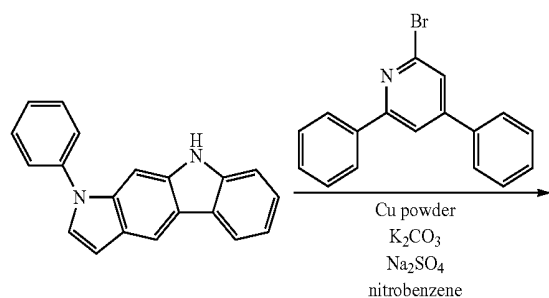
<Step 2> Synthesis of IC-31



IC-31 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that 1-(3-(4,6-diphenylpyrimidin-2-yl)phenyl)-5-(2-nitrophenyl)-1H-indole obtained in <Step 1> was used instead of 5-(2-nitrophenyl)-1-phenyl-1H-indole.

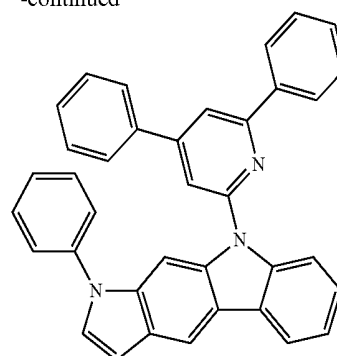
GC-Mass (theoretical value: 512.20 g/mol, measured value: 512 g/mol)

[Synthesis Example 1] Synthesis of Inv-1



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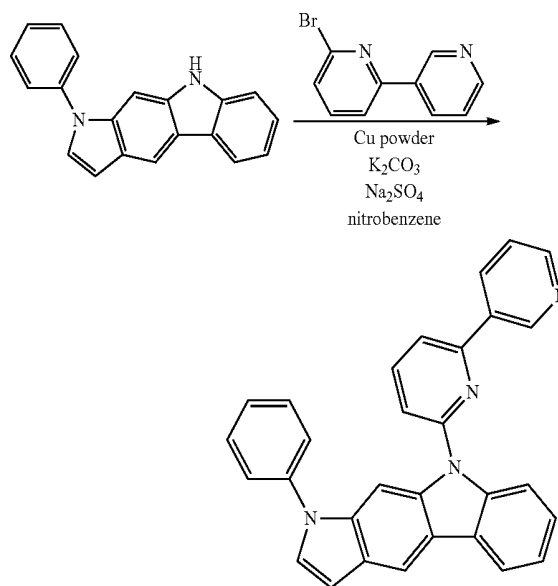
Inv-1

IC-1a (5 g, 17.71 mmol) as a compound prepared in Preparation Example 1, 2-bromo-4,6-diphenylpyridine (8.24 g, 26.56 mmol), Cu powder (0.11 g, 1.77 mmol), K₂CO₃ (2.44 g, 17.71 mmol), Na₂SO₄ (2.52 g, 17.71 mmol), and nitrobenzene (100 ml) were mixed under nitrogen flow, and the mixture was stirred at 190° C. for 12 hours.

After the reaction was completed, nitrobenzene was removed, the organic layer was separated with methylene chloride, and water was removed by using MgSO₄. After the solvent was removed from the organic layer, the residue was purified by column chromatography (Hexane:EA=1:1 (v/v)), thereby obtaining a target compound Inv-1 (6.25 g, yield 69%).

GC-Mass (theoretical value: 511.20 g/mol, measured value: 511 g/mol)

[Synthesis Example 2] Synthesis of Inv-2



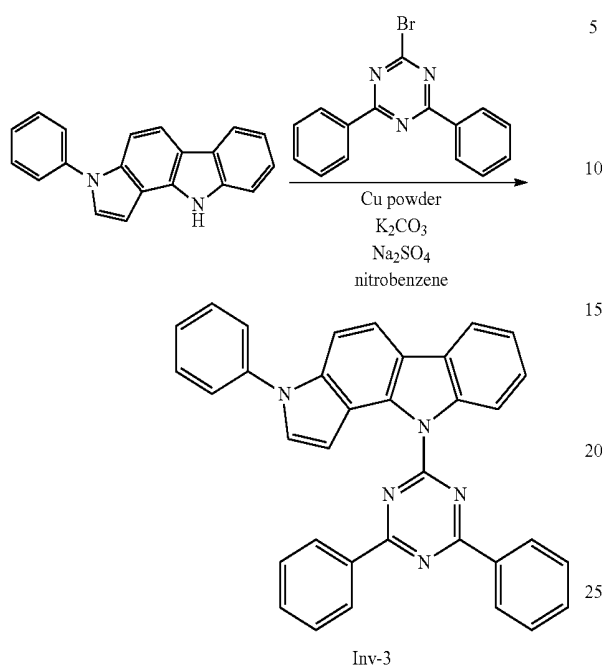
Inv-2

A target compound Inv-2 (5.02 g, yield 65%) was obtained by performing the same procedure as in Synthesis Example 1, except that 6-bromo-2,3'-bipyridine was used instead of 2-bromo-4,6-diphenylpyridine.

GC-Mass (theoretical value: 436.17 g/mol, measured value: 436 g/mol)

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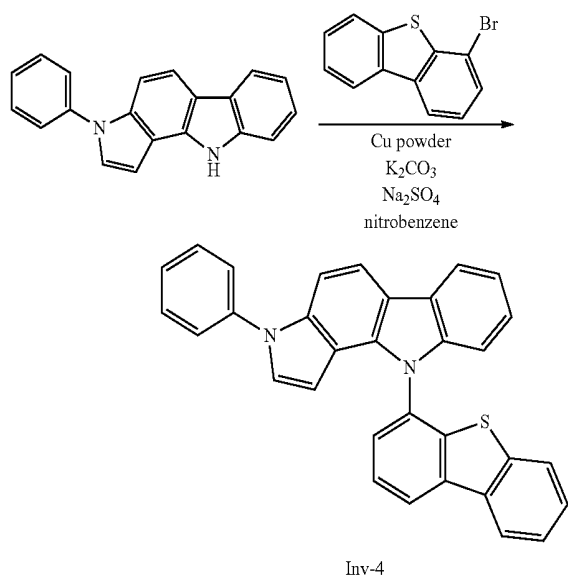
[Synthesis Example 3] Synthesis of Inv-3



A target compound Inv-3 (3.91 g, yield 43%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-1b as another compound prepared in Preparation Example 1 was used instead of IC-1a, and 2-bromo-4,6-diphenyl-1,3,5-triazine was used instead of 2-bromo-4,6-diphenylpyridine.

GC-Mass (theoretical value: 513.20 g/mol, measured value: 513 g/mol)

[Synthesis Example 4] Synthesis of Inv-4



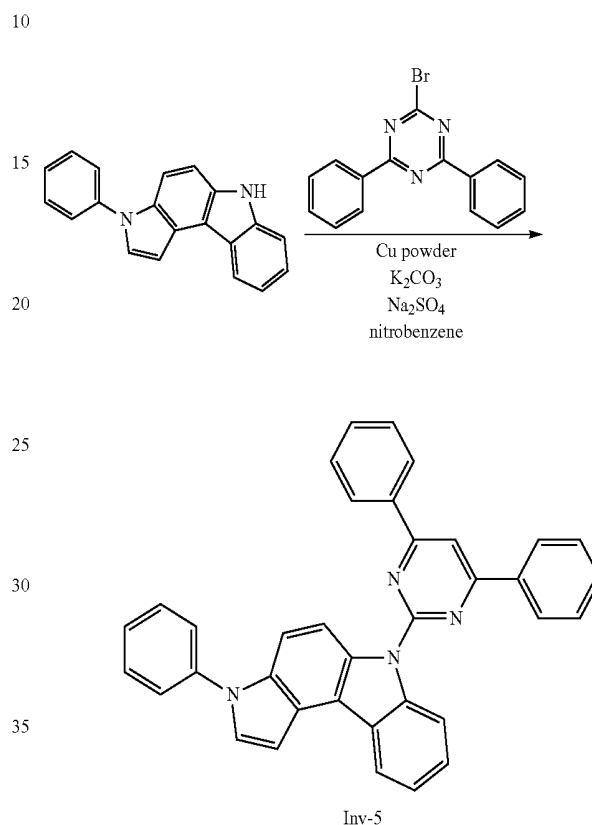
A target compound Inv-4 (5.02 g, yield 61%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-1b as another compound prepared

460

in Preparation Example 1 was used instead of IC-1a, and 4-bromodibenzo[b,d]thiophene was used instead of 2-bromo-4,6-diphenylpyridine.

GC-Mass (theoretical value: 464.13 g/mol, measured value: 464 g/mol)

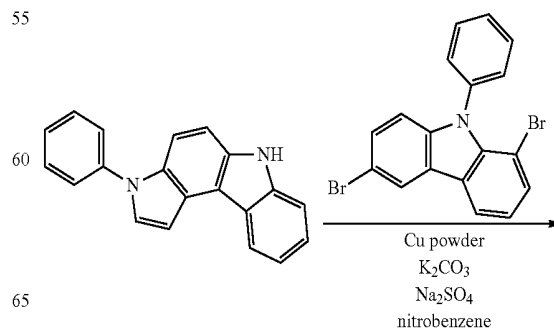
[Synthesis Example 5] Synthesis of Inv-5



A target compound Inv-5 (5.36 g, yield 59%) was obtained by performing the same procedure as in Synthesis Example 1, except that 3-phenyl-3,6-dihydropyrrolo[2,3-c] carbazole prepared in Preparation Example 2 was used instead of IC-1a, and 2-bromo-4,6-diphenylpyrimidine was used instead of 2-bromo-4,6-diphenylpyridine.

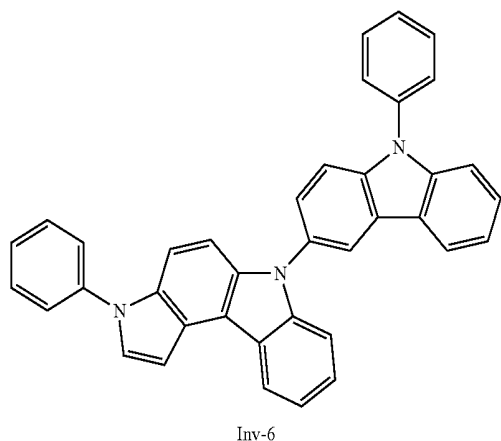
GC-Mass (theoretical value: 512.20 g/mol, measured value: 512 g/mol)

[Synthesis Example 6] Synthesis of Inv-6



461

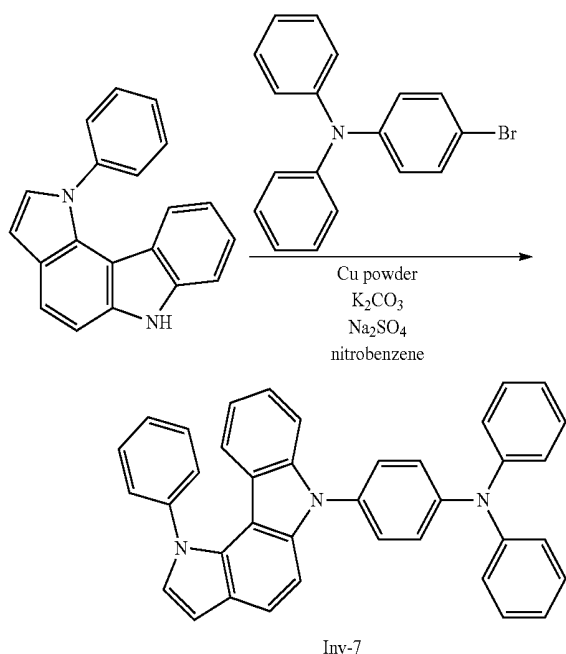
-continued



A target compound Inv-6 (6.58 g, yield 71%) was obtained by performing the same procedure as in Synthesis Example 1, except that 3-phenyl-3,6-dihydropyrrolo[2,3-c]carbazole prepared in Preparation Example 2 was used instead of IC-1a, and 3-bromo-9-phenyl-9H-carbazole was used instead of 2-bromo-4,6-diphenylpyridine.

GC-Mass (theoretical value: 523.20 g/mol, measured value: 523 g/mol)

[Synthesis Example 7] Synthesis of Inv-7

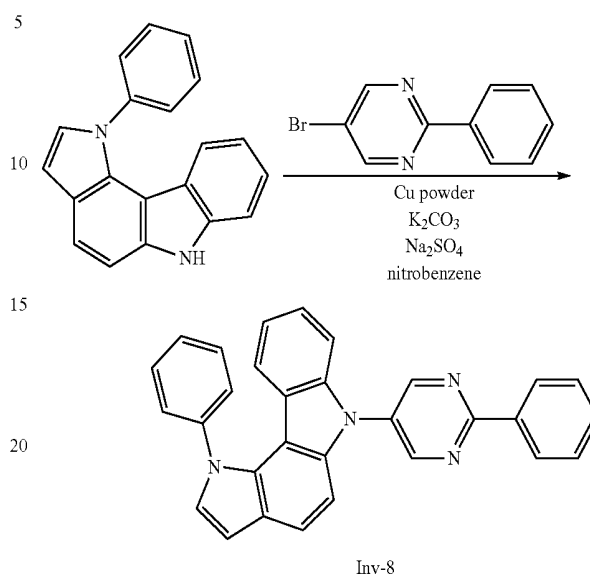


A target compound Inv-7 (6.8 g, yield 73%) was obtained by performing the same procedure as in Synthesis Example 1, except that 1-phenyl-1,6-dihydropyrrolo[3.2-c]carbazole prepared in Preparation Example 3 was used instead of IC-1a, and 4-bromo-N,N-diphenylaniline was used instead of 2-bromo-4,6-diphenylpyridine.

GC-Mass (theoretical value: 525.22 g/mol, measured value: 525 g/mol)

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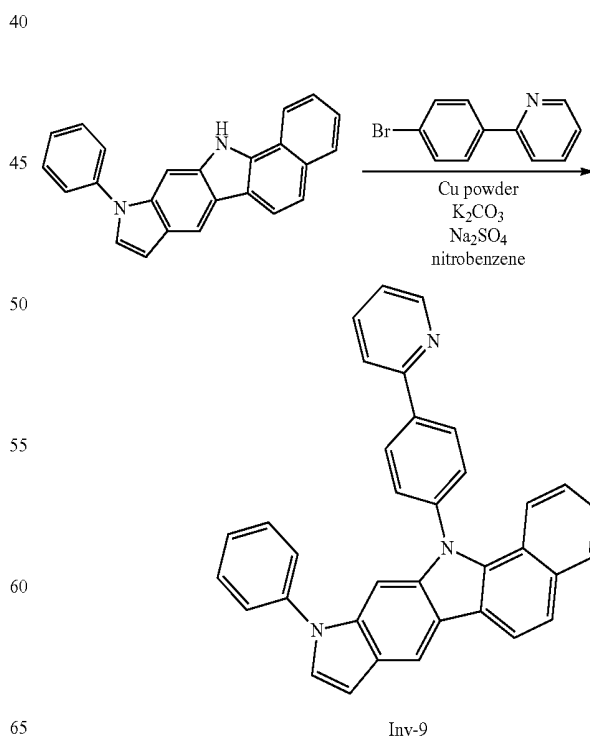
[Synthesis Example 8] Synthesis of Inv-8



A target compound Inv-8 (3.48 g, yield 45%) was obtained by performing the same procedure as in Synthesis Example 1, except that 1-phenyl-1,6-dihydropyrrolo[3.2-c]carbazole prepared in Preparation Example 3 was used instead of IC-1a, and 5-bromo-2-phenylpyrimidine was used instead of 2-bromo-4,6-diphenylpyridine.

GC-Mass (theoretical value: 436.17 g/mol, measured value: 436 g/mol)

[Synthesis Example 9] Synthesis of Inv-9

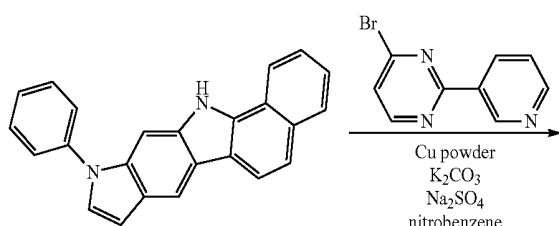


463

A target compound Inv-9 (4.97 g, yield 68%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-4-a as a compound prepared in Preparation Example 4 was used instead of IC-1a, and 2-(4-bromophenyl)pyridine was used instead of 2-bromo-4,6-diphenylpyridine.

GC-Mass (theoretical value: 485.19 g/mol, measured value: 485 g/mol)

[Synthesis Example 10] Synthesis of Inv-10



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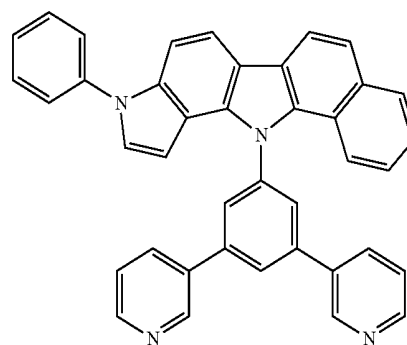
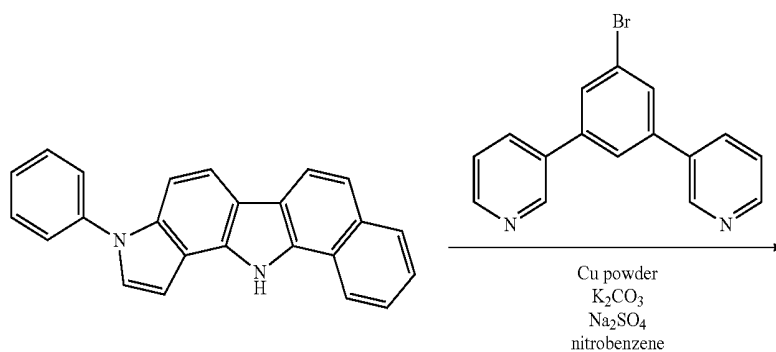
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A target compound Inv-10 (3.08 g, yield 42%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-4-a as a compound prepared in Preparation Example 4 was used instead of IC-1a, and 4-bromo-2-(pyridin-3-yl)pyrimidine was used instead of 2-bromo-4,6-diphenylpyridine.

GC-Mass (theoretical value: 487.18 g/mol, measured value: 487 g/mol)

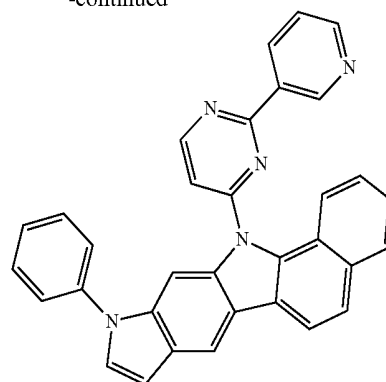
[Synthetic Example 11] Synthesis of Inv-11



Inv-11

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Inv-10

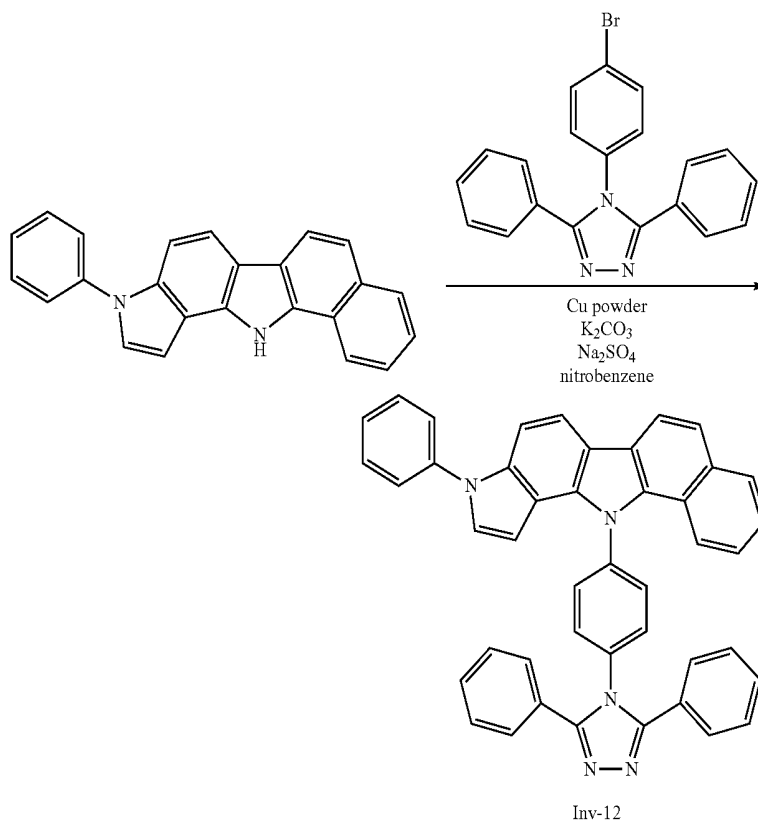
465

A target compound Inv-11 (5.08 g, yield 60%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-4-b as another compound prepared in Preparation Example 4 was used instead of IC-1a, and 3,3'-(5-bromo-1,3-phenylene)dipyridine was used instead of 2-bromo-4,6-diphenylpyridine.

466

GC-Mass (theoretical value: 562.22 g/mol, measured value: 562 g/mol)

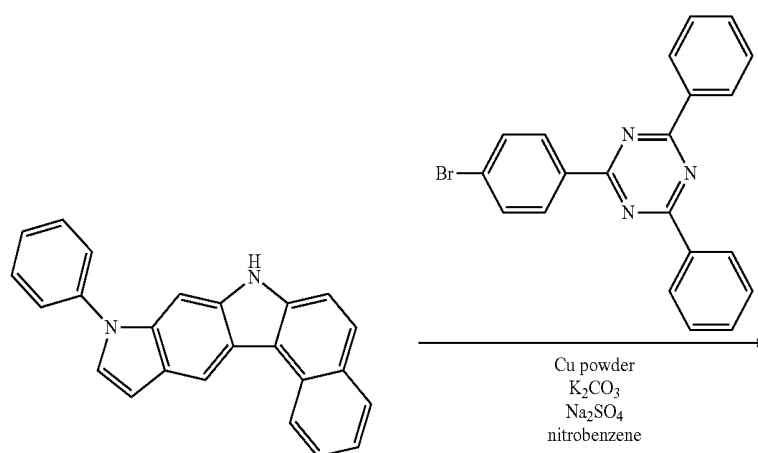
[Synthesis Example 12] Synthesis of Inv-12



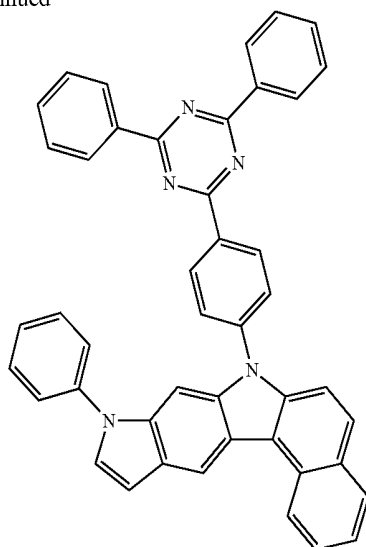
40 A target compound Inv-12 (4.91 g, yield 52%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-4-b as another compound prepared in Preparation Example 4 was used instead of IC-1a, and 4-(4-bromophenyl)-3,5-diphenyl-4H-1,2,4-triazole was used instead of 2-bromo-4,6-diphenylpyridine.

45 GC-Mass (theoretical value: 627.24 g/mol, measured value: 627 g/mol)

[Synthesis Example 13] Synthesis of Inv-13



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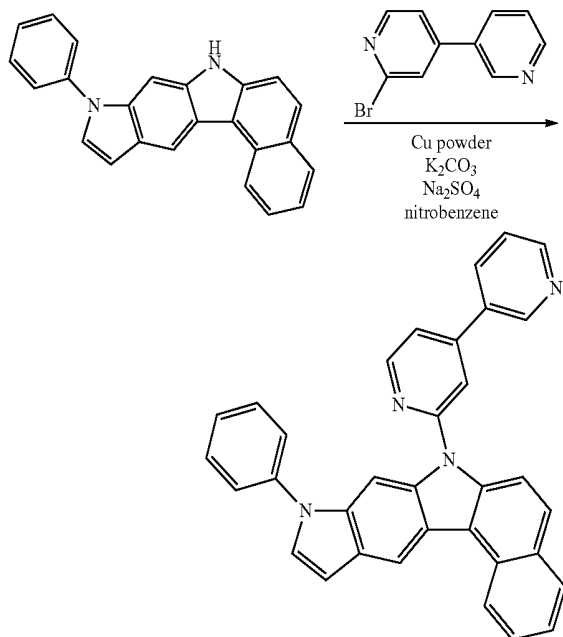


Inv-13

A target compound Inv-13 (6.06 g, yield 63%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-5a as a compound prepared in Preparation Example 5 was used instead of IC-1a, and 2-(4-bromophenyl)-4,6-diphenyl-1,3,5-triazine was used instead of 2-bromo-4,6-diphenylpyridine.

GC-Mass (theoretical value: 639.24 g/mol, measured value: 639 g/mol)

[Synthesis Example 14] Synthesis of Inv-14



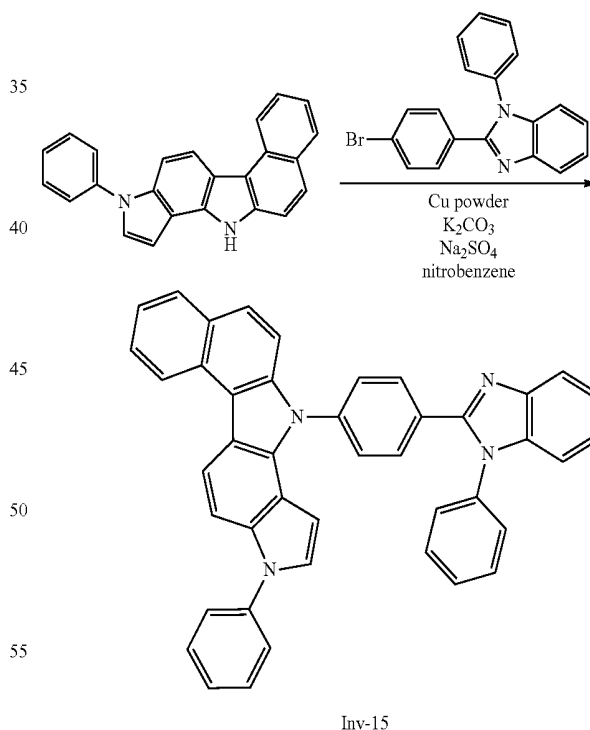
Inv-14

A target compound Inv-14 (5.05 g, yield 69%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-5a as a compound prepared in

Preparation Example 5 was used instead of IC-1a, and 2'-bromo-3,4'-bipyridine was used instead of 2-bromo-4,6-diphenylpyridine.

GC-Mass (theoretical value: 486.18 g/mol, measured value: 486 g/mol)

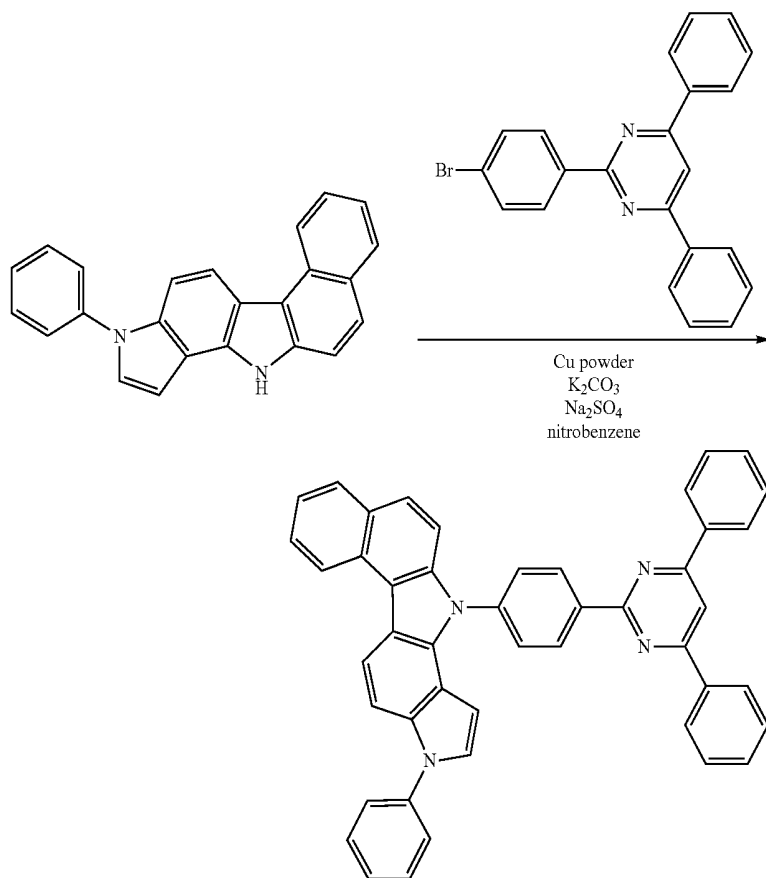
[Synthesis Example 15] Synthesis of Inv-15



Inv-15

A target compound Inv-15 (4.34 g, yield 48%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-5b as another compound prepared in Preparation Example 5 was used instead of IC-1a, and 2-(4-bromophenyl)-1-phenyl-1H-benzotriazole was used instead of 2-bromo-4,6-diphenylpyridine.

GC-Mass (theoretical value: 600.23 g/mol, measured value: 600 g/mol)

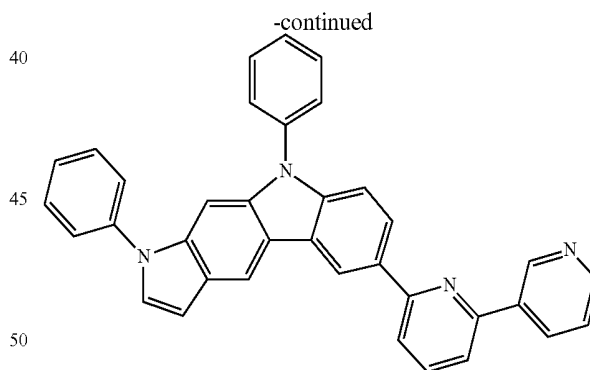
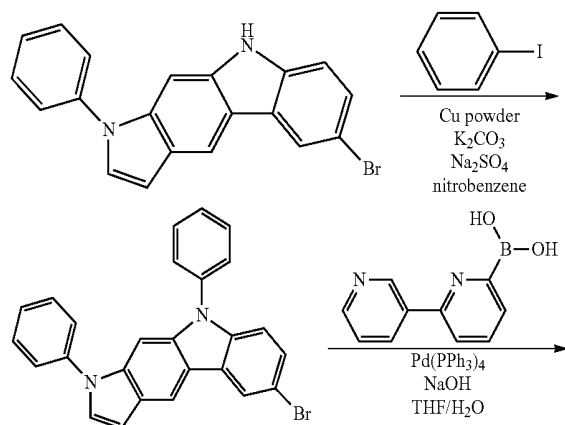


Inv-16

A target compound Inv-16 (4.13 g, yield 43%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-5b as another compound prepared in Preparation Example 5 was used instead of IC-1a, and 2-(4-bromophenyl)-4,6-diphenylpyrimidine was used instead of 2-bromo-4,6-diphenylpyridine.

GC-Mass (theoretical value: 638.25 g/mol, measured value: 638 g/mol)

[Synthesis Example 17] Synthesis of Inv-17



Inv-17

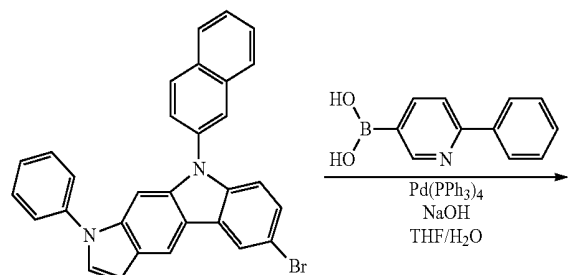
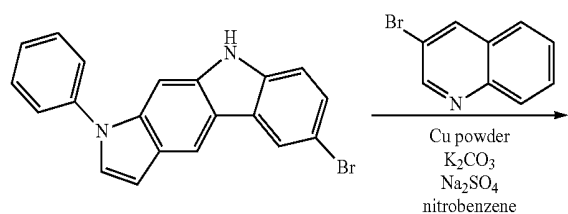
IC-6a (5 g, 13.84 mmol) as a compound prepared in Preparation Example 6, iodobenzene (4.24 g, 20.76 mmol), Cu powder (0.09 g, 1.38 mmol), K₂CO₃ (1.91 g, 13.84 mmol), Na₂SO₄ (1.97 g, 13.84 mmol), and nitrobenzene (80 ml) were mixed under nitrogen flow, and the mixture was stirred at 190° C. for 12 hours. After the reaction was completed, nitrobenzene was removed, the organic layer was separated with methylene chloride, and water was removed by using MgSO₄. After the solvent was removed from the organic layer, the residue was purified by column chromatography (Hexane:EA=5:1 (v/v)), thereby obtaining an intermediate compound 6-bromo-1,9-diphenyl-1,9-dihydropyrrolo[2,3-b]carbazole (3.45 g, yield 57%).

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The intermediate material (3.45 g, 7.89 mmol) obtained, 2,3'-bipyridin-6-ylboronic acid (1.89 g, 9.47 mmol), NaOH (0.95 g, 23.67 mmol), and THF/H₂O (100 ml/50 ml) were mixed under nitrogen flow, then 0.46 g (5 mol %) of Pd(PPh₃)₄ was added to the mixture, and the resulting mixture was stirred at 80° C. for 12 hours. After the reaction was completed, extraction was performed with methylene chloride, MgSO₄ was added thereto, and the mixture was filtered. After the solvent was removed from the organic layer obtained, the residue was purified by column chromatography (Hexane:EA=3:1 (v/v)), thereby obtaining a target compound Inv-17 (3.36 g, yield 83%).

GC-Mass (theoretical value: 512.20 g/mol, measured value: 512 g/mol)

[Synthesis Example 18] Synthesis of Inv-18



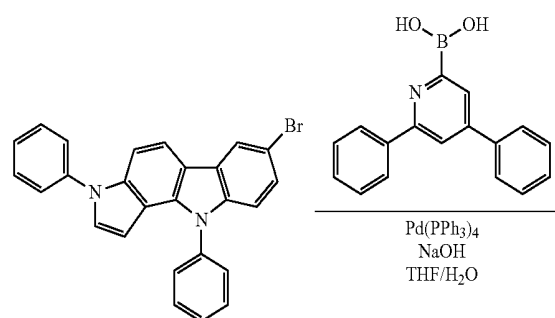
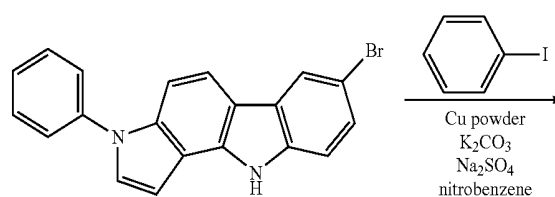
Inv-18

The same procedure as Synthesis Example 17 was performed, but an intermediate compound 6-bromo-1-phenyl-9-(quinolin-2-yl)-1,9-dihydropyrrolo[2,3-b]carbazole was obtained by using 3-bromoquinoline instead of iodobenzene, and a target compound Inv-18 (2.63 g, yield 76%) was obtained by using 6-phenylpyridin-3-ylboronic acid instead of 2,3'-bipyridin-6-ylboronic acid.

GC-Mass (theoretical value: 562.22 g/mol, measured value: 562 g/mol)

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[Synthesis Example 19] Synthesis of Inv-19



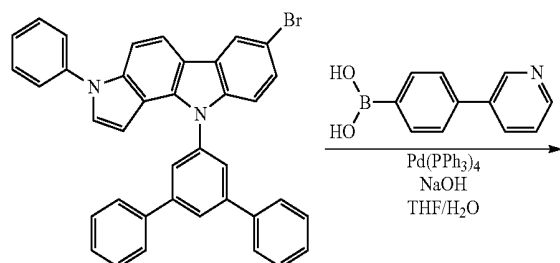
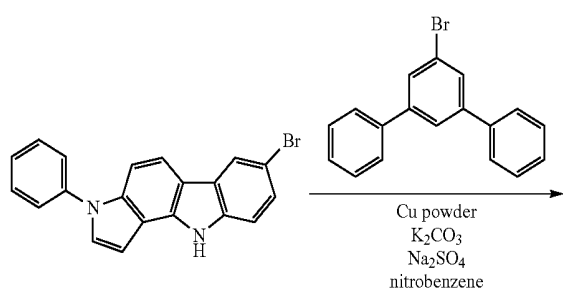
Inv-19

The same procedure as Synthesis Example 17 was performed, but an intermediate compound 7-bromo-3,10-diphenylpyrrolo[3,2-a]carbazole was obtained by using IC-6b as another compound prepared in Preparation Example 6 instead of IC-6a, and a target compound Inv-19 (3.1 g, yield 77%) was obtained by using 4,6-diphenylpyridin-2-ylboronic acid instead of 2,3'-bipyridin-6-ylboronic acid.

GC-Mass (theoretical value: 587.24 g/mol, measured value: 587 g/mol)

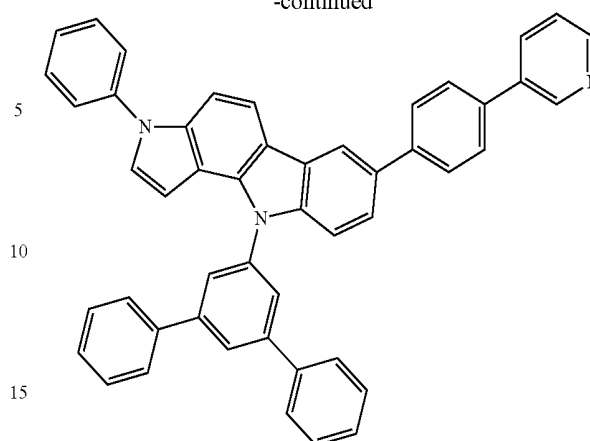
473

[Synthesis Example 20] Synthesis of Inv-20



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Inv-20

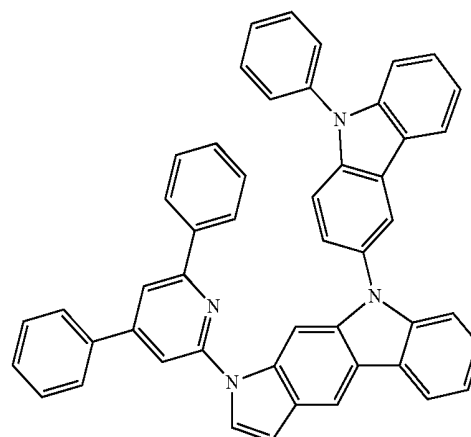
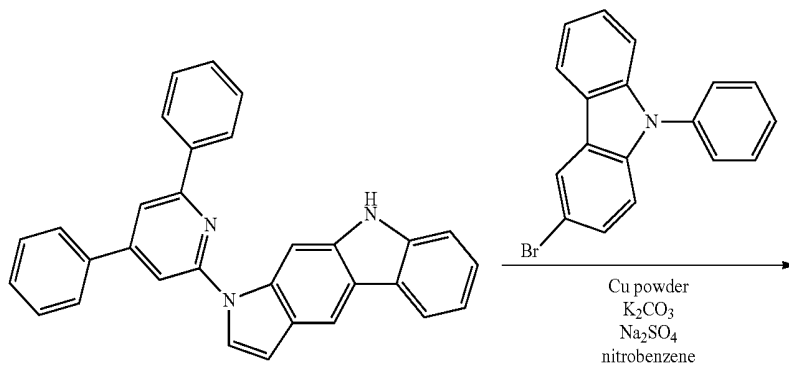
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The same procedure as Synthesis Example 17 was performed, but an intermediate compound was obtained by using IC-6b as another compound prepared in Preparation Example 6 instead of IC-6a and using 1-bromo-3,5-diphenylbenzene instead of iodobenzene, and a target compound Inv-20 (2.67 g, yield 79%) was obtained by using 4-(pyridin-3-yl)phenylboronic acid instead of 2,3'-bipyridin-6-ylboronic acid.

GC-Mass (theoretical value: 663.27 g/mol, measured value: 663 g/mol)

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[Synthetic Example 21] Synthesis of Inv-21



Inv-21

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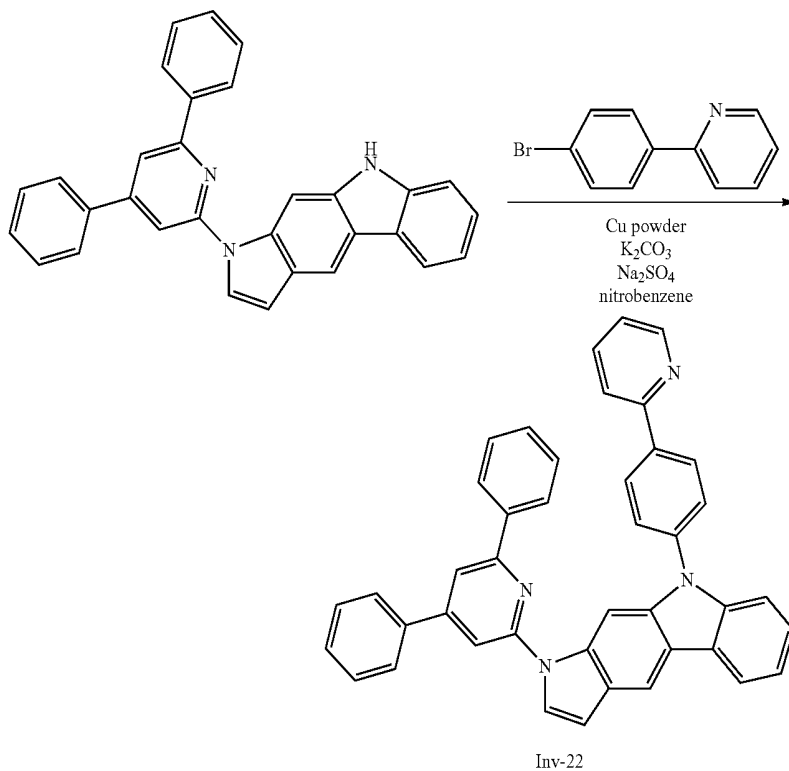
A target compound Inv-21 (2.84 g, yield 61%) was obtained by performing the same procedure as in Synthesis Example 1, except that 1-(4,6-diphenylpyridin-2-yl)-1,9-dihydropyrrolo[2,3-b]carbazole prepared in Preparation Example 8 was used instead of IC-1a, and 3-bromo-9-

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phenyl-9H-carbazole was used instead of 2-bromo-4,6-diphenylpyridine.

GC-Mass (theoretical value: 676.26 g/mol, measured value: 676 g/mol)

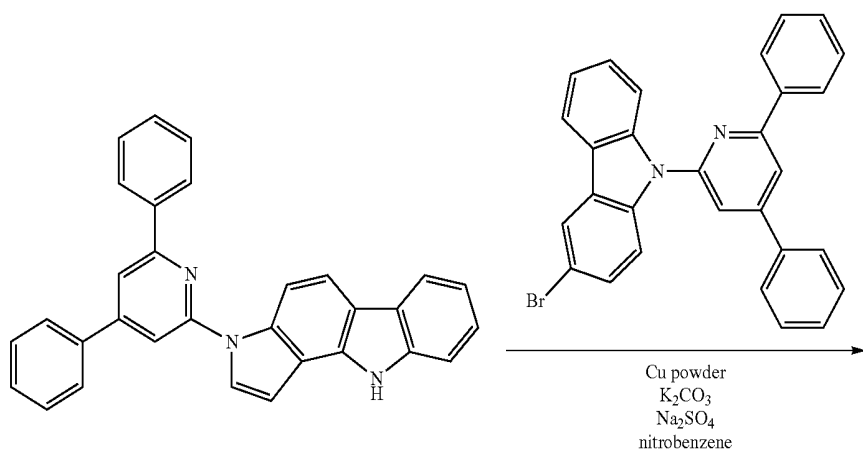
[Synthesis Example 22] Synthesis of Inv-22



A target compound Inv-22 (2.64 g, yield 65%) was obtained by performing the same procedure as in Synthesis Example 1, except that 1-(4,6-diphenylpyridin-2-yl)-1,9-dihydropyrrolo[2,3-b]carbazole prepared in Preparation Example 8 was used instead of IC-1a, and 2-(4-bromophenyl)pyridine was used instead of 2-bromo-4,6-diphenylpyridine.

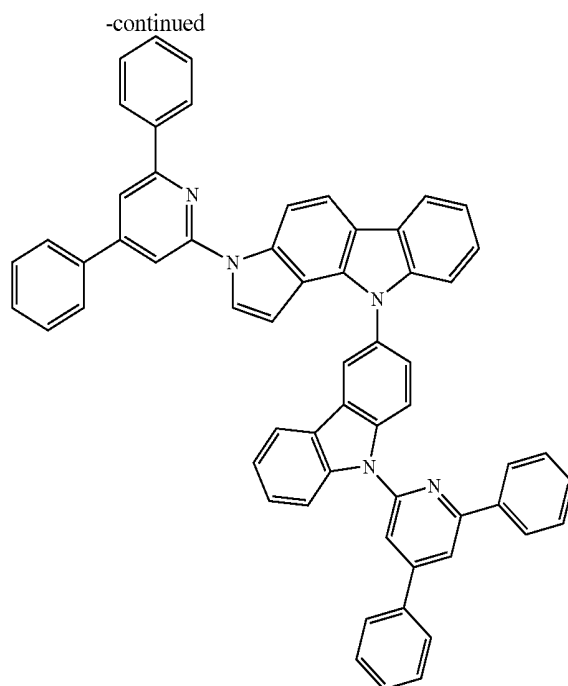
GC-Mass (theoretical value: 588.23 g/mol, measured value: 588 g/mol)

[Synthesis Example 23] Synthesis of Inv-23



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478

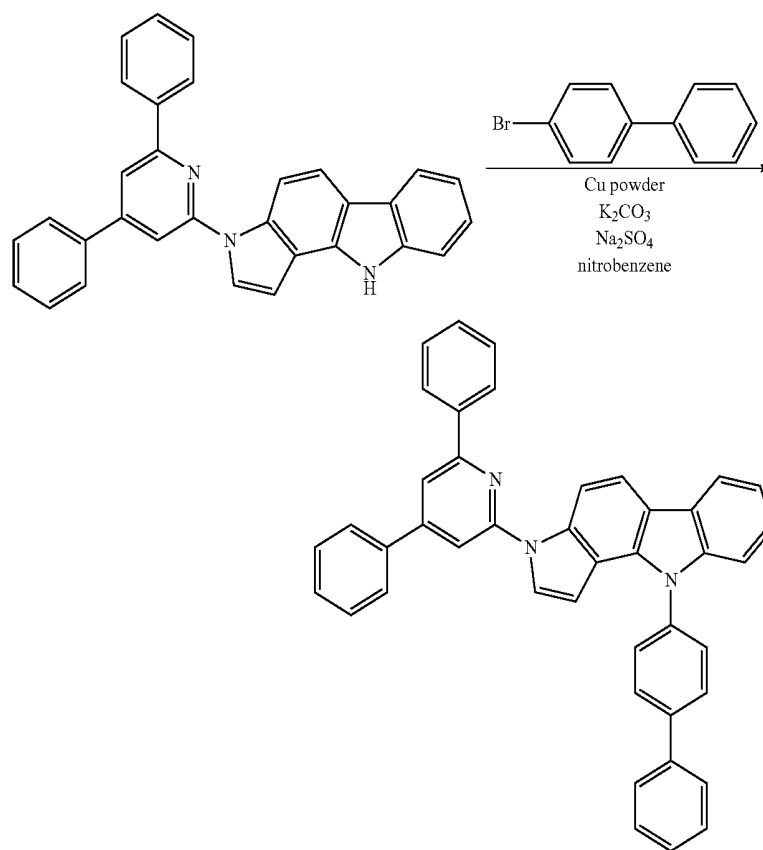


A target compound Inv-23 (2.74 g, yield 48%) was obtained by performing the same procedure as in Synthesis Example 1, except that 3-(4,6-diphenylpyridin-2-yl)-3,10-dihydropyrrolo[3,2-a]carbazole prepared in Preparation Example 7 was used instead of IC-1a, and 3-bromo-9-(4,6-

diphenylpyridin-2-yl)-9H-carbazole was used instead of 2-bromo-4,6-diphenylpyridine.

GC-Mass (theoretical value: 829.32 g/mol, measured value: 829 g/mol)

[Synthesis Example 24] Synthesis of Inv-24

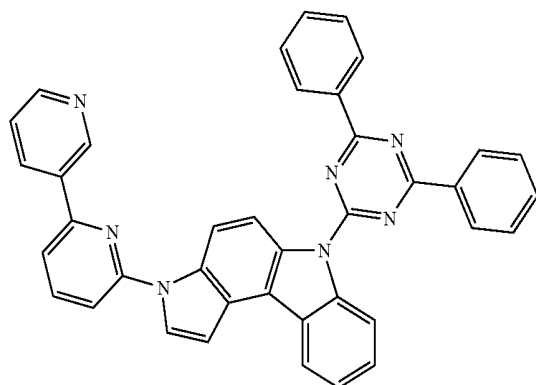
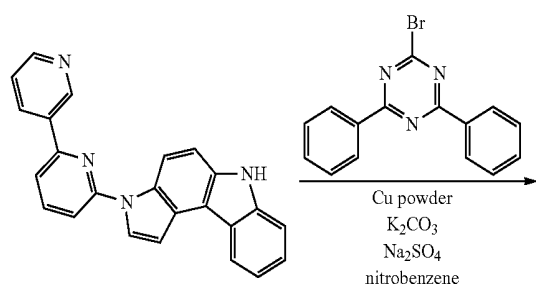


479

A target compound Inv-24 (2.83 g, yield 70%) was obtained by performing the same procedure as in Synthesis Example 1, except that 3-(4,6-diphenylpyridin-2-yl)-3,10-dihydropyrrolo[3,2-a]carbazole prepared in Preparation Example 7 was used instead of IC-1a, and 4-bromobiphenyl

GC-Mass (theoretical value: 587.24 g/mol, measured value: 587 g/mol)

[Synthesis Example 25] Synthesis of Inv-25

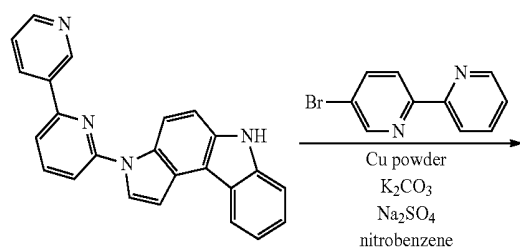


Inv-25

A target compound Inv-25 (2.12 g, yield 43%) was obtained by performing the same procedure as in Synthesis Example 1, except that 3-(2,3'-bipyridin-6-yl)-3,6-dihydropyrrolo[2,3-c]carbazole prepared in Preparation Example 9 was used instead of IC-1a, and 2-bromo-4,6-diphenyl-1,3,5-triazine was used instead of 2-bromo-4,6-diphenylpyridine.

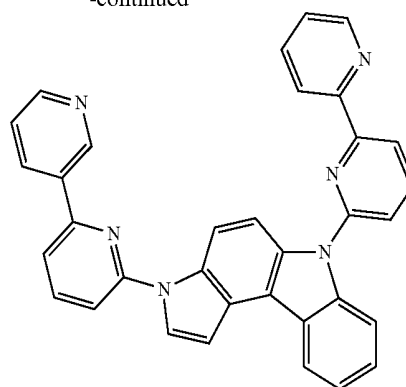
GC-Mass (theoretical value: 591.22 g/mol, measured value: 591 g/mol)

[Synthesis Example 26] Synthesis of Inv-26



480

-continued

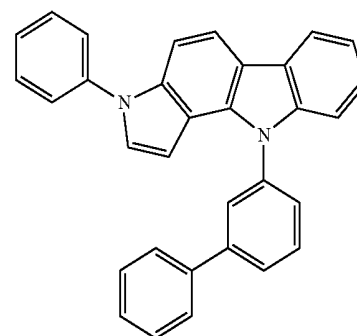
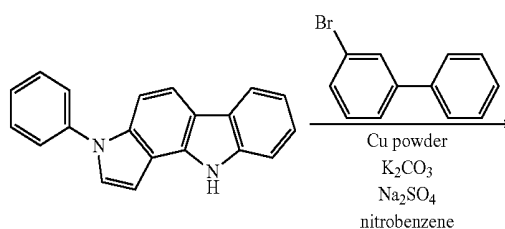


Inv-26

A target compound Inv-26 (2.23 g, yield 52%) was obtained by performing the same procedure as in Synthesis Example 1, except that 3-(2,3'-bipyridin-6-yl)-3,6-dihydropyrrolo[2,3-c]carbazole prepared in Preparation Example 9 was used instead of IC-1a, and 5-bromo-2,2'-bipyridine was used instead of 2-bromo-4,6-diphenylpyridine.

GC-Mass (theoretical value: 514.19 g/mol, measured value: 514 g/mol)

[Synthesis Example 27] Synthesis of Inv-27



Inv-27

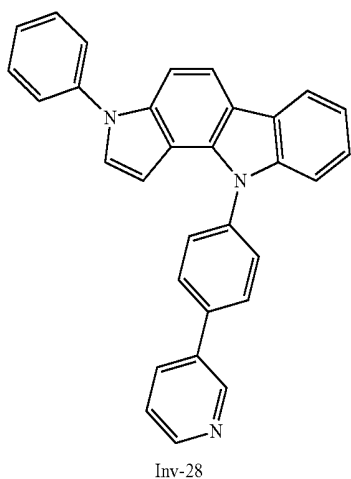
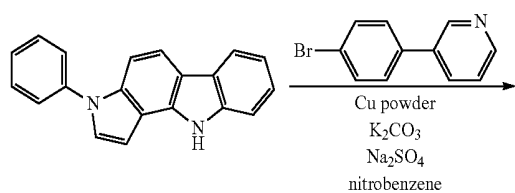
IC-1a (3 g, 10.63 mmol), 3-bromobiphenyl (3.72 g, 15.94 mmol), Cu powder (0.07 g, 1.06 mmol), K₂CO₃ (1.47 g, 10.63 mmol), Na₂SO₄ (1.51 g, 10.63 mmol), and nitrobenzene (100 ml) were mixed under nitrogen flow, and the mixture was stirred at 200° C. for 24 hours.

After the reaction was completed, nitrobenzene was removed, the organic layer was separated with methylene chloride, and water was removed by using MgSO₄. After the solvent was removed from the organic layer in which water was removed, the residue was purified by column chromatography (Hexane:MC=1:1 (v/v)), thereby obtaining a target compound Inv-27 (2.26 g, yield 49%).

GC-Mass (theoretical value: 434.18 g/mol, measured value: 434 g/mol)

481

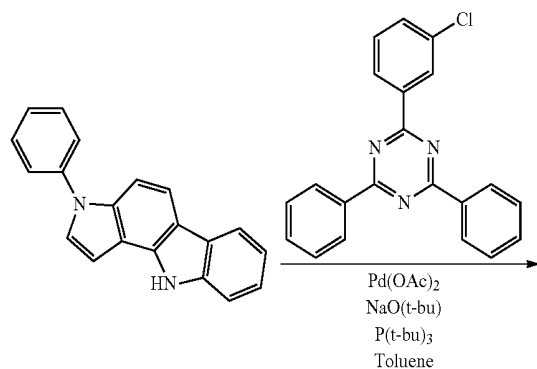
[Synthesis Example 28] Synthesis of Inv-28



A target compound Inv-28 (2.13 g, 46%) was obtained by performing the same procedure as in Synthesis Example 27, except that 3-(4-bromophenyl)pyridine was used instead of 3-bromobiphenyl.

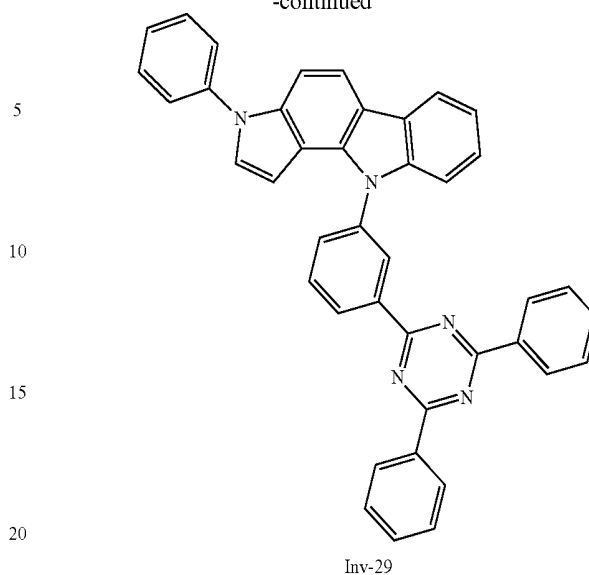
GC-Mass (theoretical value: 435.17 g/mol, measured value: 435.17 g/mol)

[Synthesis Example 29] Synthesis of Inv-29



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-continued

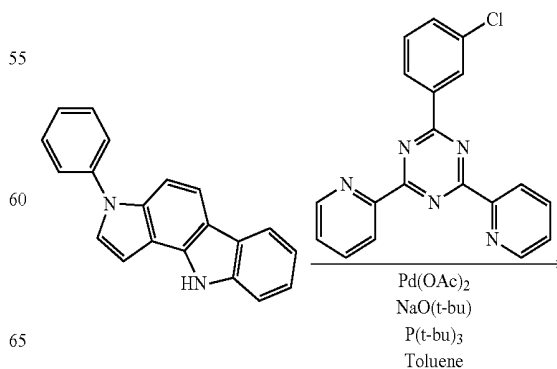


IC-1a (3 g, 10.63 mmol), 2-(3-chlorophenyl)-4,6-diphenyl-1,3,5-triazine (4.38 g, 12.75 mmol), Pd(OAc)₂ (0.12 g, 5 mol %), NaO(t-bu) (2.04 g, 21.25 mmol), P(t-bu)₃ (0.21 g, 1.06 mmol), and Toluene (100 ml) were mixed under nitrogen flow, and the mixture was stirred at 110° C. for 12 hours.

After the reaction was completed, extraction was performed with ethyl acetate, moisture was removed with MgSO₄, and purification was performed by column chromatography (Hexane:EA=2:1 (v/v)), thereby obtaining a target compound Inv-29 (4.89 g, yield 78%).

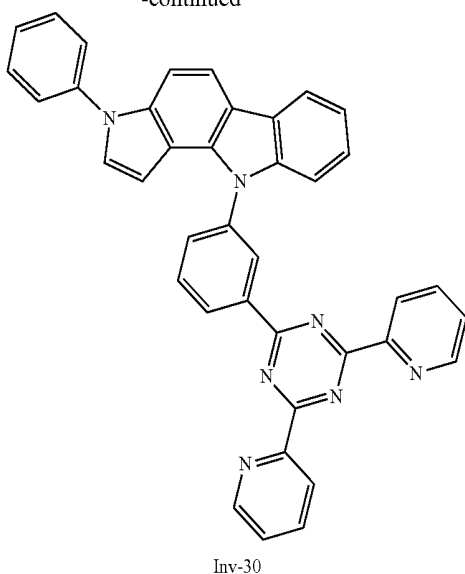
GC-Mass (theoretical value: 589.23 g/mol, measured value: 589 g/mol)

[Synthesis Example 30] Synthesis of Inv-30



483

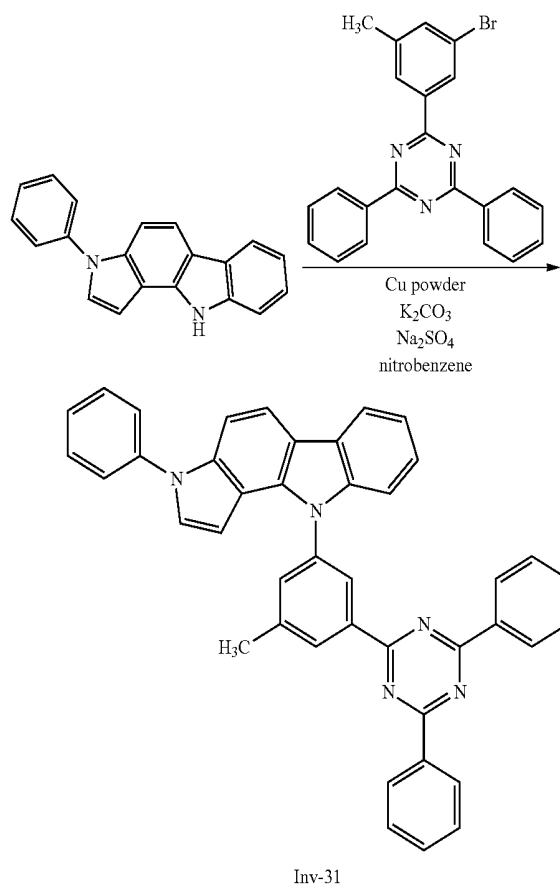
-continued



A target compound Inv-30 (4.97 g, 79%) was obtained by performing the same procedure as in Synthesis Example 29, except that 2-(3-chlorophenyl)-4,6-di(pyridin-2-yl)-1,3,5-triazine was used instead of 2-(3-chlorophenyl)-4,6-diphenyl-1,3,5-triazine.

GC-Mass (theoretical value: 591.22 g/mol, measured value: 591 g/mol)

[Synthesis Example 31] Synthesis of Inv-31

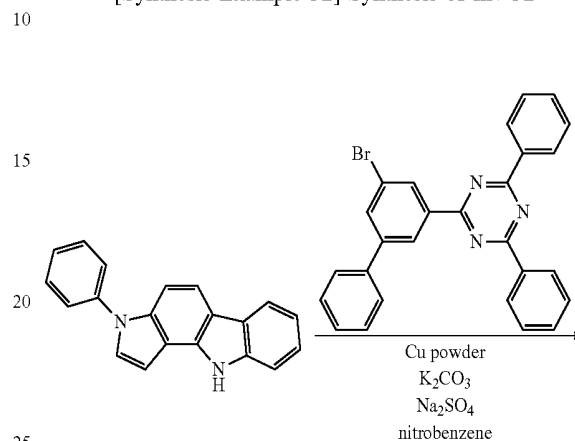


484

A target compound Inv-31 (3.21 g, 50%) was obtained by performing the same procedure as in Synthesis Example 27, except that 2-(3-bromo-5-methylphenyl)-4,6-diphenyl-1,3,5-triazine was used instead of 3-bromobiphenyl.

GC-Mass (theoretical value: 603.24 g/mol, measured value: 603 g/mol)

[Synthesis Example 32] Synthesis of Inv-32

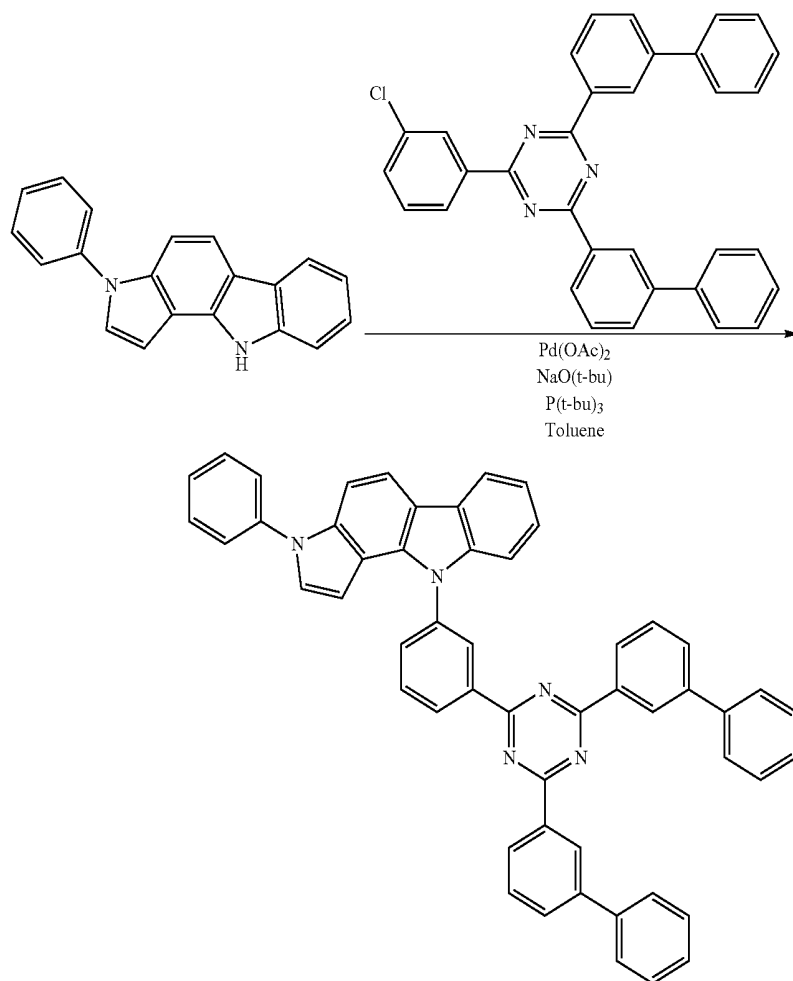


A target compound Inv-32 (3.47 g, 49%) was obtained by performing the same procedure as in Synthesis Example 27, except that 2-(5-bromobiphenyl-3-yl)-4,6-diphenyl-1,3,5-triazine was used instead of 3-bromobiphenyl.

GC-Mass (theoretical value: 665.26 g/mol, measured value: 665 g/mol)

485

[Synthesis Example 33] Synthesis of Inv-33

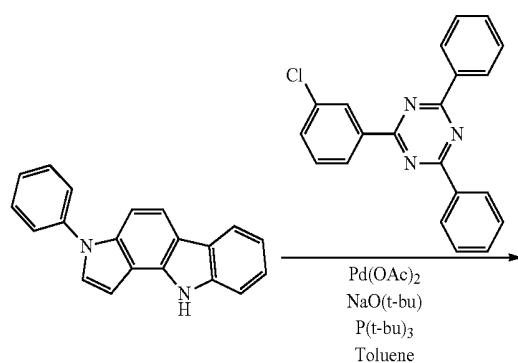


Inv-33

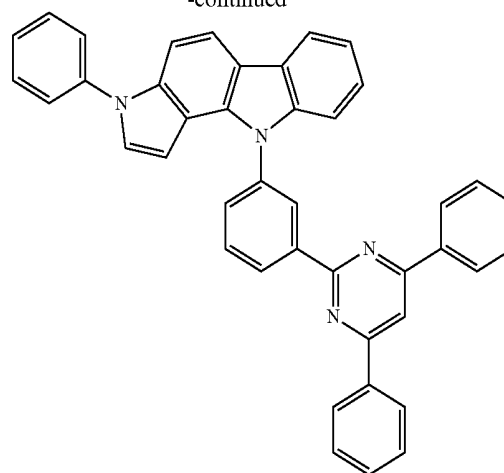
A target compound Inv-33 (5.38 g, 76%) was obtained by performing the same procedure as in Synthesis Example 29, except that 2,4-di(biphenyl-3-yl)-6-(3-chlorophenyl)-1,3,5-triazine was used instead of 2-(3-chlorophenyl)-4,6-diphenyl-1,3,5-triazine.

GC-Mass (theoretical value: 665.26 g/mol, measured value: 665 g/mol)

[Synthesis Example 34] Synthesis of Inv-34



-continued



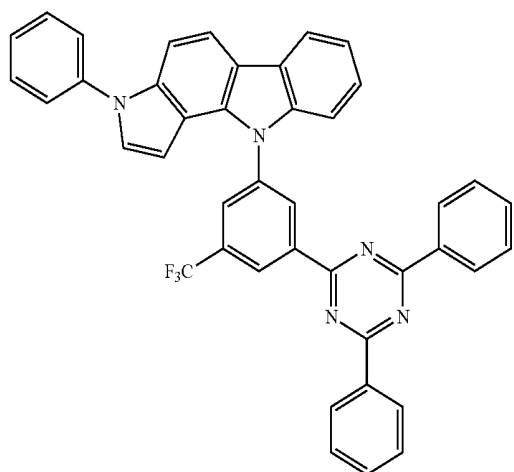
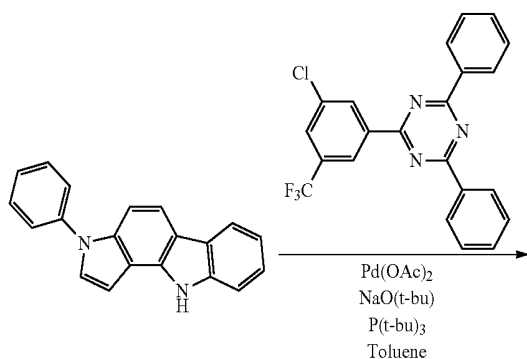
Inv-34

A target compound Inv-34 (4.63 g, 74%) was obtained by performing the same procedure as in Synthesis Example 29, except that 2-(3-chlorophenyl)-4,6-diphenylpyrimidine was used instead of 2-(3-chlorophenyl)-4,6-diphenyl-1,3,5-triazine.

GC-Mass (theoretical value: 588.23 g/mol, measured value: 588 g/mol)

487

[Synthesis Example 35] Synthesis of Inv-35

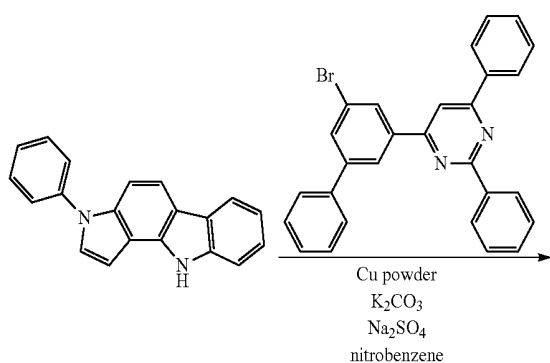


Inv-35

A target compound Inv-35 (4.89 g, 70%) was obtained by performing the same procedure as in Synthesis Example 29, except that 2-(3-chloro-5-(trifluoromethyl)phenyl)-4,6-diphenyl-1,3,5-triazine was used instead of 2-(3-chlorophenyl)-4,6-diphenyl-1,3,5-triazine.

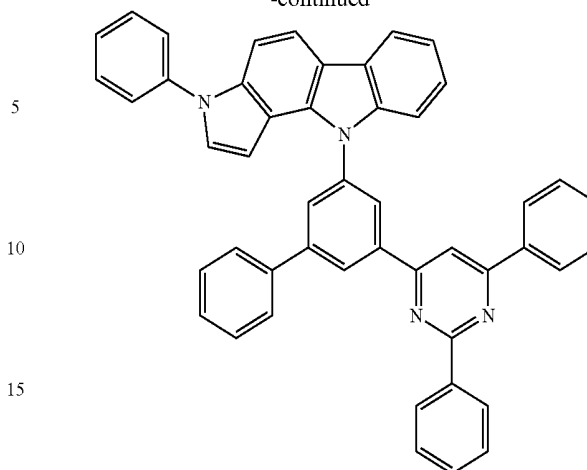
GC-Mass (theoretical value: 657.21 g/mol, measured value: 657 g/mol)

[Synthesis Example 36] Synthesis of Inv-36



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-continued



Inv-36

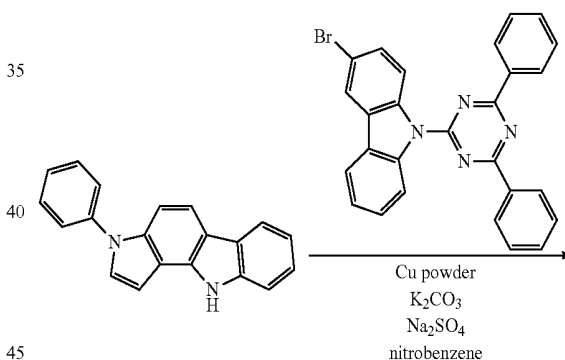
20

A target compound Inv-36 (3.53 g, 50%) was obtained by performing the same procedure as in Synthesis Example 27, except that 4-(5-bromobiphenyl-3-yl)-2,6-diphenylpyrimidine was used instead of 3-bromobiphenyl.

GC-Mass (theoretical value: 664.26 g/mol, measured value: 664 g/mol)

25

[Synthesis Example 37] Synthesis of Inv-37



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100

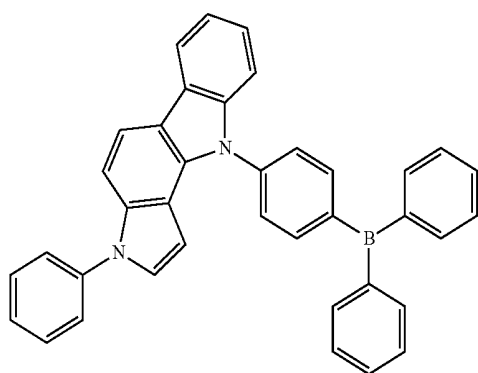
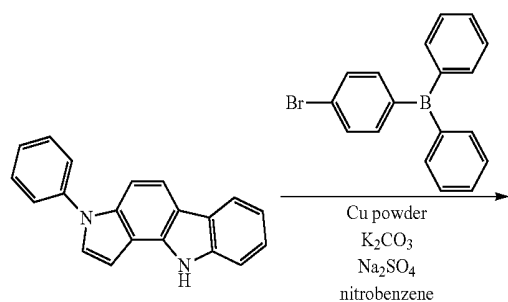
Inv-37

A target compound Inv-37 (3.39 g, 47%) was obtained by performing the same procedure as in Synthesis Example 27, except that 3-bromo-9-(4,6-diphenyl-1,3,5-triazin-2-yl)-9H-carbazole was used instead of 3-bromobiphenyl.

GC-Mass (theoretical value: 678.25 g/mol, measured value: 678 g/mol)

489

[Synthesis Example 38] Synthesis of Inv-38

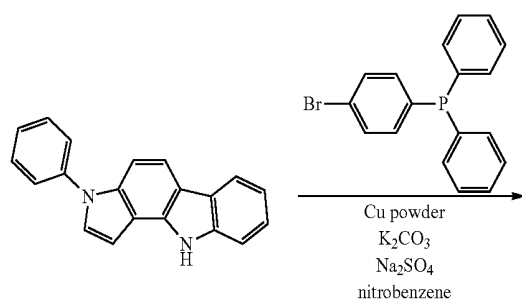


Inv-38

A target compound Inv-38 (2.44 g, 44%) was obtained by performing the same procedure as in Synthesis Example 27, except that (4-bromophenyl)diphenylborane was used instead of 3-bromobiphenyl.

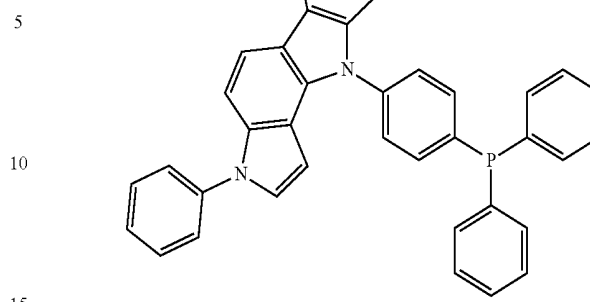
GC-Mass (theoretical value: 522.23 g/mol, measured value: 522 g/mol)

[Synthesis Example 39] Synthesis of Inv-39



490

-continued

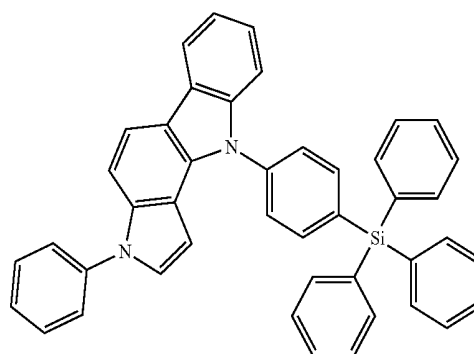
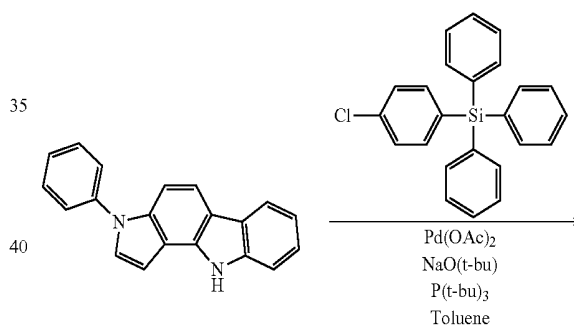


Inv-39

A target compound Inv-39 (2.59 g, 45%) was obtained by performing the same procedure as in Synthesis Example 27, except that (4-bromophenyl)diphenylphosphine was used instead of 3-bromobiphenyl.

GC-Mass (theoretical value: 542.19 g/mol, measured value: 542 g/mol)

[Synthesis Example 40] Synthesis of Inv-40



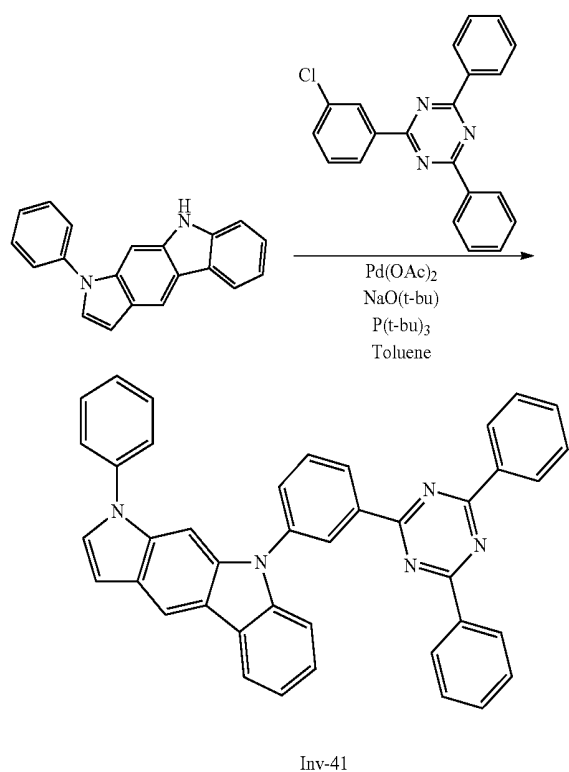
Inv-40

A target compound Inv-40 (4.92 g, 75%) was obtained by performing the same procedure as in Synthesis Example 29, except that 4-chlorophenyl)triphenylsilane was used instead of 2-(3-chlorophenyl)-4,6-diphenyl-1,3,5-triazine.

GC-Mass (theoretical value: 616.23 g/mol, measured value: 616 g/mol)

491

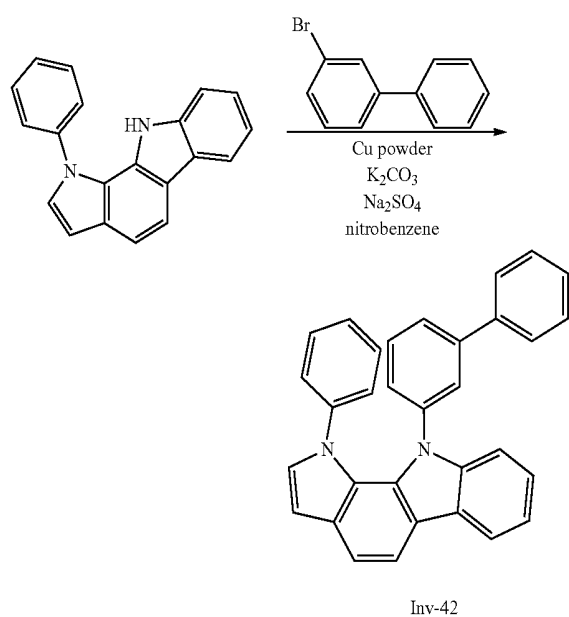
[Synthesis Example 41] Synthesis of Inv-41



A target compound Inv-41 (4.51 g, 72%) was obtained by performing the same procedure as in Synthesis Example 29, except that IC-1a was used instead of IC-1b.

GC-Mass (theoretical value: 589.23 g/mol, measured value: 589 g/mol)

[Synthesis Example 42] Synthesis of Inv-42

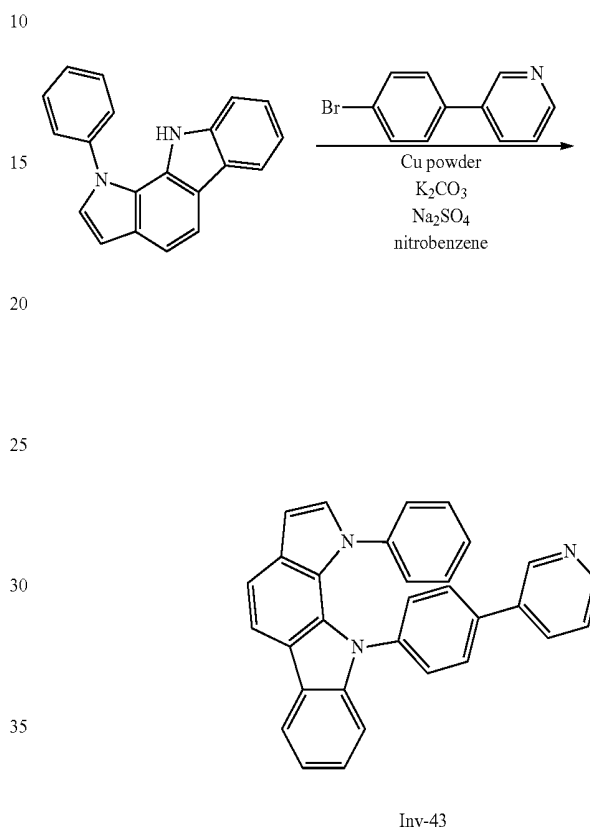


492

A target compound Inv-42 (2.35 g, 51%) was obtained by performing the same procedure as in Synthesis Example 27, except that IC-10a was used instead of IC-1b.

GC-Mass (theoretical value: 434.18 g/mol, measured value: 434 g/mol)

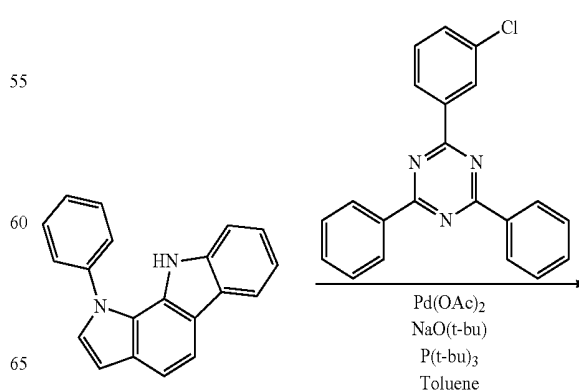
[Synthesis Example 43] Synthesis of Inv-43



A target compound Inv-43 (2.45, 53%) was obtained by performing the same procedure as in Synthesis Example 27, except that IC-10a and 3-(4-bromophenyl)pyridine were used instead of IC-1b and 3-bromobiphenyl.

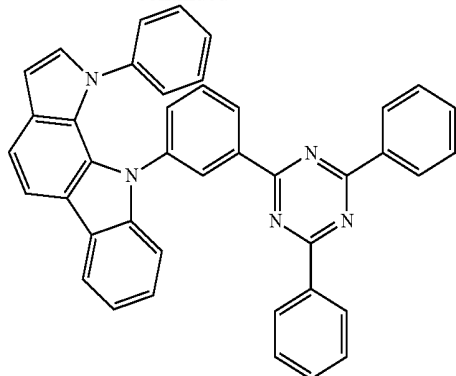
GC-Mass (theoretical value: 435.17 g/mol, measured value: 435 g/mol)

[Synthesis Example 44] Synthesis of Inv-44



493

-continued

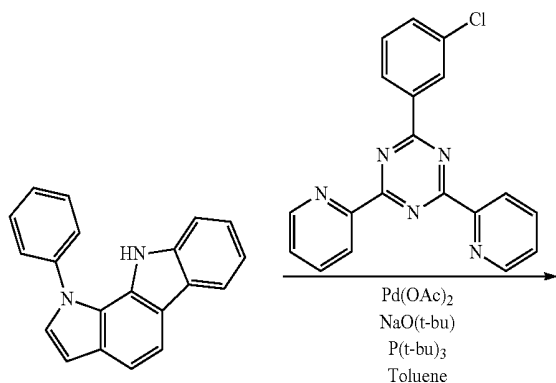


Inv-44

A target compound Inv-44 (4.32 g, 69%) was obtained by performing the same procedure as in Synthesis Example 29, except that IC-10a was used instead of IC-1b.

GC-Mass (theoretical value: 589.23 g/mol, measured value: 589 g/mol)

[Synthesis Example 45] Synthesis of Inv-45



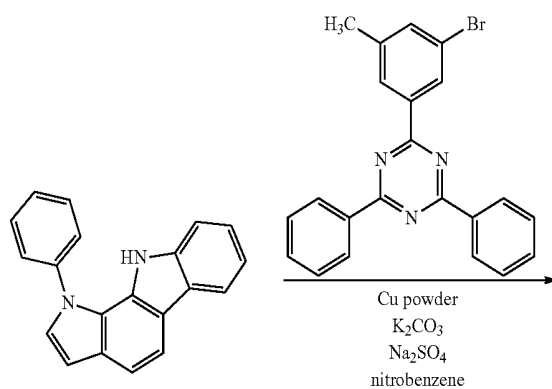
Inv-45

494

A target compound Inv-45 (4.53 g, 72%) was obtained by performing the same procedure as in Synthesis Example 29, except that IC-10a and 2-(3-chlorophenyl)-4,6-di(pyridin-2-yl)-1,3,5-triazine were used instead of IC-1b and 2-(3-chlorophenyl)-4,6-diphenyl-1,3,5-triazine.

GC-Mass (theoretical value: 591.22 g/mol, measured value: 591 g/mol)

[Synthesis Example 46] Synthesis of Inv-46



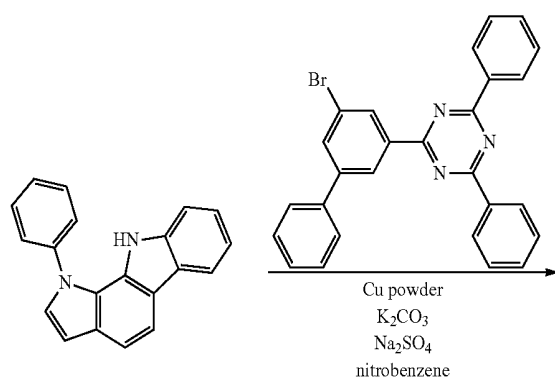
Inv-46

495

A target compound Inv-46 (2.95 g, 46%) was obtained by performing the same procedure as in Synthesis Example 27, except that IC-10a and 2-(3-bromo-5-methylphenyl)-4,6-diphenyl-1,3,5-triazine were used instead of IC-1b and 3-bromobiphenyl.

GC-Mass (theoretical value: 603.24 g/mol, measured value: 603 g/mol)

[Synthesis Example 47] Synthesis of Inv-47



10

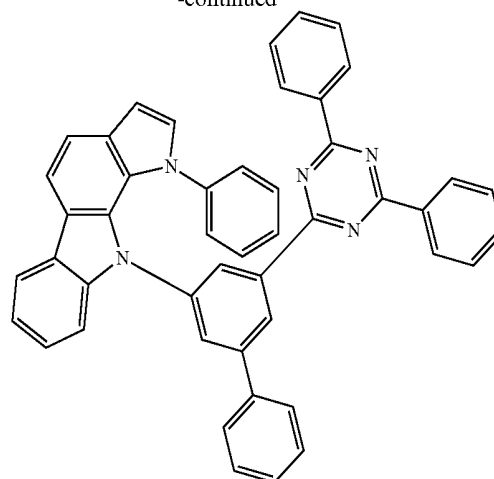
15

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496

-continued

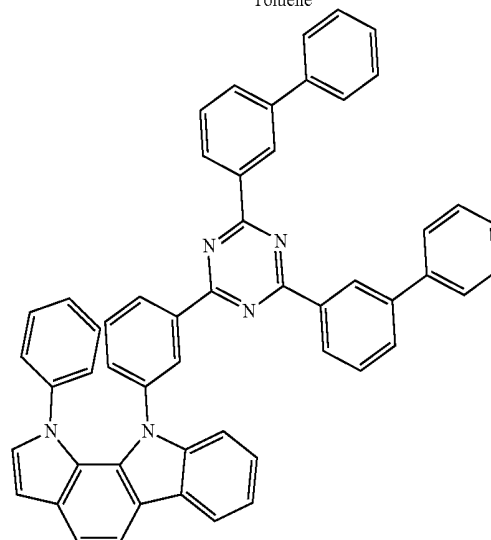
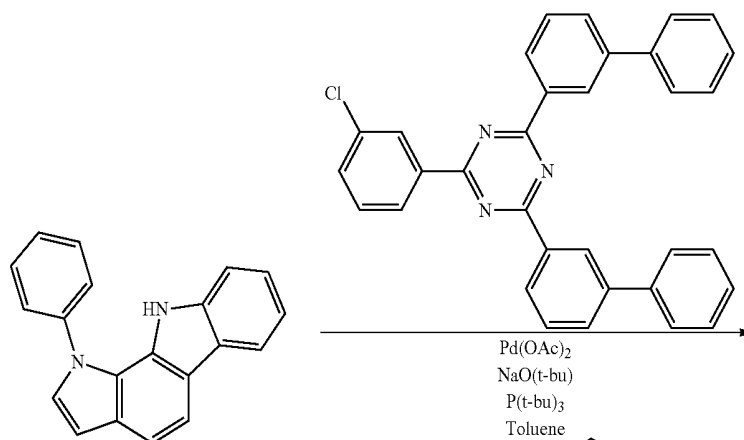


Inv-47

A target compound Inv-47 (3.18, 45%) was obtained by performing the same procedure as in Synthesis Example 27, except that IC-10a and 2-(5-bromobiphenyl-3-yl)-4,6-diphenyl-1,3,5-triazine were used instead of IC-1b and 3-bromobiphenyl.

GC-Mass (theoretical value: 665.26 g/mol, measured value: 665 g/mol)

[Synthesis Example 48] Synthesis of Inv-48



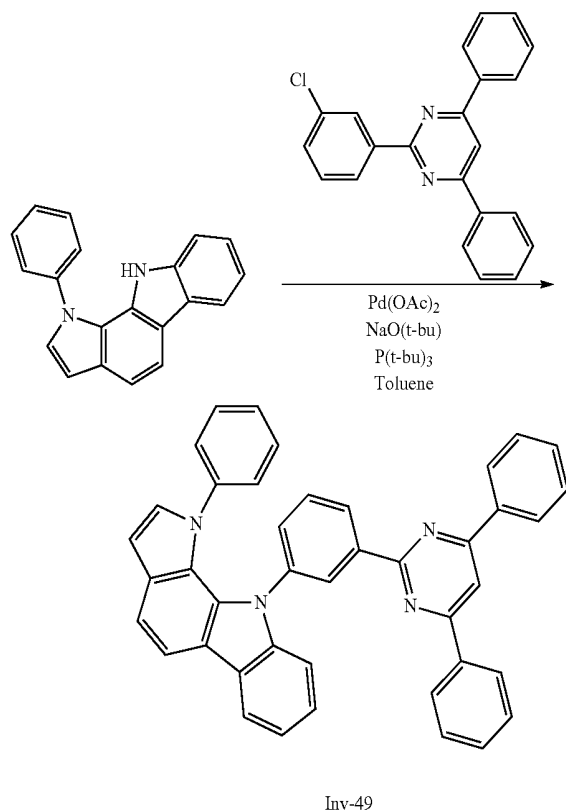
Inv-48

497

A target compound Inv-48 (6.07 g, 72%) was obtained by performing the same procedure as in Synthesis Example 29, except that IC-10a and 2,4-di(biphenyl-3-yl)-6-(3-chlorophenyl)-1,3,5-triazine were used instead of IC-1b and 2-(3-chlorophenyl)-4,6-diphenyl-1,3,5-triazine.

GC-Mass (theoretical value: 741.29 g/mol, measured value: 741 g/mol)

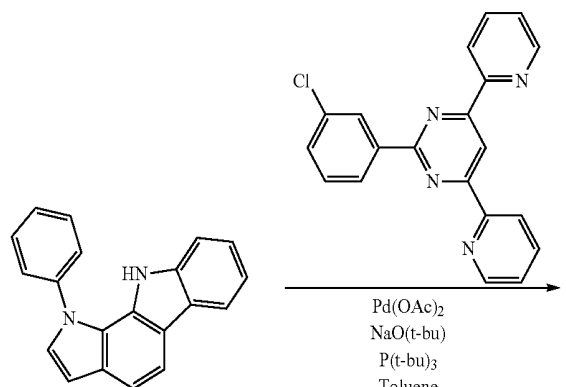
[Synthesis Example 49] Synthesis of Inv-49



A target compound Inv-49 (4.69 g, 75%) was obtained by performing the same procedure as in Synthesis Example 29, except that IC-10a and 2-(3-chlorophenyl)-4,6-diphenylpyrimidine were used instead of IC-1b and 2-(3-chlorophenyl)-4,6-diphenyl-1,3,5-triazine.

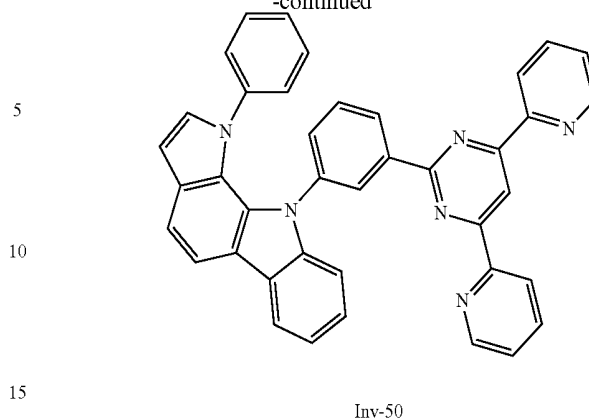
GC-Mass (theoretical value: 588.23 g/mol, measured value: 588 g/mol)

[Synthesis Example 50] Synthesis of Inv-50



498

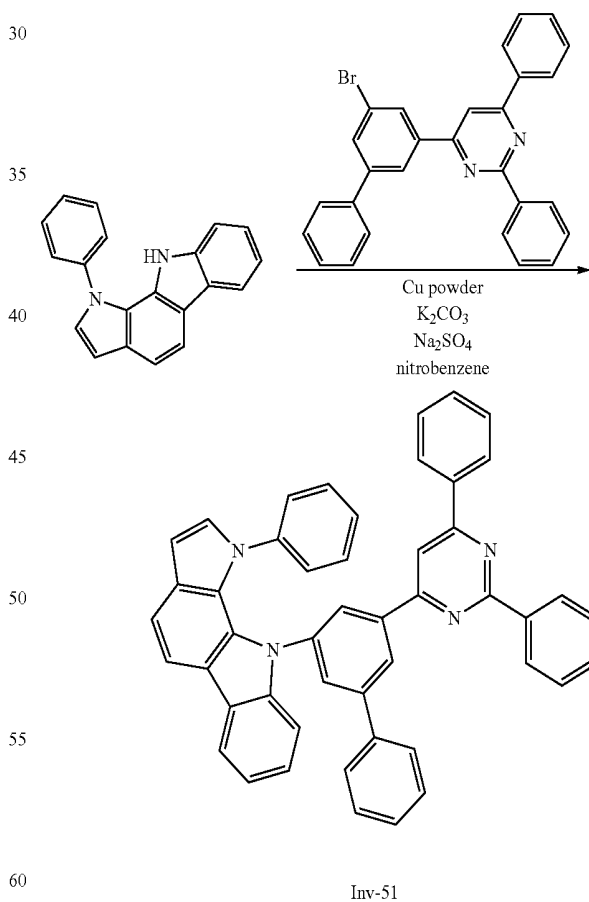
-continued



A target compound Inv-50 (4.46 g, 71%) was obtained by performing the same procedure as in Synthesis Example 29, except that IC-10a and 2-(3-chlorophenyl)-4,6-di(pyridin-2-yl)pyrimidine were used instead of IC-1b and 2-(3-chlorophenyl)-4,6-diphenyl-1,3,5-triazine.

GC-Mass (theoretical value: 590.22 g/mol, measured value: 590 g/mol)

[Synthesis Example 51] Synthesis of Inv-51

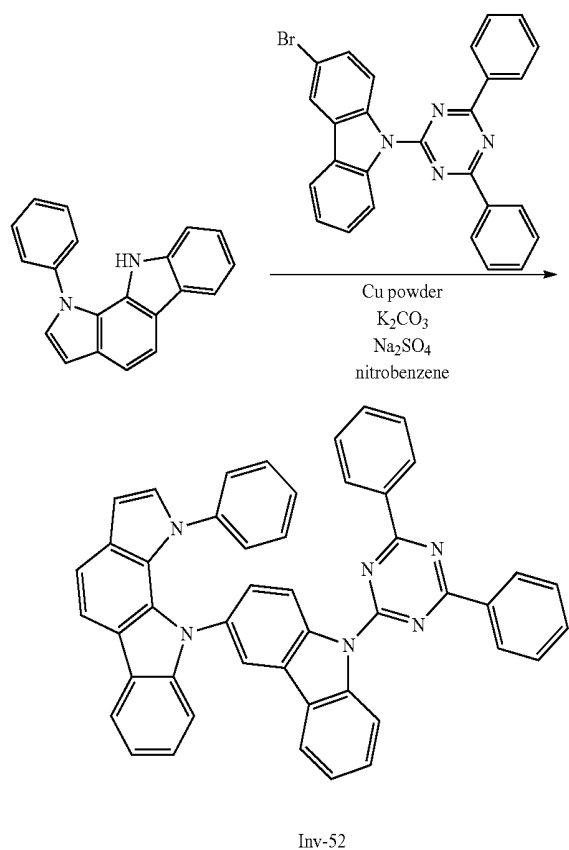


A target compound Inv-51 (3.04 g, 43%) was obtained by performing the same procedure as in Synthesis Example 27, except that IC-10a and 4-(5-bromobiphenyl-3-yl)-2,6-diphenylpyrimidine were used instead of IC-1b and 3-bromobiphenyl.

499

GC-Mass (theoretical value: 664.26 g/mol, measured value: 664 g/mol)

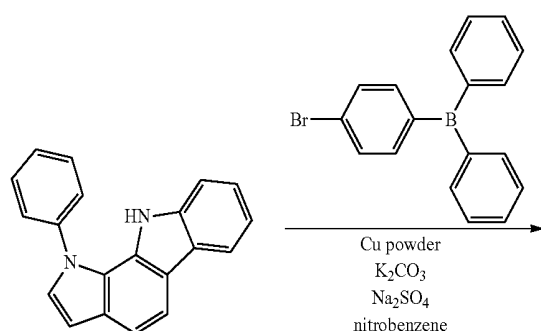
[Synthesis Example 52] Synthesis of Inv-52



A target compound Inv-52 (2.96 g, 41%) was obtained by performing the same procedure as in Synthesis Example 27, except that IC-10a and 3 3-bromo-9-(4,6-diphenyl-1,3,5-triazin-2-yl)-9H-carbazole were used instead of IC-1b and 3-bromobiphenyl.

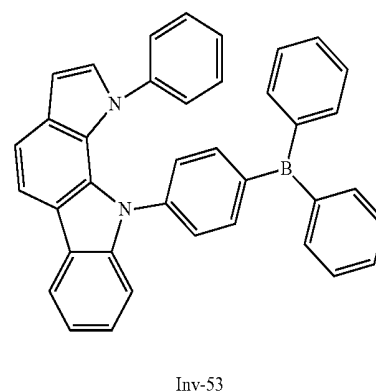
GC-Mass (theoretical value: 678.25 g/mol, measured value: 678 g/mol)

[Synthesis Example 53] Synthesis of Inv-53



500

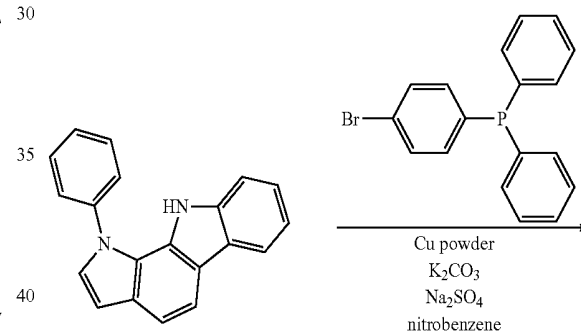
-continued



A target compound Inv-53 (2.66 g, 48%) was obtained by performing the same procedure as in Synthesis Example 27, except that IC-10a and (4-bromophenyl)diphenylborane were used instead of IC-1b and 3-bromobiphenyl.

GC-Mass (theoretical value: 522.23 g/mol, measured value: 522 g/mol)

[Synthesis Example 54] Synthesis of Inv-54



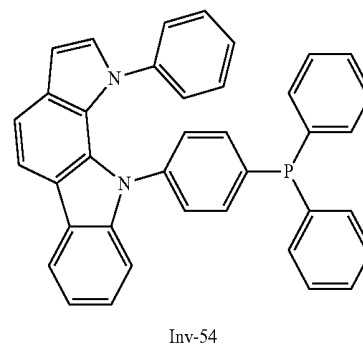
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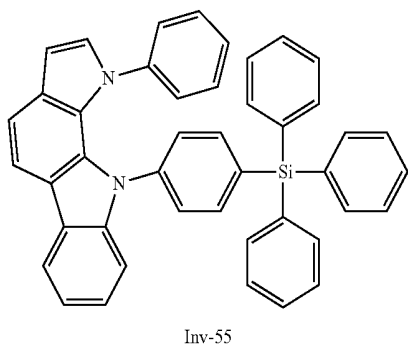
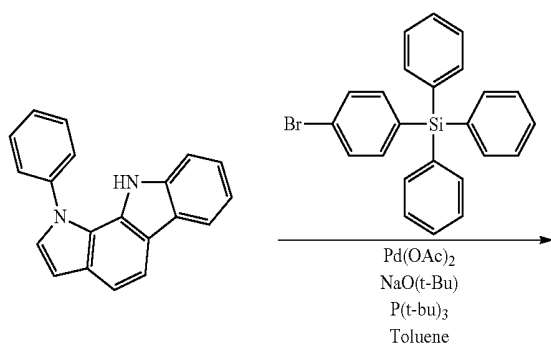


A target compound Inv-54 (2.54 g, 44%) was obtained by performing the same procedure as in Synthesis Example 27, except that IC-10a and (4-bromophenyl)diphenylphosphine were used instead of IC-1b and 3-bromobiphenyl.

GC-Mass (theoretical value: 542.19 g/mol, measured value: 542 g/mol)

501

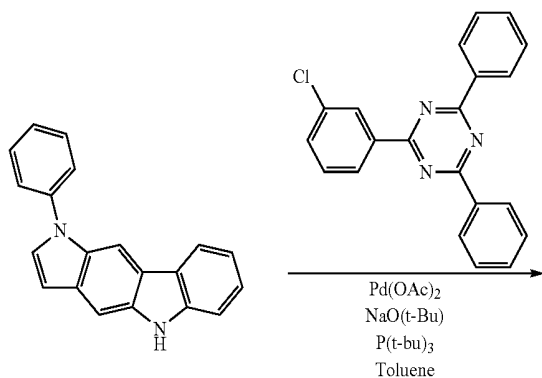
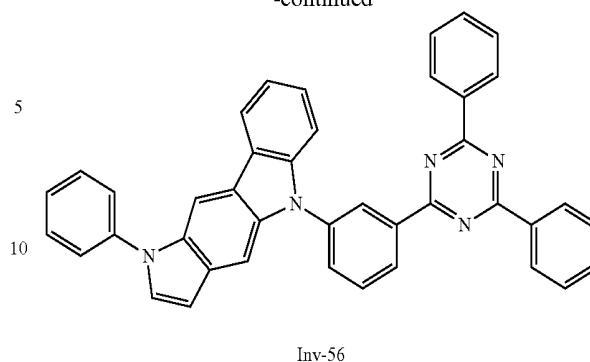
[Synthesis Example 55] Synthesis of Inv-55



A target compound Inv-55 (4.65 g, 71%) was obtained by performing the same procedure as in Synthesis Example 29, except that IC-10a and (4-chlorophenyl)triphenylsilane were used instead of IC-1b and 2-(3-chlorophenyl)-4,6-diphenyl-1,3,5-triazine.

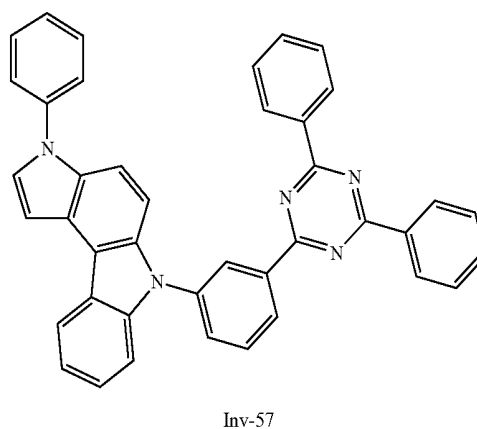
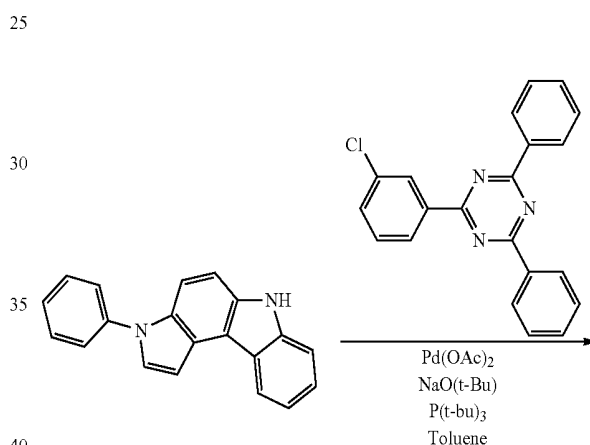
GC-Mass (theoretical value: 616.23 g/mol, measured value: 616 g/mol)

[Synthesis Example 56] Synthesis of Inv-56

502
-continued

A target compound Inv-56 (4.70 g, 75%) was obtained by performing the same procedure as in Synthesis Example 29, except that IC-10b was used instead of IC-1b. GC-Mass (theoretical value: 589.23 g/mol, measured value: 589 g/mol)

[Synthesis Example 57] Synthesis of Inv-57

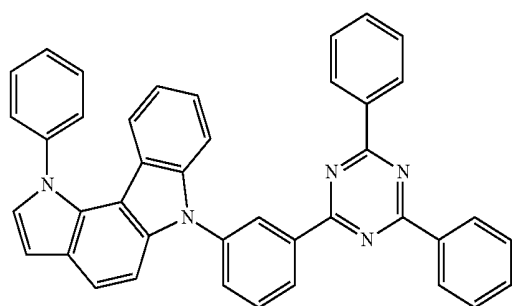
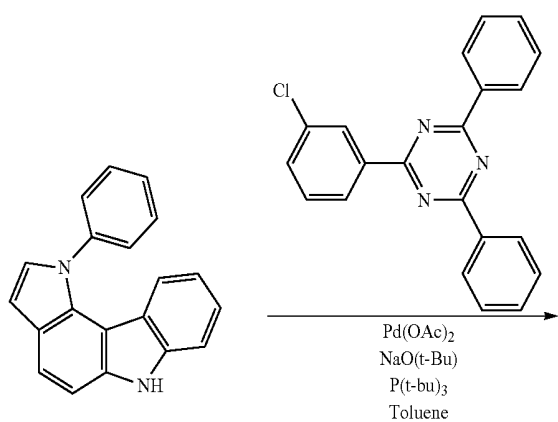


A target compound Inv-57 (4.57 g, 73%) was obtained by performing the same procedure as in Synthesis Example 29, except that IC-2 was used instead of IC-1b.

GC-Mass (theoretical value: 589.23 g/mol, measured value: 589 g/mol)

503

[Synthesis Example 58] Synthesis of Inv-58

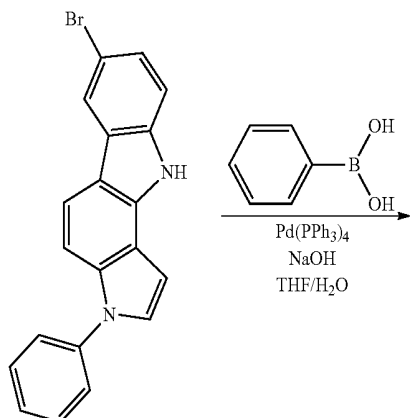


Inv-58

A target compound Inv-58 (4.82 g, 77%) was obtained by performing the same procedure as in Synthesis Example 29, except that IC-3 was used instead of IC-1b.

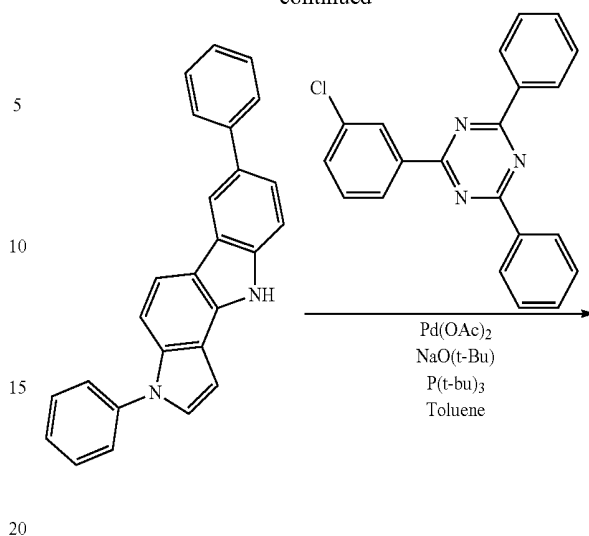
GC-Mass (theoretical value: 589.23 g/mol, measured value: 589 g/mol)

[Synthesis Example 59] Synthesis of Inv-59



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-continued



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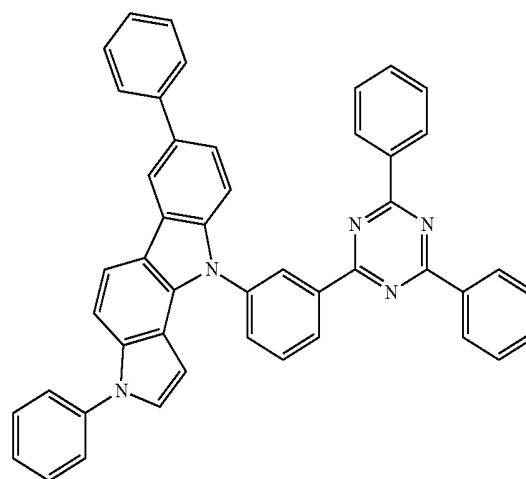
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Inv-59

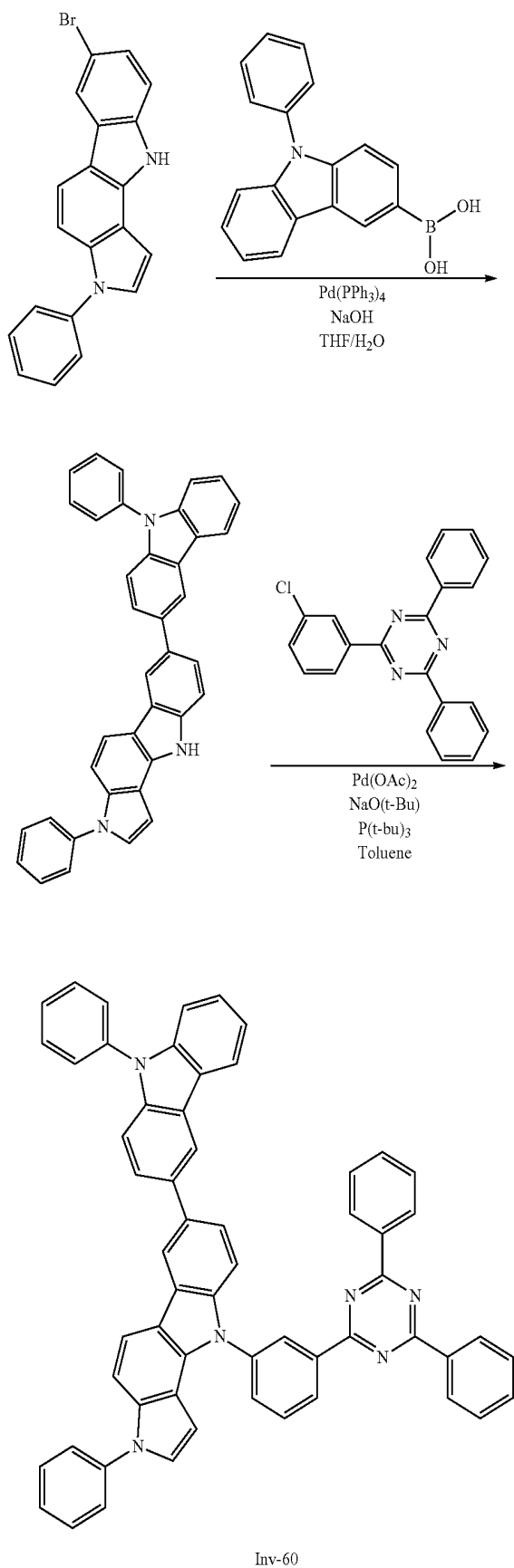
IC-6b (5 g, 13.84 mmol), phenylboronic acid (2.03 g, 16.61 mmol), NaOH (1.66 g, 41.52 mmol), and THF/H₂O (100 ml/500 ml) were mixed under nitrogen flow, and the mixture was stirred at 80° C. for 12 hours.

After the reaction was completed, extraction was performed with methylene chloride, MgSO₄ was added thereto, and the mixture was filtered. After the solvent was removed from the organic layer obtained, purification was performed by column chromatography (Hexane:EA=3:1 (v/v)) to obtain 3,7-diphenyl-3,10-dihydropyrrolo[3,2-a]carbazole, and a target compound Inv-59 (6.27 g, 68%) was obtained by performing the same procedure as in Synthesis Example 29 using the obtained compound instead of IC-1b.

GC-Mass (theoretical value: 665.26 g/mol, measured value: 665 g/mol)

505

[Synthesis Example 60] Synthesis of Inv-60

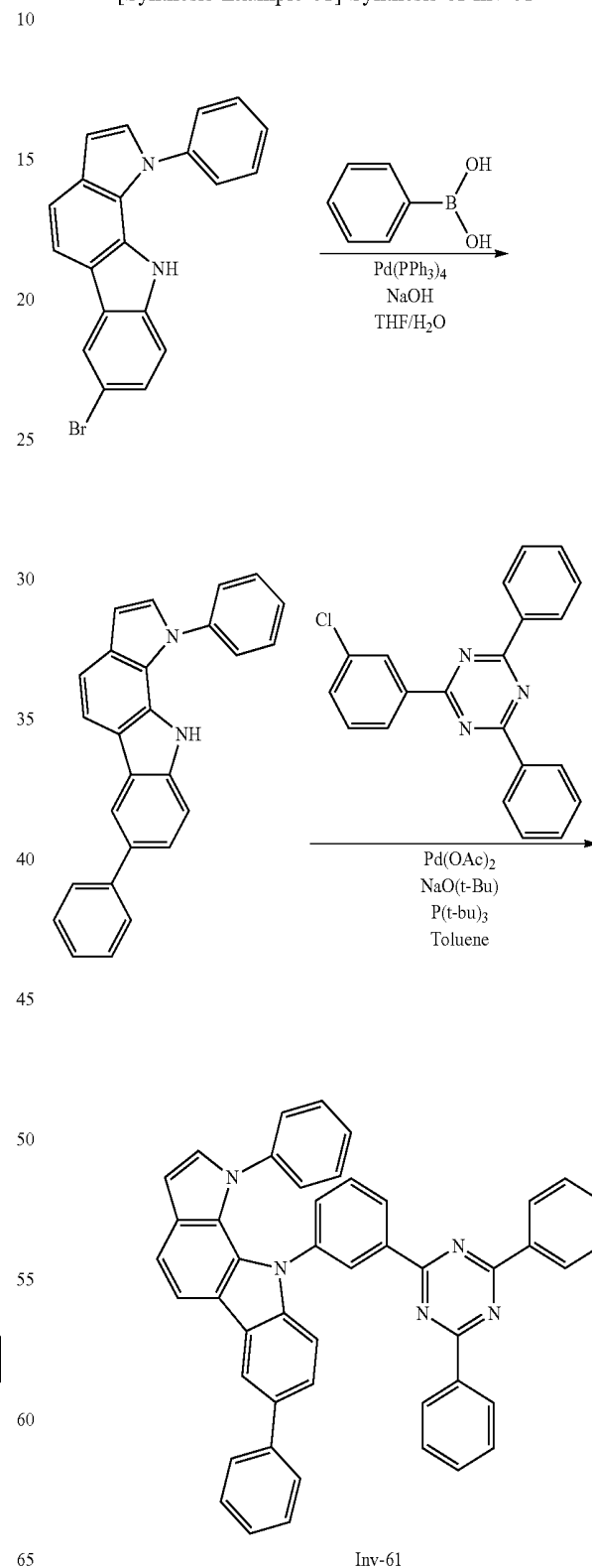


506

A target compound Inv-60 (7.94 g, 69%) was obtained by performing the same procedure as in Synthesis Example 59, except that 9-phenyl-9H-carbazol-3-ylboronic acid was used instead of phenylboronic acid.

5 GC-Mass (theoretical value: 830.32 g/mol, measured value: 830 g/mol)

[Synthesis Example 61] Synthesis of Inv-61

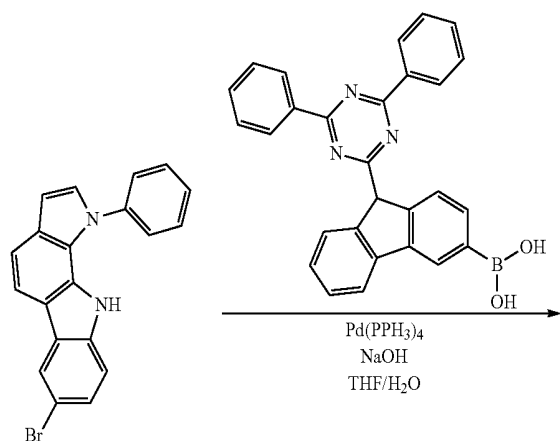


507

A target compound Inv-61 (6.64 g, 72%) was obtained by performing the same procedure as in Synthesis Example 59, except that IC-11 was used instead of IC-6b.

GC-Mass (theoretical value: 665.26 g/mol, measured value: 665 g/mol)

[Synthesis Example 62] Synthesis of Inv-62



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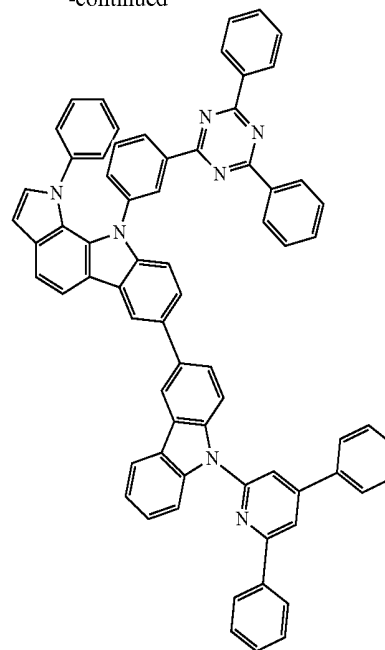
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508

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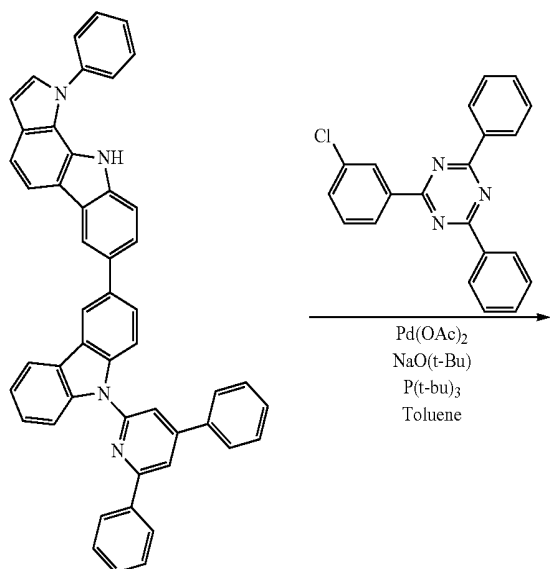


Inv-62

A target compound Inv-62 (10.22 g, 75%) was obtained by performing the same procedure as in Synthesis Example 59, except that IC-11 and 9-(4,6-diphenylpyridin-2-yl)-9H-carbazol-3-ylboronic acid were used instead of IC-6b and phenylboronic acid.

GC-Mass (theoretical value: 983.37 g/mol, measured value: 983 g/mol)

[Synthesis Example 63] Synthesis of Inv-63

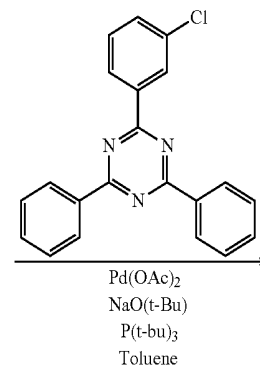


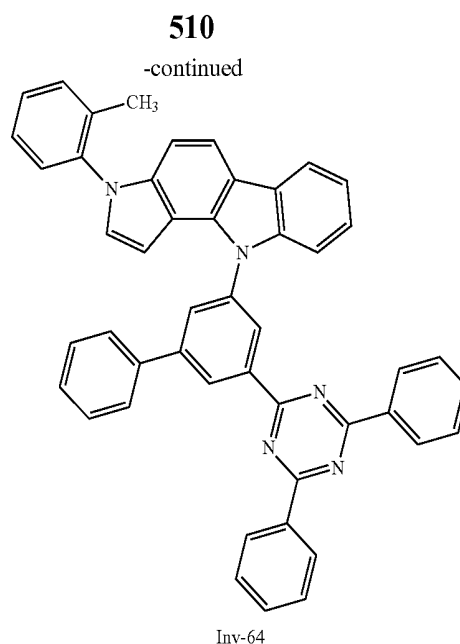
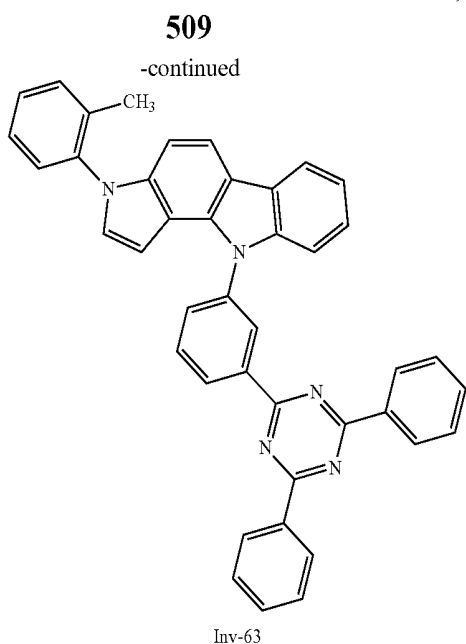
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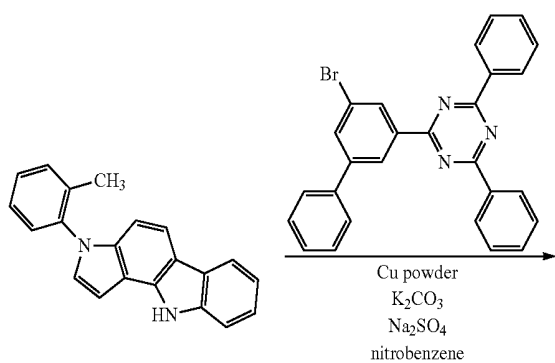




A target compound Inv-63 (4.34 g, 71%) was obtained by performing the same procedure as in Synthesis Example 29, except that IC-12 was used instead of IC-1b.

GC-Mass (theoretical value: 603.24 g/mol, measured value: 603 g/mol)

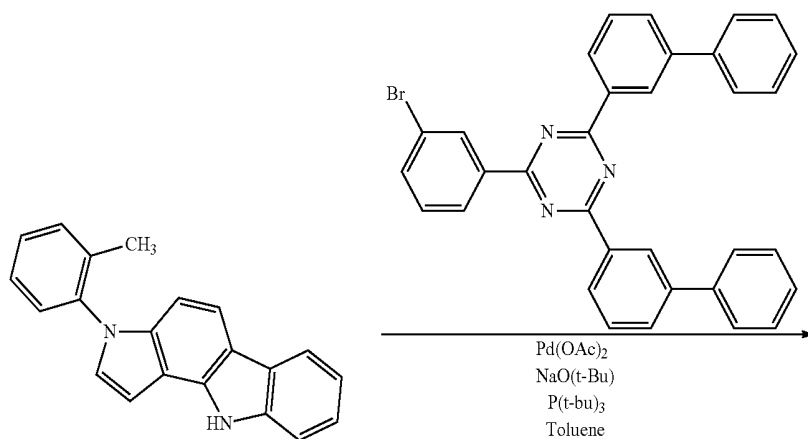
[Synthesis Example 64] Synthesis of Inv-64



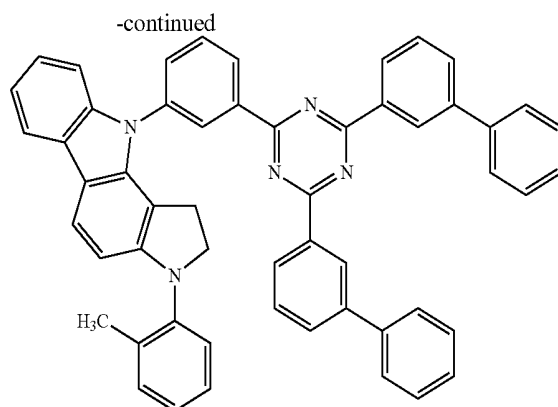
A target compound Inv-64 (3.58 g, 52%) was obtained by performing the same procedure as in Synthesis Example 27, except that IC-12 and 2-(5-bromophenyl-3-yl)-4,6-diphenyl-1,3,5-triazine were used instead of IC-1b and 3-bromobiphenyl.

GC-Mass (theoretical value: 679.27 g/mol, measured value: 679 g/mol)

[Synthesis Example 65] Synthesis of Inv-65



511

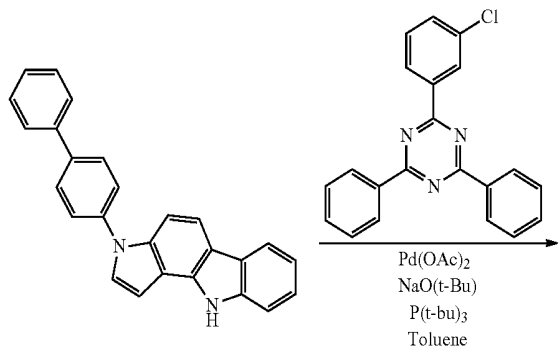


Inv-65

A target compound Inv-65 (5.20 g, 68%) was obtained by performing the same procedure as in Synthesis Example 29, except that IC-12 and 2,4-di(biphenyl-3-yl)-6-(3-chlorophenyl)-1,3,5-triazine were used instead of IC-1b and 2-(3-chlorophenyl)-4,6-diphenyl-1,3,5-triazine.

GC-Mass (theoretical value: 775.30 g/mol, measured value: 775 g/mol)

[Synthesis Example 66] Synthesis of Inv-66



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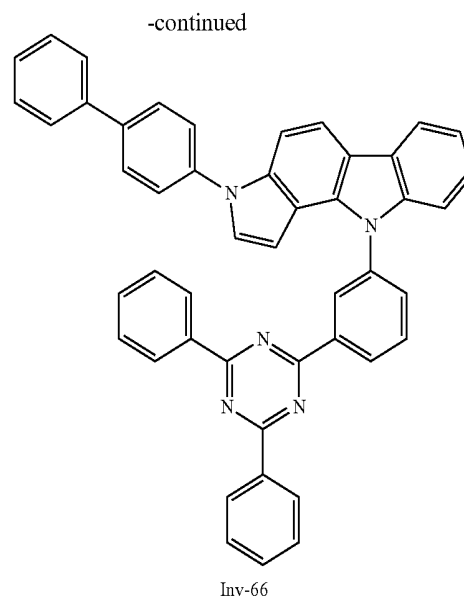
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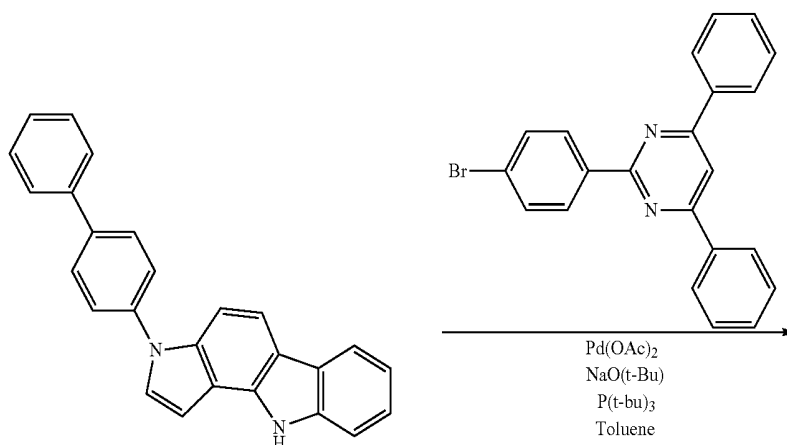
512



A target compound Inv-66 (3.90 g, 70%) was obtained by performing the same procedure as in Synthesis Example 29, except that IC-13 was used instead of IC-1b.

GC-Mass (theoretical value: 665.26 g/mol, measured value: 665 g/mol)

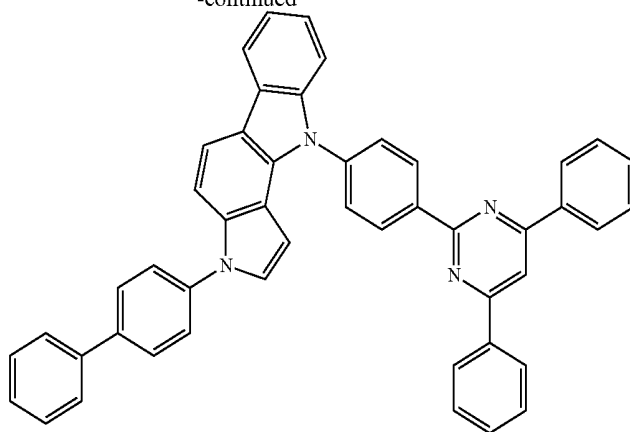
[Synthesis Example 67] Synthesis of Inv-67



513

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-continued



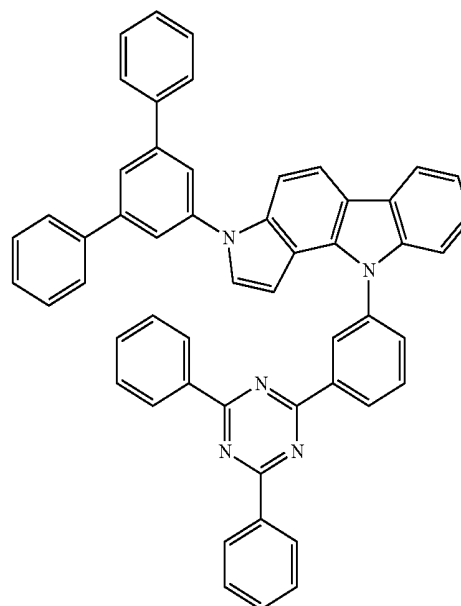
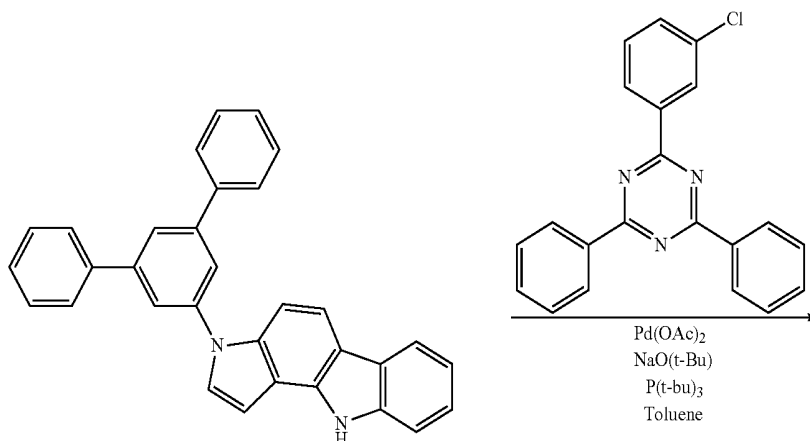
Inv-67

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A target compound Inv-67 (2.67 g, 48%) was obtained by performing the same procedure as in Synthesis Example 3, except that IC-13 and 2-(4-bromophenyl)-4,6-diphenylpyrimidine were used instead of IC-1b and 2-bromo-4,6-diphenyl-1,3,5-triazine.

GC-Mass (theoretical value: 664.26 g/mol, measured value: 664 g/mol)

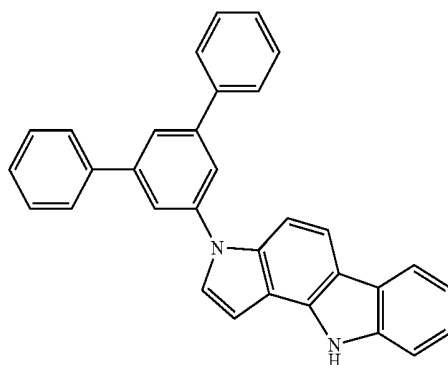
[Synthesis Example 68] Synthesis of Inv-68



Inv-68

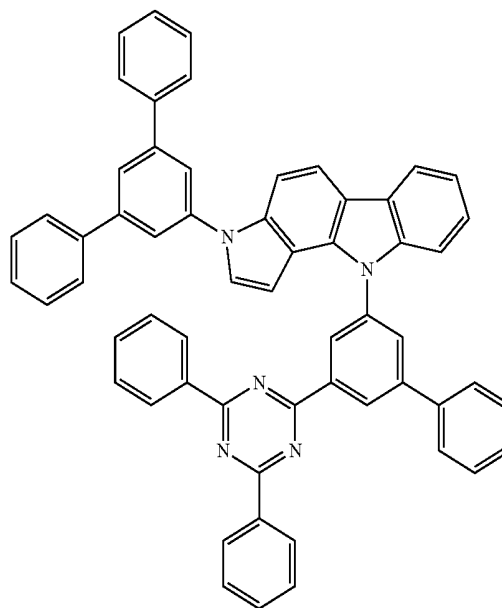
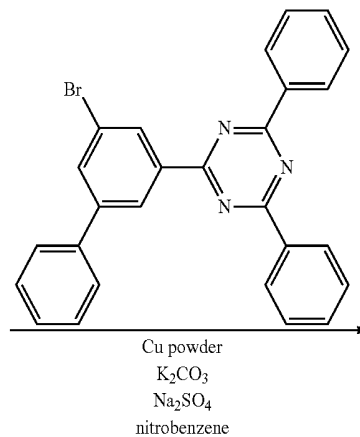
515

A target compound Inv-68 (3.74 g, 73%) was obtained by performing the same procedure as in Synthesis Example 29, except that IC-14 was used instead of IC-1b.

**516**

GC-Mass (theoretical value: 741.29 g/mol, measured value: 741 g/mol)

[Synthesis Example 69] Synthesis of Inv-69



Inv-69

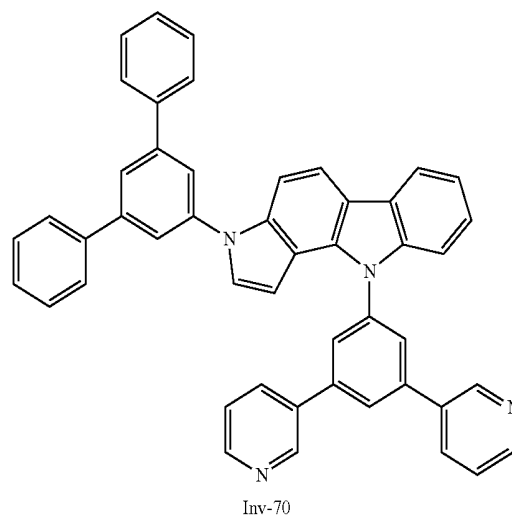
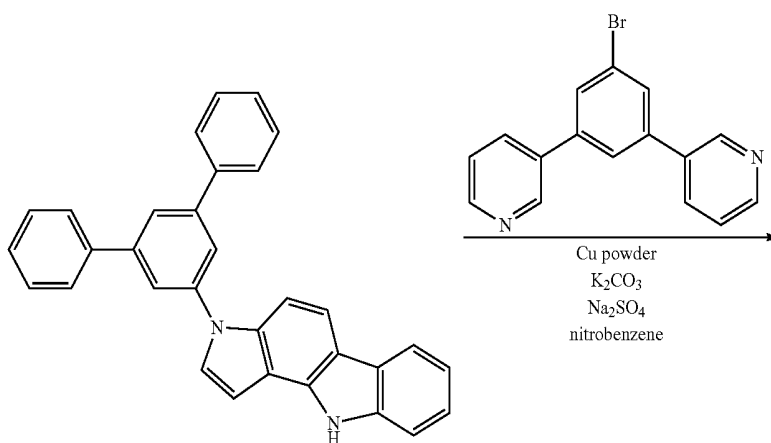
517

A target compound Inv-69 (2.94 g, 52%) was obtained by performing the same procedure as in Synthesis Example 27, except that IC-14 and 2-(5-bromobiphenyl-3-yl)-4,6-diphenyl-1,3,5-triazine were used instead of IC-1b and 3-bromo-biphenyl.

518

GC-Mass (theoretical value: 817.32 g/mol, measured value: 817 g/mol)

[Synthesis Example 70] Synthesis of Inv-70



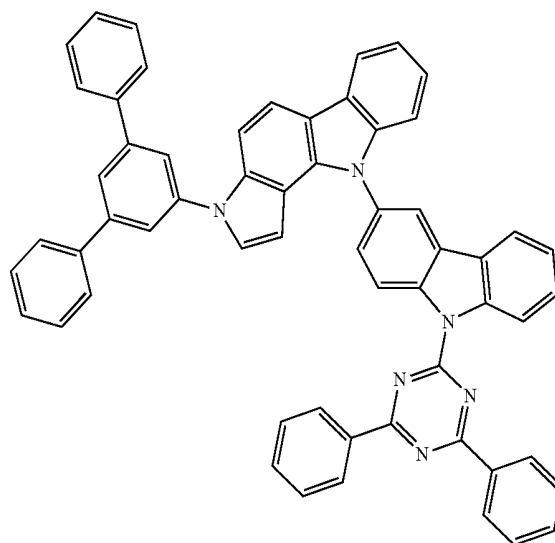
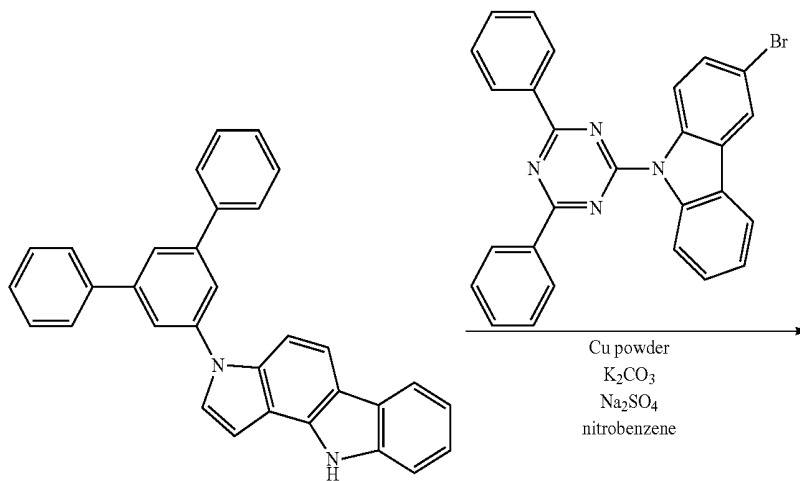
519

A target compound Inv-70 (2.34 g, 51%) was obtained by performing the same procedure as in Synthesis Example 27, except that IC-14 and 3,3'-(5-bromo-1,3-phenylene)dipyridine were used instead of IC-1b and 3-bromobiphenyl.

520

GC-Mass (theoretical value: 664.26 g/mol, measured value: 664 g/mol)

[Synthesis Example 71] Synthesis of Inv-71



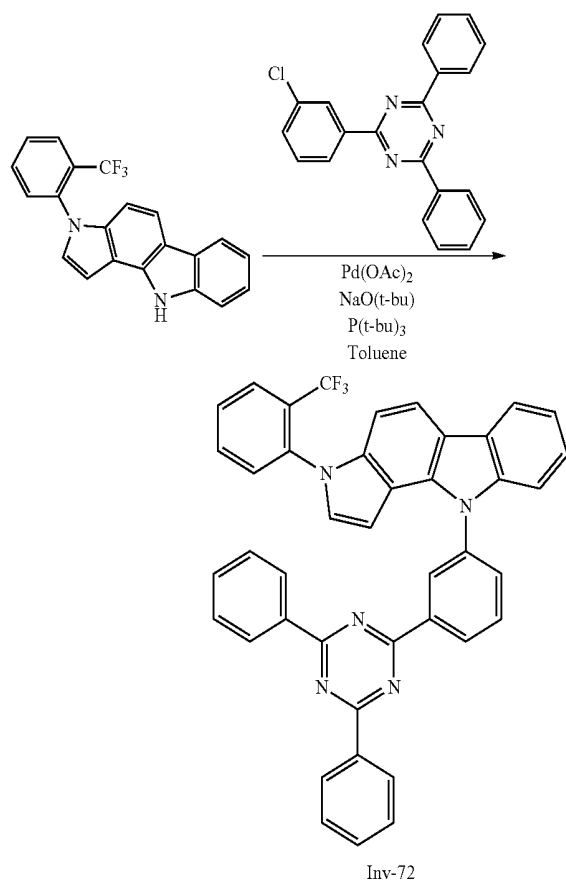
Inv-71

521

A target compound Inv-71 (2.81 g, 49%) was obtained by performing the same procedure as in Synthesis Example 27, except that IC-14 and 3-bromo-9-(4,6-diphenyl-1,3,5-triazin-2-yl)-9H-carbazole were used instead of IC-1b and 3-bromobiphenyl.

GC-Mass (theoretical value: 830.32 g/mol, measured value: 830 g/mol)

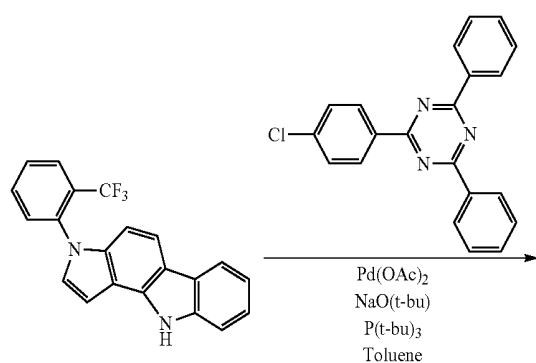
[Synthesis Example 72] Synthesis of Inv-72



A target compound Inv-72 (4.05 g, 72%) was obtained by performing the same procedure as in Synthesis Example 29, except that IC-15 was used instead of IC-1b.

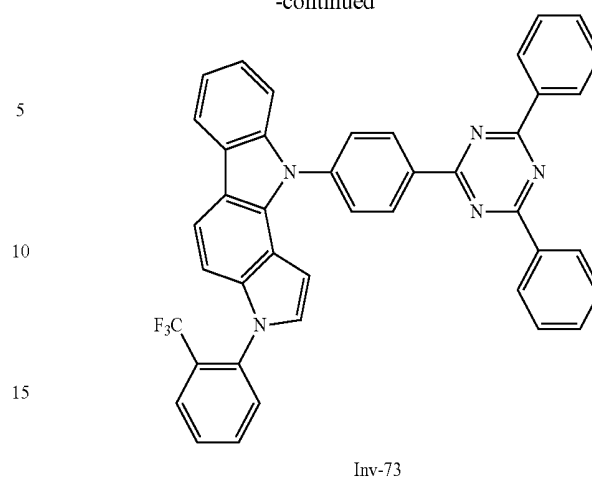
GC-Mass (theoretical value: 657.21 g/mol, measured value: 657 g/mol)

[Synthesis Example 73] Synthesis of Inv-73



522

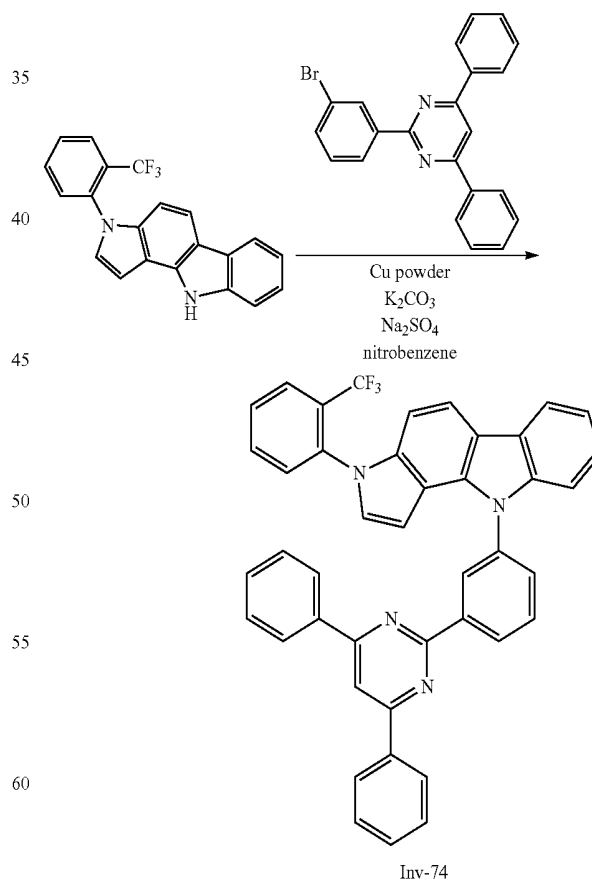
-continued



A target compound Inv-73 (3.66 g, 65%) was obtained by performing the same procedure as in Synthesis Example 29, except that IC-15 and 3-bromo-9-(4,6-diphenyl-1,3,5-triazin-2-yl)-9H-carbazole were used instead of IC-1b and 2-(3-chlorophenyl)-4,6-diphenyl-1,3,5-triazine.

GC-Mass (theoretical value: 657.21 g/mol, measured value: 657 g/mol)

[Synthesis Example 74] Synthesis of Inv-74



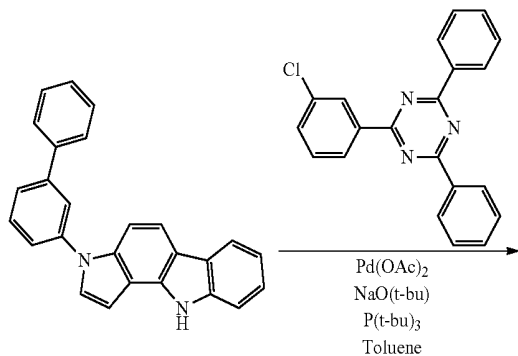
A target compound Inv-74 (2.64 g, 47%) was obtained by performing the same procedure as in Synthesis Example 27,

523

except that IC-15 and 2-(3-bromophenyl)-4,6-diphenylpyrimidine were used instead of IC-1b and 3-bromobiphenyl.

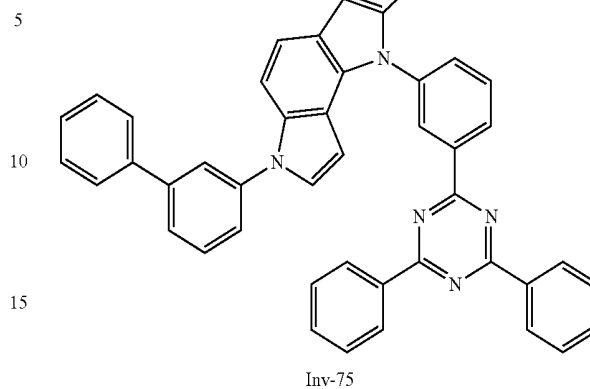
GC-Mass (theoretical value: 656.22 g/mol, measured value: 656 g/mol)

[Synthesis Example 75] Synthesis of Inv-75



524

-continued

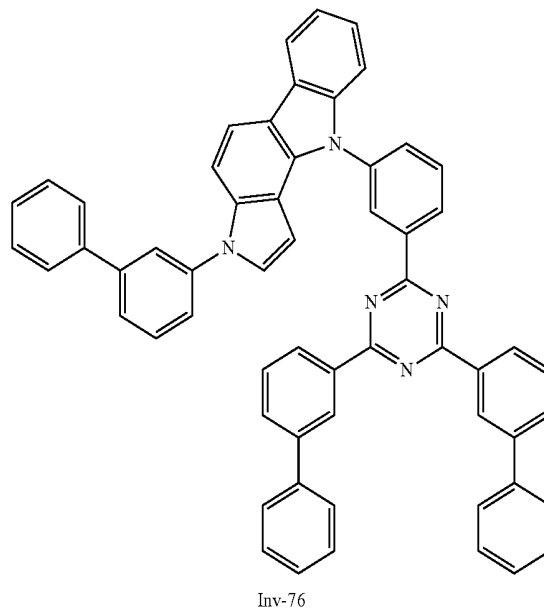
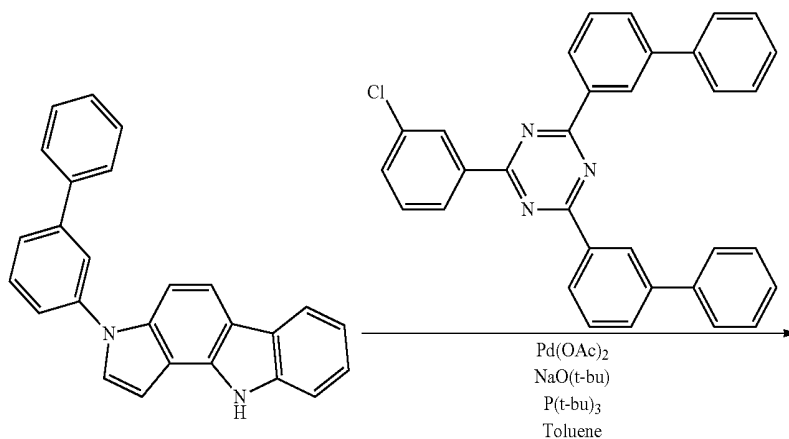


20 A target compound Inv-75 (3.90 g, 70%) was obtained by performing the same procedure as in Synthesis Example 29, except that IC-16 was used instead of IC-1b.

GC-Mass (theoretical value: 665.26 g/mol, measured value: 665 g/mol)

25

[Synthesis Example 76] Synthesis of Inv-76

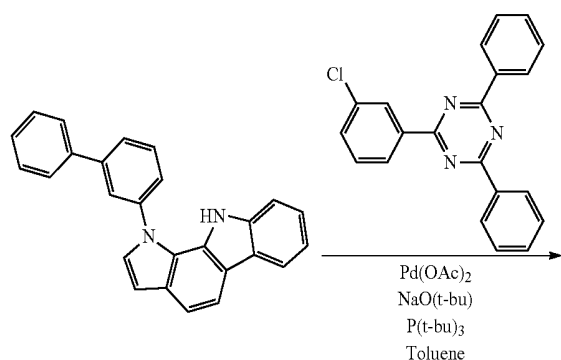


525

A target compound Inv-76 (5.00 g, 73%) was obtained by performing the same procedure as in Synthesis Example 29, except that IC-16 and 2,4-di(biphenyl-3-yl)-6-(3-chlorophenyl)-1,3,5-triazine were used instead of IC-1b and 2-(3-chlorophenyl)-4,6-diphenyl-1,3,5-triazine.

GC-Mass (theoretical value: 817.32 g/mol, measured value: 817 g/mol)

[Synthesis Example 77] Synthesis of Inv-77



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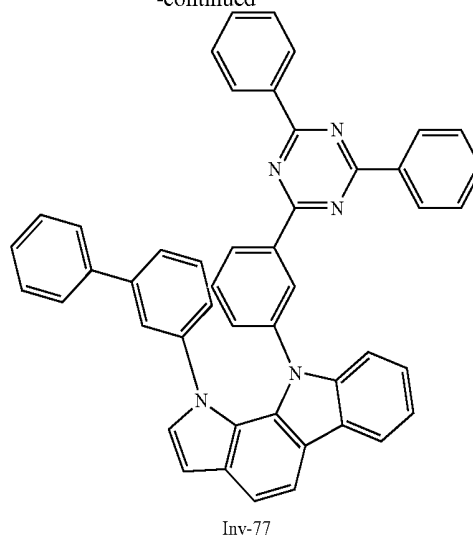
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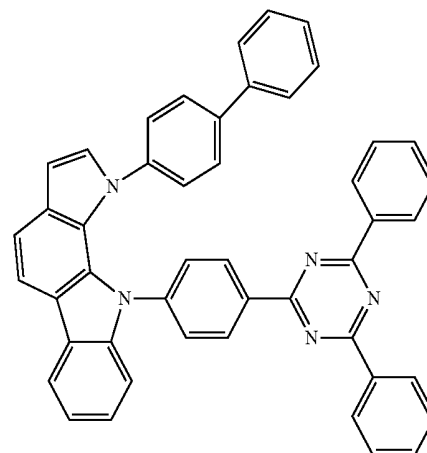
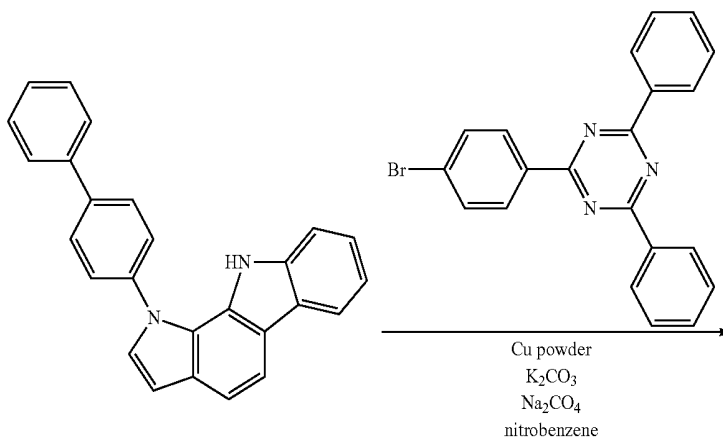
-continued



A target compound Inv-77 (3.85 g, 69%) was obtained by performing the same procedure as in Synthesis Example 29, except that IC-17 was used instead of IC-1b.

GC-Mass (theoretical value: 665.26 g/mol, measured value: 665 g/mol)

[Synthesis Example 78] Synthesis of Inv-78



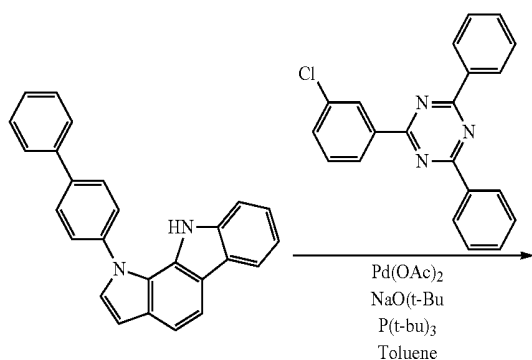
Inv-78

527

A target compound Inv-78 (2.90 g, 52%) was obtained by performing the same procedure as in Synthesis Example 27, except that IC-18 and 2-(4-bromophenyl)-4,6-diphenyl-1,3,5-triazine were used instead of IC-1b and 3-bromobiphenyl.

GC-Mass (theoretical value: 665.26 g/mol, measured value: 665 g/mol)

[Synthesis Example 79] Synthesis of Inv-79



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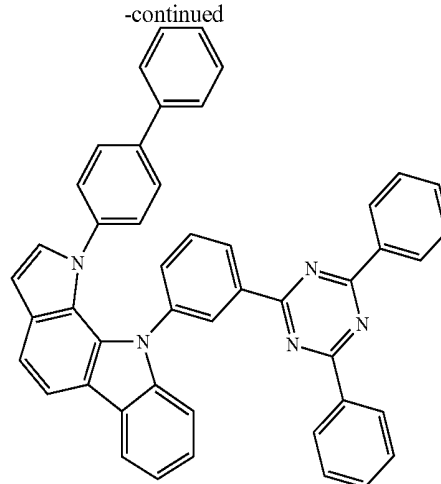
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528

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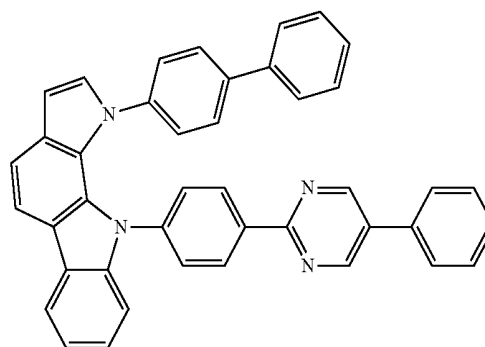
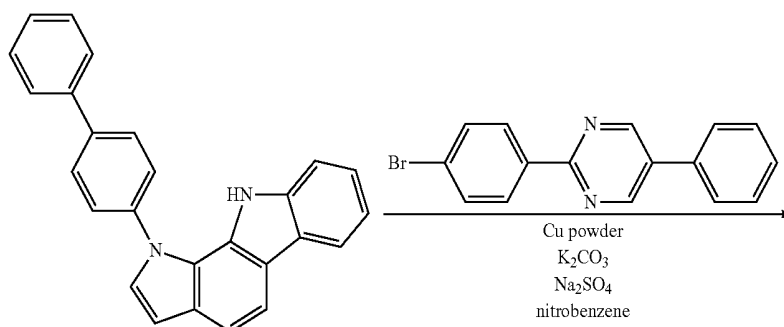


Inv-79

A target compound Inv-79 (3.85 g, 69%) was obtained by performing the same procedure as in Synthesis Example 29, except that IC-18 was used instead of IC-1b.

GC-Mass (theoretical value: 665.26 g/mol, measured value: 665 g/mol)

[Synthesis Example 80] Synthesis of Inv-80



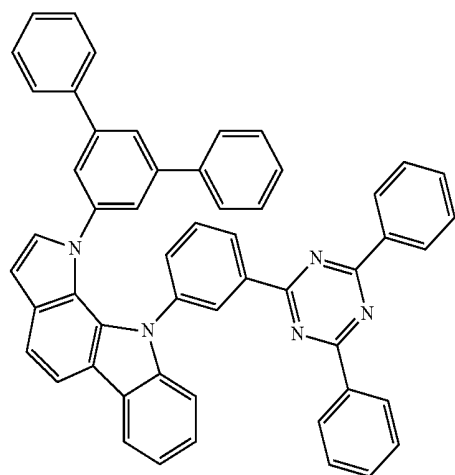
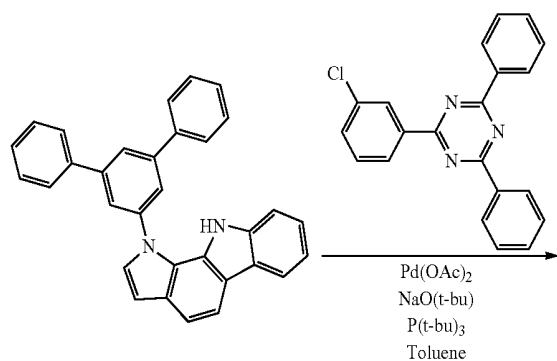
Inv-80

529

A target compound Inv-80 (2.66 g, 54%) was obtained by performing the same procedure as in Synthesis Example 27, except that IC-18 and 2-(4-bromophenyl)-5-phenylpyrimidine were used instead of IC-1b and 3-bromobiphenyl.

GC-Mass (theoretical value: 588.23 g/mol, measured value: 588 g/mol)

[Synthesis Example 81] Synthesis of Inv-81

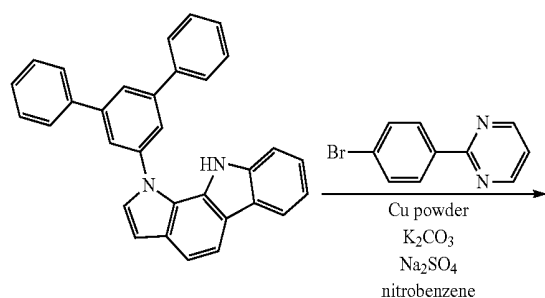


Inv-81

A target compound Inv-81 (3.48 g, 68%) was obtained by performing the same procedure as in Synthesis Example 29, except that IC-19 was used instead of IC-1b.

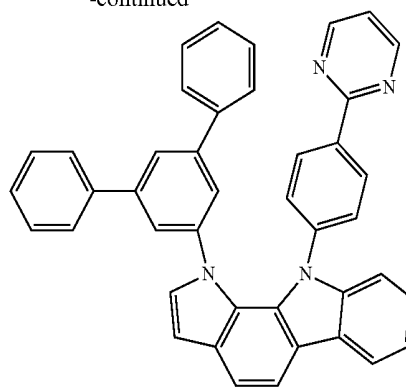
GC-Mass (theoretical value: 741.29 g/mol, measured value: 741 g/mol)

[Synthesis Example 82] Synthesis of Inv-82



530

-continued

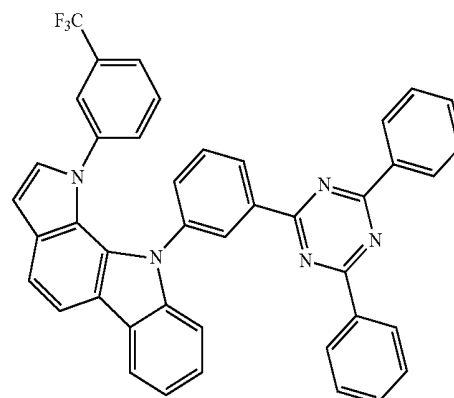
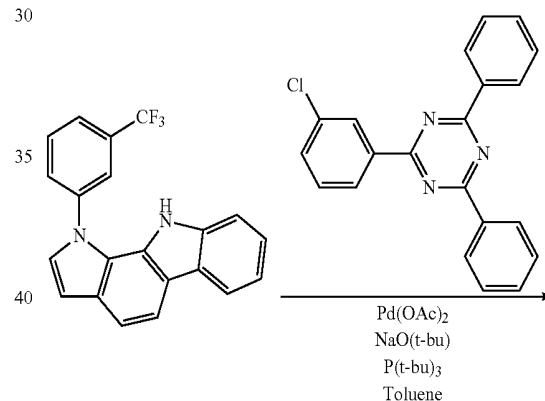


Inv-82

A target compound Inv-82 (1.99 g, 49%) was obtained by performing the same procedure as in Synthesis Example 27, except that IC-19 and 2-(4-bromophenyl)pyrimidine were used instead of IC-1b and 3-bromobiphenyl.

GC-Mass (theoretical value: 588.23 g/mol, measured value: 588 g/mol)

[Synthesis Example 83] Synthesis of Inv-83



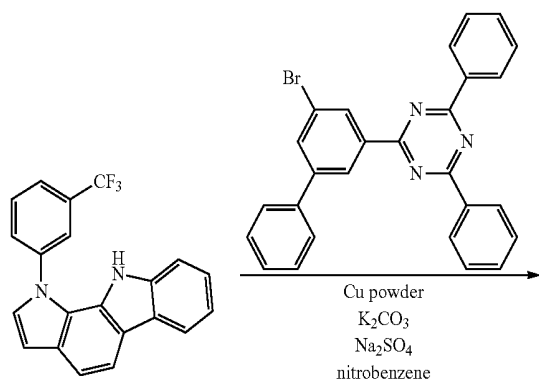
Inv-83

531

A target compound Inv-83 (4.00 g, 71%) was obtained by performing the same procedure as in Synthesis Example 29, except that IC-20 was used instead of IC-1b.

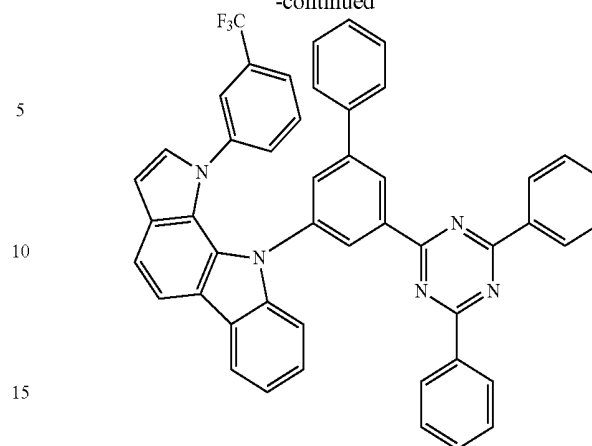
GC-Mass (theoretical value: 657.21 g/mol, measured value: 657 g/mol)

[Synthesis Example 84] Synthesis of Inv-84



532

-continued

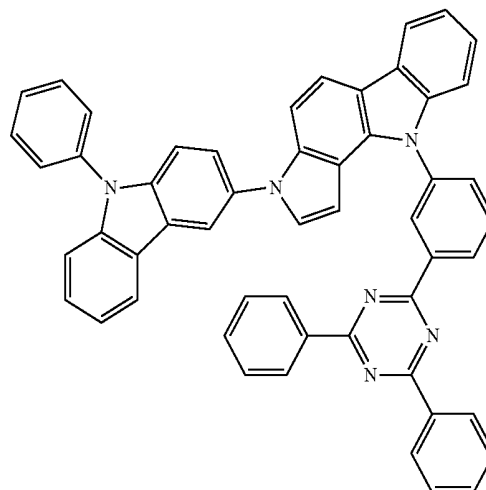
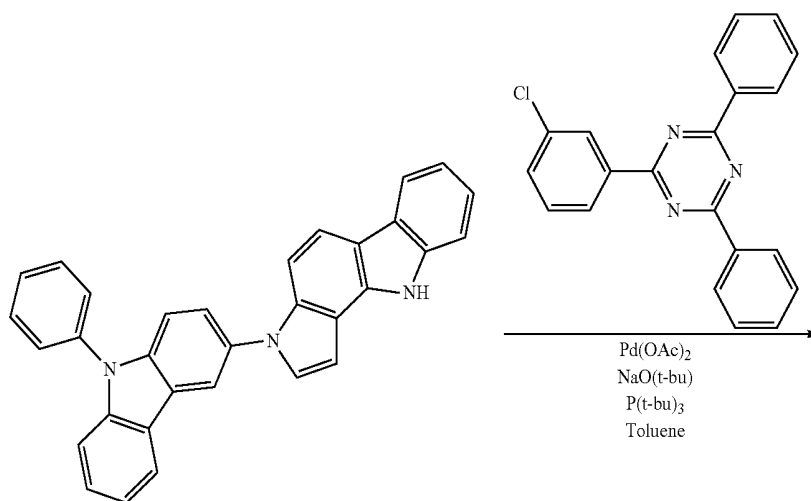


Inv-84

A target compound Inv-84 (2.89 g, 46%) was obtained by performing the same procedure as in Synthesis Example 27, except that IC-20 and 2-(5-bromophenyl-3-yl)-4,6-diphenyl-1,3,5-triazine were used instead of IC-1b and 3-bromobiphenyl.

GC-Mass (theoretical value: 733.25 g/mol, measured value: 733 g/mol)

[Synthesis Example 85] Synthesis of Inv-85



Inv-85

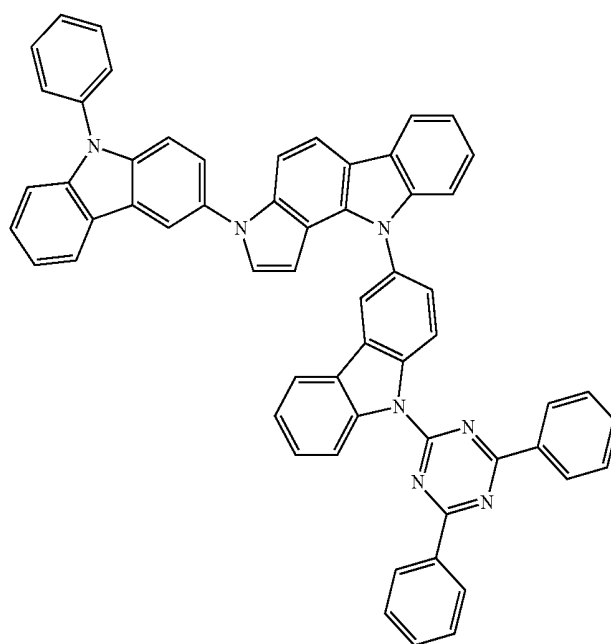
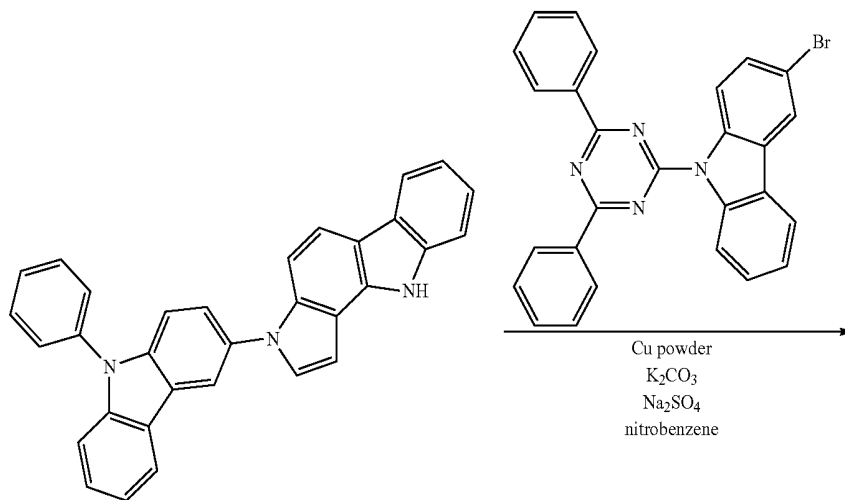
533

A target compound Inv-85 (3.49 g, 69%) was obtained by performing the same procedure as in Synthesis Example 29, except that IC-21 was used instead of IC-1b.

534

GC-Mass (theoretical value: 754.28 g/mol, measured value: 754 g/mol)

[Synthesis Example 86] Synthesis of Inv-86



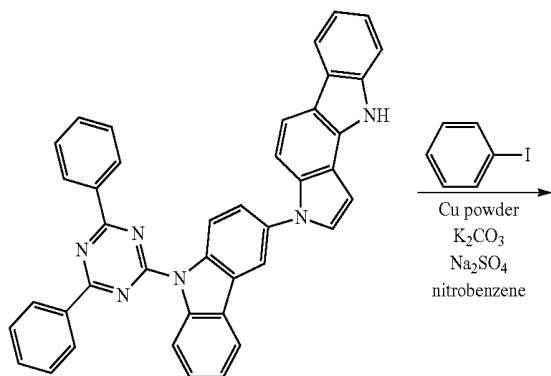
Inv-86

535

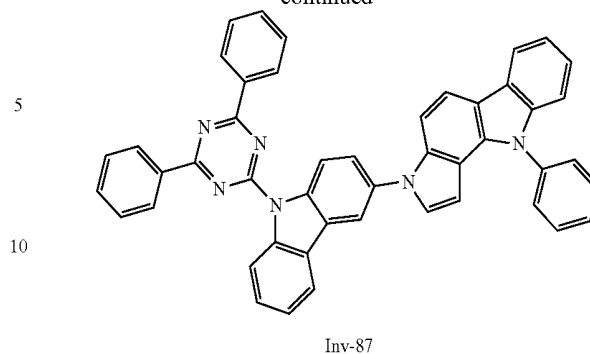
A target compound Inv-86 (2.49 g, 44%) was obtained by performing the same procedure as in Synthesis Example 27, except that IC-21 and 3-bromo-9-(4,6-diphenyl-1,3,5-triazin-2-yl)-9H-carbazole were used instead of IC-1b and 3-bromobiphenyl.

GC-Mass (theoretical value: 843.31 g/mol, measured value: 843 g/mol)

[Synthesis Example 87] Synthesis of Inv-87

**536**

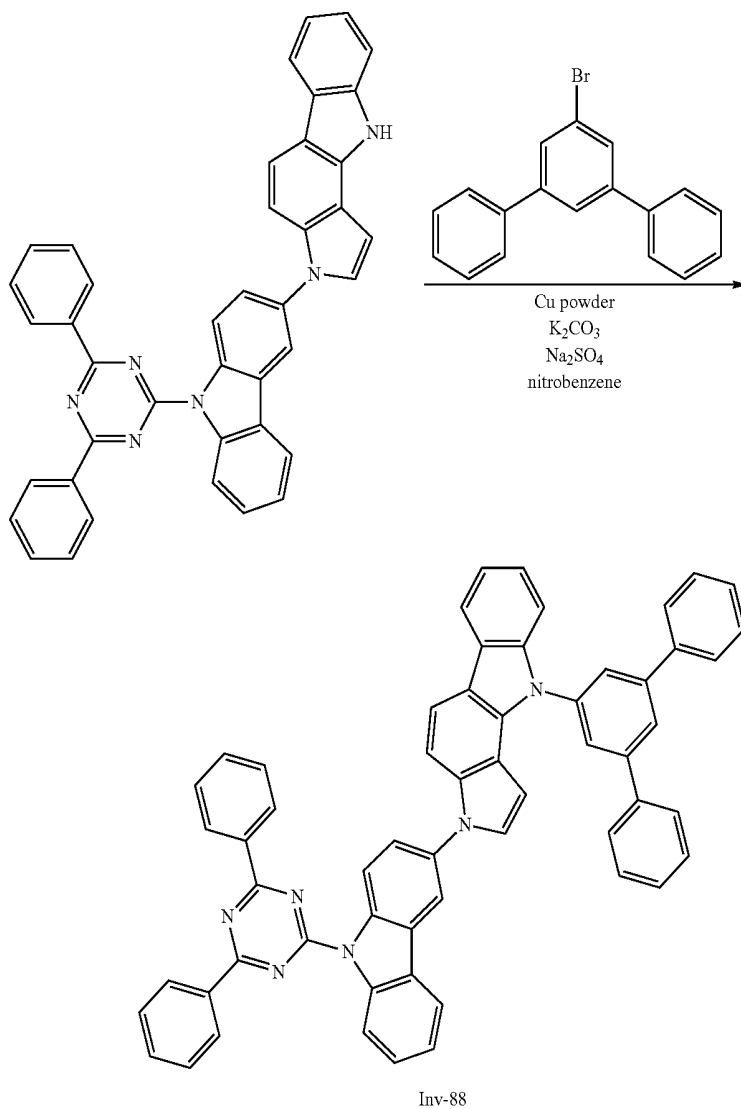
-continued



A target compound Inv-87 (1.62 g, 48%) was obtained by performing the same procedure as in Synthesis Example 27, except that IC-22 and iodobenzene were used instead of IC-1b and 3-bromobiphenyl.

GC-Mass (theoretical value: 678.25 g/mol, measured value: 678 g/mol)

[Synthesis Example 88] Synthesis of Inv-88

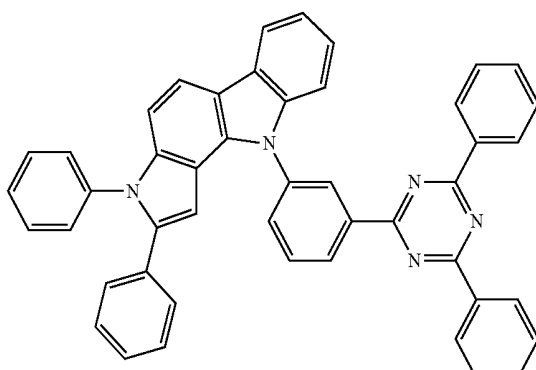
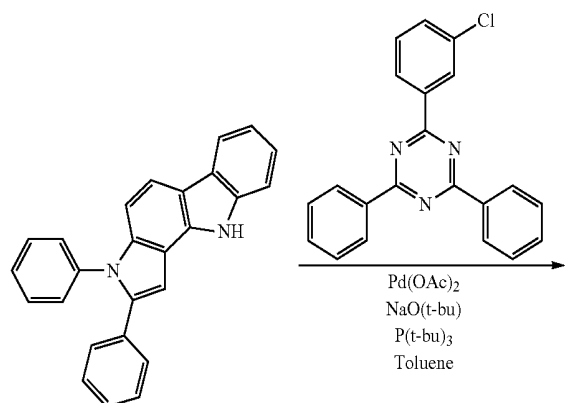


537

A target compound Inv-88 (1.94 g, 47%) was obtained by performing the same procedure as in Synthesis Example 27, except that IC-22 and 1-bromo-3,5-diphenyl benzene were used instead of IC-1b and 3-bromobiphenyl.

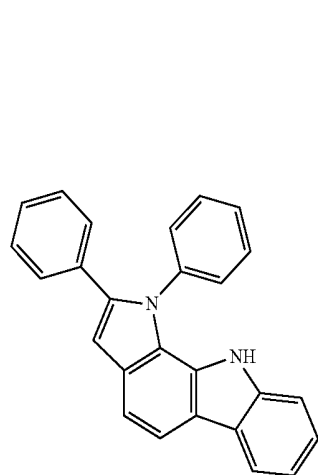
GC-Mass (theoretical value: 830.32 g/mol, measured value: 830 g/mol)

[Synthesis Example 89] Synthesis of Inv-89



Inv-89

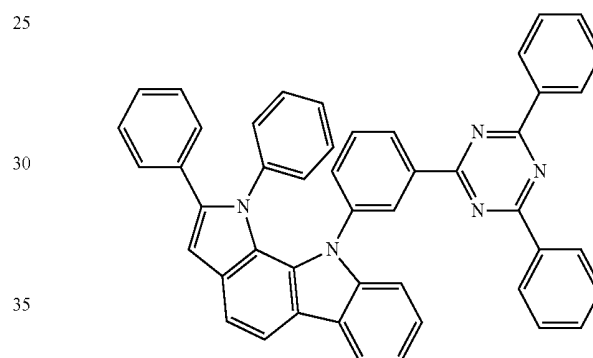
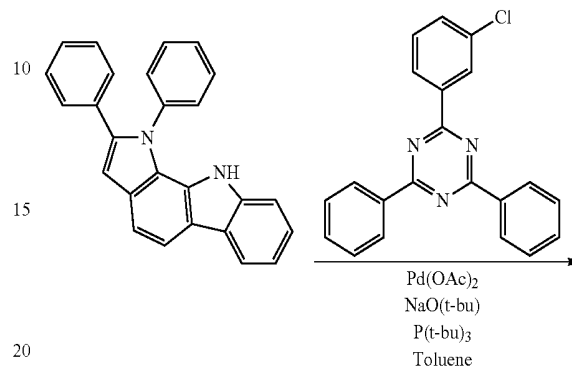
A target compound Inv-89 (3.79 g, 68%) was obtained by performing the same procedure as in Synthesis Example 29, except that IC-23 was used instead of IC-1b.



538

GC-Mass (theoretical value: 665.26 g/mol, measured value: 665 g/mol)

[Synthesis Example 90] Synthesis of Inv-90

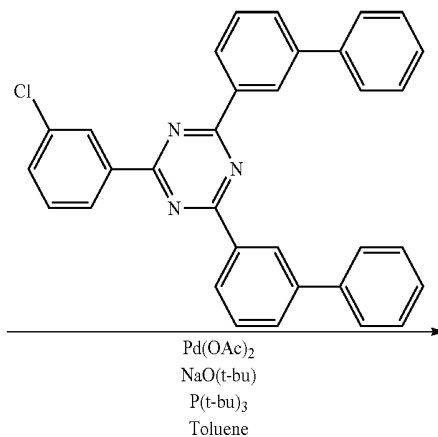


Inv-90

A target compound Inv-90 (4.18 g, 75%) was obtained by performing the same procedure as in Synthesis Example 29, except that IC-24 was used instead of IC-1b.

GC-Mass (theoretical value: 665.26 g/mol, measured value: 665.26 g/mol)

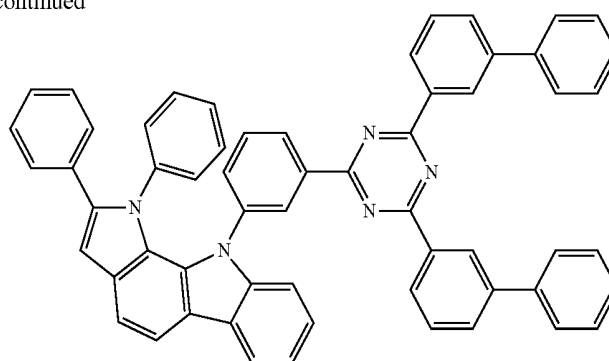
[Synthesis Example 91] Synthesis of Inv-91



539

540

-continued

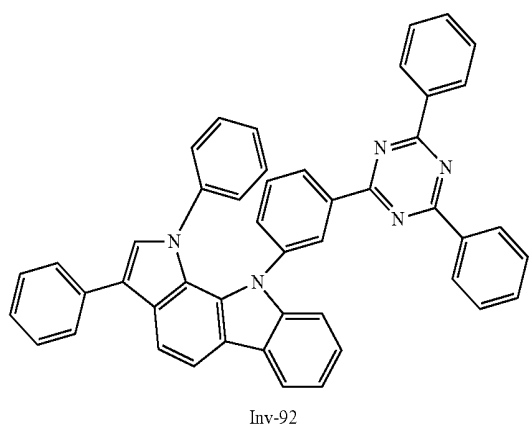
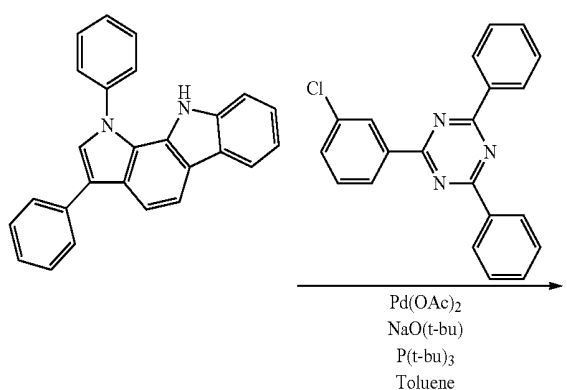


Inv-91

A target compound Inv-91 (5.07 g, 74%) was obtained by performing the same procedure as in Synthesis Example 29, except that IC-24 and 2,4-di(biphenyl-3-yl)-6-(3-chlorophenyl)-1,3,5-triazine were used instead of IC-1b and 2-(3-chlorophenyl)-4,6-diphenyl-1,3,5-triazine.

GC-Mass (theoretical value: 817.32 g/mol, measured value: 817 g/mol)

[Synthesis Example 92] Synthesis of Inv-92

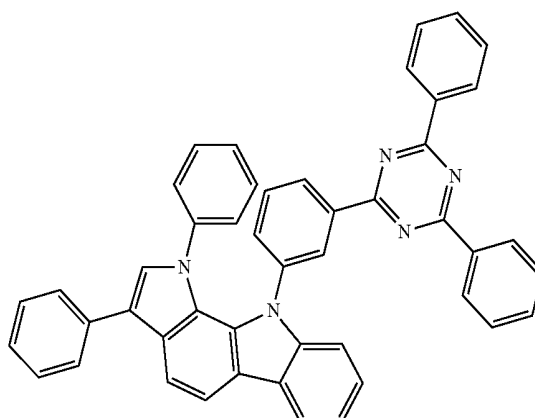
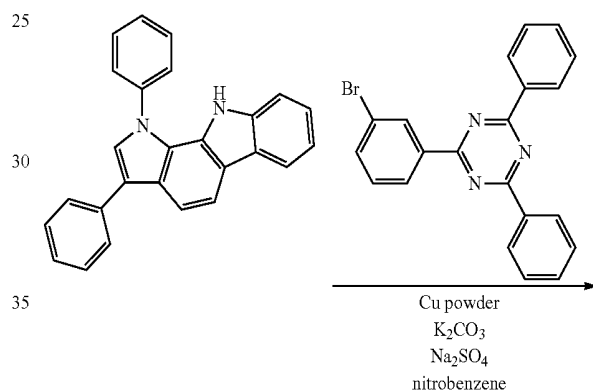


Inv-92

A target compound Inv-92 (4.01 g, 72%) was obtained by performing the same procedure as in Synthesis Example 29, except that IC-25 was used instead of IC-1b.

GC-Mass (theoretical value: 665.26 g/mol, measured value: 665 g/mol)

[Synthesis Example 93] Synthesis of Inv-93



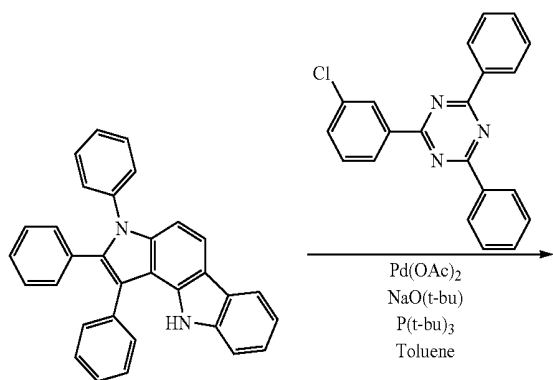
Inv-93

541

A target compound Inv-93 (2.84 g, 51%) was obtained by performing the same procedure as in Synthesis Example 27, except that IC-25 and 2-(3-bromophenyl)-4,6-diphenylpyrimidine were used instead of IC-1b and 3-bromobiphenyl.

GC-Mass (theoretical value: 664.26 g/mol, measured value: 664 g/mol)

[Synthesis Example 94] Synthesis of Inv-94



5

10

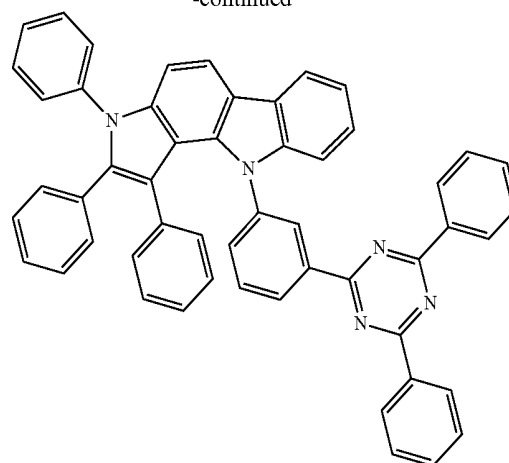
15

20

25

542

-continued

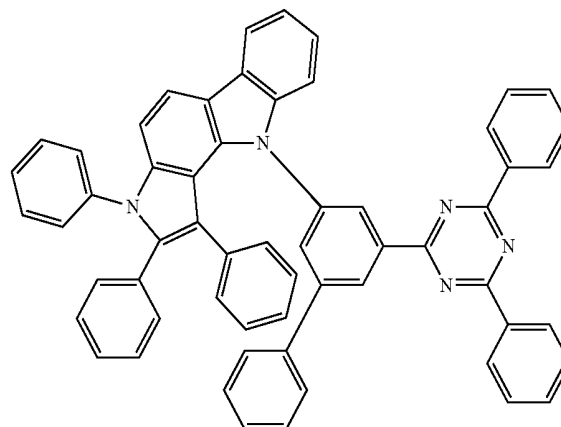
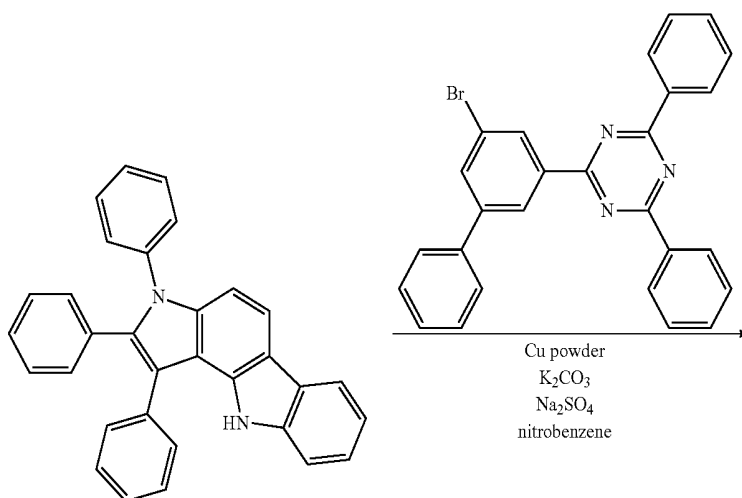


Inv-94

A target compound Inv-94 (3.74 g, 73%) was obtained by performing the same procedure as in Synthesis Example 29, except that IC-26 was used instead of IC-1b.

GC-Mass (theoretical value: 741.29 g/mol, measured value: 741 g/mol)

[Synthesis Example 95] Synthesis of Inv-95



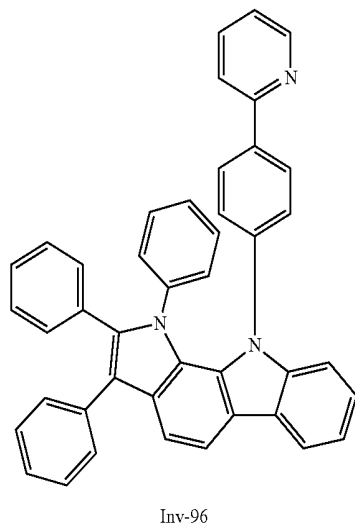
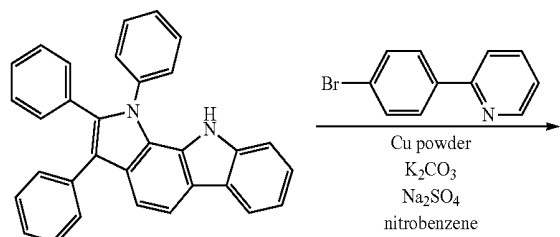
Inv-95

543

A target compound Inv-95 (2.71 g, 48%) was obtained by performing the same procedure as in Synthesis Example 27, except that IC-26 and 2-(5-bromobiphenyl-3-yl)-4,6-diphenyl-1,3,5-triazine were used instead of IC-1b and 3-bromobiphenyl.

GC-Mass (theoretical value: 817.32 g/mol, measured value: 817 g/mol)

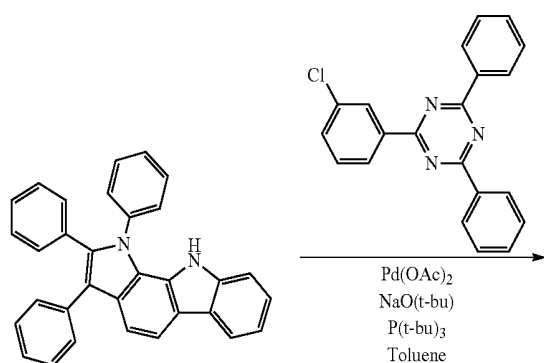
[Synthesis Example 96] Synthesis of Inv-96



A target compound Inv-96 (2.07 g, 51%) was obtained by performing the same procedure as in Synthesis Example 27, except that IC-27 and 2-(4-bromophenyl)pyridine were used instead of IC-1b and 3-bromobiphenyl.

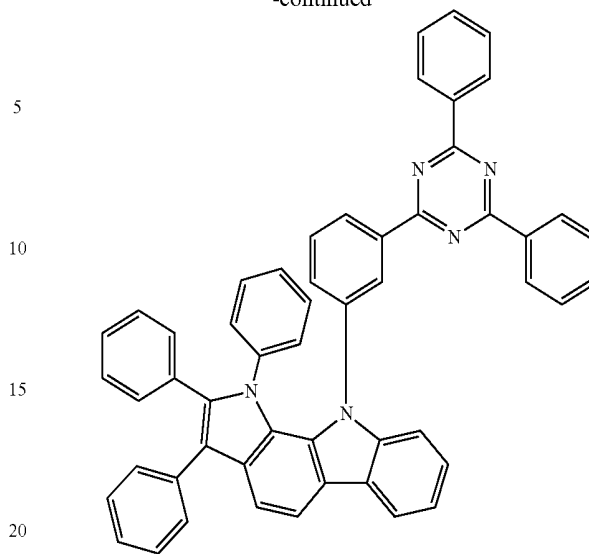
GC-Mass (theoretical value: 587.24 g/mol, measured value: 587 g/mol)

[Synthesis Example 97] Synthesis of Inv-97



544

-continued

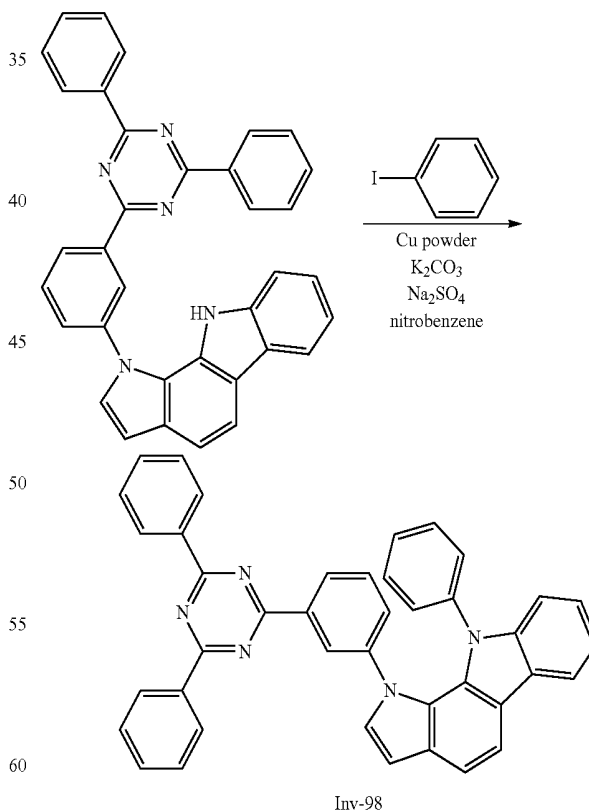


Inv-97

A target compound Inv-97 (4.00 g, 78%) was obtained by performing the same procedure as in Synthesis Example 29, except that IC-27 was used instead of IC-1b.

GC-Mass (theoretical value: 741.29 g/mol, measured value: 741 g/mol)

[Synthesis Example 98] Synthesis of Inv-98



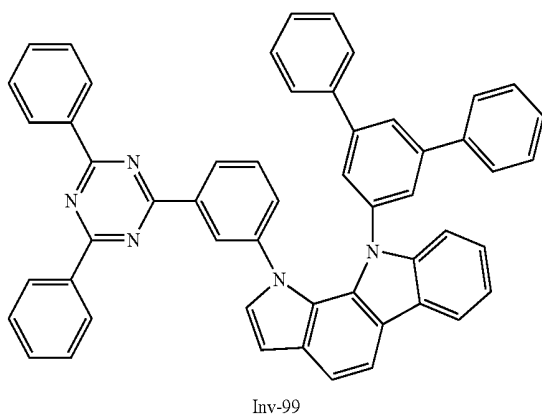
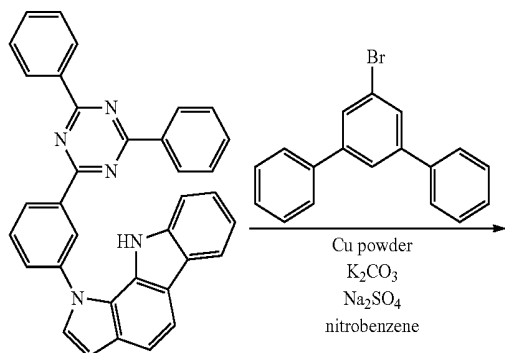
Inv-98

A target compound Inv-98 (1.83 g, 53%) was obtained by performing the same procedure as in Synthesis Example 27, except that IC-28 and iodobenzene were used instead of IC-1b and 3-bromobiphenyl.

545

GC-Mass (theoretical value: 589.23 g/mol, measured value: 589 g/mol)

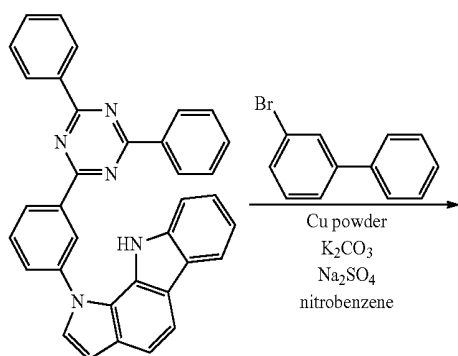
[Synthesis Example 99] Synthesis of Inv-99



A target compound Inv-99 (2.25 g, 52%) was obtained by performing the same procedure as in Synthesis Example 27, except that IC-28 and 1-bromo-3,5-diphenyl benzene were used instead of IC-1b and 3-bromobiphenyl.

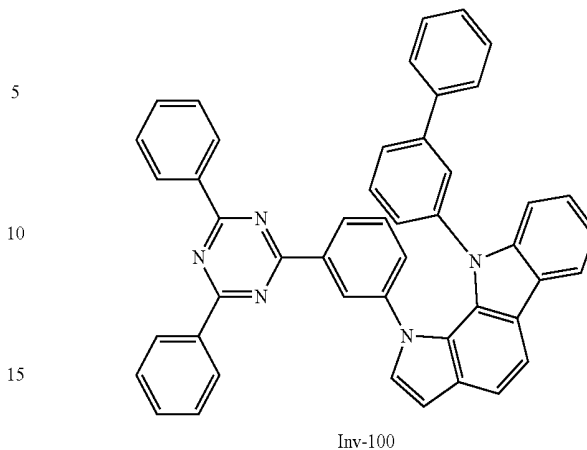
GC-Mass (theoretical value: 741.29 g/mol, measured value: 741 g/mol)

[Synthesis Example 100] Synthesis of Inv-100



546

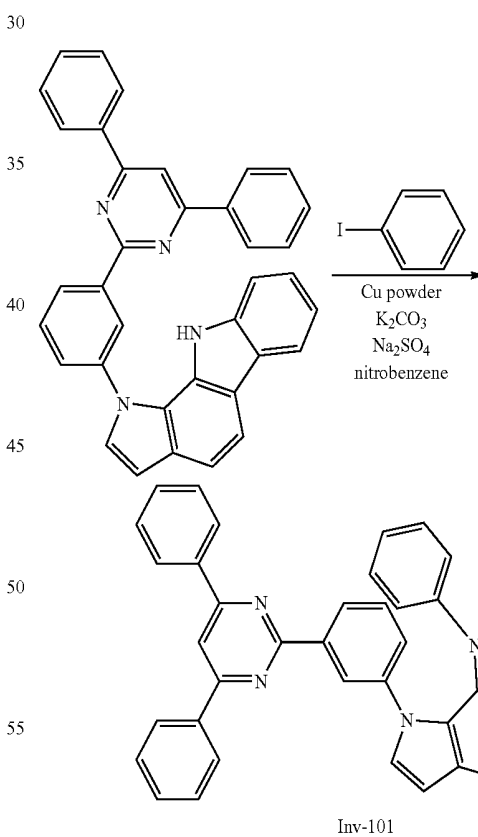
-continued



A target compound Inv-100 (1.91 g, 49%) was obtained by performing the same procedure as in Synthesis Example 27, except that IC-28 was used instead of IC-1b.

GC-Mass (theoretical value: 665.26 g/mol, measured value: 665 g/mol)

[Synthesis Example 101] Synthesis of Inv-101

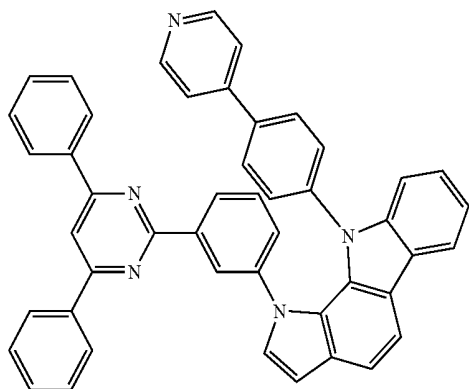
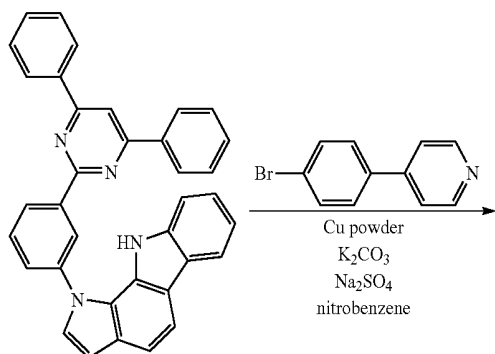


A target compound Inv-101 (1.55 g, 45%) was obtained by performing the same procedure as in Synthesis Example 27, except that IC-29 and iodobenzene were used instead of IC-1b and 3-bromobiphenyl.

GC-Mass (theoretical value: 588.23 g/mol, measured value: 588 g/mol)

547

[Synthesis Example 102] Synthesis of Inv-102



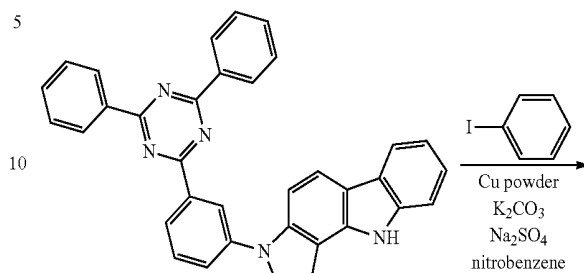
Inv-102

A target compound Inv-102 (1.83 g, 47%) was obtained by performing the same procedure as in Synthesis Example 27, except that IC-29 and 4-(4-bromophenyl)pyridine were used instead of IC-1b and 3-bromobiphenyl.

GC-Mass (theoretical value: 665.26 g/mol, measured value: 665 g/mol)

548

[Synthesis Example 103] Synthesis of Inv-103



15

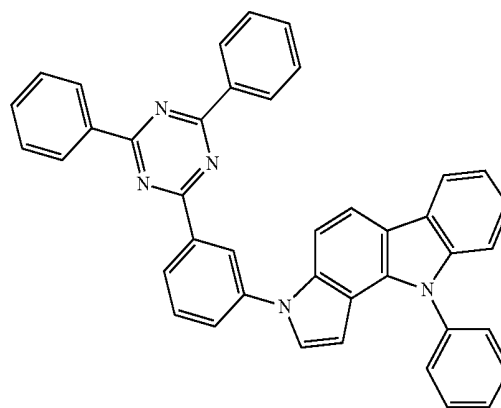
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40

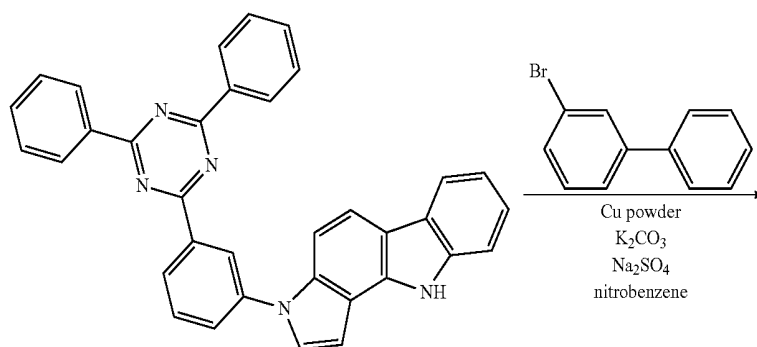


Inv-103

A target compound Inv-103 (1.48 g, 43%) was obtained by performing the same procedure as in Synthesis Example 27, except that IC-30 and iodobenzene were used instead of IC-1b and 3-bromobiphenyl.

GC-Mass (theoretical value: 589.23 g/mol, measured value: 589 g/mol)

[Synthesis Example 104] Synthesis of Inv-104



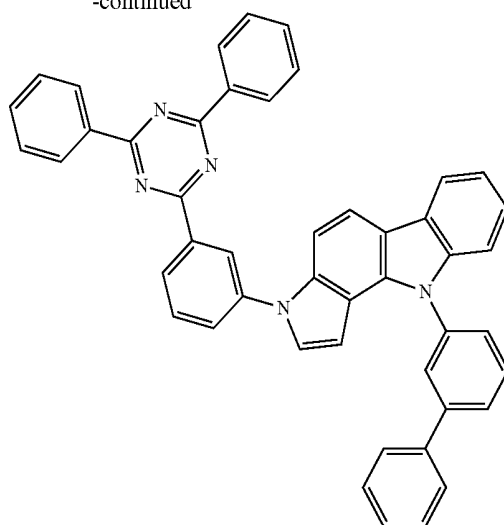
45

50

549

550

-continued

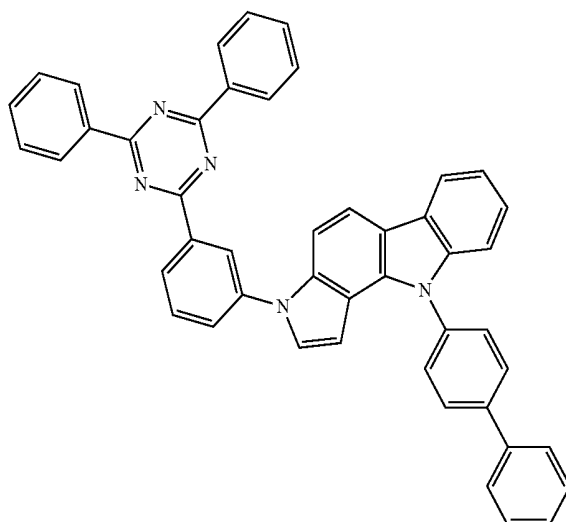
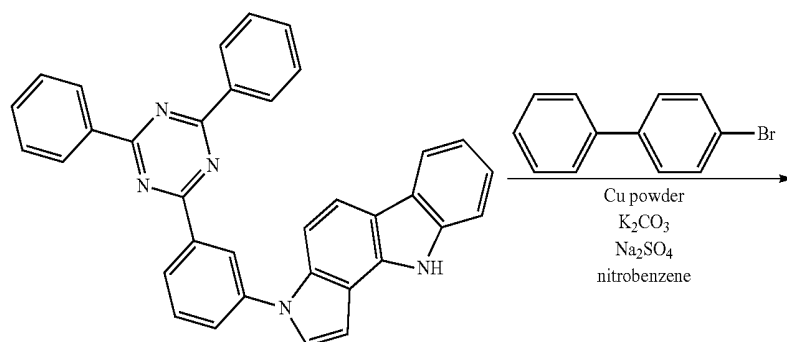


Inv-104

A target compound Inv-104 (1.87 g, 48%) was obtained by performing the same procedure as in Synthesis Example 25, except that IC-30 was used instead of IC-1b.

GC-Mass (theoretical value: 665.26 g/mol, measured value: 665 g/mol)

[Synthesis Example 105] Synthesis of Inv-105



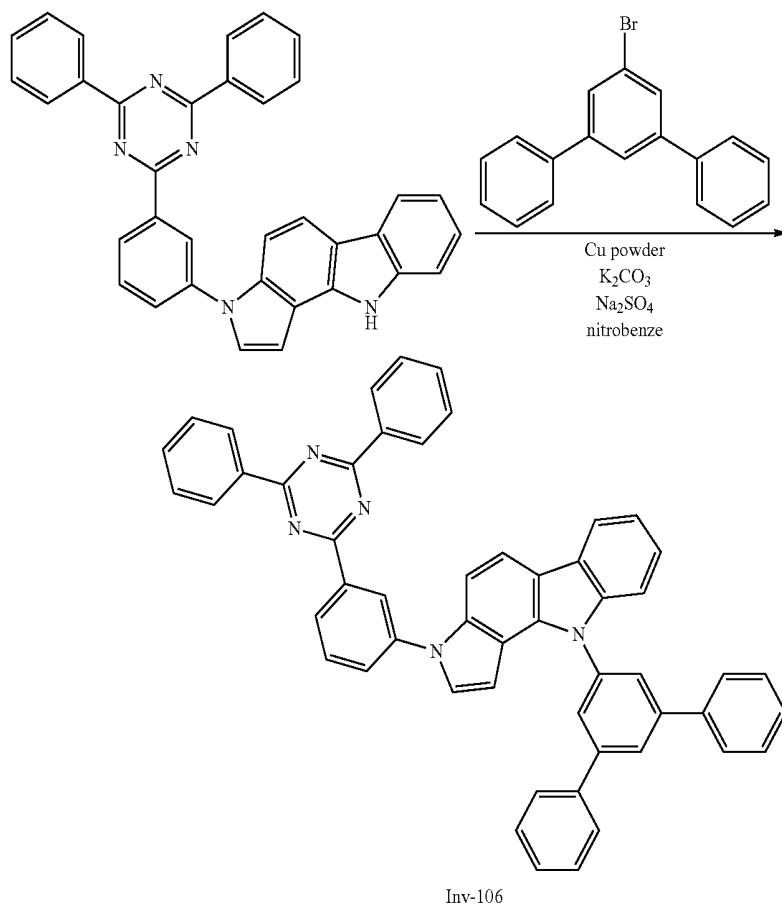
Inv-105

551

A target compound Inv-105 (1.75 g, 45%) was obtained by performing the same procedure as in Synthesis Example 27, except that IC-30 and 4-bromobiphenyl were used instead of IC-1b and 3-bromobiphenyl.

GC-Mass (theoretical value: 665.26 g/mol, measured value: 665.26 g/mol)

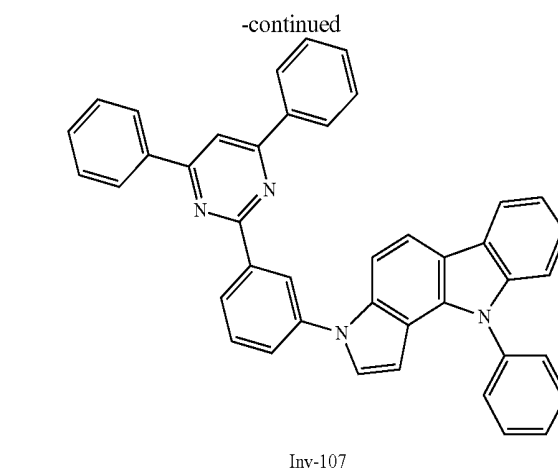
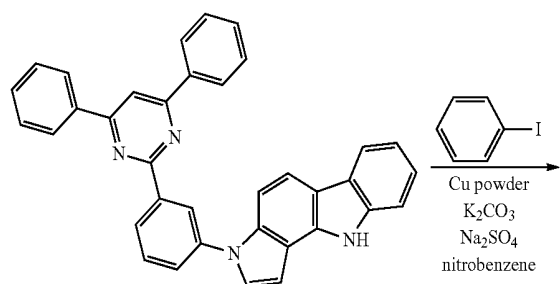
[Synthesis Example 106] Synthesis of Inv-106



A target compound Inv-106 (2.12 g, 49%) was obtained by performing the same procedure as in Synthesis Example 27, except that IC-30 and 1-bromo-3,5-diphenyl benzene were used instead of IC-1b and 3-bromobiphenyl.

GC-Mass (theoretical value: 741.29 g/mol, measured value: 741 g/mol)

[Synthesis Example 107] Synthesis of Inv-107



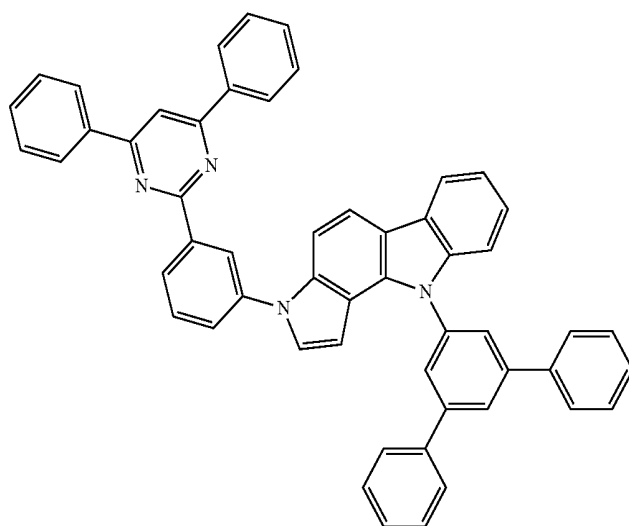
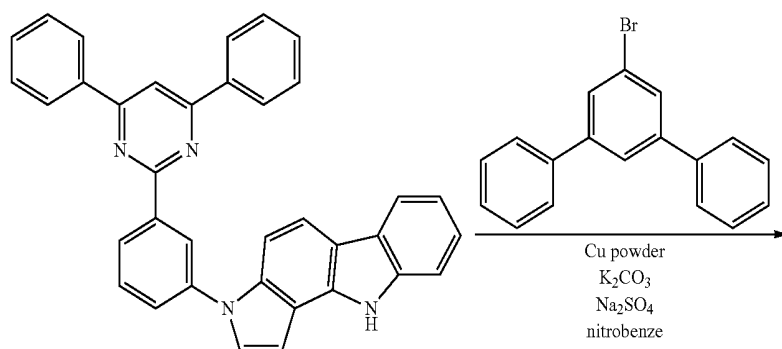
A target compound Inv-107 (1.79 g, 52%) was obtained by performing the same procedure as in Synthesis Example 27, except that IC-31 and iodobenzene were used instead of IC-1b and 3-bromobiphenyl.

GC-Mass (theoretical value: 588.23 g/mol, measured value: 588 g/mol)

553

[Synthesis Example 108] Synthesis of Inv-108

554

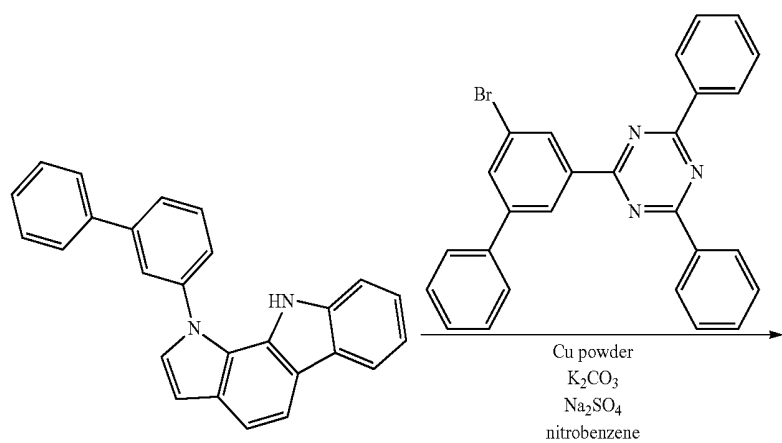


Inv-108

A target compound Inv-108 (1.99 g, 46%) was obtained by performing the same procedure as in Synthesis Example 27, except that IC-31 and 1-bromo-3,5-diphenyl benzene were used instead of IC-1b and 3-bromobiphenyl.

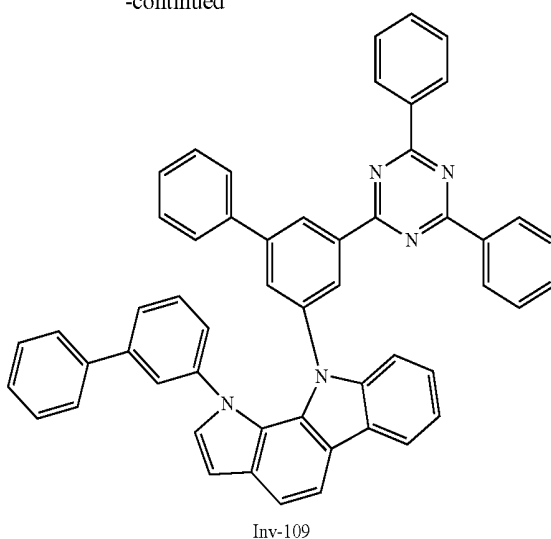
GC-Mass (theoretical value: 740.29 g/mol, measured value: 740 g/mol)

[Synthesis Example 109] Synthesis of Inv-109



555

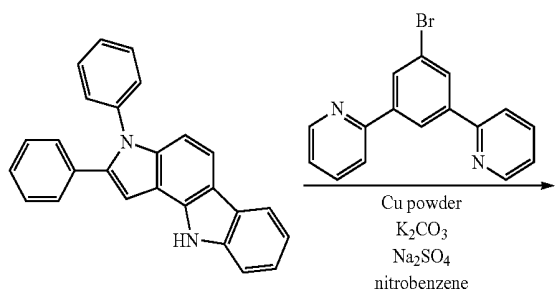
-continued



A target compound Inv-109 (3.54 g, 57%) was obtained by performing the same procedure as in Synthesis Example 27, except that IC-17 and 2-(5-bromobiphenyl-3-yl)-4,6-

GC-Mass (theoretical value: 741.29 g/mol, measured value: 741 g/mol)

[Synthesis Example 110] Synthesis of Inv-110



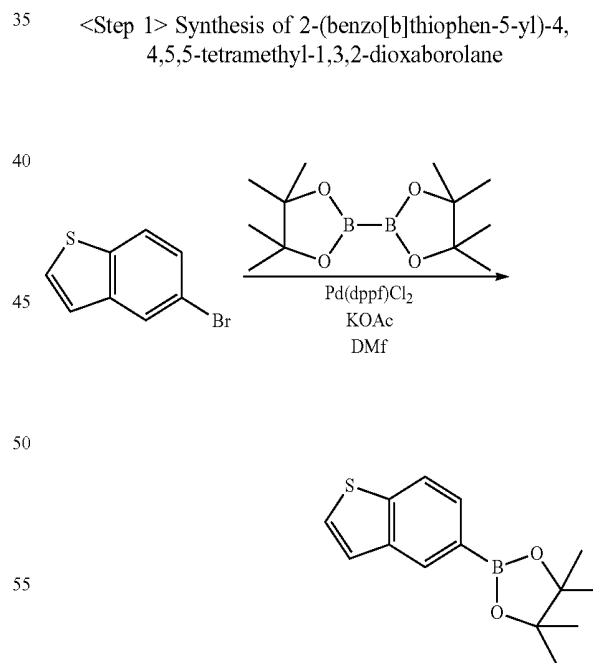
556

A target compound Inv-110 (2.61 g, 53%) was obtained by performing the same procedure as in Synthesis Example 27, except that IC-23 and 2,2'-(5-bromo-1,3-phenylene) dipyridine were used instead of IC-1b and 3-bromobiphenyl.

GC-Mass (theoretical value: 588.23 g/mol, measured value: 588 g/mol)

[Preparation Example 32] Synthesis of IC-32a and IC-32b

<Step 1> Synthesis of 2-(benzo[b]thiophen-5-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane

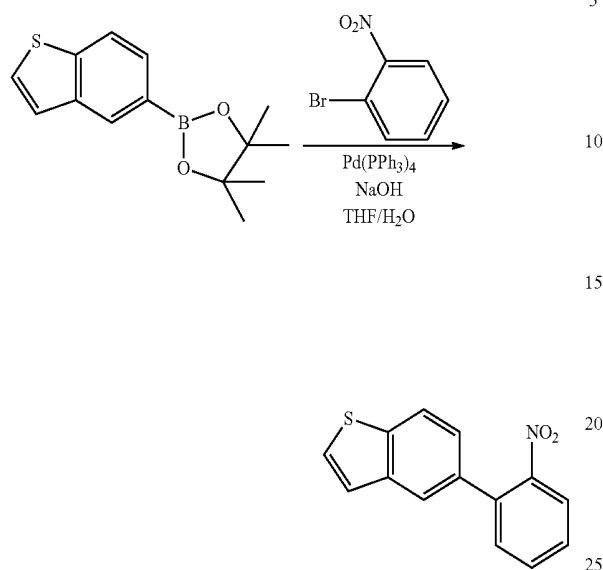


2-(benzo[b]thiophen-5-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane was obtained by performing the same process as <Step 1> of Preparation Example 1, except that 5-bromobenzo[b]thiophene was used instead of 5-bromo-1H-indole.

¹H NMR: δ 1.24 (s, 12H), 7.65 (d, 1H), 7.85 (d, 1H), 7.98 (d, 1H), 8.07 (d, 1H), 8.12 (s, 1H)

557

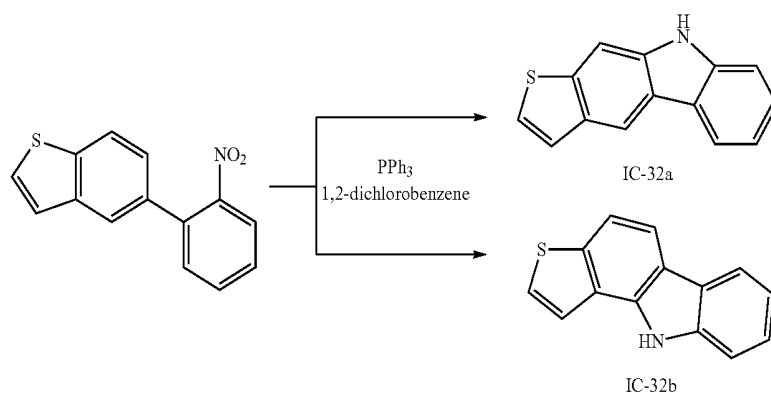
<Step 2> Synthesis of
5-(2-nitrophenyl)benzo[b]thiophene



5-(2-nitrophenyl)benzo[b]thiophene was obtained by performing the same procedure as in <Step 2> of Preparation Example 1, except that 2-(benzo[b]thiophen-5-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane obtained in <Step 1> was used instead of 5-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole.

¹H NMR: δ 7.67 (m, 2H), 7.88 (m, 2H), 7.98 (d, 1H), 8.00 (d, 1H), 8.07 (m, 2H), 8.13 (s, 1H)

<Step 3> Synthesis of IC-32a and IC-32b



1.70 g (7.60 mmol, yield: 35%) of IC-32a and 1.89 g (8.46 mmol, yield: 39%) of IC-32b were obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that 5-(2-nitrophenyl)benzo[b]thiophene obtained in <Step 2> was used instead of 5-(2-nitrophenyl)-1-phenyl-1H-indole.

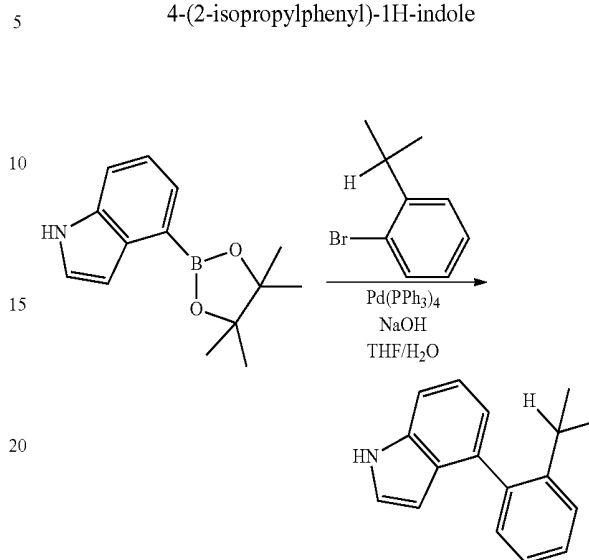
¹H-NMR for IC-32a: δ 7.29 (t, 1H), 7.59 (m, 3H), 7.79 (m, 3H), 8.11 (d, 1H), 8.26 (s, 1H)

¹H-NMR for IC-32b: δ 7.29 (t, 1H), 7.53 (m, 2H), 7.81 (m, 3H), 8.12 (m, 2H), 8.25 (s, 1H)

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[Preparation Example 33] Synthesis of IC-33

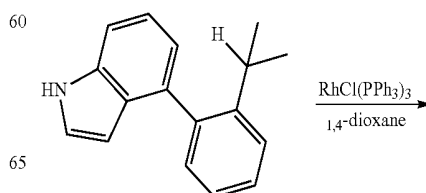
<Step 1> Synthesis of
4-(2-isopropylphenyl)-1H-indole



4-(2-isopropylphenyl)-1H-indole was obtained by performing the same procedure as in <Step 1> of Preparation Example 1, except that 4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole was used instead of 5-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole, and 1-bromo-2-isopropylbenzene was used instead of 1-bromo-2-nitrobenzene.

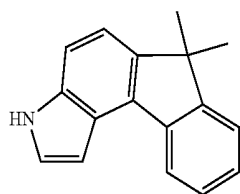
¹H NMR: δ 1.21 (s, 6H), 2.87 (m, 1H), 6.43 (d, 1H), 7.26 (t, 1H), 7.35 (m, 3H), 7.48 (d, 1H), 7.74 (m, 2H), 7.85 (d, 1H), 8.23 (s, 1H)

<Step 2> Synthesis of IC-33



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-continued



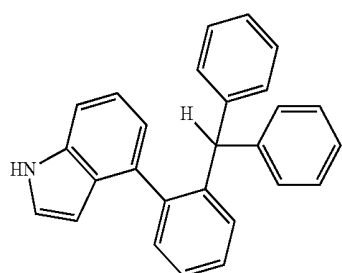
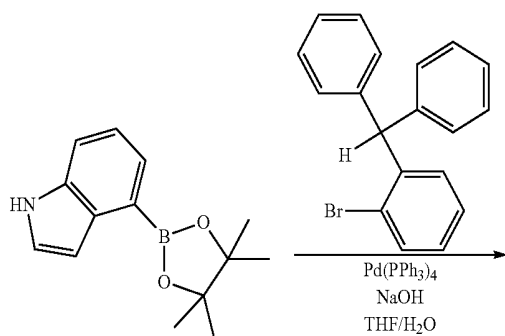
4-(2-isopropylphenyl)-1H-indole (5 g, 21.25 mmol) obtained in <Step 1> and $\text{RhCl}(\text{PPh}_3)_3$ (98.3 mg, 0.5 mol %) were dissolved in 50 ml of 1,4-dioxane under nitrogen flow, and the solution stirred at 135° C. for 1 hour.

After the reaction was completed, the solvent was removed, and the residue was purified by column chromatography (Hexane:MC=3:1 (v/v)), thereby obtaining IC-33 (4 g, yield 81%).

$^1\text{H NMR}$: δ 1.20 (s, 6H), 6.45 (d, 1H), 7.25 (d, 1H), 7.37 (m, 3H), 7.49 (d, 1H), 7.75 (d, 1H), 7.86 (d, 1H), 8.22 (s, 1H)

[Preparation Example 34] Synthesis of IC-34

<Step 1> Synthesis of 4-(2-benzhydrylphenyl)-1H-indole

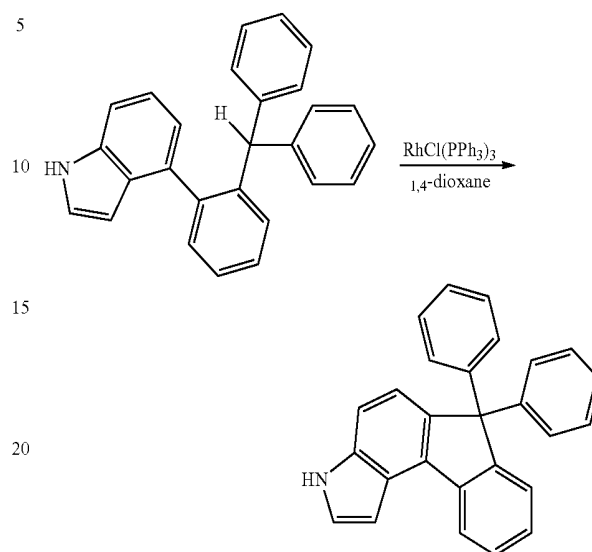


4-(2-benzhydrylphenyl)-1H-indole was obtained by performing the same process as <Step 2> of Preparation Example 1, except that 4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole was used instead of 5-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole, and (2-bromophenyl)methylene dibenzene was used instead of 1-bromo-2-nitrobenzene.

$^1\text{H NMR}$: δ 2.88 (m, 1H), 6.44 (d, 1H), 7.27 (m, 6H), 7.34 (m, 8H), 7.47 (d, 1H), 7.75 (m, 2H), 7.86 (d, 1H), 8.21 (s, 1H)

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<Step 2> Synthesis of IC-34



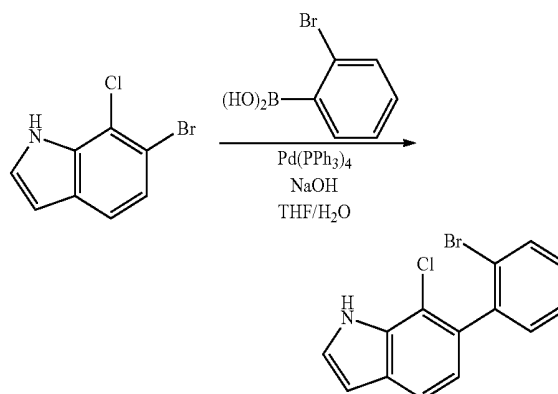
IC-34 was obtained by performing the same procedure as in <Step 2> of Preparation Example 11, except that 4-(2-benzhydrylphenyl)-1H-indole obtained in

<Step 1> was used instead of 4-(2-isopropylphenyl)-1H-indole

$^1\text{H NMR}$: δ 6.43 (d, 1H), 7.26 (m, 5H), 7.34 (m, 8H), 7.46 (d, 1H), 7.76 (m, 2H), 7.85 (d, 1H), 8.20 (s, 1H)

[Preparation Example 35] Synthesis of IC-35

<Step 1> Synthesis of 6-(2-bromophenyl)-7-chloro-1H-indole



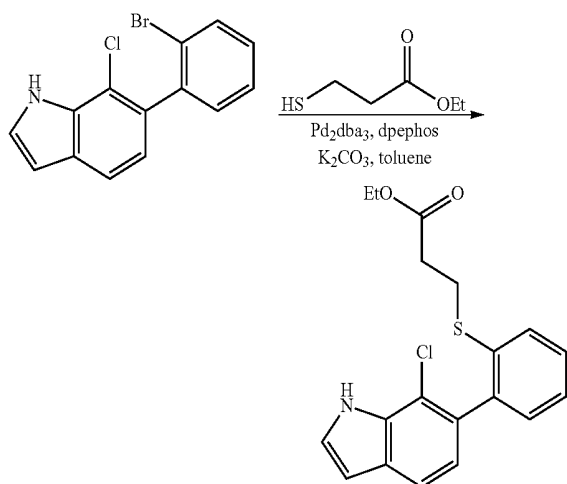
9.13 g (39.6 mmol) of 6-bromo-7-chloro-1H-indole, 9.54 g (47.5 mmol) of 2-bromophenylboronic acid, 4.75 g (118.8 mmol) of NaOH, and 200 ml/100 ml of THF/H₂O were mixed under nitrogen flow, and the mixture was stirred. 2.29 g (5 mol %) of $\text{Pd}(\text{PPh}_3)_4$ was added thereto at 40° C., and the resulting mixture was stirred at 80° C. for 12 hours. After the reaction was completed, extraction was performed with methylene chloride, MgSO_4 was added thereto, and the mixture was filtered. After the solvent was removed from the

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filtered organic layer, 8.86 g (28.9 mmol, yield: 73%) of a target compound 6-(2-bromophenyl)-7-chloro-1H-indole was obtained by using column chromatography.

¹H-NMR: δ 6.45 (d, 1H), 7.35 (m, 3H), 7.74 (m, 3H), 8.06 (d, 1H), 8.64 (s, 1H)

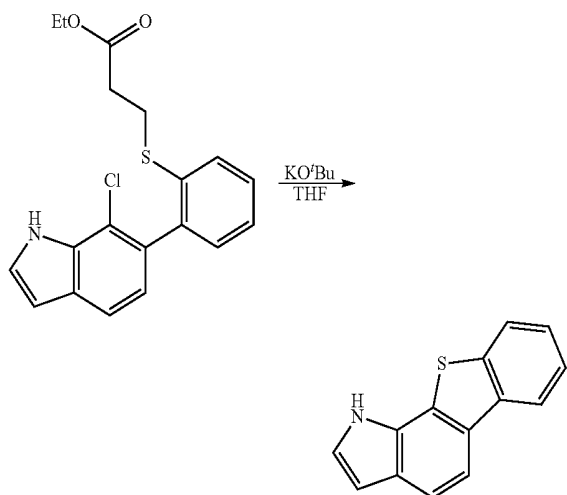
<Step 2> Synthesis of Ethyl 3-(2-(7-chloro-1H-indol-6-yl)phenylthio)propanoate



7.45 g (24.3 mmol) of 6-(2-bromophenyl)-7-chloro-1H-indole, 3.59 g (26.77 mmol) of ethyl 3-mercapto-1-propanoate, 167 mg (0.18 mmol) of Pd₂dba₃, 197 mg (0.37 mmol) of dpephos, and 8.4 g (61 mmol) of K₂CO₃ were added to 100 ml of toluene under nitrogen flow, and the mixture was stirred at 110° C. for 15 hours. After the reaction was completed, extraction was performed with methylene chloride, MgSO₄ was added thereto, and the mixture was filtered. After the solvent was removed from the filtered organic layer, 6.38 g (17.7 mmol, yield: 73%) of a target compound ethyl 3-(2-(7-chloro-1H-indol-6-yl)phenylthio)propanoate was obtained by using column chromatography.

¹H-NMR: δ 1.29 (t, 3H), 2.58 (t, 2H), 3.12 (t, 2H), 4.12 (q, 2H), 6.25 (d, 1H), 7.37 (m, 4H), 7.70 (m, 2H), 8.06 (d, 1H), 8.60 (s, 1H)

<Step 3> Synthesis of IC-35



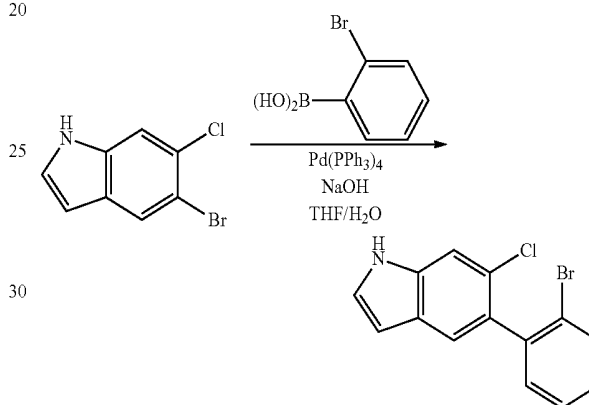
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6.34 g (15.4 mmol) of ethyl 3-(2-(7-chloro-1H-indol-6-yl)phenylthio)propanoate and 2.60 g (23.2 mmol) of potassium tert-butoxide were added to 100 ml of THF under nitrogen flow, and the mixture was stirred at 50° C. for 8 hours. After the reaction was completed, extraction was performed with methylene chloride, MgSO₄ was added thereto, and the mixture was filtered. After the solvent was removed from the filtered organic layer, 2.30 g (10.3 mmol, yield: 67%) of IC-35 was obtained by using column chromatography.

¹H-NMR: δ 6.44 (d, 1H), 7.25 (d, 1H), 7.51 (m, 3H), 8.00 (m, 2H), 8.40 (d, 1H), 8.63 (s, 1H)

[Preparation Example 36] Synthesis of IC-36

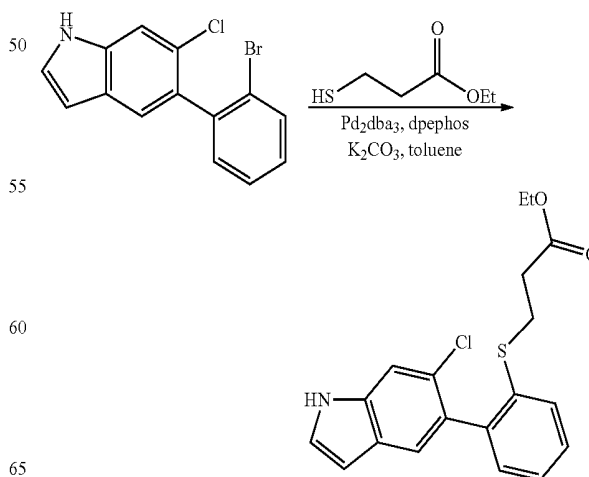
<Step 1> Synthesis of 5-(2-bromophenyl)-6-chloro-1H-indole



8.62 g (28.1 mmol, yield: 71%) of 5-(2-bromophenyl)-6-chloro-1H-indole was obtained by performing the same procedure as in <Step 1> of Preparation Example 35, except that 9.13 g (39.6 mmol) of 5-bromo-6-chloro-1H-indole was used instead of 6-bromo-7-chloro-1H-indole.

¹H-NMR: δ 6.44 (d, 1H), 7.34 (m, 4H), 7.61 (m, 3H), 8.59 (s, 1H)

<Step 2> Synthesis of Ethyl 3-(2-(6-chloro-1H-indol-5-yl)phenylthio)propanoate

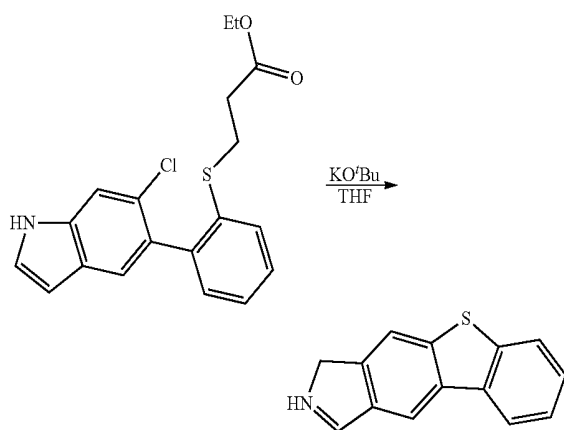


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6.73 g (18.71 mmol, yield: 77%) of ethyl 3-(2-(6-chloro-1H-indol-5-yl)phenylthio)propanoate was obtained by performing the same procedure as in <Step 2> of Preparation Example 35, except that 7.45 g (24.3 mmol) of 5-(2-bromophenyl)-6-chloro-1H-indole was used instead of 6-(2-bromophenyl)-7-chloro-1H-indole.

¹H-NMR: δ 1.29 (t, 3H), 2.58 (t, 2H), 3.17 (t, 2H), 4.13 (q, 2H), 6.35 (d, 1H), 7.39 (m, 5H), 7.70 (m, 2H), 8.64 (s, 1H)

<Step 3> Synthesis of IC-36

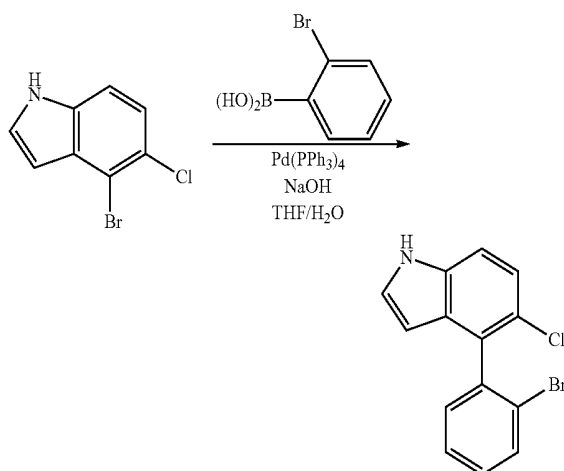


2.44 g (10.9 mmol, yield: 71%) of IC-36 was obtained by performing the same procedure as in <Step 3> of Preparation Example 35, except that 6.34 g (15.4 mmol) of ethyl 3-(2-(6-chloro-1H-indol-5-yl)phenylthio)propanoate was used instead of ethyl 3-(3-(2-chloro-9H-carbazol-3-yl)pyridin-2-ylthio)propanoate.

¹H-NMR: δ 6.50 (d, 1H), 7.51 (m, 3H), 7.71 (d, 1H), 8.01 (m, 2H), 8.45 (d, 1H), 8.68 (s, 1H)

[Preparation Example 37] Synthesis of IC-37

<Step 1> Synthesis of 4-(2-bromophenyl)-5-chloro-1H-indole



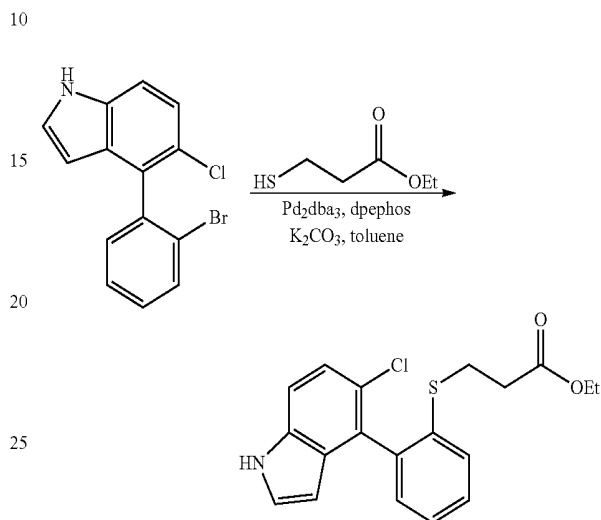
8.50 g (27.7 mmol, yield: 70%) of 4-(2-bromophenyl)-5-chloro-1H-indole was obtained by performing the same

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procedure as in <Step 1> of Preparation Example 35, except that 9.13 g (39.6 mmol) of 4-bromo-5-chloro-1H-indole was used instead of 6-bromo-7-chloro-1H-indole.

¹H-NMR: δ 6.48 (d, 1H), 7.39 (m, 4H), 7.62 (m, 3H), 8.61 (s, 1H)

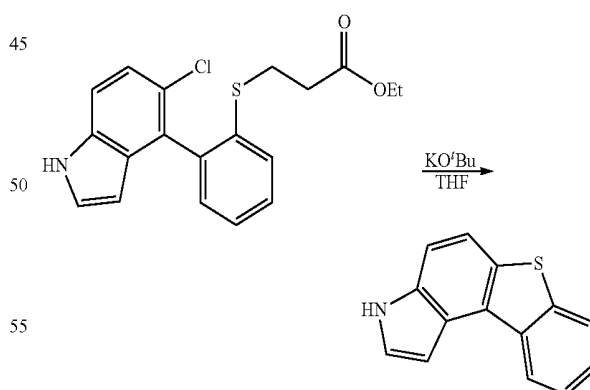
<Step 2> Synthesis of Ethyl 3-(2-(5-chloro-1H-indol-4-yl)phenylthio)propanoate



6.56 g (18.2 mmol, yield: 75%) of ethyl 3-(2-(5-chloro-1H-indol-4-yl)phenylthio)propanoate was obtained by performing the same procedure as in <Step 2> of Preparation Example 35, except that 7.45 g (24.3 mmol) of 4-(2-bromophenyl)-5-chloro-1H-indole was used instead of 6-(2-bromophenyl)-7-chloro-1H-indole.

¹H-NMR: δ 1.28 (t, 3H), 2.58 (t, 2H), 3.11 (t, 2H), 4.12 (q, 2H), 6.27 (d, 1H), 7.27 (m, 4H), 7.55 (m, 3H), 8.61 (s, 1H)

<Step 3> Synthesis of IC-37



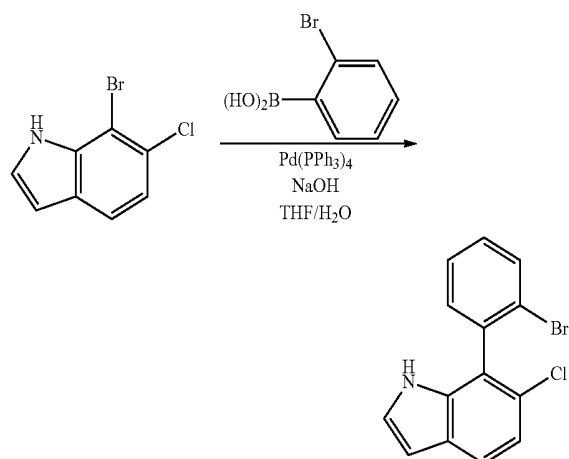
2.68 g (12.0 mmol, yield: 78%) of IC-37 was obtained by performing the same procedure as in <Step 3> of Preparation Example 35, except that 6.34 g (15.4 mmol) of ethyl 3-(2-(5-chloro-1H-indol-4-yl)phenylthio)propanoate was used instead of ethyl 3-(3-(2-chloro-9H-carbazol-3-yl)pyridin-2-ylthio)propanoate.

¹H-NMR: δ 6.50 (d, 1H), 7.31 (m, 2H), 7.51 (m, 2H), 8.01 (m, 2H), 8.44 (d, 1H), 8.58 (s, 1H)

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[Preparation Example 38] Synthesis of IC-38

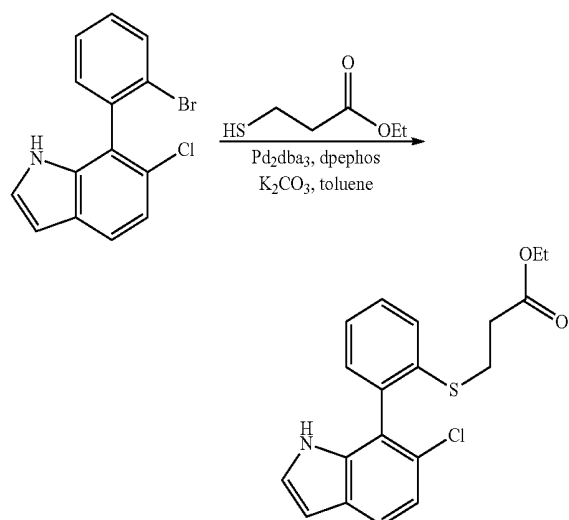
<Step 1> Synthesis of
7-(2-bromophenyl)-6-chloro-1H-indole



9.59 g (31.3 mmol, yield: 79%) of 7-(2-bromophenyl)-6-chloro-1H-indole was obtained by performing the same procedure as in <Step 1> of Preparation Example 35, except that 9.13 g (39.6 mmol) of 7-bromo-6-chloro-1H-indole was used instead of 6-bromo-7-chloro-1H-indole.

¹H-NMR: δ 6.48 (d, 1H), 7.06 (d, 1H), 7.33 (m, 3H), 7.62 (m, 2H), 8.01 (d, 1H), 8.71 (s, 1H)

<Step 2> Synthesis of Ethyl 3-(2-(6-chloro-1H-indol-7-yl)phenylthio)propanoate

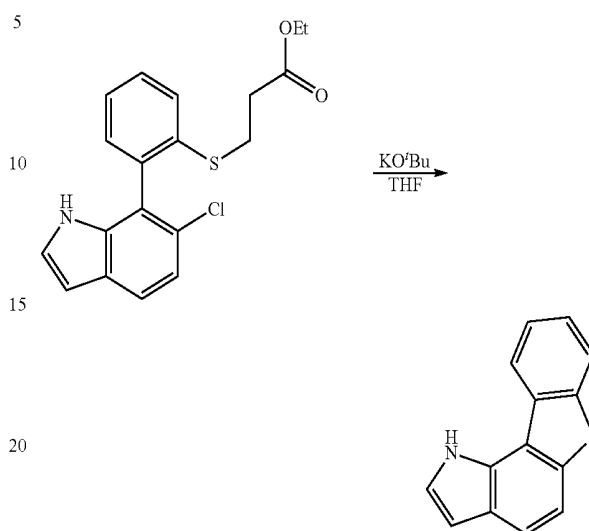


6.47 g (18.0 mmol, yield: 74%) of ethyl 3-(2-(6-chloro-1H-indol-7-yl)phenylthio)propanoate was obtained by performing the same procedure as in <Step 2> of Preparation Example 35, except that 7.45 g (24.3 mmol) of 7-(2-bromophenyl)-6-chloro-1H-indole was used instead of 6-(2-bromophenyl)-7-chloro-1H-indole.

¹H-NMR: δ 1.29 (t, 3H), 2.58 (t, 2H), 3.13 (t, 2H), 4.12 (q, 2H), 6.24 (d, 1H), 7.06 (d, 1H), 7.27 (m, 3H), 7.70 (m, 2H), 8.00 (d, 1H), 8.61 (s, 1H)

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<Step 3> Synthesis of IC-38

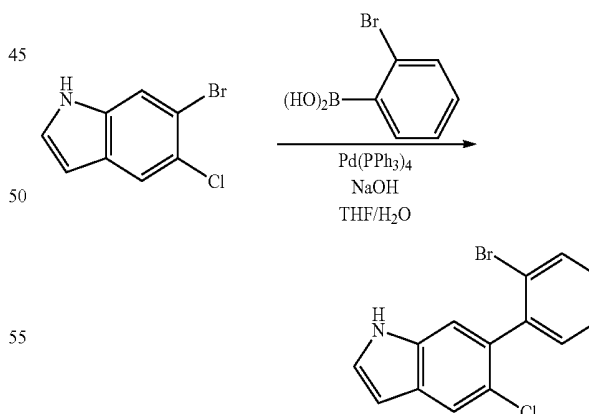


2.48 g (11.1 mmol, yield: 72%) of IC-38 was obtained by performing the same procedure as in <Step 3> of Preparation Example 35, except that 6.34 g (15.4 mmol) of ethyl 3-(2-(6-chloro-1H-indol-7-yl)phenylthio)propanoate was used instead of ethyl 3-(3-(2-chloro-9H-carbazol-3-yl)pyridin-2-ylthio)propanoate.

¹H-NMR: δ 6.44 (d, 1H), 7.51 (m, 4H), 7.89 (m, 2H), 8.48 (d, 1H), 8.68 (s, 1H)

[Preparation Example 39] Synthesis of IC-39

<Step 1> Synthesis of
6-(2-bromophenyl)-5-chloro-1H-indole

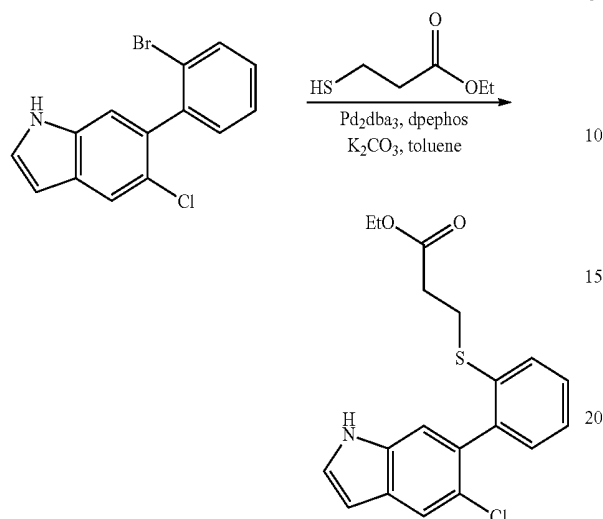


8.13 g (26.5 mmol, yield: 67%) of 6-(2-bromophenyl)-5-chloro-1H-indole was obtained by performing the same procedure as in <Step 1> of Preparation Example 35, except that 9.13 g (39.6 mmol) of 6-bromo-5-chloro-1H-indole was used instead of 6-bromo-7-chloro-1H-indole.

¹H-NMR: δ 6.45 (d, 1H), 7.29 (m, 3H), 7.62 (m, 4H), 8.71 (s, 1H)

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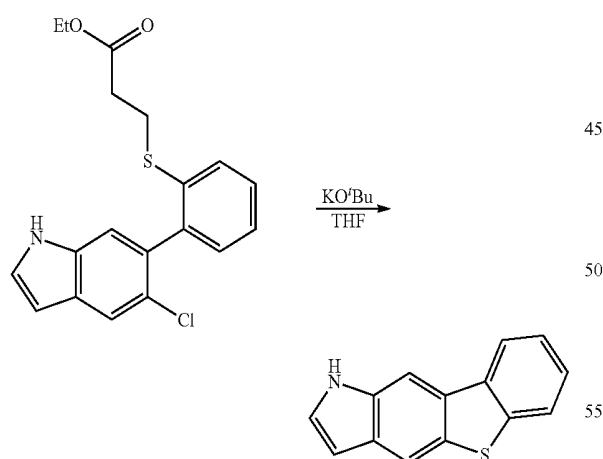
<Step 2> Synthesis of Ethyl 3-(2-(5-chloro-1H-indol-6-yl)phenylthio)propanoate



7.00 g (19.4 mmol, yield: 81%) of ethyl 3-(2-(5-chloro-1H-indol-6-yl)phenylthio)propanoate was obtained by performing the same procedure as in <Step 2> of Preparation Example 35, except that 7.45 g (24.3 mmol) of 6-(2-bromophenyl)-5-chloro-1H-indole was used instead of 6-(2-bromophenyl)-7-chloro-1H-indole.

¹H-NMR: δ 1.29 (t, 3H), 2.58 (t, 2H), 3.12 (t, 2H), 4.13 (q, 2H), 6.26 (d, 1H), 7.37 (m, 4H), 7.66 (m, 3H), 8.61 (s, 1H)

<Step 3> Synthesis of IC-39



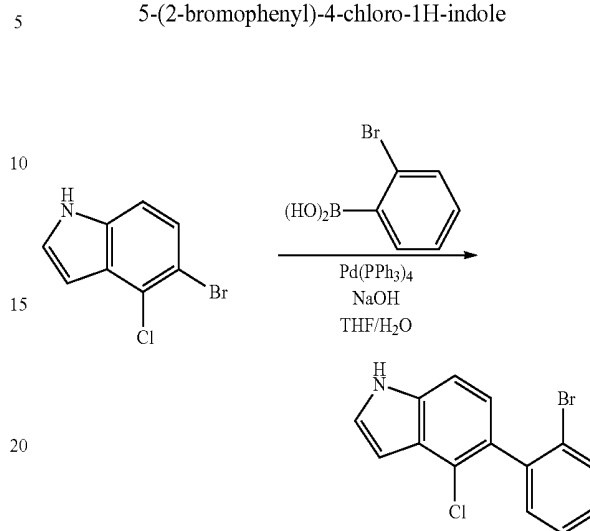
2.58 g (11.5 mmol, yield: 75%) of IC-39 was obtained by performing the same procedure as in <Step 3> of Preparation Example 35, except that 6.34 g (15.4 mmol) of ethyl 3-(2-(5-chloro-1H-indol-6-yl)phenylthio)propanoate was used instead of ethyl 3-(3-(2-chloro-9H-carbazol-3-yl)pyridin-2-ylthio)propanoate.

¹H-NMR: δ 6.45 (d, 1H), 7.31 (d, 1H), 7.50 (m, 2H), 7.81 (m, 2H), 8.01 (d, 1H), 8.48 (d, 1H), 8.68 (s, 1H)

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[Preparation Example 40] Synthesis of IC-40

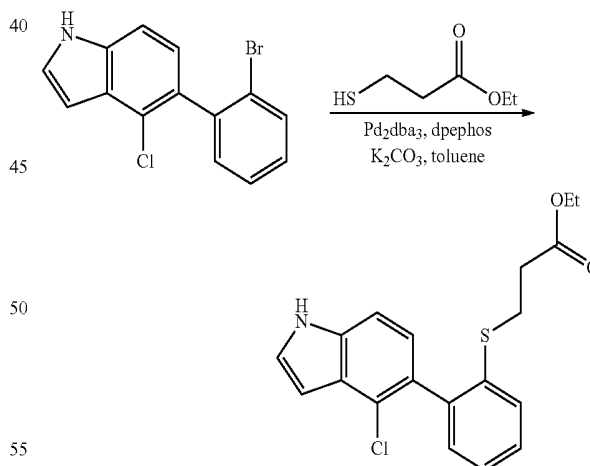
<Step 1> Synthesis of 5-(2-bromophenyl)-4-chloro-1H-indole



8.98 g (29.3 mmol, yield: 74%) of 5-(2-bromophenyl)-4-chloro-1H-indole was obtained by performing the same procedure as in <Step 1> of Preparation Example 35, except that 9.13 g (39.6 mmol) of 4-bromo-5-chloro-1H-indole was used instead of 5-bromo-4-chloro-1H-indole.

¹H-NMR: δ 6.44 (d, 1H), 7.38 (m, 3H), 7.59 (m, 3H), 7.82 (d, 1H), 8.71 (s, 1H)

<Step 2> Synthesis of Ethyl 3-(2-(4-chloro-1H-indol-5-yl)phenylthio)propanoate

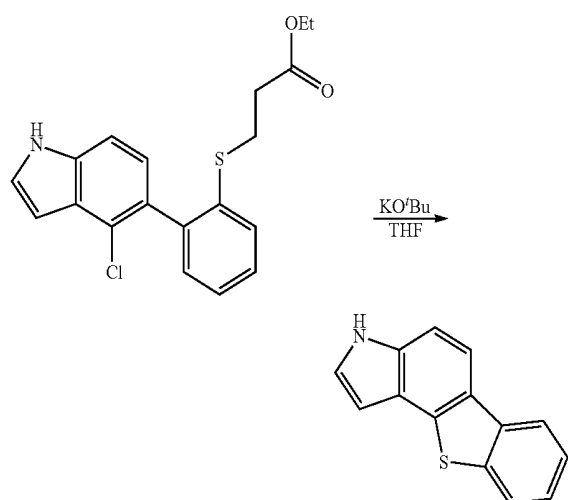


6.82 g (19.0 mmol, yield: 78%) of ethyl 3-(2-(4-chloro-1H-indol-5-yl)phenylthio)propanoate was obtained by performing the same procedure as in <Step 2> of Preparation Example 35, except that 7.45 g (24.3 mmol) of 5-(2-bromophenyl)-4-chloro-1H-indole was used instead of 6-(2-bromophenyl)-7-chloro-1H-indole.

¹H-NMR: δ 1.30 (t, 3H), 2.58 (t, 2H), 3.12 (t, 2H), 4.11 (q, 2H), 6.25 (d, 1H), 7.33 (m, 4H), 7.65 (m, 3H), 8.61 (s, 1H)

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<Step 3> Synthesis of IC-40

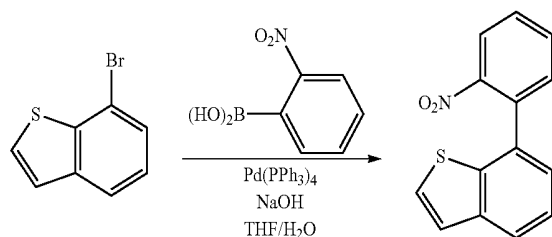


2.58 g (11.6 mmol, yield: 75%) of IC-40 was obtained by performing the same procedure as in <Step 3> of Preparation Example 35, except that 6.34 g (15.4 mmol) of ethyl 3-(2-(4-chloro-1H-indol-5-yl)phenylthio)propanoate was used instead of ethyl 3-(3-(2-chloro-9H-carbazol-3-yl)pyridin-2-ylthio)propanoate.

¹H-NMR: δ 6.43 (d, 1H), 7.33 (m, 2H), 7.51 (m, 2H), 7.99 (m, 2H), 8.48 (d, 1H), 8.68 (s, 1H)

[Preparation Example 41] Synthesis of IC-41

<Step 1> Synthesis of 7-(2-nitrophenyl)benzo[b]thiophene

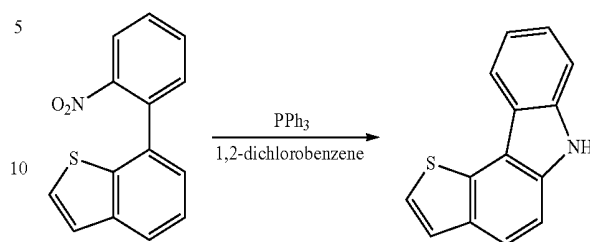


12.2 g (35.2 mmol) of 7-bromobenzo[b]thiophene, 6.44 g (38.7 mmol) of 2-nitrophenylboronic acid, 4.22 g (105.6 mmol) of NaOH, and 300 ml/150 ml of THF/H₂O were mixed under nitrogen flow, and the mixture was stirred. 2.03 g (5 mol %) of Pd(PPh₃)₄ was added thereto at 40° C., and the resulting mixture was stirred at 80° C. for 12 hours. After the reaction was completed, extraction was performed with methylene chloride, MgSO₄ was added thereto, and the mixture was filtered. After the solvent was removed from the filtered organic layer, 7.38 g (28.9 mmol, yield 82%) of 7-(2-nitrophenyl)benzo[b]thiophene was obtained by using column chromatography.

¹H-NMR: δ 7.63 (m, 5H), 7.96 (m, 3H), 8.21 (d, 1H)

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<Step 2> Synthesis of IC-41

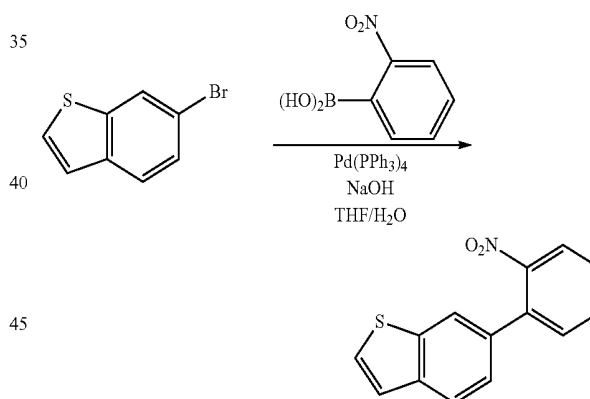


5.53 g (21.7 mmol) of 7-(2-nitrophenyl)benzo[b]thiophene, 14.2 g (54.2 mmol) of triphenylphosphine, and 100 ml of 1,2-dichlorobenzene were mixed under nitrogen flow, and then the mixture was stirred for 12 hours. After the reaction was completed, 1,2-dichlorobenzene was removed, and extraction was performed with dichloromethane. Water was removed from the extracted organic layer by MgSO₄, and 3.29 g (14.8 mmol, yield: 68%) of a target compound IC-41 was obtained by using column chromatography.

¹H-NMR: δ 7.37 (t, 1H), 7.46 (m, 5H), 7.87 (d, 1H), 8.20 (d, 1H), 8.24 (s, 1H)

[Preparation Example 42] Synthesis of IC-42a and IC-42b

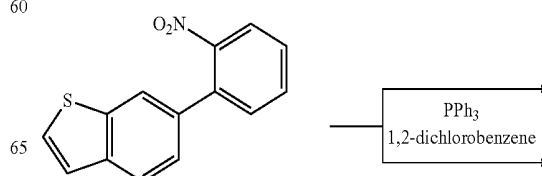
<Step 1> Synthesis of 6-(2-nitrophenyl)benzo[b]thiophene



7.01 g (27.5 mmol, yield: 78%) of 6-(2-nitrophenyl)benzo[b]thiophene was obtained by performing the same procedure as in <Step 1> of Preparation Example 41, except that 12.2 g (35.2 mmol) of 6-bromobenzo[b]thiophene was used instead of 7-bromobenzo[b]thiophene.

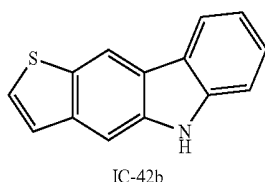
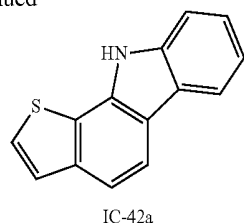
¹H-NMR: δ 7.68 (m, 3H), 7.98 (m, 6H)<

<Step 2> Synthesis of IC-42a and IC-42b



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-continued



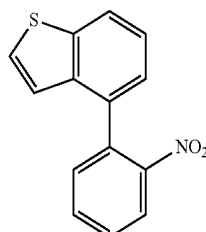
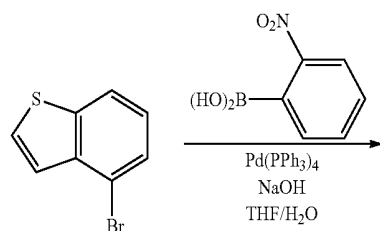
1.60 g (7.16 mmol, yield: 33%) of IC-42a and 1.79 g (8.03 mmol, yield: 37%) of IC-42b were obtained by performing the same procedure as in <Step 2> of Preparation Example 41, except that 5.53 g (21.7 mmol) of 6-(2-nitrophenyl)benzo[b]thiophene was used instead of 7-(2-nitrophenyl)benzo[b]thiophene.

¹H-NMR for IC-42a: δ 7.27 (t, 1H), 7.53 (m, 4H), 7.78 (d, 1H), 7.92 (d, 1H), 8.10 (d, 1H), 8.25 (s, 1H)

¹H-NMR for IC-42b: δ 7.29 (t, 1H), 7.63 (m, 3H), 7.79 (m, 3H), 8.11 (d, 1H), 8.25 (s, 1H)

[Preparation Example 43] Synthesis of IC-43

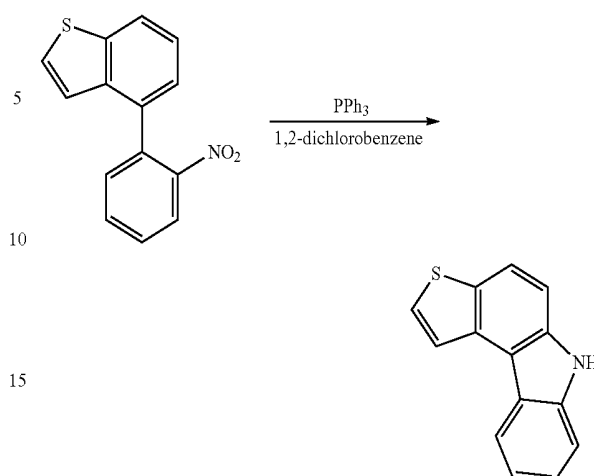
<Step 1> Synthesis of 4-(2-nitrophenyl)benzo[b]thiophene



7.28 g (28.5 mmol, yield: 81%) of 4-(2-nitrophenyl)benzo[b]thiophene was obtained by performing the same procedure as in <Step 1> of Preparation Example 41, except that 12.2 g (35.2 mmol) of 4-bromobenzo[b]thiophene was used instead of 7-bromobenzo[b]thiophene.

¹H-NMR: δ 7.68 (m, 4H), 7.89 (m, 3H), 8.01 (m, 2H)<Step 2> Synthesis of IC-43

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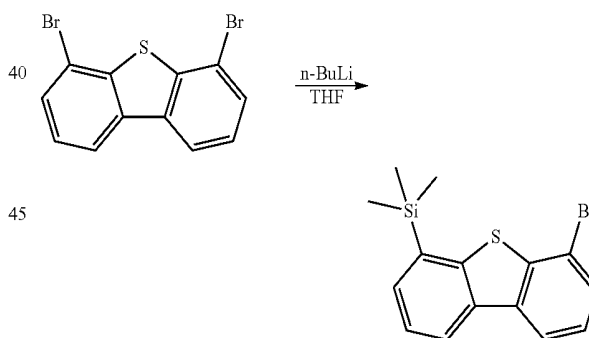


3.05 g (13.7 mmol, yield: 63%) of IC-43 was obtained by performing the same procedure as in <Step 2> of Preparation Example 41, except that 5.53 g (21.7 mmol) of 4-(2-nitrophenyl)benzo[b]thiophene was used instead of 7-(2-nitrophenyl)benzo[b]thiophene.

¹H-NMR: δ 7.31 (m, 2H), 7.73 (m, 4H), 7.96 (d, 1H), 8.10 (d, 1H), 8.26 (s, 1H)

[Preparation Example 44] Synthesis of IC-44

<Step 1> Synthesis of (6-bromodibenzo[b,d]thiophen-4-yl)trimethylsilane

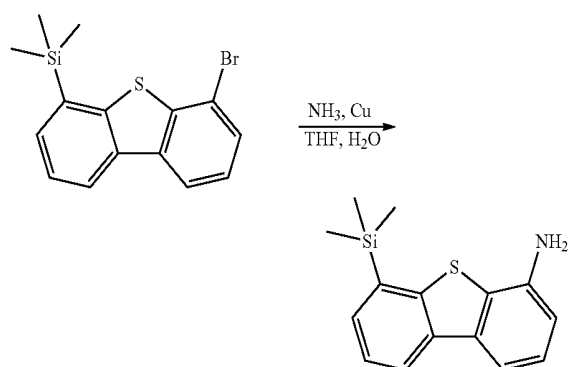


After 17.1 g (50.0 mmol) of 4,6-dibromodibenzo[b,d]thiophene was dissolved in 300 ml of THF under nitrogen flow, 19.6 ml (50.0 mmol) of n-butyllithium (2.5 M in hexane) was slowly added to the solution at -78° C., and after 30 minutes, the mixture was stirred at normal temperature for 1 hour, 5.43 g (50.0 mmol) of chlorotrimethylsilane was added thereto, and the resulting mixture was stirred at normal temperature for 12 hours. After the reaction was completed, extraction was performed with methylene chloride, MgSO₄ was added thereto, and the mixture was filtered. After the solvent was removed from the filtered organic layer, 10.2 g (30.5 mmol, yield: 61%) of (6-bromodibenzo[b,d]thiophen-4-yl)trimethylsilane was obtained by using column chromatography.

¹H-NMR: δ 0.27 (s, 9H), 7.48 (m, 4H), 8.41 (m, 2H)<

573

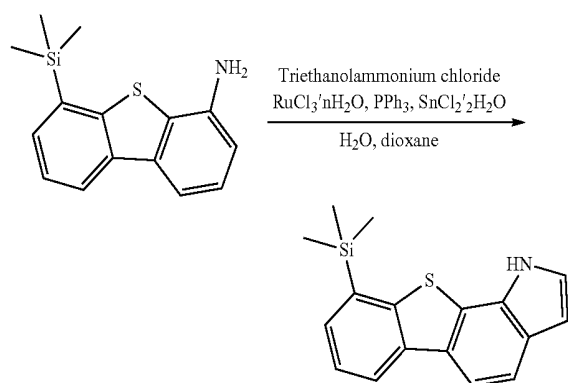
<Step 2> Synthesis of 6-(trimethylsilyl)dibenzo[b,d]thiophen-4-amine



After 10.1 g (30.0 mmol) of 6-(trimethylsilyl)dibenzo[b,d]thiophen-4-yl)trimethylsilane was dissolved in 100 ml of toluene under nitrogen flow, 10.2 ml (150 mmol) of 28% aqueous ammonia and 0.10 g (5 mol %) of Cu were added to the solution, and the mixture was stirred at 110° C. for 12 hours. After the reaction was completed, extraction was performed with methylene chloride, MgSO₄ was added thereto, and the mixture was filtered. After the solvent was removed from the filtered organic layer, 6.60 g (24.3 mmol, yield: 81%) of 6-(trimethylsilyl)dibenzo[b,d]thiophen-4-amine was obtained by using column chromatography.

¹H-NMR: δ 0.26 (s, 9H), 5.27 (s, 2H), 6.89 (d, 1H), 7.29 (t, 1H), 7.52 (m, 2H), 7.81 (d, 1H), 8.39 (d, 1H)

<Step 3> Synthesis of IC-44-1

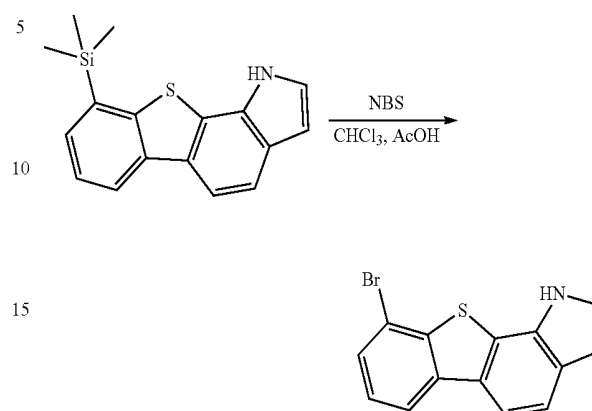


After 5.43 g (20.0 mmol) of 6-(trimethylsilyl)dibenzo[b,d]thiophen-4-amine was dissolved in H₂O/dioxane (10 ml/90 ml) under nitrogen flow, 0.372 g (2 mmol) of triethanolammonium chloride, 0.052 g (0.2 mmol) of RuCl₃·nH₂O, 0.158 g (0.6 mmol) of PPh₃, and 0.452 g (2 mmol) of SnCl₂·2H₂O were added to the solution, and the resulting mixture was stirred at 180° C. for 20 hours. After the reaction was completed, the reactant was poured into aqueous 5% HCl, extraction was performed with methylene chloride, MgSO₄ was added thereto, and the mixture was filtered. After the solvent was removed from the filtered organic layer, 2.60 g (8.8 mmol, yield: 44%) of IC-44-1 was obtained by using column chromatography.

¹H-NMR: δ 0.26 (s, 9H), 6.45 (d, 1H), 7.28 (d, 1H), 7.56 (m, 3H), 8.09 (d, 1H), 8.41 (d, 1H), 8.65 (s, 1H)

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<Step 4> Synthesis of IC-44

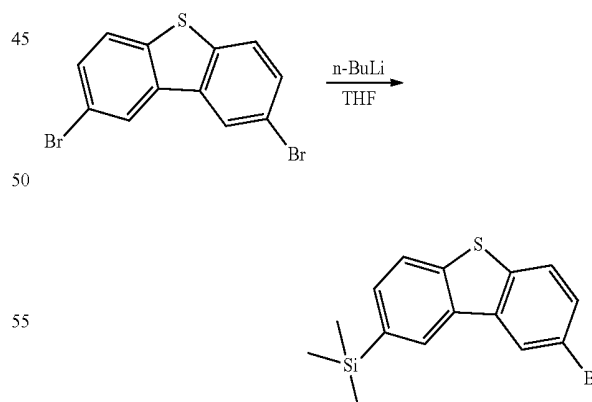


After 2.60 g (8.8 mmol) of IC-44-1 was dissolved in CHCl₃/AcOH (50 ml/50 ml) under nitrogen flow, 1.58 g (8.8 mmol) of NBS was slowly added thereto at 0° C., and the mixture was stirred at normal temperature for 1 hour. After the reaction was completed, the reactant was poured into a 5% NaHCO₃ aqueous solution, extraction was performed with methylene chloride, MgSO₄ was added thereto, and the mixture was filtered. After the solvent was removed from the filtered organic layer, 2.37 g (7.83 mmol, yield: 89%) of IC-44 was obtained by using column chromatography.

¹H-NMR: δ 6.45 (d, 1H), 7.27 (d, 1H), 7.54 (m, 3H), 8.05 (d, 1H), 8.40 (d, 1H), 8.65 (s, 1H)

[Preparation Example 45] Synthesis of IC-45a and IC-45b

<Step 1> Synthesis of (8-bromodibenzo[b,d]thiophen-2-yl)trimethylsilane

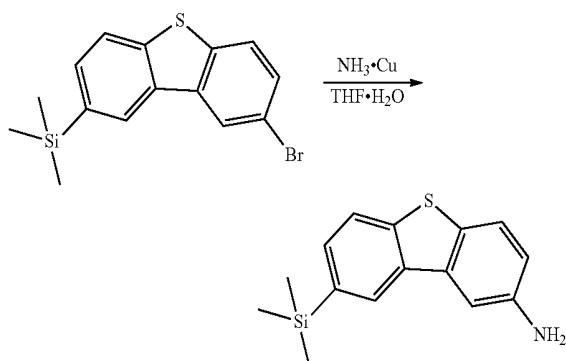


11.6 g (34.5 mmol, yield: 69%) of (8-bromodibenzo[b,d]thiophen-2-yl)trimethylsilane was obtained by performing the same procedure as in <Step 1> of Preparation Example 44, except that 17.1 g (50.0 mmol) of 2,8-dibromodibenzo[b,d]thiophene was used instead of 4,6-dibromodibenzo[b,d]thiophene.

¹H-NMR: δ 0.25 (s, 9H), 7.48 (m, 2H), 7.96 (m, 4H)<

575

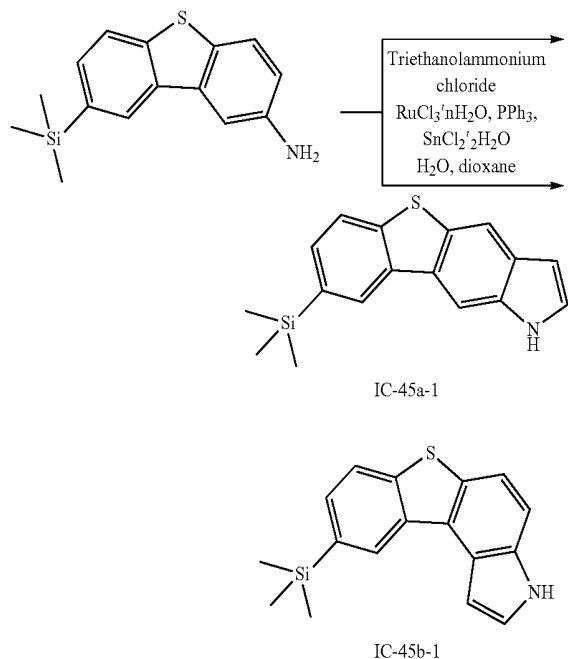
<Step 2> Synthesis of 8-(trimethylsilyl)dibenzo[b,d]thiophen-2-amine



6.35 g (23.4 mmol, yield: 78%) of 8-(trimethylsilyl)dibenzo[b,d]thiophen-2-amine was obtained by performing the same procedure as <Step 2> of Preparation Example 44, except that 10.1 g (30.0 mmol) of (8-bromodibenzo[b,d]thiophen-2-yl)trimethylsilane was used instead of (6-bromodibenzo[b,d]thiophen-4-yl)trimethylsilane.

¹H-NMR: δ 0.26 (s, 9H), 5.26 (s, 2H), 7.48 (m, 3H), 7.79 (d, 1H), 7.96 (d, 1H), 8.01 (s, 1H)

<Step 3> Synthesis of IC-45a-1 and IC-45b-1



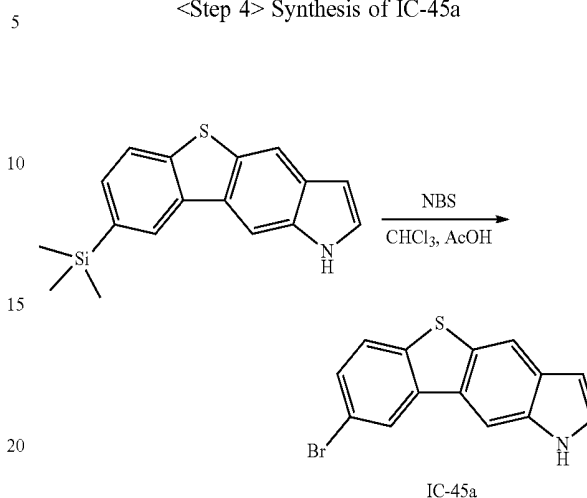
2.07 g (7.00 mmol, yield: 35%) of IC-45a-1 and 1.95 g (6.60 mmol, yield: 33%) of IC-45b-1 were obtained by performing the same procedure as <Step 3> of Preparation Example 44, except that 5.43 g (20.0 mmol) of 8-(trimethylsilyl)dibenzo[b,d]thiophen-2-amine was used instead of 6-(trimethylsilyl)dibenzo[b,d]thiophen-4-amine.

¹H-NMR for IC-45a-1: δ 0.26 (s, 9H), 6.45 (d, 1H), 7.27 (d, 1H), 7.56 (d, 1H), 7.82 (m, 2H), 8.02 (m, 2H), 8.65 (s, 1H)

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¹H-NMR for IC-45b-1: δ 0.26 (s, 9H), 6.44 (d, 1H), 7.29 (m, 2H), 7.53 (d, 1H), 8.01 (m, 3H), 8.65 (s, 1H)

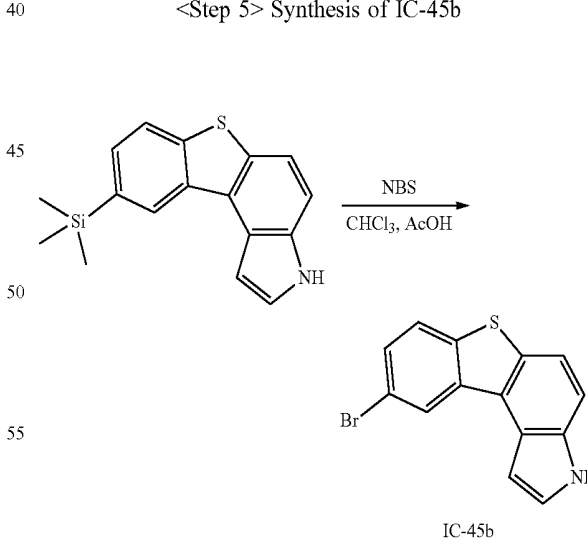
<Step 4> Synthesis of IC-45a



After 1.95 g (6.6 mmol) of IC-45a-1 was dissolved in CHCl₃/AcOH (40 ml/40 ml) under nitrogen flow, 1.19 g (6.6 mol) of NBS was slowly added thereto at 0° C., and the mixture was stirred at normal temperature for 1 hour. After the reaction was completed, the reactant was poured into a 5% NaHCO₃ aqueous solution, extraction was performed with methylene chloride, MgSO₄ was added thereto, and the mixture was filtered. After the solvent was removed from the filtered organic layer, 1.72 g of (5.68 mmol, yield: 86%) of a target compound IC-45a was obtained by using column chromatography.

¹H-NMR: δ 6.44 (d, 1H), 7.28 (t, 1H), 7.42 (d, 1H), 7.83 (m, 4H), 8.63 (s, 1H)

<Step 5> Synthesis of IC-45b



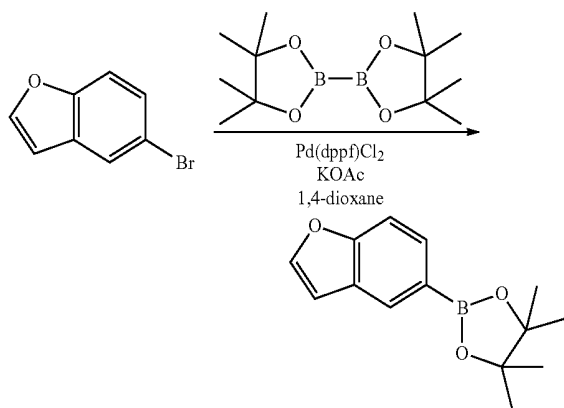
1.76 g (5.81 mmol, yield: 88%) of IC-45b was obtained by performing the same procedure as in <Step 4> in Preparation Example 45, except that 1.95 g (6.60 mmol) of IC-45b-1 was used instead of IC-45a-1.

¹H-NMR: δ 6.45 (d, 1H), 7.30 (m, 2H), 7.45 (d, 1H), 7.92 (m, 3H), 8.61 (s, 1H)

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[Preparation Example 46] Synthesis of IC-46

<Step 1> Synthesis of 2-(benzofuran-5-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane

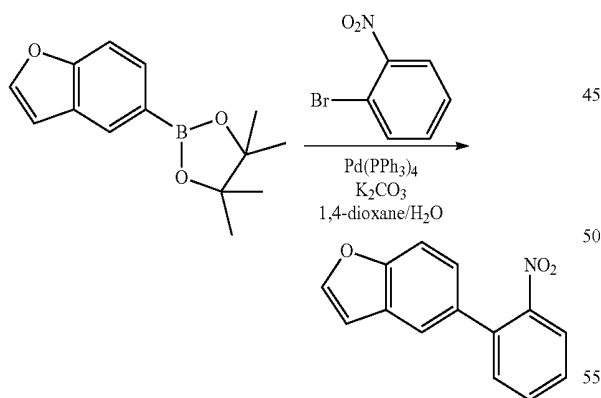


5-bromobenzofuran (25 g, 0.126 mol), 4,4,4',4',5,5,5',5'-octamethyl-2,2'-bi(1,3,2-dioxaborolane) (38.67 g, 0.152 mol), Pd(dppf)Cl₂ (3.11 g, 3 mol), KOAc (37.36 g, 0.381 mol) and 1,4-dioxane (500 ml) were mixed under nitrogen flow, and the mixture was stirred at 130° C. for 12 hours.

After the reaction was completed, extraction was performed with ethyl acetate, moisture was removed with MgSO₄, and purification was performed by column chromatography (Hexane:EA=10:1 (v/v)), thereby obtaining 2-(benzofuran-5-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (23.23 g, yield 75%).

¹H-NMR: δ 1.25 (s, 12H), 6.46 (d, 1H), 7.28 (d, 1H), 7.43 (d, 1H), 7.53 (d, 1H), 7.98 (s, 1H)

<Step 2> Synthesis of 5-(2-nitrophenyl)-1H-indole



1-bromo-2-nitrobenzene (15.86 g, 78.52 mmol), 2-(benzofuran-5-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (23 g, 94.23 mmol) obtained in <Step 1>, K₂CO₃ (32.56 g, 235.57 mmol) and 1,4-dioxane/H₂O (400 ml/200 ml) were mixed under nitrogen flow, then Pd(PPh₃)₄ (4.54 g, 5 mol %) was added to the mixture at 40° C., and the resulting mixture was stirred at 110° C. for 12 hours.

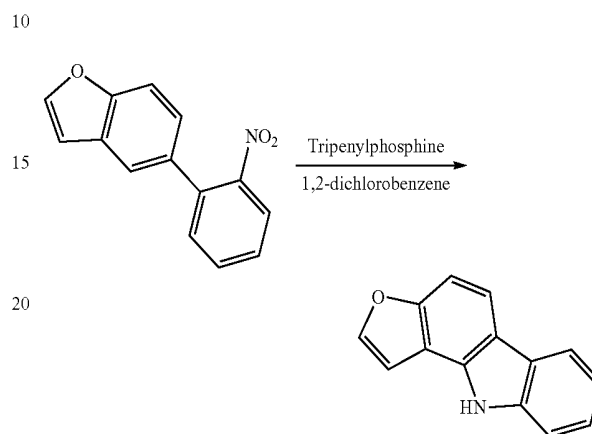
After the reaction was completed, extraction was performed with methylene chloride, MgSO₄ was added thereto, and the mixture was filtered. After the solvent was removed

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from the organic layer obtained, the residue was purified by column chromatography (Hexane:EA=3:1 (v/v)), thereby obtaining 5-(2-nitrophenyl)benzofuran (12.40 g, yield 66%).

¹H-NMR: δ 6.45 (d, 1H), 7.26 (d, 1H), 7.42 (d, 1H), 7.52 (d, 1H), 7.66 (t, 1H), 7.85 (t, 1H), 7.96 (s, 1H), 8.01 (d, 1H), 8.06 (t, 1H)

<Step 3> Synthesis of IC-46



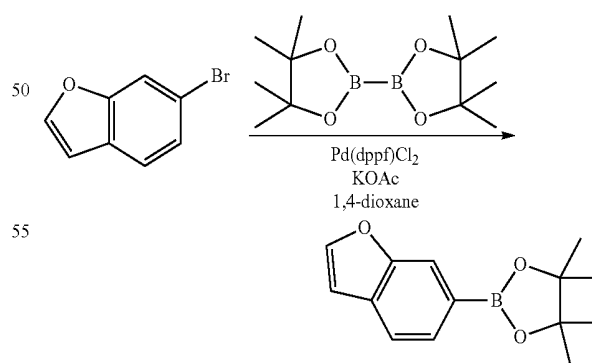
5-(2-nitrophenyl)benzofuran (10 g, 41.80 mmol) obtained in <Step 2>, triphenylphosphine (27.41 g, 104.50 mmol) and 1,2-dichlorobenzene (150 ml) were mixed under nitrogen flow, and the mixture was stirred for 12 hours.

After the reaction was completed, 1,2-dichlorobenzene was removed, and extraction was performed with dichloromethane. For the organic layer obtained, water was removed with MgSO₄, and purification was performed by column chromatography (Hexane:MC=3:1 (v/v)), thereby obtaining IC-46 (4.76 g, yield 55%).

¹H-NMR: δ 6.51 (d, 1H), 7.27 (d, 1H), 7.43 (d, 1H), 7.54 (d, 1H), 7.68 (t, 1H), 7.86 (t, 1H), 8.00 (d, 1H), 8.05 (t, 1H), 10.58 (s, 1H)

[Preparation Example 47] Synthesis of IC-47

<Step 1> Synthesis of 2-(benzofuran-6-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane

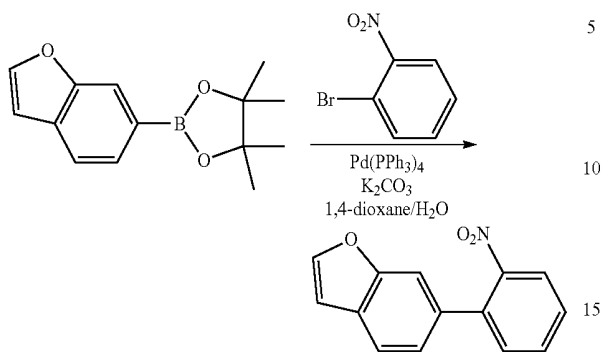


2-(benzofuran-6-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane was obtained by performing the same procedure as in <Step 1> of Preparation Example 46, except that 6-bromobenzofuran was used instead of 5-bromobenzofuran.

¹H-NMR: δ 1.25 (s, 12H), 6.46 (d, 1H), 7.28 (d, 1H), 7.43 (d, 1H), 7.53 (d, 1H), 7.98 (s, 1H)

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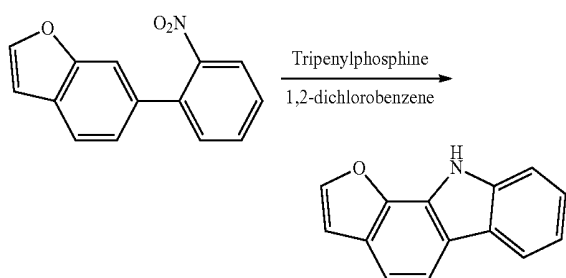
<Step 2> Synthesis of 6-(2-nitrophenyl)benzofuran



6-(2-nitrophenyl)benzofuran was obtained by performing the same procedure as in <Step 2> of Preparation Example 46, except that 2-(benzofuran-6-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane was used instead of 2-(benzofuran-5-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (23 g, 94.23 mmol).

¹H-NMR: δ 6.45 (d, 1H), 7.26 (d, 1H), 7.42 (d, 1H), 7.52 (d, 1H), 7.66 (t, 1H), 7.85 (t, 1H), 7.96 (s, 1H), 8.01 (d, 1H), 8.06 (t, 1H)

<Step 3> Synthesis of IC-47

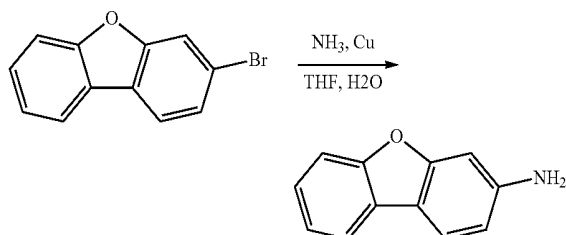


IC-47 was obtained by performing the same procedure as in <Step 3> of Preparation Example 46, except that 6-(2-nitrophenyl)benzofuran was used instead of 5-(2-nitrophenyl)benzofuran.

¹H-NMR: δ 6.51 (d, 1H), 7.27 (d, 1H), 7.43 (d, 1H), 7.54 (d, 1H), 7.68 (t, 1H), 7.86 (t, 1H), 8.00 (d, 1H), 8.05 (t, 1H), 10.58 (s, 1H)

[Preparation Example 48] Synthesis of IC-48

<Step 1> Synthesis of Dibenzo[b,d]furan-3-amine



After 3-bromodibenzo[b,d]furan (7.41 g, 30.0 mmol) was dissolved in 100 ml of THF under nitrogen flow, 28%

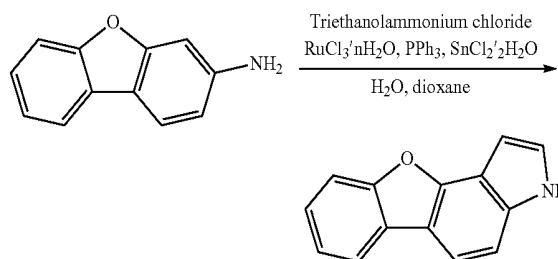
580

aqueous ammonia (10.2 ml, 150 mmol) and Cu (0.10 g, 5 mol %) were added to the solution, and the mixture was stirred at 110° C. for 12 hours. After the reaction was completed, extraction was performed with methylene chloride, MgSO₄ was added thereto, and the mixture was filtered.

After the solvent was removed from the filtered organic layer, purification was performed by column chromatography (Hexane:EA=10:1 (v/v)), thereby obtaining 4.45 g (yield: 81%) of dibenzo[b,d]furan-3-amine.

¹H-NMR: δ 5.32 (s, 2H), 6.33 (d, 1H), 7.34 (m, 2H), 7.43 (s, 1H), 7.65 (d, 2H), 7.89 (d, 1H)

<Step 2> Synthesis of IC-48

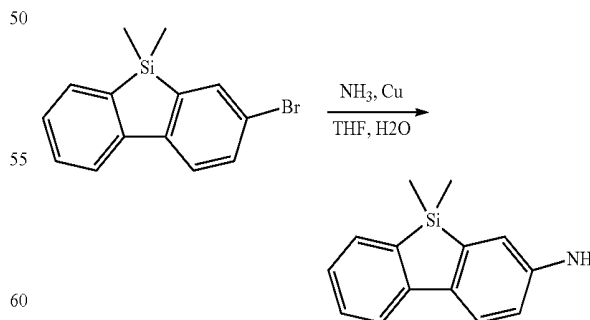


After dibenzo[b,d]furan-3-amine (4.45 g, 24.29 mmol) was dissolved in H₂O/dioxane (10 ml/90 ml) under nitrogen flow, triethanolammonium chloride (0.45 g, 2.43 mmol), (0.055 g, 0.2 mmol), PPh₃ (0.191 g, 0.7 mmol), and (0.548 g, 2.43 mmol) were added to the solution, and the resulting mixture was stirred at 180° C. for 20 hours. After the reaction was completed, the reactant was poured into aqueous 5% HCl, extraction was performed with methylene chloride, MgSO₄ was added thereto, and the mixture was filtered. After the solvent was removed from the filtered organic layer, purification was performed by column chromatography (Hexane:MC=1:1 (v/v)), thereby obtaining 2.7 g (yield: 53%) of IC-48.

¹H-NMR: δ 6.45 (d, 1H), 7.13 (d, 1H), 7.27 (d, 1H), 7.35 (m, 2H), 7.66 (d, 1H), 7.88 (d, 2H), 10.46 (s, 1H)

[Preparation Example 49] Synthesis of IC-49

<Step 1> Synthesis of 5,5-dimethyl-5H-dibenzo[b,d]silol-3-amine

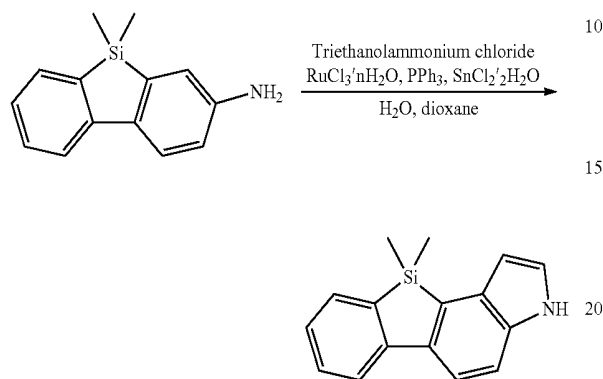


5,5-dimethyl-5H-dibenzo[b,d]silol-3-amine was obtained by performing the same procedure as in <Step 1> of Preparation Example 48, except that 3-bromo-5,5-dimethyl-5H-dibenzo[b,d]silole was used instead of 3-bromodibenzo[b,d]furan.

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$^1\text{H-NMR}$: δ 0.68 (s, 6H), 5.31 (s, 2H), 6.68 (d, 1H), 6.80 (s, 1H), 7.33 (t, 1H), 7.52 (d, 1H), 7.61 (t, 1H), 7.64 (d, 1H), 7.91 (d, 1H)

<Step 2> Synthesis of IC-49

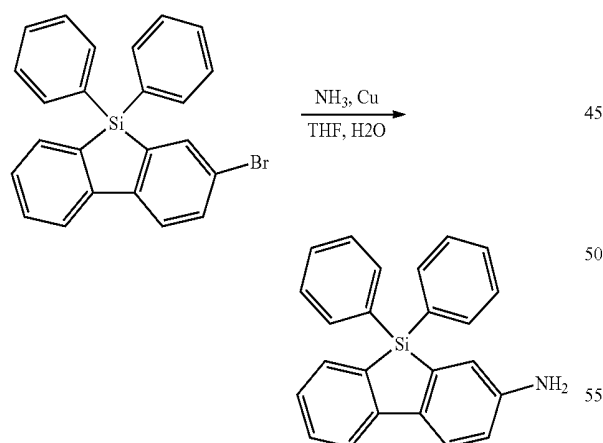


IC-49 was obtained by performing the same procedure as in <Step 2> of Preparation Example 48, except that 5,5-dimethyl-5H-dibenzo[b,d]silol-3-amine obtained in <Step 1> was used instead of dibenzo[b,d]furan-3-amine.

$^1\text{H-NMR}$: δ 0.66 (s, 6H), 6.45 (d, 1H), 7.27 (d, 1H), 7.33 (t, 1H), 7.52 (d, 1H), 7.61 (t, 1H), 7.79 (d, 1H), 7.89 (d, 1H), 7.97 (d, 1H), 10.42 (s, 1H)

[Preparation Example 50] Synthesis of IC-50

<Step 1> Synthesis of 5,5-diphenyl-5H-dibenzo[b,d]silol-3-amine

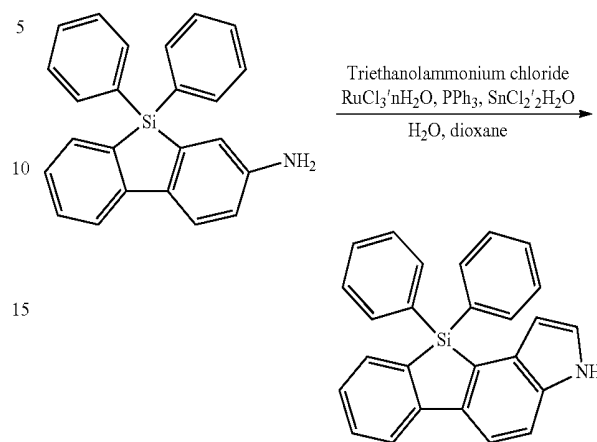


5,5-diphenyl-5H-dibenzo[b,d]silol-3-amine was obtained by performing the same procedure as in <Step 1> of Preparation Example 48, except that 3-bromo-5,5-diphenyl-5H-dibenzo[b,d]silole was used instead of 3-bromodibenzo[b,d]furan.

$^1\text{H-NMR}$: δ 5.33 (s, 2H), 6.67 (d, 1H), 6.81 (s, 1H), 7.31 (t, 1H), 7.37 (m, 4H), 7.46 (m, 4H), 7.54 (m, 3H), 7.62 (t, 1H), 7.66 (d, 1H), 7.92 (d, 1H)

582

<Step 2> Synthesis of IC-50

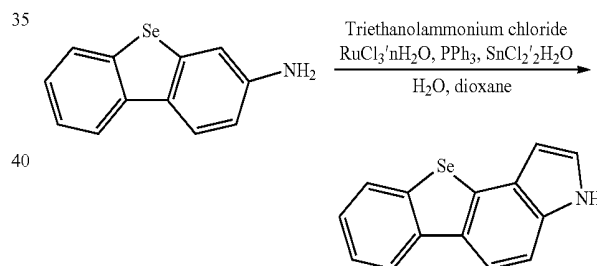


IC-50 was obtained by performing the same procedure as in <Step 2> of Preparation Example 48, except that 5,5-diphenyl-5H-dibenzo[b,d]silol-3-amine obtained in <Step 1> was used instead of dibenzo[b,d]furan-3-amine.

$^1\text{H-NMR}$: δ 6.44 (d, 1H), 7.26 (d, 1H), 7.35 (m, 5H), 7.47 (m, 4H), 7.53 (m, 3H), 7.62 (t, 1H), 7.78 (d, 1H), 7.90 (d, 1H), 7.96 (d, 1H), 10.41 (s, 1H)

[Preparation Example 51] Synthesis of IC-51

<Step 1> Synthesis of IC-51

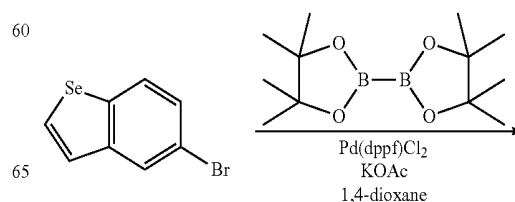


IC-51 was obtained by performing the same procedure as in <Step 2> of Preparation Example 48, except that dibenzo[b,d]selenophen-3-amine was used instead of dibenzo[b,d]furan-3-amine.

$^1\text{H-NMR}$: δ 6.47 (d, 1H), 7.15 (d, 1H), 7.26 (d, 1H), 7.36 (m, 2H), 7.67 (d, 1H), 7.89 (d, 2H), 10.45 (s, 1H)

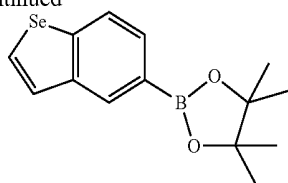
[Preparation Example 52] Synthesis of IC-52

<Step 1> Synthesis of 2-(benzo[b]selenophen-5-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane



583

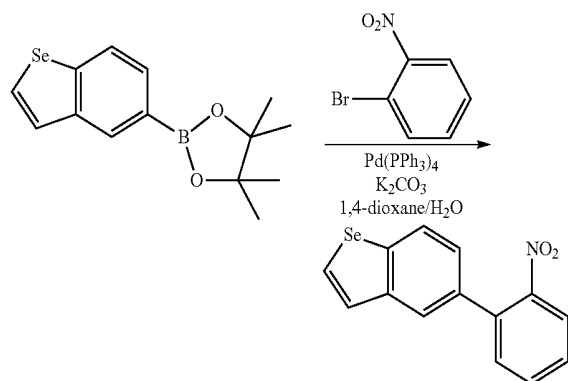
-continued



2-(benzo[b]selenophen-5-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane was obtained by performing the same procedure as in <Step 1> of Preparation Example 46, except that 5-bromobenzo[b]selenophene was used instead of 5-bromobenzofuran.

$^1\text{H-NMR}$: δ 1.26 (s, 12H), 6.45 (d, 1H), 7.27 (d, 1H), 7.43 (d, 1H), 7.54 (d, 1H), 8.00 (s, 1H)

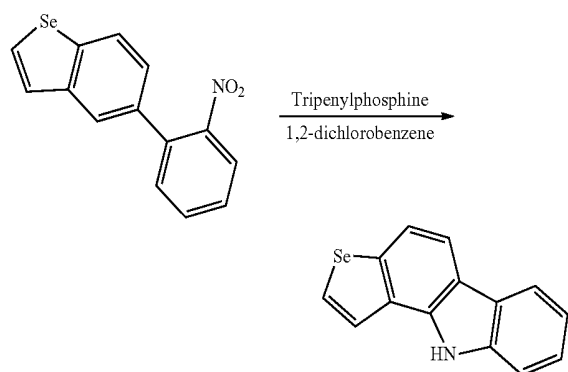
<Step 2> Synthesis of 5-(2-nitrophenyl)benzo[b]selenophene



5-(2-nitrophenyl)benzo[b]selenophene was obtained by performing the same procedure as in <Step 2> of Preparation Example 46, except that 2-(benzo[b]selenophen-5-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane was used instead of 2-(benzofuran-5-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane.

$^1\text{H-NMR}$: δ 6.44 (d, 1H), 7.27 (d, 1H), 7.43 (d, 1H), 7.51 (d, 1H), 7.65 (t, 1H), 7.84 (t, 1H), 7.94 (s, 1H), 8.00 (d, 1H), 8.05 (t, 1H)

<Step 3> Synthesis of IC-52



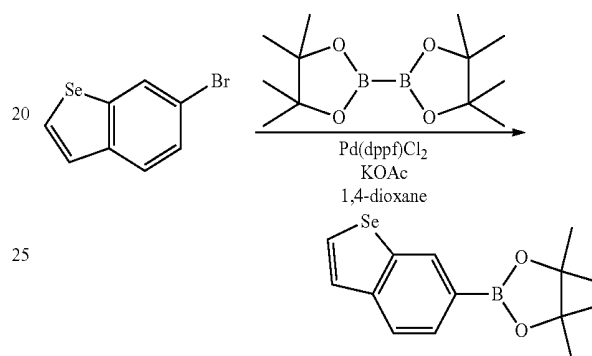
584

IC-52 was obtained by performing the same procedure as in <Step 3> of Preparation Example 46, except that 5-(2-nitrophenyl)benzo[b]selenophene was used instead of 5-(2-nitrophenyl)benzofuran.

$^1\text{H-NMR}$: δ 6.52 (d, 1H), 7.26 (d, 1H), 7.44 (d, 1H), 7.55 (d, 1H), 7.69 (t, 1H), 7.85 (t, 1H), 7.96 (d, 1H), 8.03 (t, 1H), 10.56 (s, 1H)

[Preparation Example 53] Synthesis of IC-53

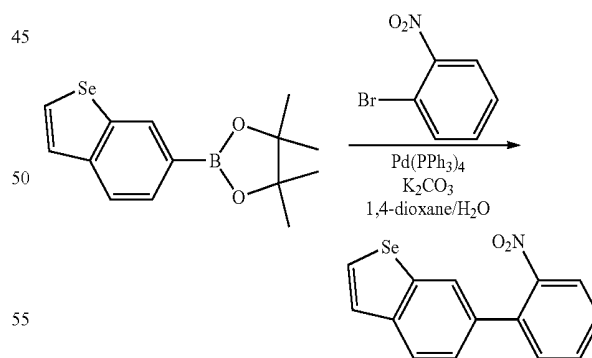
<Step 1> Synthesis of 2-(benzo[b]selenophen-6-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane



2-(benzo[b]selenophen-6-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane was obtained by performing the same procedure as in <Step 1> of Preparation Example 46, except that 6-bromobenzo[b]selenophene was used instead of 5-bromobenzofuran.

$^1\text{H-NMR}$: δ 1.24 (s, 12H), 6.45 (d, 1H), 7.28 (d, 1H), 7.44 (d, 1H), 7.57 (d, 1H), 7.96 (s, 1H)

<Step 2> Synthesis of 6-(2-nitrophenyl)benzo[b]selenophene

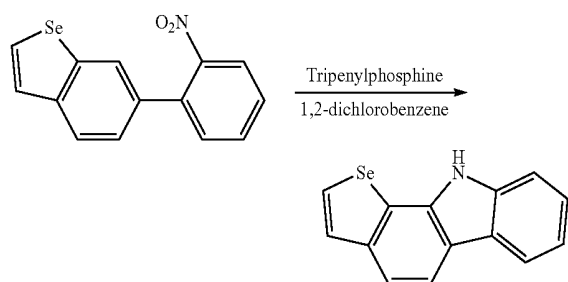


6-(2-nitrophenyl)benzo[b]selenophene was obtained by performing the same procedure as in <Step 2> of Preparation Example 46, except that 2-(benzo[b]selenophen-6-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane was used instead of 2-(benzofuran-5-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane.

$^1\text{H-NMR}$: δ 6.46 (d, 1H), 7.26 (d, 1H), 7.43 (d, 1H), 7.54 (d, 1H), 7.67 (t, 1H), 7.86 (t, 1H), 7.93 (s, 1H), 8.02 (d, 1H), 8.08 (t, 1H)

585

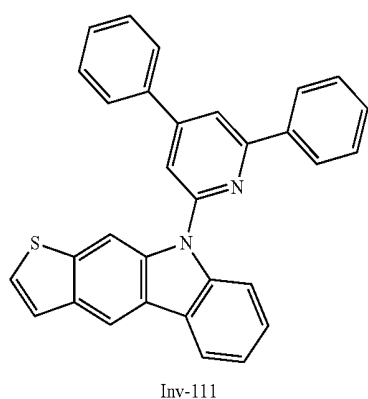
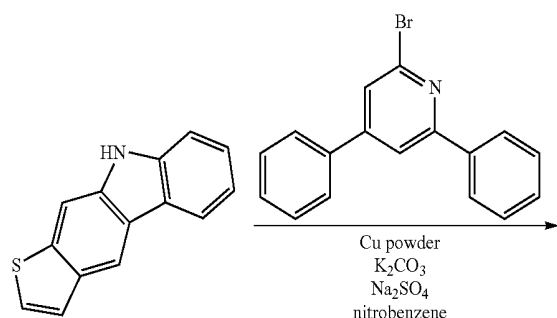
<Step 3> Synthesis of IC-53



IC-53 was obtained by performing the same procedure as in <Step 3> of Preparation Example 46, except that 6-(2-nitrophenyl)benzo[b]selenophene was used instead of 5-(2-nitrophenyl)benzofuran.

$^1\text{H-NMR}$: δ 6.52 (d, 1H), 7.27 (d, 1H), 7.43 (d, 1H), 7.52 (d, 1H), 7.67 (t, 1H), 7.85 (t, 1H), 8.01 (d, 1H), 8.09 (t, 1H), 10.55 (s, 1H)

[Synthesis Example 111] Synthesis of Inv-111

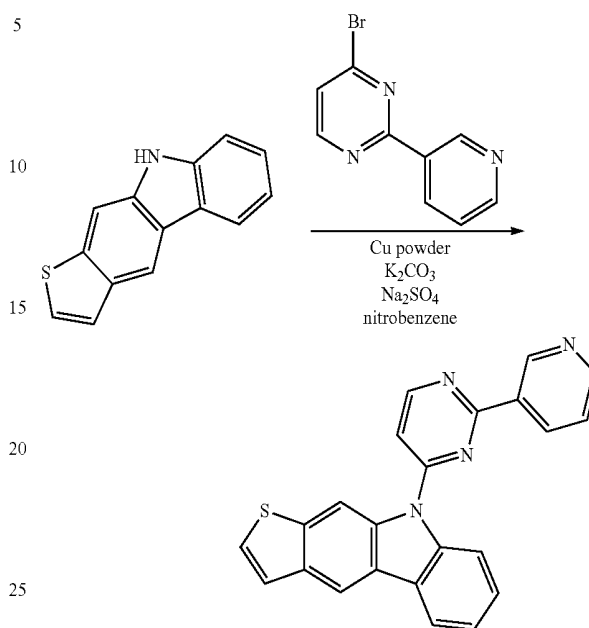


A target compound Inv-111 (3.89 g, yield 64%) was obtained by performing the same procedure as Synthesis Example 1, except that IC-32a prepared in Preparation Example 32 was used instead of IC-1a, and 2-bromo-4,6-diphenylpyridine was used instead of 2-bromo-4,6-diphenylpyridine.

GC-Mass (theoretical value: 452.13 g/mol, measured value: 452 g/mol)

586

[Synthesis Example 112] Synthesis of Inv-112

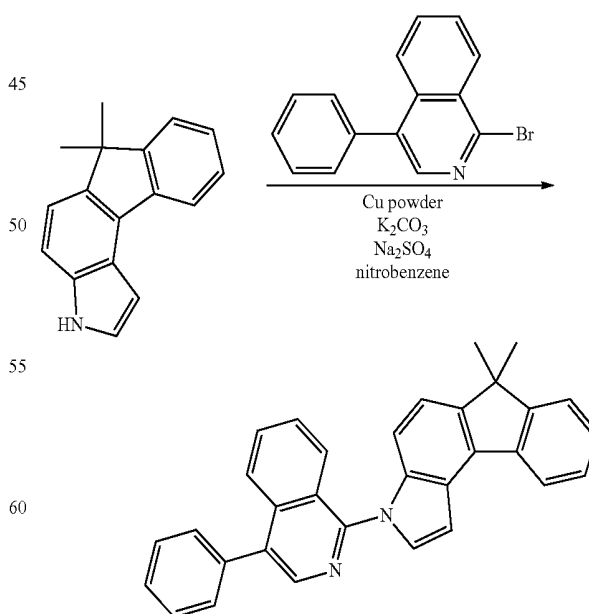


Inv-112

A target compound Inv-112 (3 g, yield 59%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-32a prepared in Preparation Example 32 was used instead of IC-1a, and 4-bromo-2-(pyridin-3-yl)pyrimidine was used instead of 2-bromo-4,6-diphenyl pyridine.

GC-Mass (theoretical value: 378.09 g/mol, measured value: 378 g/mol)

[Synthesis Example 113] Synthesis of Inv-113



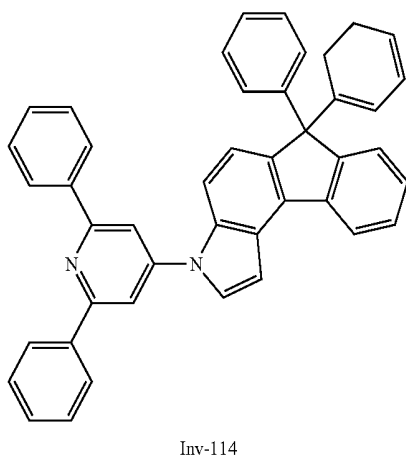
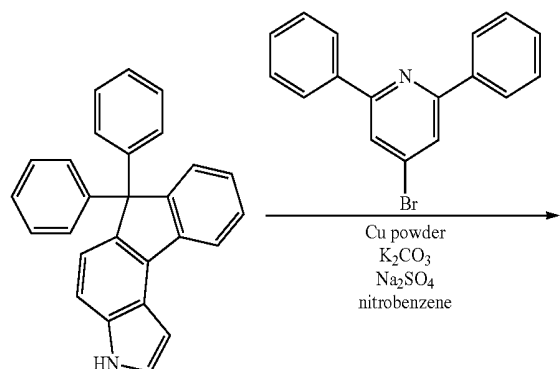
Inv-113

587

A target compound Inv-113 (3.26 g, yield 58%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-33 prepared in Preparation Example 33 was used instead of IC-1a, and 1-bromo-4-phenylisoquinoline was used instead of 2-bromo-4,6-diphenylpyridine.

GC-Mass (theoretical value: 436.19 g/mol, measured value: 436 g/mol)

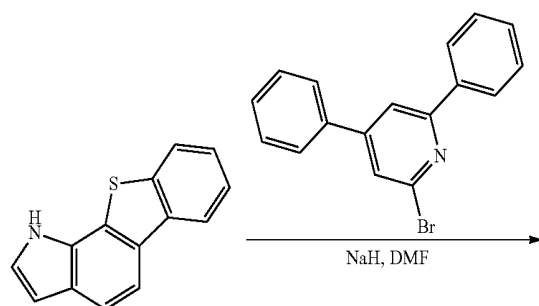
[Synthesis Example 114] Synthesis of Inv-114



A target compound Inv-114 (3.11 g, yield 63%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-34 prepared in Preparation Example 34 was used instead of IC-1a, and 4-bromo-2,6-diphenylpyridine was used instead of 2-bromo-4,6-diphenylpyridine.

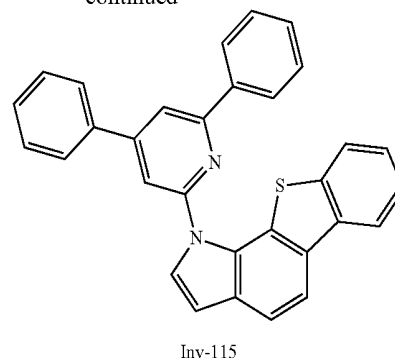
GC-Mass (theoretical value: 586.24 g/mol, measured value: 586 g/mol)

[Synthesis Example 115] Synthesis of Inv-115



588

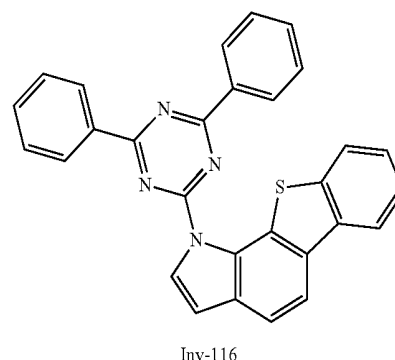
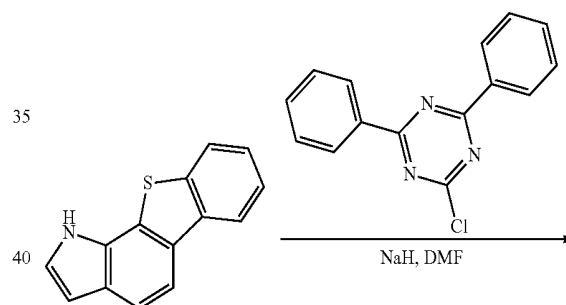
-continued



IC-35 (2.23 g, 10.0 mmol), 2-bromo-4,6-diphenylpyridine (3.72 g, 12.0 mmol), NaH (0.29 g, 12.0 mmol) and DMF (30 ml) were mixed under nitrogen flow, and the mixture was stirred at normal temperature for 3 hours. After the reaction was completed, water was added thereto, the solid compound was filtered, and purification was performed by column chromatography, thereby obtaining a target compound Inv-115 (3.85 g, yield: 85%).

GC-Mass (theoretical value: 452.57 g/mol, measured value: 452 g/mol)

[Synthesis Example 116] Synthesis of Inv-116



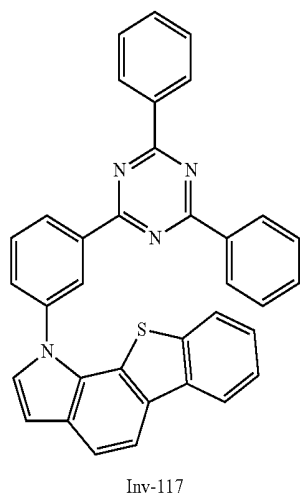
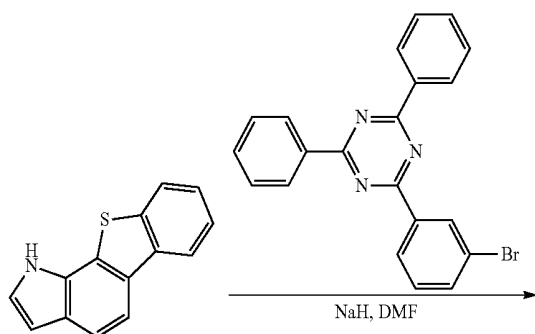
IC-35 (2.23 g, 10.0 mmol), 2-chloro-4,6-diphenyl-1,3,5-triazine (3.21 g, 12.0 mmol), NaH (0.29 g, 12.0 mmol) and DMF (30 ml) were mixed under nitrogen flow, and the mixture was stirred at normal temperature for 3 hours. After the reaction was completed, water was added thereto, the solid compound was filtered, and purification was performed by column chromatography, thereby obtaining a target compound

Inv-116 (3.95 g, yield: 87%).

GC-Mass (theoretical value: 454.55 g/mol, measured value: 454 g/mol)

589

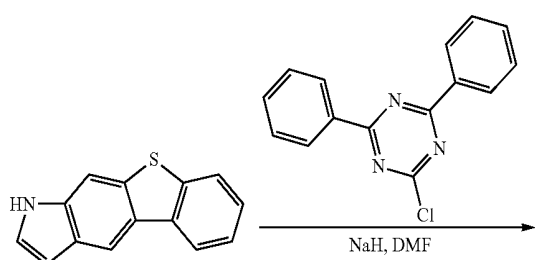
[Synthesis Example 117] Synthesis of Inv-117



IC-35 (2.23 g, 10.0 mmol), 2-(3-bromophenyl)-4,6-diphenyl-1,3,5-triazine (4.66 g, 12.0 mmol), NaH (0.29 g, 12.0 mmol) and DMF (30 ml) were mixed under nitrogen flow, and the mixture was stirred at normal temperature for 3 hours. After the reaction was completed, water was added thereto, the solid compound was filtered, and purification was performed by column chromatography, thereby obtaining a target compound Inv-117 (3.40 g, yield: 64%).

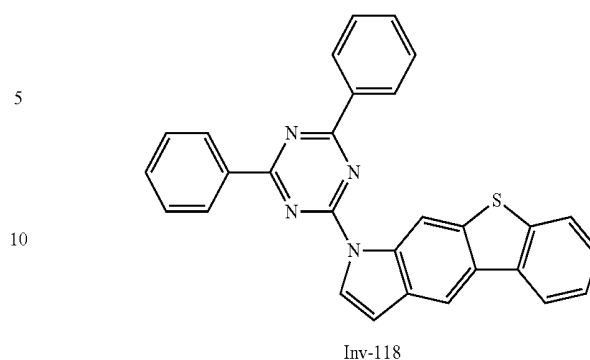
GC-Mass (theoretical value: 530.64 g/mol, measured value: 530 g/mol)

[Synthesis Example 118] Synthesis of Inv-118



590

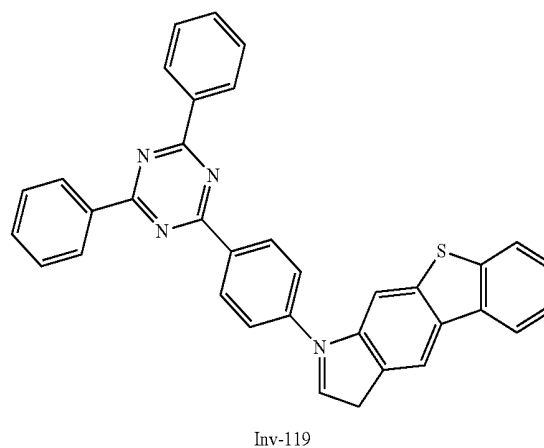
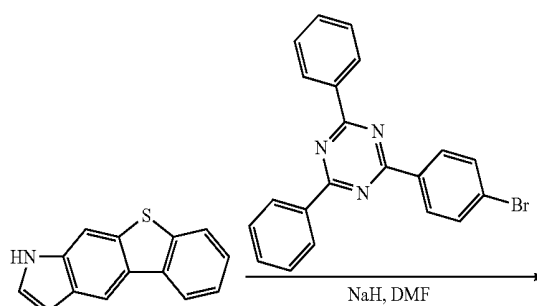
-continued



Inv-118 (3.95 g, yield: 87%) was obtained by performing the same procedure as in Synthesis Example 116, except that IC-36 (2.23 g, 10.0 mmol) was used instead of IC-35.

GC-Mass (theoretical value: 454.55 g/mol, measured value: 454 g/mol)

[Synthesis Example 119] Synthesis of Inv-119

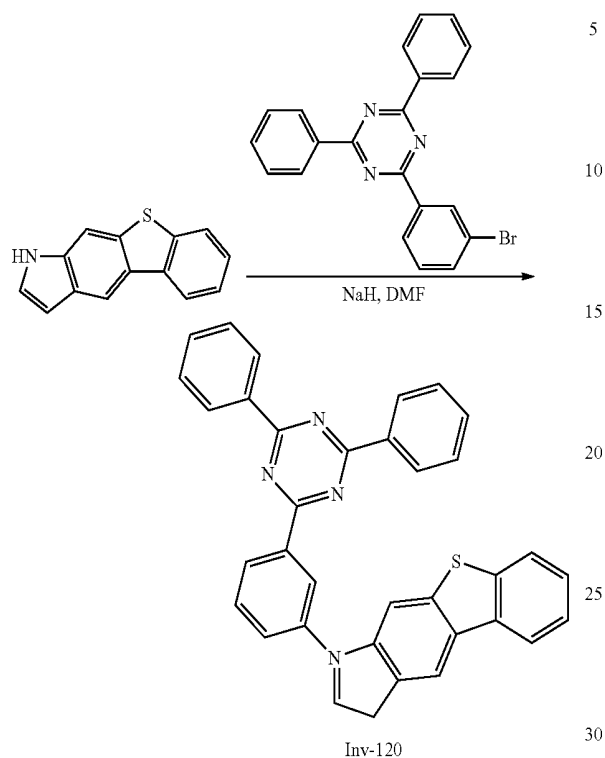


IC-36 (2.23 g, 10.0 mmol), 2-(4-bromophenyl)-4,6-diphenyl-1,3,5-triazine (4.66 g, 12.0 mmol), NaH (0.29 g, 12.0 mmol) and DMF (30 ml) were mixed under nitrogen flow, and the mixture was stirred at normal temperature for 3 hours. After the reaction was completed, water was added thereto, the solid compound was filtered, and purification was performed by column chromatography, thereby obtaining a target compound Inv-119 (3.61 g, yield: 68%).

GC-Mass (theoretical value: 530.64 g/mol, measured value: 530 g/mol)

591

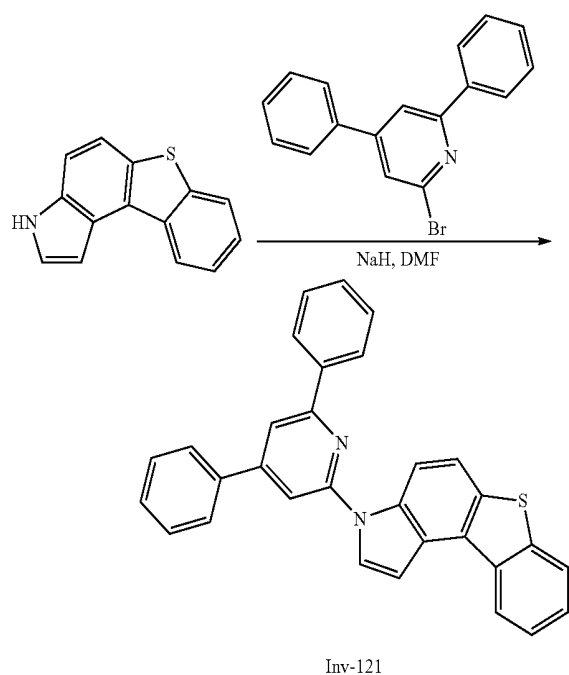
[Synthesis Example 120] Synthesis of Inv-120



Inv-120 (3.50 g, yield: 66%) was obtained by performing the same procedure as in Synthesis Example 117, except that IC-36 (2.23 g, 10.0 mmol) was used instead of IC-35.

GC-Mass (theoretical value: 530.64 g/mol, measured value: 530 g/mol)

[Synthesis Example 121] Synthesis of Inv-121

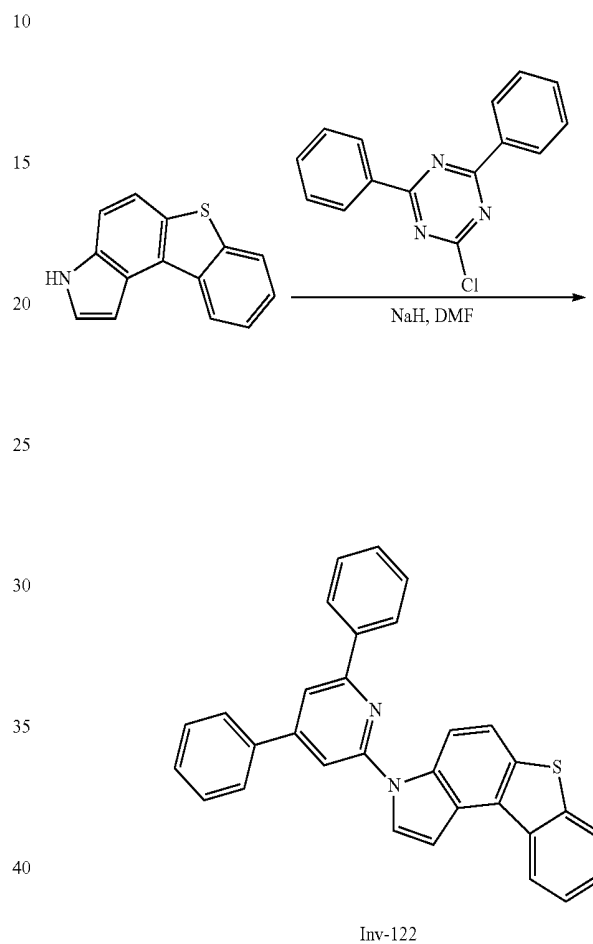


592

Inv-121 (3.67 g, yield: 81%) was obtained by performing the same procedure as in Synthesis Example 115, except that IC-37 (2.23 g, 10.0 mmol) was used instead of IC-35.

GC-Mass (theoretical value: 452.57 g/mol, measured value: 452 g/mol)

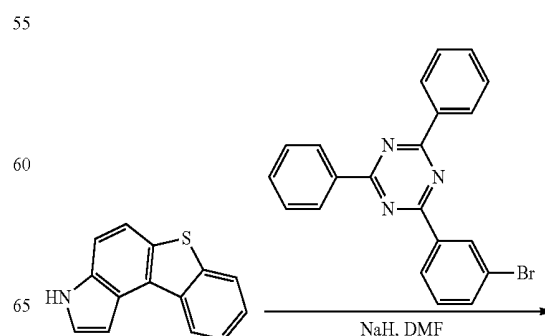
[Synthesis Example 122] Synthesis of Inv-122



Inv-122 (3.73 g, yield: 82%) was obtained by performing the same procedure as in Synthesis Example 116, except that IC-37 (2.23 g, 10.0 mmol) was used instead of IC-35.

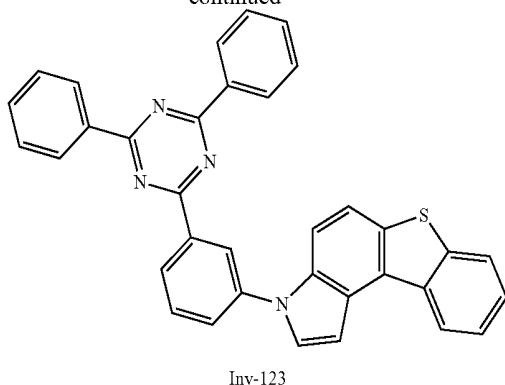
GC-Mass (theoretical value: 454.55 g/mol, measured value: 454 g/mol)

[Synthesis Example 123] Synthesis of Inv-123



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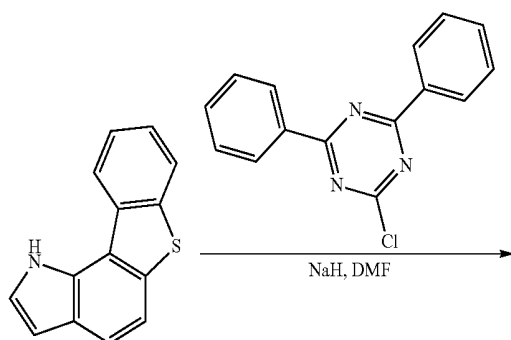
-continued



Inv-123 (3.66 g, yield: 69%) was obtained by performing the same procedure as in Synthesis Example 117, except that IC-37 (2.23 g, 10.0 mmol) was used instead of IC-35.

GC-Mass (theoretical value: 530.64 g/mol, measured value: 530 g/mol)

[Synthesis Example 124] Synthesis of Inv-124

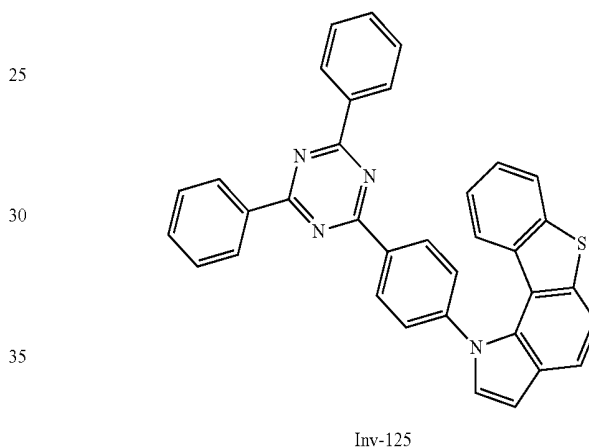
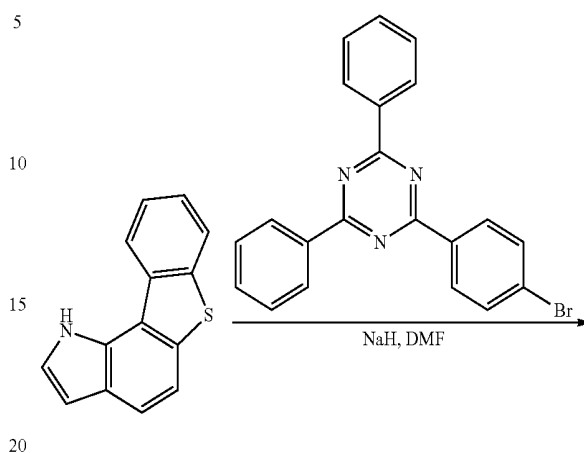


Inv-124 (3.91 g, yield: 86%) was obtained by performing the same procedure as in Synthesis Example 116, except that IC-38 (2.23 g, 10.0 mmol) was used instead of IC-35.

GC-Mass (theoretical value: 454.55 g/mol, measured value: 454 g/mol)

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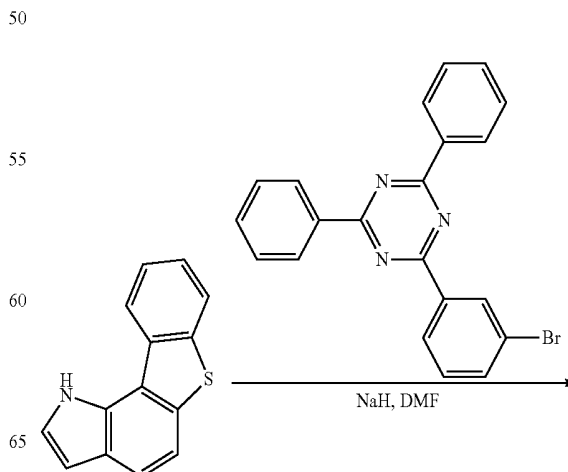
[Synthesis Example 125] Synthesis of Inv-125



Inv-125 (3.24 g, yield: 61%) was obtained by performing the same procedure as in Synthesis Example 119, except that IC-38 (2.23 g, 10.0 mmol) was used instead of IC-36.

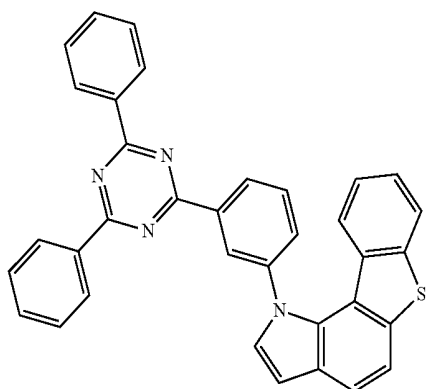
GC-Mass (theoretical value: 530.64 g/mol, measured value: 530 g/mol)

[Synthesis Example 126] Synthesis of Inv-126



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-continued

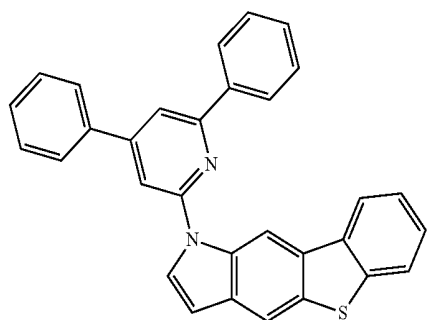
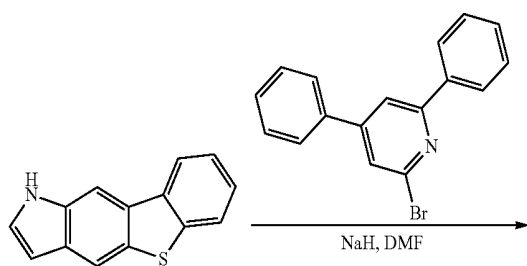


Inv-126

Inv-126 (3.50 g, yield: 66%) was obtained by performing the same procedure as in Synthesis Example 117, except that IC-38 (2.23 g, 10.0 mmol) was used instead of IC-35.

GC-Mass (theoretical value: 530.64 g/mol, measured value: 530 g/mol)

[Synthesis Example 127] Synthesis of Inv-127



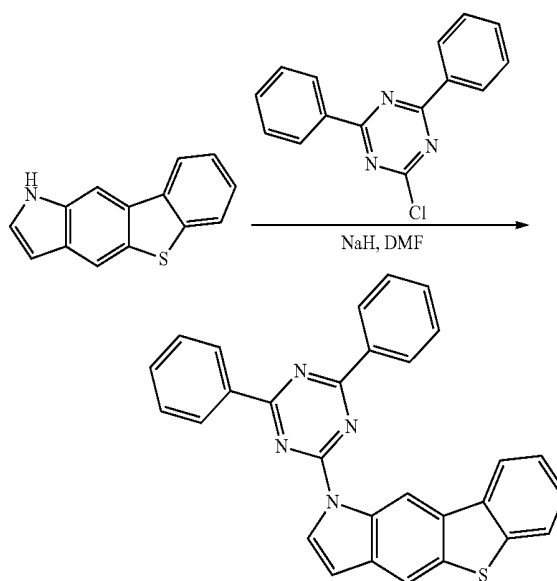
Inv-127

Inv-127 (3.94 g, yield: 87%) was obtained by performing the same procedure as in Synthesis Example 115, except that IC-39 (2.23 g, 10.0 mmol) was used instead of IC-35.

GC-Mass (theoretical value: 452.57 g/mol, measured value: 452 g/mol)

596

[Synthesis Example 128] Synthesis of Inv-128

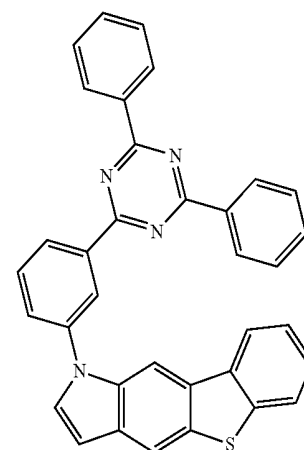
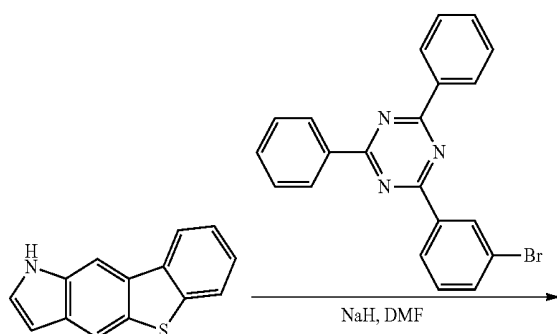


Inv-128

Inv-128 (3.64 g, yield: 80%) was obtained by performing the same procedure as in Synthesis Example 116, except that IC-39 (2.23 g, 10.0 mmol) was used instead of IC-35.

GC-Mass (theoretical value: 454.55 g/mol, measured value: 454 g/mol)

[Synthesis Example 129] Synthesis of Inv-129



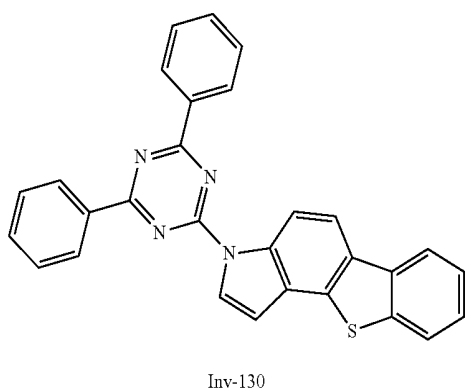
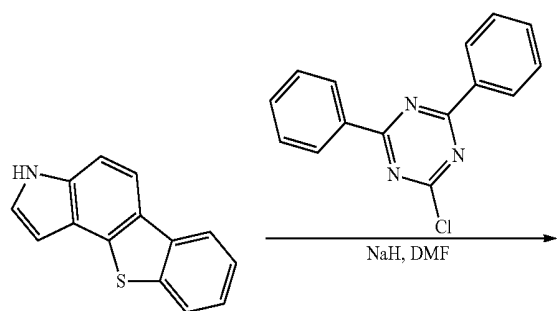
Inv-129

597

Inv-129 (2.44 g, yield: 46%) was obtained by performing the same procedure as in Synthesis Example 117, except that IC-39 (2.23 g, 10.0 mmol) was used instead of IC-35.

GC-Mass (theoretical value: 530.64 g/mol, measured value: 530 g/mol)

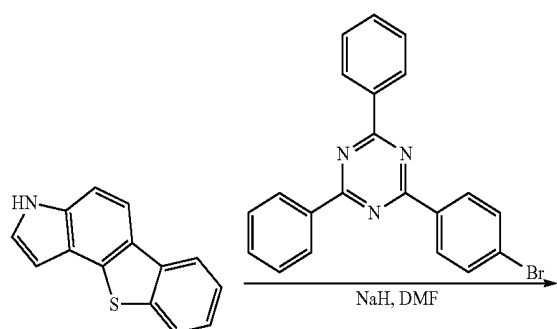
[Synthesis Example 130] Synthesis of Inv-130



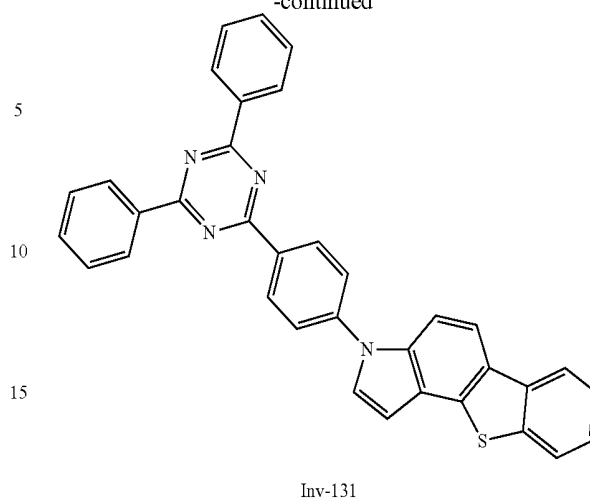
Inv-130 (4.05 g, yield: 89%) was obtained by performing the same procedure as in Synthesis Example 116, except that IC-40 (2.23 g, 10.0 mmol) was used instead of IC-35.

GC-Mass (theoretical value: 454.55 g/mol, measured value: 454 g/mol)

[Synthesis Example 131] Synthesis of Inv-131

**598**

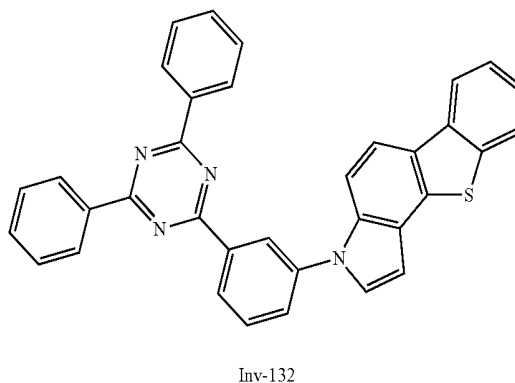
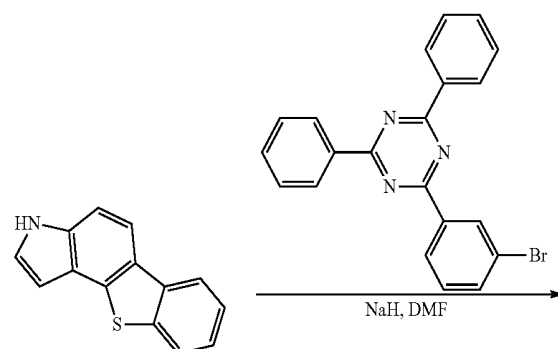
-continued



Inv-131 (2.92 g, yield: 55%) was obtained by performing the same procedure as in Synthesis Example 119, except that IC-40 (2.23 g, 10.0 mmol) was used instead of IC-36.

GC-Mass (theoretical value: 530.64 g/mol, measured value: 530 g/mol)

[Synthesis Example 132] Synthesis of Inv-132

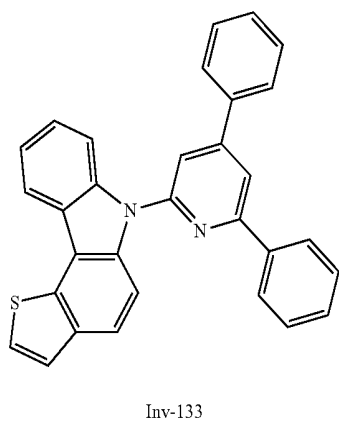
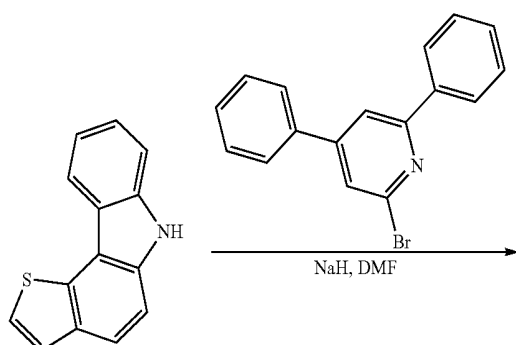


Inv-132 (3.34 g, yield: 63%) was obtained by performing the same procedure as in Synthesis Example 117, except that IC-40 (2.23 g, 10.0 mmol) was used instead of IC-35.

GC-Mass (theoretical value: 530.64 g/mol, measured value: 530 g/mol)

599

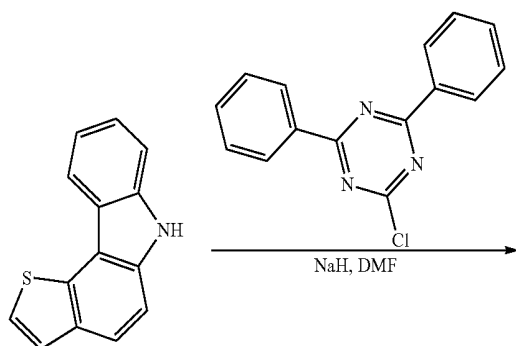
[Synthesis Example 133] Synthesis of Inv-133



Inv-133 (3.85 g, yield: 85%) was obtained by performing the same procedure as in Synthesis Example 115, except that IC-41 (2.23 g, 10.0 mmol) was used instead of IC-35.

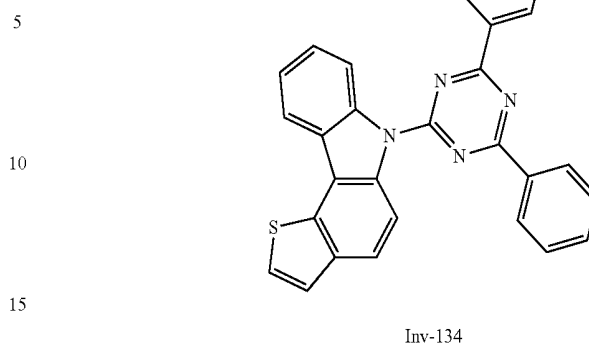
GC-Mass (theoretical value: 452.57 g/mol, measured value: 452 g/mol)

[Synthesis Example 134] Synthesis of Inv-134



600

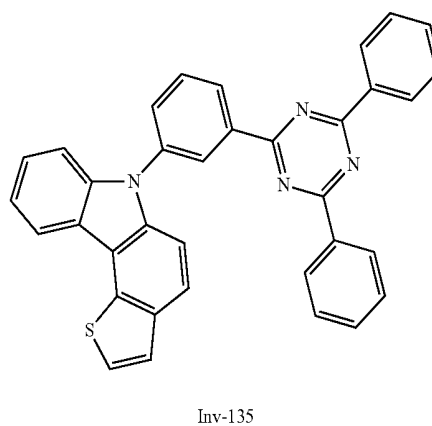
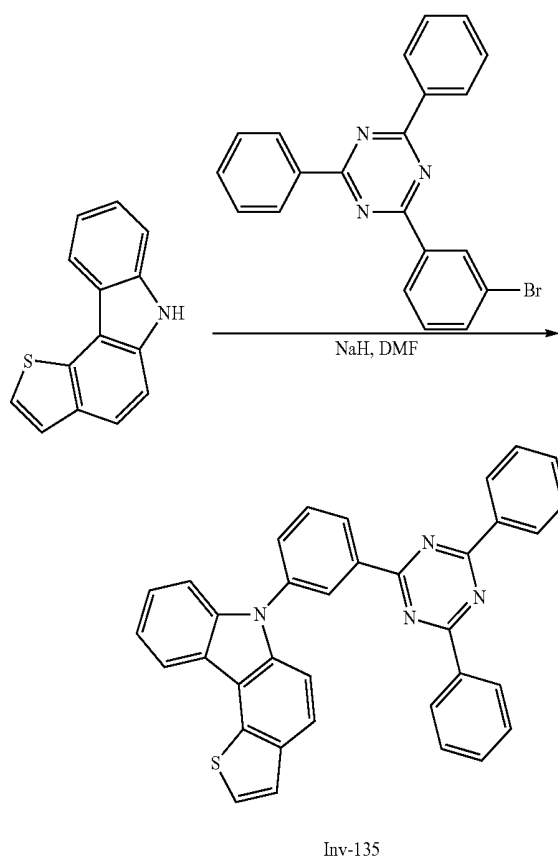
-continued



Inv-134 (3.95 g, yield: 87%) was obtained by performing the same procedure as in Synthesis Example 116, except that IC-41 (2.23 g, 10.0 mmol) was used instead of IC-35.

GC-Mass (theoretical value: 454.55 g/mol, measured value: 454 g/mol)

[Synthesis Example 135] Synthesis of Inv-135

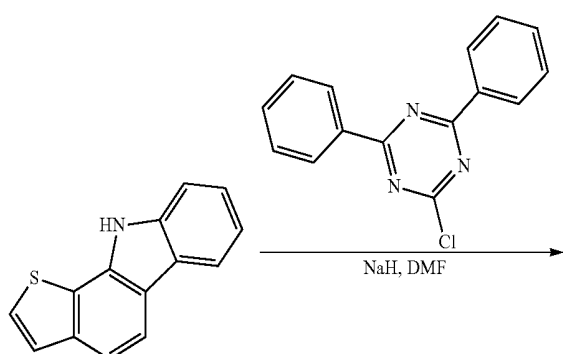


Inv-135 (3.50 g, yield: 66%) was obtained by performing the same procedure as in Synthesis Example 117, except that IC-41 (2.23 g, 10.0 mmol) was used instead of IC-35.

GC-Mass (theoretical value: 530.64 g/mol, measured value: 530 g/mol)

601

[Synthesis Example 136] Synthesis of Inv-136

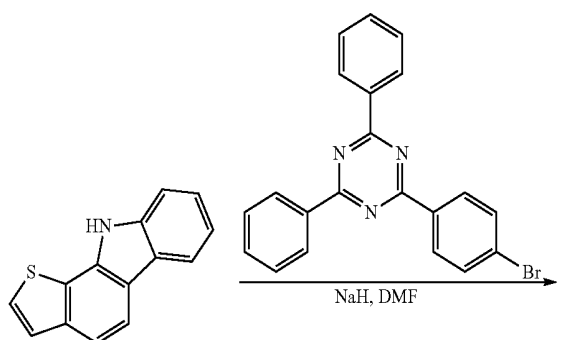


Inv-136

Inv-136 (4.09 g, yield: 90%) was obtained by performing the same procedure as in Synthesis Example 116, except that IC-42a (2.23 g, 10.0 mmol) was used instead of IC-35.

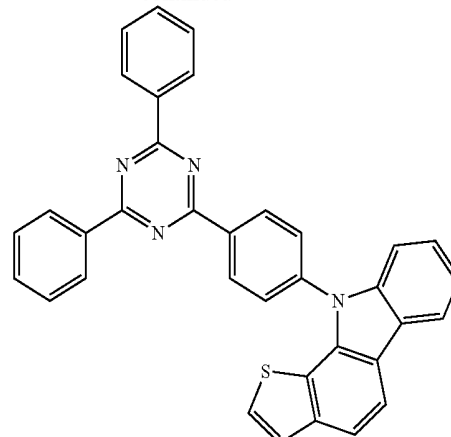
GC-Mass (theoretical value: 454.55 g/mol, measured value: 454 g/mol)

[Synthesis Example 137] Synthesis of Inv-137



602

-continued

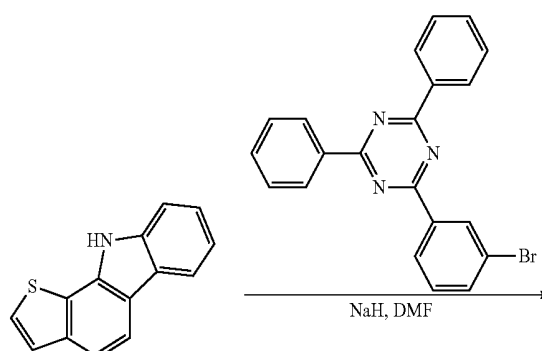


Inv. 137

Inv-137 (3.18 g, yield: 60%) was obtained by performing the same procedure as in Synthesis Example 119, except that IC-42a (2.23 g, 10.0 mmol) was used instead of IC-36.

GC-Mass (theoretical value: 530.64 g/mol, measured value: 530 g/mol)

[Synthesis Example 138] Synthesis of Inv-138



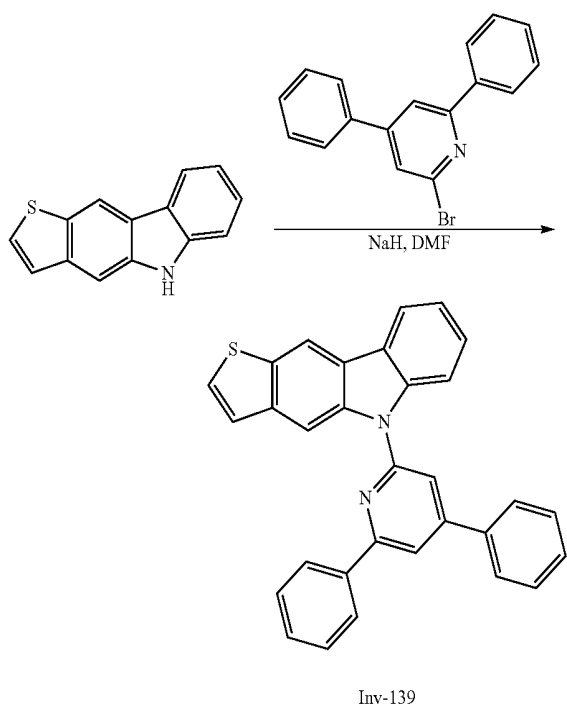
Inv-138

Inv-138 (2.97 g, yield: 56%) was obtained by performing the same procedure as in Synthesis Example 117, except that IC-42a (2.23 g, 10.0 mmol) was used instead of IC-35.

GC-Mass (theoretical value: 530.64 g/mol, measured value: 530 g/mol)

603

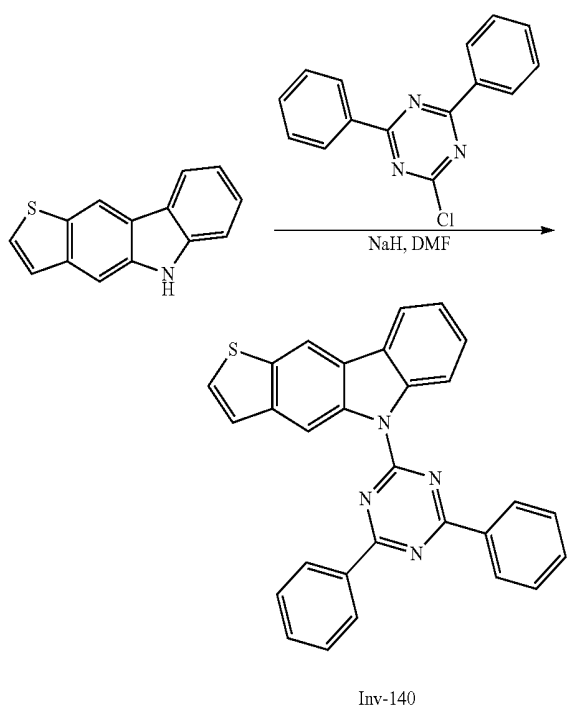
[Synthesis Example 139] Synthesis of Inv-139



Inv-139 (3.67 g, yield: 81%) was obtained by performing the same procedure as in Synthesis Example 115, except that IC-42b (2.23 g, 10.0 mmol) was used instead of IC-35.

GC-Mass (theoretical value: 452.57 g/mol, measured value: 452 g/mol)

[Synthesis Example 140] Synthesis of Inv-140

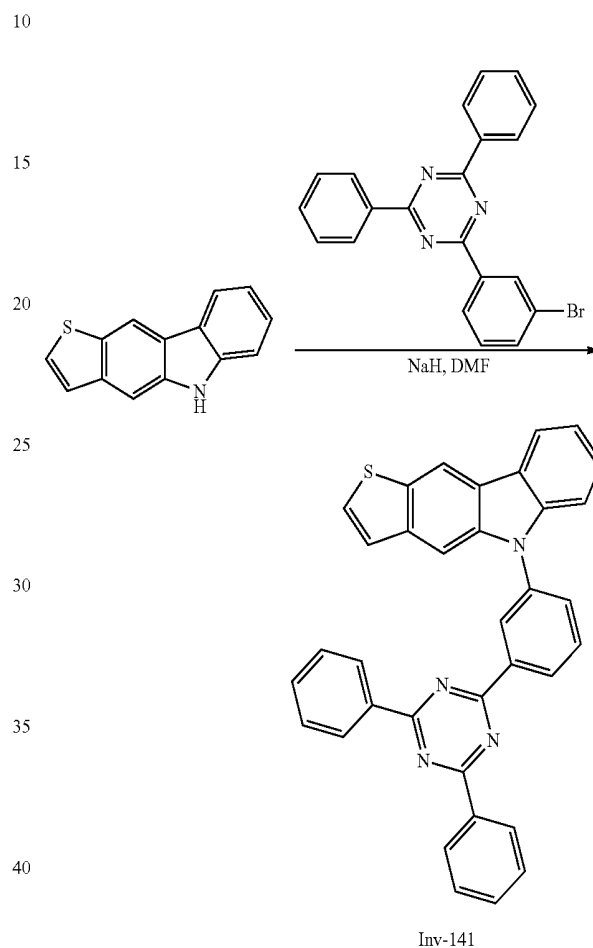


604

Inv-140 (3.95 g, yield: 87%) was obtained by performing the same procedure as in Synthesis Example 116, except that IC-42b (2.23 g, 10.0 mmol) was used instead of IC-35.

GC-Mass (theoretical value: 454.55 g/mol, measured value: 454 g/mol)

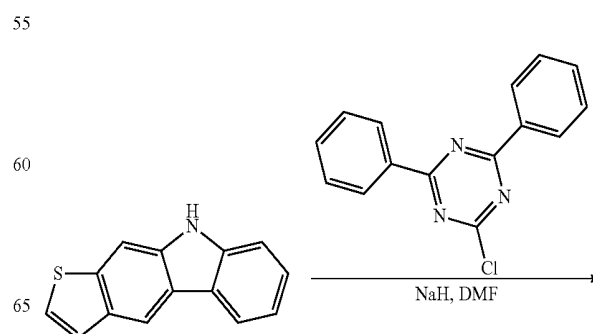
[Synthesis Example 141] Synthesis of Inv-141



Inv-141 (3.45 g, yield: 65%) was obtained by performing the same procedure as in Synthesis Example 117, except that IC-42b (2.23 g, 10.0 mmol) was used instead of IC-35.

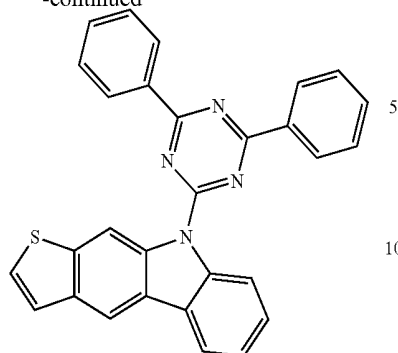
GC-Mass (theoretical value: 530.64 g/mol, measured value: 530 g/mol)

[Synthesis Example 142] Synthesis of Inv-142



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-continued

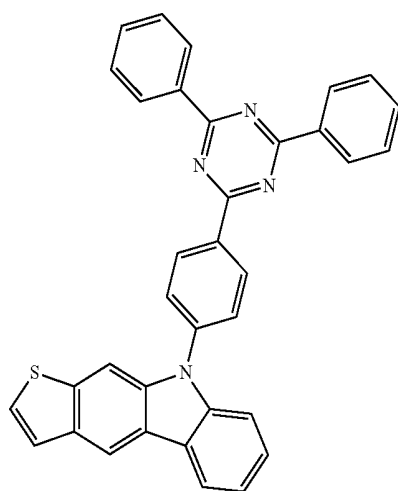
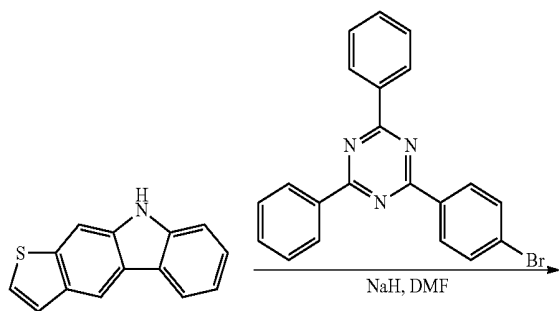


Inv-142

Inv-142 (3.77 g, yield: 83%) was obtained by performing the same procedure as in Synthesis Example 116, except that IC-32a (2.23 g, 10.0 mmol) was used instead of IC-35.

GC-Mass (theoretical value: 454.55 g/mol, measured value: 454 g/mol)

[Synthesis Example 143] Synthesis of Inv-143



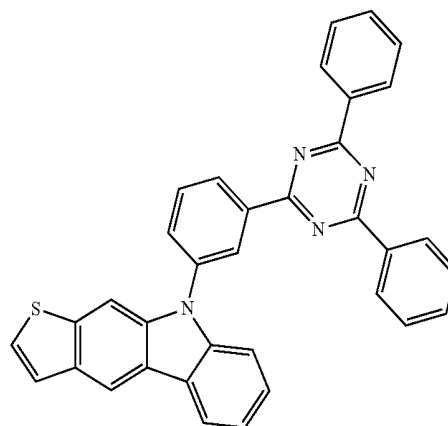
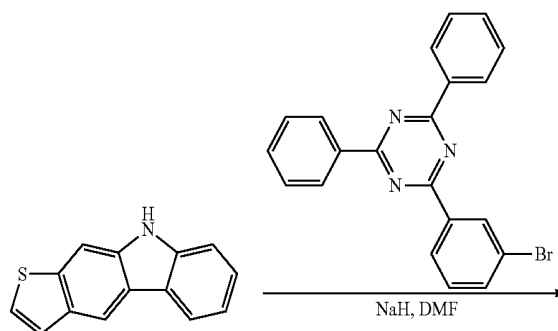
Inv-143

Inv-143 (3.45 g, yield: 65%) was obtained by performing the same procedure as in Synthesis Example 119, except that IC-32a (2.23 g, 10.0 mmol) was used instead of IC-36.

GC-Mass (theoretical value: 530.64 g/mol, measured value: 530 g/mol)

606

[Synthesis Example 144] Synthesis of Inv-144

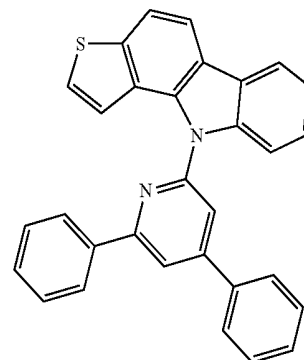
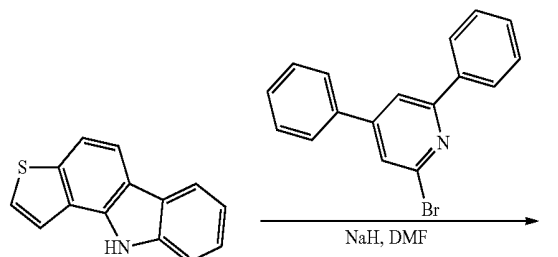


Inv-144

Inv-144 (3.77 g, yield: 71%) was obtained by performing the same procedure as in Synthesis Example 117, except that IC-32a (2.23 g, 10.0 mmol) was used instead of IC-35.

GC-Mass (theoretical value: 530.64 g/mol, measured value: 530 g/mol)

[Synthesis Example 145] Synthesis of Inv-145



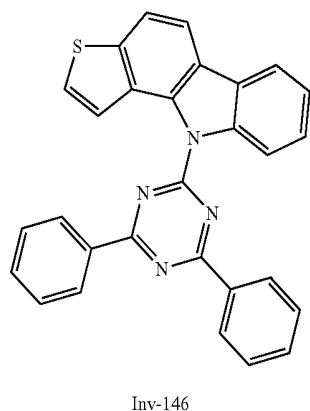
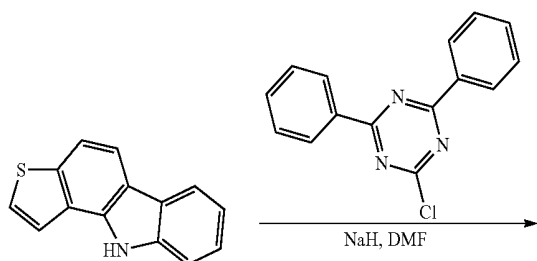
Inv-145

Inv-145 (3.76 g, yield: 83%) was obtained by performing the same procedure as in Synthesis Example 115, except that IC-32b (2.23 g, 10.0 mmol) was used instead of IC-35.

607

GC-Mass (theoretical value: 452.57 g/mol, measured value: 452 g/mol)

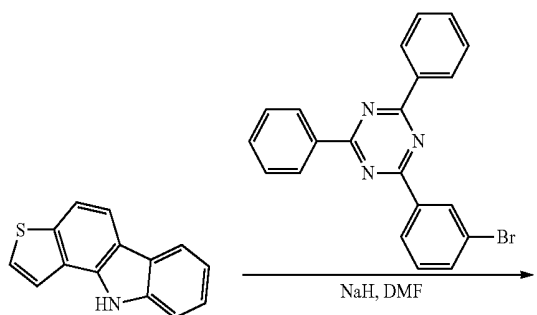
[Synthesis Example 146] Synthesis of Inv-146



Inv-146 (3.77 g, yield: 83%) was obtained by performing the same procedure as in Synthesis Example 116, except that IC-32b (2.23 g, 10.0 mmol) was used instead of IC-35.

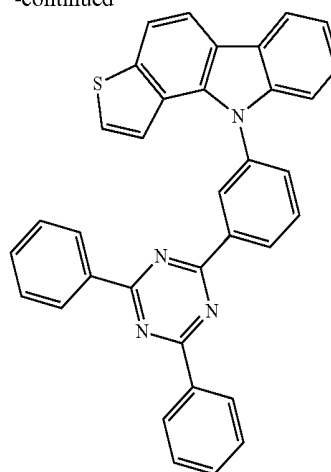
GC-Mass (theoretical value: 454.55 g/mol, measured value: 454 g/mol)

[Synthesis Example 147] Synthesis of Inv-147



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-continued

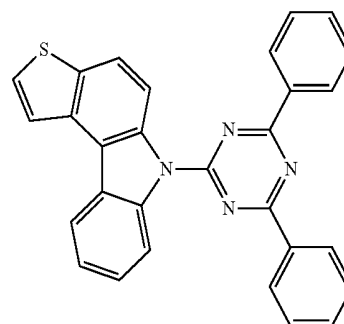
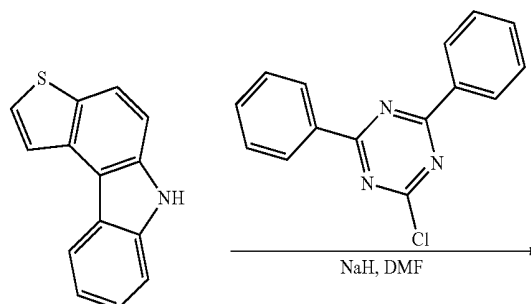


Inv-147

Inv-147 (3.77 g, yield: 71%) was obtained by performing the same procedure as in Synthesis Example 117, except that IC-32b (2.23 g, 10.0 mmol) was used instead of IC-35.

GC-Mass (theoretical value: 530.64 g/mol, measured value: 530 g/mol)

[Synthesis Example 148] Synthesis of Inv-148



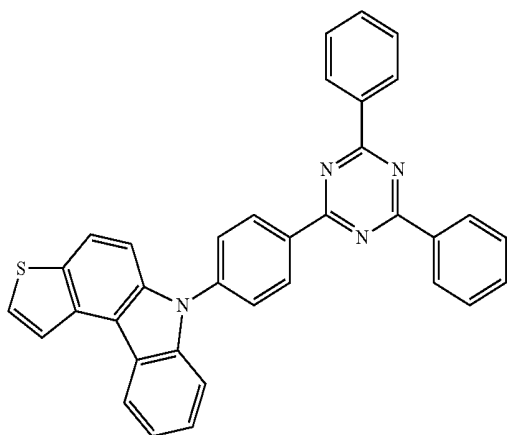
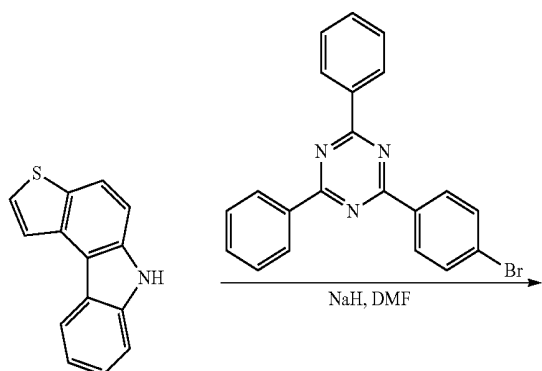
Inv-148

Inv-148 (3.50 g, yield: 77%) was obtained by performing the same procedure as in Synthesis Example 116, except that IC-43 (2.23 g, 10.0 mmol) was used instead of IC-35.

GC-Mass (theoretical value: 454.55 g/mol, measured value: 454 g/mol)

609

[Synthesis Example 149] Synthesis of Inv-149

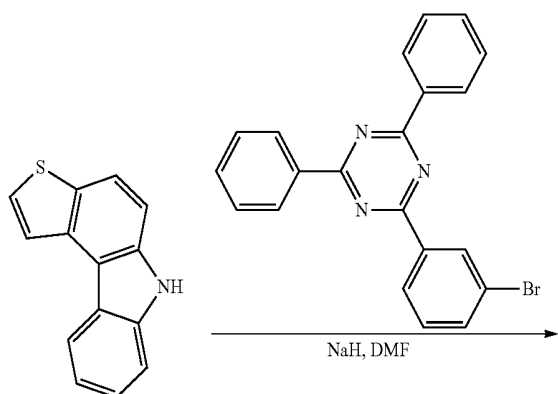


Inv-149

Inv-149 (3.08 g, yield: 58%) was obtained by performing the same procedure as in Synthesis Example 119, except that IC-43 (2.23 g, 10.0 mmol) was used instead of IC-36.

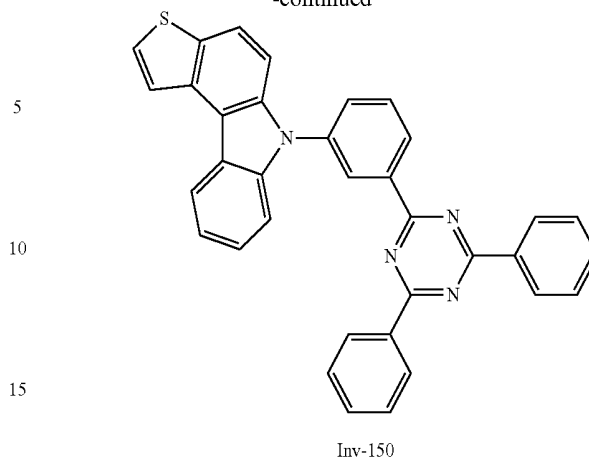
GC-Mass (theoretical value: 530.64 g/mol, measured value: 530 g/mol)

[Synthesis Example 150] Synthesis of Inv-150



610

-continued

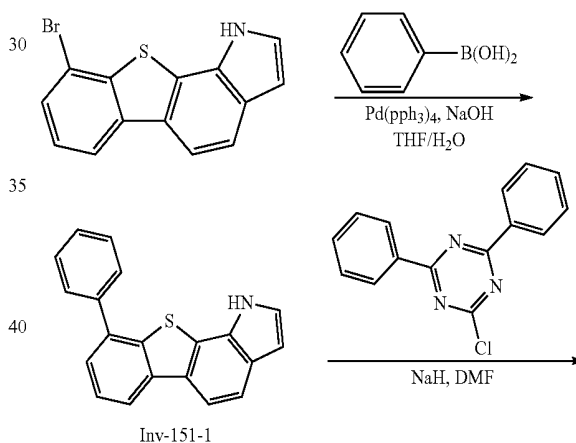


Inv-150

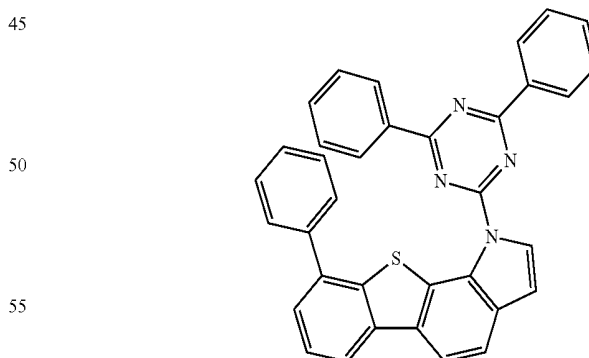
Inv-150 (4.14 g, yield: 78%) was obtained by performing the same procedure as in Synthesis Example 117, except that IC-43 (2.23 g, 10.0 mmol) was used instead of IC-35.

GC-Mass (theoretical value: 530.64 g/mol, measured value: 530 g/mol)

[Synthesis Example 151] Synthesis of Inv-151



Inv-151-1



Inv-151

2.42 g (8.0 mmol) of IC-44, 1.07 g (8.8 mmol) of phenylboronic acid, 0.96 g (24.0 mmol) of NaOH, and 40 ml/20 ml of THF/H₂O were mixed under nitrogen flow, and the mixture was stirred. 0.46 g (5 mol %) of Pd(PPh₃)₄ was added thereto at 40° C., and the resulting mixture was stirred at 80° C. for 12 hours. After the reaction was completed, extraction was performed with methylene chloride, MgSO₄

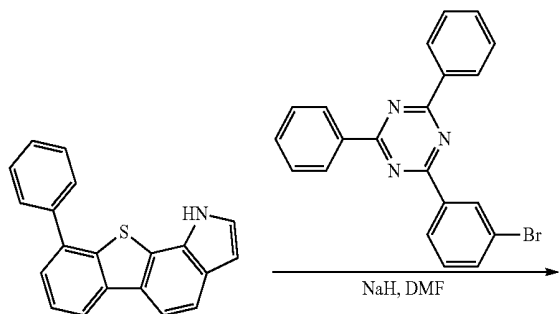
611

was added thereto, and the mixture was filtered. After the solvent was removed from the filtered organic layer, 2.06 g (yield: 86%) of the intermediate compound Inv-151-1 was obtained by using column chromatography.

The intermediate compound Inv-151-1 (2.06 g, 6.88 mmol), 2-chloro-4,6-diphenyl-1,3,5-triazine (2.21 g, 8.26 mmol), NaH (1.98 g, 8.26 mmol) and DMF (40 ml) were mixed under nitrogen flow, and the mixture was stirred at normal temperature for 3 hours. After the reaction was completed, water was added thereto, the solid compound was filtered, and purification was performed by column chromatography, thereby obtaining a target compound Inv-151 (3.10 g, yield: 85%).

GC-Mass (theoretical value: 530.64 g/mol, measured value: 530 g/mol)

[Synthesis Example 152] Synthesis of Inv-152

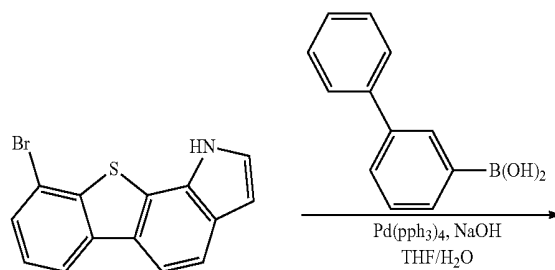


20

Inv-152 (4.14 g, yield: 78%) was obtained by performing the same procedure as in Synthesis Example 151, except that 2-(3-bromophenyl)-4,6-diphenyl-1,3,5-triazine (3.21 g, 8.26 mmol) was used instead of 2-chloro-4,6-diphenyl-1,3,5-triazine.

GC-Mass (theoretical value: 606.74 g/mol, measured value: 606 g/mol)

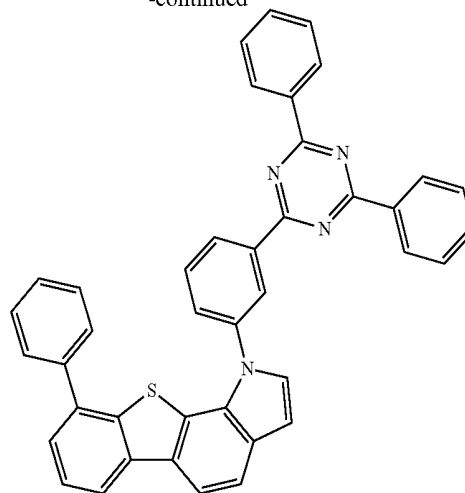
[Synthesis Example 153] Synthesis of Inv-153



Inv-153-1

612

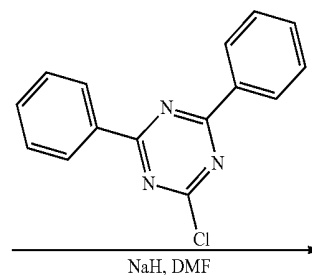
-continued



Inv-152

25

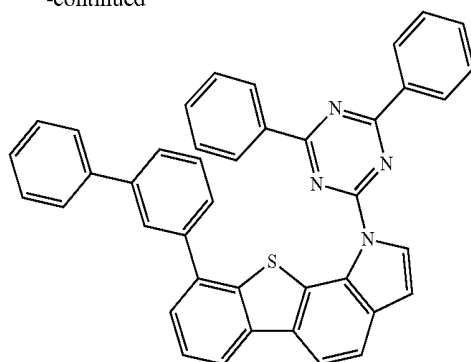
30



NaH, DMF

613

-continued



Inv-153

The intermediate compound Inv-153-1 (2.58 g, yield: 86%) was obtained by performing the same procedure as in Synthesis Example 151, except that biphenyl-3-ylboronic acid (1.74 g, 8.8 mmol) was used instead of phenylboronic acid.

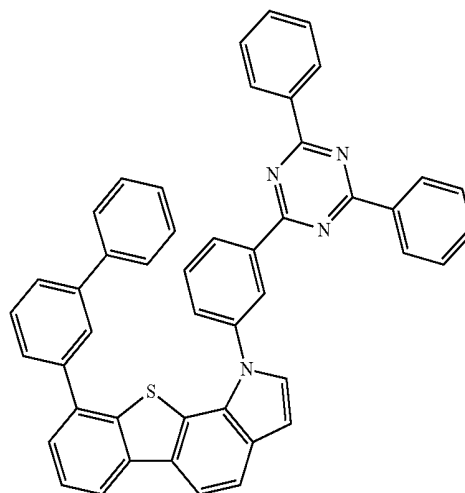
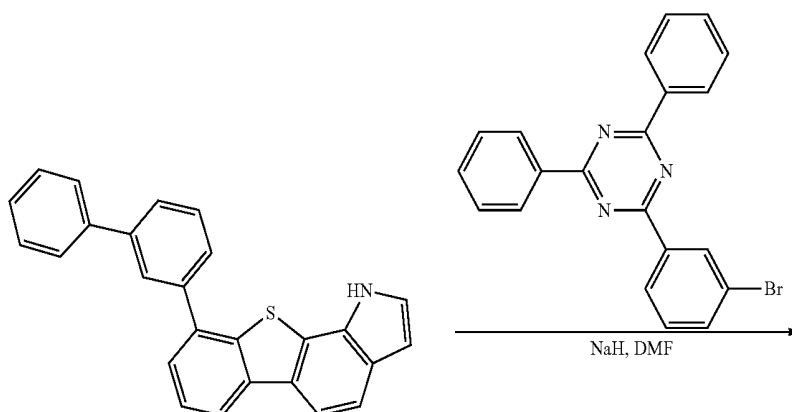
A target compound Inv-153 (3.34 g, yield: 80%) was obtained by performing the same procedure as in Synthesis

614

Example 151, except that Inv-153-1 (2.58 g, 6.88 mmol) was used instead of Inv-151-1.

GC-Mass (theoretical value: 606.74 g/mol, measured value: 606 g/mol)

[Synthesis Example 154] Synthesis of Inv-154



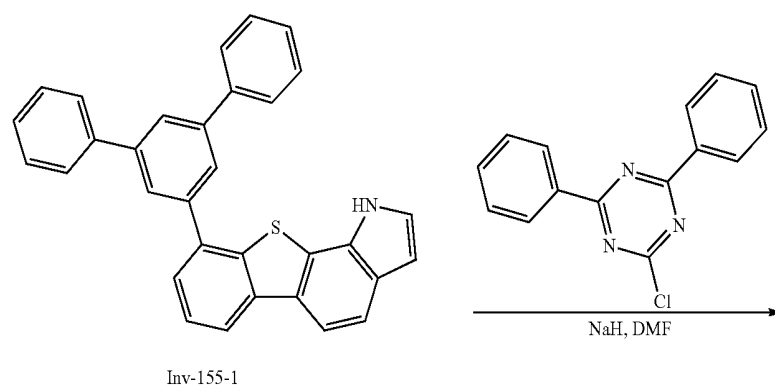
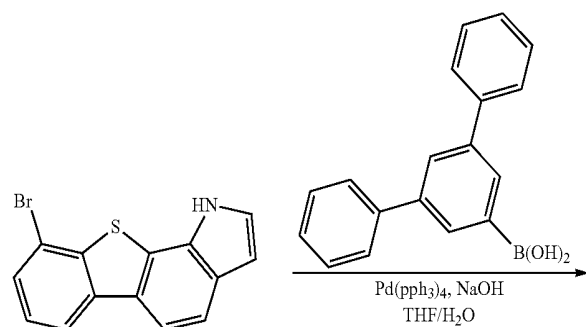
Inv-154

615

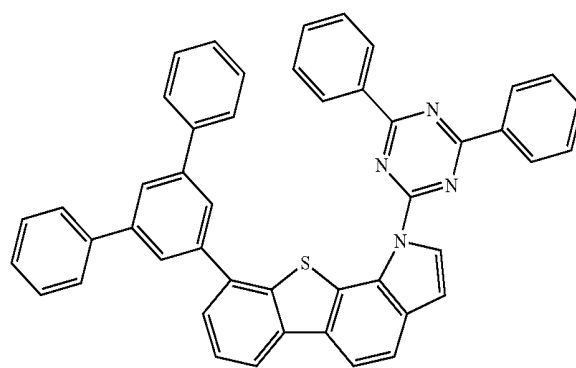
A target compound Inv-154 (3.24 g, yield: 69%) was obtained by performing the same procedure as in Synthesis Example 152, except that Inv-153-1 (2.58 g, 6.88 mmol) was used instead of Inv-151-1.

GC-Mass (theoretical value: 682.83 g/mol, measured value: 682 g/mol)

[Synthesis Example 155] Synthesis of Inv-155



Inv-155-1



Inv-155

616

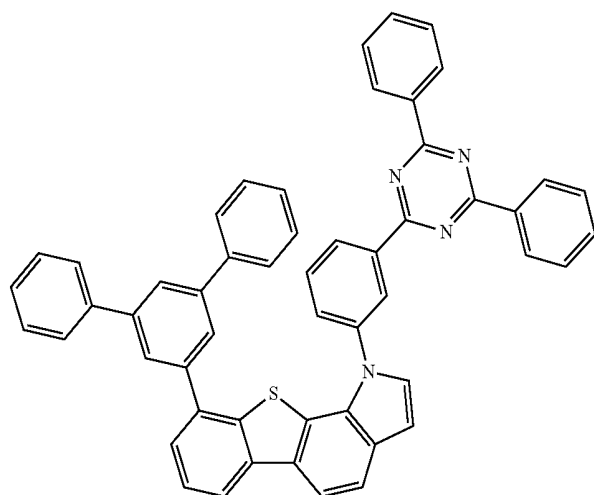
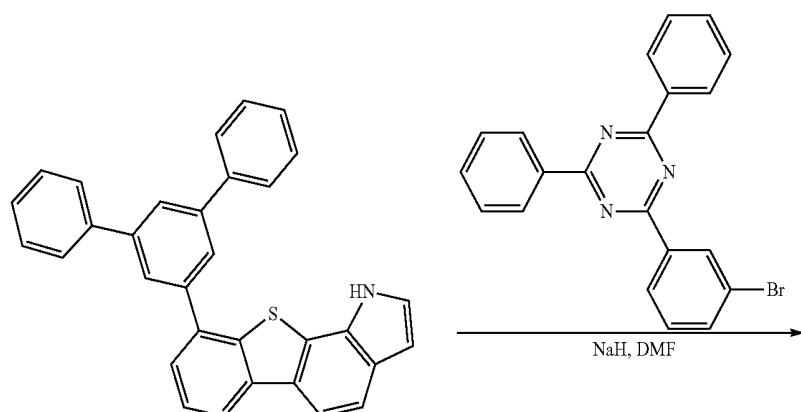
The intermediate compound Inv-155-1 (3.29 g, yield: 91%) was obtained by performing the same procedure as in Synthesis Example 151, except that 3,5-diphenylphenylboronic acid (2.41 g, 8.8 mmol) was used instead of phenylboronic acid.

A target compound Inv-155 (3.99 g, yield: 85%) was obtained by performing the same procedure as in Synthesis Example 151, except that Inv-155-1 (2.58 g, 6.88 mmol) was used instead of Inv-151-1.

GC-Mass (theoretical value: 682.83 g/mol, measured value: 682 g/mol)

617

[Synthesis Example 156] Synthesis of Inv-156

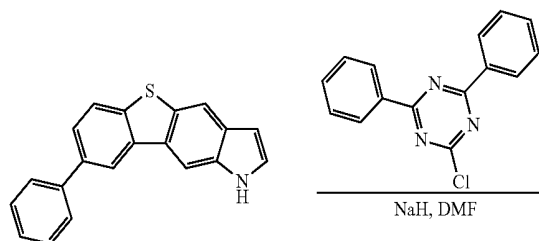
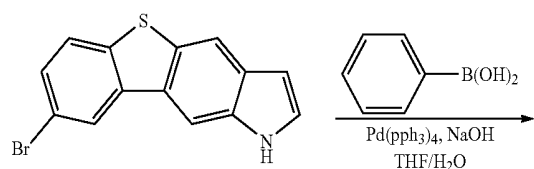


Inv-156

A target compound Inv-156 (3.03 g, yield: 58%) was obtained by performing the same procedure as in Synthesis Example 152, except that Inv-155-1 (2.58 g, 6.88 mmol) was used instead of Inv-151-1.

GC-Mass (theoretical value: 758.93 g/mol, measured value: 758 g/mol)

[Synthesis Example 157] Synthesis of Inv-157



Inv-157-1

618

-continued

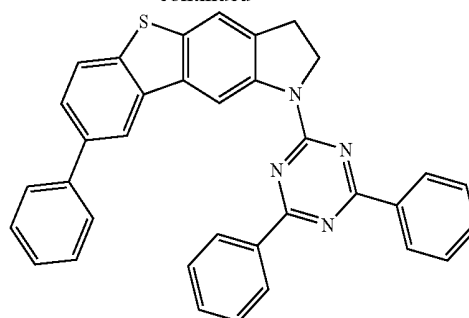
45

50

55

60

65



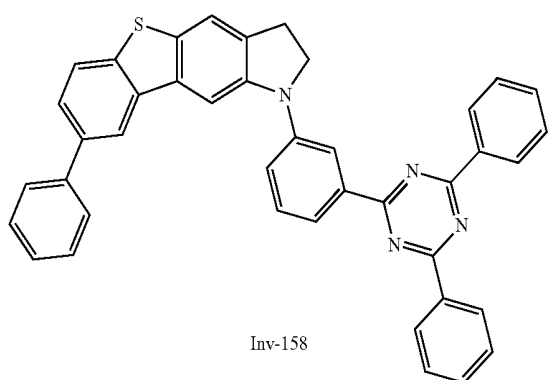
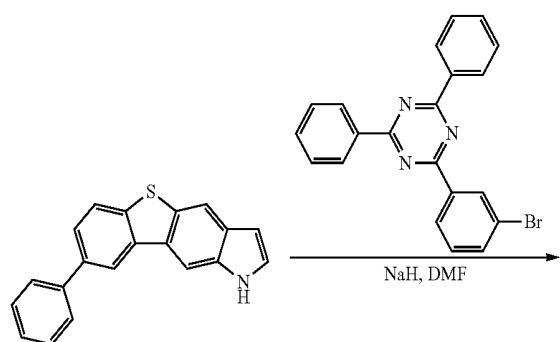
Inv-157

A target compound Inv-157 (2.72 g, yield: 64%) was obtained by performing the same procedure as in Synthesis Example 151, except that IC-45a (2.42 g, 8.0 mmol) was used instead of IC-44.

GC-Mass (theoretical value: 530.64 g/mol, measured value: 530 g/mol)

619

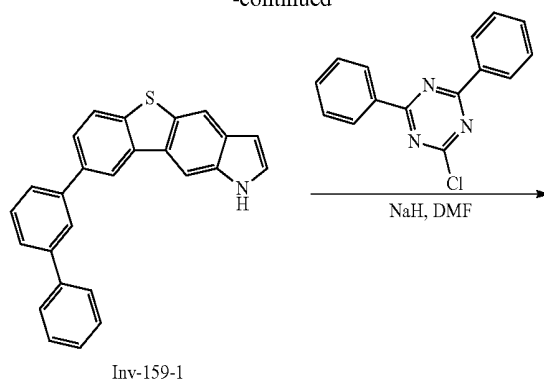
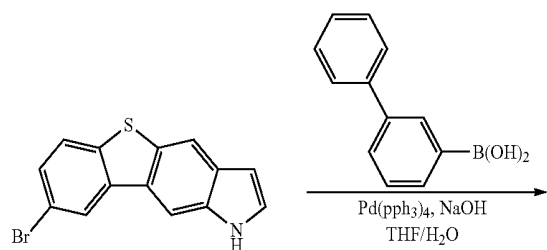
[Synthesis Example 158] Synthesis of Inv-158



A target compound Inv-158 (2.67 g, yield: 64%) was obtained by performing the same procedure as in Synthesis Example 152, except that Inv-157-1 (2.58 g, 6.88 mmol) was used instead of Inv-151-1.

GC-Mass (theoretical value: 606.74 g/mol, measured value: 606 g/mol)

[Synthesis Example 159] Synthesis of Inv-159



Inv-159-1

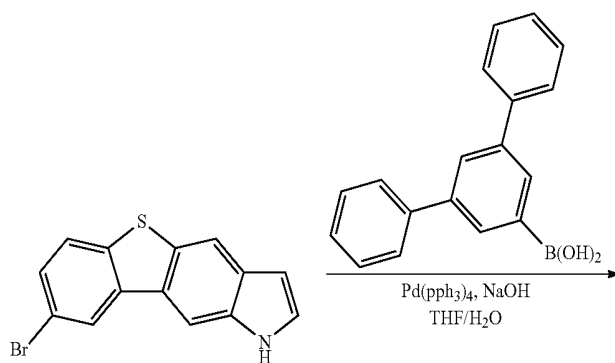


Inv-159

A target compound Inv-159 (2.80 g, yield: 55%) was obtained by performing the same procedure as in Synthesis Example 153, except that IC-45a (2.42 g, 8.0 mmol) was used instead of IC-44.

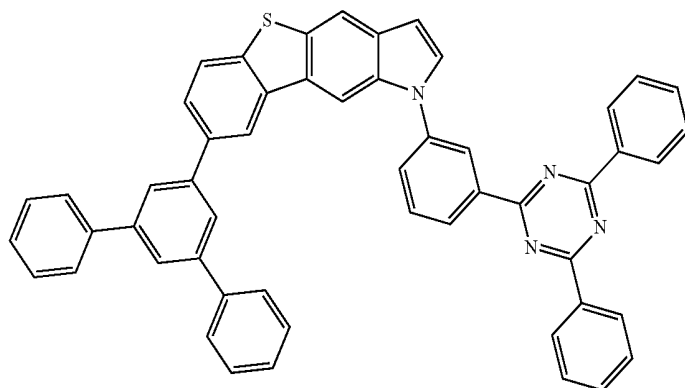
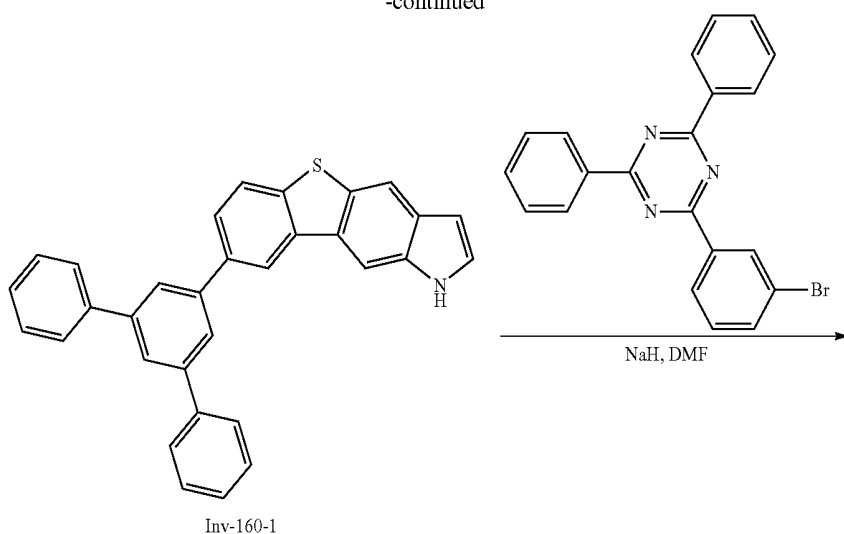
GC-Mass (theoretical value: 606.74 g/mol, measured value: 606 g/mol)

[Synthesis Example 160] Synthesis of Inv-160



621

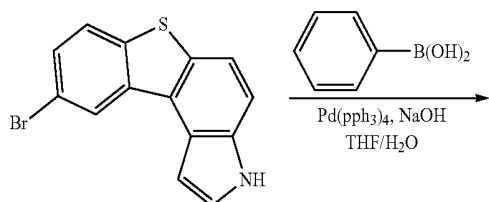
-continued



A target compound Inv-160 (2.62 g, yield: 43%) was obtained by performing the same procedure as in Synthesis Example 155, except that IC-45a (2.42 g, 8.0 mmol) was used instead of IC-44.

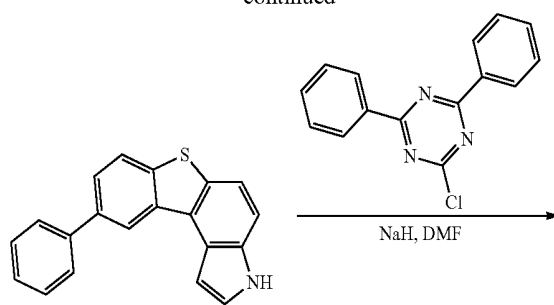
GC-Mass (theoretical value: 758.93 g/mol, measured value: 758 g/mol)

[Synthesis Example 161] Synthesis of Inv-161



622

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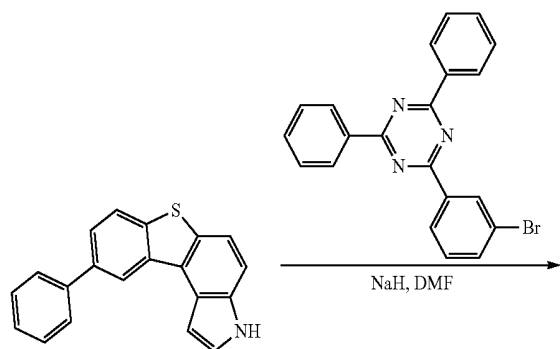
Inv-161

623

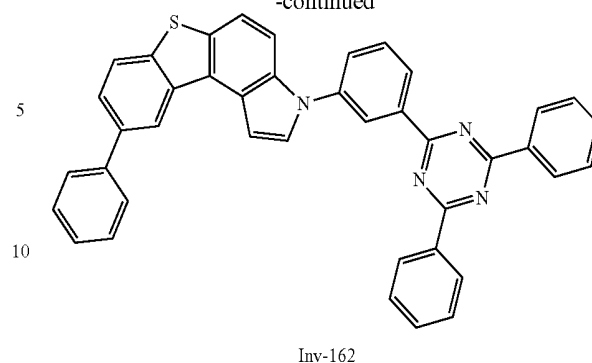
A target compound Inv-161 (2.42 g, yield: 57%) was obtained by performing the same procedure as in Synthesis Example 151, except that IC-45b (2.42 g, 8.0 mmol) was used instead of IC-44.

GC-Mass (theoretical value: 530.64 g/mol, measured value: 530 g/mol)

[Synthesis Example 162] Synthesis of Inv-162

**624**

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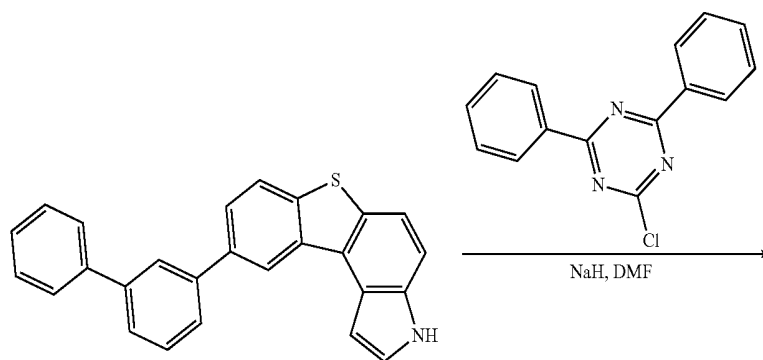
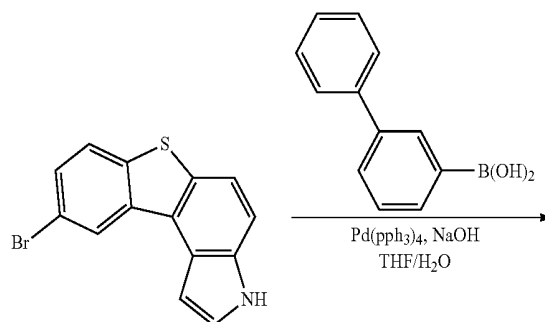


Inv-162

A target compound Inv-162 (2.55 g, yield: 61%) was obtained by performing the same procedure as in Synthesis Example 152, except that Inv-161-1 (2.58 g, 6.88 mmol) was used instead of Inv-151-1.

GC-Mass (theoretical value: 606.74 g/mol, measured value: 606 g/mol)

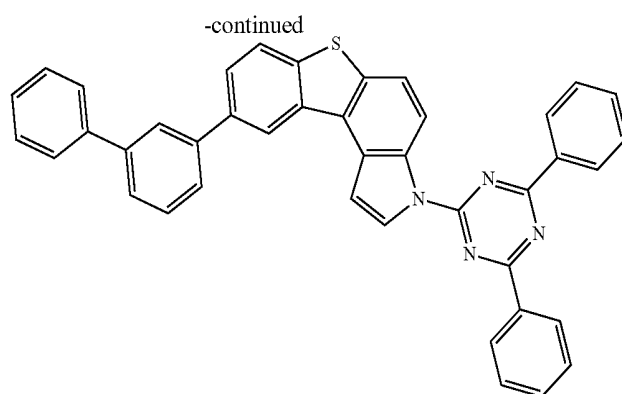
[Synthesis Example 163] Synthesis of Inv-163



Inv-163-1

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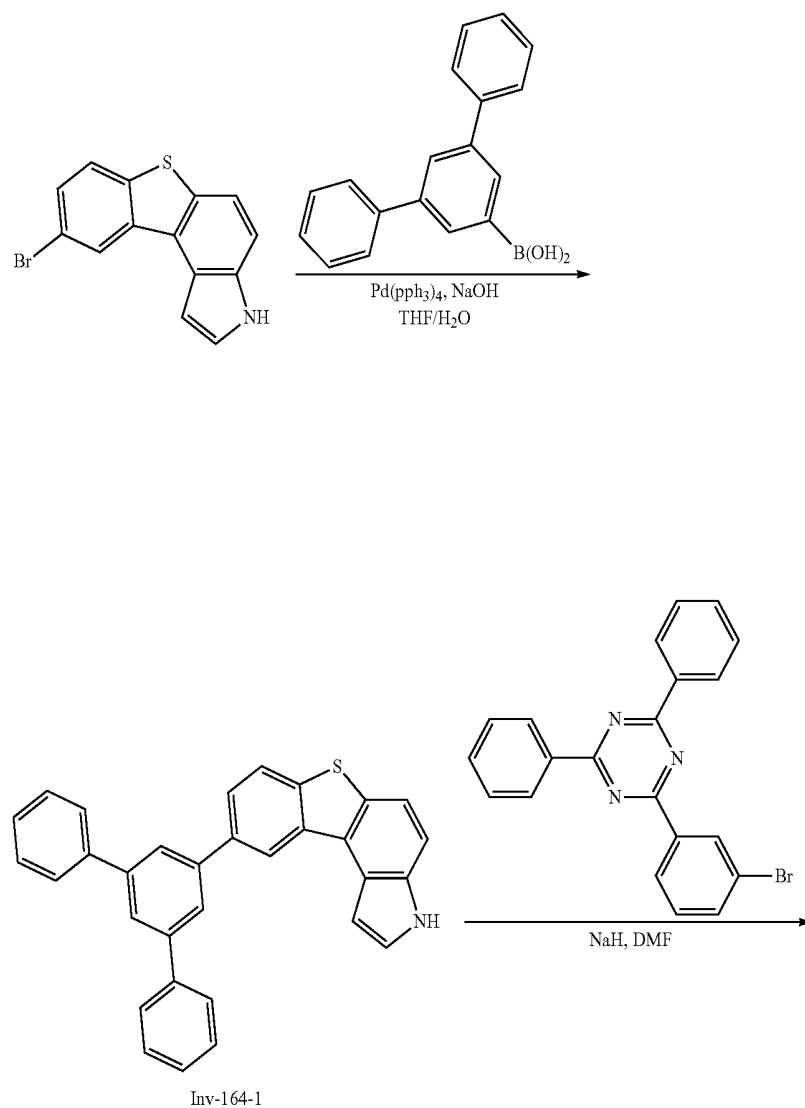


Inv-163

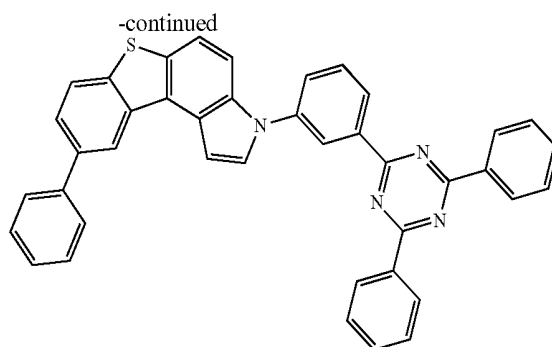
A target compound Inv-163 (2.04 g, yield: 42%) was obtained by performing the same procedure as in Synthesis Example 153, except that IC-45b (2.42 g, 8.0 mmol) was used instead of IC-44. 20

GC-Mass (theoretical value: 606.74 g/mol, measured value: 606 g/mol)

[Synthesis Example 164] Synthesis of Inv-164



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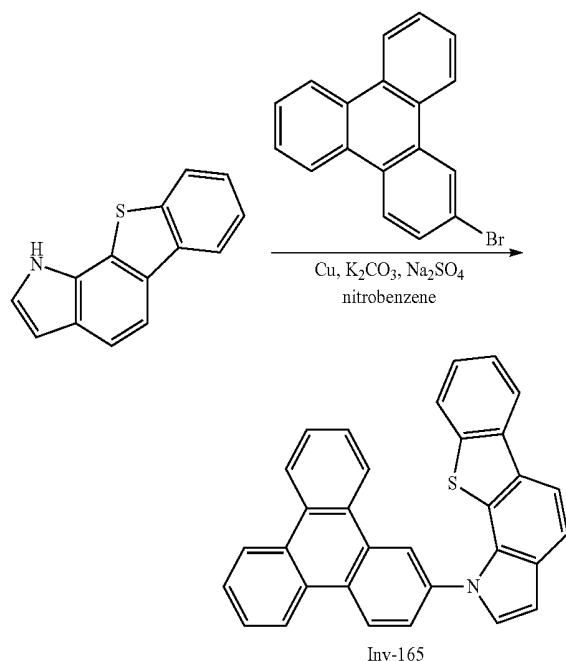


Inv-164

A target compound Inv-164 (2.85 g, yield: 47%) was obtained by performing the same procedure as in Synthesis Example 155, except that IC-45b (2.42 g, 8.0 mmol) was used instead of IC-44.

GC-Mass (theoretical value: 758.93 g/mol, measured value: 758 g/mol)

[Synthesis Example 165] Synthesis of Inv-165



The compound IC-35 (4.47 g, 20.00 mmol), 2-bromotriphenylene (9.22 g, 30.00 mmol), Cu powder (0.38 g, 1.00 mmol), K_2CO_3 (5.52 g, 40.00 mmol), Na_2SO_4 (5.68 g, 40.00 mmol), and nitrobenzene (100 ml) were mixed under nitrogen flow, and the mixture was stirred at $190^\circ C$. for 12 hours. After the reaction was completed, nitrobenzene was removed, the organic layer was separated with methylene chloride, and water was removed by using $MgSO_4$. After the solvent was removed from the organic layer, purification was performed by column chromatography, thereby obtaining a target compound Inv-165 (5.93 g, yield 66%).

GC-Mass (theoretical value: 449.56 g/mol, measured value: 449 g/mol)

628

[Synthesis Example 166] Synthesis of Inv-166

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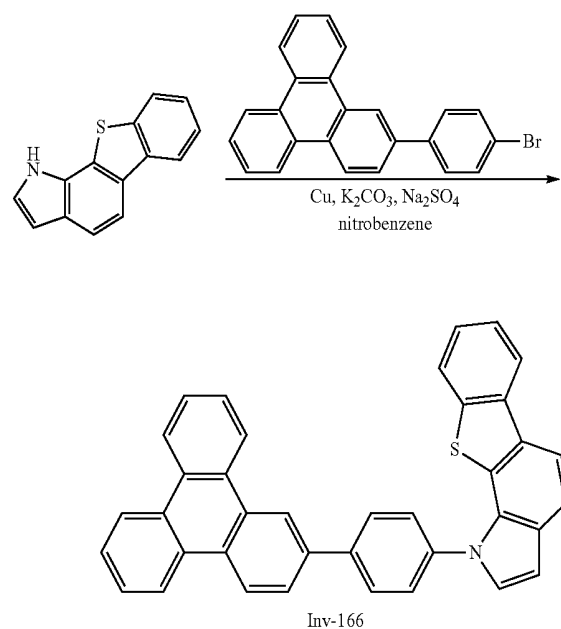
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Inv-166 (7.04 g, yield: 67%) was obtained by performing the same procedure as in Synthesis Example 165, except that 2-(4-bromophenyl)triphenylene (11.50 g, 30.0 mmol) was used instead of 2-bromotriphenylene.

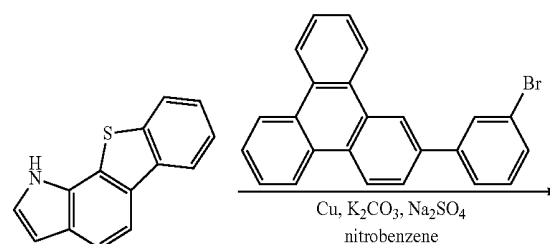
GC-Mass (theoretical value: 525.66 g/mol, measured value: 525 g/mol)

[Synthesis Example 167] Synthesis of Inv-167

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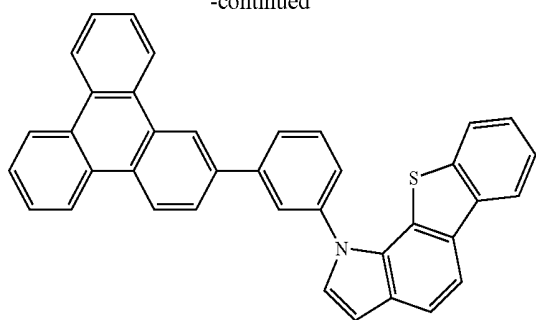
60

65



629

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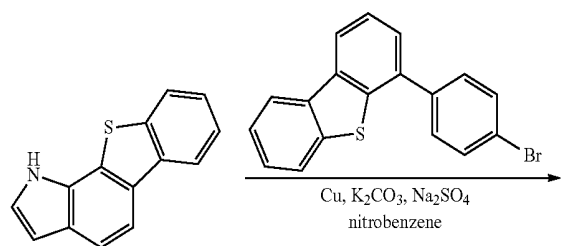


Inv-167

Inv-167 (6.90 g, yield: 61%) was obtained by performing the same procedure as in Synthesis Example 165, except that 2-(3-bromophenyl)triphenylene (11.50 g, 30.0 mmol) was used instead of 2-bromotriphenylene.

GC-Mass (theoretical value: 525.66 g/mol, measured value: 525 g/mol)

[Synthesis Example 168] Synthesis of Inv-168

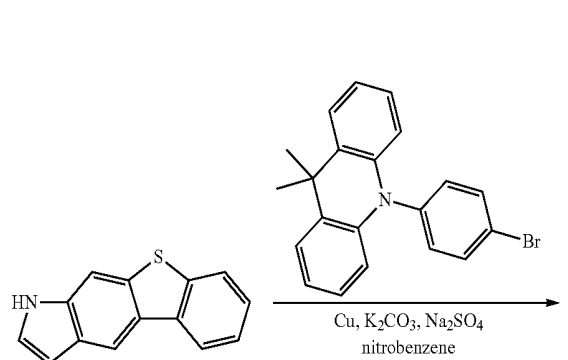


Inv-168

Inv-168 (5.68 g, yield: 59%) was obtained by performing the same procedure as in Synthesis Example 165, except that 4-(4-bromophenyl)dibenzo[b,d]thiophene (10.18 g, 30.0 mmol) was used instead of 2-bromotriphenylene.

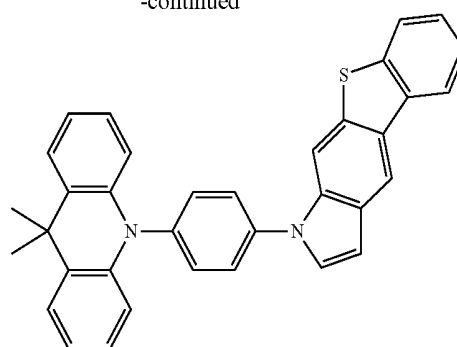
GC-Mass (theoretical value: 481.63 g/mol, measured value: 481 g/mol)

[Synthesis Example 169] Synthesis of Inv-169



630

-continued

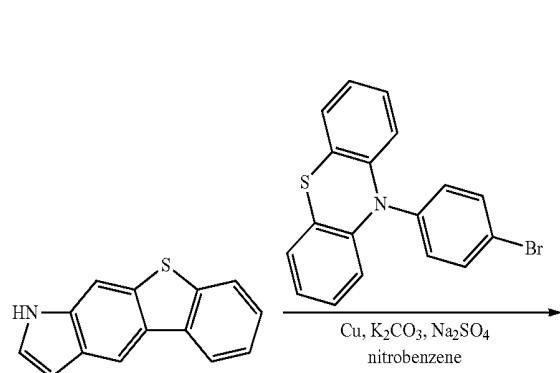


Inv-169

The compound IC-36 (4.47 g, 20.00 mmol), 10-(4-bromophenyl)-9,9-dimethyl-9,10-dihydroacridine (10.93 g, 30.00 mmol), Cu powder (0.38 g, 1.00 mmol), K₂CO₃ (5.52 g, 40.00 mmol), Na₂SO₄ (5.68 g, 40.00 mmol) and nitrobenzene (100 ml) were mixed under nitrogen flow, and the mixture was stirred at 190° C. for 12 hours. After the reaction was completed, nitrobenzene was removed, the organic layer was separated with methylene chloride, and water was removed by using MgSO₄. After the solvent was removed from the organic layer, purification was performed by column chromatography, thereby obtaining a target compound Inv-169 (6.38 g, yield 63%).

GC-Mass (theoretical value: 506.66 g/mol, measured value: 506 g/mol)

[Synthesis Example 170] Synthesis of Inv-170



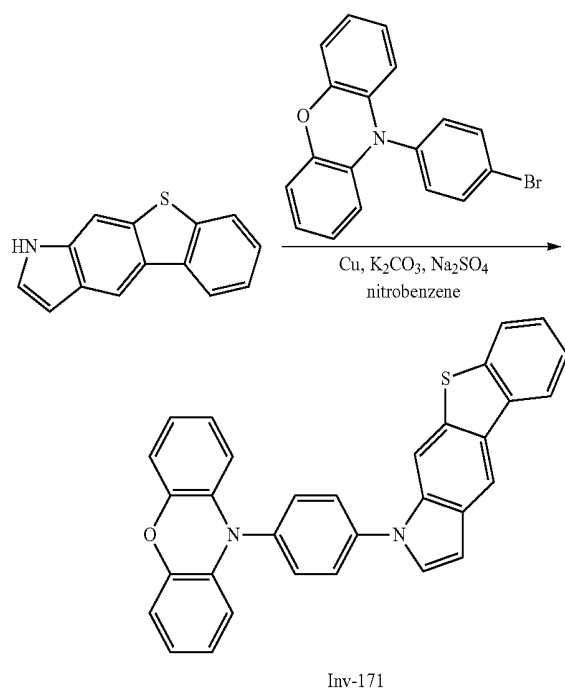
Inv-170

Inv-170 (6.85 g, yield: 69%) was obtained by performing the same procedure as in Synthesis Example 169, except that 10-(4-bromophenyl)-10H-phenothiazine (10.63 g, 30.0 mmol) was used instead of 10-(4-bromophenyl)-9,9-dimethyl-9,10-dihydroacridine.

631

GC-Mass (theoretical value: 496.64 g/mol, measured value: 496 g/mol)

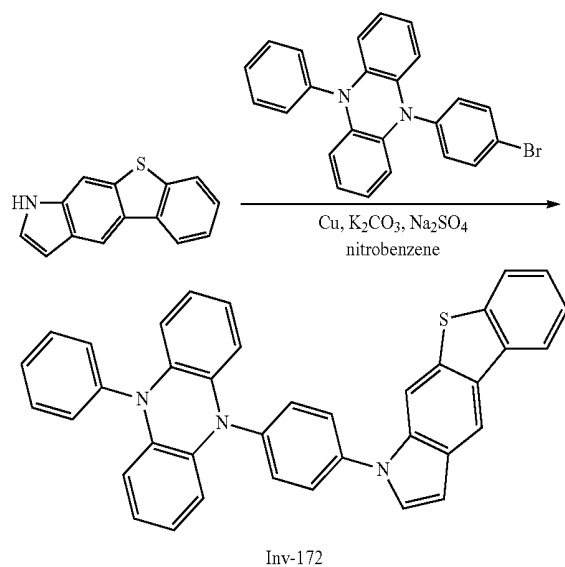
[Synthesis Example 171] Synthesis of Inv-171



Inv-171 (6.92 g, yield: 72%) was obtained by performing the same procedure as in Synthesis Example 169, except that 10-(4-bromophenyl)-10H-phenothiazine (10.15 g, 30.0 mmol) was used instead of 10-(4-bromophenyl)-9,9-dimethyl-9,10-dihydroacridine.

GC-Mass (theoretical value: 480.58 g/mol, measured value: 480 g/mol)

[Synthesis Example 172] Synthesis of Inv-172

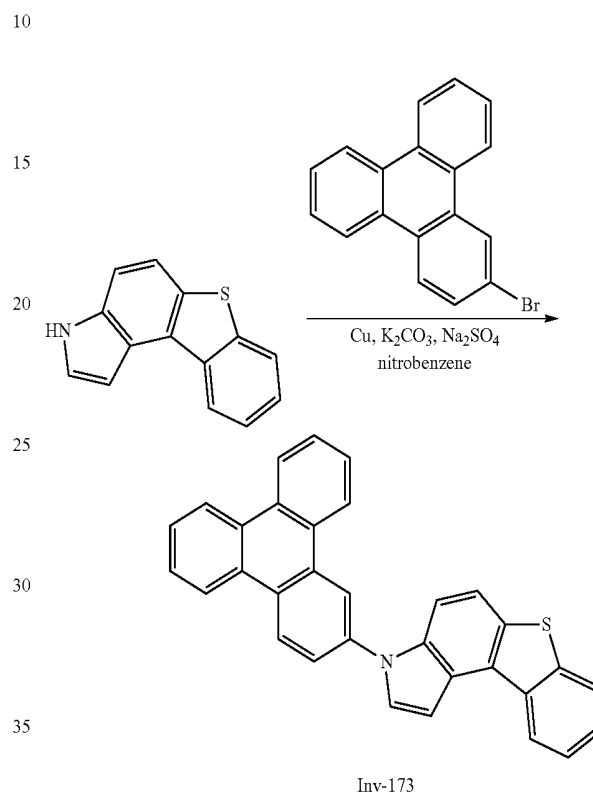


632

Inv-172 (5.78 g, yield: 52%) was obtained by performing the same procedure as in Synthesis Example 169, except that 5-(4-bromophenyl)-10-phenyl-5,10-dihydrophenazine (12.40 g, 30.0 mmol) was used instead of 10-(4-bromophenyl)-9,9-dimethyl-9,10-dihydroacridine.

GC-Mass (theoretical value: 555.69 g/mol, measured value: 555 g/mol)

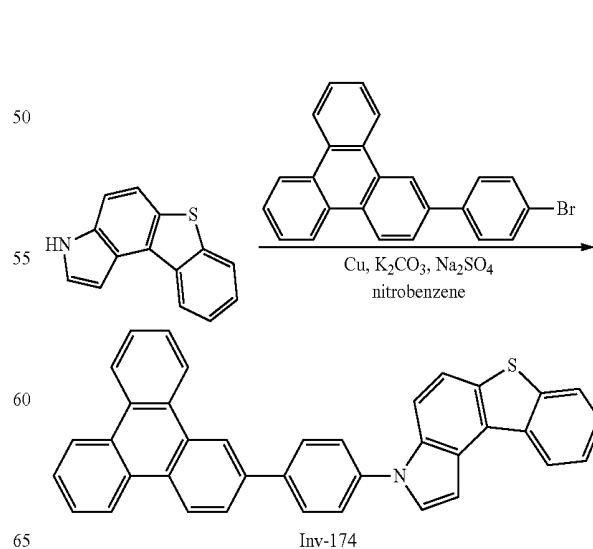
[Synthesis Example 173] Synthesis of Inv-173



Inv-173 (5.30 g, yield: 59%) was obtained by performing the same procedure as in Synthesis Example 165, except that IC-37 (4.47 g, 20.0 mmol) was used instead of IC-35.

GC-Mass (theoretical value: 449.56 g/mol, measured value: 449 g/mol)

[Synthesis Example 174] Synthesis of Inv-174

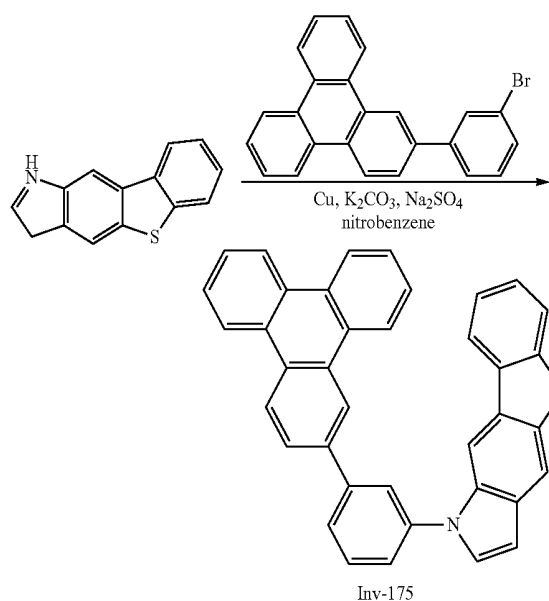


633

Inv-174 (6.73 g, yield: 64%) was obtained by performing the same procedure as in Synthesis Example 166, except that IC-37 (4.47 g, 20.0 mmol) was used instead of IC-35.

GC-Mass (theoretical value: 525.66 g/mol, measured value: 525 g/mol)

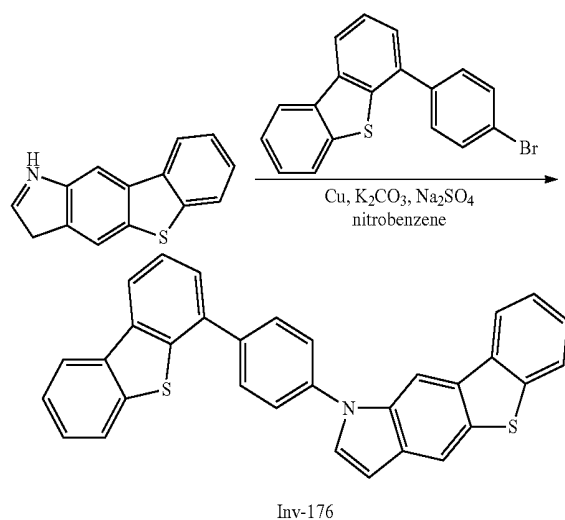
[Synthesis Example 175] Synthesis of Inv-175



Inv-175 (6.41 g, yield: 61%) was obtained by performing the same procedure as in Synthesis Example 167, except that IC-39 (4.47 g, 20.0 mmol) was used instead of IC-35.

GC-Mass (theoretical value: 525.66 g/mol, measured value: 525 g/mol)

[Synthesis Example 176] Synthesis of Inv-176

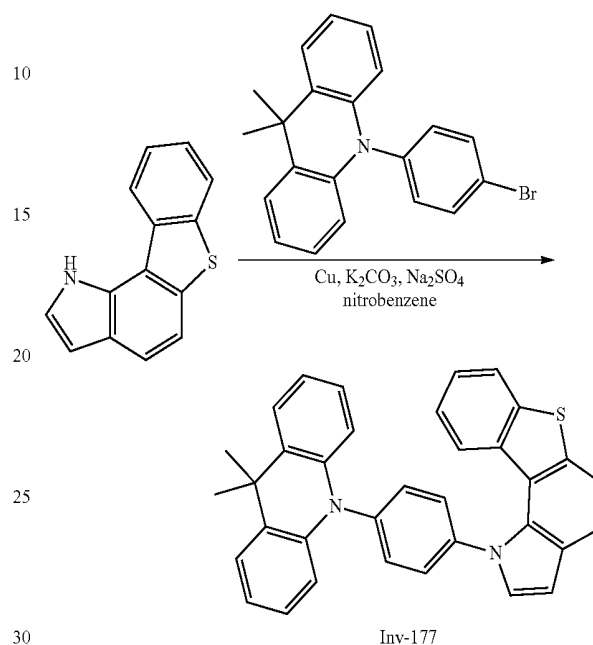


Inv-176 (6.36 g, yield: 66%) was obtained by performing the same procedure as in Synthesis Example 168, except that IC-39 (4.47 g, 20.0 mmol) was used instead of IC-35.

634

GC-Mass (theoretical value: 481.63 g/mol, measured value: 481 g/mol)

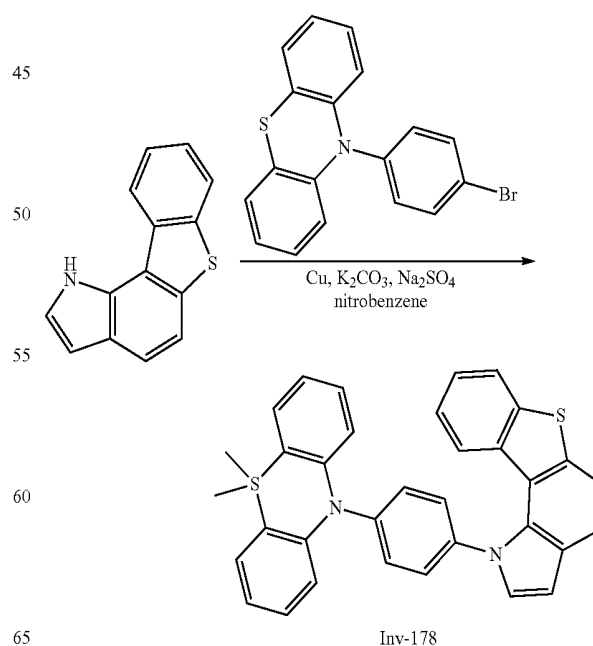
[Synthesis Example 177] Synthesis of Inv-177



Inv-177 (6.69 g, yield: 66%) was obtained by performing the same procedure as in Synthesis Example 169, except that IC-38 (4.47 g, 20.0 mmol) was used instead of IC-36.

GC-Mass (theoretical value: 506.66 g/mol, measured value: 506 g/mol)

[Synthesis Example 178] Synthesis of Inv-178

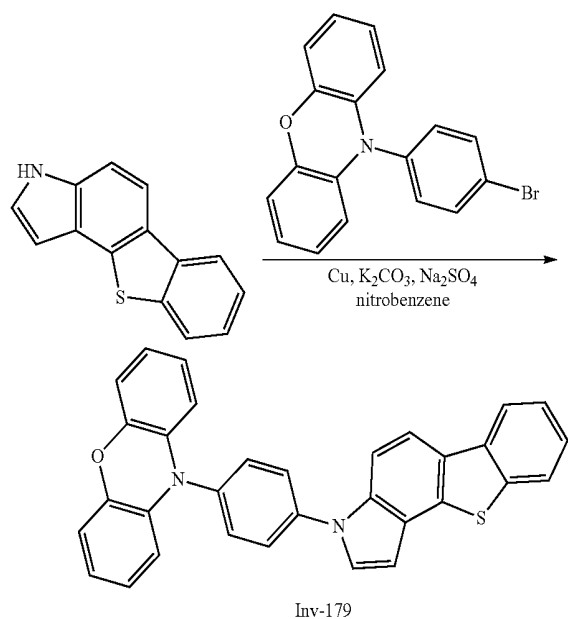


635

Inv-178 (5.36 g, yield: 54%) was obtained by performing the same procedure as in Synthesis Example 170, except that IC-38 (4.47 g, 20.0 mmol) was used instead of IC-36.

GC-Mass (theoretical value: 496.64 g/mol, measured value: 496 g/mol)

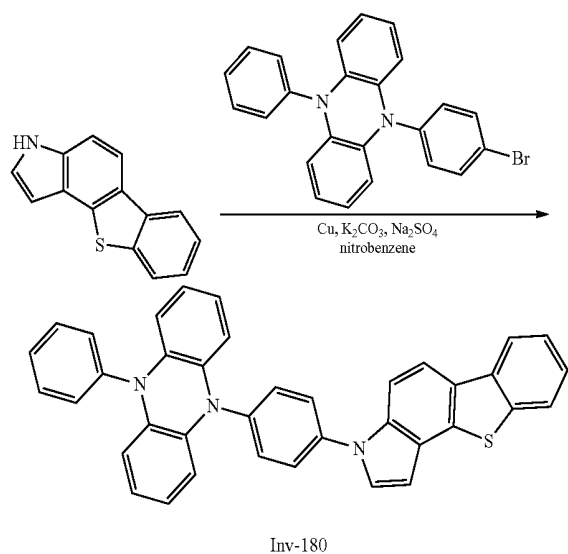
[Synthesis Example 179] Synthesis of Inv-179



Inv-179 (5.86 g, yield: 61%) was obtained by performing the same procedure as in Synthesis Example 171, except that IC-40 (4.47 g, 20.0 mmol) was used instead of IC-36.

GC-Mass (theoretical value: 480.58 g/mol, measured value: 480 g/mol)

[Synthesis Example 180] Synthesis of Inv-180

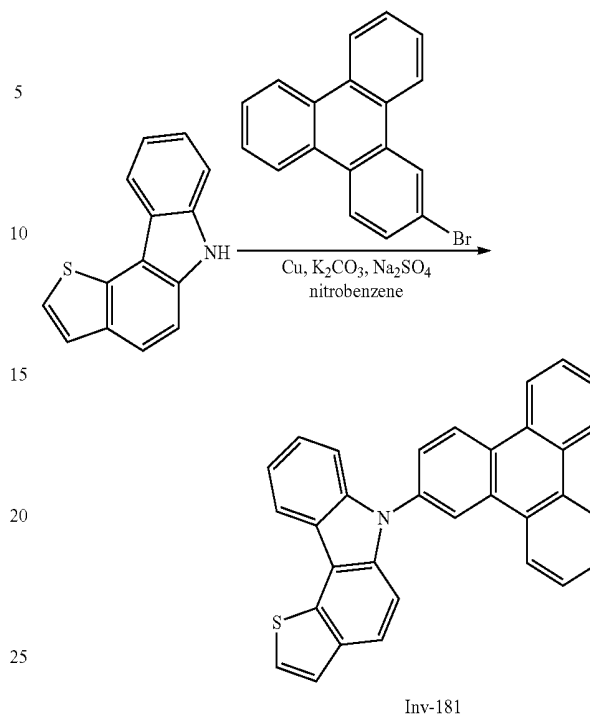


Inv-180 (7.11 g, yield: 64%) was obtained by performing the same procedure as in Synthesis Example 172, except that IC-40 (4.47 g, 20.0 mmol) was used instead of IC-36.

GC-Mass (theoretical value: 555.69 g/mol, measured value: 555 g/mol)

636

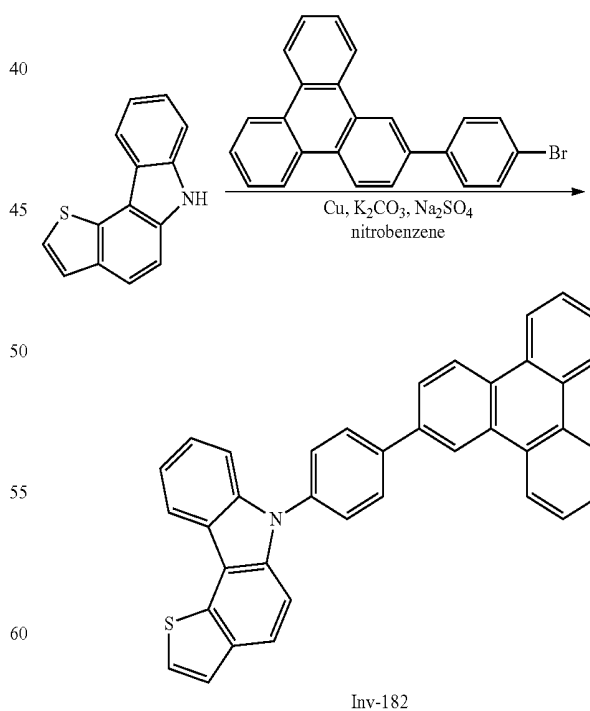
[Synthesis Example 181] Synthesis of Inv-181



Inv-181 (5.30 g, yield: 59%) was obtained by performing the same procedure as in Synthesis Example 165, except that IC-41 (4.47 g, 20.0 mmol) was used instead of IC-35.

GC-Mass (theoretical value: 449.56 g/mol, measured value: 449 g/mol)

[Synthesis Example 182] Synthesis of Inv-182

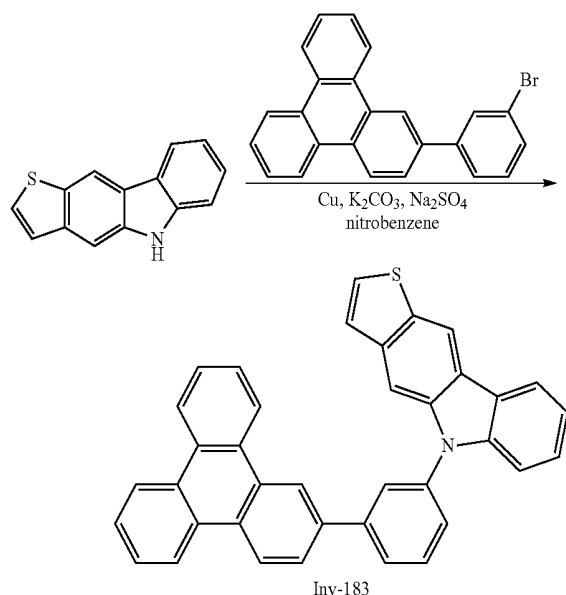


Inv-182 (6.62 g, yield: 65%) was obtained by performing the same procedure as in Synthesis Example 166, except that IC-41 (4.47 g, 20.0 mmol) was used instead of IC-35.

637

GC-Mass (theoretical value: 525.66 g/mol, measured value: 525 g/mol)

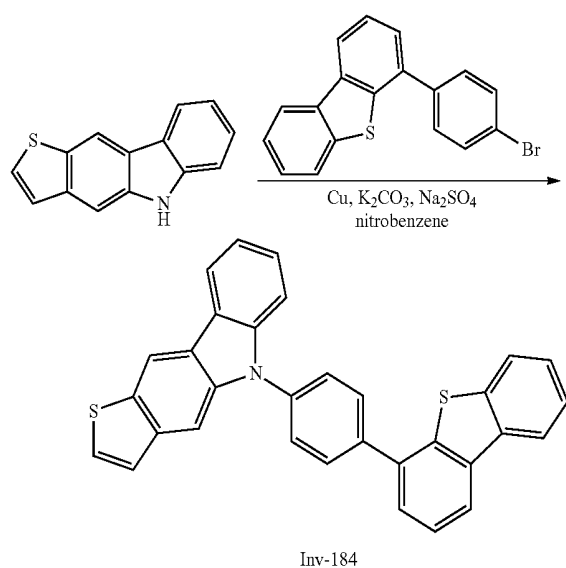
[Synthesis Example 183] Synthesis of Inv-183



Inv-183 (6.31 g, yield: 64%) was obtained by performing the same procedure as in Synthesis Example 167, except that IC-42b (4.47 g, 20.0 mmol) was used instead of IC-35.

GC-Mass (theoretical value: 525.66 g/mol, measured value: 525 g/mol)

[Synthesis Example 184] Synthesis of Inv-184

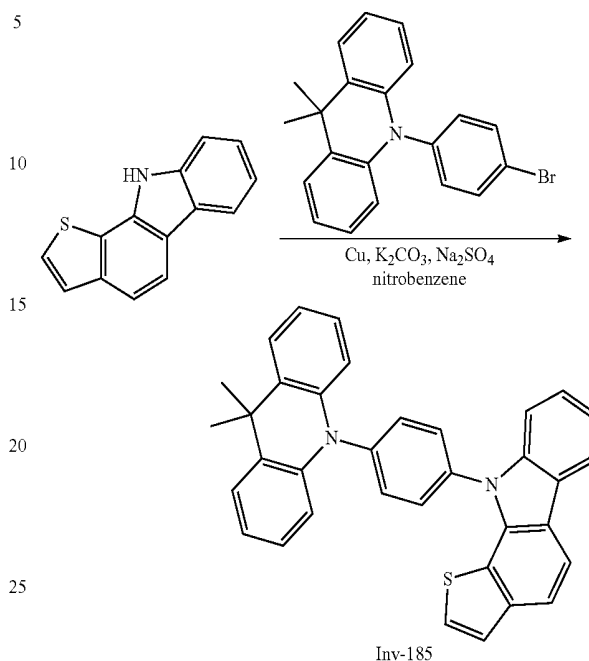


Inv-184 (5.59 g, yield: 58%) was obtained by performing the same procedure as in Synthesis Example 168, except that IC-42b (4.47 g, 20.0 mmol) was used instead of IC-35.

GC-Mass (theoretical value: 481.63 g/mol, measured value: 481 g/mol)

638

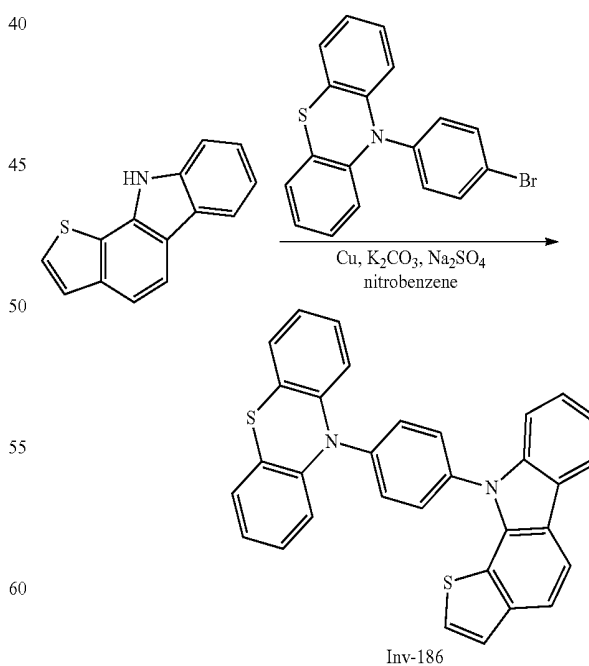
[Synthesis Example 185] Synthesis of Inv-185



Inv-185 (5.68 g, yield: 56%) was obtained by performing the same procedure as in Synthesis Example 169, except that IC-42a (4.47 g, 20.0 mmol) was used instead of IC-36.

GC-Mass (theoretical value: 506.66 g/mol, measured value: 506 g/mol)

[Synthesis Example 186] Synthesis of Inv-186

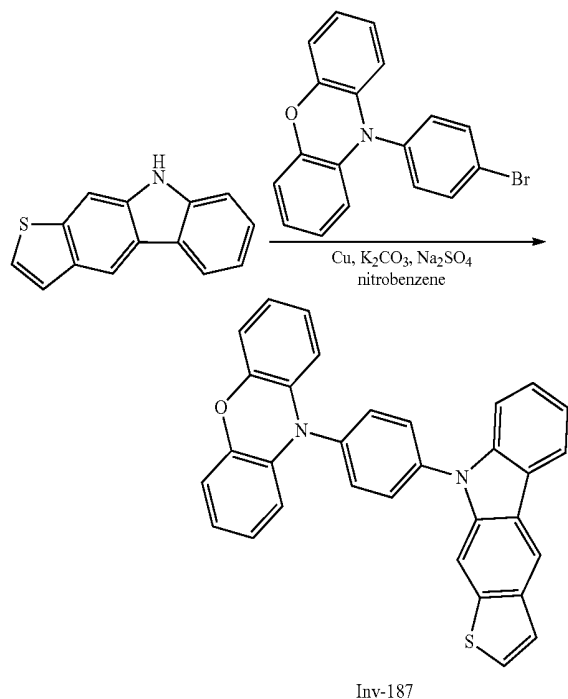


Inv-186 (5.86 g, yield: 59%) was obtained by performing the same procedure as in Synthesis Example 170, except that IC-42a (4.47 g, 20.0 mmol) was used instead of IC-36.

639

GC-Mass (theoretical value: 496.64 g/mol, measured value: 496 g/mol)

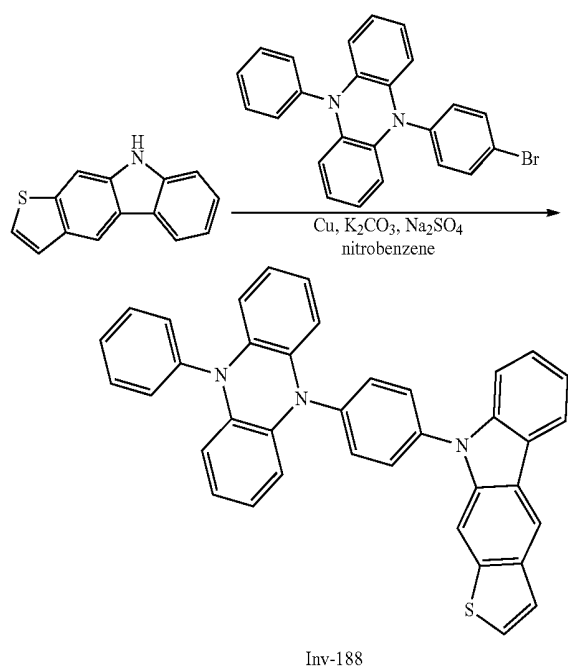
[Synthesis Example 187] Synthesis of Inv-187



Inv-187 (5.86 g, yield: 61%) was obtained by performing the same procedure as in Synthesis Example 171, except that IC-32a (4.47 g, 20.0 mmol) was used instead of IC-36.

GC-Mass (theoretical value: 480.58 g/mol, measured value: 480 g/mol)

[Synthesis Example 188] Synthesis of Inv-188

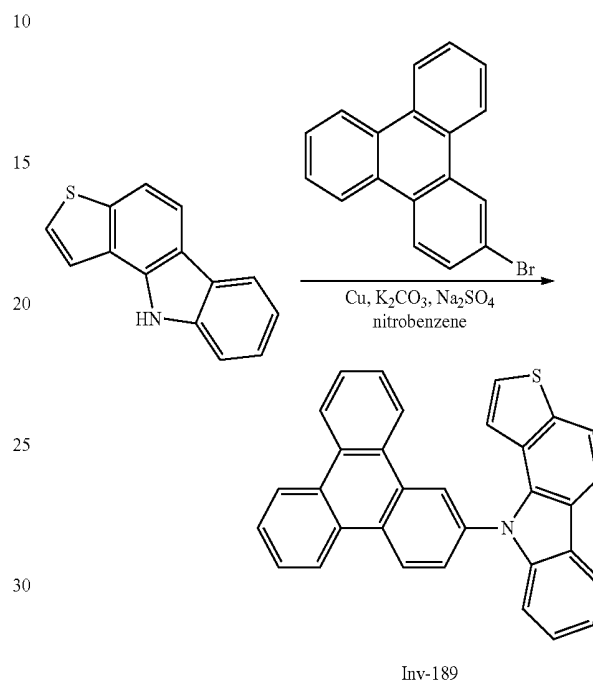


640

Inv-188 (6.33 g, yield: 57%) was obtained by performing the same procedure as in Synthesis Example 172, except that IC-32a (4.47 g, 20.0 mmol) was used instead of IC-36.

GC-Mass (theoretical value: 555.69 g/mol, measured value: 555 g/mol)

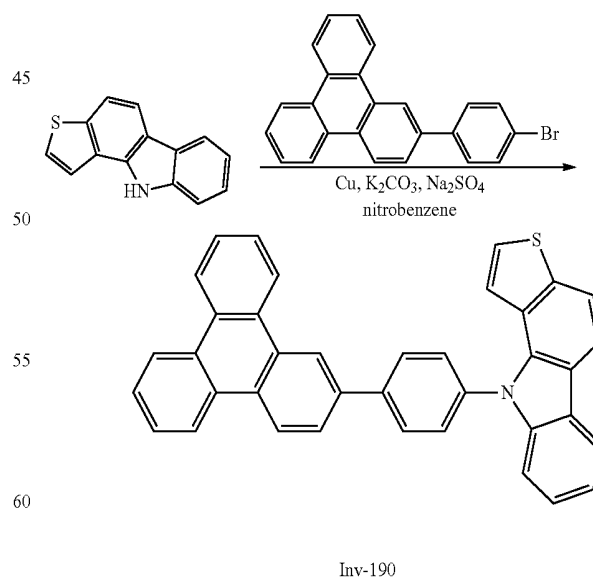
[Synthesis Example 189] Synthesis of Inv-189



Inv-189 (6.89 g, yield: 69%) was obtained by performing the same procedure as in Synthesis Example 165, except that IC-32b (4.47 g, 20.0 mmol) was used instead of IC-35.

GC-Mass (theoretical value: 449.56 g/mol, measured value: 449 g/mol)

[Synthesis Example 190] Synthesis of Inv-190

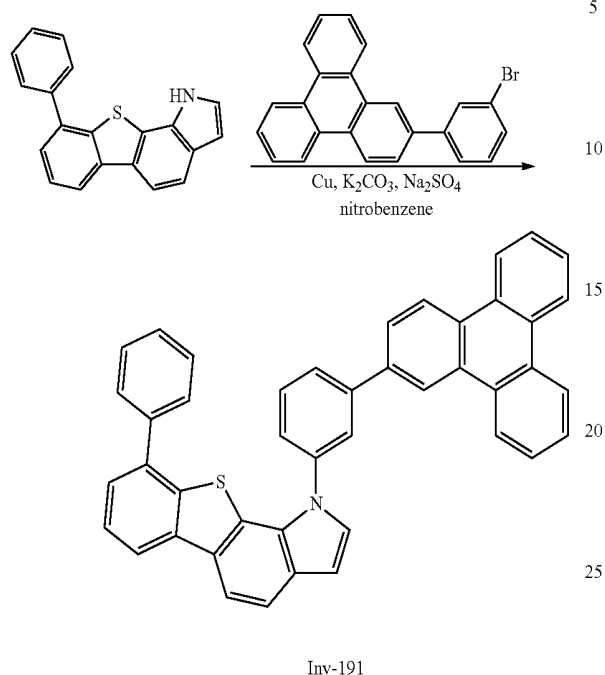


Inv-190 (5.68 g, yield: 54%) was obtained by performing the same procedure as in Synthesis Example 166, except that IC-32b (4.47 g, 20.0 mmol) was used instead of IC-35.

641

GC-Mass (theoretical value: 525.66 g/mol, measured value: 525 g/mol)

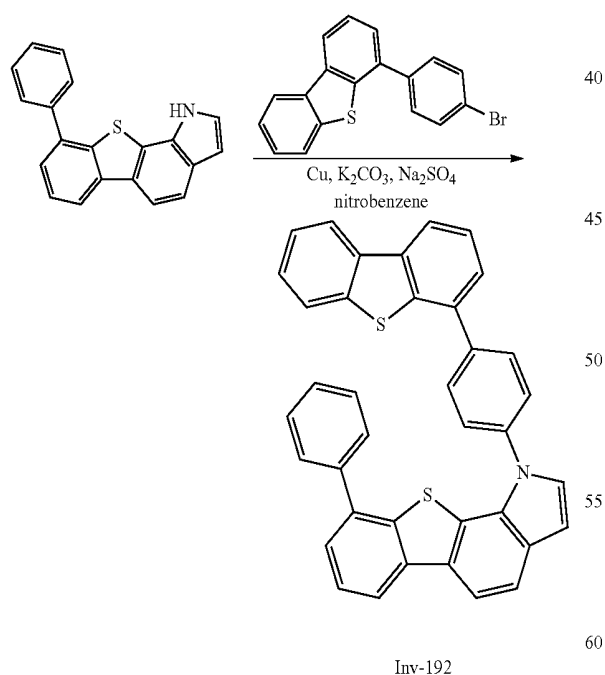
[Synthesis Example 191] Synthesis of Inv-191



Inv-191 (7.34 g, yield: 61%) was obtained by performing the same procedure as in Synthesis Example 167, except that Inv-151-1 (5.98 g, 20.0 mmol) was used instead of IC-35.

GC-Mass (theoretical value: 601.76 g/mol, measured value: 601 g/mol)

[Synthesis Example 192] Synthesis of Inv-192

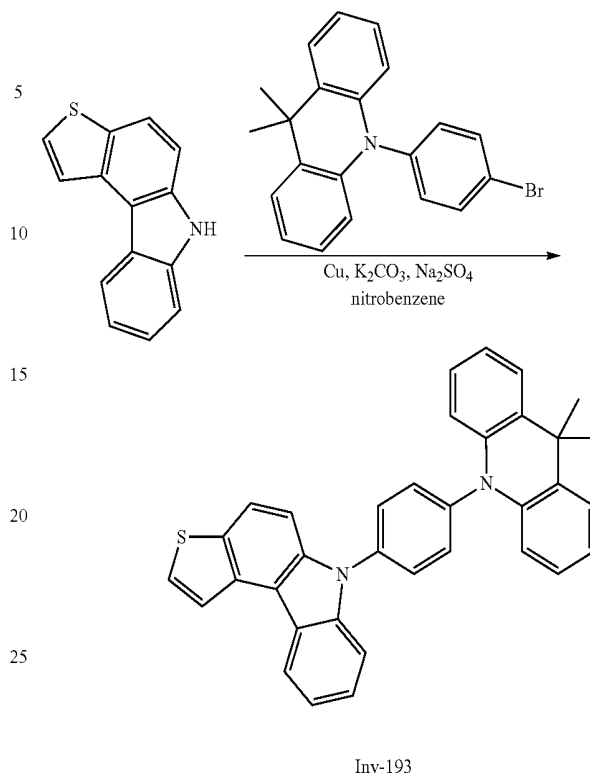


Inv-192 (7.70 g, yield: 69%) was obtained by performing the same procedure as in Synthesis Example 168, except that Inv-151-1 (5.98 g, 20.0 mmol) was used instead of IC-35.

GC-Mass (theoretical value: 557.73 g/mol, measured value: 557 g/mol)

642

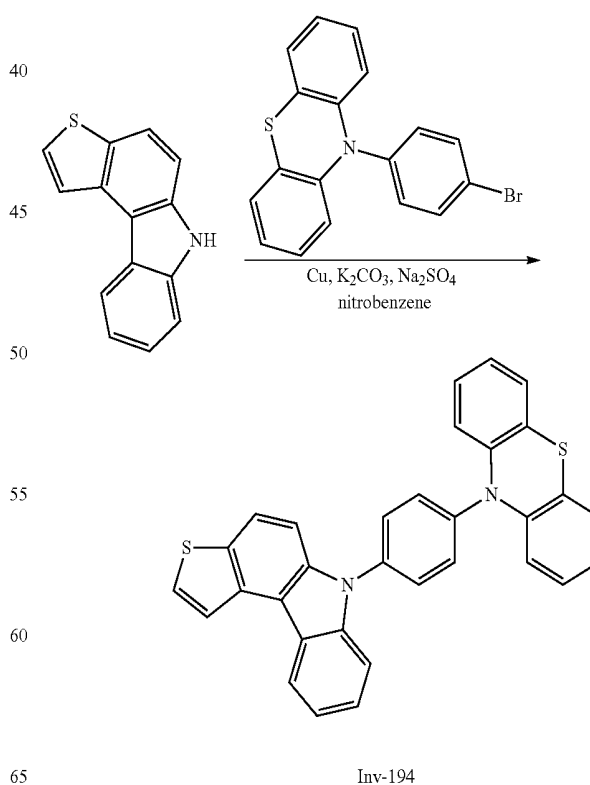
[Synthesis Example 193] Synthesis of Inv-193



Inv-193 (6.69 g, yield: 66%) was obtained by performing the same procedure as in Synthesis Example 169, except that IC-43 (4.47 g, 20.0 mmol) was used instead of IC-36.

GC-Mass (theoretical value: 506.66 g/mol, measured value: 506 g/mol)

[Synthesis Example 194] Synthesis of Inv-194



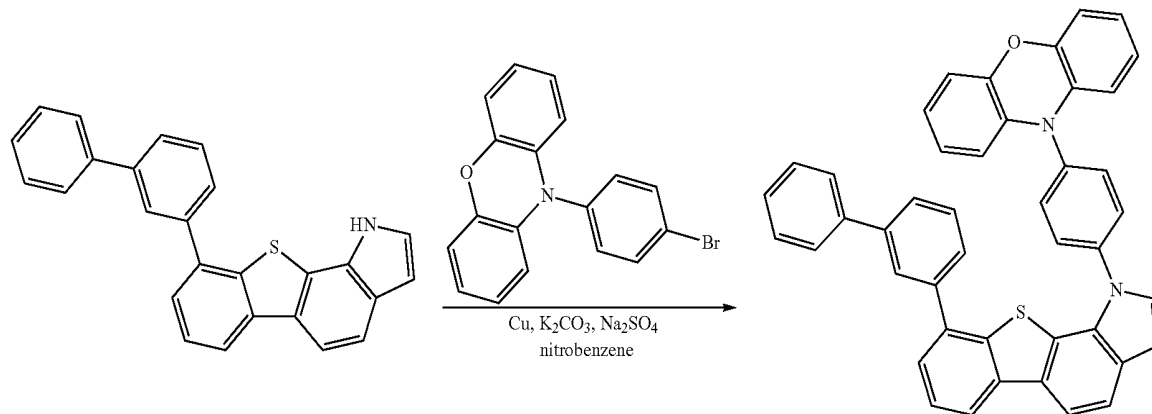
643

Inv-194 (5.66 g, yield: 57%) was obtained by performing the same procedure as in Synthesis Example 170, except that IC-43 (4.47 g, 20.0 mmol) was used instead of IC-36.

GC-Mass (theoretical value: 496.64 g/mol, measured value: 496 g/mol)

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[Synthesis Example 195] Synthesis of Inv-195



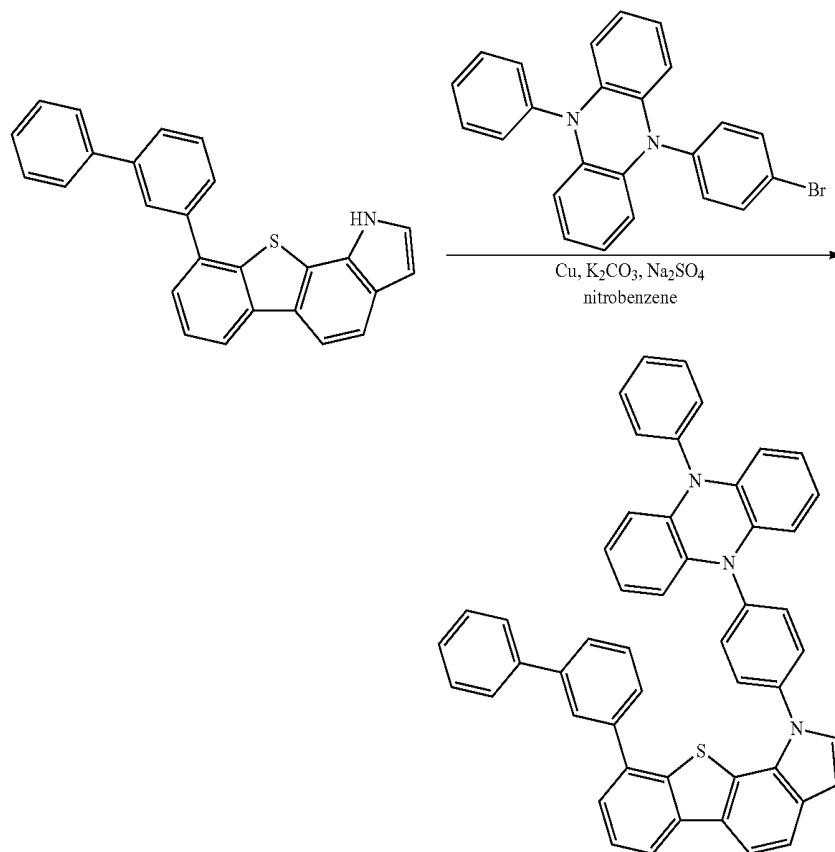
Inv-195

Inv-195 (8.10 g, yield: 64%) was obtained by performing the same procedure as in Synthesis Example 171, except that Inv-153-1 (5.98 g, 20.0 mmol) was used instead of IC-36.

GC-Mass (theoretical value: 632.77 g/mol, measured value: 632 g/mol)

30

[Synthesis Example 196] Synthesis of Inv-196



Inv-196

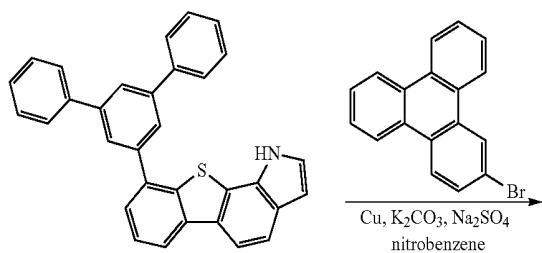
644

645

Inv-196 (7.65 g, yield: 54%) was obtained by performing the same procedure as in Synthesis Example 172, except that Inv-153-1 (5.98 g, 20.0 mmol) was used instead of IC-36.

GC-Mass (theoretical value: 707.88 g/mol, measured value: 707 g/mol)

[Synthesis Example 197] Synthesis of Inv-197



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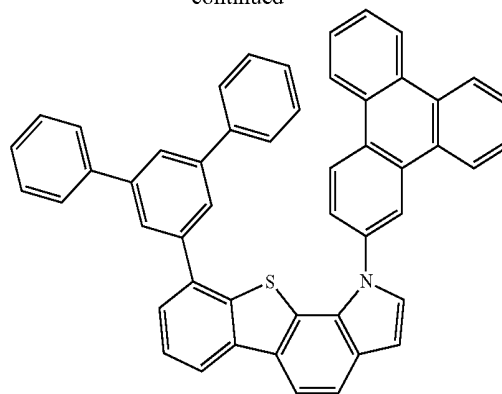
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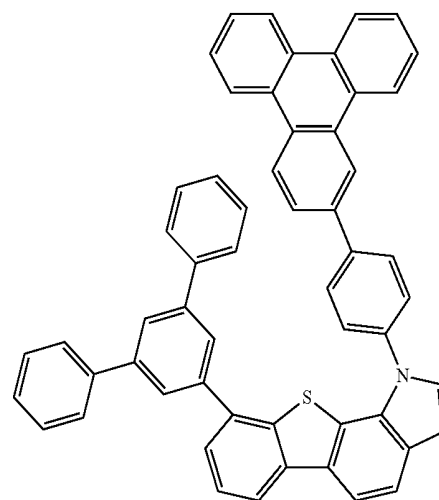
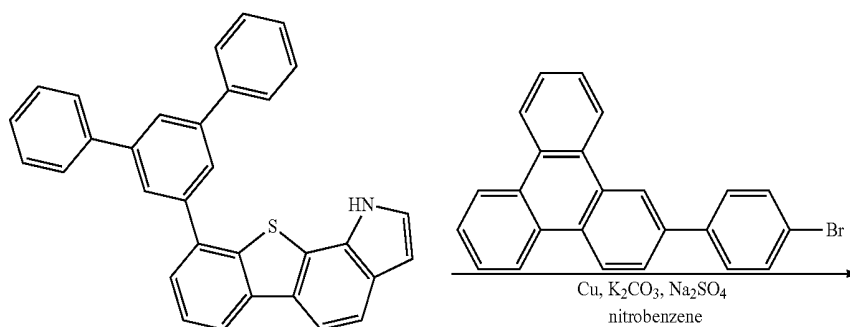


Inv-197

Inv-197 (8.41 g, yield: 62%) was obtained by performing the same procedure as in Synthesis Example 165, except that Inv-155-1 (9.03 g, 20.0 mmol) was used instead of IC-35.

GC-Mass (theoretical value: 677.85 g/mol, measured value: 677 g/mol)

[Synthesis Example 198] Synthesis of Inv-198



Inv-198

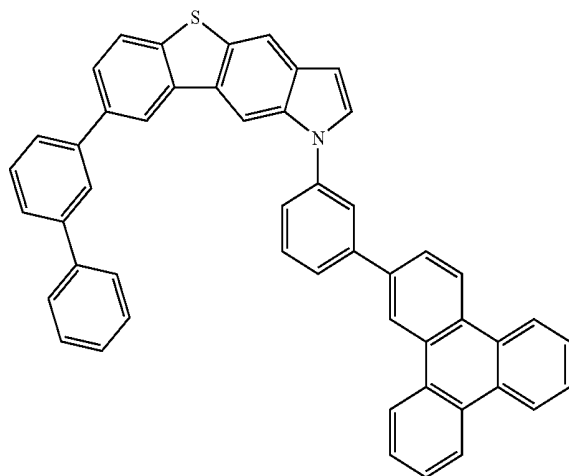
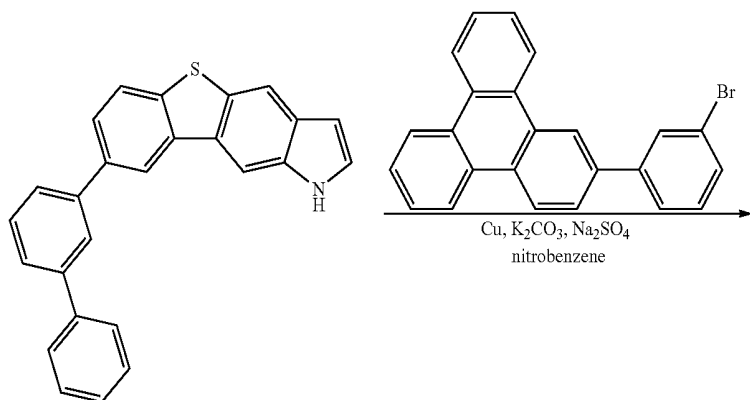
647

Inv-198 (9.95 g, yield: 66%) was obtained by performing the same procedure as in Synthesis Example 166, except that Inv-155-1 (9.03 g, 20.0 mmol) was used instead of IC-35.

GC-Mass (theoretical value: 753.95 g/mol, measured value: 753 g/mol)

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[Synthesis Example 199] Synthesis of Inv-199



Inv-199

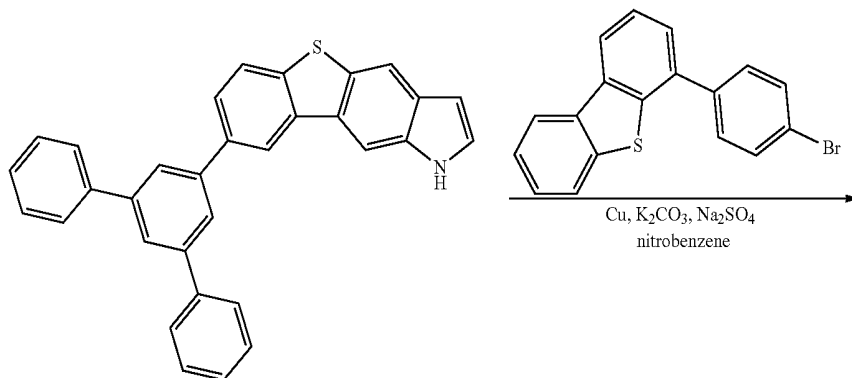
45

Inv-199 (8.54 g, yield: 63%) was obtained by performing the same procedure as in Synthesis Example 167, except that Inv-159-1 (7.51 g, 20.0 mmol) was used instead of IC-35.

GC-Mass (theoretical value: 677.85 g/mol, measured value: 677 g/mol)

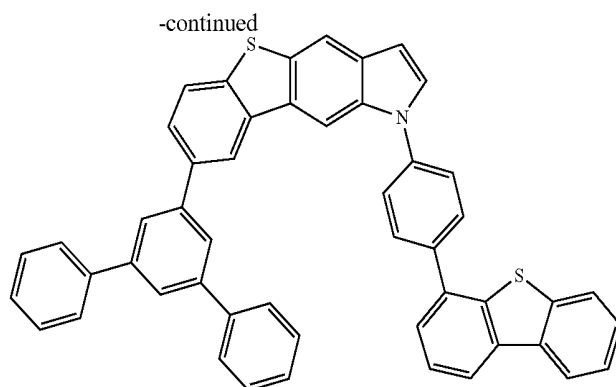
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[Synthesis Example 200] Synthesis of Inv-200



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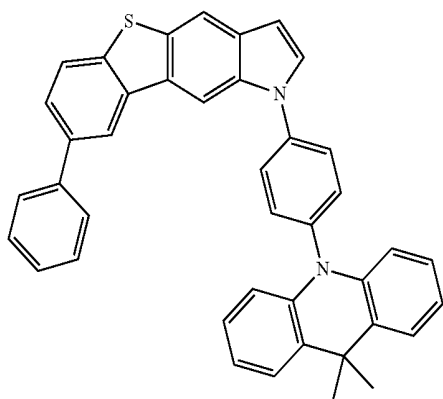
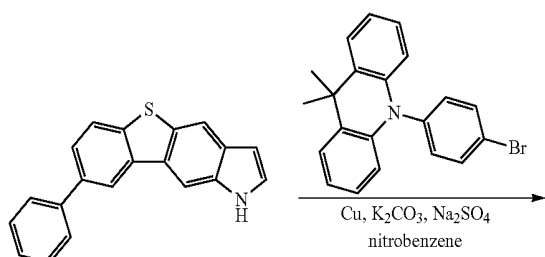


Inv-200

Inv-200 (8.52 g, yield: 60%) was obtained by performing the same procedure as in Synthesis Example 168, except that Inv-159-1 (9.03 g, 20.0 mmol) was used instead of IC-35.

GC-Mass (theoretical value: 709.92 g/mol, measured value: 709 g/mol)

[Synthesis Example 201] Synthesis of Inv-201



Inv-201

Inv-201 (6.18 g, yield: 53%) was obtained by performing the same procedure as in Synthesis Example 169, except that Inv-157-1 (5.98 g, 20.0 mmol) was used instead of IC-36.

GC-Mass (theoretical value: 582.76 g/mol, measured value: 582 g/mol)

[Synthesis Example 202] Synthesis of Inv-202

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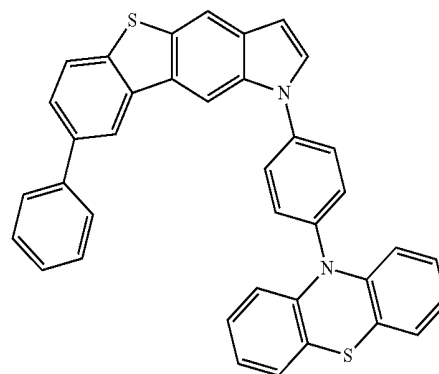
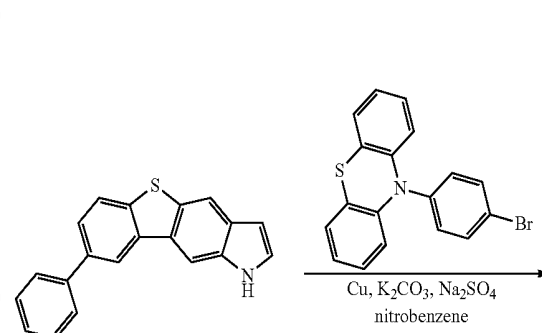
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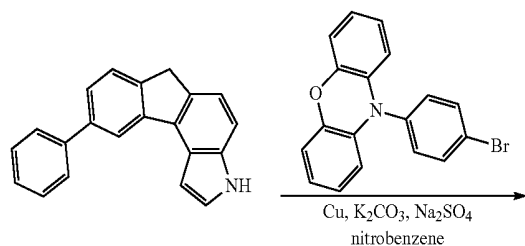
Inv-202

651

Inv-202 (5.84 g, yield: 51%) was obtained by performing the same procedure as in Synthesis Example 170, except that Inv-157-1 (5.98 g, 20.0 mmol) was used instead of IC-36.

GC-Mass (theoretical value: 572.74 g/mol, measured value: 572 g/mol)

[Synthesis Example 203] Synthesis of Inv-203



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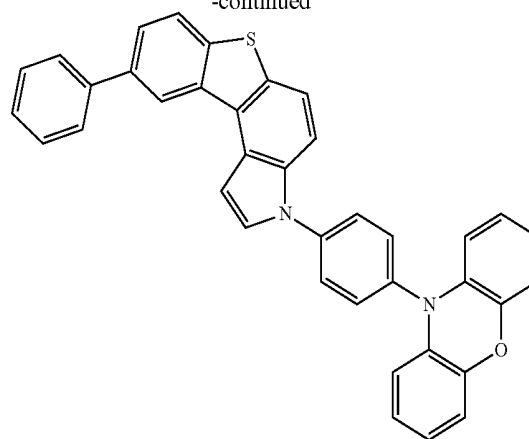
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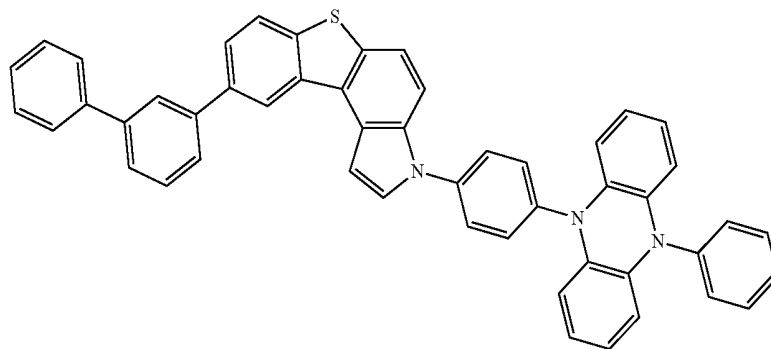
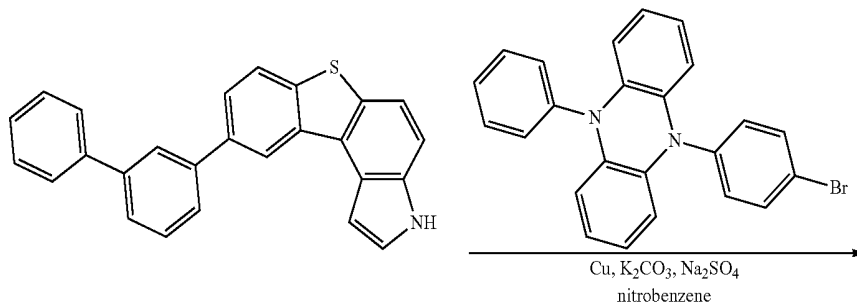


Inv-203

Inv-203 (7.46 g, yield: 67%) was obtained by performing the same procedure as in Synthesis Example 171, except that Inv-161-1 (5.98 g, 20.0 mmol) was used instead of IC-36.

GC-Mass (theoretical value: 556.67 g/mol, measured value: 556 g/mol)

[Synthesis Example 204] Synthesis of Inv-204



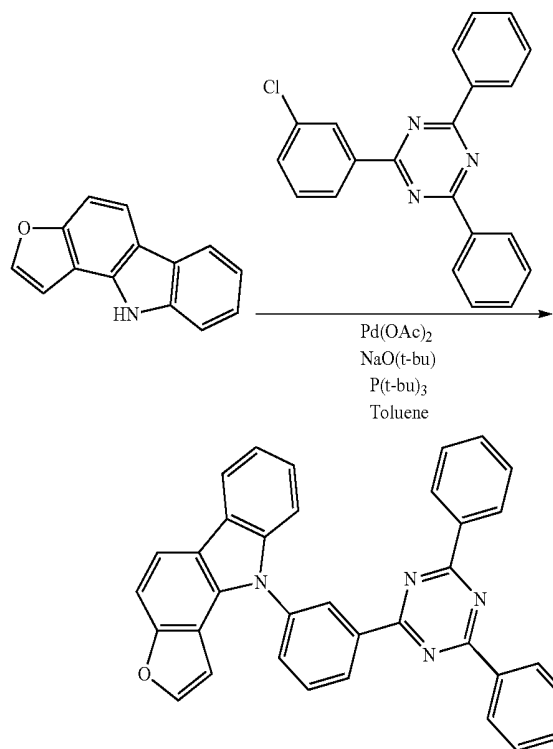
Inv-204

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Inv-204 (9.06 g, yield: 64%) was obtained by performing the same procedure as in Synthesis Example 172, except that Inv-163-1 (7.51 g, 20.0 mmol) was used instead of IC-36.

GC-Mass (theoretical value: 707.88 g/mol, measured value: 707 g/mol)

[Synthesis Example 205] Synthesis of Inv-205

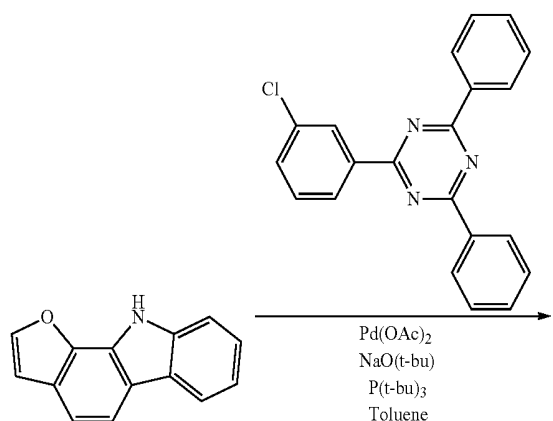


IC-46 (3 g, 14.48 mmol), 2-(3-chlorophenyl)-4,6-diphenyl-1,3,5-triazine (5.97 g, 17.37 mmol), Pd(OAc)_2 (0.16 g, 5 mol %), NaO(t-bu) (2.78 g, 28.95 mmol), P(t-bu)_3 (0.29 g, 1.45 mmol), and toluene (100 ml) were mixed under nitrogen flow, and the mixture was stirred at 110° C. for 12 hours.

After the reaction was completed, extraction was performed with ethyl acetate, moisture was removed with MgSO_4 , and purification was performed by column chromatography (Hexane:EA=2:1 (v/v)), thereby obtaining Inv-205 (5.59 g, yield 75%).

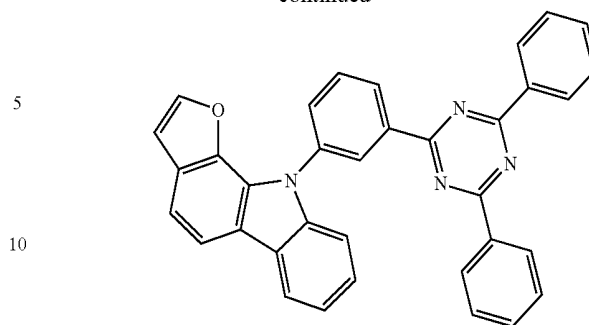
GC-Mass (theoretical value: 514.18 g/mol, measured value: 514 g/mol)

[Synthesis Example 206] Synthesis of Inv-206



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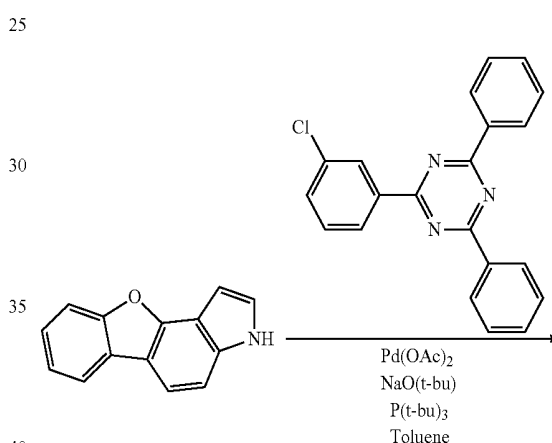
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A target compound Inv-206 (5.29 g, 71%) was obtained by performing the same procedure as in Synthesis Example 205, except that IC-47 was used instead of IC-46.

GC-Mass (theoretical value: 514.18 g/mol, measured value: 514 g/mol)

[Synthesis Example 207] Synthesis of Inv-207

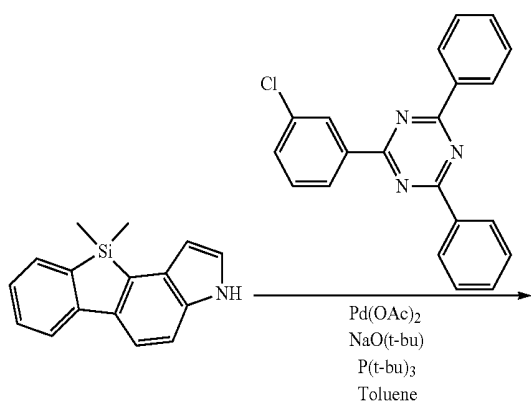


A target compound Inv-207 (5.44 g, 73%) was obtained by performing the same procedure as in Synthesis Example 205, except that IC-48 was used instead of IC-46.

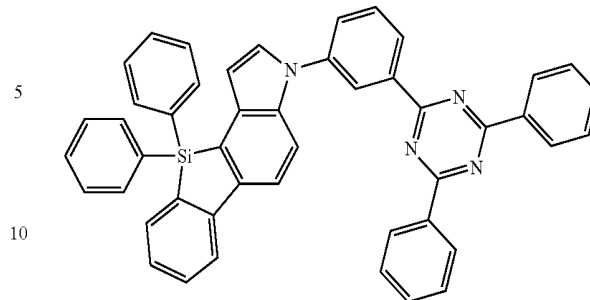
GC-Mass (theoretical value: 514.18 g/mol, measured value: 514 g/mol)

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[Synthesis Example 208] Synthesis of Inv-208

**656**

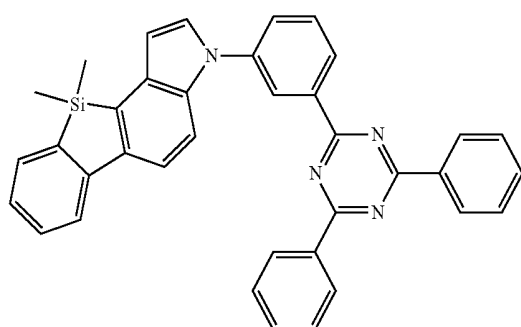
-continued



15 A target compound Inv-209 (3.66 g, 67%) was obtained by performing the same procedure as in Synthesis Example 205, except that IC-50 was used instead of IC-46.

20 GC-Mass (theoretical value: 680.24 g/mol, measured value: 680 g/mol)

[Synthesis Example 210] Synthesis of Inv-210

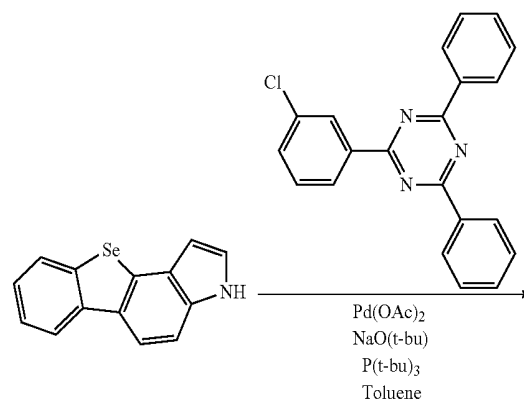


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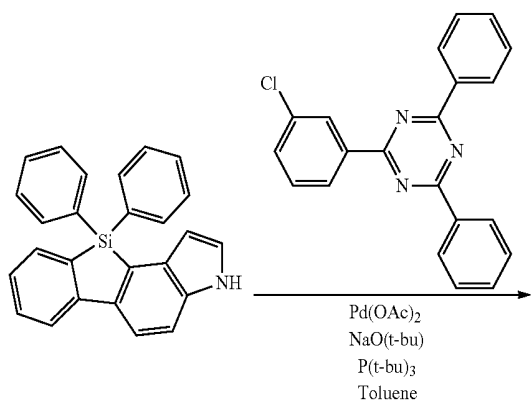
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A target compound Inv-208 (4.62 g, 69%) was obtained by performing the same procedure as in Synthesis Example 205, except that IC-49 was used instead of IC-46.

45 GC-Mass (theoretical value: 556.21 g/mol, measured value: 556 g/mol)

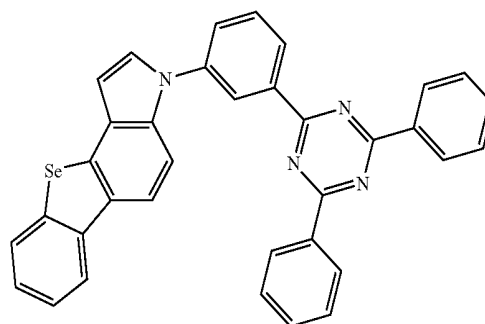
[Synthesis Example 209] Synthesis of Inv-209



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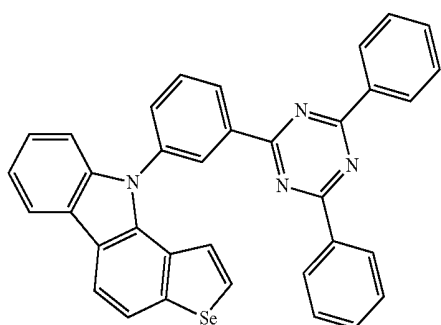
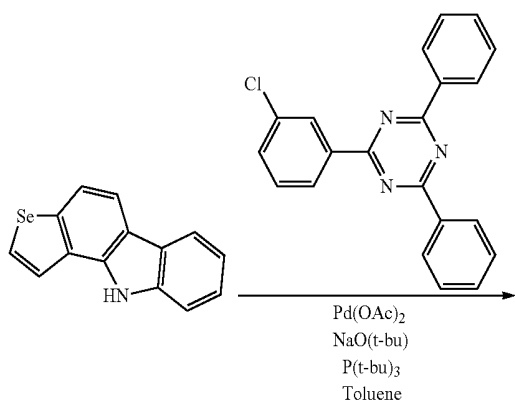


65 A target compound Inv-210 (4.87 g, 76%) was obtained by performing the same procedure as in Synthesis Example 205, except that IC-51 was used instead of IC-46.

GC-Mass (theoretical value: 578.10 g/mol, measured value: 578 g/mol)

657

[Synthesis Example 211] Synthesis of Inv-211

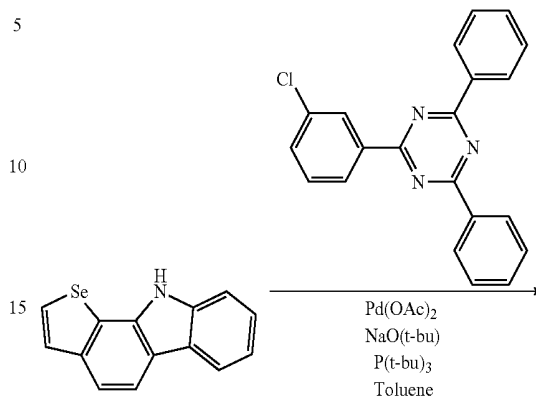


A target compound Inv-211 (4.75 g, 74%) was obtained by performing the same procedure as in Synthesis Example 205, except that IC-52 was used instead of IC-46.

GC-Mass (theoretical value: 578.10 g/mol, measured value: 578 g/mol)

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[Synthesis Example 212] Synthesis of Inv-212



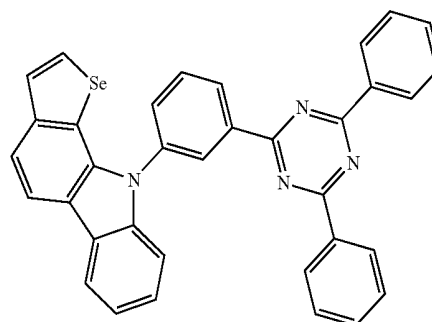
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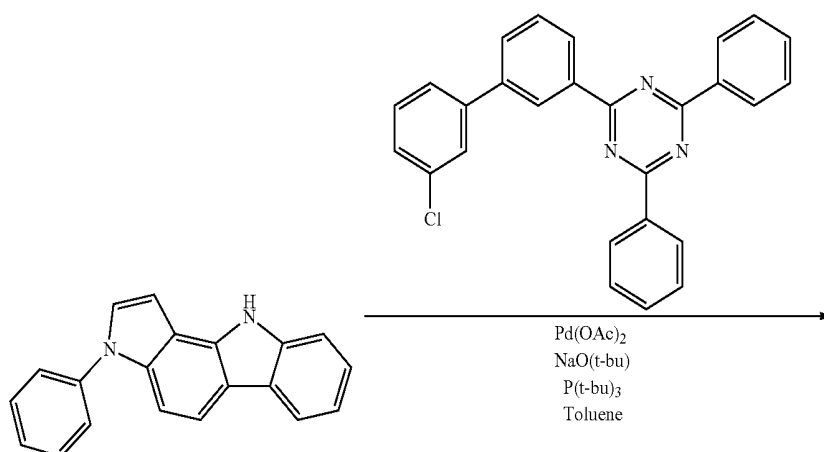
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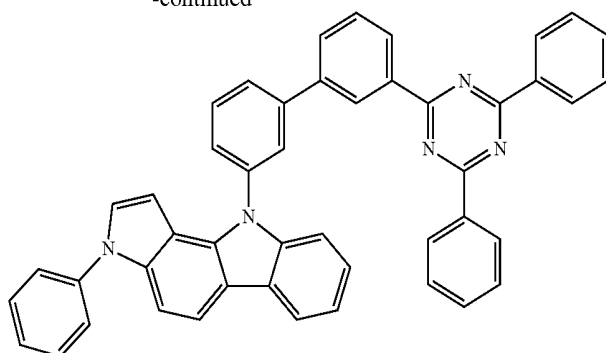
A target compound Inv-212 (4.68 g, 73%) was obtained by performing the same procedure as in Synthesis Example 205, except that IC-53 was used instead of IC-46.

GC-Mass (theoretical value: 578.10 g/mol, measured value: 578 g/mol)

[Synthesis Example 213] Synthesis of Inv-213



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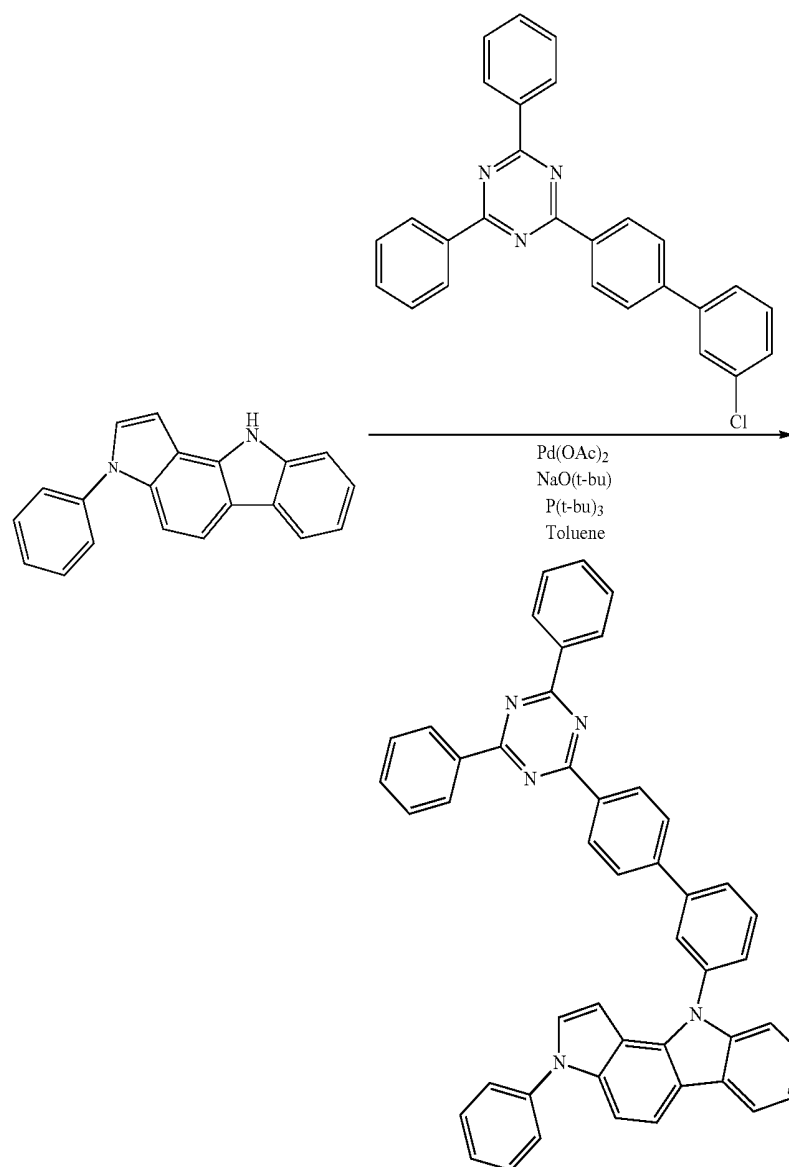
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A target compound Inv-213 (4.31 g, yield 61%) was obtained by performing the same procedure as in Synthesis Example 29, except that 2-(3'-chlorobiphenyl-3-yl)-4,6-diphenyl-1,3,5-triazine was used instead of 2-(3-chlorophenyl)-4,6-diphenyl-1,3,5-triazine.

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GC-Mass (theoretical value: 665.26 g/mol, measured value: 665 g/mol)

[Synthesis Example 214] Synthesis of Inv-214

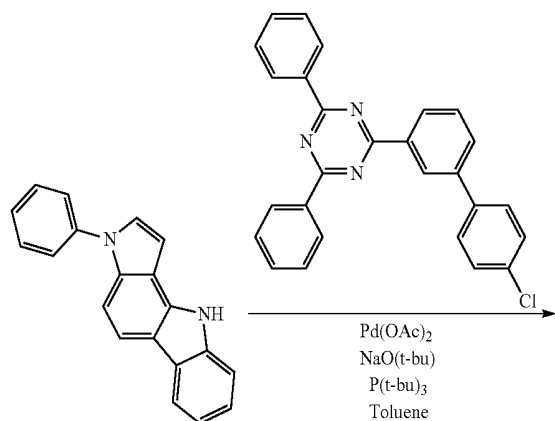


661

A target compound Inv-214 (4.10 g, yield 58%) was obtained by performing the same procedure as in Synthesis Example 29, except that 2-(3'-chlorobiphenyl-4-yl)-4,6-diphenyl-1,3,5-triazine was used instead of 2-(3-chlorophenyl)-4,6-diphenyl-1,3,5-triazine.

GC-Mass (theoretical value: 665.26 g/mol, measured value: 665 g/mol)

[Synthetic Example 215] Synthesis of Inv-215



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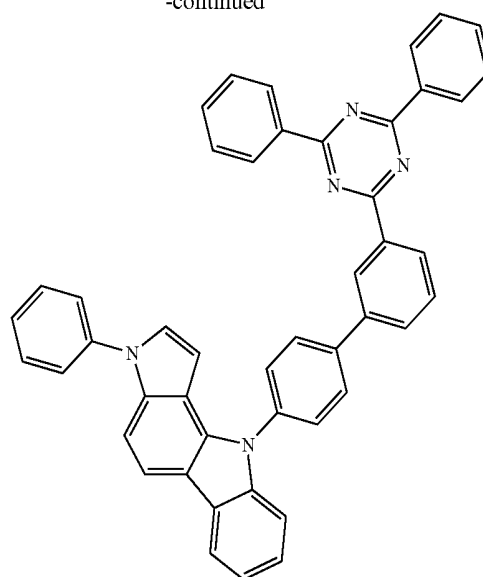
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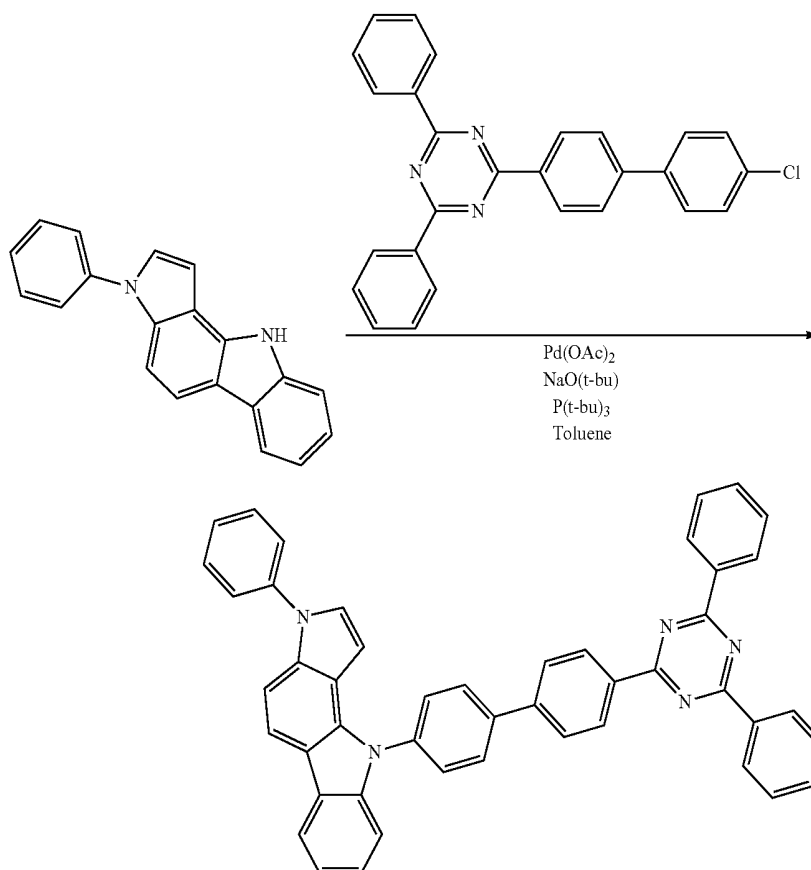
-continued



A target compound Inv-215 (4.66 g, yield 66%) was obtained by performing the same procedure as in Synthesis Example 29, except that 2-(4'-chlorobiphenyl-3-yl)-4,6-diphenyl-1,3,5-triazine was used instead of 2-(3-chlorophenyl)-4,6-diphenyl-1,3,5-triazine.

GC-Mass (theoretical value: 665.26 g/mol, measured value: 665 g/mol)

[Synthesis Example 216] Synthesis of Inv-216



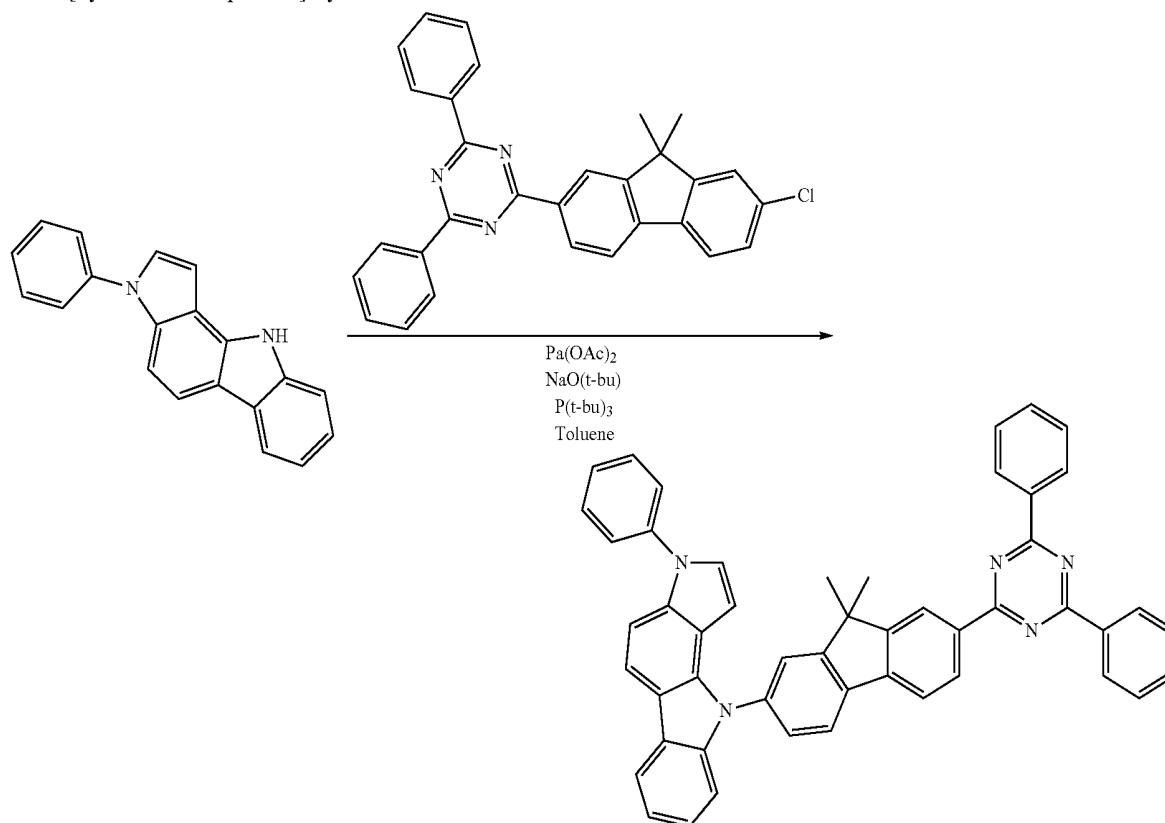
663

A target compound Inv-216 (4.24 g, yield 60%) was obtained by performing the same procedure as in Synthesis Example 29, except that 2-(4'-chlorobiphenyl-4-yl)-4,6-diphenyl-1,3,5-triazine was used instead of 2-(3-chlorophenyl)-4,6-diphenyl-1,3,5-triazine.

GC-Mass (theoretical value: 665.26 g/mol, measured value: 665 g/mol)

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[Synthesis Example 217] Synthesis of Inv-217



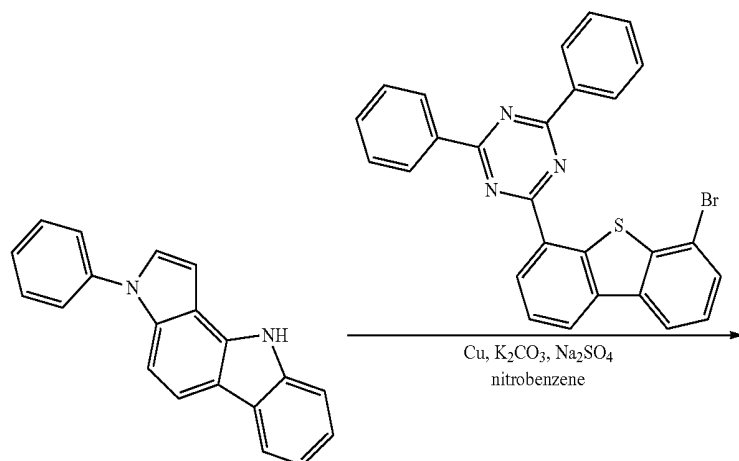
A target compound Inv-217 (4.12 g, 55%) was obtained by performing the same procedure as in Synthesis Example 29, except that 2-(7-chloro-9,9-dimethyl-9H-fluorene-2-yl)-4,6-diphenyl-1,3,5-triazine was used instead of 2-(3-chlorophenyl)-4,6-diphenyl-1,3,5-triazine.

GC-Mass (theoretical value: 705.29 g/mol, measured value: 705 g/mol)

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[Synthesis Example 218] Synthesis of Inv-218

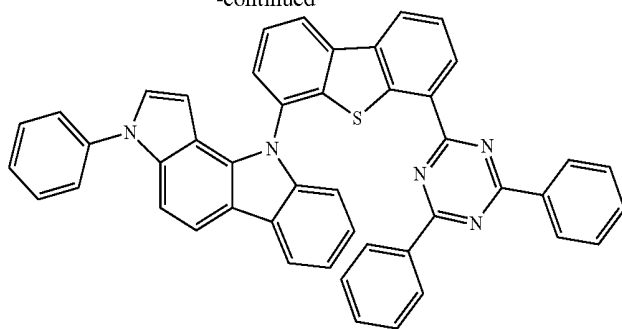


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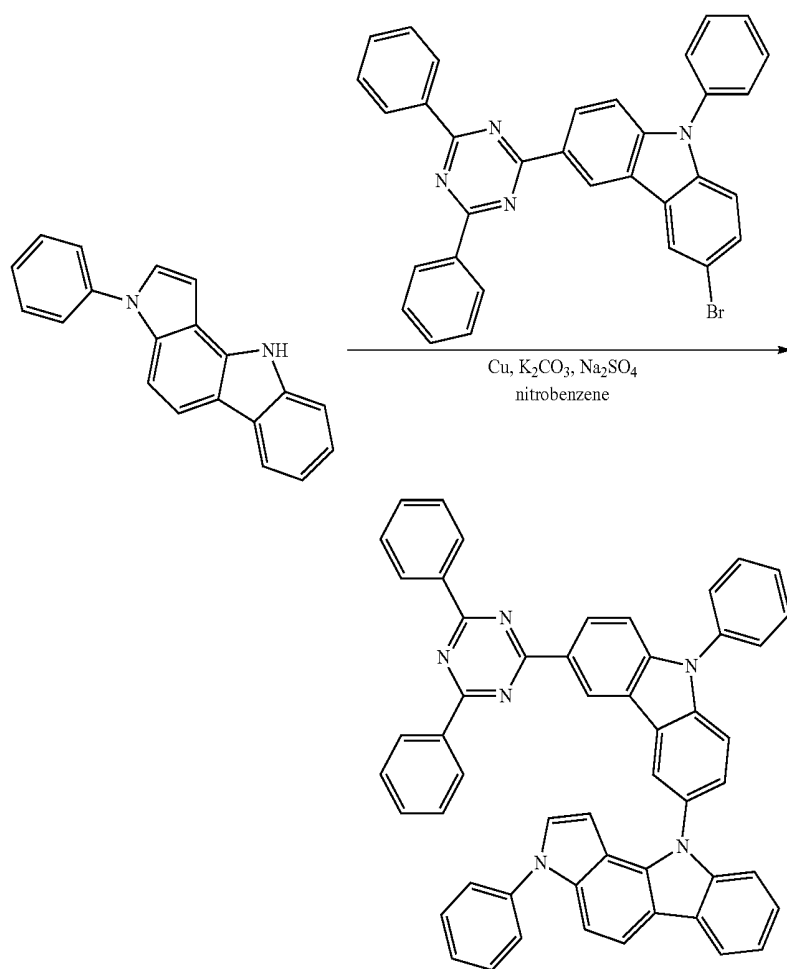
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A target compound Inv-218 (4.67 g, yield 38%) was obtained by performing the same procedure as Synthesis Example 1, except that IC-1b as another compound prepared in Preparation Example 1 was used instead of IC-1a, and 2-(6-bromodibenzo[b,c]thiophen-4-yl)-4,6-diphenyl-1,3,5-

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triazine was used instead of 2-bromo-4,6-diphenylpyridine. GC-Mass (theoretical value: 695.21 g/mol, measured value: 695 g/mol)

[Synthesis Example 219] Synthesis of Inv-219



A target compound Inv-219 (5.34 g, yield 40%) was obtained by performing the same procedure as Synthesis Example 1, except that IC-1b as another compound prepared in Preparation Example 1 was used instead of IC-1a, and

65

3-bromo-6-(4,6-diphenyl-1,3,5-triazin-2-yl)-9-phenyl-9H-carbazole was used instead of 2-bromo-4,6-diphenylpyridine.

GC-Mass (theoretical value: 754.28 g/mol, measured value: 754 g/mol)

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[Examples 1 to 30] Manufacture of Organic Electroluminescent Device

Compounds Inv-1 to Inv-26 and Inv-111 to Inv-114 synthesized in Synthesis Examples 1 to 26 and 111 to 114 were subjected to highly-pure sublimation purification by a typically known method, and then a green organic electroluminescent device was manufactured according to the following procedure.

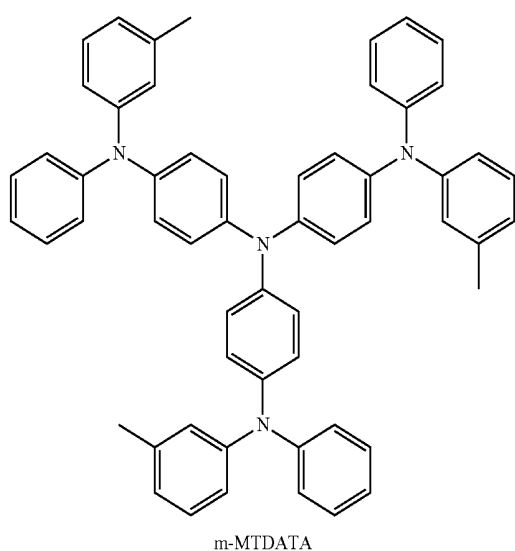
First, a glass substrate on which a thin film of indium tin oxide (ITO) was coated to a thickness of 1500 Å was washed with distilled water under ultrasonic wave. After washed with distilled water, the glass substrate was ultrasonically washed with a solvent such as isopropyl alcohol, acetone and methanol, dried, and transferred to a UV ozone cleaner (Power sonic 405, Hwashin Technology Co., Ltd.), and then the substrate was cleaned for 5 minutes by using UV rays, and transferred to a vacuum deposition system.

An organic electroluminescent device was manufactured by laminating m-MTDATA (60 nm)/TCTA (80 nm)/each compound of Inv-1 to Inv-26 and Inv-111 to Inv-114+10% Ir(ppy)₃ (300 nm)/BCP (10 nm)/Alq₃ (30 nm)/LiF (1 nm)/Al (200 nm) in this order on the ITO transparent electrode thus-prepared.

[Comparative Example 1] Manufacture of Organic Electroluminescent Device

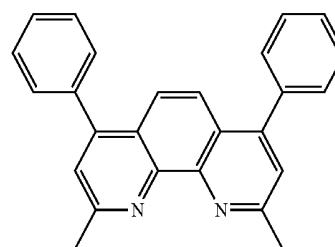
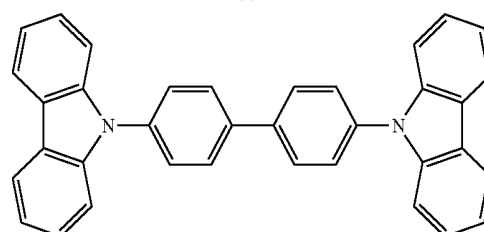
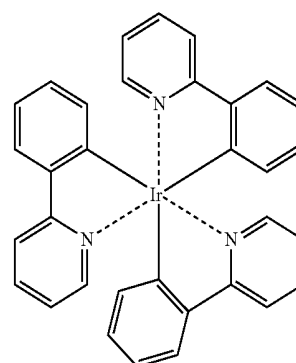
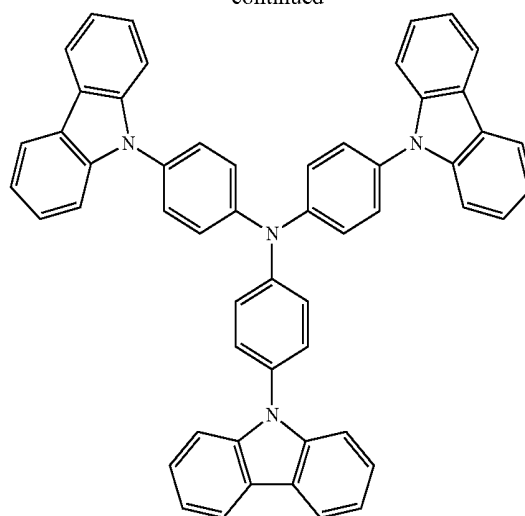
An organic electroluminescent device was manufactured in the same manner as in Example 1, except that CBP was used instead of Compound Inv-1 as a light-emitting host material when a light-emitting layer is formed.

The structures of m-MTDATA, TCTA, Ir(ppy)₃, CBP and BCP used in Examples 1 to 30 and Comparative Example 1 are as follows.



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Evaluative Example

For each of the green organic electroluminescent devices manufactured in Examples 1 to 30 and Comparative Example 1, the driving voltage, current efficiency, and light-emitting peak are measured at a current density of 10 mA/cm², and the results are shown in the following Table 1.

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TABLE 1

Sample	Host	Driving voltage (V)	EL Peak (nm)	Current efficiency (cd/A)
Example 1	Inv-1	6.78	517	42.4
Example 2	Inv-2	6.81	516	41.1
Example 3	Inv-3	6.83	517	40.8
Example 4	Inv-4	6.81	515	41.0
Example 5	Inv-5	6.81	517	40.4
Example 6	Inv-6	6.77	516	42.1
Example 7	Inv-7	6.78	518	41.5
Example 8	Inv-8	6.80	516	40.2
Example 9	Inv-9	6.79	517	41.3
Example 10	Inv-10	6.85	516	40.6
Example 11	Inv-11	6.77	515	42.0
Example 12	Inv-12	6.79	518	41.3
Example 13	Inv-13	6.82	517	40.2
Example 14	Inv-14	6.83	518	40.9
Example 15	Inv-15	6.81	516	41.0
Example 16	Inv-16	6.79	516	41.3
Example 17	Inv-17	6.87	517	39.4
Example 18	Inv-18	6.86	515	37.6
Example 19	Inv-19	6.89	518	38.3
Example 20	Inv-20	6.85	517	38.8
Example 21	Inv-21	7.06	518	37.2
Example 22	Inv-22	7.12	518	37.5
Example 23	Inv-23	7.22	519	36.2
Example 24	Inv-24	6.83	516	39.1
Example 25	Inv-25	7.09	517	37.9
Example 26	Inv-26	7.01	515	38.1
Example 27	Inv-111	6.98	517	37.5
Example 28	Inv-112	7.02	518	37.9
Example 29	Inv-113	6.95	517	38.1
Example 30	Inv-114	6.86	516	39.2
Comparative Example 1	CBP	6.93	516	38.2

As shown in Table 1, it can be seen that when compared with the green organic electroluminescent device using a CBP in the related art (Comparative Example 1), the green organic electroluminescent devices using the compounds (Inv-1 to Inv-26 and Inv-111 to Inv-114) according to the present invention as a light-emitting layer of the green organic electroluminescent device (Examples 1 to 30) show excellent performances in terms of efficiency and driving voltage.

[Examples 31 to 114] Manufacture of Organic Electroluminescent Device

Compounds Inv-27 to Inv-110 synthesized in Synthesis Examples 27 to 110 were subjected to highly-pure sublimation purification by a typically known method, and then a green organic electroluminescent device was manufactured in the same manner as in Example 1.

Evaluative Example

For each of the green organic electroluminescent devices manufactured in Examples 31 to 114 and Comparative Example 1, the driving voltage, current efficiency, and light-emitting peak are measured at a current density of 10 mA/cm², and the results are shown in the following Table 2.

TABLE 2

Sample	Host	Driving voltage (V)	EL Peak (nm)	Current efficiency (cd/A)
Example 31	Inv-27	6.88	518	41.4
Example 32	Inv-28	6.87	519	40.9
Example 33	Inv-29	6.63	516	43.2
Example 34	Inv-30	6.65	516	43.5

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TABLE 2-continued

Sample	Host	Driving voltage (V)	EL Peak (nm)	Current efficiency (cd/A)
5 Example 35	Inv-31	6.71	516	41.7
Example 36	Inv-32	6.68	516	42.1
Example 37	Inv-33	6.66	516	42.6
Example 38	Inv-34	6.91	517	40.4
Example 39	Inv-35	6.85	518	38.8
Example 40	Inv-36	6.86	519	39.1
10 Example 41	Inv-37	6.84	515	40.1
Example 42	Inv-38	6.63	517	42.8
Example 43	Inv-39	6.75	516	40.2
Example 44	Inv-40	6.73	515	40.9
Example 45	Inv-41	6.75	515	41.2
Example 46	Inv-42	6.89	516	39.2
15 Example 47	Inv-43	6.87	517	39.4
Example 48	Inv-44	6.61	516	40.6
Example 49	Inv-45	6.69	518	41.2
Example 50	Inv-46	6.67	517	40.7
Example 51	Inv-47	6.68	516	41.3
Example 52	Inv-48	6.67	518	40.8
20 Example 53	Inv-49	6.91	516	39.1
Example 54	Inv-50	6.83	516	39.5
Example 55	Inv-51	6.89	517	41.9
Example 56	Inv-52	6.81	515	40.3
Example 57	Inv-53	6.64	517	42.0
Example 58	Inv-54	6.66	518	41.1
Example 59	Inv-55	6.69	517	40.9
25 Example 60	Inv-56	6.70	516	41.8
Example 61	Inv-57	6.65	518	41.3
Example 62	Inv-58	6.66	519	42.2
Example 63	Inv-59	6.64	516	41.3
Example 64	Inv-60	6.88	516	41.8
Example 65	Inv-61	6.72	517	40.5
30 Example 66	Inv-62	6.69	516	42.9
Example 67	Inv-63	6.65	517	41.3
Example 68	Inv-64	6.68	517	41.7
Example 69	Inv-65	6.61	518	41.6
Example 70	Inv-66	6.73	516	40.4
Example 71	Inv-67	6.68	516	40.9
35 Example 72	Inv-68	6.62	518	41.2
Example 73	Inv-69	6.61	516	41.8
Example 74	Inv-70	6.83	516	39.1
Example 75	Inv-71	6.85	517	38.5
Example 76	Inv-72	6.63	516	42.0
Example 77	Inv-73	6.68	517	41.3
Example 78	Inv-74	6.91	518	42.8
40 Example 79	Inv-75	6.73	516	40.6
Example 80	Inv-76	6.62	516	41.1
Example 81	Inv-77	6.77	517	40.5
Example 82	Inv-78	6.65	516	41.0
Example 83	Inv-79	6.66	518	41.2
Example 84	Inv-80	6.67	516	40.8
45 Example 85	Inv-81	6.90	517	41.9
Example 86	Inv-82	6.75	516	40.3
Example 87	Inv-83	6.83	517	40.3
Example 88	Inv-84	6.63	516	41.2
Example 89	Inv-85	6.69	517	40.9
Example 90	Inv-86	6.67	516	41.3
50 Example 91	Inv-87	6.89	518	41.5
Example 92	Inv-88	6.73	518	40.8
Example 93	Inv-89	6.72	516	40.3
Example 94	Inv-90	6.68	516	41.0
Example 95	Inv-91	6.69	517	40.8
Example 96	Inv-92	6.70	516	40.5
55 Example 97	Inv-93	6.65	517	41.3
Example 98	Inv-94	6.67	518	41.1
Example 99	Inv-95	6.60	517	42.1
Example 100	Inv-96	6.65	518	41.9
Example 101	Inv-97	6.85	518	41.1
Example 102	Inv-98	6.73	518	40.3
Example 103	Inv-99	6.71	517	40.2
60 Example 104	Inv-100	6.68	516	41.2
Example 105	Inv-101	6.74	517	40.7
Example 106	Inv-102	6.69	517	41.3
Example 107	Inv-103	6.85	517	40.5
Example 108	Inv-104	6.65	518	41.1
Example 109	Inv-105	6.68	517	40.8
65 Example 110	Inv-106	6.70	517	40.9
Example 111	Inv-107	6.73	517	41.5

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TABLE 2-continued

Sample	Host	Driving voltage (V)	EL Peak (nm)	Current efficiency (cd/A)
Example 112	Inv-108	6.75	516	40.8
Example 113	Inv-109	6.74	518	41.8
Example 114	Inv-110	6.88	516	41.3
Comparative Example 1	CBP	6.93	516	38.2

As shown in Table 2, it can be seen that when compared with the green organic electroluminescent device using a CBP in the related art (Comparative Example 1), the green organic electroluminescent devices using the compounds (Inv-27 to Inv-110) according to the present invention as a light-emitting layer of the green organic electroluminescent device (Examples 31 to 114) show excellent performances in terms of efficiency and driving voltage.

[Examples 115 to 212] Manufacture of Organic Electroluminescent Device

Compounds Inv-115 to Inv-212 synthesized in Synthesis Examples 115 to 212 were subjected to highly-pure sublimation purification by a typically known method, and then a red organic electroluminescent device was manufactured according to the following procedure.

First, a glass substrate on which a thin film of indium tin oxide (ITO) was coated to a thickness of 1500 Å was washed with distilled water under ultrasonic wave. After washed with distilled water, the glass substrate was ultrasonically washed with a solvent such as isopropyl alcohol, acetone and methanol, dried, and transferred to a UV ozone cleaner (Power sonic 405, Hwashin Technology Co., Ltd.), and then the substrate was cleaned for 5 minutes by using UV rays, and transferred to a vacuum deposition system.

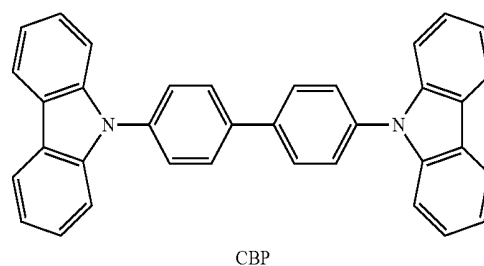
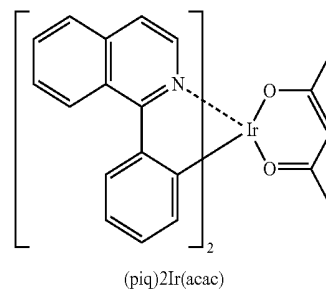
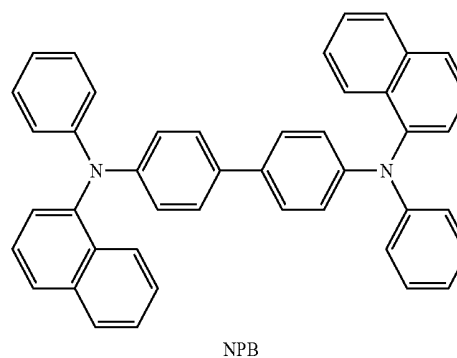
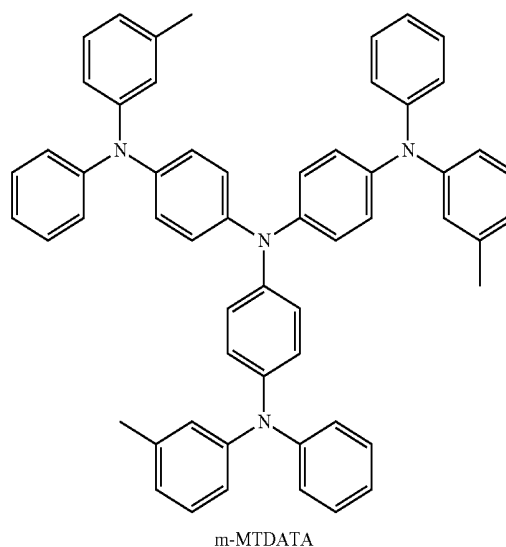
An organic electroluminescent device was manufactured by laminating m-MTDATA (60 nm)/NPB (20 nm)/each compound of Inv-115 to Inv-212+10% (piq)₂Ir(acac) (30 nm)/BCP (10 nm)/Alq₃ (30 nm)/LiF (1 nm)/Al (200 nm) in this order on the ITO transparent electrode thus-prepared.

[Comparative Example 2] Manufacture of Organic Electroluminescent Device

A red organic electroluminescent device was manufactured in the same manner as in Example 115, except that CBP was used instead of Compound Inv-115 as a light-emitting host material when a light-emitting layer is formed.

The structures of m-MTDATA, NPB, (piq)₂Ir(acac) and CBP used in Examples 115 to 212 and Comparative Example 2 are as follows.

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Evaluative Example

For each of the red organic electroluminescent devices manufactured in Examples 115 to 212 and Comparative Example 2, the driving voltage, current efficiency, and light-emitting peak are measured at a current density of 10 mA/cm², and the results are shown in the following Table 3.

TABLE 3

Sample	Host	Driving voltage (V)	Electric current efficiency (cd/A)
Example 115	Inv-115	4.75	12.4
Example 116	Inv-116	4.51	12.3
Example 117	Inv-117	4.53	12.5
Example 118	Inv-118	4.61	12.0
Example 119	Inv-119	4.71	12.6
Example 120	Inv-120	4.75	12.0
Example 121	Inv-121	4.70	12.5
Example 122	Inv-122	4.68	12.2
Example 123	Inv-123	4.74	12.3
Example 124	Inv-124	4.65	14.2
Example 125	Inv-125	4.77	12.1
Example 126	Inv-126	4.80	12.3
Example 127	Inv-127	4.66	14.2
Example 128	Inv-128	4.71	12.5
Example 129	Inv-129	4.81	12.2
Example 130	Inv-130	4.79	14.3
Example 131	Inv-131	4.67	12.5
Example 132	Inv-132	4.54	12.6
Example 133	Inv-133	4.59	12.3
Example 134	Inv-134	4.65	12.8
Example 135	Inv-135	4.54	14.2
Example 136	Inv-136	4.72	12.5
Example 137	Inv-137	4.70	12.2
Example 138	Inv-138	4.63	14.1
Example 139	Inv-139	4.59	12.9
Example 140	Inv-140	4.71	12.1
Example 141	Inv-141	4.69	12.5
Example 142	Inv-142	4.59	12.9
Example 143	Inv-143	4.70	12.1
Example 144	Inv-144	4.64	12.2
Example 145	Inv-145	4.75	12.0
Example 146	Inv-146	4.70	14.3
Example 147	Inv-147	4.62	12.2
Example 148	Inv-148	4.73	12.3
Example 149	Inv-149	4.71	12.7
Example 150	Inv-150	4.77	14.3
Example 151	Inv-151	4.69	12.9

TABLE 3-continued

Example 152	Inv-152	4.56	14.1
Example 153	Inv-153	4.59	12.5
Example 154	Inv-154	4.60	12.9
Example 155	Inv-155	4.70	12.1
Example 156	Inv-156	4.84	12.2
Example 157	Inv-157	4.75	14.0
Example 158	Inv-158	4.78	12.3
Example 159	Inv-159	4.62	12.2
Example 160	Inv-160	4.80	12.4
Example 161	Inv-161	4.66	13.4
Example 162	Inv-162	4.70	12.9
Example 163	Inv-163	4.75	14.0
Comparative Example 2	CBP	5.25	8.2
Sample	Host	Driving voltage (V)	Current efficiency
Example 164	Inv-164	4.78	12.5
Example 165	Inv-165	4.75	13.3
Example 166	Inv-166	4.70	14.1
Example 167	Inv-167	4.73	13.6
Example 168	Inv-168	4.74	12.9
Example 169	Inv-169	4.60	12.9
Example 170	Inv-170	4.70	13.8
Example 171	Inv-171	4.83	13.3
Example 172	Inv-172	4.79	14.0
Example 173	Inv-173	4.75	13.5
Example 174	Inv-174	4.80	13.0
Example 175	Inv-175	4.69	14.0
Example 176	Inv-176	4.73	13.5
Example 177	Inv-177	4.60	12.8
Example 178	Inv-178	4.66	12.9
Example 179	Inv-179	4.69	13.8
Example 180	Inv-180	4.70	12.9
Example 181	Inv-181	4.75	13.3
Example 182	Inv-182	4.70	12.6
Example 183	Inv-183	4.80	13.1
Example 184	Inv-184	4.81	13.7
Example 185	Inv-185	4.79	12.5
Example 186	Inv-186	4.69	13.5
Example 187	Inv-187	4.70	12.7

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TABLE 3-continued

Example	Inv-	4.74	12.9
Example 188	Inv-188	4.74	12.9
Example 189	Inv-189	4.67	12.8
Example 190	Inv-190	4.75	13.0
Example 191	Inv-191	4.77	13.1
Example 192	Inv-192	4.66	12.9
Example 193	Inv-193	4.75	13.3
Example 194	Inv-194	4.70	12.9
Example 195	Inv-195	4.75	13.2
Example 196	Inv-196	4.79	13.8
Example 197	Inv-197	4.70	14.3
Example 198	Inv-198	4.79	13.5
Example 199	Inv-199	4.76	12.8
Example 200	Inv-200	4.80	14.1
Example 201	Inv-201	4.81	12.2
Example 202	Inv-202	4.80	14.1
Example 203	Inv-203	4.75	12.5
Example 204	Inv-204	4.72	12.8
Example 205	Inv-205	4.90	12.5
Example 206	Inv-206	4.86	12.0
Example 207	Inv-207	4.91	12.7
Example 208	Inv-208	4.88	13.0
Example 209	Inv-209	4.80	13.5
Example 210	Inv-210	4.90	12.9
Example 211	Inv-211	4.88	12.5
Example 212	Inv-212	4.92	12.8

[Examples 213 to 317] Manufacture of Organic Electroluminescent Device

Compounds Inv-115 to Inv-219 synthesized in Synthesis Examples 115 to 219 were subjected to highly-pure sublimation purification by a typically known method, and then a green organic electroluminescent device was manufactured in the same manner as in Example 1.

Evaluative Example

For each of the green organic electroluminescent devices manufactured in Examples 213 to 317 and Comparative Example 1, the driving voltage, current efficiency, and light-emitting peak are measured at a current density of 10 mA/cm², and the results are shown in the following Table 4.

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TABLE 4

Sample	Host	Driving voltage (V)	Current efficiency (cd/A)
Example 213	Inv-115	6.78	41.5
Example 214	Inv-116	6.61	41.0
Example 215	Inv-117	6.63	41.2
Example 216	Inv-118	6.61	41.0
Example 217	Inv-119	6.61	40.9
Example 218	Inv-120	6.77	41.5
Example 219	Inv-121	6.78	41.4
Example 220	Inv-122	6.60	41.0
Example 221	Inv-123	6.79	41.3
Example 222	Inv-124	6.65	41.2
Example 223	Inv-125	6.77	40.5
Example 224	Inv-126	6.79	41.0
Example 225	Inv-127	6.62	40.7
Example 226	Inv-128	6.63	40.8
Example 227	Inv-129	6.61	41.0
Example 228	Inv-130	6.79	41.6
Example 229	Inv-131	6.67	40.5
Example 230	Inv-132	6.66	40.3
Example 231	Inv-133	6.69	39.9
Example 232	Inv-134	6.65	40.0
Example 233	Inv-135	6.66	40.1
Example 234	Inv-136	6.72	39.9
Example 235	Inv-137	6.60	39.5
Example 236	Inv-138	6.63	39.8
Example 237	Inv-139	6.69	40.9
Example 238	Inv-140	6.51	40.3
Example 239	Inv-141	6.59	39.9
Example 240	Inv-142	6.51	40.4
Example 241	Inv-143	6.72	41.1
Example 242	Inv-144	6.66	40.4
Example 243	Inv-145	6.77	40.9
Example 244	Inv-146	6.78	40.5
Example 245	Inv-147	6.62	41.1
Example 246	Inv-148	6.63	42.3
Example 247	Inv-149	6.61	40.7
Example 248	Inv-150	6.70	41.3
Example 249	Inv-151	6.69	40.8
Example 250	Inv-152	6.51	40.6

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TABLE 4-continued

Sample	Host	Driving voltage (V)	Current efficiency (cd/A)
Example 251	Inv-153	6.59	41.1
Example 252	Inv-154	6.51	40.9
Example 253	Inv-155	6.72	40.1
Example 254	Inv-156	6.66	40.2
Example 255	Inv-157	6.77	40.9
Example 256	Inv-158	6.78	41.1
Example 257	Inv-159	6.62	41.0
Example 258	Inv-160	6.78	41.2
Example 259	Inv-161	6.61	41.0
Example 260	Inv-162	6.63	40.9
Example 261	Inv-163	6.61	41.0
Example 262	Inv-164	6.61	40.7
Example 263	Inv-165	6.77	42.1
Example 264	Inv-166	6.78	40.4
Example 265	Inv-167	6.60	41.0
Example 266	Inv-168	6.79	41.1
Example 267	Inv-169	6.65	40.2
Example 268	Inv-170	6.77	40.2
Example 269	Inv-171	6.79	41.0
Example 270	Inv-172	6.62	41.2
Example 271	Inv-173	6.63	40.6
Example 272	Inv-174	6.61	41.0
Example 273	Inv-175	6.79	41.1
Example 274	Inv-176	6.67	39.9
Example 275	Inv-177	6.66	40.6
Example 276	Inv-178	6.69	39.8
Example 277	Inv-179	6.65	40.8
Example 278	Inv-180	6.66	40.5
Example 279	Inv-181	6.72	39.9
Example 280	Inv-182	6.60	40.2
Example 281	Inv-183	6.63	39.9
Example 282	Inv-184	6.69	40.4
Example 283	Inv-185	6.51	40.1
Example 284	Inv-186	6.59	39.9
Example 285	Inv-187	6.51	40.3
Example 286	Inv-188	6.72	39.8
Example 287	Inv-189	6.66	40.3
Example 288	Inv-190	6.77	40.5

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TABLE 4-continued

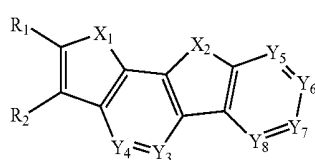
Sample	Host	Driving voltage (V)	Current efficiency (cd/A)
Example 289	Inv-191	6.78	40.1
Example 290	Inv-192	6.62	41.0
Example 291	Inv-193	6.63	42.1
Example 292	Inv-194	6.61	40.8
Example 293	Inv-195	6.70	41.0
Example 294	Inv-196	6.69	39.9
Example 295	Inv-197	6.51	40.2
Example 296	Inv-198	6.59	40.5
Example 297	Inv-199	6.51	39.9
Example 298	Inv-200	6.72	39.1
Example 299	Inv-201	6.66	40.2
Example 300	Inv-202	6.77	40.7
Example 301	Inv-203	6.78	40.3
Example 302	Inv-204	6.62	41.5
Example 303	Inv-205	6.70	40.1
Example 304	Inv-206	6.65	40.2
Example 305	Inv-207	6.79	40.5
Example 306	Inv-208	6.70	40.8
Example 307	Inv-209	6.75	40.4
Example 308	Inv-210	6.69	40.8
Example 309	Inv-211	6.70	40.7
Example 310	Inv-212	6.71	40.5
Example 311	Inv-213	6.55	41.2
Example 312	Inv-214	6.59	42.5
Example 313	Inv-215	6.50	41.8
Example 314	Inv-216	6.55	41.4
Example 315	Inv-217	6.59	42.2
Example 316	Inv-218	6.50	41.7
Example 317	Inv-219	6.51	41.6
Comparative Example 2	CBP	6.93	38.2

As shown in Table 3 and Table 4, it can be seen that when compared with the red or green organic electroluminescent device using a CBP in the related art (Comparative Examples 1 and 2), the red or green organic electroluminescent devices using the compounds (Inv-115 to Inv-219) according to the present invention as a light-emitting layer of the red or green organic electroluminescent device (Examples 115 to 317) show excellent performances in terms of efficiency and driving voltage.

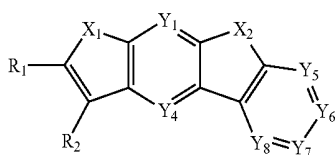
Since the indole-based compound represented by Formula 1 according to the present invention has superior thermal resistance, hole injection and transport capabilities, electron injection and transport capabilities, light-emitting capabilities, and the like, an organic electroluminescent device including the compound as a hole injection/transporting layer, an electron injection/transporting layer, or a phosphorescent/fluorescent-host/dopant of a light-emitting layer and the like may be significantly enhanced in terms of light-emitting performance, driving voltage, lifespan, efficiency, and the like, and thus may be effectively applied to a full-color display panel and the like.

The invention claimed is:

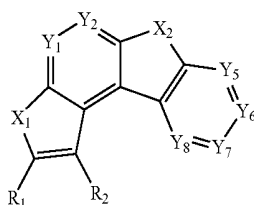
1. A compound of the following Formulae 1a to 1f:



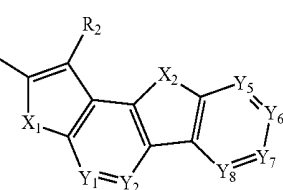
Formula 1a



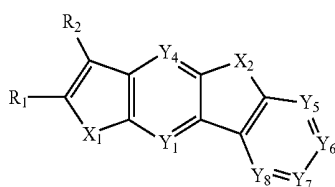
Formula 1b



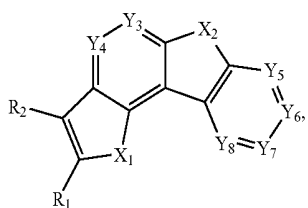
Formula 1c



Formula 1d



Formula 1e



Formula 1f

wherein R_1 and R_2 are each independently selected from the group consisting of hydrogen, deuterium, halogen, a cyano group, a nitro group, a C_1 to C_{40} alkyl group,

a C_6 to C_{60} aryl group, a heteroaryl group having 5 to 60 nuclear atoms and a C_6 to C_{60} arylamine group,

Y_1 to Y_4 are each independently N or CR_3 ,

Y_5 to Y_8 are each independently N or CR_4 ,

X_1 and X_2 are each independently selected from the group consisting of Se, $N(Ar_1)$, $C(Ar_2)(Ar_3)$ and $Si(Ar_4)(Ar_5)$, and at least one of X_1 and X_2 is $N(Ar_1)$,

R_3 and R_4 are each independently selected from the group consisting of hydrogen, deuterium, halogen, a cyano group, a nitro group, a C_1 to C_{40} alkyl group, a C_6 to C_{60} aryl group, a heteroaryl group having 5 to 60 nuclear atoms, a C_6 to C_{60} aryloxy group, a C_6 to C_{60} arylsilyl group, a C_6 to C_{60} aryl boron group, a C_6 to C_{60} arylphosphine group, a C_6 to C_{60} arylphosphine oxide group and a C_6 to C_{60} arylamine group, or an adjacent group forming a part of the fused ring,

Ar_1 to Ar_5 are each independently selected from the group consisting of a C_6 to C_{60} aryl group, a heteroaryl group having 5 to 60 nuclear atoms, a C_6 to C_{60} aryloxy group, a C_6 to C_{60} arylsilyl group, a C_6 to C_{60} aryl boron group, a C_6 to C_{60} arylphosphine group, a C_6 to C_{60} arylphosphine oxide group and a C_6 to C_{60} arylamine group, and

the C_1 to C_{40} alkyl group, the C_6 to C_{60} aryl group, the heteroaryl group having 5 to 60 nuclear atoms, the C_6 to C_{60} aryloxy group, the C_6 to C_{60} arylsilyl group, the C_6 to C_{60} arylboron group, the C_6 to C_{60} arylphosphine group, the C_6 to C_{60} arylphosphine oxide group and the C_6 to C_{60} arylamine group of R_1 to R_4 and Ar_1 to Ar_5 are optionally each independently unsubstituted or substituted with one or more substituents selected from the group consisting of deuterium, halogen, a cyano group, a nitro group, a C_1 to C_{40} alkyl group, a C_3 to C_{40} cycloalkyl group, a heterocycloalkyl group having 3 to 40 nuclear atoms, a C_6 to C_{60} aryl group, a heteroaryl group having 5 to 60 nuclear atoms, a C_1 to C_{40} alkyloxy group, a C_6 to C_{60} aryloxy group, a C_3 to C_{40} alkylsilyl group, a C_6 to C_{60} arylsilyl group, a C_2 to C_{40} alkylboron group, a C_6 to C_{60} aryl boron group, a C_6 to C_{60} arylphosphine group, a C_6 to C_{60} arylphosphine oxide group and a C_6 to C_{60} arylamine group.

2. The compound of claim 1, wherein Ar_1 to Ar_5 are each independently selected from the group consisting of a C_6 to C_{60} aryl group, a heteroaryl group having 5 to 60 nuclear atoms, and a C_6 to C_{60} arylamine group.

3. The compound of claim 1, wherein R_1 to R_4 are each independently selected from the group consisting of a C_6 to C_{60} aryl group, a heteroaryl group having 5 to 60 nuclear atoms, and a C_6 to C_{60} arylamine group.

4. The compound of claim 1, wherein both X_1 and X_2 are $N(Ar_1)$.

5. The compound of claim 1, wherein the compound of Formulae 1a to 1f is selected from the group consisting of compounds of the following Formulae 5a to 5f:

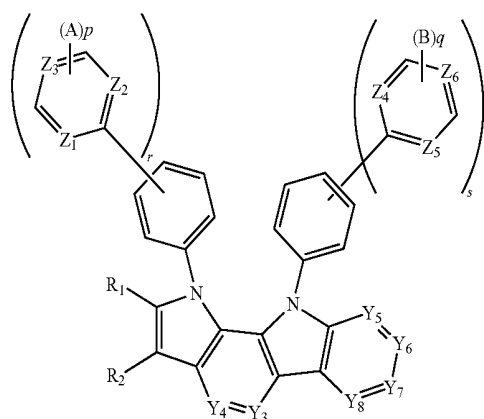
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Formula 5a

Formula 5d



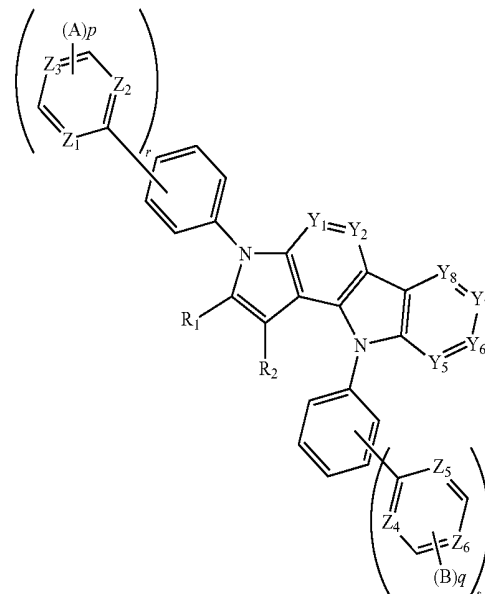
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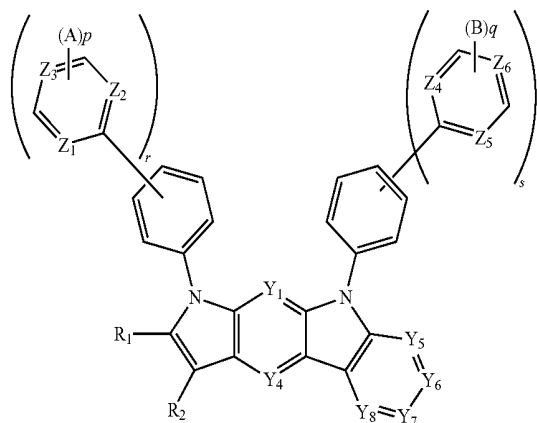
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Formula 5e

Formula 5b



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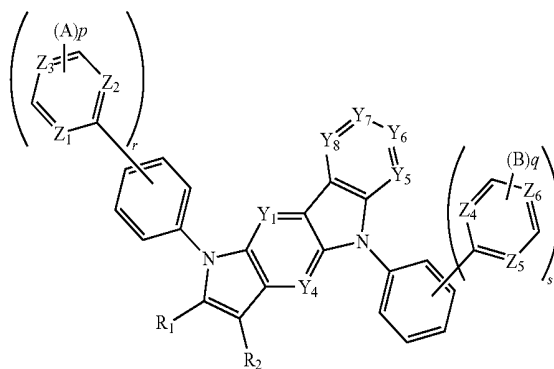
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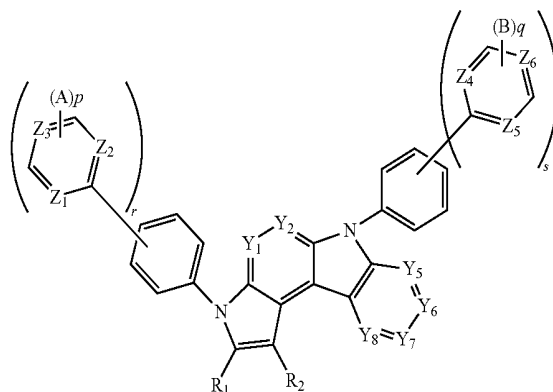
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Formula 5f

Formula 5c



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in the formulae, R₁, R₂ and Y₁ to Y₈ are the same as those defined in claim 1,

Z₁ to Z₅ are each independently N or CAr₆,

Ar₆, A and B are each independently selected from the group consisting of a C₁ to C₄₀ alkyl group, a C₃ to C₄₀ cycloalkyl group, a heterocycloalkyl group having 3 to 40 nuclear atoms, a C₆ to C₆₀ aryl group, a heteroaryl group having 5 to 60 nuclear atoms, a C₁ to C₄₀ alkyloxy group, a C₆ to C₆₀ aryloxy group, a C₃ to C₄₀

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alkylsilyl group, a C₆ to C₆₀ arylsilyl group, a C₂ to C₄₀ alkylboron group, a C₆ to C₆₀ aryl boron group, a C₆ to C₆₀ arylphosphine group, a C₆ to C₆₀ arylphosphine oxide group and a C₆ to C₆₀ arylamine group, r and s are each an integer of 0 to 6, provided that r+s is at least 1 or more, and p and q are each an integer of 0 to 3.

6. The compound of claim 5, wherein Ar₆, A and B are each independently selected from the group consisting of a C₆ to C₆₀ aryl group, a heteroaryl group having 5 to 60 nuclear atoms, and a C₆ to C₆₀ arylamine group.

7. An organic electroluminescent device comprising:

- (i) an anode;
- (ii) a cathode; and
- (iii) an organic layer having one or more layers interposed between the anode and the cathode,

wherein at least one in the organic layer comprises the compound of claim 1.

8. The organic electroluminescent device of claim 7, wherein the organic layer comprising the compound is selected from the group consisting of a hole injection layer, a hole transporting layer, an electron injection layer, an electron transporting layer and a light-emitting layer.

9. The organic electroluminescent device of claim 6, wherein the compound is a phosphorescent host of a light-emitting layer.

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专利名称(译)	有机发光化合物和使用其的有机电致发光器件		
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摘要(译)

本发明涉及具有优异的空穴注入和传输能力，发光能力等的新型吡啶基化合物，以及在其一个或多个有机层中包含吡啶基化合物的有机电致发光器件，以便从而实现改善的特性，例如发光效率，驱动电压和寿命特性。

