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(54) **ORGANIC LIGHT-EMITTING COMPOUND
AND ORGANIC ELECTROLUMINESCENT
DEVICE USING SAME**

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H01L 51/0058 (2013.01); **H01L 51/0061**
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C09K 2211/1007 (2013.01); **C09K 2211/1011**
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(2013.01); **C09K 2211/1062** (2013.01); **C09K**
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H01L 51/5088 (2013.01)

(58) **Field of Classification Search**

None

See application file for complete search history.

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(57) **ABSTRACT**

The present invention relates to a novel indole-based com-
pound having excellent hole injection and transport capa-
bilities, light-emission, and other properties, and to an
organic electroluminescent device the luminous efficiency,
driving voltage, service life, and other characteristics of
which are improved due to containing the compound in one
or more organic material layers.

14 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/KR2013/002526 filed Mar. 27, 2013, claiming priority based on patent application Ser. No. KR10-2012-0087997 filed Aug. 10, 2012, the contents of all of which are incorporated herein by reference in their entirety.

TECHNICAL FIELD

The present disclosure 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 excellent hole injection and transport capabilities, light-emitting capabilities, and the like, and an organic electroluminescent device which contains the indole-based compound in one or more organic material layers thereof so as to improve characteristics such as light-emitting efficiency, driving voltage, and a lifespan.

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 observing 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. Until now, the organic EL device has been developed in the form of introducing each characteristic organic material layer into a device in order to manufacture the organic EL device having high efficiency and a long service life (lifespan), thereby leading to the development of specialized materials used therein.

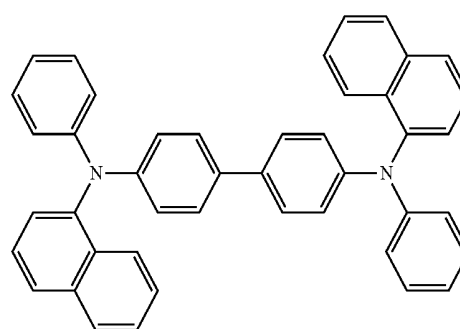
When voltage is applied between two electrodes of the organic EL device, holes are injected into the organic material layer at the anode and electrons are injected into the organic material layer at the cathode. When the injected holes and electrons meet each other, an exciton is formed, and when the exciton falls down to a bottom state, light is emitted. Materials used as the organic material 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 in order to enhance color purity and light-emitting efficiency through an energy transfer. Dopant materials may be 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,

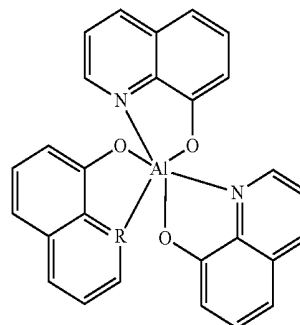
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interests in not only phosphorescent dopant, but also phosphorescent host materials have come into focus.

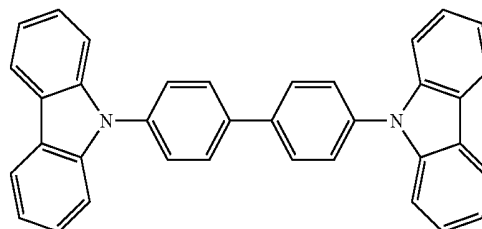
As the hole transporting layer, the hole blocking layer and the electron transporting layer, NPB, BCP, Alq₃ and the like represented by the following Formulae have been widely known until now, and for the light-emitting material, anthracene derivatives have been reported as a fluorescent dopant/host 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, have been used as blue, green and red dopant materials. Until now, CBP have exhibited excellent characteristics as a phosphorescent host material.



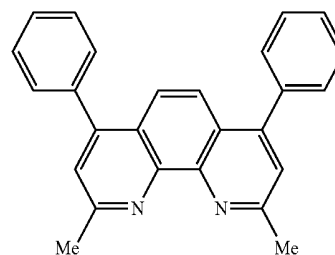
NPB



Alq3

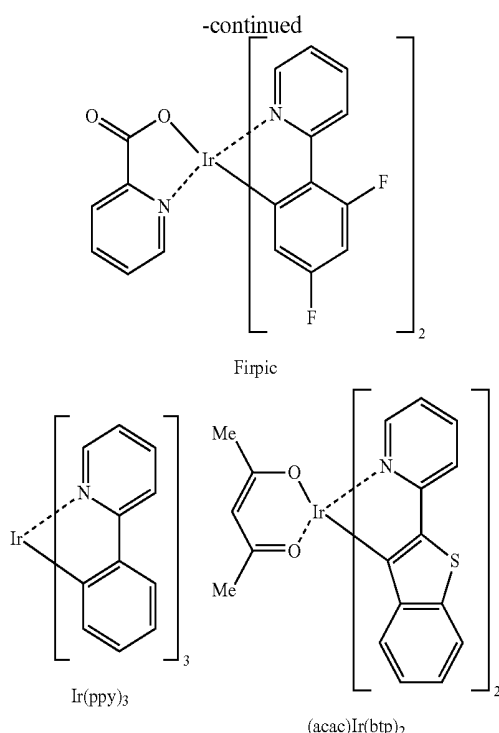


CBP



BCP

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

DISCLOSURE

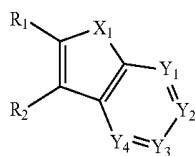
Technical Problem

The present disclosure has been contrived to solve the problem, and an object of the present disclosure is to provide a novel indole-based material which is used as a light-emitting layer, and thus may enhance driving voltage, light-emitting efficiency, and the like of a device, and an organic electroluminescent device using the same.

Further, other technical problems which the present disclosure intends to solve are not limited to the technical problems which have been mentioned above, and still other technical problems which have not been mentioned will be apparently understood to those skilled in the art to which the present disclosure pertains from the following description.

Technical Solution

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



[Formula 1]

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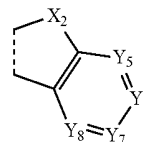
In the formula,

Y₁ to Y₄ are the same as or different from each other, and are each independently selected from N and CR₃, and

at least one of Y₁ and Y₂, Y₂ and Y₃, or Y₃ and Y₄ is CR₃,

and forms a fused ring represented by the following Formula 2;

[Formula 2]



the dotted line means a site where a fusion (condensation) with the compound of Formula 1 occurs;

Y₅ to Y₈ are the same as or different from each other, and are each independently selected from N and CR₄,

X₁ and X₂ are the same as or different from each other, and are each independently selected from O, S, Se, N(Ar₁), C(Ar₂)(Ar₃), and Si(Ar₄)(Ar₅), and here, at least one of X₁ and X₂ is N(Ar₁), and

R₁ to R₄ are the same as or different from each other, and are each independently selected from the group consisting of hydrogen, deuterium, halogen, cyano, a substituted or unsubstituted C₁ to C₄₀ alkyl group, a substituted or unsubstituted C₃ to C₄₀ cycloalkyl group, a substituted or unsubstituted heterocycloalkyl group having 3 to 40 nuclear atoms, a substituted or unsubstituted C₆ to C₆₀ aryl group, a substituted or unsubstituted heteroaryl group having 5 to 60 nuclear atoms, a substituted or unsubstituted C₁ to C₄₀ alkyloxy group, a substituted or unsubstituted C₆ to C₆₀ aryloxy group, a substituted or unsubstituted C₁ to C₄₀ alkylsilyl group, a substituted or unsubstituted C₆ to C₆₀ arylsilyl group, a substituted or unsubstituted C₁ to C₄₀ alkyl boron group, a substituted or unsubstituted C₆ to C₆₀ aryl boron group, a substituted or unsubstituted C₆ to C₆₀ arylphosphine group, a substituted or unsubstituted C₆ to C₆₀ arylphosphine oxide group, and a substituted or unsubstituted C₆ to C₆₀ arylamine group, and these form or do not form a fused ring with an adjacent group;

Ar₁ to Ar₅ are the same as or different from each other, and are each independently selected from the group consisting of a substituted or unsubstituted C₁ to C₄₀ alkyl group, a substituted or unsubstituted C₃ to C₄₀ cycloalkyl group, a substituted or unsubstituted heterocycloalkyl group having 3 to 40 nuclear atoms, a substituted or unsubstituted C₆ to C₆₀ aryl group, a substituted or unsubstituted heteroaryl group having 5 to 60 nuclear atoms, a substituted or unsubstituted C₁ to C₄₀ alkyloxy group, a substituted or unsubstituted C₆ to C₆₀ aryloxy group, a substituted or unsubstituted C₁ to C₄₀ alkylsilyl group, a substituted or unsubstituted C₆ to C₆₀ arylsilyl group, a substituted or unsubstituted C₁ to C₄₀ alkyl boron group, a substituted or unsubstituted C₆ to C₆₀ aryl boron group, a substituted or unsubstituted C₆ to C₆₀ arylphosphine group, a substituted or unsubstituted C₆ to C₆₀ arylphosphine oxide group, and a substituted or unsubstituted C₆ to C₆₀ arylamine group, and

provided that Y₁ to Y₈ include at least one N.

Furthermore, the present disclosure provides an organic EL device including (i) an anode, (ii) a cathode, and (iii) an organic material layer including one or more layers interposed between the anode and the cathode, in which at least one organic material layer comprises one or more of the compounds represented by Formula 1.

Here, it is preferred that the compound represented by Formula 1 is used as a phosphorescent host of a light-emitting layer.

Advantageous Effects

The novel indole-based compound represented by Formula 1 according to the present disclosure may exhibit excellent heat resistance, hole injection and transport capabilities, light-emitting capabilities, and the like.

Therefore, an organic EL device including the compound represented by Formula 1 as a phosphorescent/fluorescent host, a dopant, and the like of a hole injection/transporting layer or a light-emitting layer may be greatly enhanced in terms of light-emitting performance, driving voltage, a lifespan, efficiency, and the like, and thus may be effectively applied to a full-color display panel, and the like.

BEST MODE

The present disclosure provides a novel indole-based compound having a molecular weight larger than that of a material for an organic EL device [for example: 4,4-dicarbazolylbiphenyl (hereinafter, represented as CBP)] in the related art, and excellent driving voltage characteristics and efficiency.

The novel indole-based compound represented by Formula 1 according to the present disclosure 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, since phosphorescent characteristics of the device may be improved, and simultaneously, electron and/or hole transporting capabilities, light-emitting efficiency, driving voltage, lifespan characteristics, and the like may be improved, the indole-based compound may be applied to not only a light-emitting layer but also a hole transporting layer, an electron transporting layer, a light-emitting host, and the like by introducing various substituents. In particular, due to the indole-based basic structure, the indole-based compound may exhibit excellent characteristics as a light-emitting host material compared to the existing CBP.

Further, the molecular weight of the compound is significantly increased due to various aromatic ring substituents to be introduced into the indole-based backbone structure, so that the glass transition temperature is enhanced, and accordingly, the indole-based compound may have higher thermal stability than that of the CBP in the related art. Therefore, a device including the novel compound represented by Formula 1 according to the present disclosure may greatly enhance durability and lifespan characteristics.

Furthermore, when the compound represented by Formula 1 according to the present disclosure is adopted as a hole injection/transporting layer, a blue, green, and/or red phosphorescent host material, or a fluorescent host material of an organic EL device, much better effects may be exhibited in terms of efficiency and a lifespan compared to the CBP. Therefore, the compound according to the present disclosure may greatly contribute to the improvement of performance and the enhancement of lifespan, of the organic EL device.

Meanwhile, in R_1 to R_4 and Ar_1 to Ar_5 of the above-described Formula 1, the substituent in which the term 'substituted or unsubstituted' is described, for example, 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_1 to C_{40} alkylsilyl group, a C_6 to C_{60} arylsilyl group, a C_1 to C_{40} alkyl boron 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 may be each independently substituted with one or more substituents selected from the group consisting of hydrogen, deuterium, halogen, cyano, 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_1 to C_{40} alkylsilyl group, a C_6 to C_{60} arylsilyl group, a C_1 to C_{40} alkyl boron 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.

In the compound represented by Formula 1 according to the present disclosure, it is preferred that R_1 to R_4 are the same as or different from each other, and are each independently selected from the group consisting of hydrogen, deuterium, halogen, a cyano 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_1 to C_{40} alkylsilyl group, a C_6 to C_{60} arylsilyl group, a C_1 to C_{40} alkyl boron 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. In this case, when a wide band-gap and thermal stability are considered, it is more preferred that R_1 to R_4 are each independently hydrogen, a C_6 to C_{60} aryl group (for example: phenyl, naphthyl, and bisphenyl), or a heteroaryl group having 5 to 60 nuclear atoms (for example: pyridine).

Further, in the compound represented by Formula 1 according to the present disclosure, X_1 and X_2 may be each independently selected from O, S, Se, $N(Ar_1)$, $C(Ar_2)(Ar_3)$, and $Si(Ar_4)(Ar_5)$, herein, at least one of X_1 and X_2 may be $N(Ar_1)$, and preferably, both X_1 and X_2 are $N(Ar_1)$.

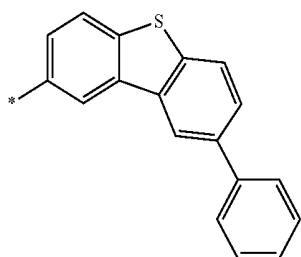
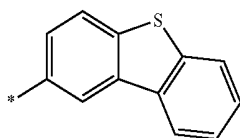
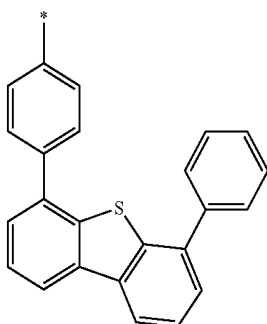
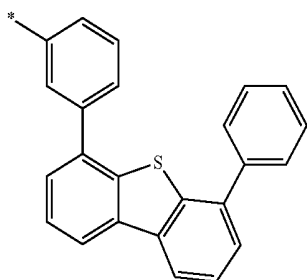
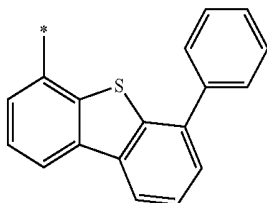
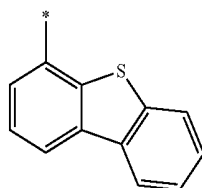
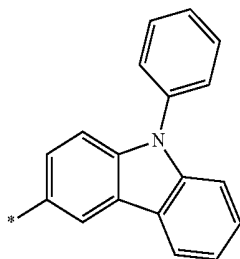
In addition, Y_1 to Y_8 are each independently selected from N and CR_4 , and include at least one N. Preferred is the case where N is 1.

Furthermore, in the compound represented by Formula 1 according to the present disclosure, Ar_1 to Ar_5 may be 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_1 to C_{40} alkylsilyl group, a C_6 to C_{60} arylsilyl group, a C_1 to C_{40} alkyl boron 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. Preferably, Ar_1 to Ar_5 may be each independently 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, or a C_6 to C_{60} arylamine group, and in this case, 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 may be each substituted with 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.

It is preferred that the substituents of the compound of Formula 1 according to the present disclosure, Ar_1 to Ar_5 are each independently selected from the group of the following substituents (function groups), for example, S1 to S177. However, the selection is not particularly limited thereto.

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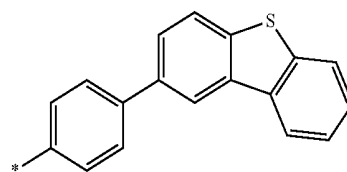
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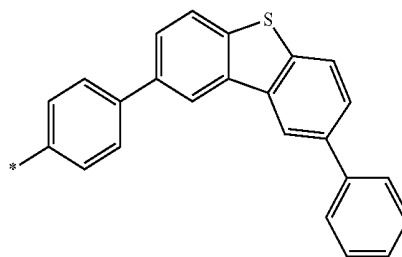
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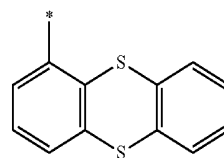
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S21

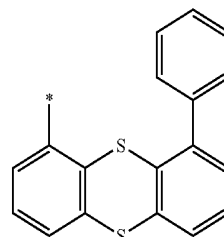
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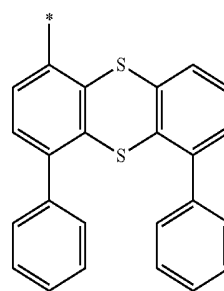
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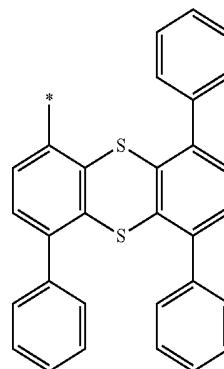
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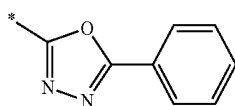
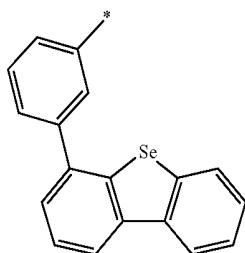
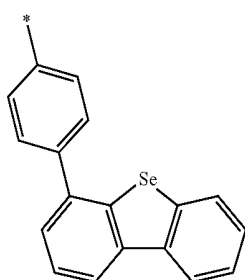
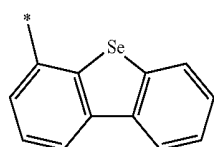
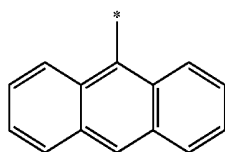
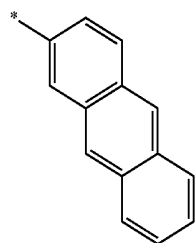
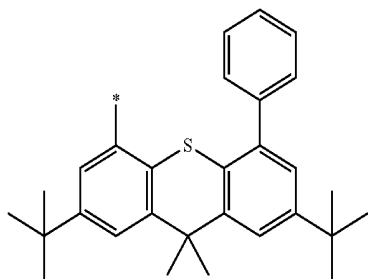
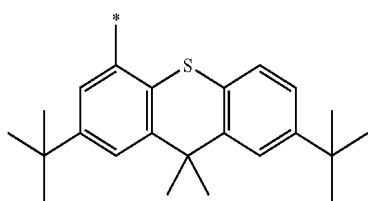
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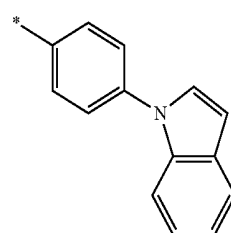
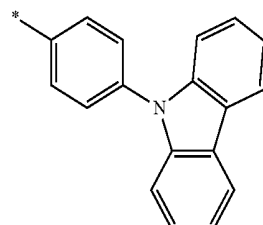
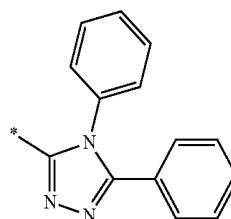
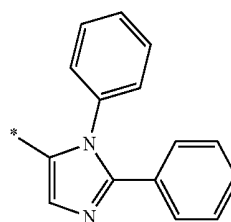
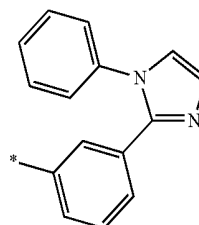
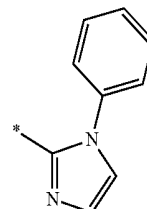
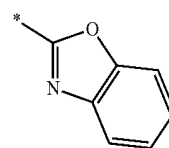
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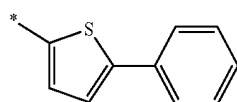
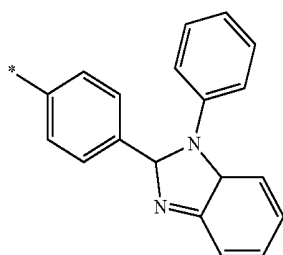
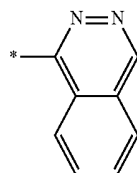
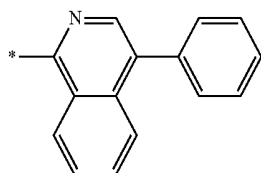
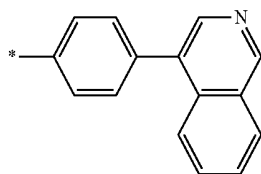
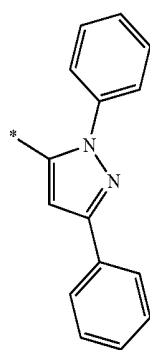
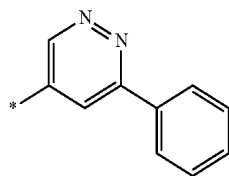
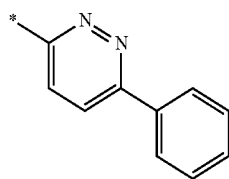
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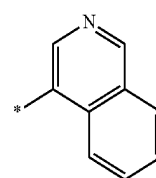
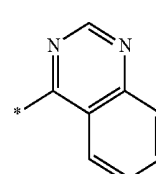
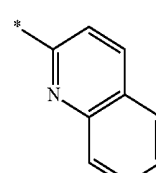
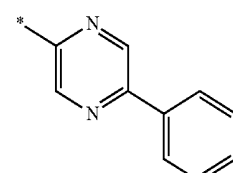
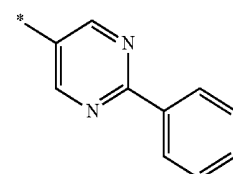
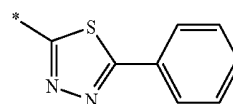
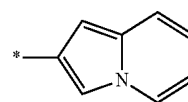
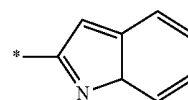
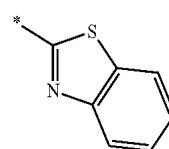
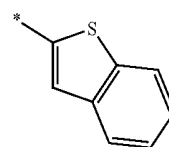


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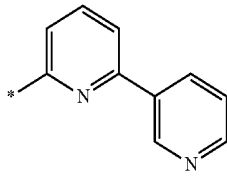
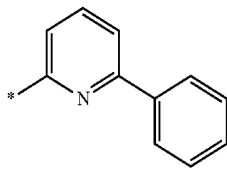
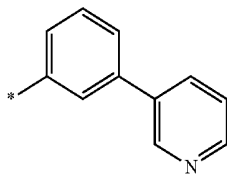
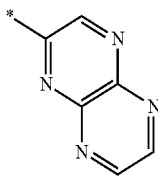
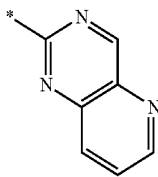
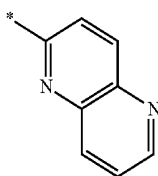
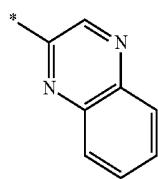
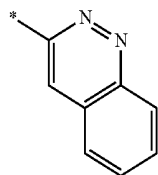
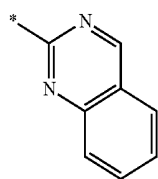
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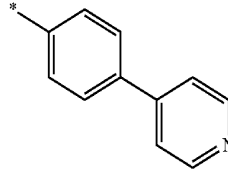
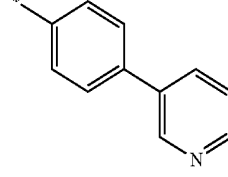
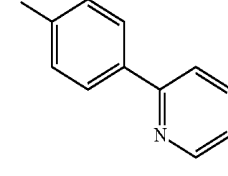
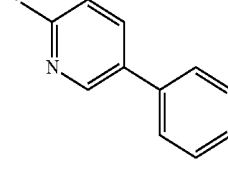
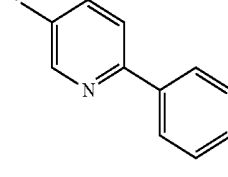
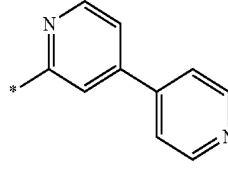
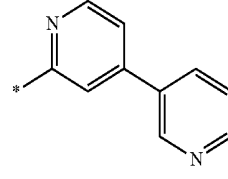
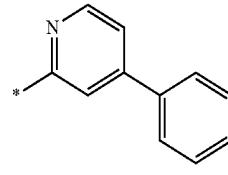
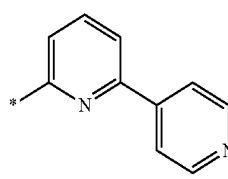
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**16**

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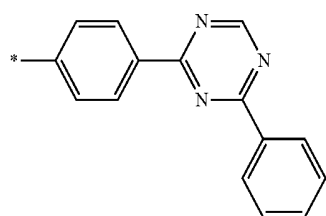
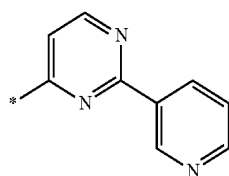
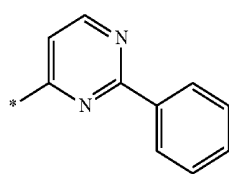
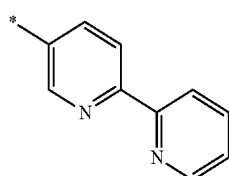
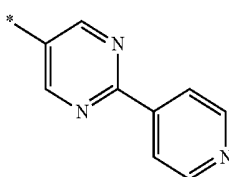
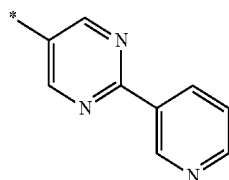
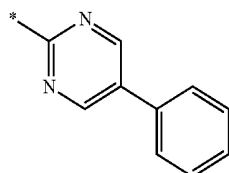
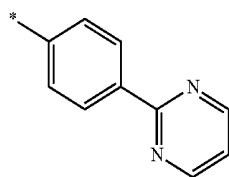
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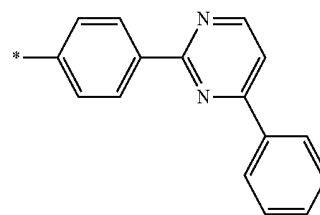
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S83

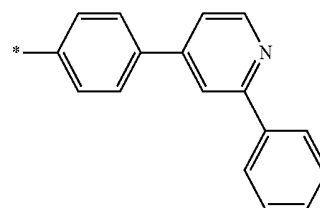
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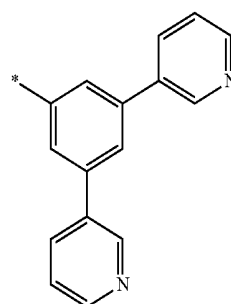
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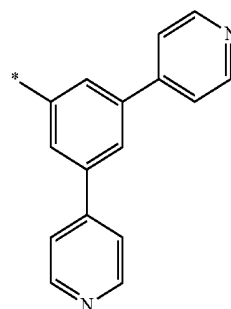
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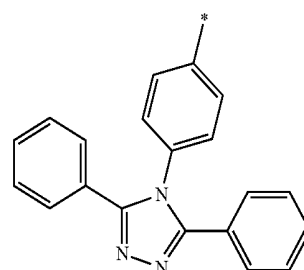
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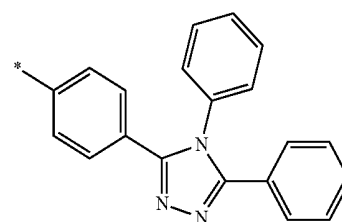


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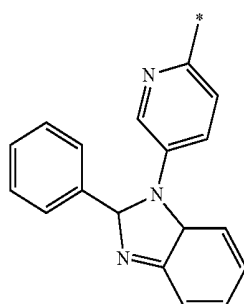
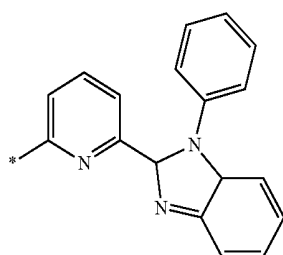
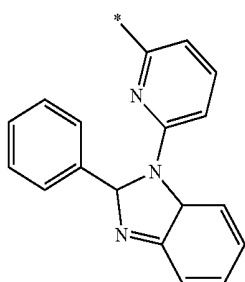
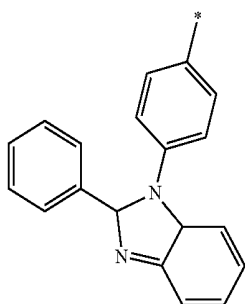
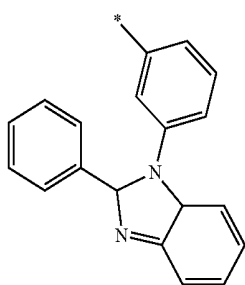
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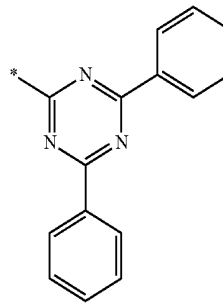
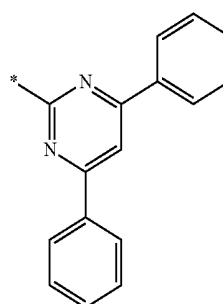
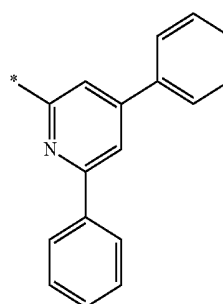
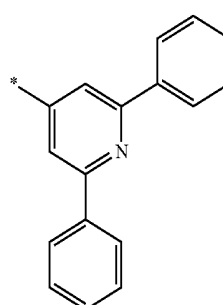
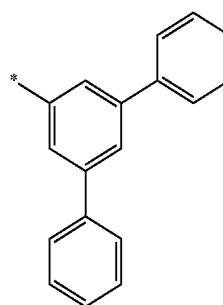
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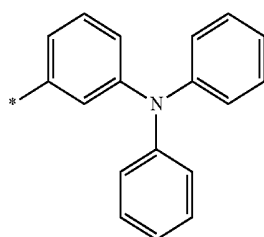
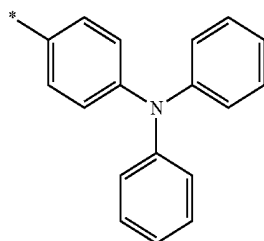
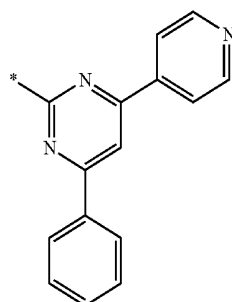
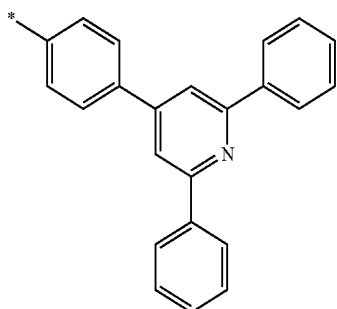
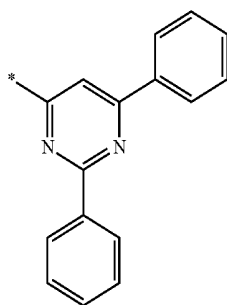
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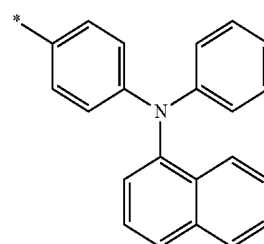
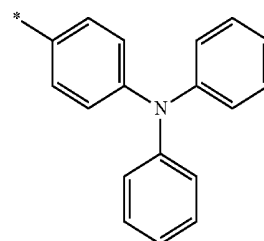
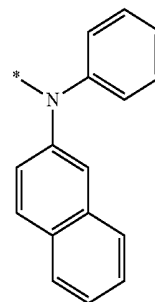
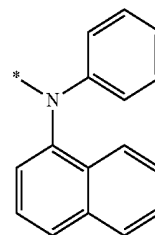
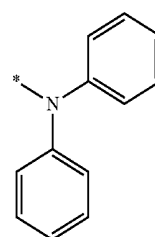
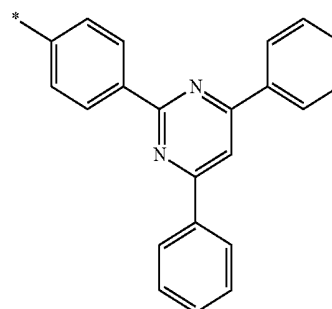
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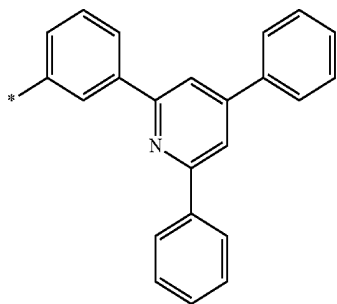
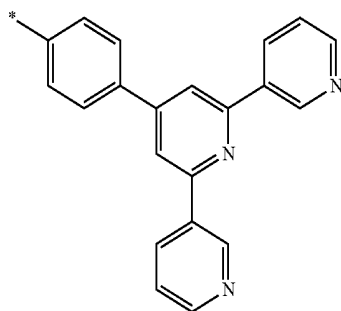
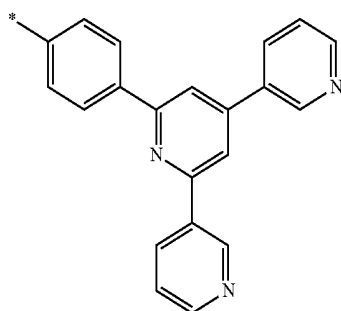
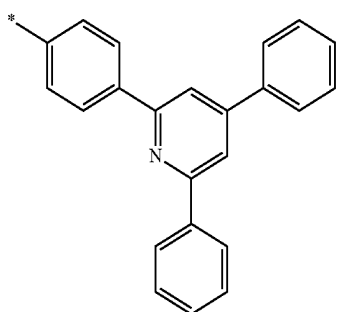
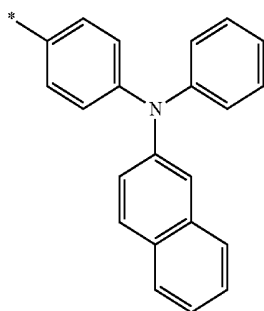
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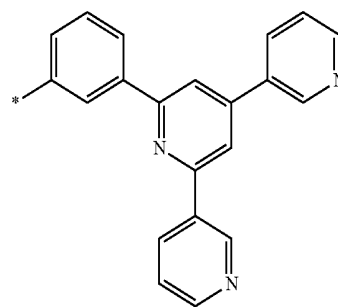
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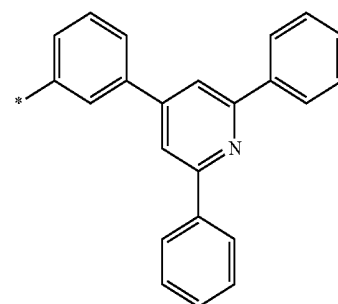
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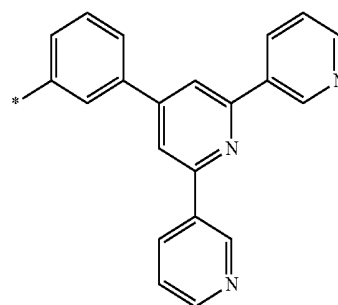
S123



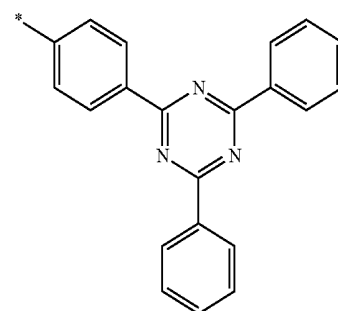
S124



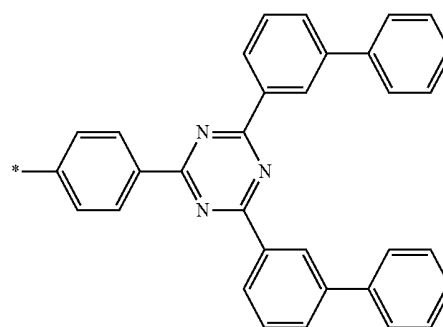
S125



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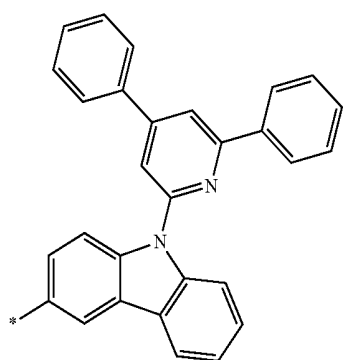
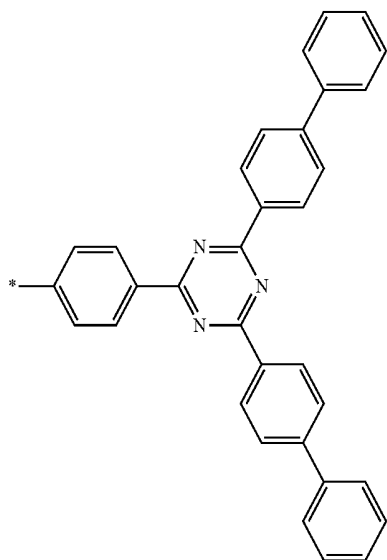
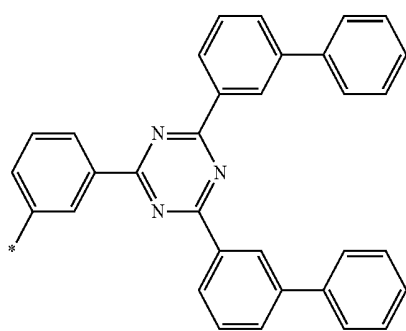
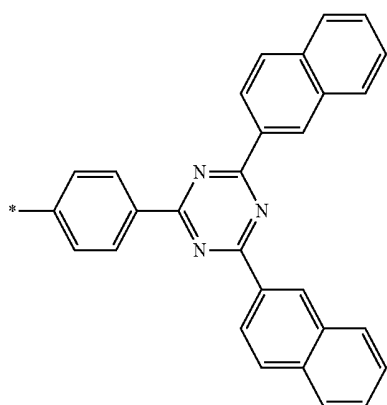


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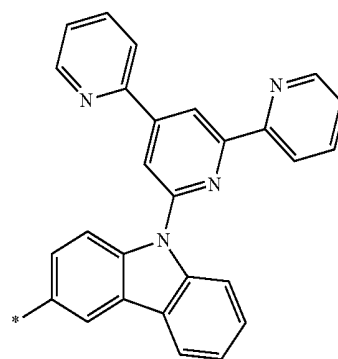
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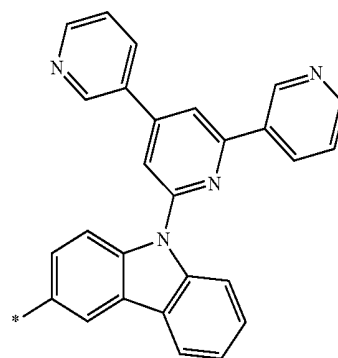
S130

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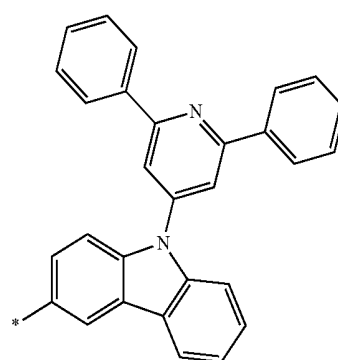
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S131

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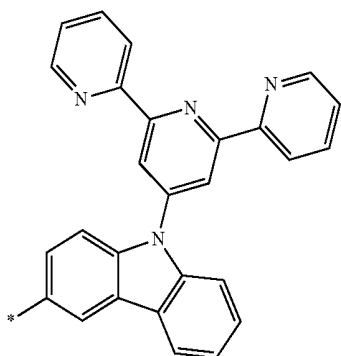
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S135

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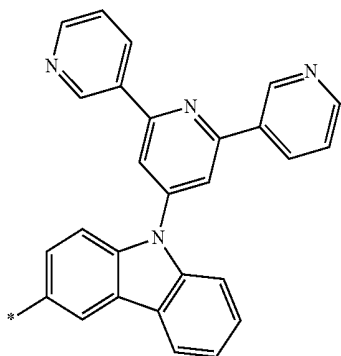


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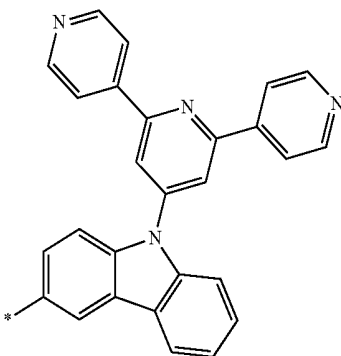


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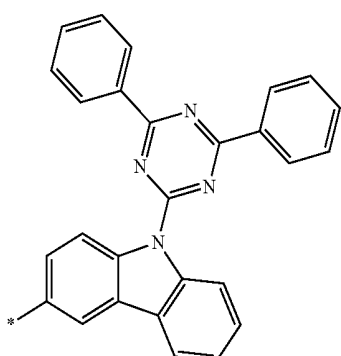


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S139

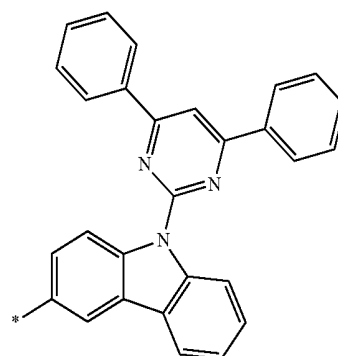
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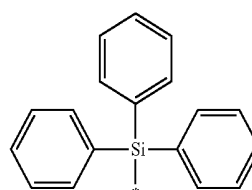
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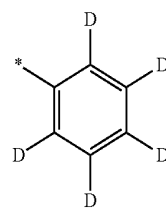
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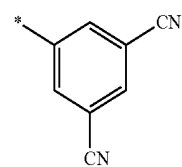
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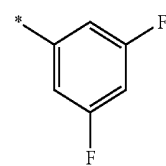
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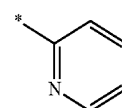
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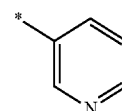
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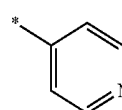
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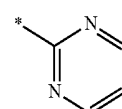
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S146



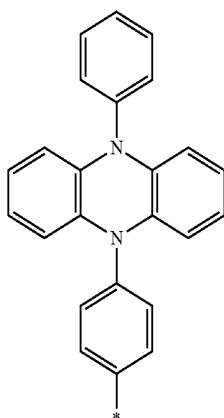
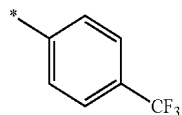
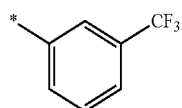
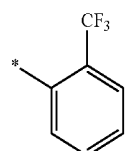
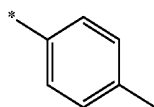
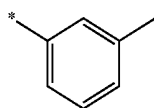
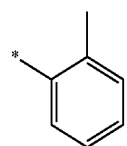
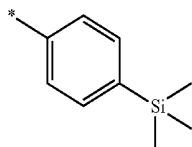
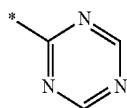
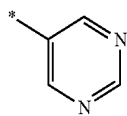
S147



S148

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S149

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S151

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S153 25

S154 30

S155 35

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S156

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S157

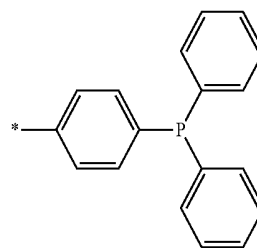
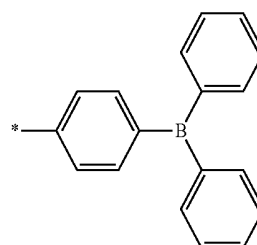
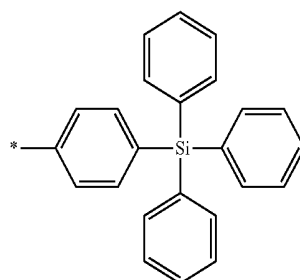
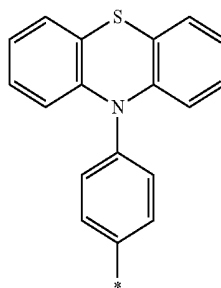
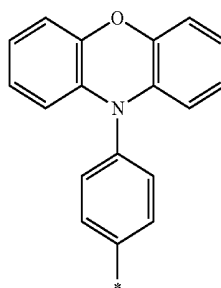
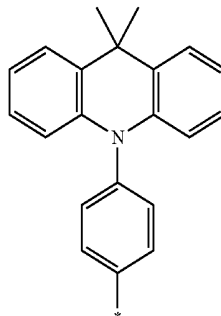
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S158

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S159

S160

S161

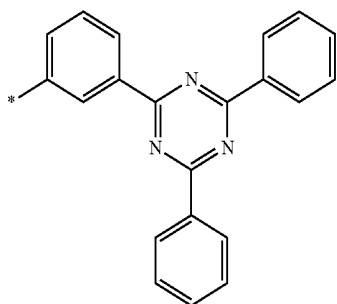
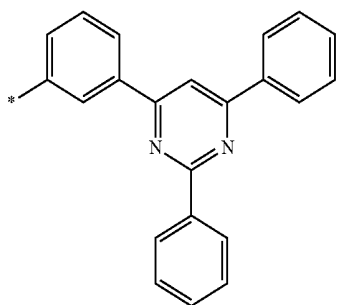
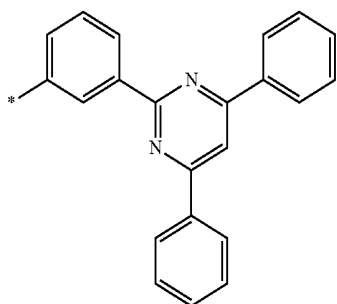
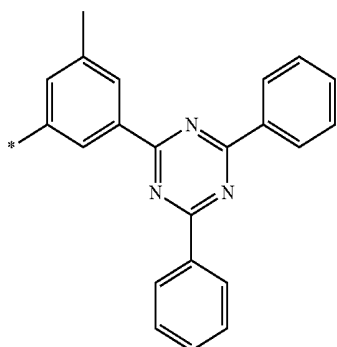
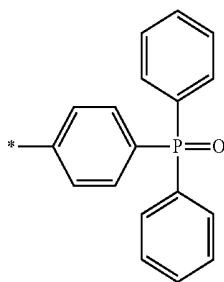
S162

S163

S164

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**32**

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S165

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S166

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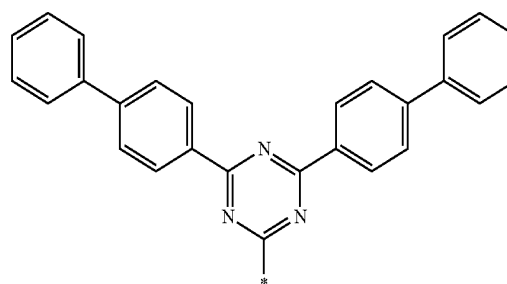
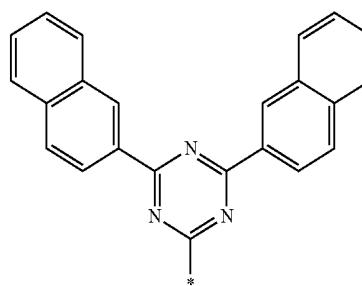
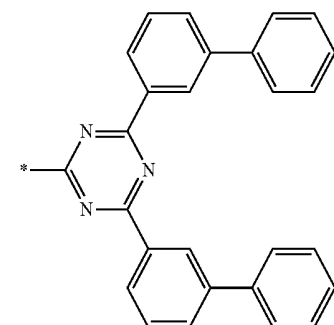
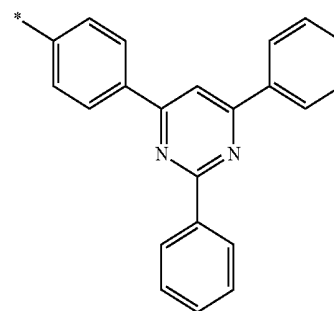
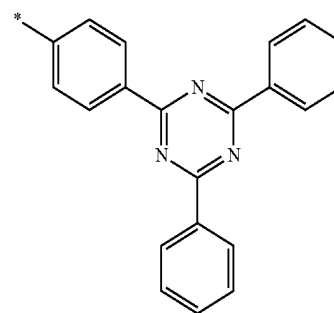
S170

S171

S172

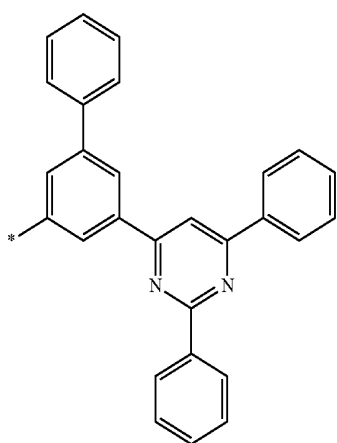
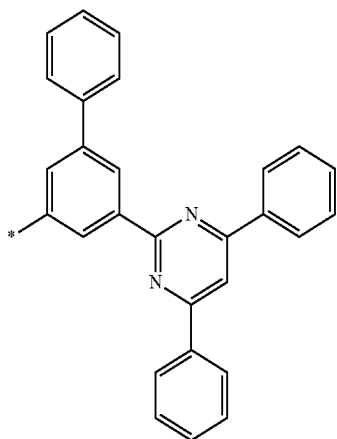
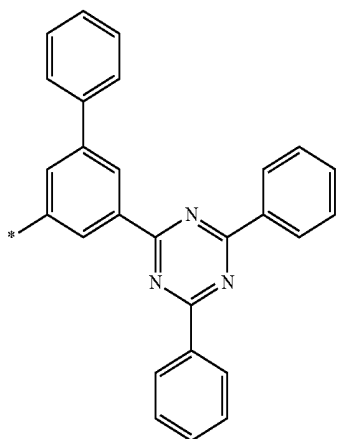
S173

S174

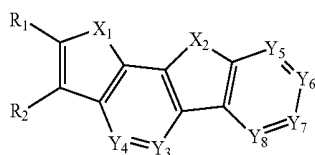


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The compound represented by Formula 1 according to the present disclosure may be more embodied as any one compound of the following Formulae 3 to 8.



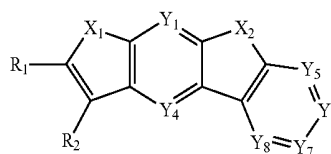
[Formula 3]

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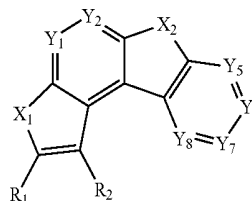
S175

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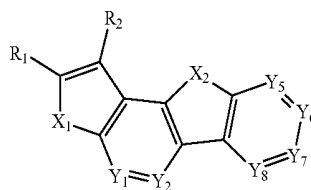
[Formula 4]

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[Formula 5]

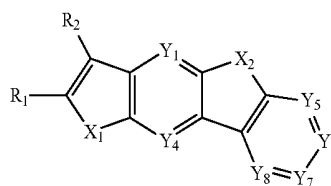
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[Formula 6]

S176

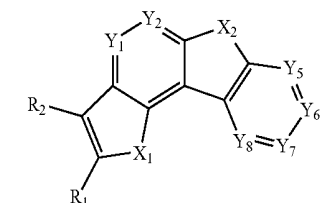
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[Formula 7]

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[Formula 8]

S177

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In the formulae, X_1 and X_2 , Y_1 to Y_8 , R_1 , and R_2 are the same as those defined in Formula 1.

More specifically, X_1 and X_2 are each independently selected from O, S, Se, $N(Ar_1)$, $C(Ar_2)(Ar_3)$, and $Si(Ar_4)(Ar_5)$, here, at least one of X_1 and X_2 may be $N(Ar_1)$, and preferably, both X_1 and X_2 are $N(Ar_1)$.

Further, Y_1 to Y_8 are each independently selected from N and CR_4 , and include at least one N. Preferred is the case where N is 1.

The “unsubstituted alkyl” used in the present disclosure 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.

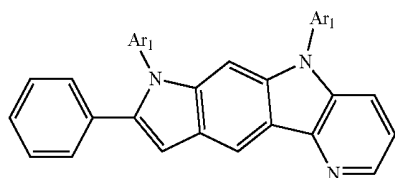
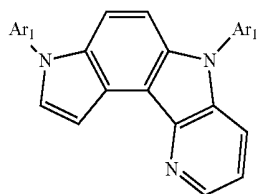
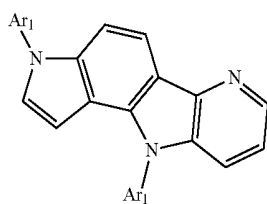
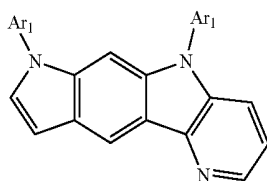
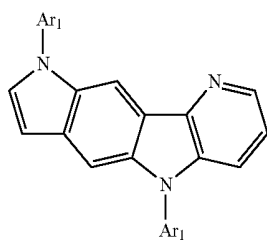
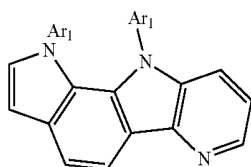
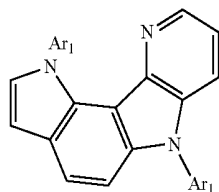
The “unsubstituted aryl” means an aromatic site having 6 to 60 carbon atoms, which is a single ring or a combination of two or more rings. Two or more rings may be simply pendant to each other or pendant to each other in a fused form.

The “unsubstituted heteroaryl” means a monoheterocyclic or polyheterocyclic aromatic site 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, or Se. Two or more rings may be simply pendant to each other or pendant to each other in a fused form, and furthermore, it is interpreted that a form that is fused with an aryl group is also included.

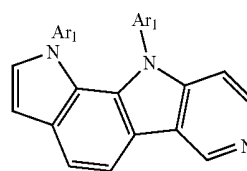
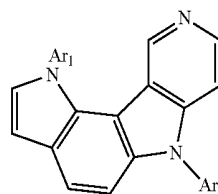
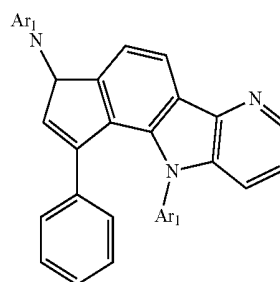
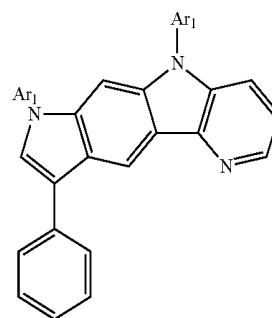
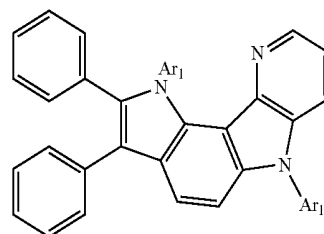
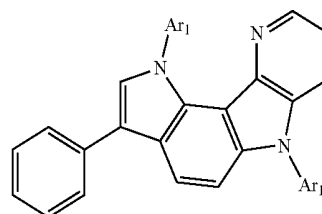
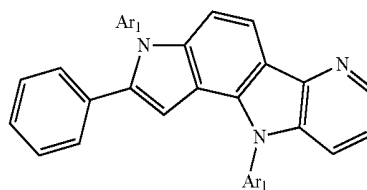
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The “fused ring (condensed ring)” means a fused aliphatic ring, a fused aromatic ring, a fused heteroaliphatic ring, a fused heteroaromatic ring, or a combined form thereof.

The aforementioned compound represented by Formula 1 according to the present disclosure may be more embodied as the formulae exemplified below, for example, Formulae C-1 to C-291. However, the compound represented by Formula 1 according to the present disclosure is not limited by those exemplified below.

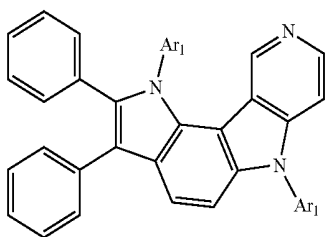
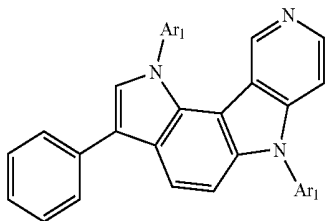
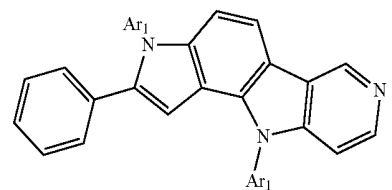
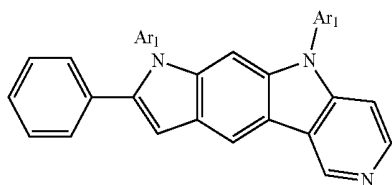
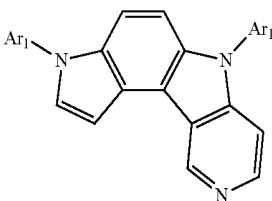
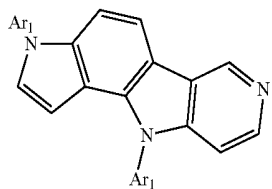
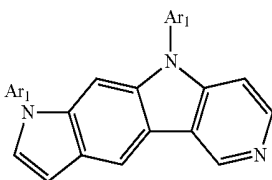
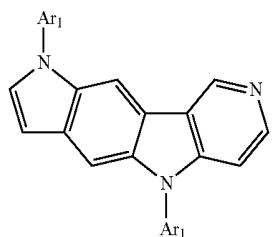
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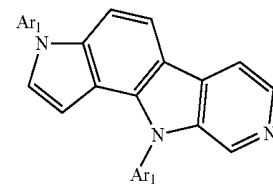
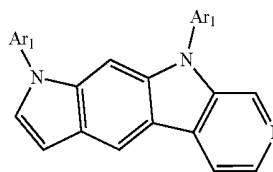
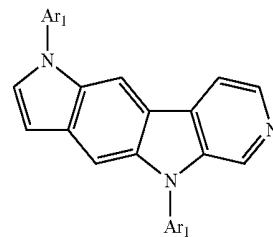
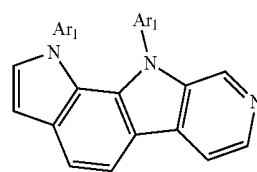
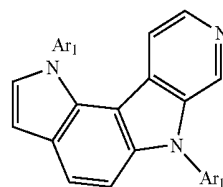
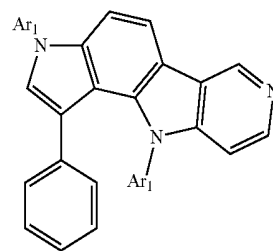
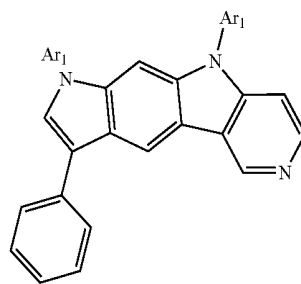


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C-15

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C-19

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C-21

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C-22

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C-25

C-26

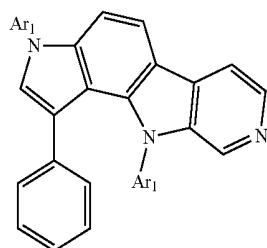
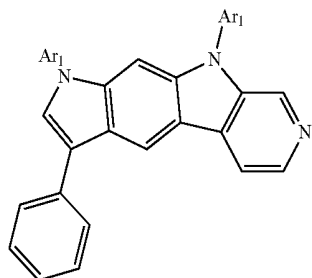
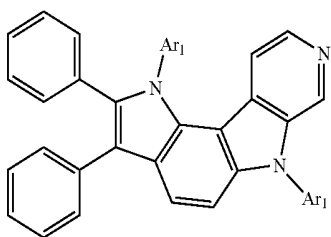
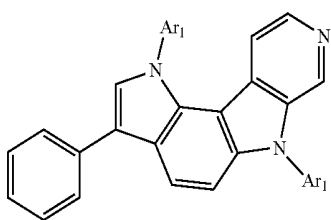
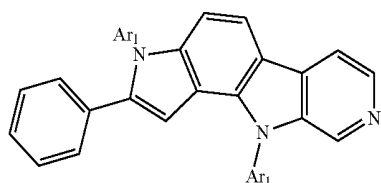
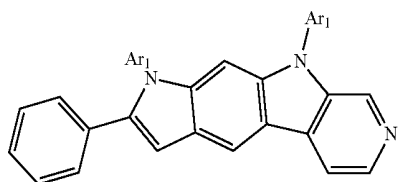
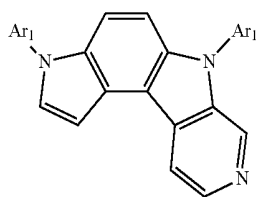
C-27

C-28

C-29

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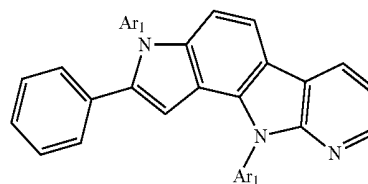
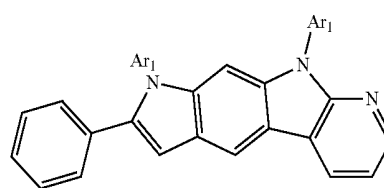
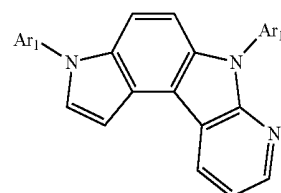
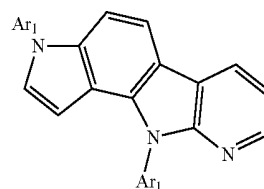
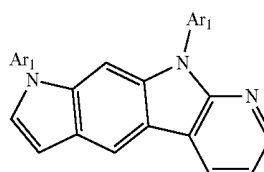
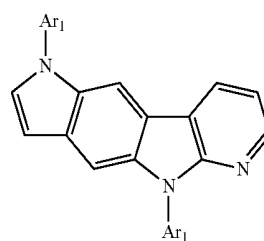
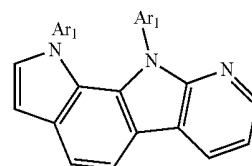
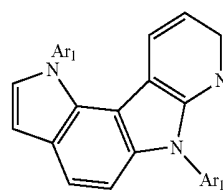
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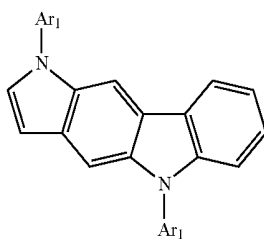
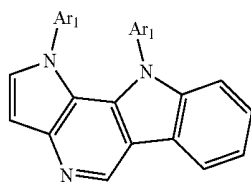
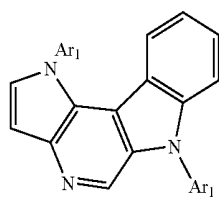
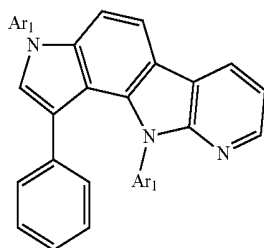
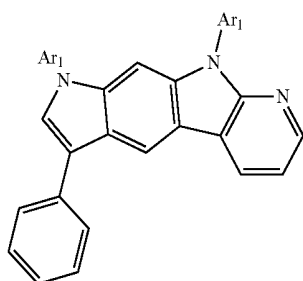
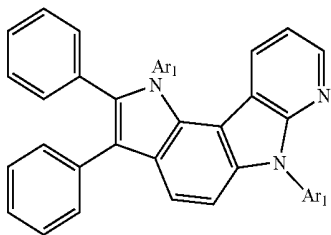
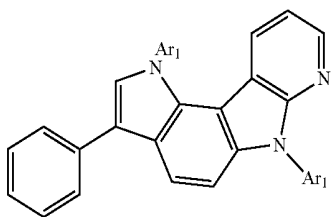
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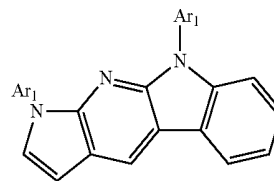
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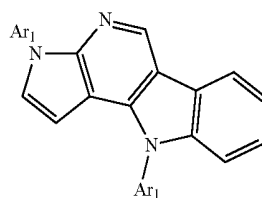
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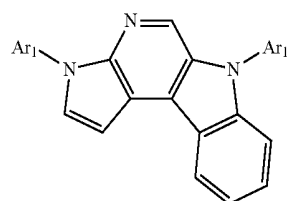
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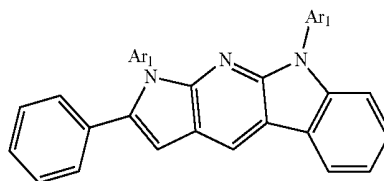
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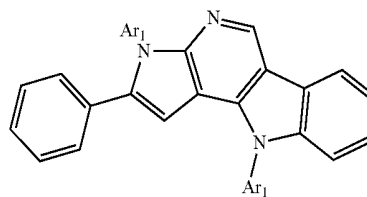
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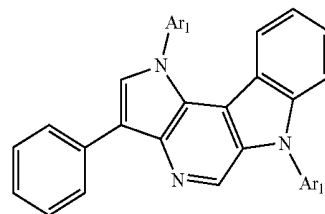
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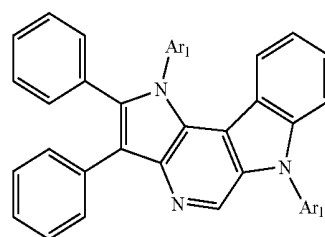
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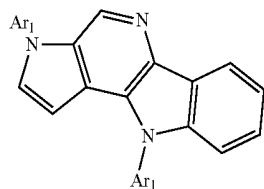
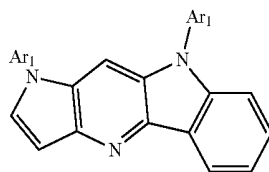
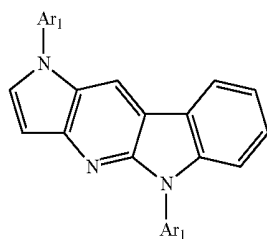
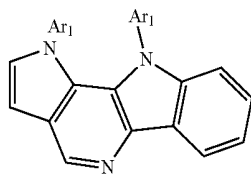
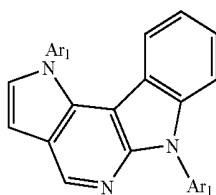
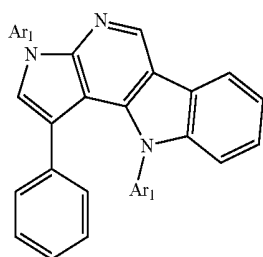
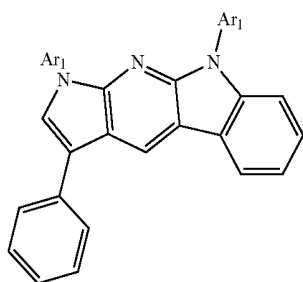
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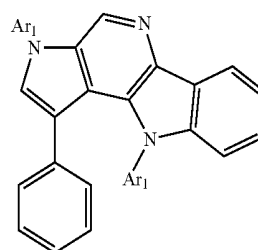
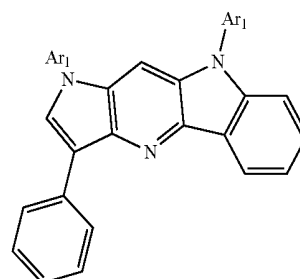
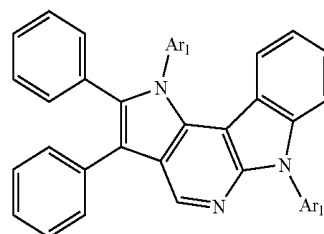
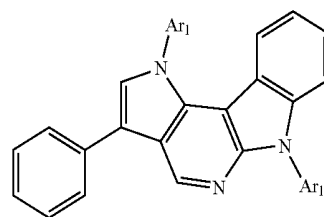
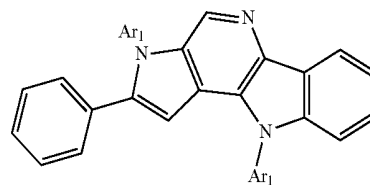
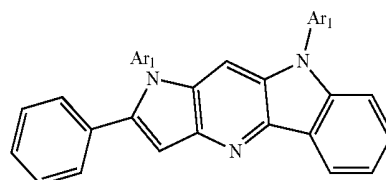
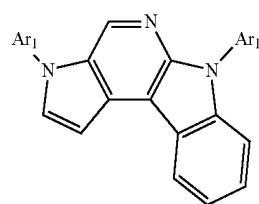
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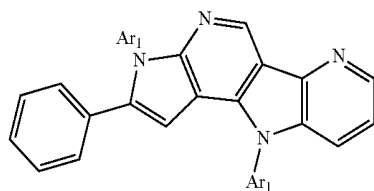
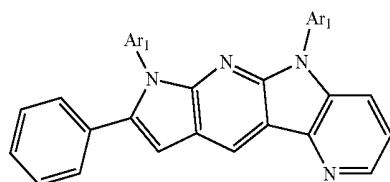
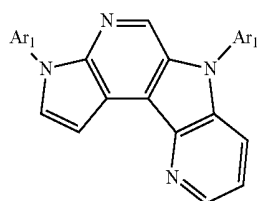
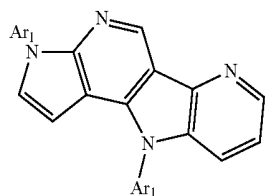
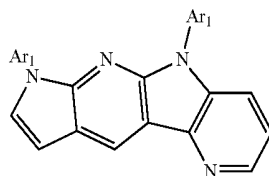
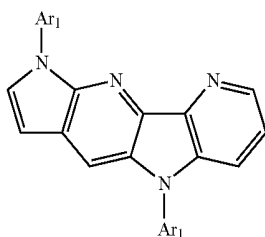
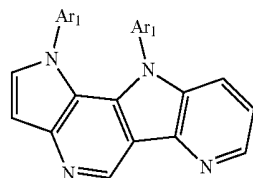
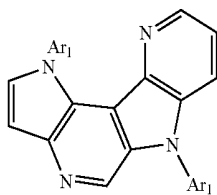
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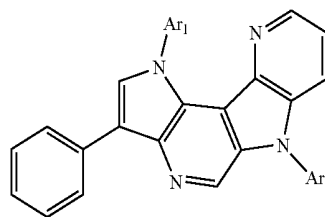
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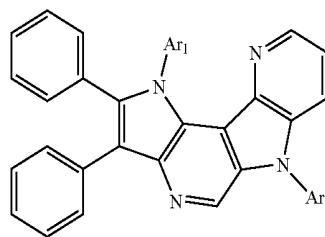
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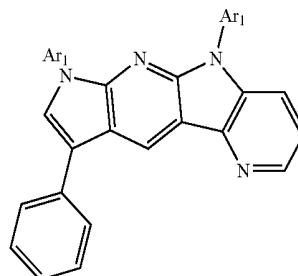
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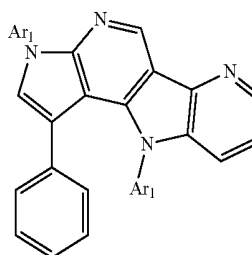
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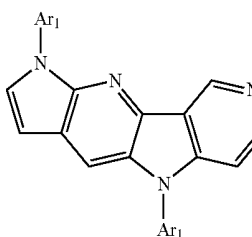
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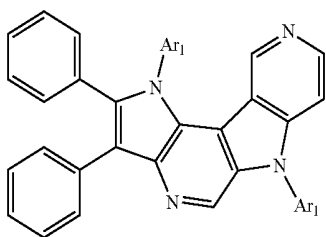
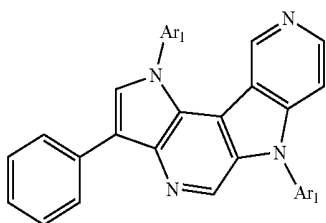
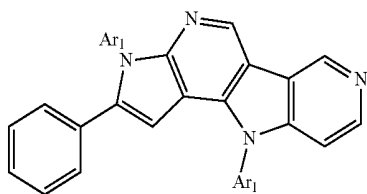
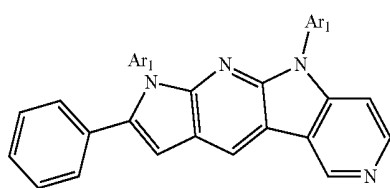
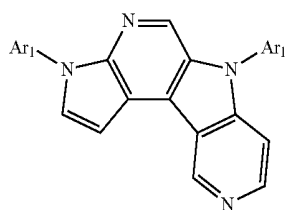
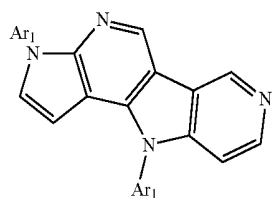
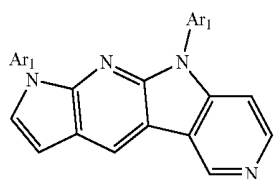
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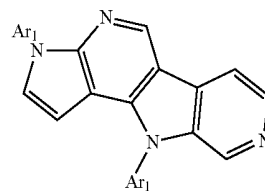
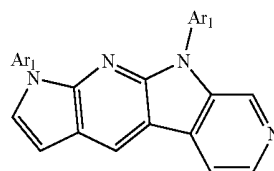
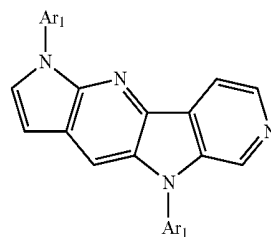
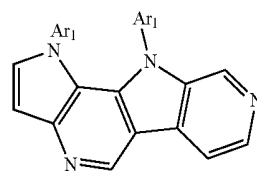
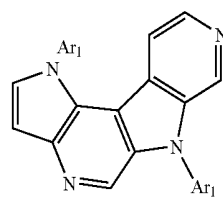
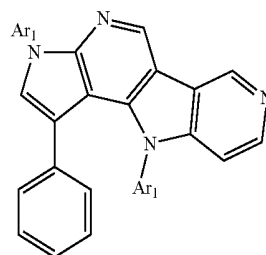
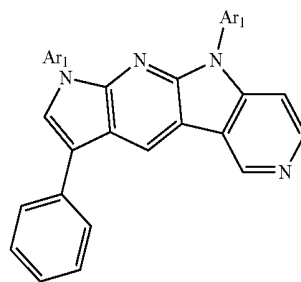
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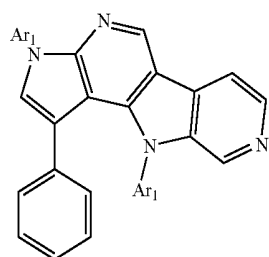
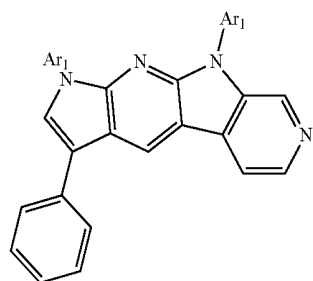
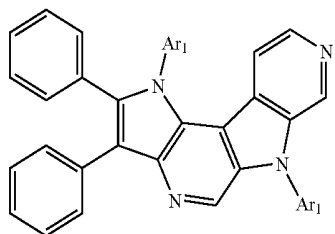
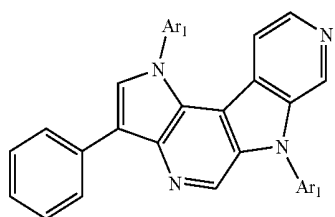
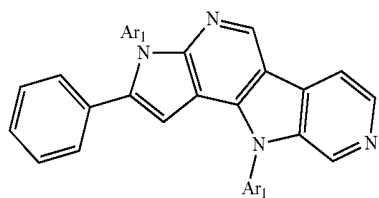
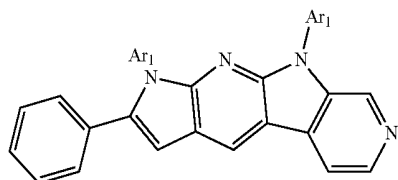
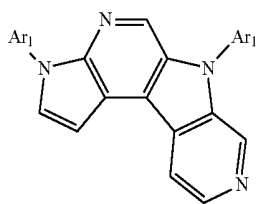
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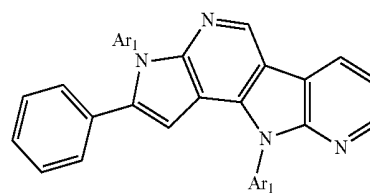
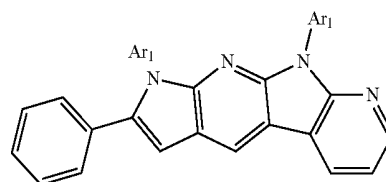
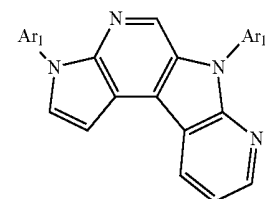
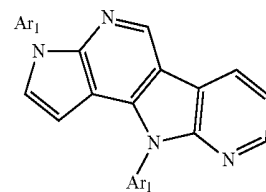
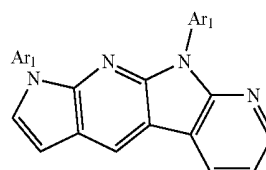
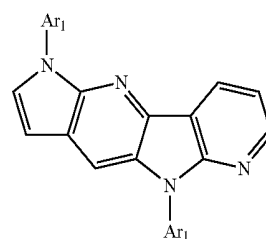
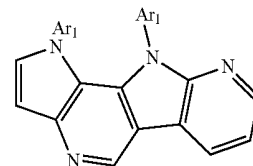
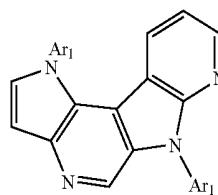
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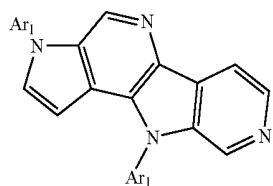
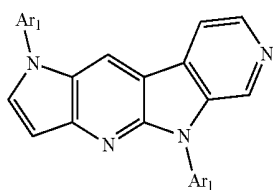
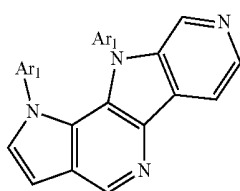
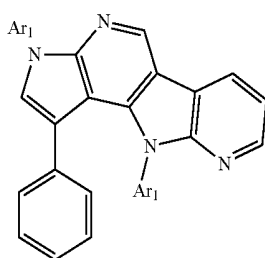
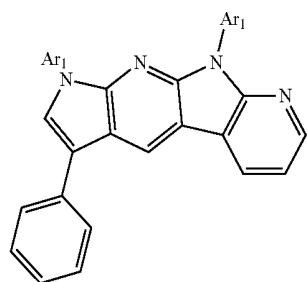
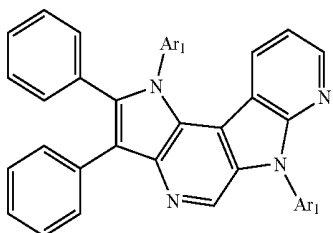
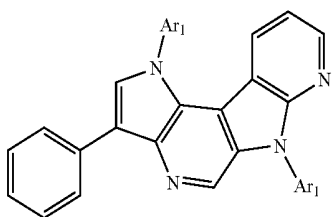
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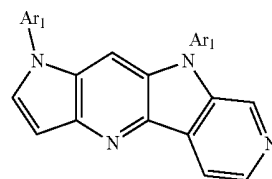
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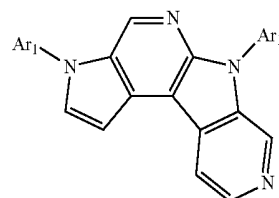
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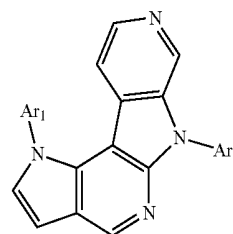
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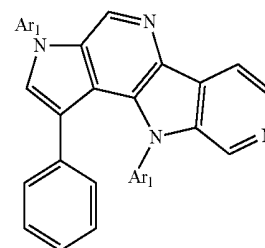
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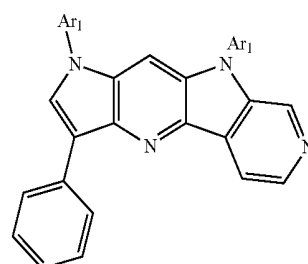
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C-121

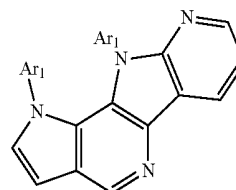
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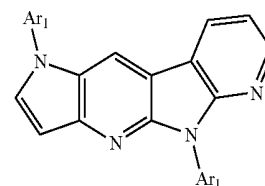
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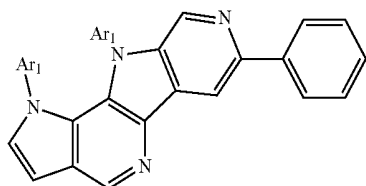
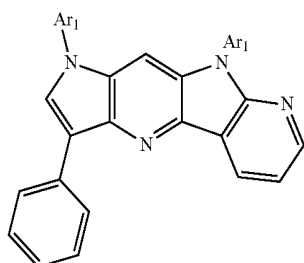
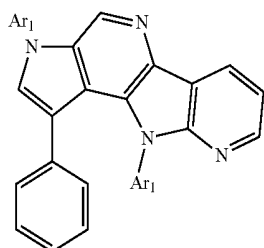
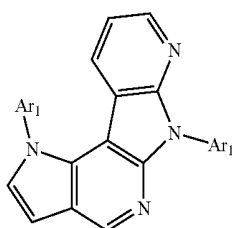
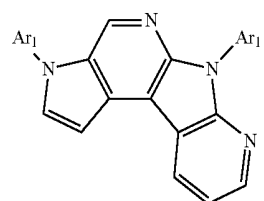
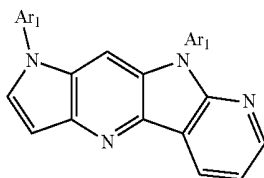
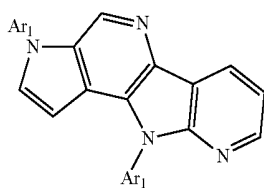
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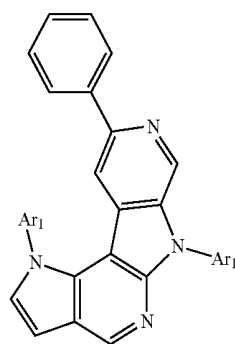
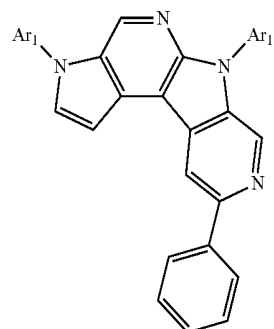
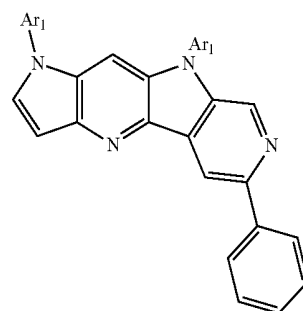
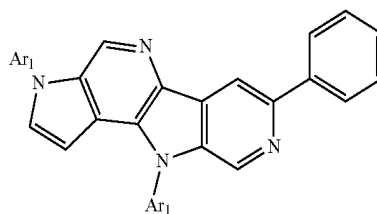
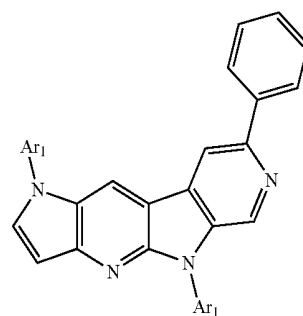
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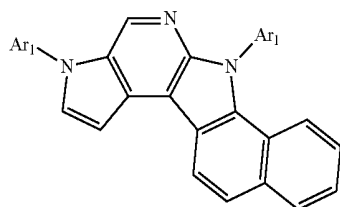
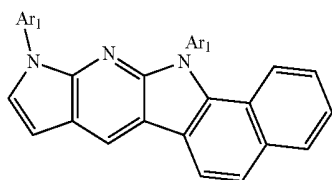
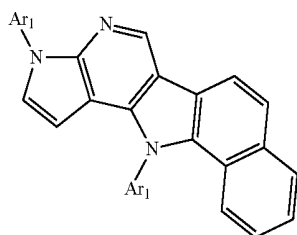
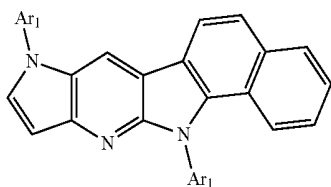
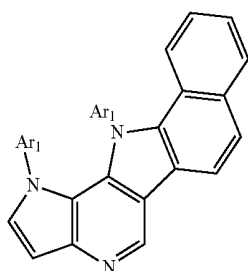
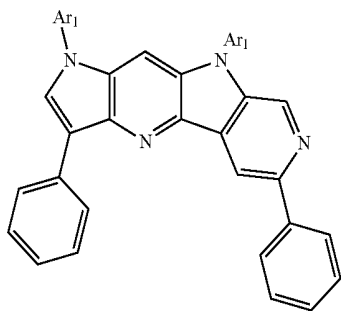
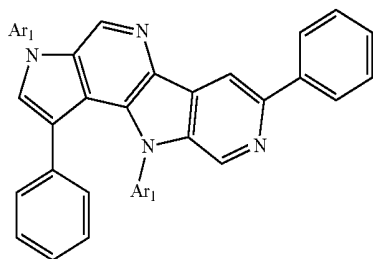
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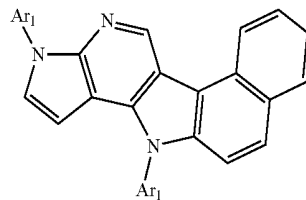
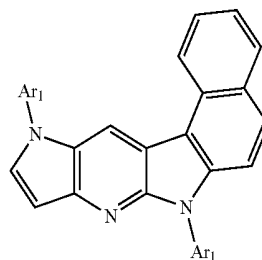
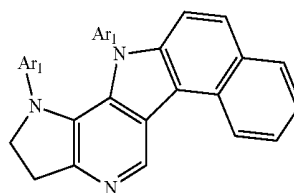
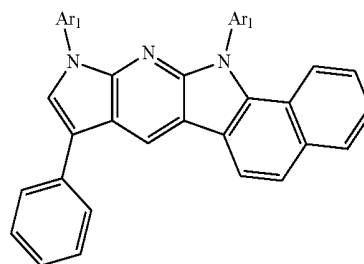
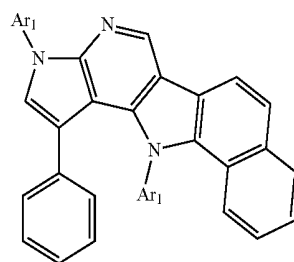
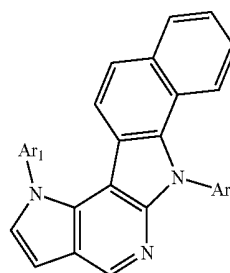
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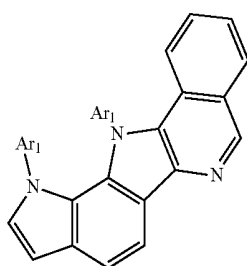
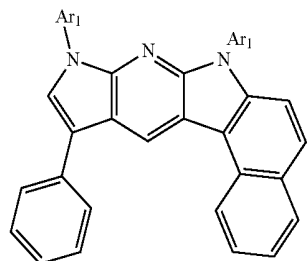
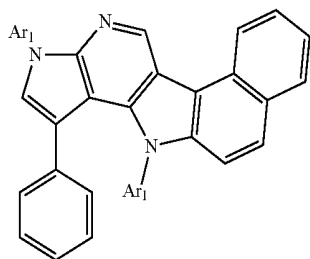
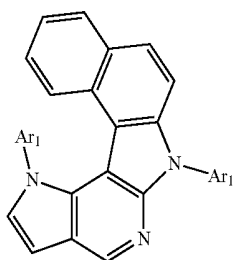
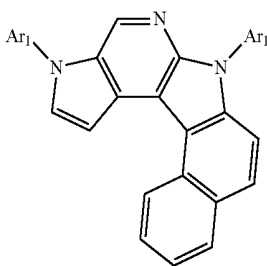
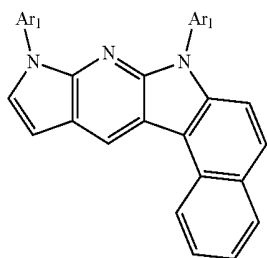
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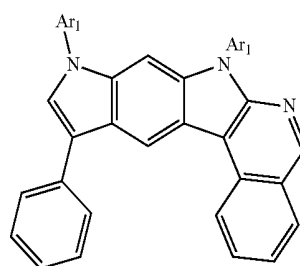
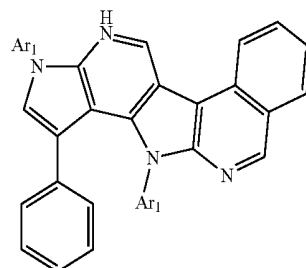
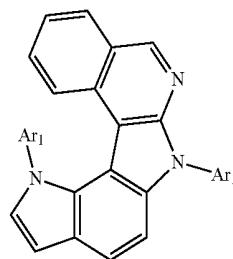
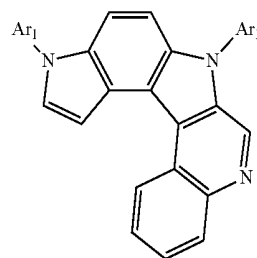
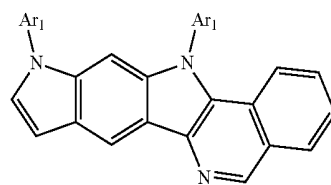
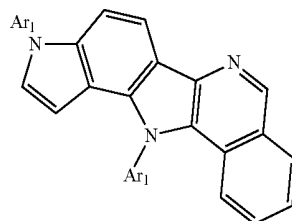
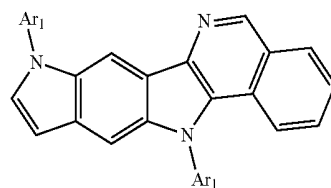
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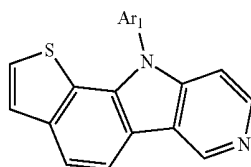
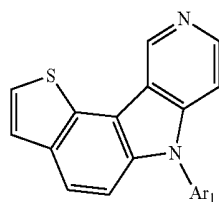
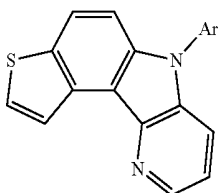
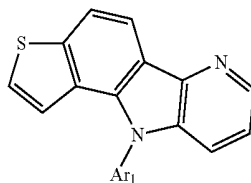
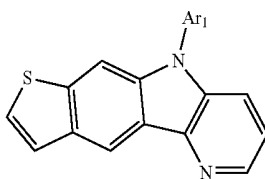
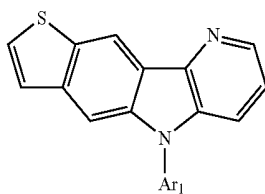
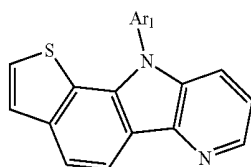
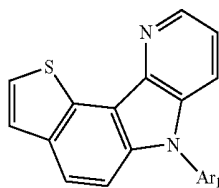
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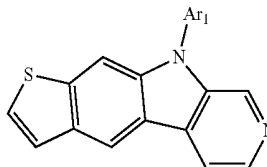
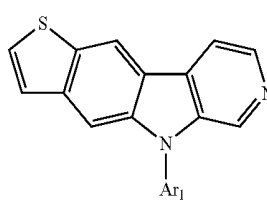
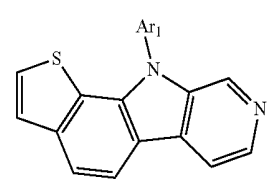
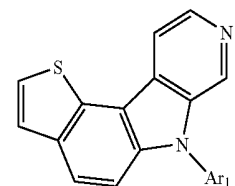
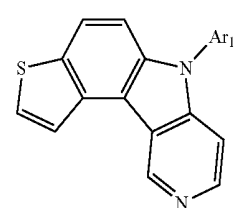
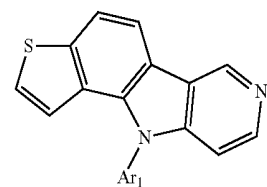
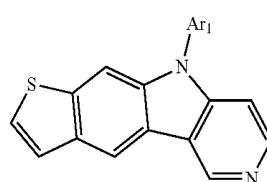
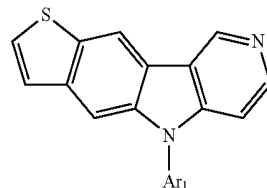
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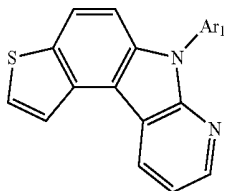
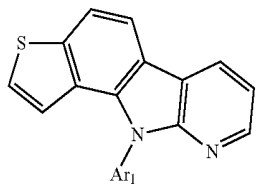
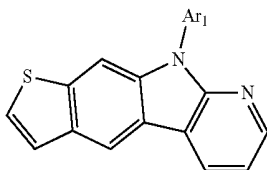
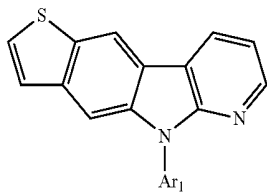
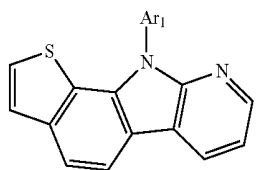
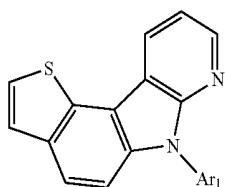
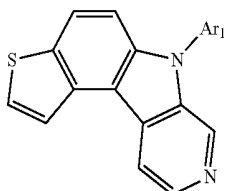
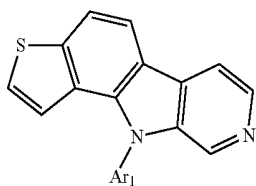
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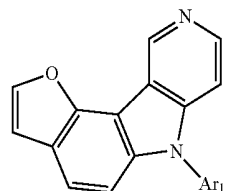
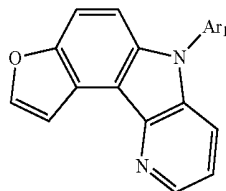
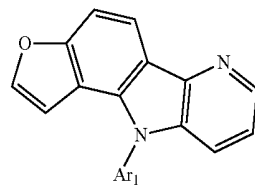
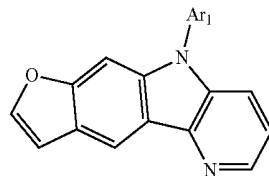
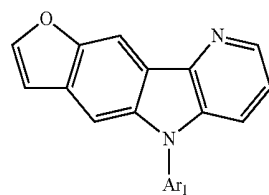
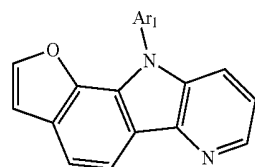
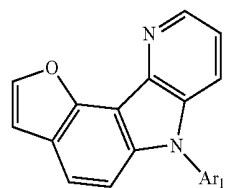
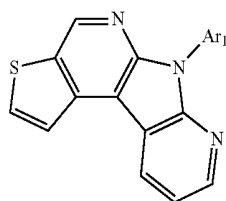
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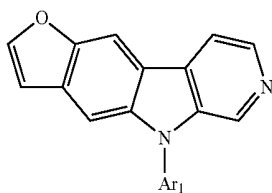
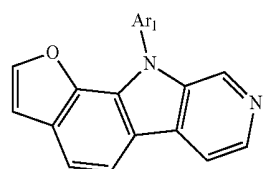
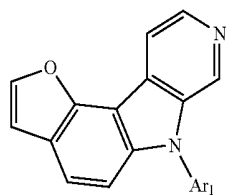
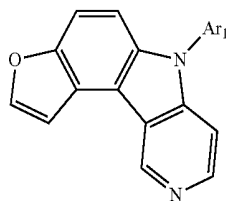
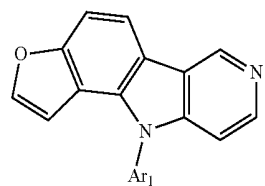
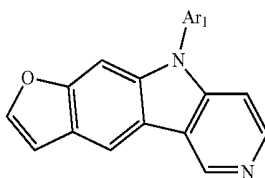
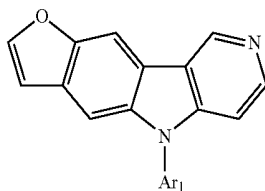
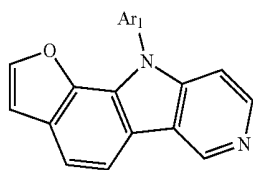
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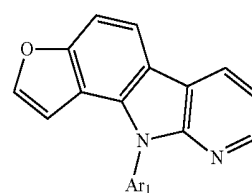
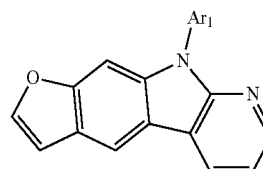
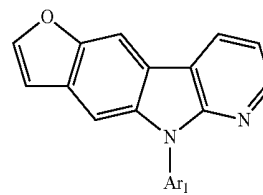
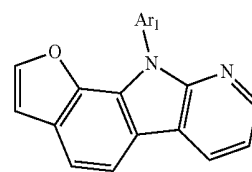
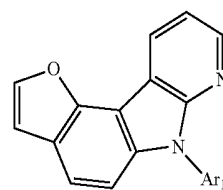
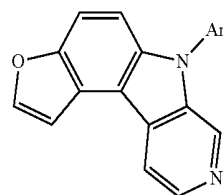
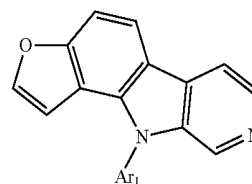
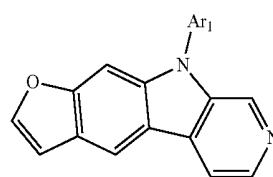
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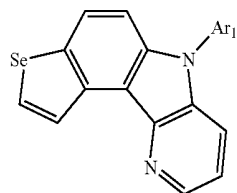
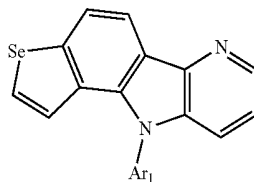
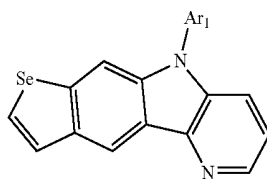
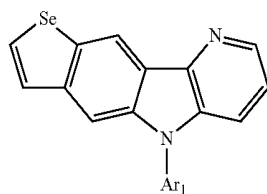
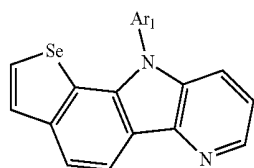
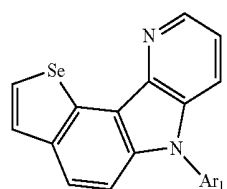
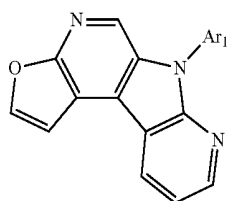
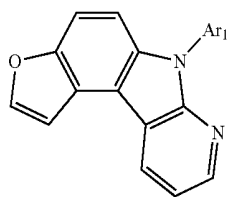
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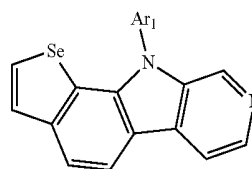
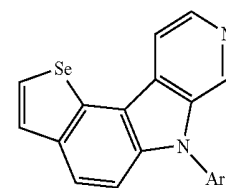
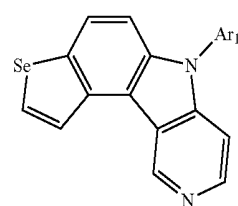
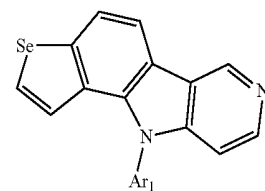
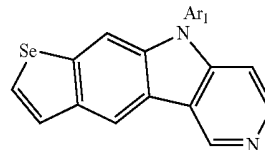
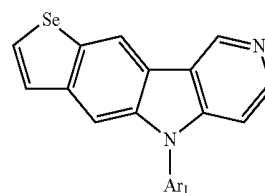
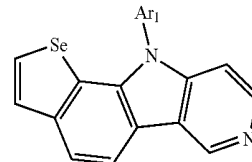
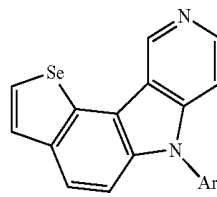
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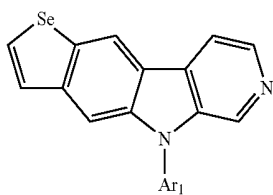
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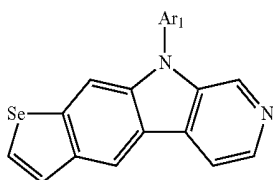
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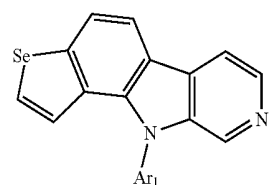


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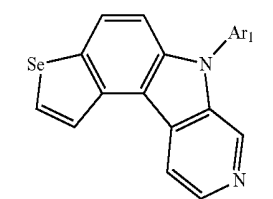


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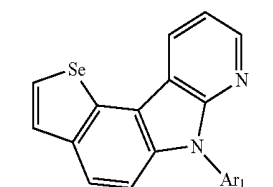
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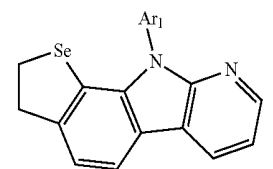


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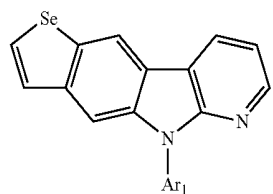


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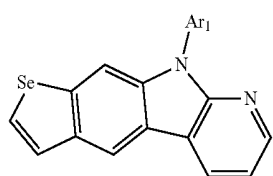


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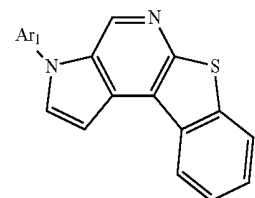
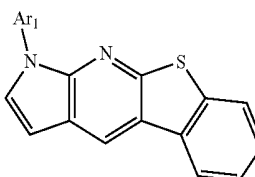
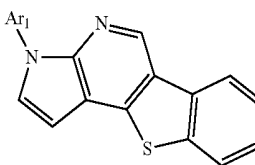
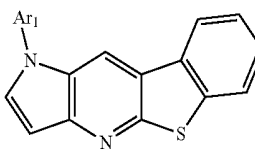
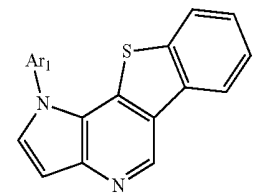
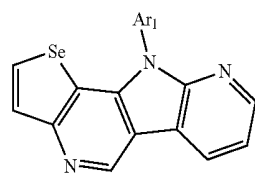
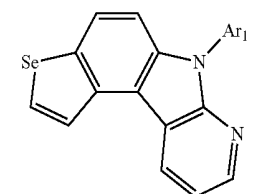
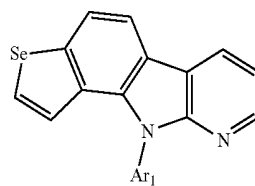
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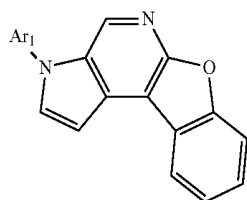
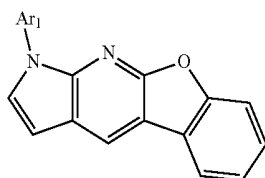
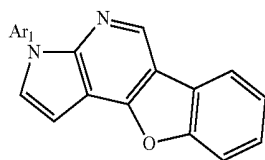
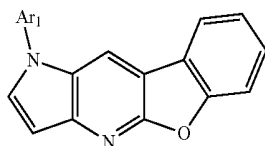
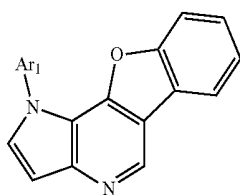
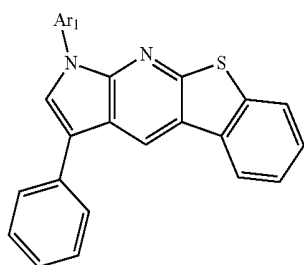
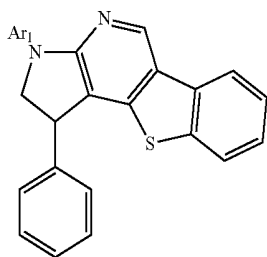
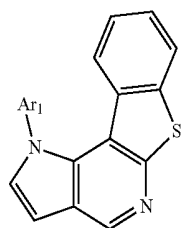
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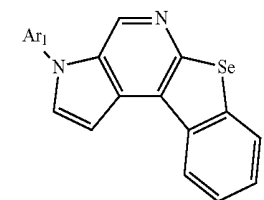
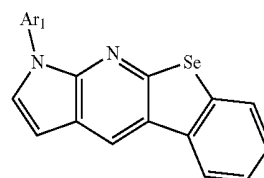
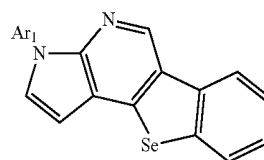
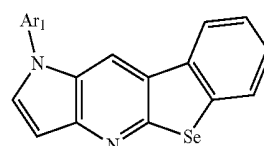
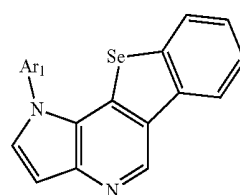
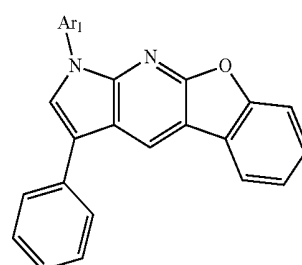
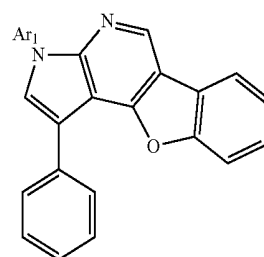
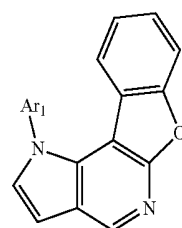


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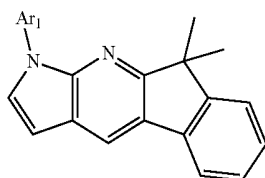
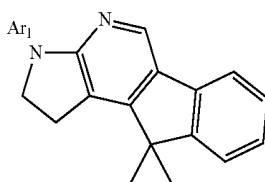
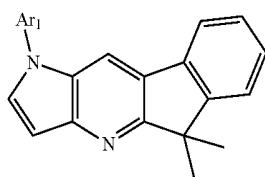
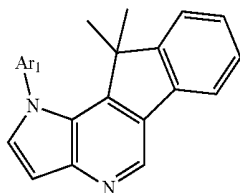
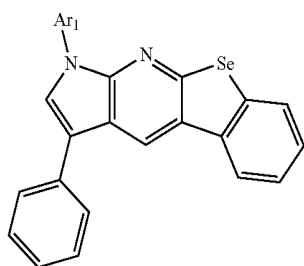
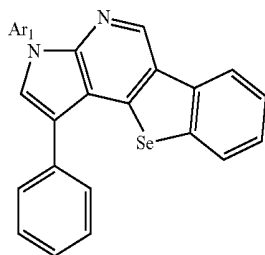
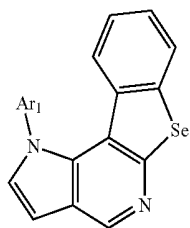
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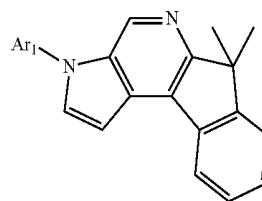
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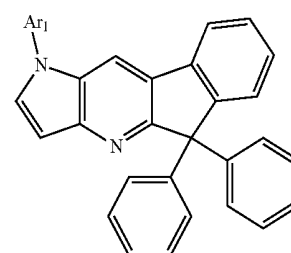
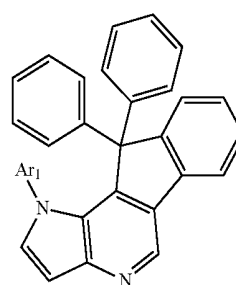
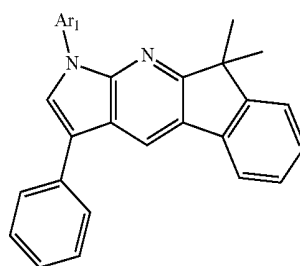
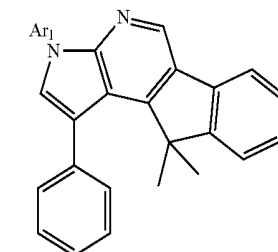
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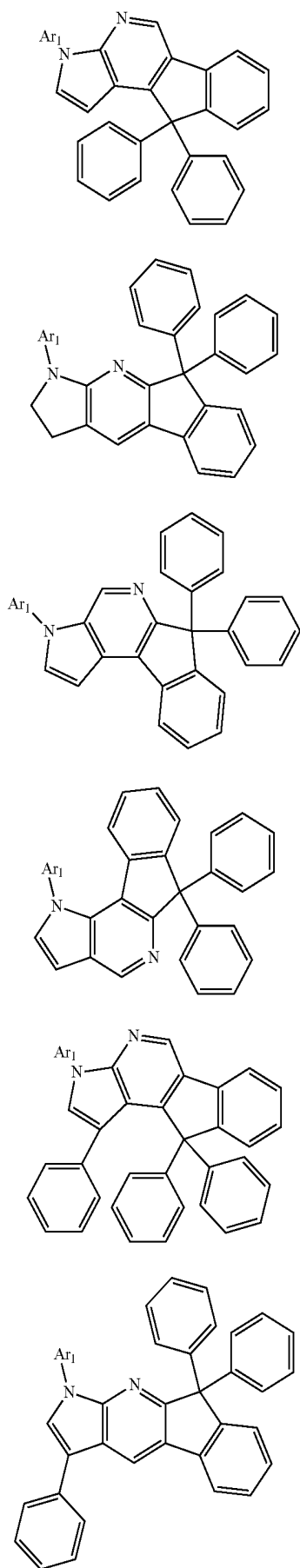
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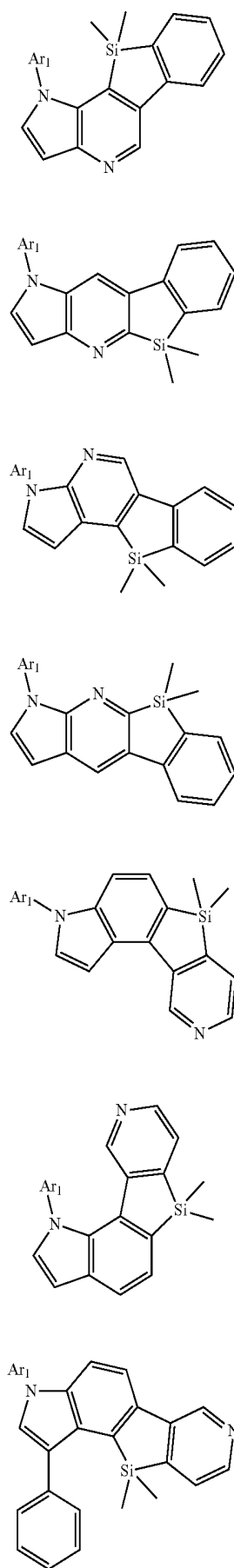
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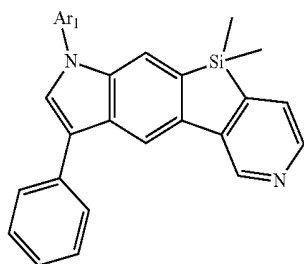
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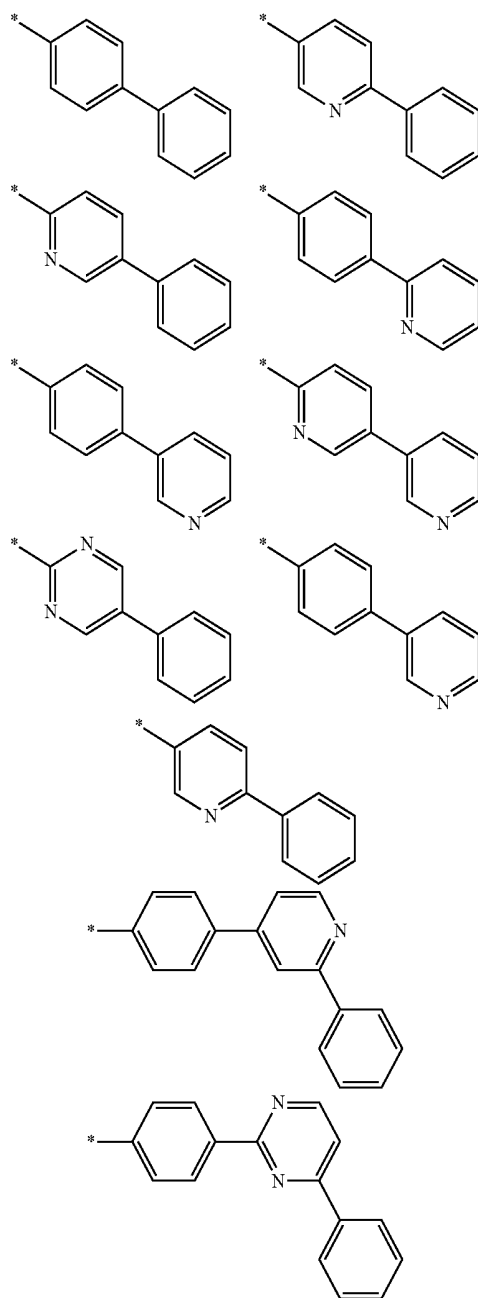
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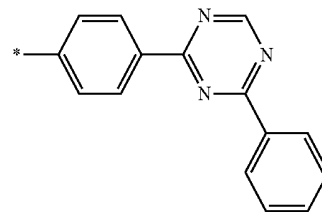


C-291

In Formulae C1 to C291 exemplified above, Ar₁'s may be the same as or different from each other even though being identically denoted, and are the same as those of Formula 1 previously defined. In this case, it is preferred that Ar₁ is selected from the group of the following substituents.

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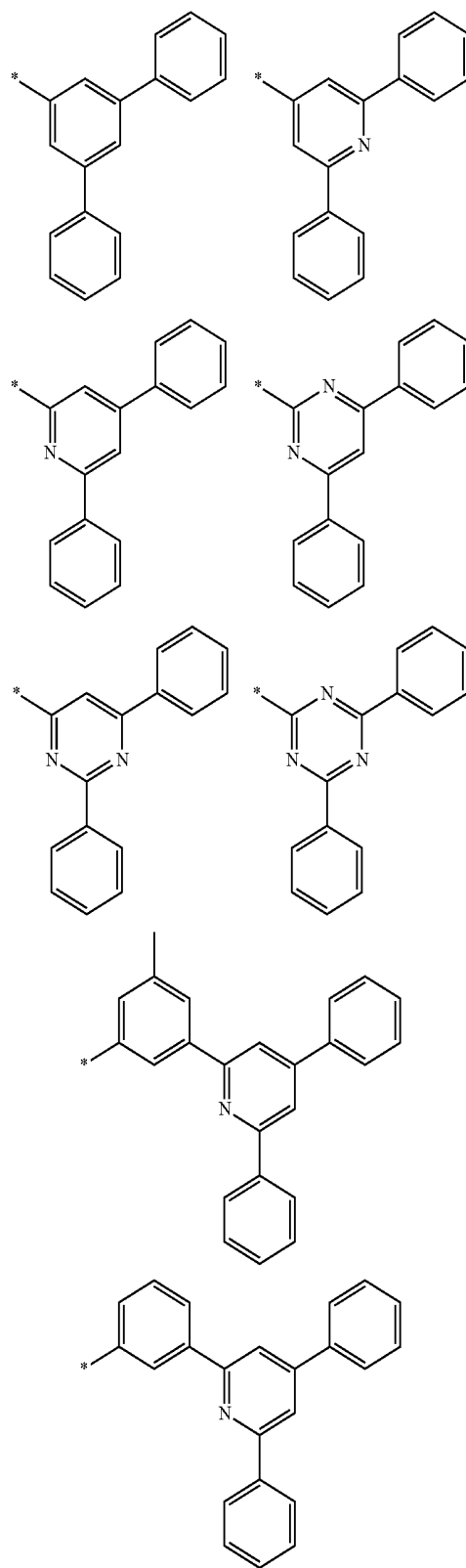
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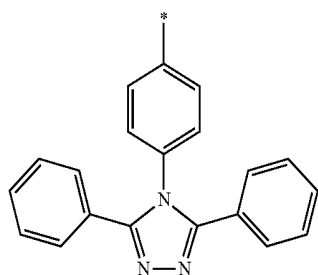
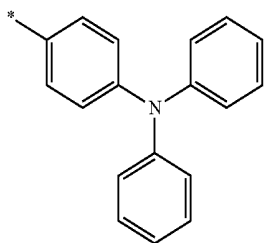
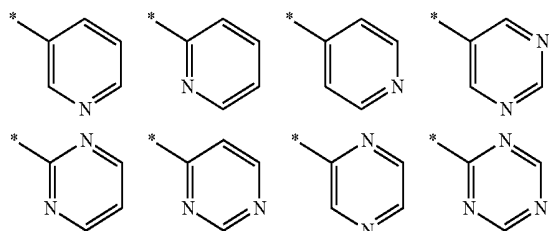
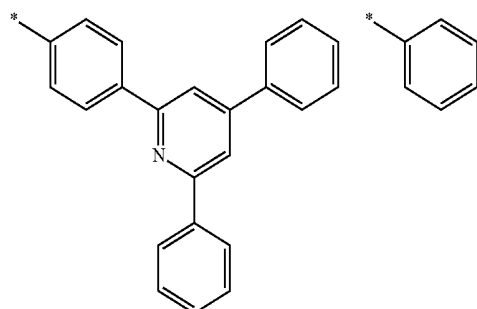
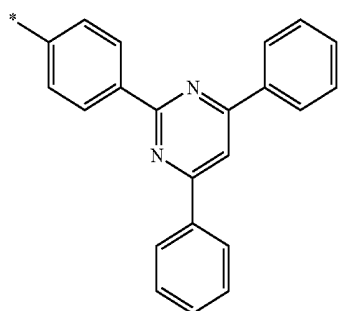
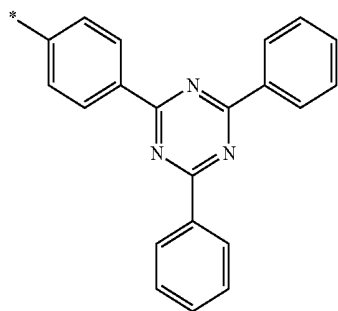
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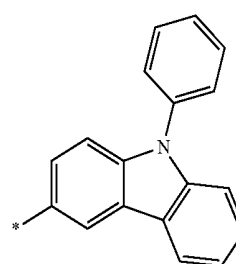
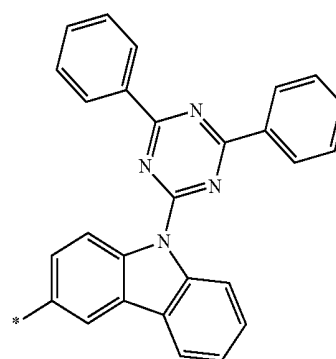
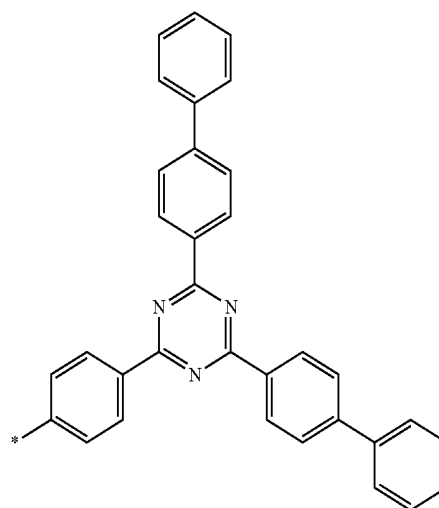
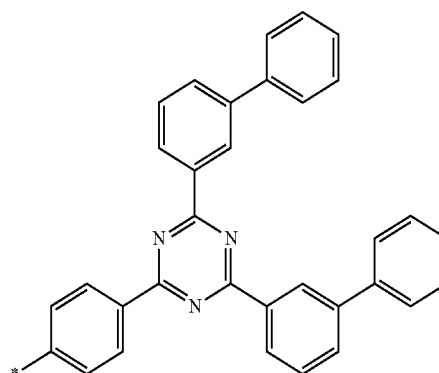
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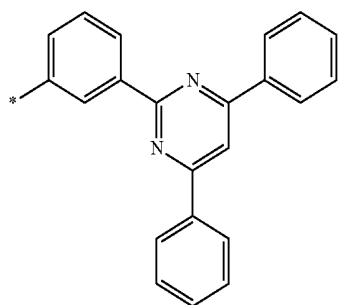
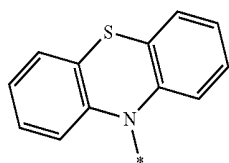
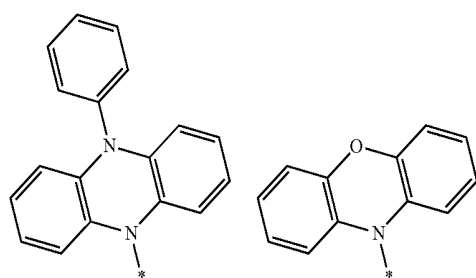
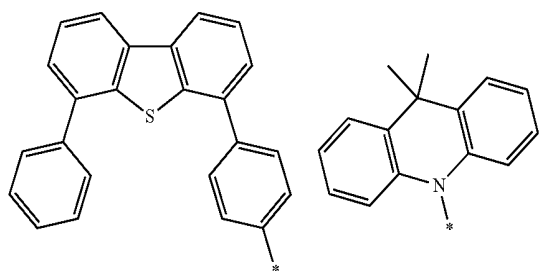
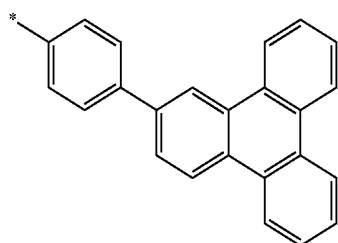
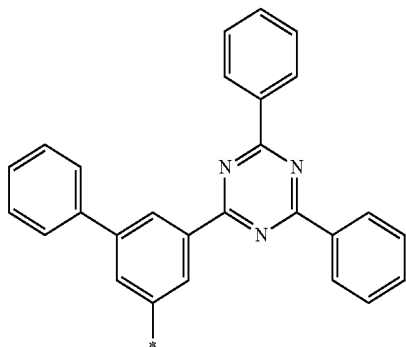
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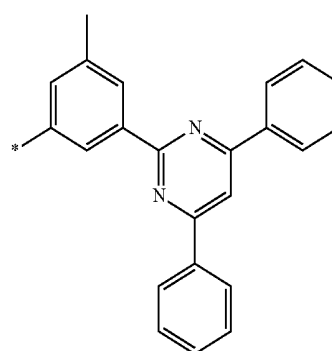
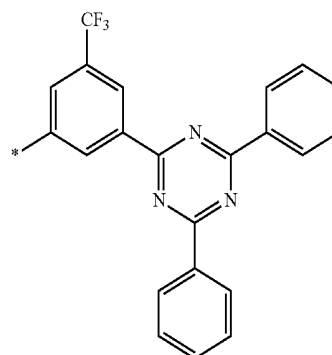
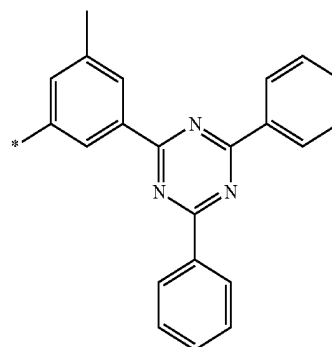
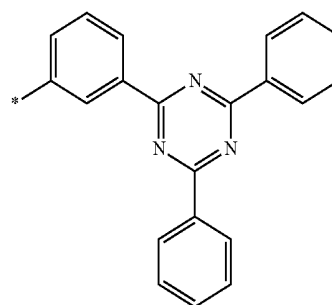
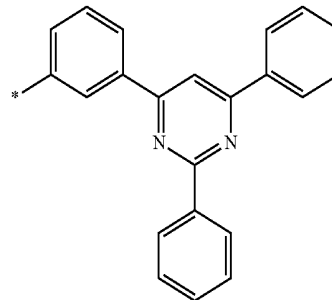
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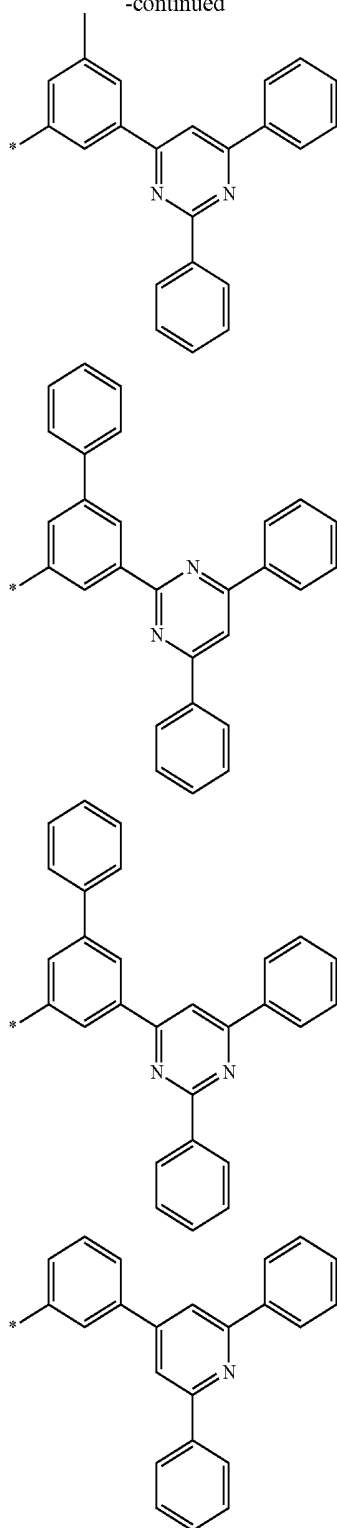
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The compound represented by Formula 1 according to the present disclosure may be synthesized according to a general synthesis method. The detailed synthesis process on the compound of the present disclosure will be specifically described in the Synthesis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

<Organic Electroluminescent Device>

Meanwhile, another aspect of the present disclosure relates to an organic electroluminescent device including the aforementioned compound represented by Formula 1 according to the present disclosure.

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Specifically, the organic electroluminescent device according to the present disclosure includes (i) an anode, (ii) a cathode, and (iii) an organic material layer including one or more layers interposed between the anode and the cathode, in which at least one of the organic material layer includes one or more of the compounds represented by Formula 1.

Here, the organic material layer including the compound represented by Formula 1 according to the present disclosure may be one or more of a hole injection layer, a hole transporting layer, a light-emitting layer, an electron transporting layer, and an electron injection layer. Specifically, the organic material layer is preferably a hole transporting layer, a light-emitting layer, or an electron transporting layer, and more preferably a light-emitting layer.

The light-emitting layer of the organic electroluminescent device according to the present disclosure may contain a host material, and in this case, as the host material, any one of the compounds represented by Formula 1 may be used. When the light-emitting layer contains any one of the compounds represented by Formula 1, it is possible to provide an organic electroluminescent device having excellent efficiency (light-emitting efficiency and power efficiency), a lifespan, brightness, driving voltage, and the like because the binding force of holes and electrons is increased in the light-emitting layer. The compound represented by Formula 1 may be included in the organic electroluminescent device as a blue, green, and/or red phosphorescent host, a fluorescent host, or a dopant material. Further, the compound may be used as a dopant material.

The structure of the organic electroluminescent device according to the present disclosure is not particularly limited, but non-limiting examples thereof include 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 a hole injection layer, a hole transporting layer, and a light-emitting layer may include one or more of the compounds represented by Formula 1. In addition, the compound of the present disclosure may be used as a phosphorescent host or fluorescent host of a light-emitting layer. An electron injection layer may also be disposed on the electron transporting layer.

Furthermore, the organic EL device according to the present disclosure, as described above may have a structure in which an anode, an organic material layer including one or more layers, and a cathode are sequentially laminated, and further, an insulating layer or an adhesive layer may be inserted at the interface between an electrode and an organic material layer.

In the organic EL device according to the present disclosure, an organic material layer including the compound represented by Formula 1 may be formed by a vacuum deposition method or a solution application method. Examples of the solution application method include spin coating, dip coating, doctor blading, inkjet printing, or a thermal transfer method, but are not limited thereto.

The organic EL device according to the present disclosure may be manufactured by forming an organic material layer and an electrode using materials and methods known in the art, except that one or more layers in the organic material layer are formed so as to include the compound represented by Formula 1 according to the present disclosure.

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

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Examples of an anode material include a metal, such as vanadium, chromium, copper, zinc, and gold, or alloys thereof; a metal oxide, such as zinc oxide, indium oxide, indium tin oxide (ITO), and indium zinc oxide (IZO); a combination of metal and 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 alloys thereof; a multi-layer structured material, such as LiF/Al or LiO₂/Al, and the like, but are not limited thereto.

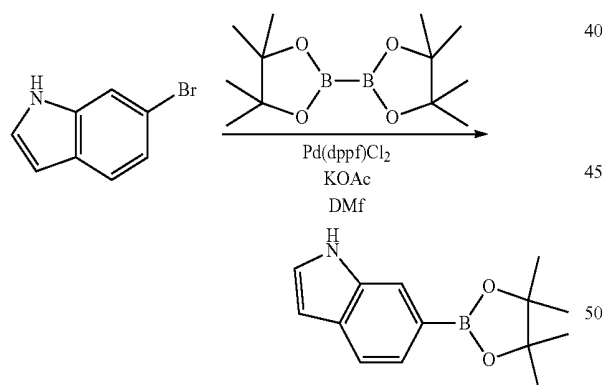
Furthermore, the hole injection layer, the hole transporting layer, the electron injection layer, and the electron transporting layer are not particularly limited, and typical materials known in the art may be used.

Hereinafter, the present disclosure will be described in detail as follows through the Examples. However, the following Examples are only for exemplifying the present disclosure, and the present disclosure is not limited by the following Examples.

PREPARATION EXAMPLE 1

Synthesis of IC-1

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

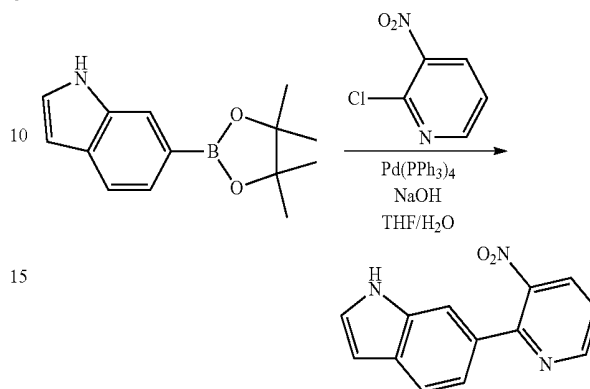


6-bromo-1H-indole (25 g, 0.128 mol), 4,4',4'',5,5',5'',5'''-octamethyl-2,2'-bi(1,3,2-dioxaborolane) (48.58 g, 0.191 mol), Pd(dppf)Cl₂ (5.2 g, 5 mol %), KOAc (37.55 g, 0.383 mol), and DMF (500 ml) were mixed under nitrogen flow, and the resulting mixture was stirred at 130° C. for 12 hours. After the reaction was terminated, 6-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole (20.15 g, yield 65%) was obtained by performing extraction with ethyl acetate, removing moisture over MgSO₄, and purifying the residue with column chromatography (Hexane:EA=10:1 (v/v)).

¹H-NMR: δ 1.25 (s, 12H), 6.47 (d, 1H), 7.28 (d, 1H), 7.43 (d, 1H), 7.54 (d, 1H), 7.99 (s, 1H), 8.25 (s, 1H)

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

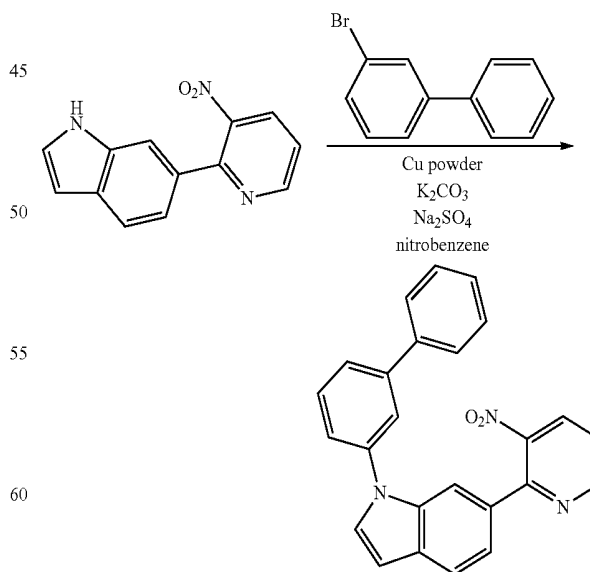


2-chloro-3-nitropyridine (10.95 g, 69.07 mmol), the 6-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole (20.15 g, 82.88 mmol) obtained in <Step 1>, NaOH (8.29 g, 207.21 mmol), and THF/H₂O (300 ml/150 ml) were mixed under nitrogen flow, Pd(PPh₃)₄ (3.99 g, 5 mol %) was added thereto at 40° C., and the resulting mixture was stirred at 80° C. for 12 hours.

After the reaction was terminated, extraction was performed with methylene chloride, MgSO₄ was added thereto, and the resulting product was filtered. 6-(3-nitropyridin-2-yl)-1H-indole (11.90 g, yield 72%) was obtained by removing the solvent from the obtained organic layer, and then purifying the residue with column chromatography (Hexane:EA=10:1 (v/v)).

¹H-NMR: δ 6.45 (d, 1H), 7.26 (m, 2H), 7.44 (d, 1H), 7.56 (d, 1H), 7.98 (s, 1H), 8.24 (s, 1H), 8.32 (d, 1H), 8.89 (d, 1H)

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



The 6-(3-nitropyridin-2-yl)-1H-indole (11.90 g, 49.74 mmol) obtained in <Step 2>, 3-bromobiphenyl (17.39 g, 74.61 mmol), Cu powder (0.32 g, 4.97 mmol), K₂CO₃ (6.87

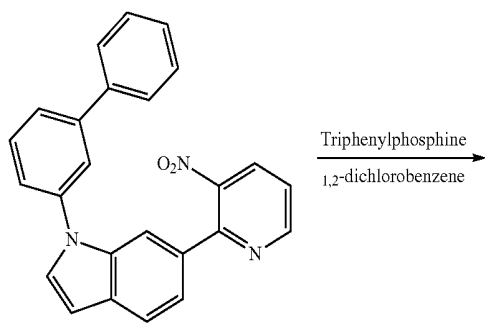
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g, 49.74 mmol), Na₂SO₄ (7.07 g, 49.74 mmol), and nitrobenzene (200 ml) were mixed under nitrogen flow, and the resulting mixture was stirred at 190° C. for 12 hours.

After the reaction was terminated, nitrobenzene was removed, the organic layer was separated by methylene chloride, and water was removed by using MgSO₄. 1-(biphenyl-3-yl)-6-(3-nitropyridin-2-yl)-1H-indole (10.51 g, yield 54%) was obtained by removing the solvent from the organic layer from which water had been removed, and then purifying the residue with column chromatography (Hexane:MC=1:1 (v/v)).

¹H-NMR: δ 6.45 (d, 1H), 7.26 (m, 2H), 7.44 (m, 5H), 7.52 (m, 4H), 7.57 (d, 1H), 7.98 (s, 1H), 8.05 (s, 1H), 8.32 (d, 1H), 8.89 (d, 1H)

<Step 4> Synthesis of IC-1



The 1-(biphenyl-3-yl)-6-(3-nitropyridin-2-yl)-1H-indole (10.51 g, 26.85 mmol) obtained in <Step 3>, triphenylphosphine (17.61 g, 67.13 mmol), and 1,2-dichlorobenzene (200 ml) were mixed under nitrogen flow, and the resulting mixture was stirred for 12 hours.

After the reaction was terminated, 1,2-dichlorobenzene was removed, and extraction was performed with dichloromethane. IC-1 (3.67 g, yield 38%) was obtained by removing water from the obtained organic layer over MgSO₄, and purifying the residue with column chromatography (Hexane:EA=3:1 (v/v)).

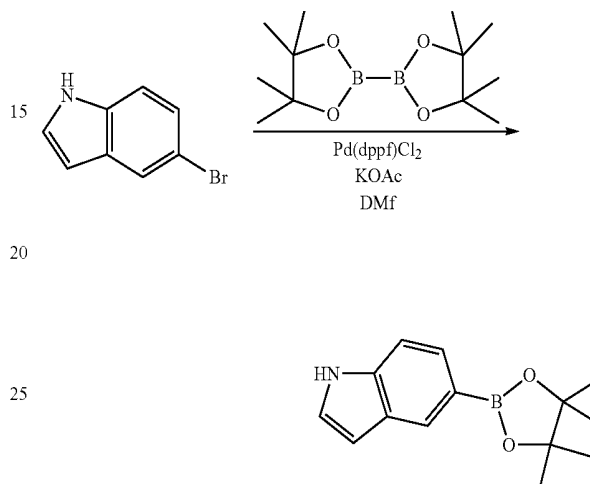
¹H-NMR: δ 6.46 (d, 1H), 7.25 (m, 2H), 7.45 (m, 5H), 7.53 (m, 4H), 7.59 (d, 1H), 7.88 (s, 1H), 8.27 (s, 1H), 8.33 (d, 1H), 8.87 (d, 1H)

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PREPARATION EXAMPLE 2

Synthesis of IC-2

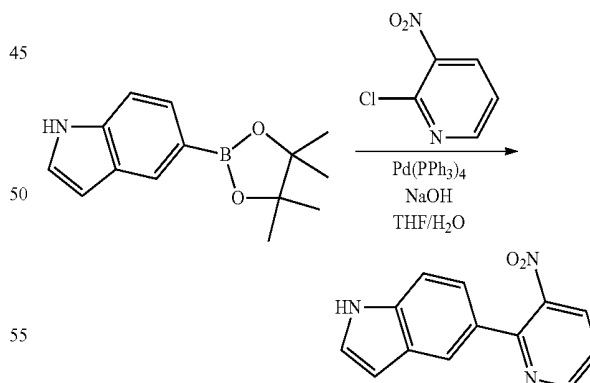
<Step 1> Synthesis of 5-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole



5-(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 5-bromo-1H-indole was used instead of 6-bromo-1H-indole.

¹H-NMR: δ 1.25 (s, 12H), 6.46 (d, 1H), 7.25 (d, 1H), 7.43 (d, 1H), 7.54 (d, 1H), 7.97 (s, 1H), 8.23 (s, 1H)

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

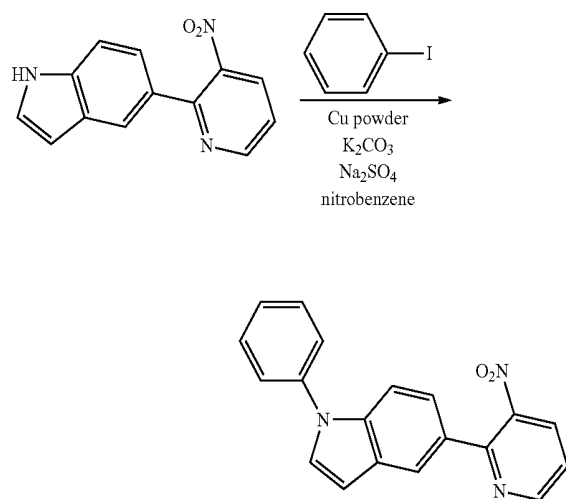


5-(3-nitropyridin-2-yl)-1H-indole was obtained by performing the same procedure as in <Step 2> of Preparation Example 1, except that the 5-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole obtained in <Step 1> was used instead of 6-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole.

¹H-NMR: δ 6.45 (d, 1H), 7.24 (m, 2H), 7.42 (d, 1H), 7.53 (d, 1H), 7.96 (s, 1H), 8.22 (s, 1H), 8.31 (d, 1H), 8.88 (d, 1H)

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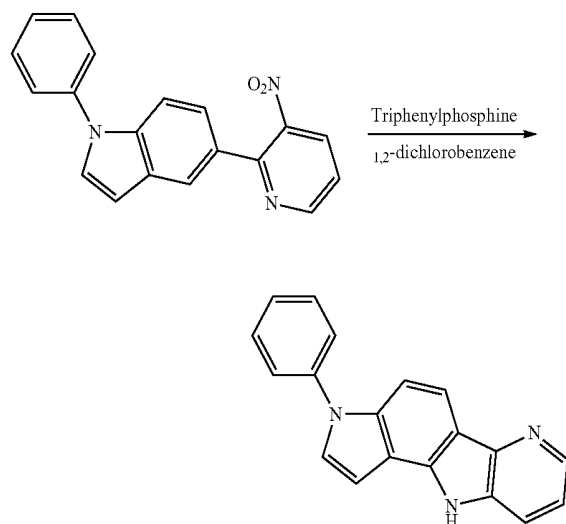
<Step 3> Synthesis of
5-(3-nitropyridin-2-yl)-1-phenyl-1H-indole



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

¹H-NMR: δ 6.44 (d, 1H), 7.23 (m, 2H), 7.41 (m, 3H), 7.51 (m, 4H), 7.95 (s, 1H), 8.33 (d, 1H), 8.86 (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 the 5-(3-nitropyridin-2-yl)-1-phenyl-1H-indole obtained in <Step 3> was used instead of 1-(biphenyl-3-yl)-6-(3-nitropyridin-2-yl)-1H-indole.

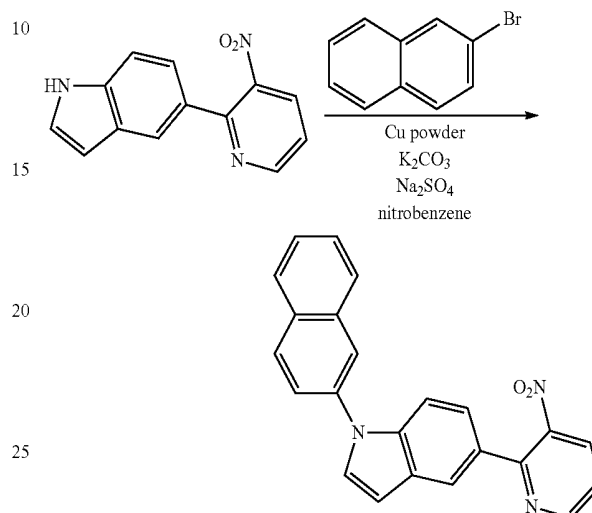
¹H-NMR: δ 6.44 (d, 1H), 7.23 (m, 2H), 7.45 (m, 3H), 7.53 (m, 4H), 8.25 (s, 1H), 8.33 (d, 1H), 8.86 (d, 1H)

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PREPARATION EXAMPLE 3

Synthesis of IC-3

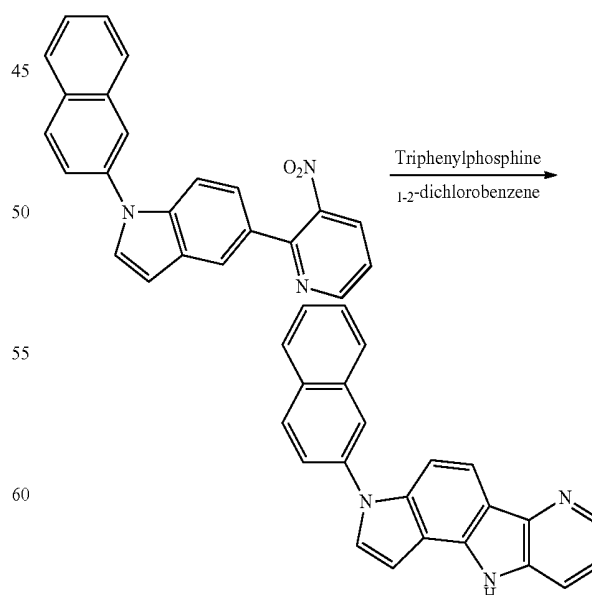
<Step 1> Synthesis of 1-(naphthalen-2-yl)-5-(3-nitropyridin-2-yl)-1H-indole



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

¹H-NMR: δ 6.44 (d, 1H), 7.23 (m, 2H), 7.36 (d, 1H), 7.41 (d, 1H), 7.55 (m, 3H), 7.82 (s, 1H), 7.98 (m, 4H), 8.33 (d, 1H), 8.86 (d, 1H)

<Step 2> Synthesis of IC-3



IC-3 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that the

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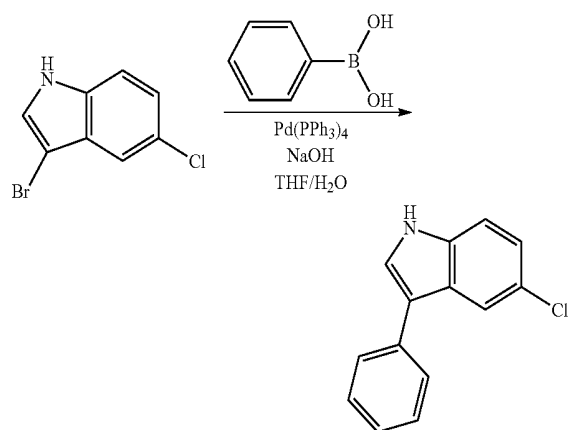
1-(naphthalen-2-yl)-5-(3-nitropyridin-2-yl)-1H-indole obtained in <Step 1> was used instead of 1-(biphenyl-3-yl)-6-(3-nitropyridin-2-yl)-1H-indole.

¹H-NMR: δ 6.44 (d, 1H), 7.23 (m, 2H), 7.36 (d, 1H), 7.41 (d, 1H), 7.55 (m, 3H), 7.82 (s, 1H), 7.98 (m, 3H), 8.23 (s, 1H), 8.33 (d, 1H), 8.86 (d, 1H)

PREPARATION EXAMPLE 4

Synthesis of IC-4

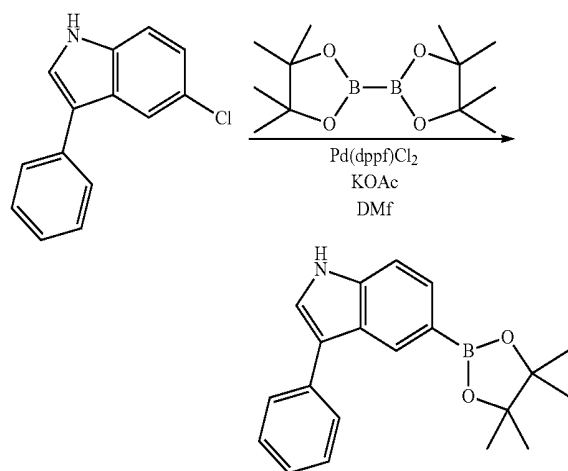
<Step 1> Synthesis of 5-chloro-3-phenyl-1H-indole



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

¹H-NMR: δ 7.18 (d, 1H), 7.25 (d, 1H), 7.45 (m, 3H), 7.55 (m, 2H), 7.68 (s, 1H), 8.24 (s, 1H), 8.31 (s, 1H)

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

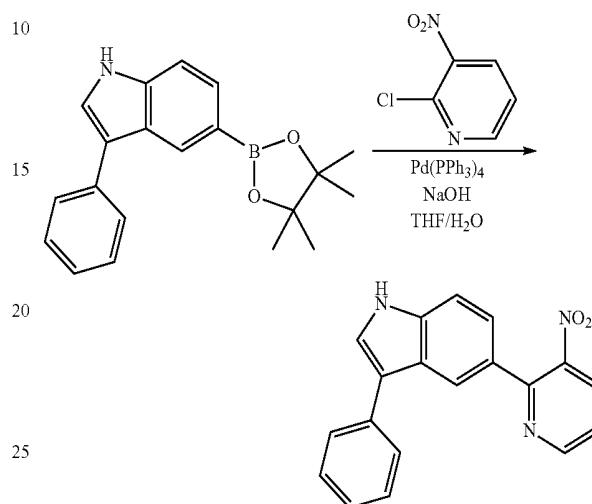


3-phenyl-5-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole was obtained by performing the same procedure as in <Step 1> of Preparation Example 1, except that the 5-chloro-3-phenyl-1H-indole obtained in <Step 1> was used instead of 6-bromo-1H-indole.

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¹H-NMR: δ 1.24 (s, 12H), 7.15 (d, 1H), 7.24 (d, 1H), 7.43 (m, 3H), 7.54 (m, 2H), 7.67 (s, 1H), 8.23 (s, 1H), 8.30 (s, 1H)

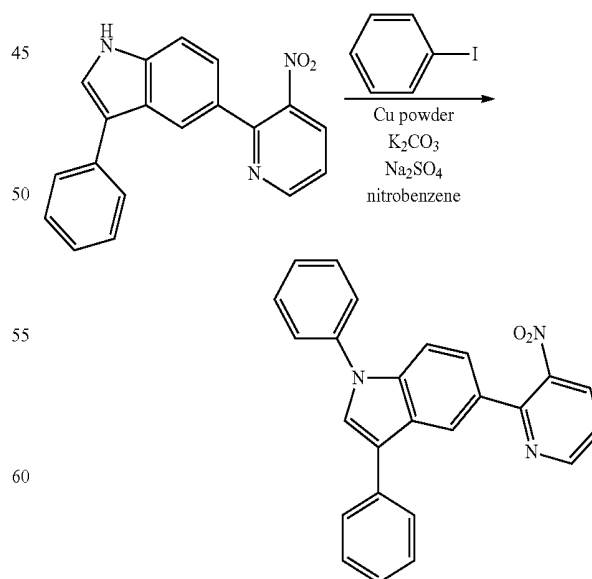
<Step 3> Synthesis of 5-(3-nitropyridin-2-yl)-3-phenyl-1H-indole



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

¹H-NMR: δ 7.17 (d, 1H), 7.24 (m, 2H), 7.44 (m, 3H), 7.55 (m, 2H), 7.66 (s, 1H), 8.24 (s, 1H), 8.32 (m, 2H), 8.86 (d, 1H)

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



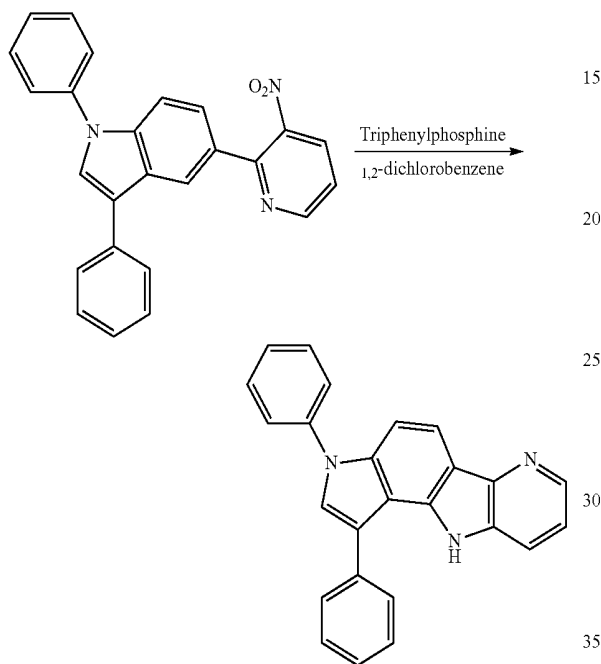
5-(3-nitropyridin-2-yl)-1,3-diphenyl-1H-indole was obtained by performing the same procedure as in <Step 3>

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of Preparation Example 1, except that the 5-(3-nitropyridin-2-yl)-3-phenyl-1H-indole obtained in <Step 3> and iodo-benzene were used instead of 6-(3-nitropyridin-2-yl)-1H-indole and 3-bromobiphenyl.

¹H-NMR: δ 7.18 (d, 1H), 7.25 (m, 2H), 7.44 (m, 4H), 7.51 (d, 2H), 7.56 (m, 4H), 7.67 (s, 1H), 8.31 (m, 2H), 8.85 (d, 1H)

<Step 5> Synthesis of IC-4



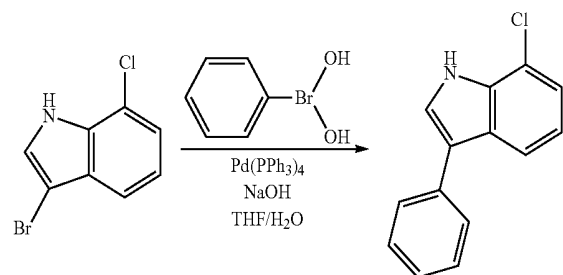
IC-4 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that the 5-(3-nitropyridin-2-yl)-1,3-diphenyl-1H-indole obtained in <Step 4> was used instead of 1-(biphenyl-3-yl)-6-(3-nitropyridin-2-yl)-1H-indole.

¹H-NMR: δ 7.18 (d, 1H), 7.25 (d, 1H), 7.44 (m, 4H), 7.51 (d, 2H), 7.56 (m, 4H), 7.67 (s, 1H), 8.25 (s, 1H), 8.31 (m, 2H), 8.85 (d, 1H)

PREPARATION EXAMPLE 5

Synthesis of IC-5

<Step 1> Synthesis of 7-chloro-3-phenyl-1H-indole



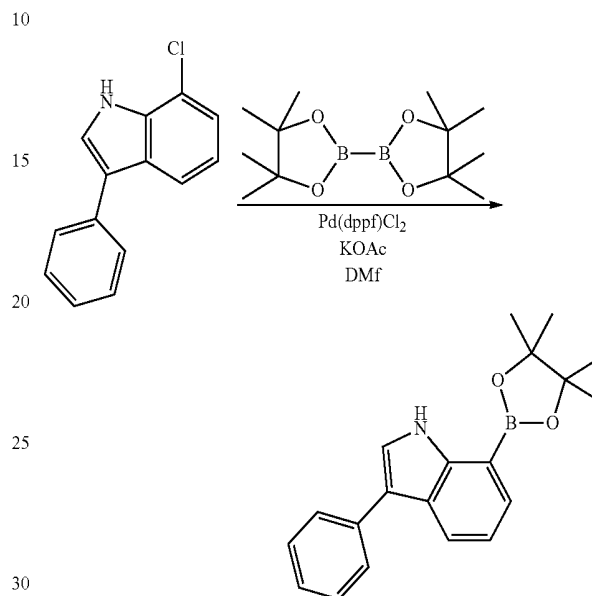
7-chloro-3-phenyl-1H-indole was obtained by performing the same procedure as in <Step 2> of Preparation Example

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1, except that 3-bromo-7-chloro-1H-indole and phenylboronic acid were used instead of 2-chloro-3-nitropyridine and 6-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole.

¹H-NMR: δ 7.04 (t, 1H), 7.17 (d, 1H), 7.41 (m, 1H), 7.52 (m, 4H), 7.64 (d, 1H), 8.24 (s, 1H), 8.31 (s, 1H)

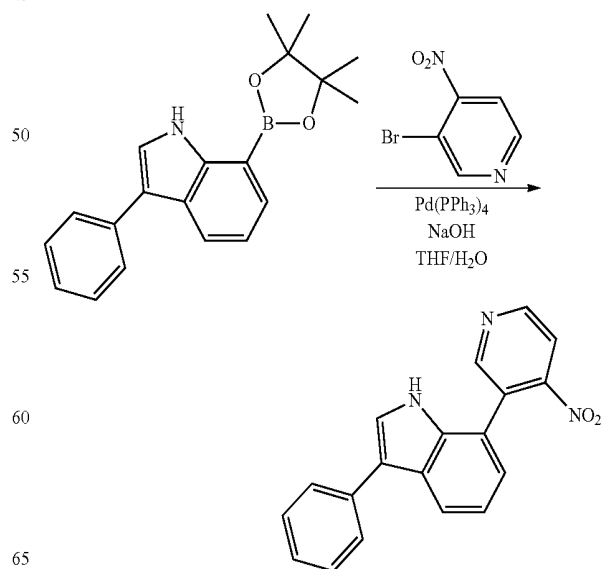
<Step 2> Synthesis of 3-phenyl-7-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole



3-phenyl-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 the 7-chloro-3-phenyl-1H-indole obtained in <Step 1> was used instead of 6-bromo-1H-indole.

¹H-NMR: δ 1.25 (s, 12H), 7.05 (t, 1H), 7.13 (d, 1H), 7.43 (m, 1H), 7.53 (m, 4H), 7.65 (d, 1H), 8.25 (s, 1H), 8.30 (s, 1H)

<Step 3> Synthesis of 7-(4-nitropyridin-3-yl)-3-phenyl-1H-indole

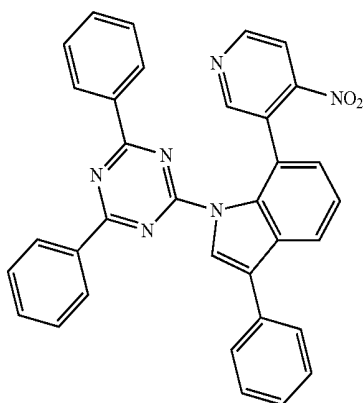
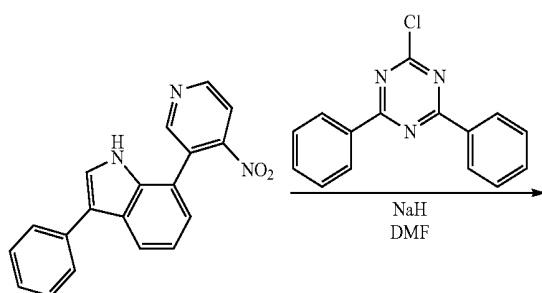


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7-(4-nitropyridin-3-yl)-3-phenyl-1H-indole was obtained by performing the same procedure as in <Step 2> of Preparation Example 1, except that the 3-phenyl-7-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole obtained in <Step 2> and 3-bromo-4-nitropyridine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

¹H-NMR: δ 7.05 (t, 1H), 7.13 (d, 1H), 7.43 (m, 1H), 7.53 (m, 4H), 7.65 (d, 1H), 7.92 (d, 1H), 8.25 (s, 1H), 8.30 (m, 2H), 8.52 (s, 1H)

<Step 4> Synthesis of 1-(4,6-diphenyl-1,3,5-triazin-2-yl)-7-(4-nitropyridin-3-yl)-3-phenyl-1H-indole

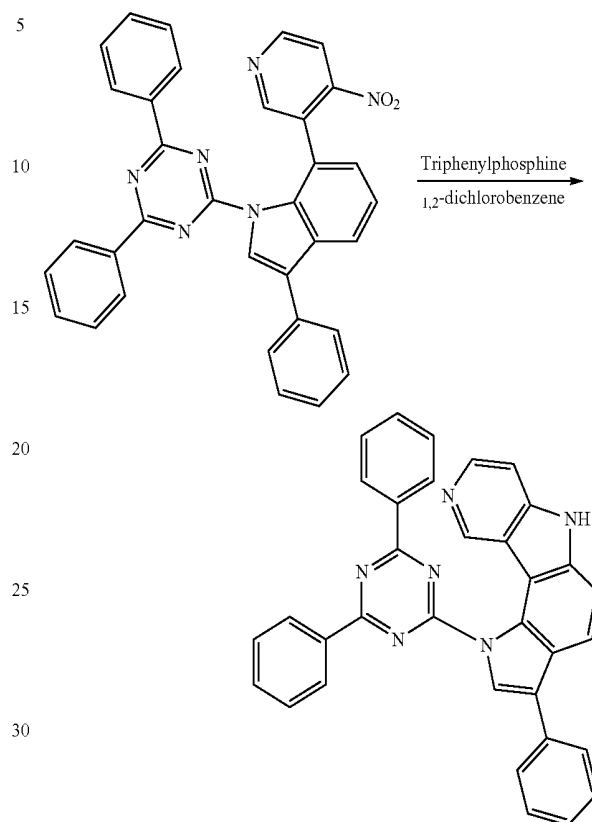


The 7-(4-nitropyridin-3-yl)-3-phenyl-1H-indole (5 g, 15.85 mmol) obtained in <Step 3> was dissolved in 50 ml of DMF under nitrogen, NaH (0.57 g, 23.77 mmol) was added thereto, and the resulting mixture was stirred for 1 hour. 2-chloro-4,6-diphenyl-1,3,5-triazine (6.36 g, 23.77 mmol) dissolved in 100 ml of DMF was slowly added thereto. After the mixture was stirred for 2 hours, 1-(4,6-diphenyl-1,3,5-triazin-2-yl)-7-(4-nitropyridin-3-yl)-3-phenyl-1H-indole (6.58 g, yield 76%) was obtained by terminating the reaction, filtering the mixture through silica, washing the filtrate with water and methanol, and then removing the solvent.

GC-Mass (theoretical value: 546.18 g/mol, measured value: 546 g/mol)

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<Step 5> Synthesis of IC-5



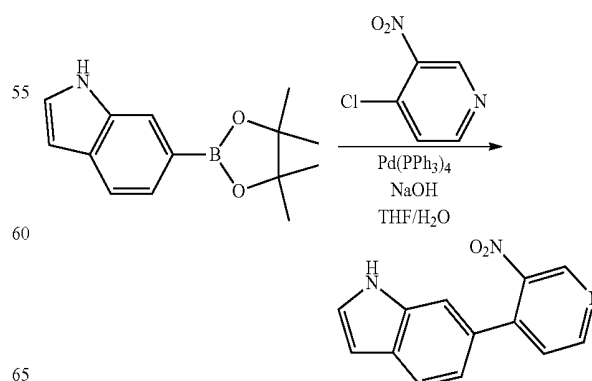
IC-5 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that the 1-(4,6-diphenyl-1,3,5-triazin-2-yl)-7-(4-nitropyridin-3-yl)-3-phenyl-1H-indole obtained in <Step 4> was used instead of 1-(biphenyl-3-yl)-6-(3-nitropyridin-2-yl)-1H-indole.

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

PREPARATION EXAMPLE 6

Synthesis of IC-6

<Step 1> Synthesis of 6-(3-nitropyridin-4-yl)-1H-indole

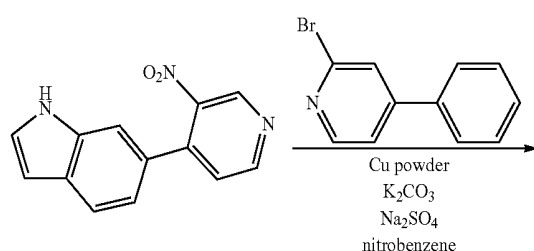


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6-(3-nitropyridin-4-yl)-1H-indole was obtained by performing the same procedure as in <Step 2> of Preparation Example 1, except that the 3-phenyl-7-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole obtained in <Step 1> of Preparation Example 1 and 4-chloro-3-nitropyridine were used instead of 2-chloro-3-nitropyridine.

¹H-NMR: δ 6.47 (d, 1H), 7.28 (d, 1H), 7.43 (d, 1H), 7.54 (d, 1H), 7.99 (s, 1H), 8.25 (s, 1H), 8.32 (d, 1H), 8.45 (d, 1H), 8.52 (s, 1H)

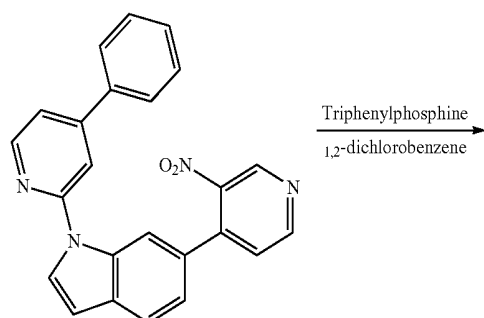
<Step 2> Synthesis of 6-(3-nitropyridin-4-yl)-1-(4-phenylpyridin-2-yl)-1H-indole



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

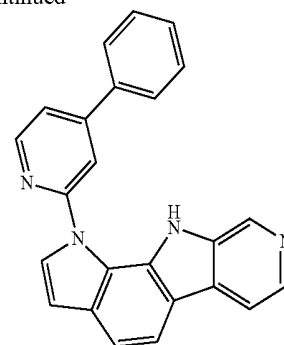
¹H-NMR: δ 6.47 (d, 1H), 7.28 (d, 1H), 7.43 (m, 4H), 7.53 (m, 3H), 7.62 (s, 1H), 7.99 (s, 1H), 8.25 (s, 1H), 8.32 (d, 1H), 8.45 (m, 2H), 8.52 (m, 2H)

<Step 3> Synthesis of IC-6



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-continued



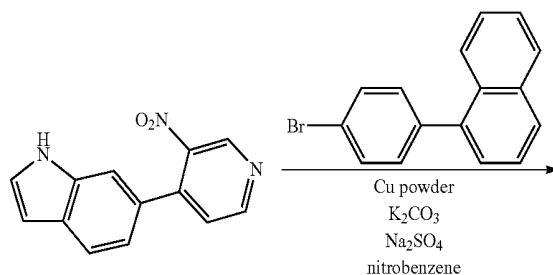
IC-6 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that the 6-(3-nitropyridin-4-yl)-1-(4-phenylpyridin-2-yl)-1H-indole obtained in <Step 2> was used instead of 1-(biphenyl-3-yl)-6-(3-nitropyridin-2-yl)-1H-indole.

¹H-NMR: δ 6.47 (d, 1H), 7.28 (d, 1H), 7.43 (m, 4H), 7.53 (m, 3H), 7.62 (s, 1H), 8.03 (s, 1H), 8.25 (s, 1H), 8.32 (d, 1H), 8.45 (m, 2H), 8.52 (m, 2H)

PREPARATION EXAMPLE 7

Synthesis of IC-7

<Step 1> Synthesis of 1-(4-(naphthalen-1-yl)phenyl)-6-(3-nitropyridin-4-yl)-1H-indole

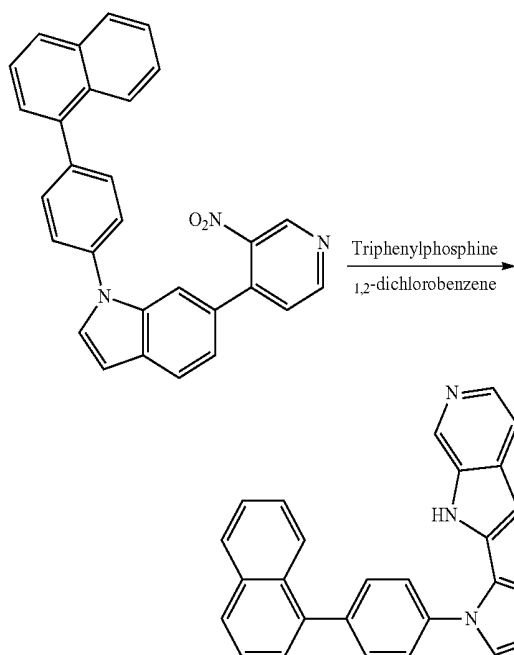


1-(4-(naphthalen-1-yl)phenyl)-6-(3-nitropyridin-4-yl)-1H-indole was obtained by performing the same procedure as in <Step 3> of Preparation Example 1, except that the 6-(3-nitropyridin-4-yl)-1H-indole obtained in <Step 1> of Preparation Example 6 and 1-(4-bromophenyl)naphthalene were used instead of 6-(3-nitropyridin-4-yl)-1H-indole and 3-bromobiphenyl.

¹H-NMR: δ 6.47 (d, 1H), 7.28 (d, 1H), 7.43 (d, 1H), 7.54 (m, 3H), 7.61 (m, 3H), 7.79 (d, 2H), 7.99 (m, 2H), 8.25 (d, 1H), 8.32 (m, 2H), 8.45 (m, 2H), 8.52 (s, 1H)

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<Step 2> Synthesis of IC-7



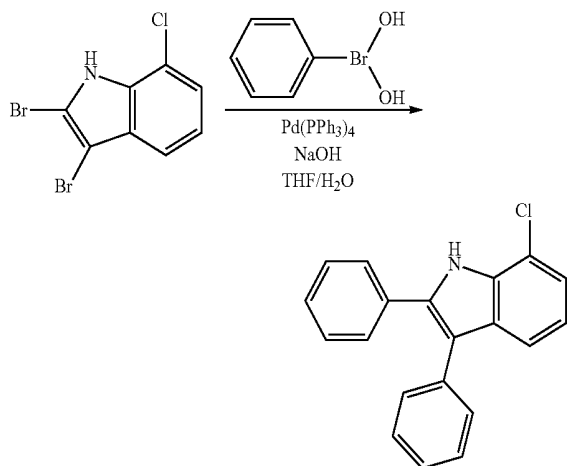
IC-7 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that the 1-(4-(naphthalen-1-yl)phenyl)-6-(3-nitropyridin-4-yl)-1H-indole obtained in <Step 1> was used instead of 1-(biphenyl-3-yl)-6-(3-nitropyridin-2-yl)-1H-indole.

GC-Mass (theoretical value: 409.16 g/mol, measured value: 409 g/mol)

PREPARATION EXAMPLE 8

Synthesis of IC-8

<Step 1> Synthesis of 7-chloro-2,3-diphenyl-1H-indole



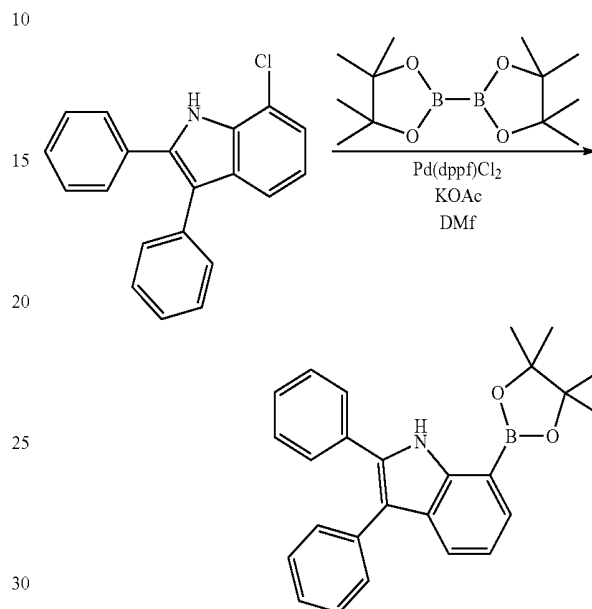
7-chloro-2,3-diphenyl-1H-indole was obtained by performing the same procedure as in <Step 2> of Preparation Example 1, except that 2,3-dibromo-7-chloro-1H-indole and

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phenylboronic acid were used instead of 2-chloro-3-nitropyridine and 6-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole.

GC-Mass (theoretical value: 303.08 g/mol, measured value: 303 g/mol)

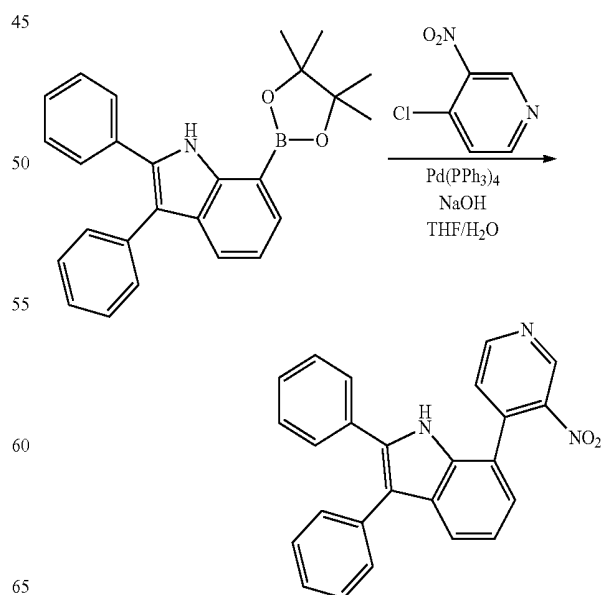
<Step 2> Synthesis of 2,3-diphenyl-7-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole



2,3-diphenyl-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 the 7-chloro-2,3-diphenyl-1H-indole obtained in <Step 1> was used instead of 6-bromo-1H-indole.

GC-Mass (theoretical value: 395.21 g/mol, measured value: 395 g/mol)

<Step 3> Synthesis of 7-(3-nitropyridin-4-yl)-2,3-diphenyl-1H-indole

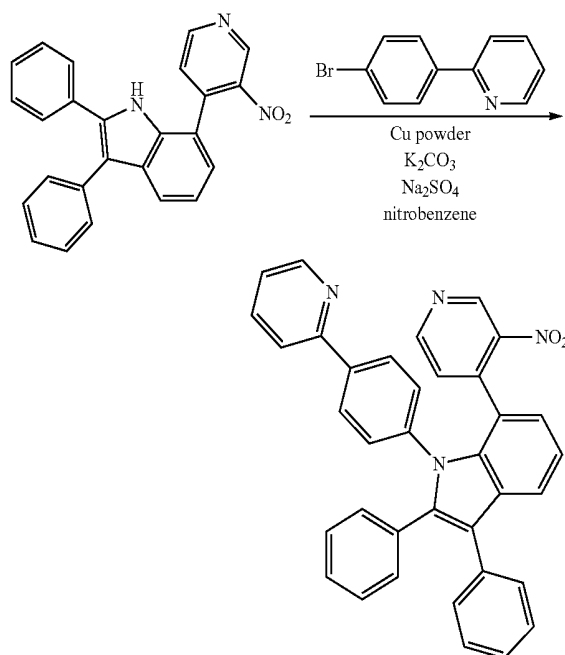


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7-(3-nitropyridin-4-yl)-2,3-diphenyl-1H-indole was obtained by performing the same procedure as in <Step 2> of Preparation Example 1, except that the 3-phenyl-7-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole obtained in <Step 2> and 4-chloro-3-nitropyridine were used instead of 6-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole and 2-chloro-3-nitropyridine.

GC-Mass (theoretical value: 391.13 g/mol, measured value: 391.13 g/mol)

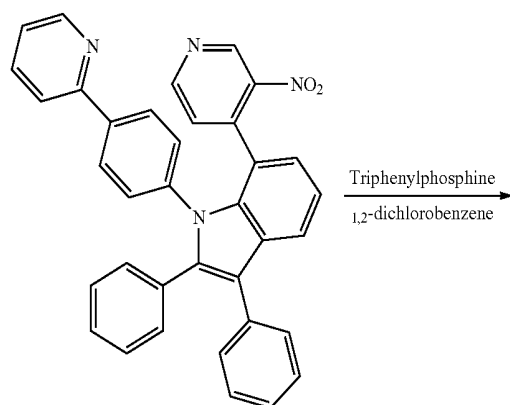
<Step 4> Synthesis of 7-(3-nitropyridin-4-yl)-2,3-diphenyl-1-(4-(pyridin-2-yl)phenyl)-1H-indole



7-(3-nitropyridin-4-yl)-2,3-diphenyl-1-(4-(pyridin-2-yl)phenyl)-1H-indole was obtained by performing the same procedure as in <Step 3> of Preparation Example 1, except that the 7-(3-nitropyridin-4-yl)-2,3-diphenyl-1H-indole obtained in <Step 3> and 2-(4-bromophenyl)pyridine were used instead of 6-(3-nitropyridin-2-yl)-1H-indole and 3-bromobiphenyl.

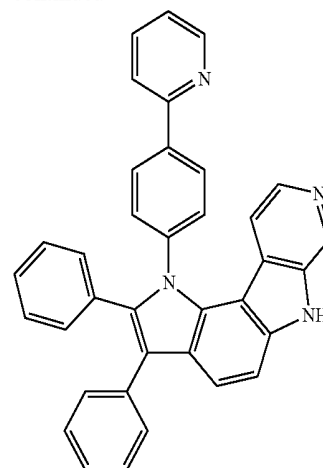
GC-Mass (theoretical value: 544.19 g/mol, measured value: 544 g/mol)

<Step 5> Synthesis of IC-8



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-continued



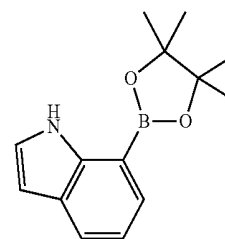
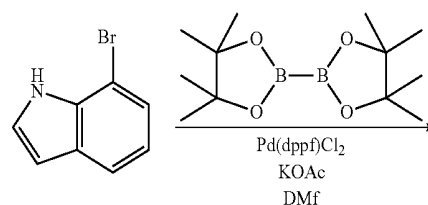
IC-8 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that the 7-(3-nitropyridin-4-yl)-2,3-diphenyl-1-(4-(pyridin-2-yl)phenyl)-1H-indole obtained in <Step 1> was used instead of 1-(biphenyl-3-yl)-6-(3-nitropyridin-2-yl)-1H-indole.

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

PREPARATION EXAMPLE 9

Synthesis of IC-9

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

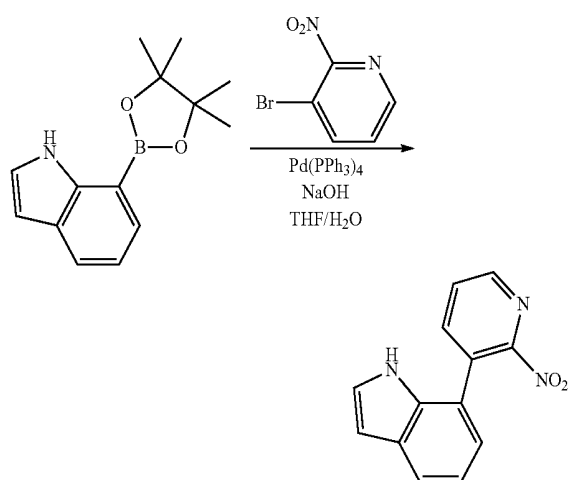


7-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole was obtained by performing the same procedure as in <Step 1> of Preparation Example 1, except that 7-bromo-1H-indole was used instead of 6-bromo-1H-indole.

¹H-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)

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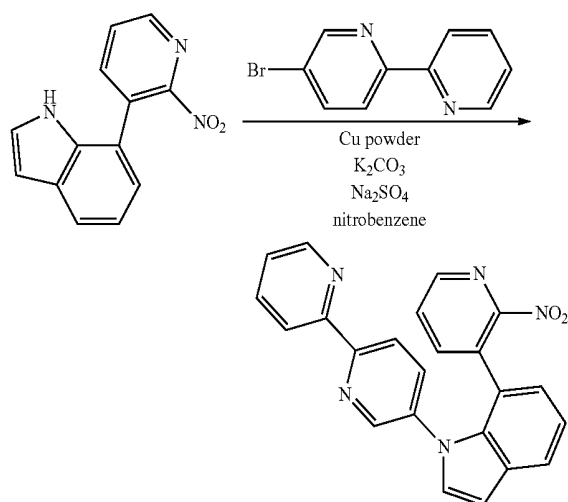
<Step 2> Synthesis of
7-(2-nitropyridin-3-yl)-1H-indole



7-(2-nitropyridin-3-yl)-1H-indole was obtained by performing the same procedure as in <Step 2> of Preparation Example 1, except that the 7-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole obtained in <Step 1> and 3-bromo-2-nitropyridine were used instead of 6-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole and 2-chloro-3-nitropyridine.

¹H-NMR: δ 6.45 (d, 1H), 7.26 (d, 1H), 7.44 (t, 1H), 7.55 (d, 1H), 7.72 (d, 1H), 8.22 (m, 2H), 8.41 (d, 1H), 8.52 (d, 1H)

<Step 3> Synthesis of 1-(2,2'-bipyridin-5-yl)-7-(2-nitropyridin-3-yl)-1H-indole

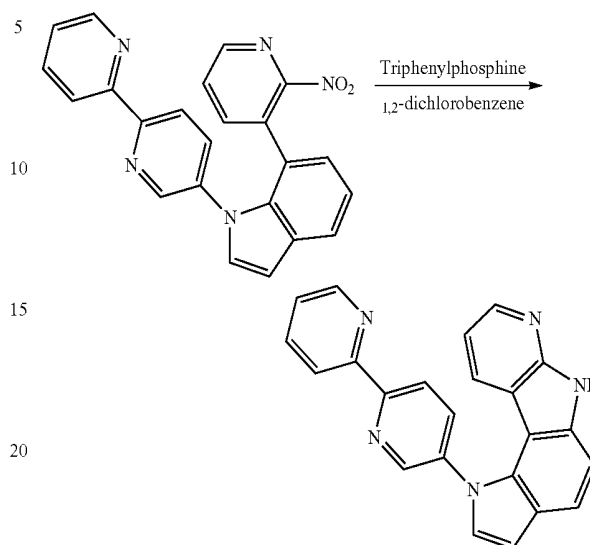


1-(2,2'-bipyridin-5-yl)-7-(2-nitropyridin-3-yl)-1H-indole was obtained by performing the same procedure as in <Step 3> of Preparation Example 1, except that the 7-(2-nitropyridin-3-yl)-1H-indole obtained in <Step 2> and 5-bromo-2,2'-bipyridine were used instead of 6-(3-nitropyridin-2-yl)-1H-indole and 3-bromobiphenyl.

GC-Mass (theoretical value: 393.12 g/mol, measured value: 393 g/mol)

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<Step 4> Synthesis of IC-9



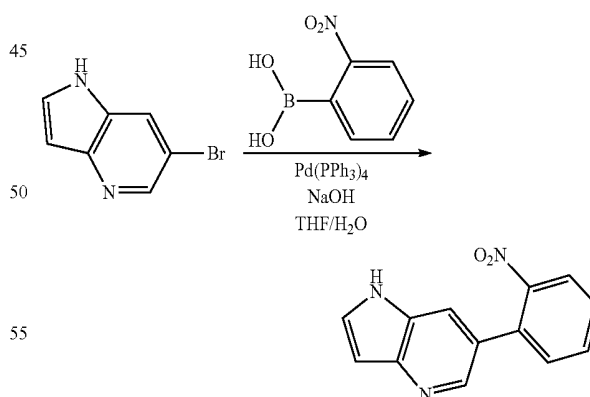
IC-9 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that the 1-(2,2'-bipyridin-5-yl)-7-(2-nitropyridin-3-yl)-1H-indole obtained in <Step 3> was used instead of 1-(biphenyl-3-yl)-6-(3-nitropyridin-2-yl)-1H-indole.

GC-Mass (theoretical value: 361.13 g/mol, measured value: 361 g/mol)

PREPARATION EXAMPLE 10

Synthesis of IC-10

<Step 1> Synthesis of
6-(2-nitrophenyl)-1H-pyrrolo[3,2-b]pyridine

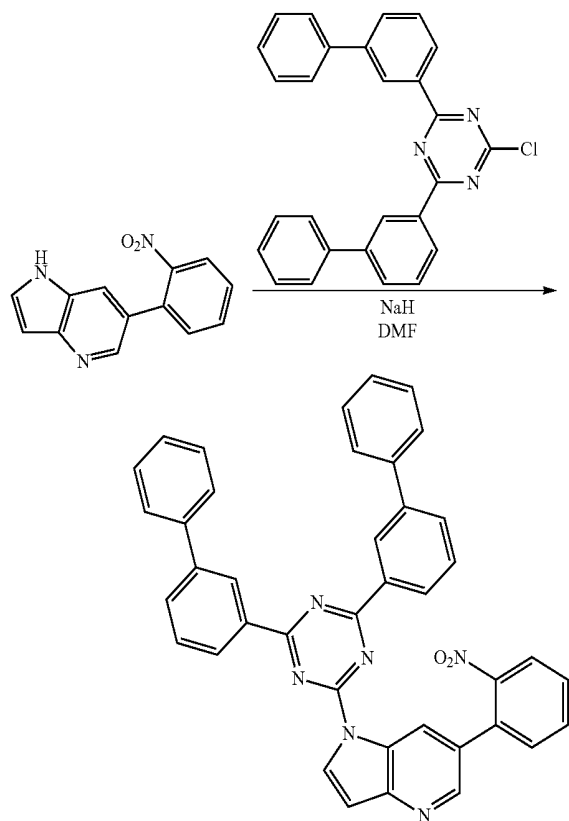


6-(2-nitrophenyl)-1H-pyrrolo[3,2-b]pyridine was obtained by performing the same procedure as in <Step 2> of Preparation Example 1, except that 6-bromo-1H-pyrrolo[3,2-b]pyridine and 2-nitrophenylboronic acid were used instead of 6-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole and 2-chloro-3-nitropyridine.

¹H-NMR: δ 6.45 (d, 1H), 7.53 (d, 1H), 7.67 (t, 1H), 7.97 (t, 1H), 7.97 (s, 1H), 8.03 (m, 2H), 8.23 (s, 1H), 8.52 (s, 1H)

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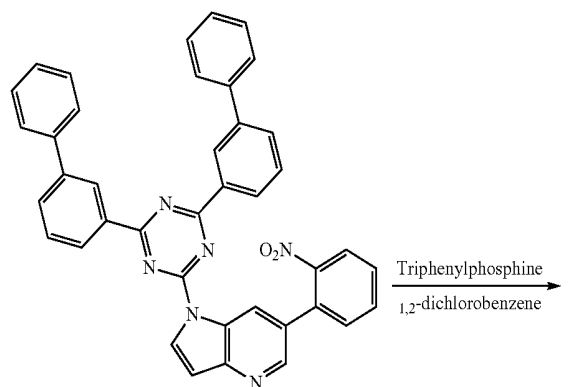
<Step 2> Synthesis of 1-(4,6-di(biphenyl-3-yl)-1,3,5-triazin-2-yl)-6-(2-nitrophenyl)-1H-pyrrolo[3,2-b]pyridine



1-(4,6-di(biphenyl-3-yl)-1,3,5-triazin-2-yl)-6-(2-nitrophenyl)-1H-pyrrolo[3,2-b]pyridine was obtained by performing the same procedure as in <Step 5> of Preparation Example 5, except that the 6-(2-nitrophenyl)-1H-pyrrolo[3,2-b]pyridine obtained in <Step 1> and 2,4-di(biphenyl-3-yl)-6-chloro-1,3,5-triazine were used instead of 7-(4-nitropyridin-3-yl)-3-phenyl-1H-indole and 2-chloro-4,6-diphenyl-1,3,5-triazine.

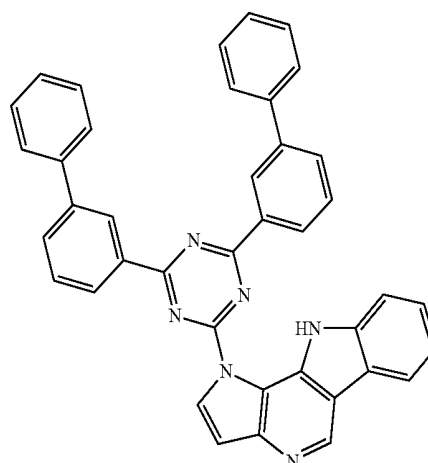
GC-Mass (theoretical value: 622.21 g/mol, measured value: 622 g/mol)

<Step 3> Synthesis of IC-10



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-continued



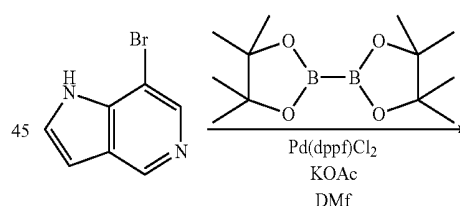
IC-10 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that the 1-(4,6-di(biphenyl-3-yl)-1,3,5-triazin-2-yl)-6-(2-nitrophenyl)-1H-pyrrolo[3,2-b]pyridine obtained in <Step 2> was used instead of 1-(biphenyl-3-yl)-6-(3-nitropyridin-2-yl)-1H-indole.

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

PREPARATION EXAMPLE 11

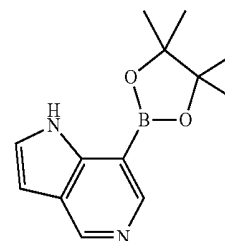
Synthesis of IC-11

<Step 1> Synthesis of 7-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-pyrrolo[3,2-c]pyridine



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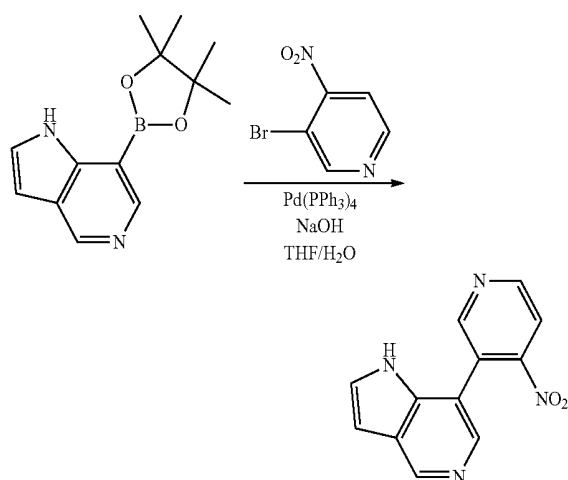
65

7-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-pyrrolo[3,2-c]pyridine was obtained by performing the same procedure as in <Step 1> of Preparation Example 1, except that 7-bromo-1H-pyrrolo[3,2-c]pyridine was used instead of 6-bromo-1H-indole.

¹H-NMR: δ 1.25 (s, 12H), 6.43 (d, 1H), 7.25 (d, 1H), 8.22 (s, 1H), 8.32 (s, 1H), 8.41 (s, 1H)

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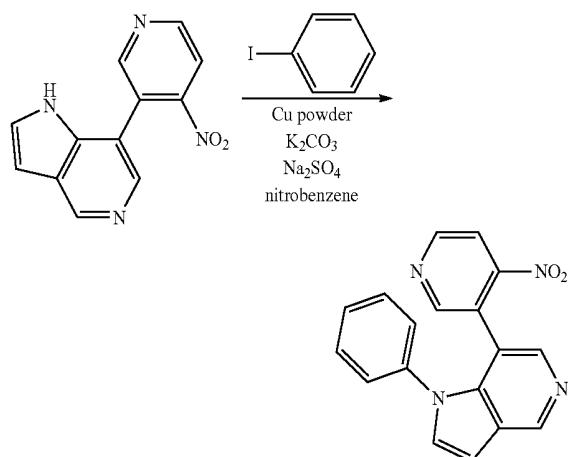
<Step 2> Synthesis of
7-(4-nitropyridin-3-yl)-1H-pyrrolo[3,2-c]pyridine



7-(4-nitropyridin-3-yl)-1H-pyrrolo[3,2-c]pyridine was obtained by performing the same procedure as in <Step 2> of Preparation Example 1, except that the 7-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-pyrrolo[3,2-c]pyridine obtained in <Step 1> and 3-bromo-4-nitropyridine were used instead of 6-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole and 2-chloro-3-nitropyridine.

¹H-NMR: δ 6.43 (d, 1H), 7.25 (d, 1H), 7.95 (d, 1H), 8.14 (d, 1H), 8.22 (s, 1H), 8.32 (s, 1H), 8.41 (m, 2H)

<Step 3> Synthesis of 7-(4-nitropyridin-3-yl)-1-phenyl-1H-pyrrolo[3,2-c]pyridine

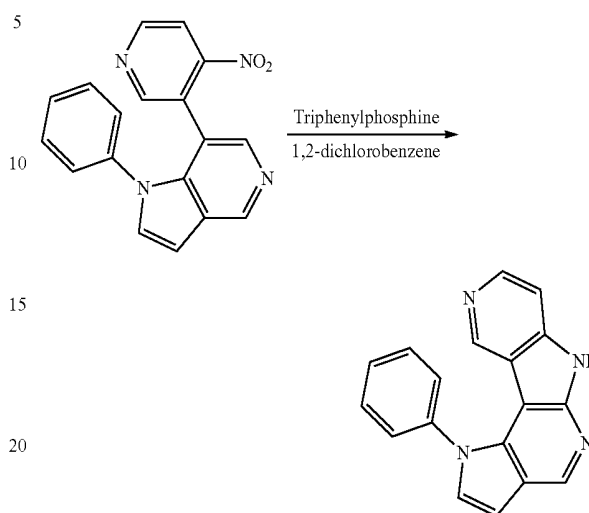


7-(4-nitropyridin-3-yl)-1-phenyl-1H-pyrrolo[3,2-c]pyridine was obtained by performing the same procedure as in <Step 3> of Preparation Example 1, except that the 7-(4-nitropyridin-3-yl)-1H-pyrrolo[3,2-c]pyridine obtained in <Step 2> and iodobenzene were used instead of 6-(3-nitropyridin-2-yl)-1H-indole and 3-bromobiphenyl.

¹H-NMR: δ 6.43 (d, 1H), 7.25 (d, 1H), 7.47 (m, 3H), 7.56 (d, 2H), 7.95 (d, 1H), 8.14 (d, 1H), 8.22 (s, 1H), 8.32 (s, 1H), 8.41 (m, 2H)

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<Step 4> Synthesis of IC-11



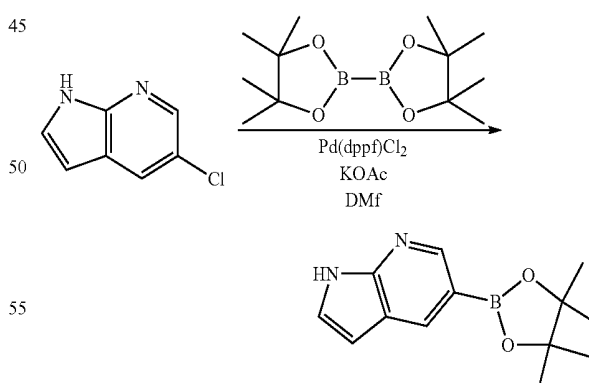
IC-11 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that the 7-(4-nitropyridin-3-yl)-1-phenyl-1H-pyrrolo[3,2-c]pyridine obtained in <Step 3> was used instead of 1-(biphenyl-3-yl)-6-(3-nitropyridin-2-yl)-1H-indole.

¹H-NMR: δ 6.44 (d, 1H), 7.26 (d, 1H), 7.46 (m, 3H), 7.55 (d, 2H), 7.96 (d, 1H), 8.15 (d, 1H), 8.23 (m, 2H), 8.32 (s, 1H)

PREPARATION EXAMPLE 12

Synthesis of IC-12

<Step 1> Synthesis of 5-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-pyrrolo[2,3-b]pyridine

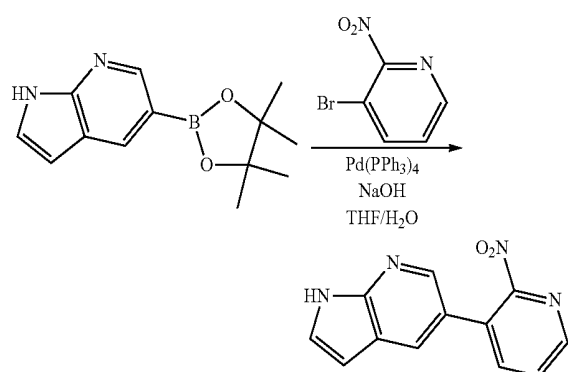


5-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-pyrrolo[2,3-b]pyridine was obtained by performing the same procedure as in <Step 1> of Preparation Example 1, except that 5-chloro-1H-pyrrolo[2,3-b]pyridine was used instead of 6-bromo-1H-indole.

¹H-NMR: δ 1.25 (s, 12H), 6.43 (d, 1H), 7.25 (d, 1H), 8.22 (s, 1H), 8.32 (s, 1H), 8.41 (s, 1H)

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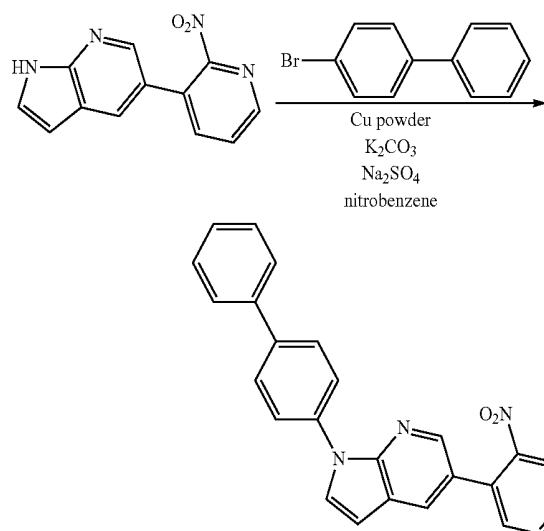
<Step 2> Synthesis of
5-(2-nitropyridin-3-yl)-1H-pyrrolo[2,3-b]pyridine



5-(2-nitropyridin-3-yl)-1H-pyrrolo[2,3-b]pyridine was obtained by performing the same procedure as in <Step 2> of Preparation Example 1, except that the 5-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-pyrrolo[2,3-b]pyridine obtained in <Step 1> and 3-bromo-2-nitropyridine were used instead of 6-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole and 2-chloro-3-nitropyridine.

¹H-NMR: δ 6.44 (d, 1H), 7.26 (d, 1H), 8.21 (m, 2H), 8.32 (s, 1H), 8.41 (m, 2H), 8.53 (d, 1H)

<Step 3> Synthesis of 1-(biphenyl-4-yl)-5-(2-nitropyridin-3-yl)-1H-pyrrolo[2,3-b]pyridine

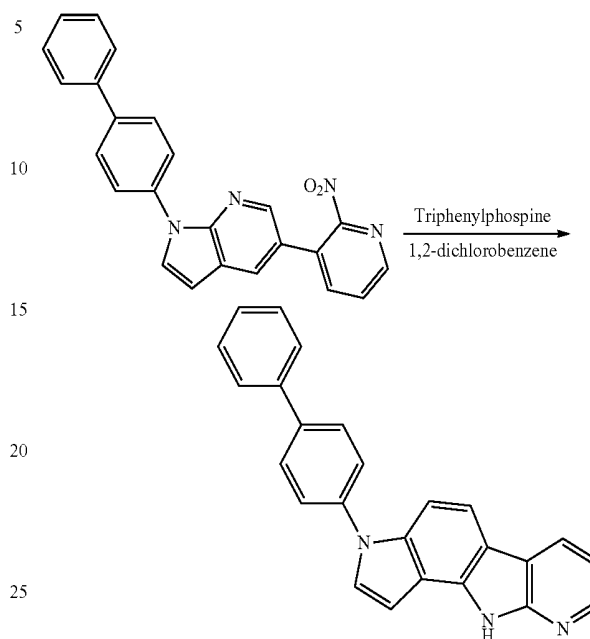


1-(biphenyl-4-yl)-5-(2-nitropyridin-3-yl)-1H-pyrrolo[2,3-b]pyridine was obtained by performing the same procedure as in <Step 3> of Preparation Example 1, except that the 5-(2-nitropyridin-3-yl)-1H-pyrrolo[2,3-b]pyridine obtained in <Step 2> and 4-bromobiphenyl were used instead of 6-(3-nitropyridin-2-yl)-1H-indole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

¹H-NMR: δ 6.45 (d, 1H), 7.25 (d, 1H), 7.41 (m, 1H), 7.52 (m, 4H), 7.68 (d, 2H), 7.79 (d, 2H), 8.22 (m, 2H), 8.42 (m, 2H), 8.52 (d, 1H)

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<Step 4> Synthesis of IC-12



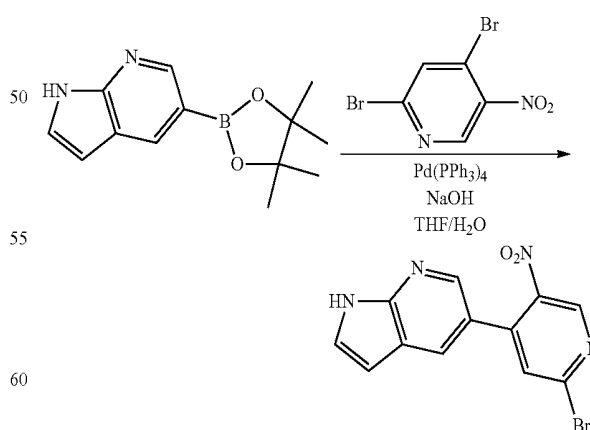
IC-12 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that the 1-(biphenyl-4-yl)-5-(2-nitropyridin-3-yl)-1H-pyrrolo[2,3-b]pyridine obtained in <Step 3> was used instead of 1-(biphenyl-3-yl)-6-(3-nitropyridin-2-yl)-1H-indole.

¹H-NMR: δ 6.45 (d, 1H), 7.25 (d, 1H), 7.41 (m, 1H), 7.52 (m, 4H), 7.68 (d, 2H), 7.79 (d, 2H), 8.22 (m, 2H), 8.32 (s, 1H), 8.42 (m, 2H)

PREPARATION EXAMPLE 13

Synthesis of IC-13

<Step 1> Synthesis of 5-(2-bromo-5-nitropyridin-4-yl)-1H-pyrrolo[2,3-b]pyridine



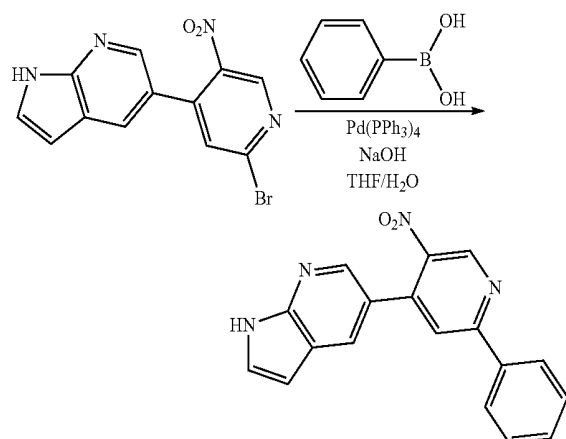
5-(2-bromo-5-nitropyridin-4-yl)-1H-pyrrolo[2,3-b]pyridine was obtained by performing the same procedure as in <Step 2> of Preparation Example 1, except that the 5-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-pyrrolo[2,3-b]

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pyridine obtained in <Step 1> of Preparation Example 12 and 2,4-bromo-5-nitropyridine were used instead of 6-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole and 2-chloro-3-nitropyridine.

¹H-NMR: δ 6.43 (d, 1H), 7.25 (d, 1H), 8.25 (m, 2H), 8.32 (s, 1H), 8.41 (s, 1H), 8.54 (s, 1H)

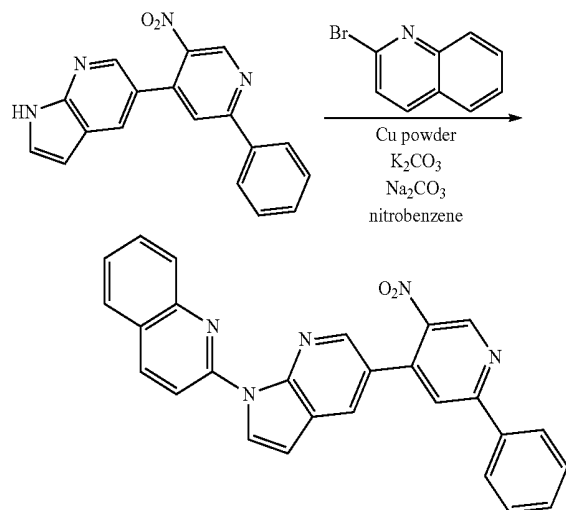
<Step 2> Synthesis of 5-(5-nitro-2-phenylpyridin-4-yl)-1H-pyrrolo[2,3-b]pyridine



5-(5-nitro-2-phenylpyridin-4-yl)-1H-pyrrolo[2,3-b]pyridine was obtained by performing the same procedure as in <Step 2> of Preparation Example 1, except that the 5-(2-bromo-5-nitropyridin-4-yl)-1H-pyrrolo[2,3-b]pyridine obtained in <Step 1> and phenylboronic acid were used instead of 6-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole and 2-chloro-3-nitropyridine.

¹H-NMR: δ 6.43 (d, 1H), 7.25 (d, 1H), 7.47 (m, 1H), 7.54 (d, 2H), 7.86 (d, 2H), 8.25 (m, 2H), 8.32 (s, 1H), 8.41 (s, 1H), 8.50 (s, 1H)

<Step 3> Synthesis of 2-(5-(5-nitro-2-phenylpyridin-4-yl)-1H-pyrrolo[2,3-b]pyridin-1-yl)quinoline



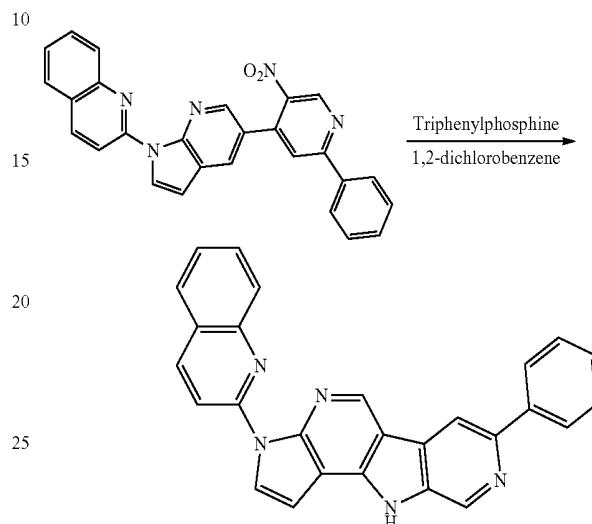
2-(5-(5-nitro-2-phenylpyridin-4-yl)-1H-pyrrolo[2,3-b]pyridin-1-yl)quinoline was obtained by performing the same

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procedure as in <Step 3> of Preparation Example 1, except that the 5-(5-nitro-2-phenylpyridin-4-yl)-1H-pyrrolo[2,3-b]pyridine obtained in <Step 2> and 2-bromoquinoline were used instead of 6-(3-nitropyridin-2-yl)-1H-indole and 3-bromobiphenyl.

GC-Mass (theoretical value: 443.14 g/mol, measured value: 443 g/mol)

<Step 4> Synthesis of IC-13



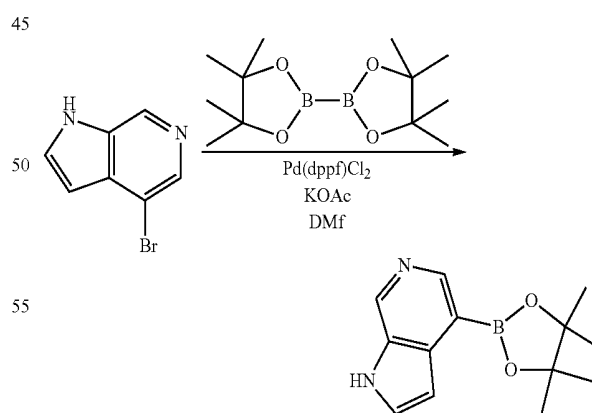
IC-13 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that the 2-(5-(5-nitro-2-phenylpyridin-4-yl)-1H-pyrrolo[2,3-b]pyridin-1-yl)quinoline obtained in <Step 3> was used instead of 1-(biphenyl-3-yl)-6-(3-nitropyridin-2-yl)-1H-indole.

GC-Mass (theoretical value: 411.15 g/mol, measured value: 411 g/mol)

PREPARATION EXAMPLE 14

Synthesis of IC-14

<Step 1> Synthesis of 4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-pyrrolo[2,3-c]pyridine

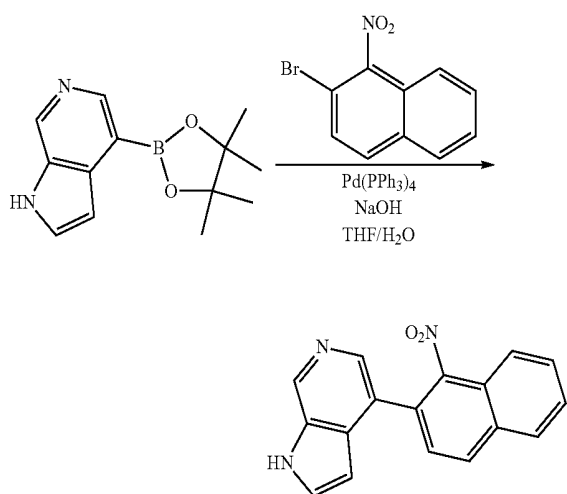


4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-pyrrolo[2,3-c]pyridine was obtained by performing the same procedure as in <Step 1> of Preparation Example 1, except that 4-bromo-1H-pyrrolo[2,3-c]pyridine was used instead of 6-bromo-1H-indole.

¹H-NMR: δ 1.24 (s, 12H), 6.44 (d, 1H), 7.24 (d, 1H), 8.41 (s, 2H)

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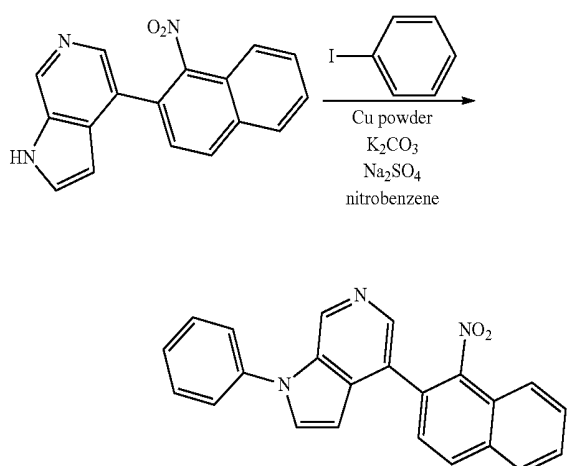
<Step 2> Synthesis of 4-(1-nitronaphthalen-2-yl)-1H-pyrrolo[2,3-c]pyridine



4-(1-nitronaphthalen-2-yl)-1H-pyrrolo[2,3-c]pyridine was obtained by performing the same procedure as in <Step 2> of Preparation Example 1, except that the 4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-pyrrolo[2,3-c]pyridine obtained in <Step 1> and 2-bromo-1-nitronaphthalene were used instead of 6-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole and 2-chloro-3-nitropyridine.

¹H-NMR: δ 6.45 (d, 1H), 7.25 (d, 1H), 7.76 (m, 2H), 7.85 (m, 2H), 7.98 (m, 2H), 8.42 (s, 2H)

<Step 3> Synthesis of 4-(1-nitronaphthalen-2-yl)-1-phenyl-1H-pyrrolo[2,3-c]pyridine

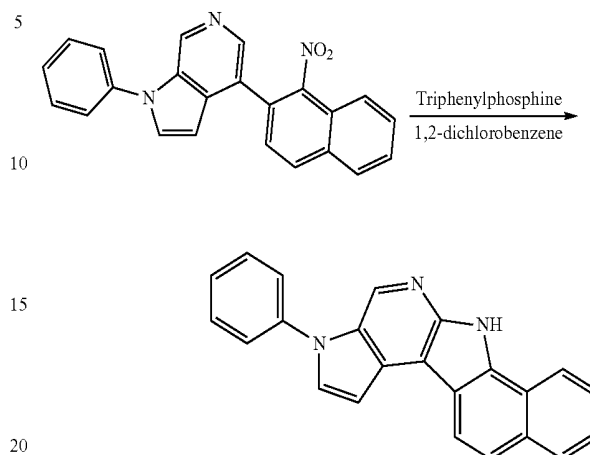


4-(1-nitronaphthalen-2-yl)-1-phenyl-1H-pyrrolo[2,3-c]pyridine was obtained by performing the same procedure as in <Step 3> of Preparation Example 1, except that the 4-(1-nitronaphthalen-2-yl)-1H-pyrrolo[2,3-c]pyridine obtained in <Step 2> and iodobenzene were used instead of 6-(3-nitropyridin-2-yl)-1H-indole and 3-bromobiphenyl.

GC-Mass (theoretical value: 365.12 g/mol, measured value: 365 g/mol)

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<Step 4> Synthesis of IC-14



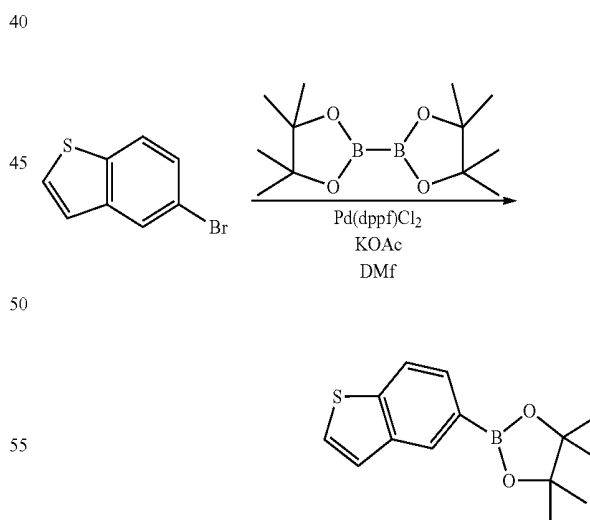
IC-14 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that the 4-(1-nitronaphthalen-2-yl)-1-phenyl-1H-pyrrolo[2,3-c]pyridine obtained in <Step 3> was used instead of 1-(biphenyl-3-yl)-6-(3-nitropyridin-2-yl)-1H-indole.

GC-Mass (theoretical value: 333.13 g/mol, measured value: 333 g/mol)

PREPARATION EXAMPLE 15

Synthesis of IC-15

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

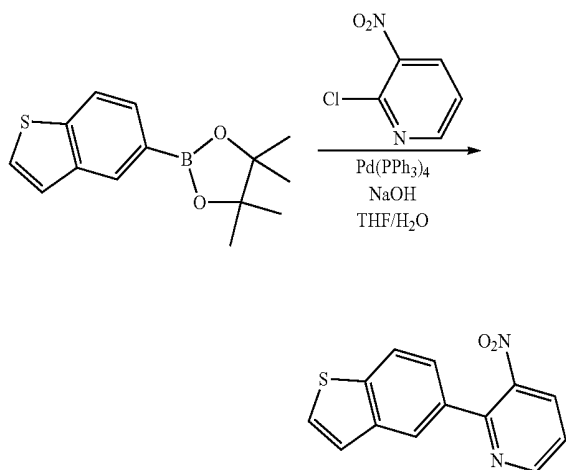


2-(benzo[b]thiophen-5-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane was obtained by performing the same procedure as in <Step 1> of Preparation Example 1, except that 5-bromobenzo[b]thiophene was used instead of 6-bromo-1H-indole.

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)

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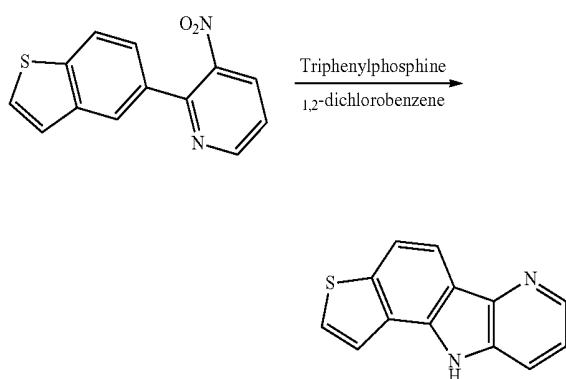
<Step 2> Synthesis of
2-(benzo[b]thiophen-5-yl)-3-nitropyridine



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

¹H-NMR: δ 7.66 (d, 1H), 7.89 (d, 1H), 7.97 (d, 1H), 8.01 (d, 1H), 8.09 (m, 2H), 8.14 (s, 1H), 8.42 (d, 1H)

<Step 3> Synthesis of IC-15



IC-15 was obtained by performing the same procedure as in <Step 4> of Preparation Example 1, except that the 2-(benzo[b]thiophen-5-yl)-3-nitropyridine obtained in <Step 2> was used instead of 1-(biphenyl-3-yl)-6-(3-nitropyridin-2-yl)-1H-indole.

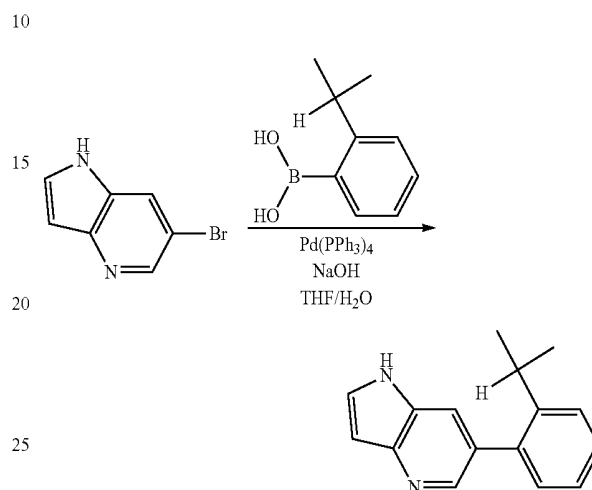
¹H-NMR: δ 7.65 (d, 1H), 7.86 (d, 1H), 7.98 (d, 1H), 8.03 (d, 1H), 8.10 (m, 2H), 8.32 (s, 1H), 8.41 (d, 1H)

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PREPARATION EXAMPLE 16

Synthesis of IC-16

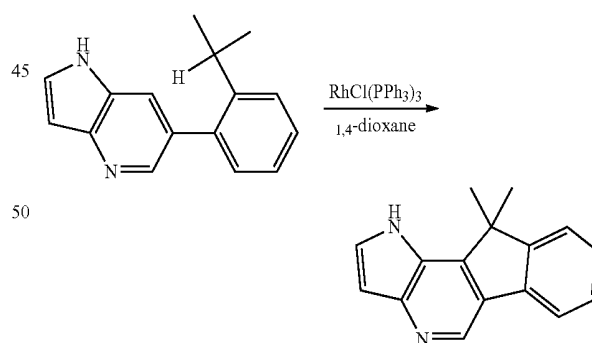
<Step 1> Synthesis of
6-(2-isopropylphenyl)-1H-pyrrolo[3,2-b]pyridine



6-(2-isopropylphenyl)-1H-pyrrolo[3,2-b]pyridine was obtained by performing the same procedure as in <Step 2> of Preparation Example 1, except that 6-bromo-1H-pyrrolo[3,2-b]pyridine and 2-isopropylphenylboronic acid were used instead of 6-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole and 2-chloro-3-nitropyridine.

¹H-NMR: δ 1.20 (s, 6H), 2.87 (s, 1H), 6.45 (d, 1H), 7.25 (d, 1H), 7.34 (m, 3H), 7.71 (d, 1H), 7.97 (s, 1H), 8.40 (s, 1H)

<Step 2> Synthesis of IC-16



The 6-(2-isopropylphenyl)-1H-pyrrolo[3,2-b]pyridine (5 g, 21.16 mmol) obtained in <Step 1> and RhCl(PPh₃)₃ (97.88 mg, 0.5 mol %) were dissolved in 50 ml of 1,4-dioxane under nitrogen flow, and then the resulting mixture was stirred at 135° C. for 1 hour. After the reaction was terminated, IC-16 (3.92 g, yield 79%) was obtained by removing the solvent and purifying the residue with column chromatography (Hexane:MC=3:1 (v:v)).

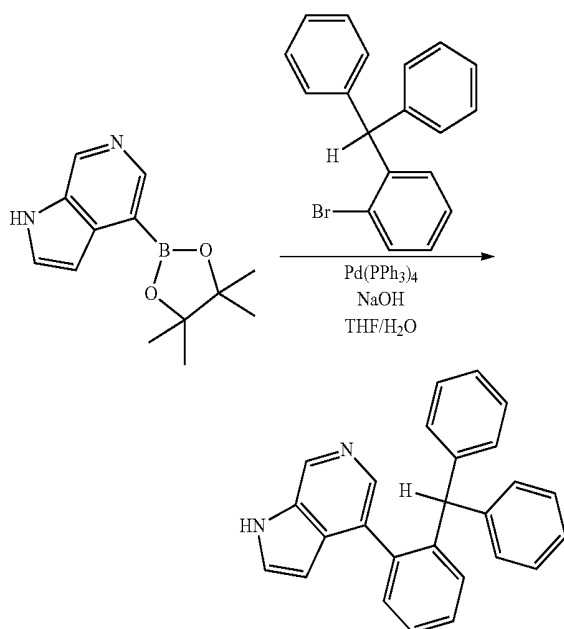
¹H-NMR: δ 1.21 (s, 6H), 6.44 (d, 1H), 7.26 (d, 1H), 7.35 (m, 3H), 7.72 (d, 1H), 8.43 (s, 1H)

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PREPARATION EXAMPLE 17

Synthesis of IC-17

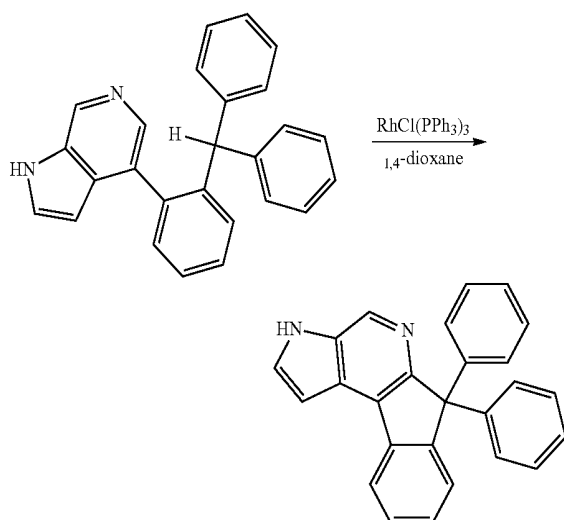
<Step 1> Synthesis of
4-(2-benzhydrylphenyl)-1H-pyrrolo[2,3-c]pyridine



4-(2-benzhydrylphenyl)-1H-pyrrolo[2,3-c]pyridine was obtained by performing the same procedure as in <Step 2> of Preparation Example 1, except that the 4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-pyrrolo[2,3-c]pyridine obtained in <Step 1> of Preparation Example 14 and ((2-bromophenyl)methylene)dibenzene were used instead of 6-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-indole and 2-chloro-3-nitropyridine.

GC-Mass (theoretical value: 360.16 g/mol, measured value: 360 g/mol)

<Step 2> Synthesis of IC-17



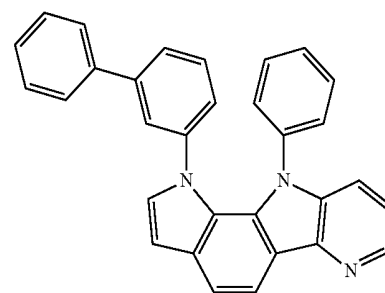
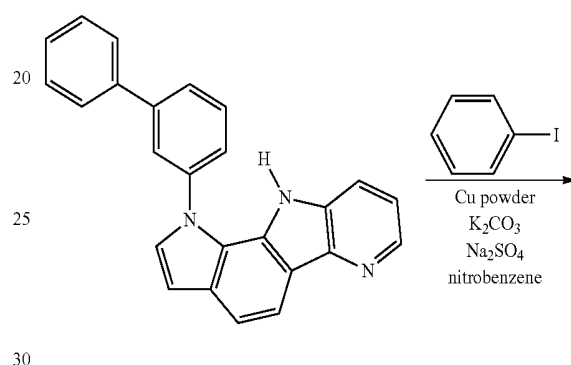
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IC-17 was obtained by performing the same procedure as in <Step 2> of Preparation Example 16, except that the 4-(2-benzhydrylphenyl)-1H-pyrrolo[2,3-c]pyridine obtained in <Step 1> was used instead of 6-(2-isopropylphenyl)-1H-pyrrolo[3,2-b]pyridine.

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

SYNTHESIS EXAMPLE 1

Synthesis of INV-1



Inv-1

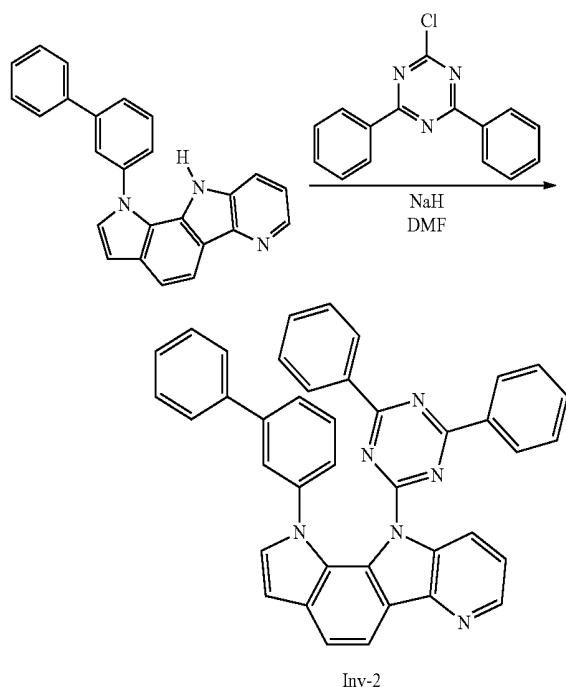
IC-1 (5 g, 13.91 mmol) which is the compound prepared in Preparation Example 1, iodobenzene (4.26 g, 20.87 mmol), Cu powder (0.09 g, 1.39 mmol), K₂CO₃ (1.92 g, 13.91 mmol), Na₂SO₄ (1.98 g, 13.91 mmol), and nitrobenzene (100 ml) were mixed under nitrogen flow, and the resulting mixture was stirred at 190° C. for 12 hours. After the reaction was terminated, nitrobenzene was removed, the organic layer was separated by methylene chloride, and water was removed by using MgSO₄. The target compound Inv-1 (4.60 g, yield 76%) was obtained by removing the solvent of the organic layer, and then purifying the residue with column chromatography (Hexane:EA=3:1 (v:v)).

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

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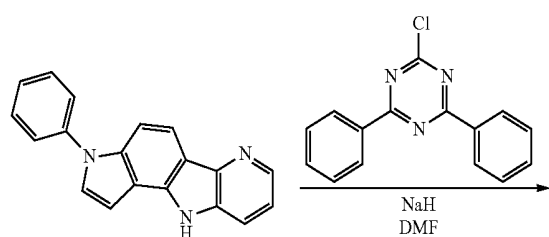
SYNTHESIS EXAMPLE 2

Synthesis of INV-2



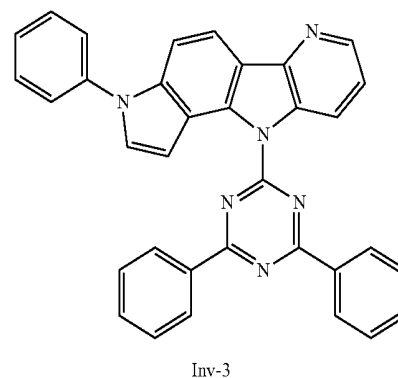
SYNTHESIS EXAMPLE 3

Synthesis of INV-3



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-continued

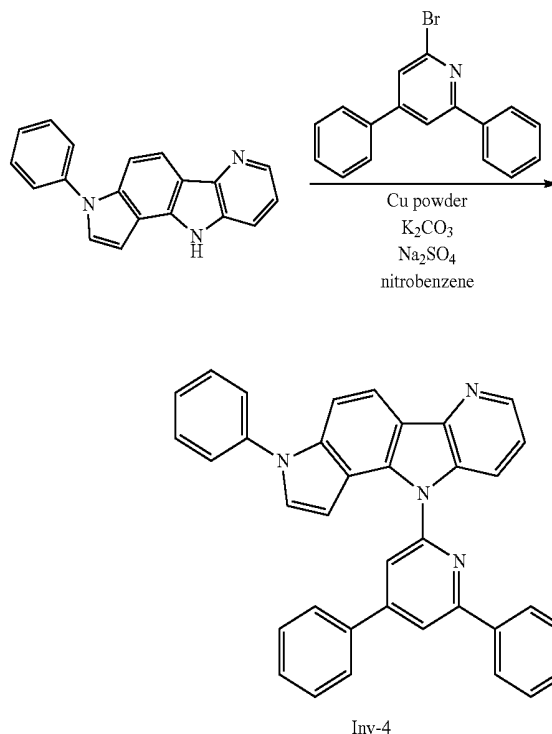


The target compound Inv-3 (7.63 g, yield 84%) was obtained by performing the same procedure as in Synthesis Example 2, except that IC-2 which is the compound prepared in Preparation Example 2 was used instead of IC-1.

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

SYNTHESIS EXAMPLE 4

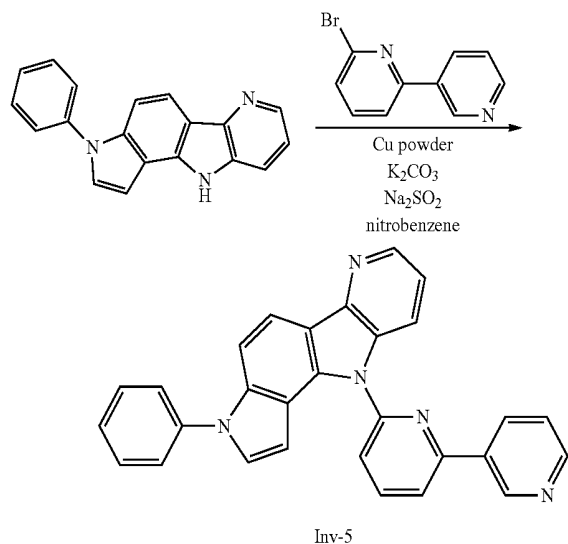
Synthesis of INV-4



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SYNTHESIS EXAMPLE 5

Synthesis of INV-5

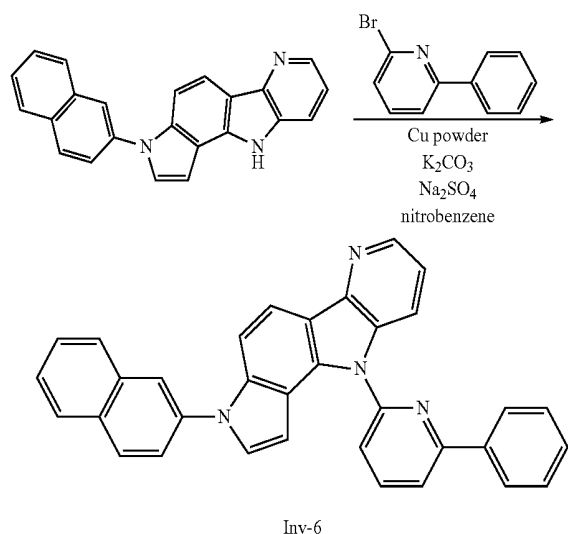


The target compound Inv-5 (4.63 g, yield 60%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-2 which is the compound prepared in Preparation Example 2 and 6-bromo-2,3'-bipyridine were used instead of IC-1 and iodobenzene.

GC-Mass (theoretical value: 437.16 g/mol, measured value: 437 g/mol)

SYNTHESIS EXAMPLE 6

Synthesis of INV-6



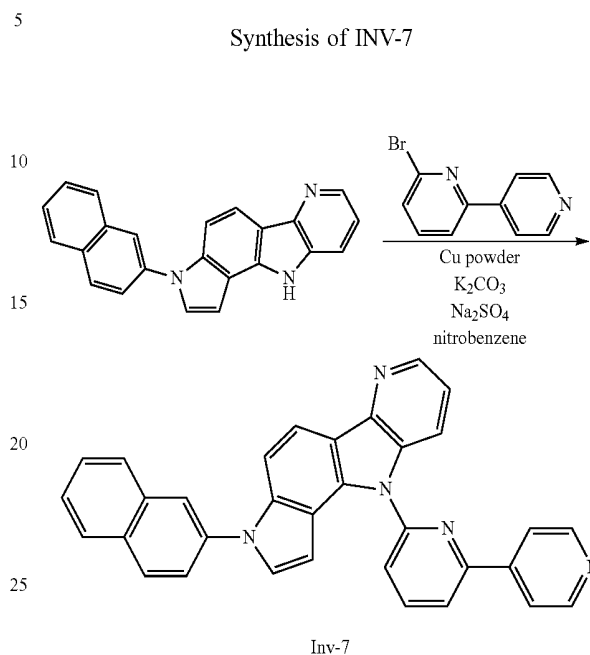
The target compound Inv-6 (4.09 g, yield 56%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-3 which is the compound prepared in Preparation Example 3 and 2-bromo-6-phenylpyridine were used instead of IC-1 and iodobenzene.

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

SYNTHESIS EXAMPLE 7

Synthesis of INV-7

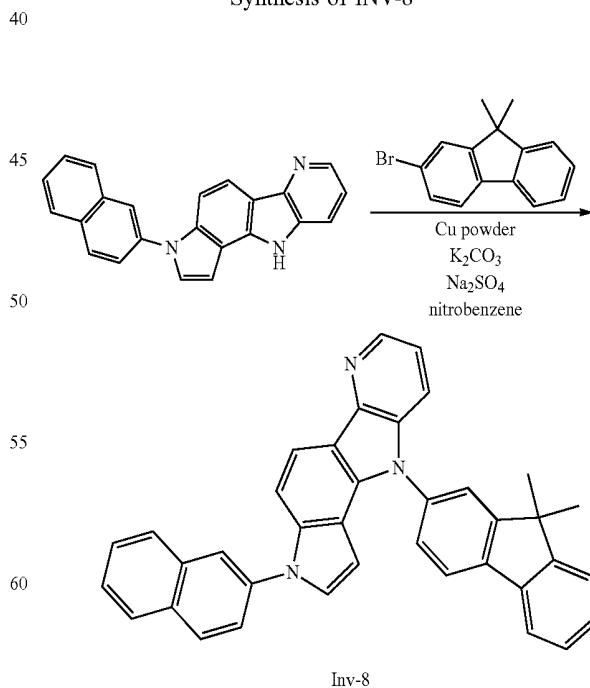


The target compound Inv-7 (3.95 g, yield 54%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-3 which is the compound prepared in Preparation Example 3 and 6-bromo-2,4'-bipyridine were used instead of IC-1 and iodobenzene.

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

SYNTHESIS EXAMPLE 8

Synthesis of INV-8



The target compound Inv-8 (5.20 g, yield 66%) was obtained by performing the same procedure as in Synthesis

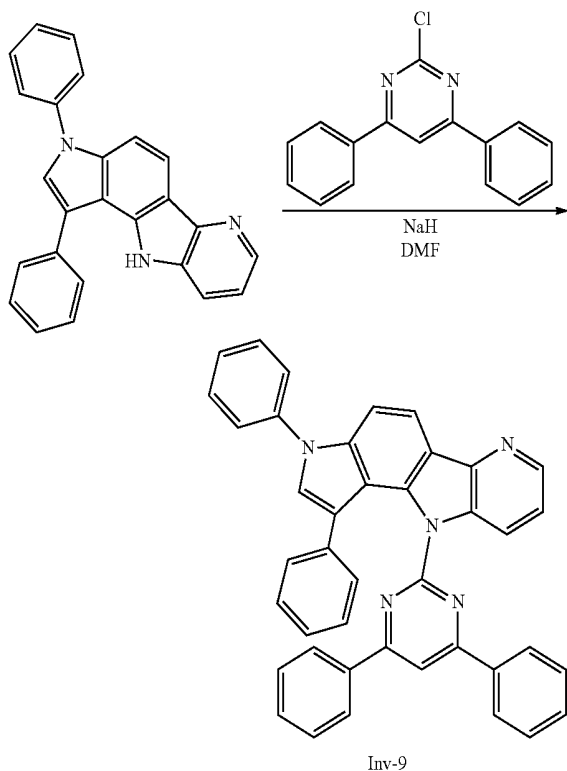
121

Example 1, except that IC-3 which is the compound prepared in Preparation Example 3 and 2-bromo-9,9-dimethyl-9H-fluorene were used instead of IC-1 and iodobenzene.

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

SYNTHESIS EXAMPLE 9

Synthesis of INV-9

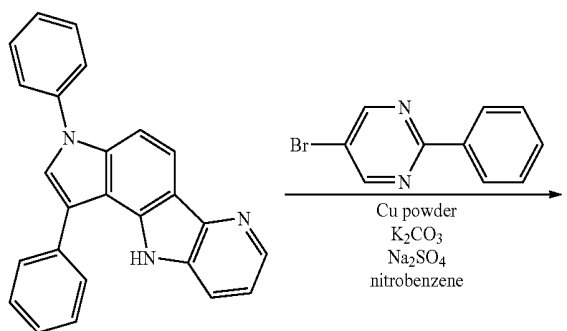


The target compound INV-9 (6.15 g, yield 75%) was obtained by performing the same procedure as in Synthesis Example 2, except that IC-4 which is the compound prepared in Preparation Example 4 and 2-chloro-4,6-diphenylpyrimidine were used instead of IC-1 and 2-chloro-4,6-diphenyl-1,3,5-triazine.

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

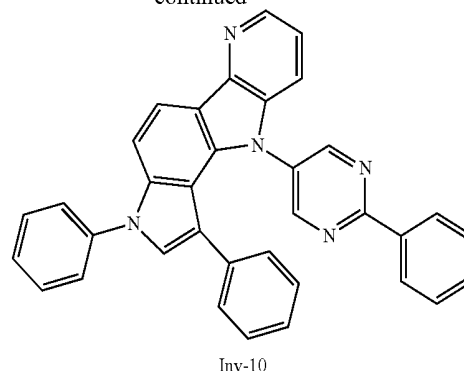
SYNTHESIS EXAMPLE 10

Synthesis of INV-10



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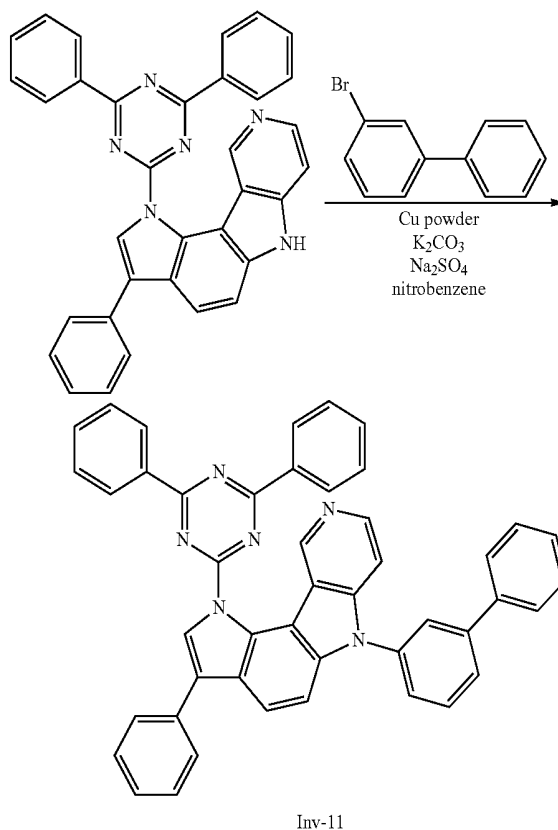


The target compound Inv-10 (3.64 g, yield 51%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-4 which is the compound prepared in Preparation Example 4 and 5-bromo-2-phenylpyridine were used instead of IC-1 and iodobenzene.

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

SYNTHESIS EXAMPLE 11

Synthesis of INV-11



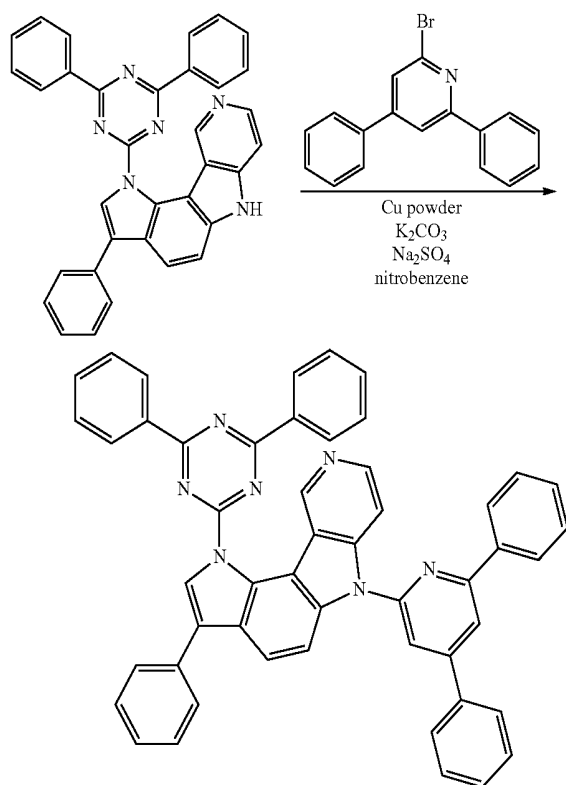
The target compound INV-11 (4.66 g, yield 72%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-5 which is the compound prepared in Preparation Example 5 and 3-bromobiphenyl were used instead of IC-1 and iodobenzene.

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GC-Mass (theoretical value: 666.25 g/mol, measured value: 666 g/mol)

SYNTHESIS EXAMPLE 12

Synthesis of INV-12

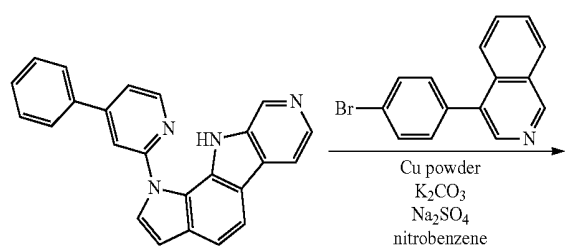


The target compound INV-12 (4.48 g, yield 62%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-5 which is the compound prepared in Preparation Example 5 and 2-bromo-4,6-diphenylpyridine were used instead of IC-1 and iodobenzene.

GC-Mass (theoretical value: 743.28 g/mol, measured value: 743 g/mol)

SYNTHESIS EXAMPLE 13

Synthesis of INV-13



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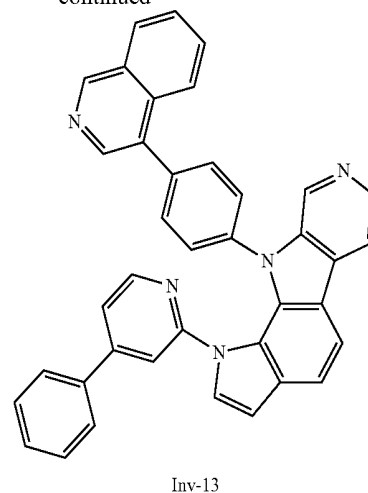
55

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65

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-continued

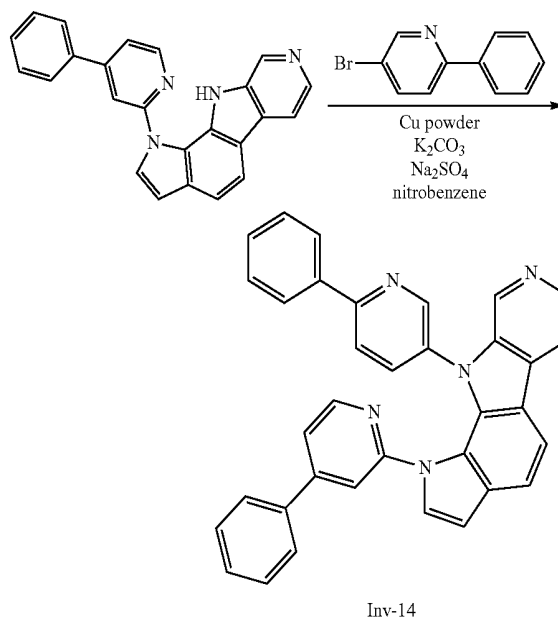


The target compound Inv-13 (4.54 g, yield 58%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-6 which is the compound prepared in Preparation Example 6 and 4-(4-bromophenyl) isoquinoline were used instead of IC-1 and iodobenzene.

GC-Mass (theoretical value: 563.21 g/mol, measured value: 563 g/mol)

SYNTHESIS EXAMPLE 14

Synthesis of INV-14



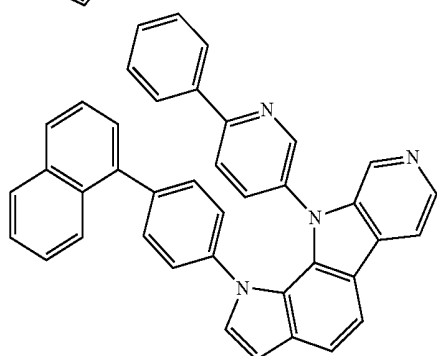
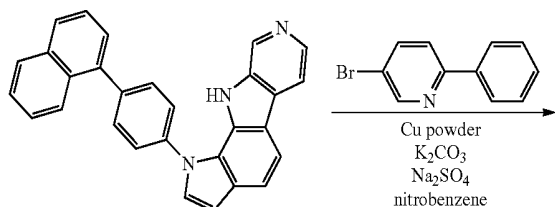
The target compound Inv-14 (3.35 g, yield 47%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-6 which is the compound prepared in Preparation Example 6 and 5-bromo-2-phenylpyridine were used instead of IC-1 and iodobenzene.

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

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SYNTHESIS EXAMPLE 15

Synthesis of INV-15



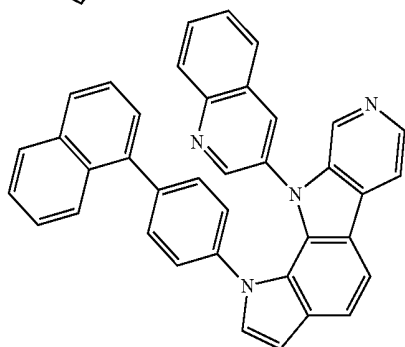
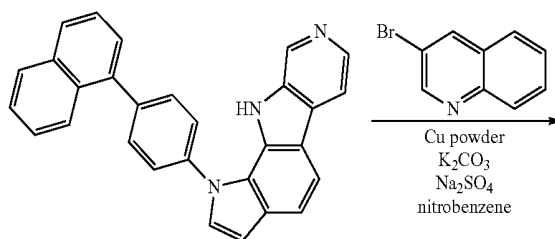
Inv-15

The target compound Inv-15 (3.16 g, yield 46%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-7 which is the compound prepared in Preparation Example 7 and 5-bromo-2-phenylpyridine were used instead of IC-1 and iodobenzene.

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

SYNTHESIS EXAMPLE 16

Synthesis of INV-16



Inv-16

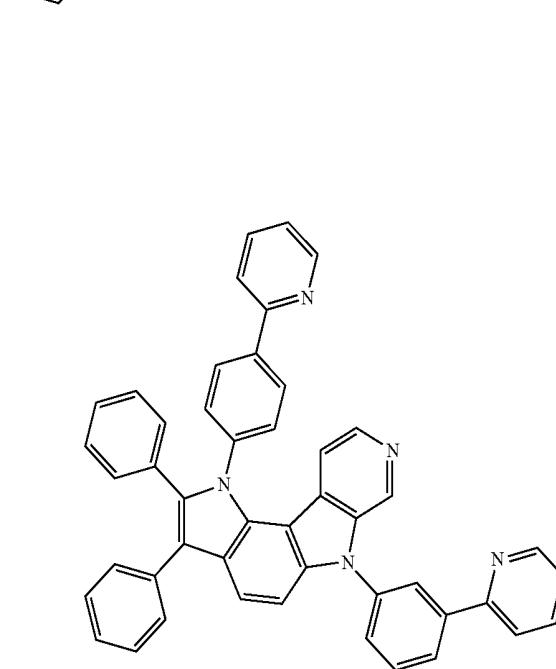
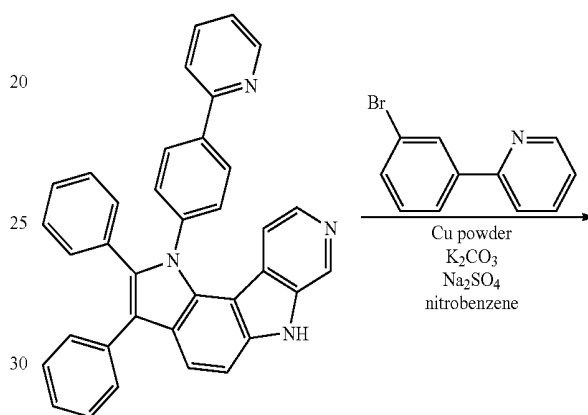
126

The target compound Inv-16 (4.00 g, yield 61%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-7 which is the compound prepared in Preparation Example 7 and 3-bromoquinoline were used instead of IC-1 and iodobenzene.

GC-Mass (theoretical value: 536.20 g/mol, measured value: 536 g/mol)

SYNTHESIS EXAMPLE 17

Synthesis of INV-17



Inv-17

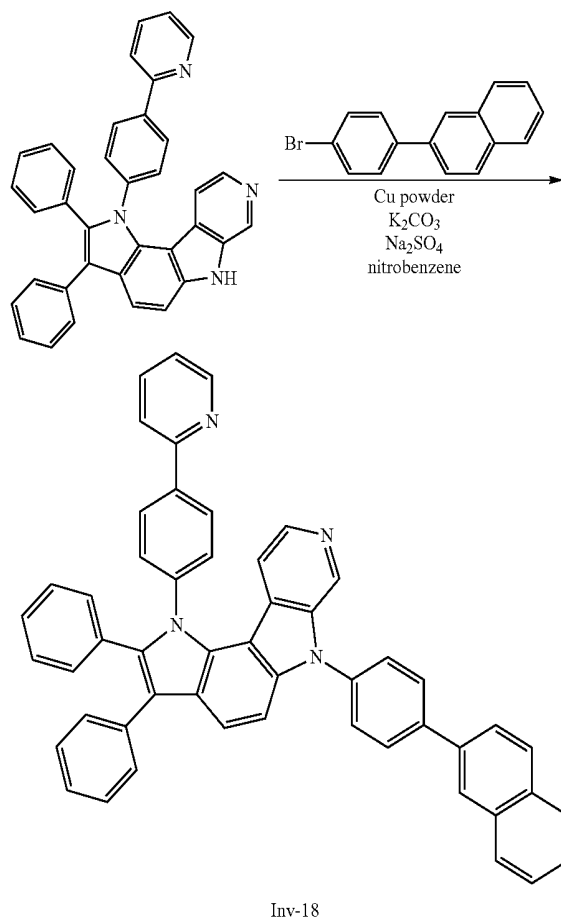
The target compound Inv-17 (4.42 g, yield 68%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-8 which is the compound prepared in Preparation Example 8 and 2-(3-bromophenyl)pyridine were used instead of IC-1 and iodobenzene.

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

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SYNTHESIS EXAMPLE 18

Synthesis of INV-18

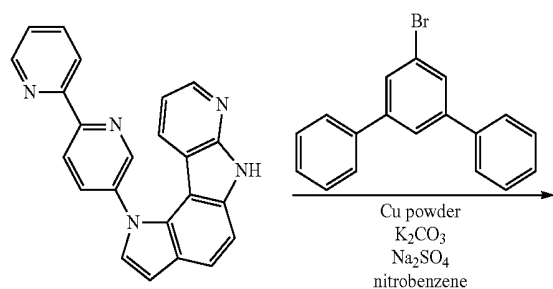


The target compound Inv-18 (3.97 g, yield 57%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-8 which is the compound prepared in Preparation Example 8 and 2-(4-bromophenyl)naphthalene were used instead of IC-1 and iodobenzene.

GC-Mass (theoretical value: 714.28 g/mol, measured value: 714 g/mol)

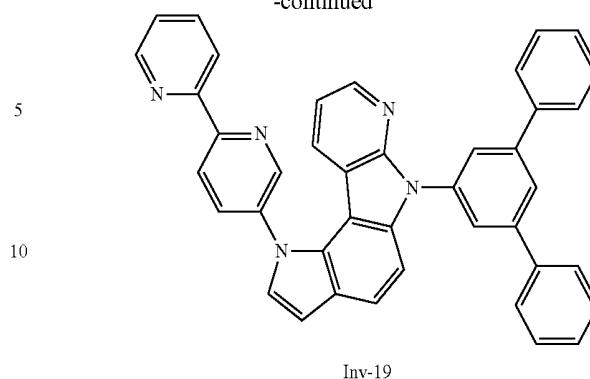
SYNTHESIS EXAMPLE 19

Synthesis of INV-19



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-continued

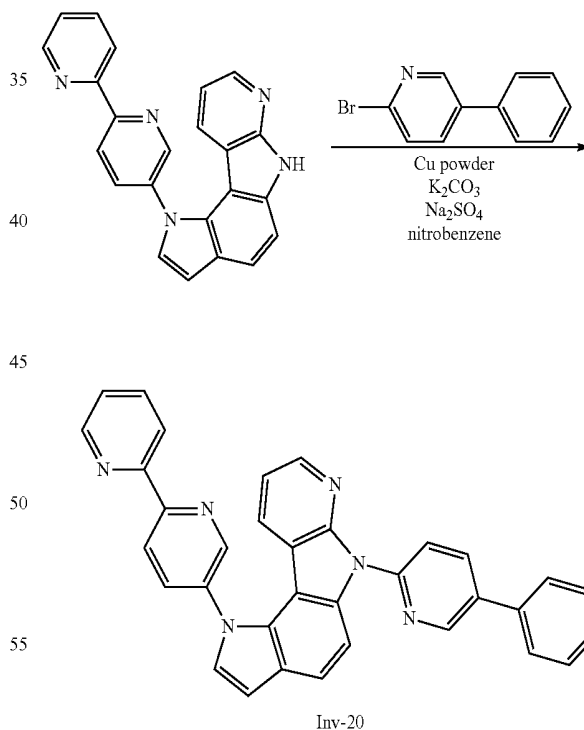


The target compound Inv-19 (5.14 g, yield 63%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-9 which is the compound prepared in Preparation Example 9 and 1-bromo-3,5-diphenylbenzene were used instead of IC-1 and iodobenzene.

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

SYNTHESIS EXAMPLE 20

Synthesis of INV-20

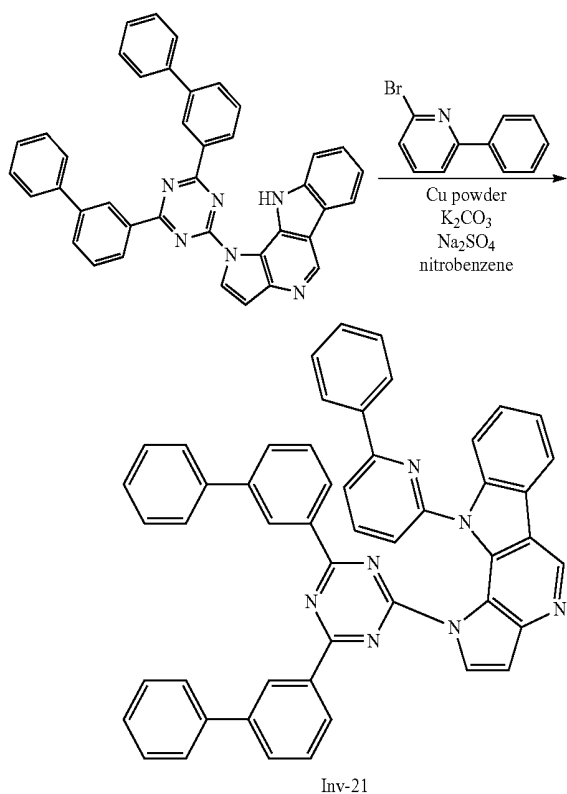


The target compound Inv-20 (4.20 g, yield 59%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-9 which is the compound prepared in Preparation Example 9 and 2-bromo-5-phenylpyridine were used instead of IC-1 and iodobenzene.

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

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SYNTHESIS EXAMPLE 21

Synthesis of INV-21

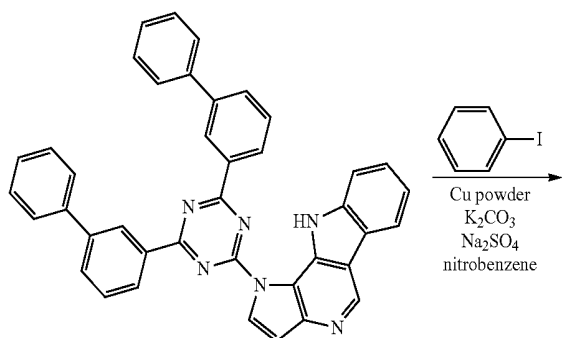


The target compound Inv-21 (4.41 g, yield 70%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-10 which is the compound prepared in Preparation Example 10 and 2-bromo-6-phenylpyridine were used instead of IC-1 and iodobenzene.

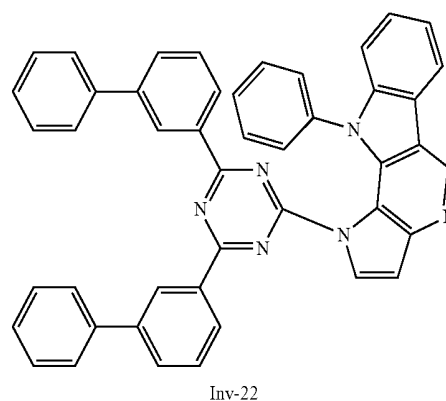
GC-Mass (theoretical value: 743.28 g/mol, measured value: 743 g/mol)

SYNTHESIS EXAMPLE 22

Synthesis of INV-22



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-continued

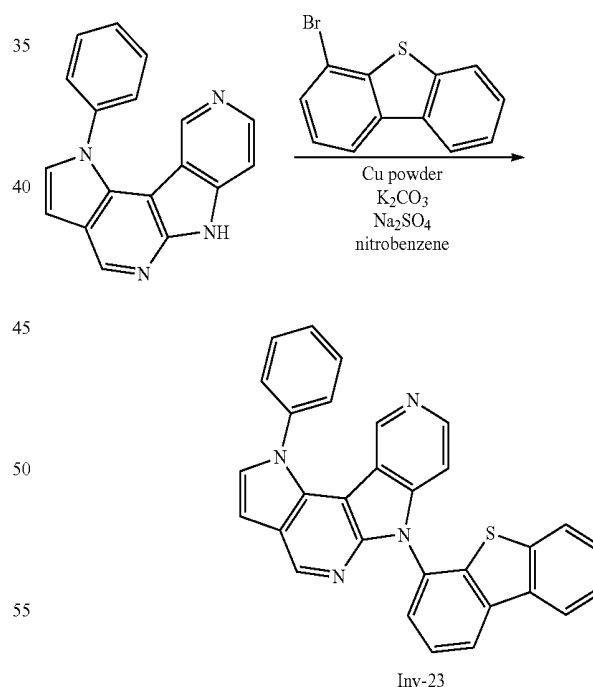


The target compound Inv-22 (4.29 g, yield 76%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-10 which is the compound prepared in Preparation Example 10 was used instead of IC-1.

GC-Mass (theoretical value: 666.25 g/mol, measured value: 666 g/mol)

SYNTHESIS EXAMPLE 23

Synthesis of INV-23



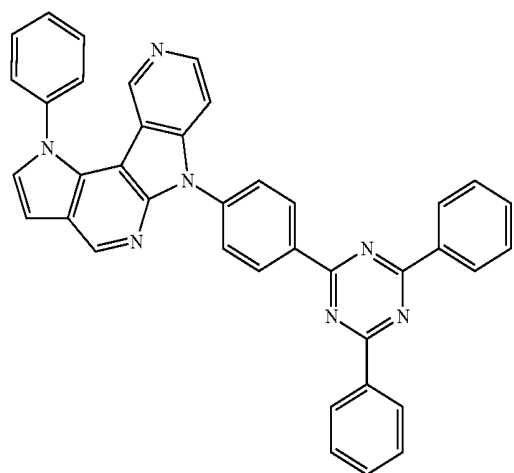
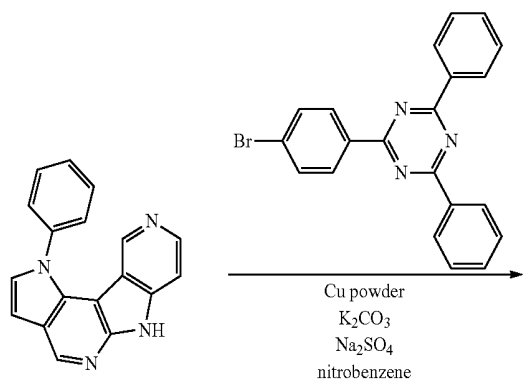
The target compound Inv-23 (5.42 g, yield 66%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-11 which is the compound prepared in Preparation Example 11 and 4-bromodibenzo[b,d]thiophene were used instead of IC-1 and iodobenzene.

GC-Mass (theoretical value: 466.13 g/mol, measured value: 466 g/mol)

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SYNTHESIS EXAMPLE 24

Synthesis of INV-24



Inv-24

The target compound Inv-24 (7.18 g, yield 69%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-11 which is the compound

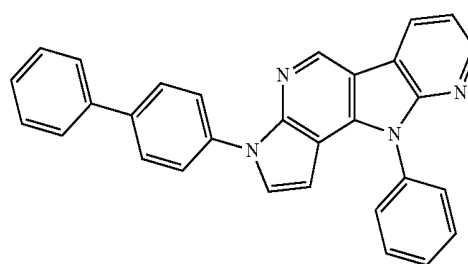
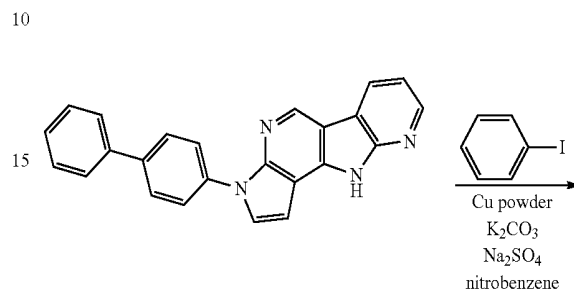
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prepared in Preparation Example 11 and 2-(4-bromophenyl)-4,6-diphenyl-1,3,5-triazine were used instead of IC-1 and iodobenzene.

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

SYNTHESIS EXAMPLE 25

Synthesis of INV-25



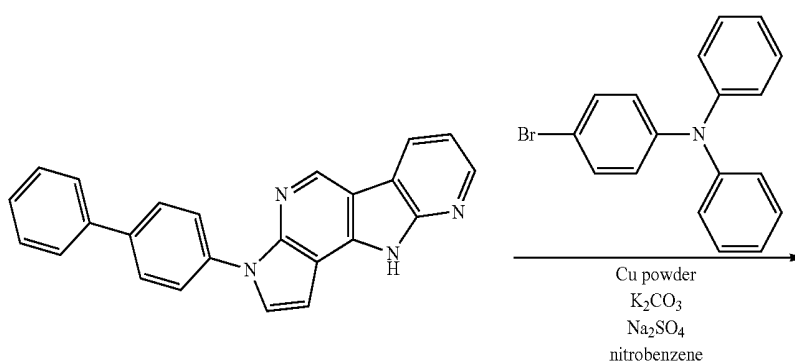
Inv-25

The target compound Inv-25 (4.54 g, yield 75%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-12 which is the compound prepared in Preparation Example 12 was used instead of IC-1.

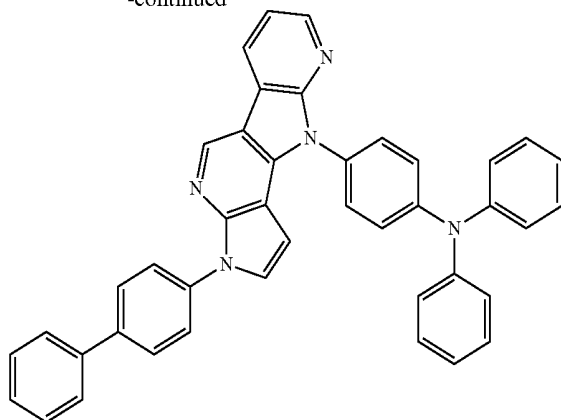
GC-Mass (theoretical value: 436.17 g/mol, measured value: 436 g/mol)

SYNTHESIS EXAMPLE 26

Synthesis of INV-26



-continued



Inv-26

The target compound Inv-26 (4.61 g, yield 55%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-12 which is the compound prepared in Preparation Example 12 and 4-bromo-N,N-diphenylaniline were used instead of IC-1 and iodobenzene.

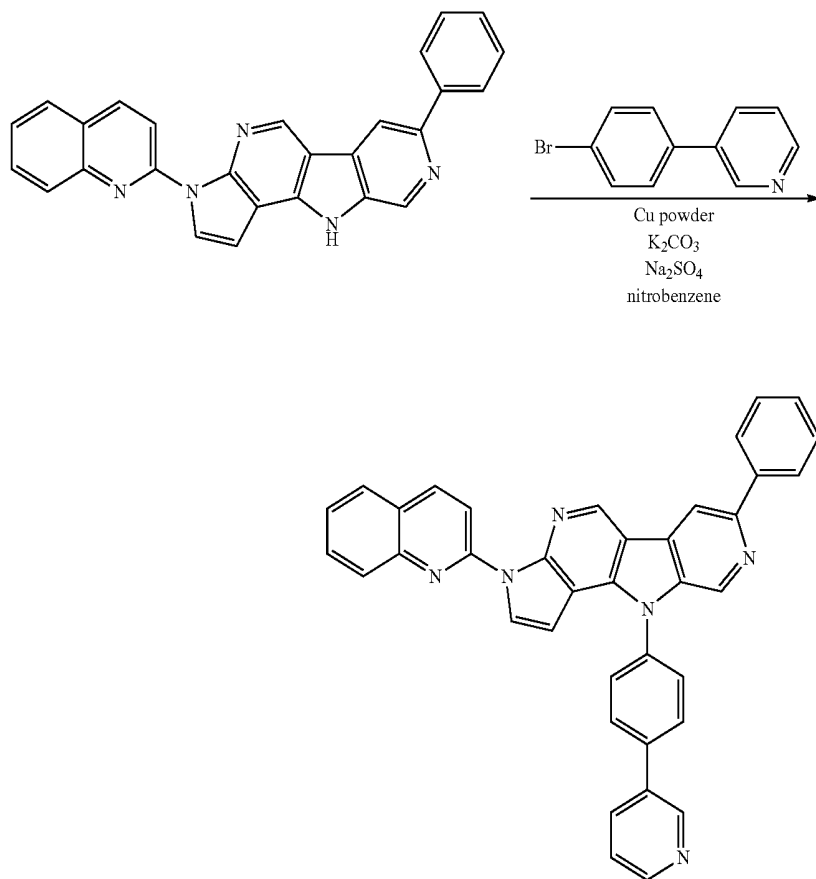
GC-Mass (theoretical value: 603.24 g/mol, measured value: 603 g/mol)

²⁰ The target compound Inv-27 (4.32 g, yield 63%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-13 which is the compound prepared in Preparation Example 13 and 3-(4-bromophenyl) pyridine were used instead of IC-1 and iodobenzene.

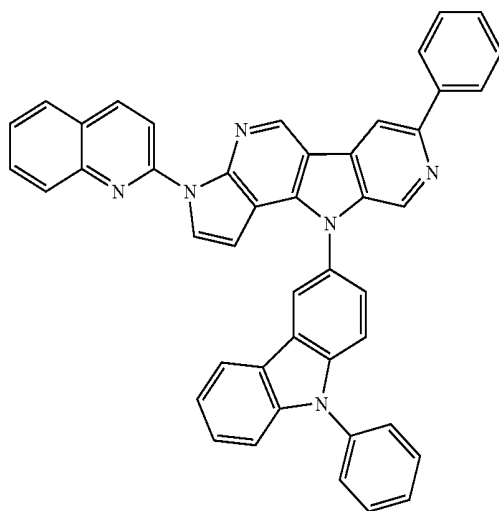
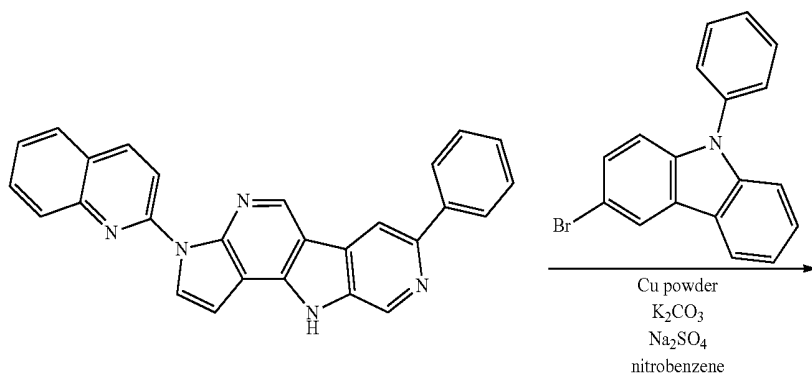
SYNTHESIS EXAMPLE 27

Synthesis of INV-27

²⁵ GC-Mass (theoretical value: 564.21 g/mol, measured value: 564 g/mol)



Inv-27

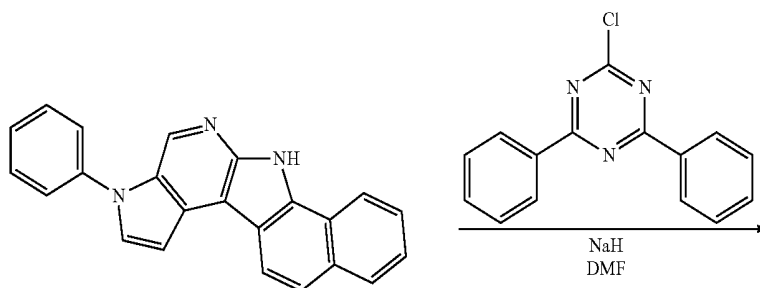


Inv-28

The target compound Inv-28 (5.16 g, yield 65%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-13 which is the compound prepared in Preparation Example 13 and 3-bromo-9-phenyl-9H-carbazole were used instead of IC-1 and iodobenzene. GC-Mass (theoretical value: 652.24 g/mol, measured value: 652 g/mol)

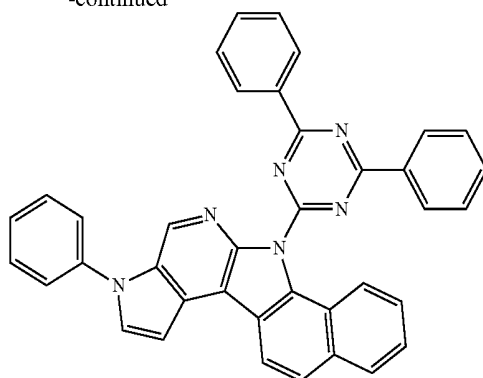
SYNTHESIS EXAMPLE 29

Synthesis of INV-29



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-continued



Inv-29

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The target compound Inv-29 (6.86 g, yield 81%) was obtained by performing the same procedure as in Synthesis Example 2, except that IC-14 which is the compound prepared in Preparation Example 14 was used instead of IC-1.

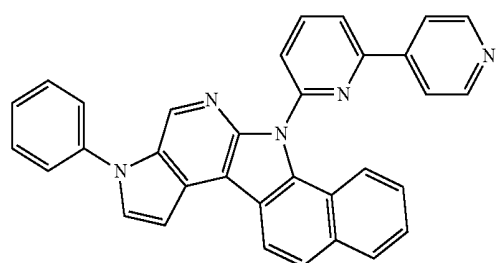
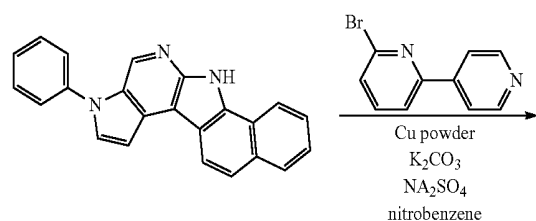
GC-Mass (theoretical value: 564.21 g/mol, measured value: 564 g/mol)

SYNTHESIS EXAMPLE 31

Synthesis of INV-31

SYNTHESIS EXAMPLE 30

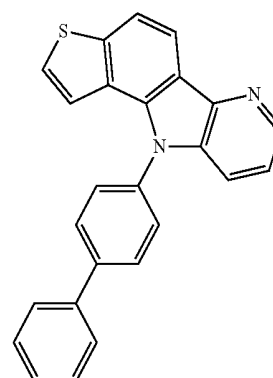
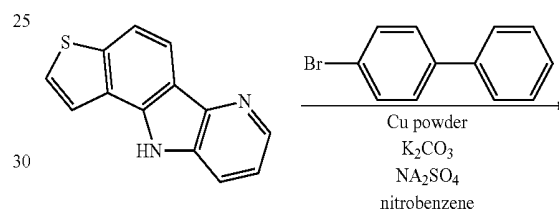
Synthesis of INV-30



Inv-30

The target compound Inv-30 (4.24 g, yield 58%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-14 which is the compound prepared in Preparation Example 14 and 6-bromo-2,4'-bipyridine were used instead of IC-1 and iodobenzene.

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



Inv-31

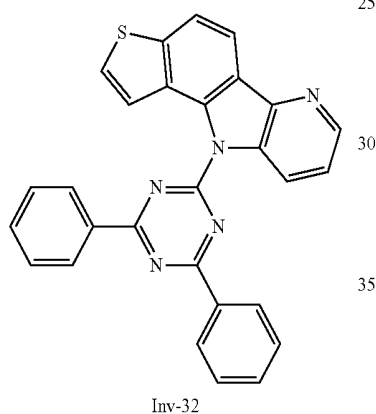
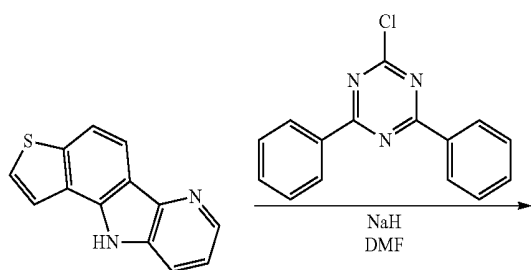
The target compound Inv-31 (4.03 g, yield 48%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-15 which is the compound prepared in Preparation Example 15 and 4-bromobiphenyl were used instead of IC-1 and iodobenzene.

GC-Mass (theoretical value: 376.10 g/mol, measured value: 376 g/mol)

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SYNTHESIS EXAMPLE 32

Synthesis of INV-32

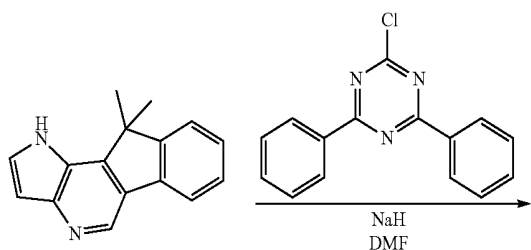


The target compound Inv-32 (7.92 g, yield 78%) was obtained by performing the same procedure as in Synthesis Example 2, except that IC-15 which is the compound prepared in Preparation Example 15 was used instead of IC-1.

GC-Mass (theoretical value: 455.12 g/mol, measured value: 455 g/mol)

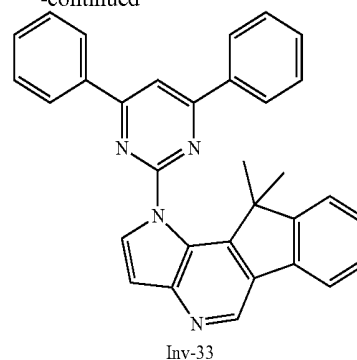
SYNTHESIS EXAMPLE 33

Synthesis of INV-33



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-continued

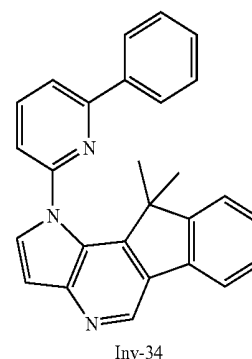
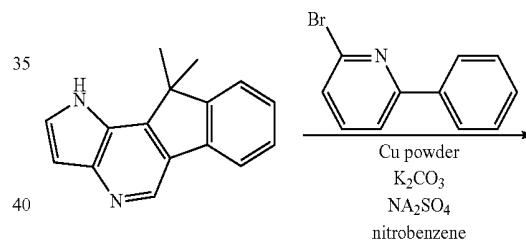


The target compound Inv-33 (6.34 g, yield 64%) was obtained by performing the same procedure as in Synthesis Example 2, except that IC-16 which is the compound prepared in Preparation Example 16 and 2-chloro-4,6-diphenylpyrimidine were used instead of IC-1 and 2-chloro-4,6-diphenyl-1,3,5-triazine.

GC-Mass (theoretical value: 464.20 g/mol, measured value: 464 g/mol)

SYNTHESIS EXAMPLE 34

Synthesis of INV-34



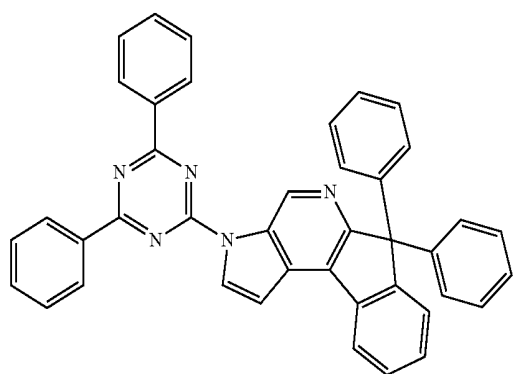
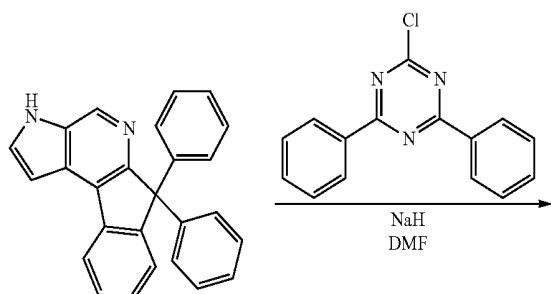
The target compound Inv-34 (4.88 g, yield 59%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-16 which is the compound prepared in Preparation Example 16 and 2-bromo-6-phenylpyridine were used instead of IC-1 and iodobenzene.

GC-Mass (theoretical value: 387.17 g/mol, measured value: 387 g/mol)

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SYNTHESIS EXAMPLE 35

Synthesis of INV-35



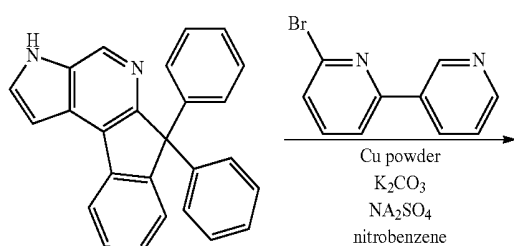
Inv-35

The target compound Inv-35 (6.00 g, yield 73%) was obtained by performing the same procedure as in Synthesis Example 2, except that IC-17 which is the compound prepared in Preparation Example 17 was used instead of IC-1.

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

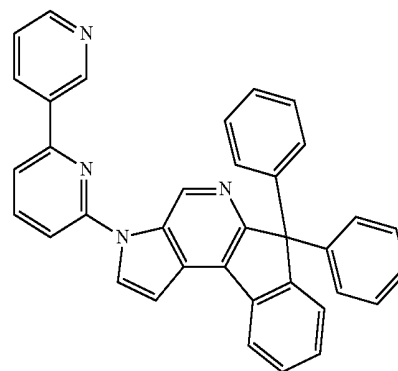
SYNTHESIS EXAMPLE 36

Synthesis of INV-36



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-continued



Inv-36

The target compound Inv-36 (4.43 g, yield 62%) was obtained by performing the same procedure as in Synthesis Example 1, except that IC-17 which is the compound prepared in Preparation Example 17 and 6-bromo-2,3'-bipyridine were used instead of IC-1 and iodobenzene.

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

EXAMPLES 1 to 36

Manufacture of Organic EL Device

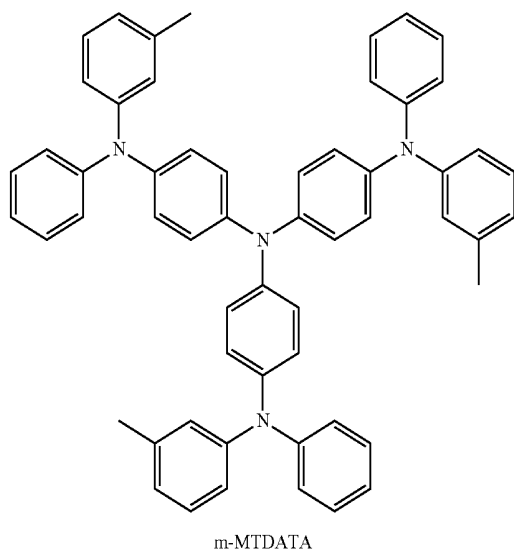
Inv-1 to Inv-36, which are the compounds synthesized in Synthesis Examples 1 to 36, were subjected to highly-pure sublimation purification by a typically known method, and then green organic EL devices were manufactured according to the following procedure.

First, a glass substrate thinly coated with indium tin oxide (ITO) to have a thickness of 1,500 Å was ultrasonically washed with distilled water. When the ultrasonic washing with distilled water was completed, the substrate was ultrasonically washed with a solvent such as isopropyl alcohol, acetone, and methanol, dried, transferred to a UV ozone cleaner (Power sonic 405, manufactured by Hwashin Tech), washed for 5 minutes by using UV, and then transferred to a vacuum evaporator.

An organic EL device was manufactured by laminating m-MTDATA (60 nm)/TCTA (80 nm)/each compound of Inv-1 to Inv-36+10% Ir(ppy)₃ (300 nm)/BCP (10 nm)/Alq₃ (30 nm)/LiF (1 nm)/Al (200 nm) in this order on the thus prepared ITO transparent electrode.

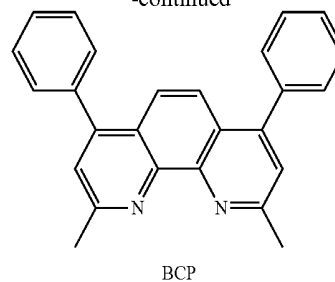
The structures of m-MTDATA, TCTA, Ir(ppy)₃, CBP, and BCP are as follows.

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-continued



COMPARATIVE EXAMPLE 1

Manufacture of Organic EL Device

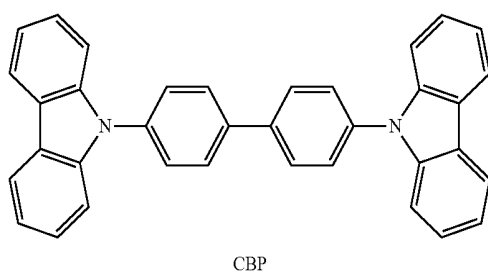
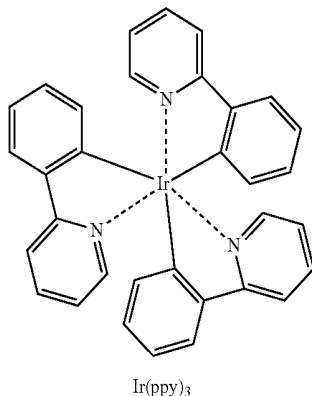
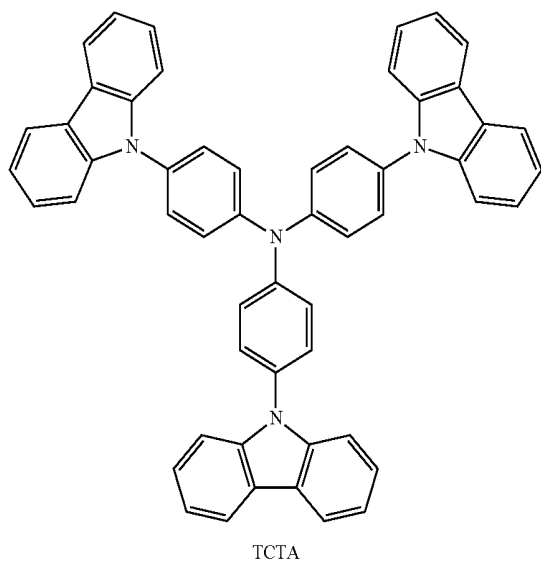
An organic EL device was manufactured by the same procedure as in Example 1, except that when a light-emitting layer is formed, CBP was used as a light-emitting host material instead of Compound Inv-1.

EVALUATION EXAMPLE

For each of the organic EL devices manufactured in Examples 1 to 36 and Comparative Example 1, the driving voltage, current efficiency, and light-emitting peaks thereof were measured at a current density of 10 mA/cm², and the results are shown in the following Table 1.

TABLE 1

Sample	Host	Driving voltage (V)	EL peak (nm)	Current efficiency (cd/A)
Example 1	Inv-1	6.78	517	41.4
Example 2	Inv-2	6.61	516	41.3
Example 3	Inv-3	6.63	516	40.5
Example 4	Inv-4	6.61	515	41.2
Example 5	Inv-5	6.61	517	40.6
Example 6	Inv-6	6.77	516	42.0
Example 7	Inv-7	6.78	51	40.5
Example 8	Inv-8	6.60	516	41.2
Example 9	Inv-9	6.79	517	41.3
Example 10	Inv-10	6.65	516	40.2
Example 11	Inv-11	6.77	515	41.1
Example 12	Inv-12	6.79	518	41.3
Example 13	Inv-13	6.62	517	40.2
Example 14	Inv-14	6.63	518	40.5
Example 15	Inv-15	6.61	516	41.2
Example 16	Inv-16	6.79	516	41.3
Example 17	Inv-17	6.67	517	39.5
Example 18	Inv-18	6.66	515	39.6
Example 19	Inv-19	6.69	518	39.3
Example 20	Inv-20	6.65	517	39.8
Example 21	Inv-21	6.66	518	40.2
Example 22	Inv-22	6.72	518	39.5
Example 23	Inv-23	6.60	519	39.2
Example 24	Inv-24	6.63	516	39.1
Example 25	Inv-25	6.69	517	39.9
Example 26	Inv-26	6.51	515	40.1
Example 27	Inv-27	6.59	517	39.5
Example 28	Inv-28	6.51	518	39.9
Example 29	Inv-29	6.72	517	39.1
Example 30	Inv-30	6.66	516	40.2
Example 31	Inv-31	6.77	515	40.0
Example 32	Inv-32	6.78	516	40.3
Example 33	Inv-33	6.62	517	41.2
Example 34	Inv-34	6.63	516	42.3
Example 35	Inv-35	6.61	518	40.7
Example 36	Inv-36	6.70	517	41.3
Comparative Example 1	CBP	6.93	516	38.2

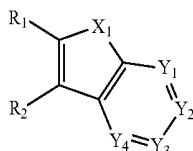


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As shown in Table 1, it can be seen that the organic EL devices of Examples 1 to 36 in which the compounds (Inv-1 to Inv-36) according to the present disclosure are used as a light-emitting layer of a green organic EL device exhibit much better performance in terms of efficiency and driving voltage than the green organic EL device of Comparative Example 1 in the related art in which the CBP is used.

The invention claimed is:

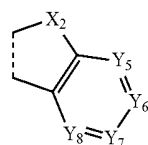
1. A compound of the following Formula 1:



Formula 1

wherein

Y₁ to Y₄ are the same as or different from each other, and are each independently selected from N and CR₃, and at least one of Y₁ and Y₂, Y₂ and Y₃, or Y₃ and Y₄ is CR₃, and forms a fused ring represented by the following Formula 2;



Formula 2

wherein the dotted line means a site where a fusion with the compound of Formula 1 occurs;

Y₅ to Y₈ are the same as or different from each other, and are each independently selected from N and CR₄, with a proviso that Y₁ to Y₈ include at least one N, and

X₁ and X₂ are the same as or different from each other, and are each independently selected from O, S, Se, N(Ar₁), C(Ar₂)(Ar₃), and Si(Ar₄)(Ar₅), and here, at least one of X₁ and X₂ is N(Ar₁), and

R₁ and R₂ are the same as or different from each other, and are each independently selected from the group consisting of hydrogen, a substitute or unsubstituted C₆ to C₆₀ aryl group, and a substituted or unsubstituted heteroaryl group having 5 to 60 nuclear atoms, and

R₃ to R₄ are the same as or different from each other, and are each independently selected from the group consisting of hydrogen, deuterium, halogen, cyano, a substituted or unsubstituted C₁ to C₄₀ alkyl group, a substituted or unsubstituted C₃ to C₄₀ cycloalkyl group, a substituted or unsubstituted heterocycloalkyl group having 3 to 40 nuclear atoms, a substituted or unsubstituted C₆ to C₆₀ aryl group, a substituted or unsubstituted heteroaryl group having 5 to 60 nuclear atoms, a substituted or unsubstituted C₁ to C₄₀ alkoxy group, a substituted or unsubstituted C₆ to C₆₀ aryloxy group, a substituted or unsubstituted C₁ to C₄₀ alkylsilyl group, a substituted or unsubstituted C₆ to C₆₀ arylsilyl group, a substituted or unsubstituted C₁ to C₄₀ alkyl boron group, a substituted or unsubstituted C₆ to C₆₀ aryl boron group, a substituted or unsubstituted C₆ to C₆₀ arylphosphine group, a substituted or unsubstituted C₆ to C₆₀ arylphosphine oxide group, and a substituted

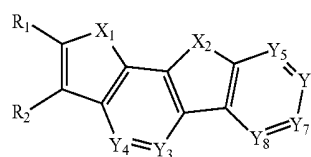
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or unsubstituted C₆ to C₆₀ arylamine group, and these form or do not form a fused ring with an adjacent group;

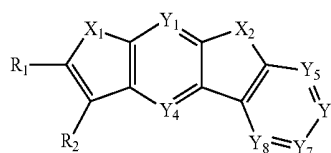
Ar₁ to Ar₅ are the same as or different from each other, and are each independently selected from the group consisting of a substituted or unsubstituted C₁ to C₄₀ alkyl group, a substituted or unsubstituted C₃ to C₄₀ cycloalkyl group, a substituted or unsubstituted heterocycloalkyl group having 3 to 40 nuclear atoms, a substituted or unsubstituted C₆ to C₆₀ aryl group, a substituted or unsubstituted heteroaryl group having 5 to 60 nuclear atoms, a substituted or unsubstituted C₁ to C₄₀ alkoxy group, a substituted or unsubstituted C₆ to C₆₀ aryloxy group, a substituted or unsubstituted C₁ to C₄₀ alkylsilyl group, a substituted or unsubstituted C₆ to C₆₀ arylsilyl group, a substituted or unsubstituted C₁ to C₄₀ alkyl boron group, a substituted or unsubstituted C₆ to C₆₀ aryl boron group, a substituted or unsubstituted C₆ to C₆₀ arylphosphine group, a substituted or unsubstituted C₆ to C₆₀ arylphosphine oxide group, and a substituted or unsubstituted 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 C₁ to C₄₀ alkylsilyl group, the C₆ to C₆₀ arylsilyl group, the C₁ to C₄₀ alkyl boron 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 are optionally each independently substituted with one or more substituents selected from the group consisting of hydrogen, deuterium, halogen, cyano, 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 C₁ to C₄₀ alkylsilyl group, a C₆ to C₆₀ arylsilyl group, a C₁ to C₄₀ alkyl boron 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.

2. The compound of claim 1, wherein the compound of Formula 1 is represented by any one of the following Formulae 3 to 8:



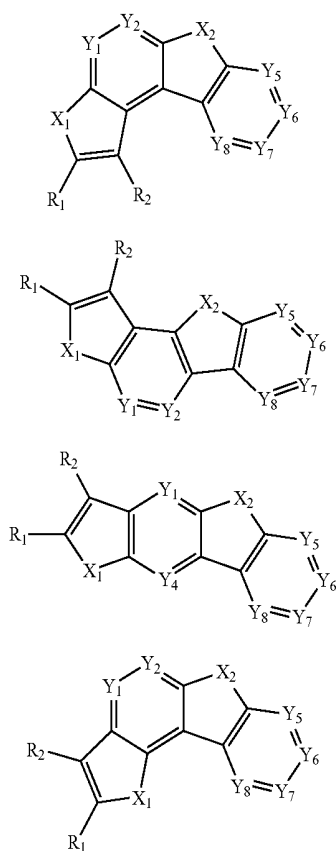
Formula 3



Formula 4

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-continued



wherein X₁ and X₂, Y₁ to Y₈, R₁, and R₂ are the same as those defined in claim 1.

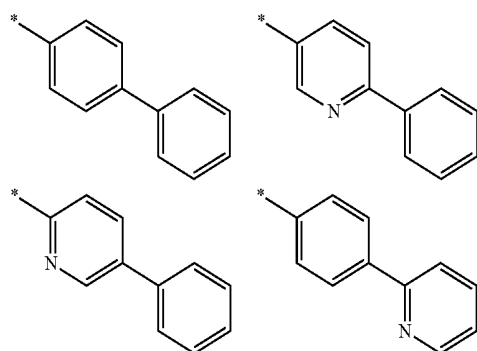
3. The compound of claim 2, wherein both X₁ and X₂ are N(Ar₁).

4. The compound of claim 2, wherein Y₁ to Y₈ comprise one N.

5. The compound of claim 1, wherein Ar₁ to Ar₅ 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; and

the C₆ to C₆₀ aryl group, the heteroaryl group having 5 to 60 nuclear atoms, and the C₆ to C₆₀ arylamine group are each unsubstituted or substituted with one or more functional groups selected from the group consisting of a C₁ to C₄₀ alkyl group, a C₆ to C₆₀ aryl group, and a heteroaryl group having 5 to 60 nuclear atoms.

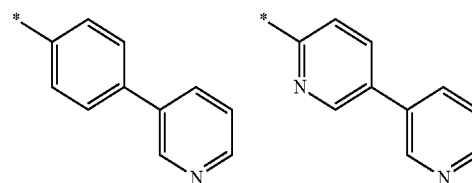
6. The compound of claim 1, wherein Ar₁ to Ar₅ are selected from the group of the following substituents:



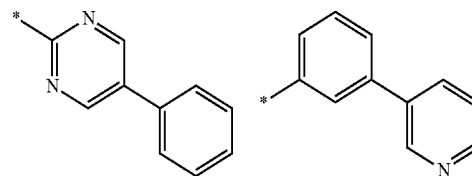
148

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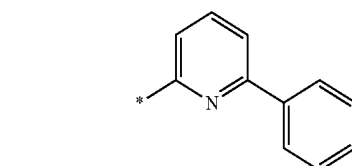
Formula 5



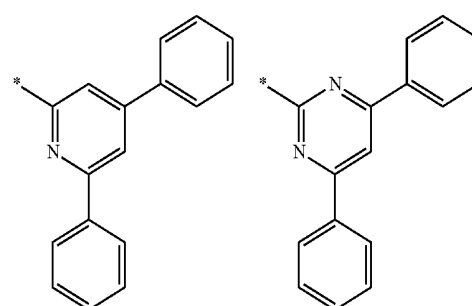
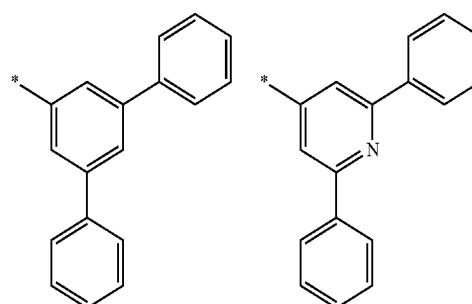
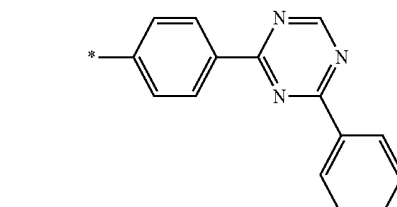
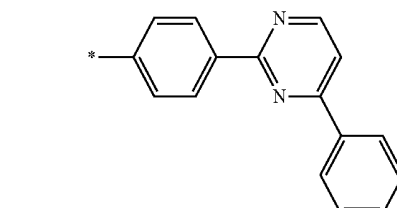
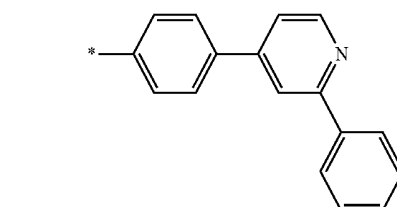
Formula 6



Formula 7

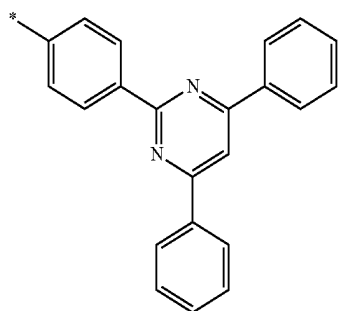
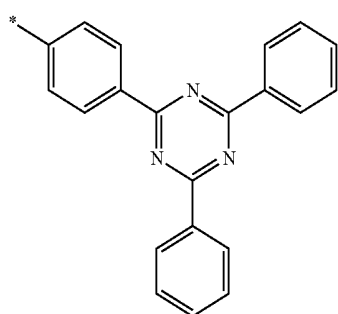
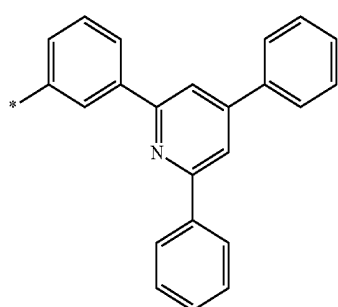
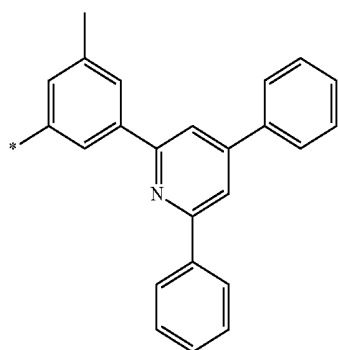
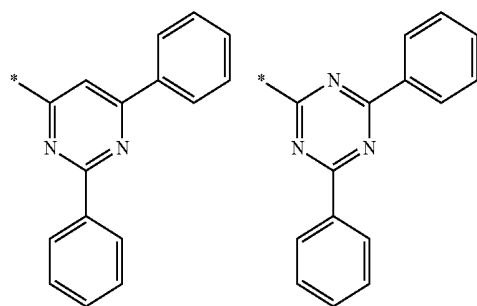


Formula 8

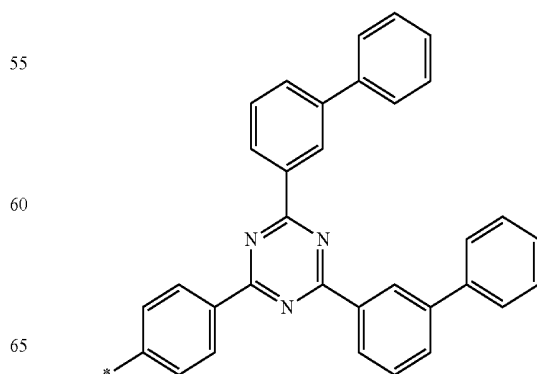
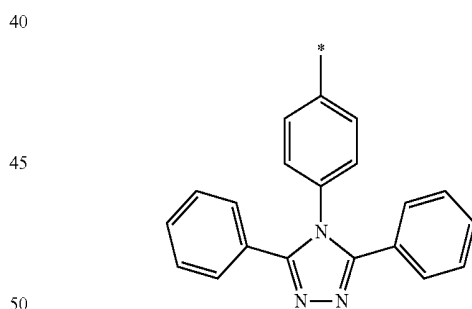
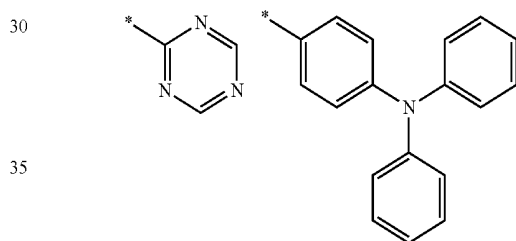
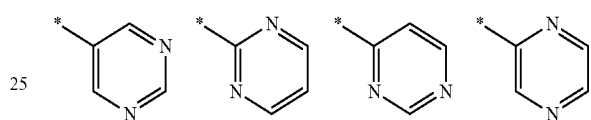
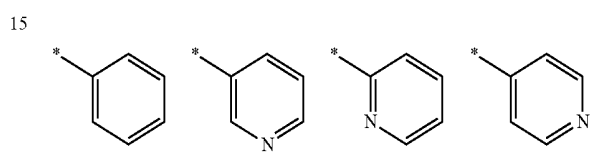
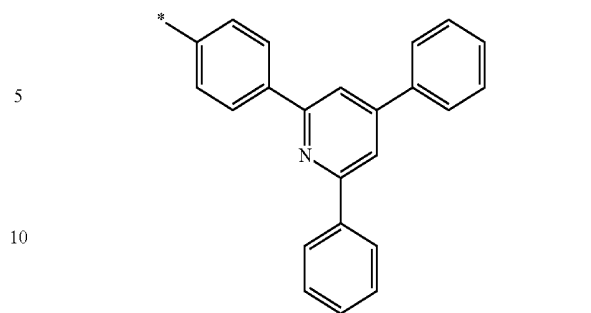


149

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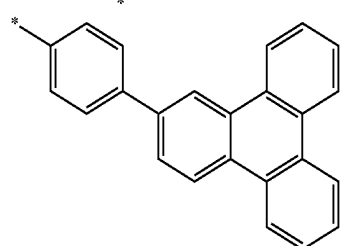
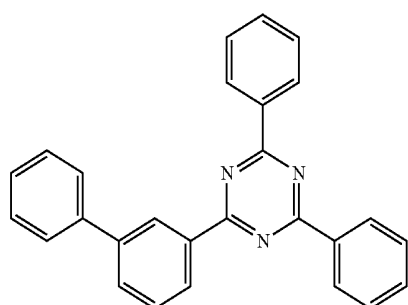
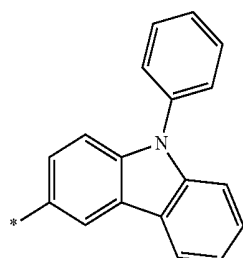
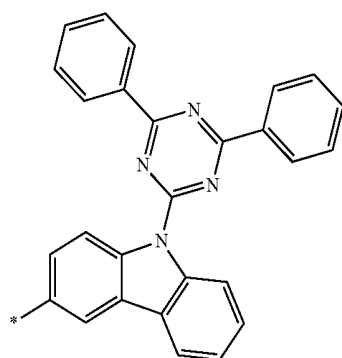
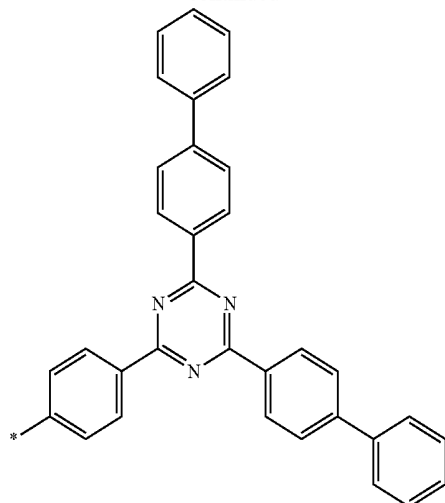
**150**

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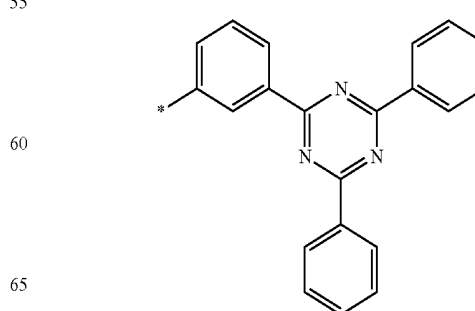
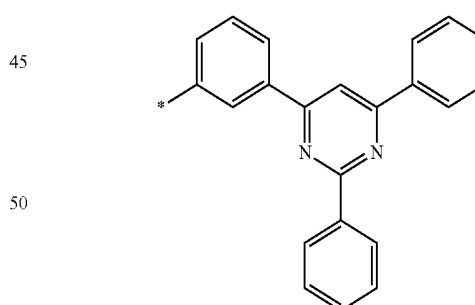
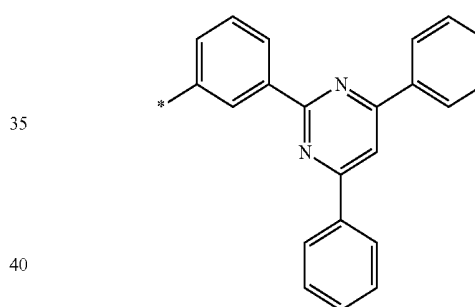
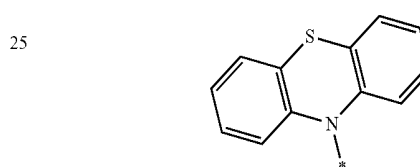
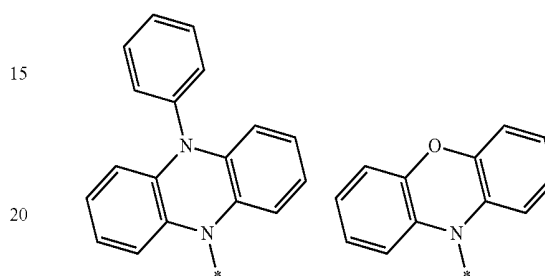
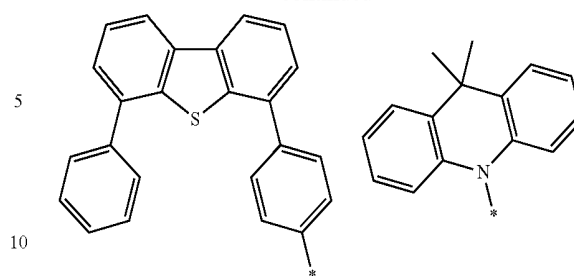
151

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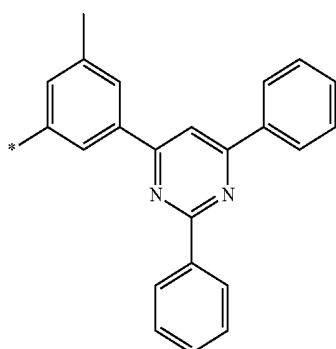
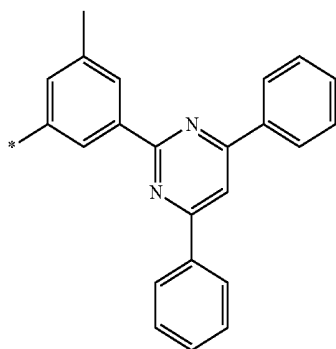
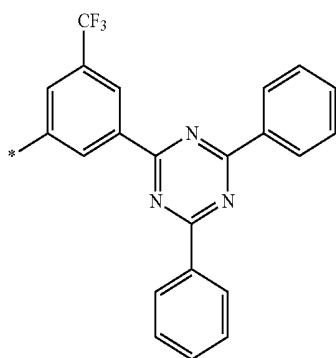
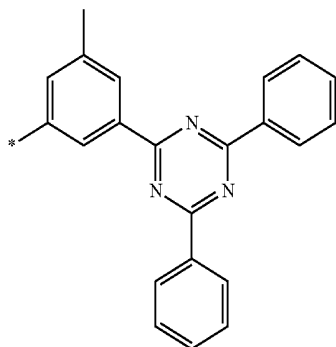
152

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**154**

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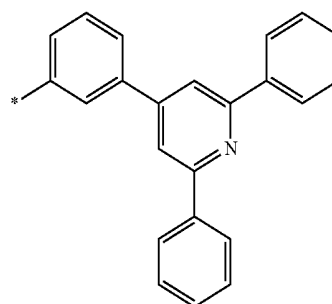
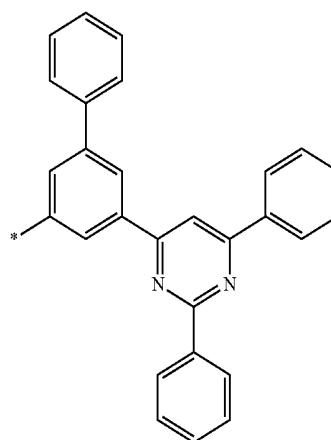
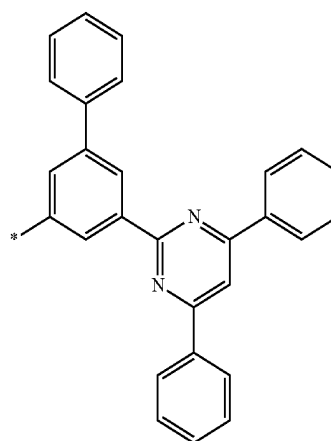
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7. An organic electroluminescent device comprising:

(i) an anode;

50 (ii) a cathode; and

(iii) an organic material layer comprising one or more layers interposed between the anode and the cathode, wherein at least one of the organic material layer comprises the compound of claim 1.

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8. The organic electroluminescent device of claim 7, wherein the organic material layer comprising the compound is selected from the group consisting of a hole injection layer, a hole transporting layer, and a light-emitting layer.

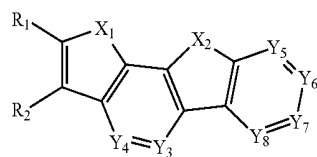
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9. The organic electroluminescent device of claim 7, wherein the compound is used as a phosphorescent host of a light-emitting layer.

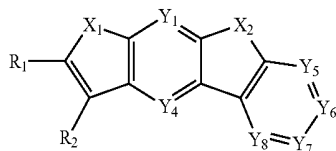
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10. The organic electroluminescent device of claim 7, wherein the compound is represented by any one of the following Formulae 3 to 8:

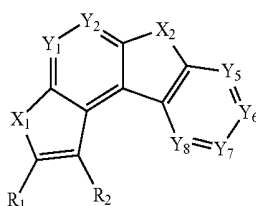
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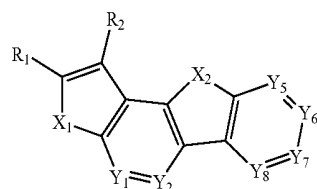
Formula 3



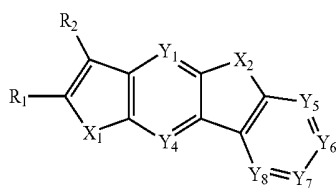
Formula 4



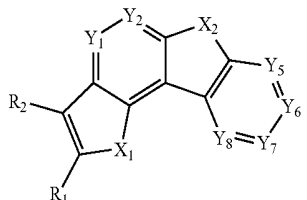
Formula 5



Formula 6



Formula 7



Formula 8

wherein

X₁ and X₂ are the same as or different from each other, and 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), and Y₁ to Y₄ are the same as or different from each other, and are each independently selected from N and CR₃, and Y₅ to Y₈ are the same as or different from each other, and are each independently selected from N and CR₄, with a proviso that Y₁ to Y₈ include at least one N, and R₁ and R₂ are the same as or different from each other, and are each independently selected from the group consisting of hydrogen, a substituted or unsubstituted C₆ to C₆₀ aryl group, and a substituted or unsubstituted heteroaryl group having 5 to 60 nuclear atoms, and R₃ to R₄ are the same as or different from each other, and are each independently selected from the group consisting of hydrogen, deuterium, halogen, cyano, a substituted or unsubstituted C₁ to C₄₀ alkyl group, a substituted or unsubstituted C₃ to C₄₀ cycloalkyl group, a substituted or unsubstituted heterocycloalkyl group

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having 3 to 40 nuclear atoms, a substituted or unsubstituted C₆ to C₆₀ aryl group, a substituted or unsubstituted heteroaryl group having 5 to 60 nuclear atoms, a substituted or unsubstituted C₁ to C₄₀ alkoxy group, a substituted or unsubstituted C₆ to C₆₀ aryloxy group, a substituted or unsubstituted C₁ to C₄₀ alkylsilyl group, a substituted or unsubstituted C₆ to C₆₀ arylsilyl group, a substituted or unsubstituted C₁ to C₄₀ alkyl boron group, a substituted or unsubstituted C₆ to C₆₀ aryl boron group, a substituted or unsubstituted C₆ to C₆₀ arylphosphine group, a substituted or unsubstituted C₆ to C₆₀ arylphosphine oxide group, and a substituted or unsubstituted C₆ to C₆₀ arylamine group, and these form or do not form a fused ring with an adjacent group;

Ar₁ to Ar₅ are the same as or different from each other, and are each independently selected from the group consisting of a substituted or unsubstituted C₁ to C₄₀ alkyl group, a substituted or unsubstituted C₃ to C₄₀ cycloalkyl group, a substituted or unsubstituted heterocycloalkyl group having 3 to 40 nuclear atoms, a substituted or unsubstituted C₆ to C₆₀ aryl group, a substituted or unsubstituted heteroaryl group having 5 to 60 nuclear atoms, a substituted or unsubstituted C₁ to C₄₀ alkoxy group, a substituted or unsubstituted C₆ to C₆₀ aryloxy group, a substituted or unsubstituted C₁ to C₄₀ alkylsilyl group, a substituted or unsubstituted C₆ to C₆₀ arylsilyl group, a substituted or unsubstituted C₁ to C₄₀ alkyl boron group, a substituted or unsubstituted C₆ to C₆₀ aryl boron group, a substituted or unsubstituted C₆ to C₆₀ arylphosphine group, a substituted or unsubstituted C₆ to C₆₀ arylphosphine oxide group, and a substituted or unsubstituted 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 C₁ to C₄₀ alkylsilyl group, the C₆ to C₆₀ arylsilyl group, the C₁ to C₄₀ alkyl boron 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 are optionally each independently substituted with one or more substituents selected from the group consisting of hydrogen, deuterium, halogen, cyano, 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 C₁ to C₄₀ alkylsilyl group, a C₆ to C₆₀ arylsilyl group, a C₁ to C₄₀ alkyl boron 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.

11. The organic electroluminescent device of claim 10, wherein both X₁ and X₂ are N(Ar₁).

12. The organic electroluminescent device of claim 10, wherein Y₁ to Y₈ comprise one N.

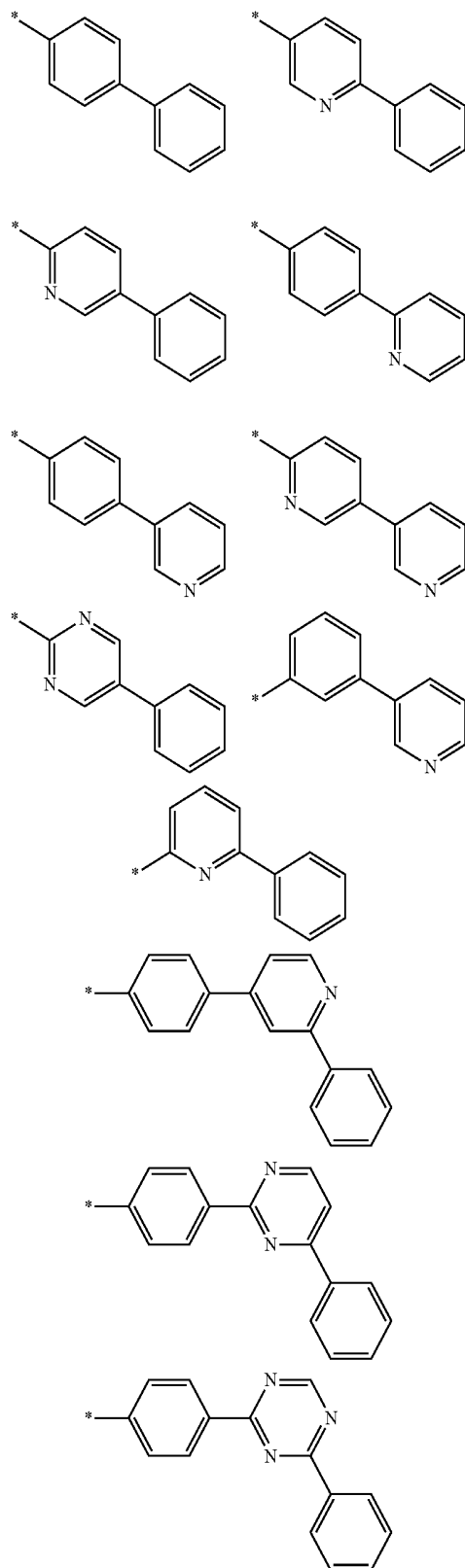
13. The organic electroluminescent device of claim 7, wherein Ar₁ to Ar₅ are each independently selected from the group consisting of a C₆ to C₆₀ aryl group, a heteroaryl group having 5 to 60 nuclear atoms, and a C₆ to C₆₀ arylamine group; and

the C₆ to C₆₀ aryl group, the heteroaryl group having 5 to 60 nuclear atoms, and the C₆ to C₆₀ arylamine group are each unsubstituted or substituted with one or more

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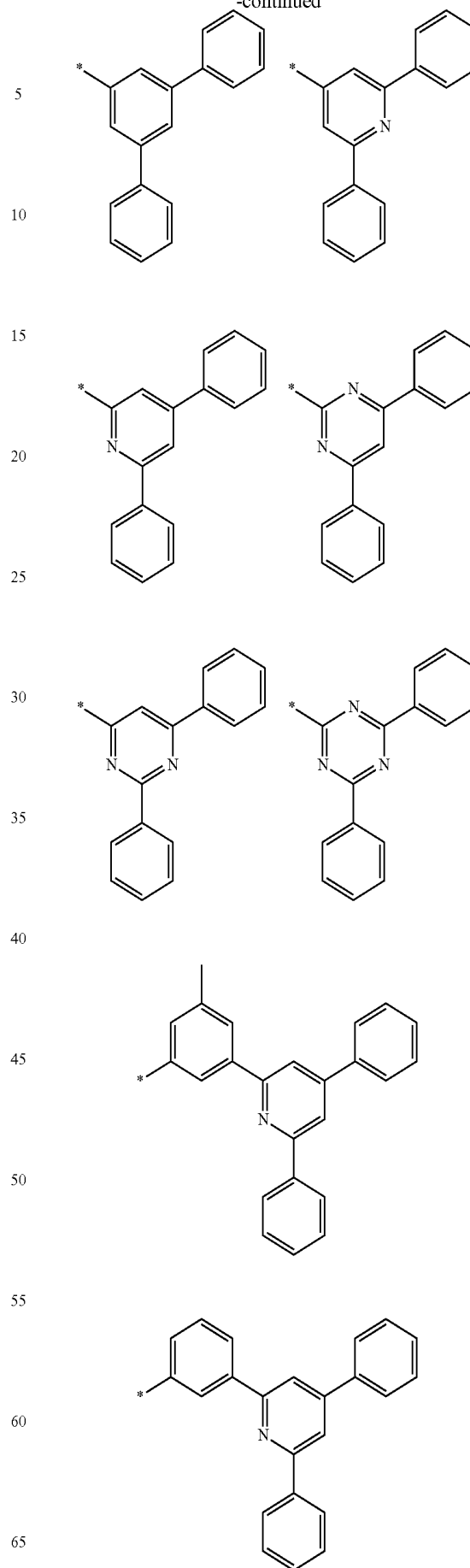
functional groups selected from the group consisting of a C₁ to C₄₀ alkyl group, a C₆ to C₆₀ aryl group, and a heteroaryl group having 5 to 60 nuclear atoms.

14. The organic electroluminescent device of claim 7, wherein Ar₁ to Ar₅ are selected from the group of the following substituents:



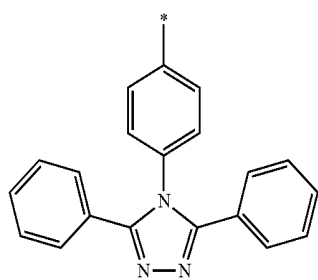
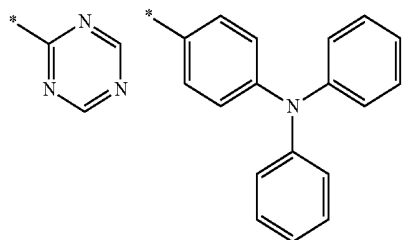
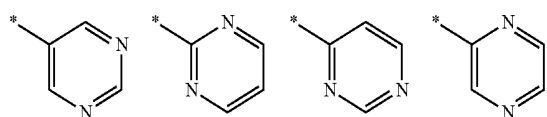
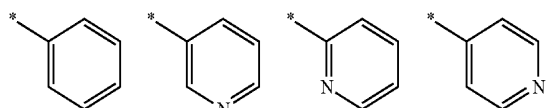
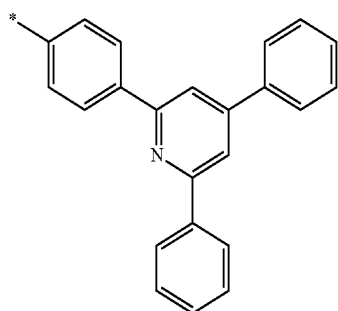
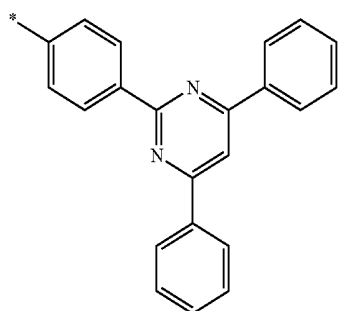
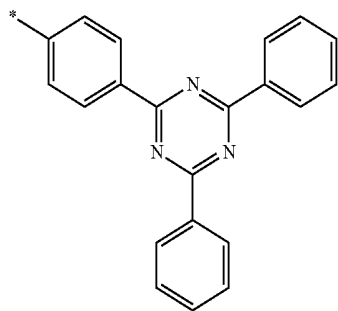
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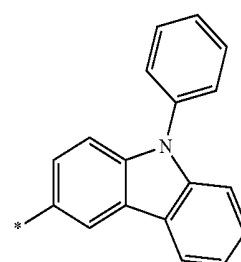
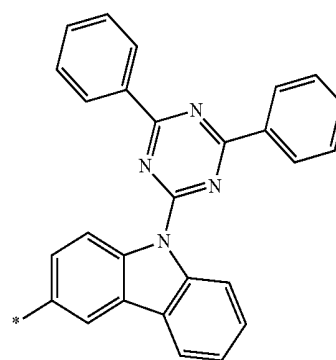
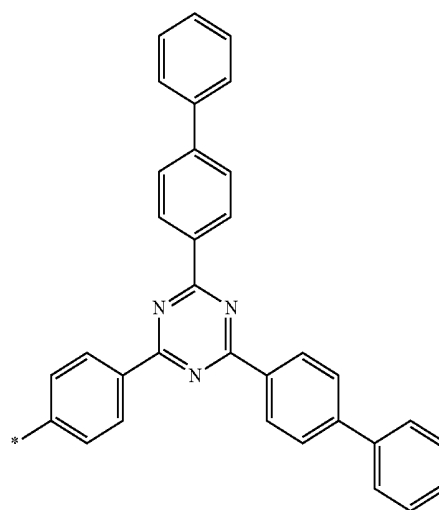
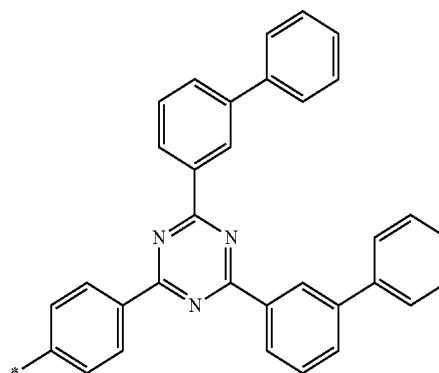
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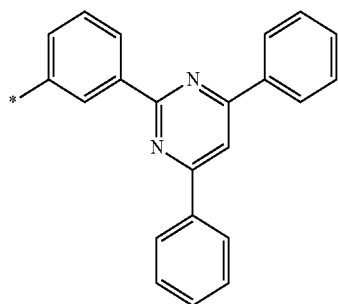
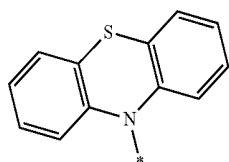
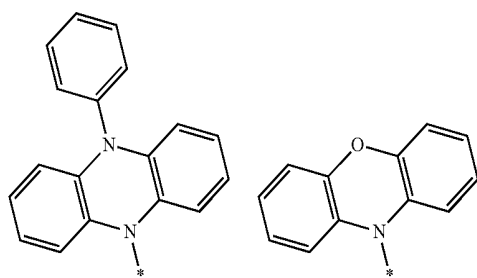
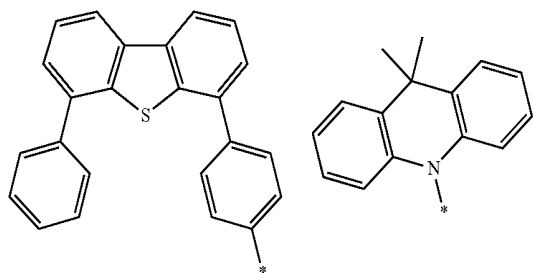
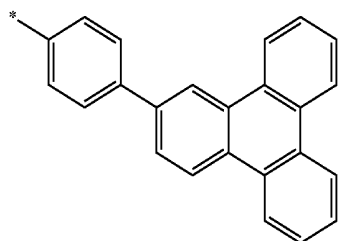
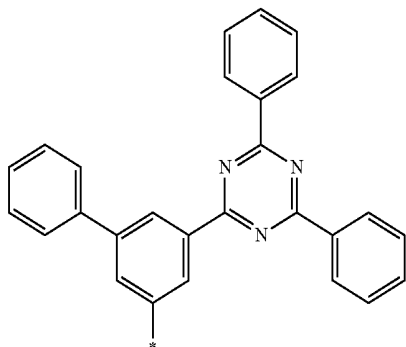
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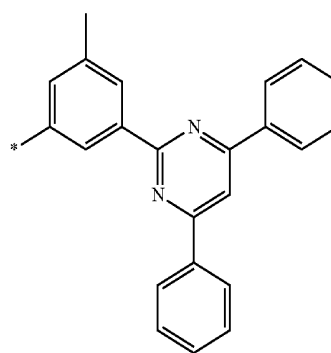
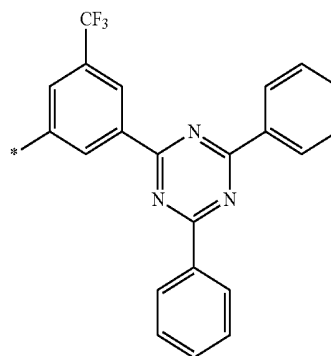
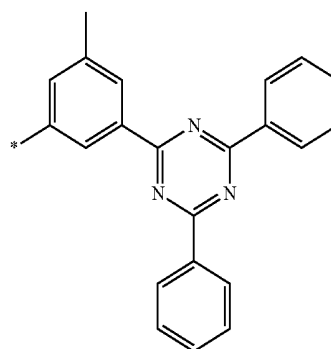
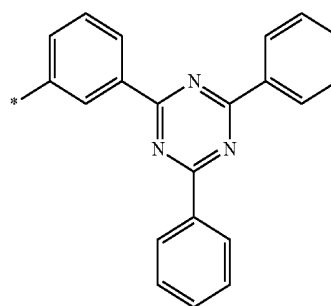
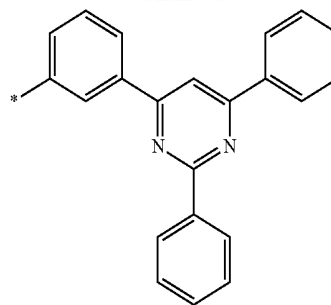


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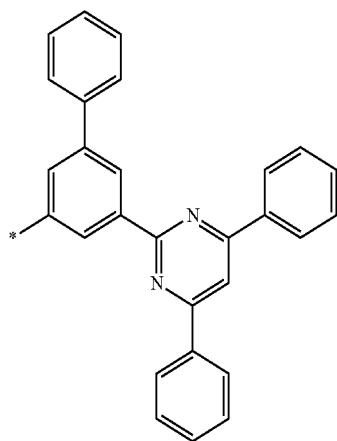
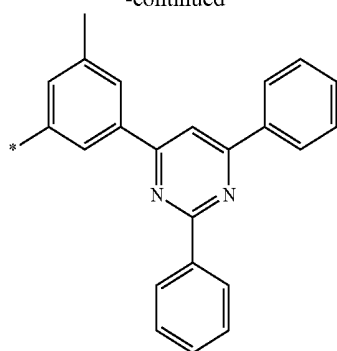
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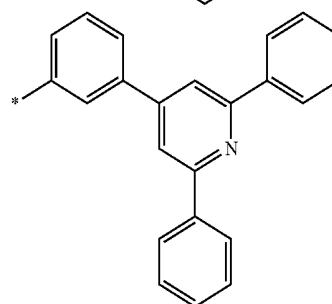
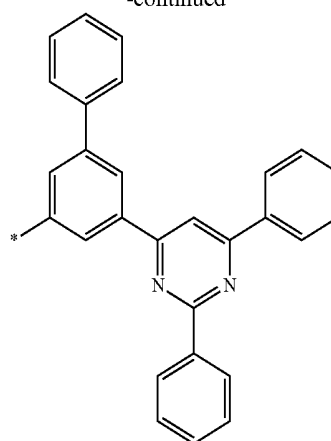
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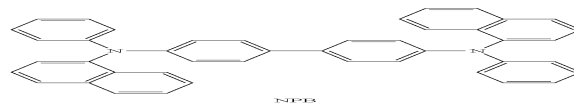


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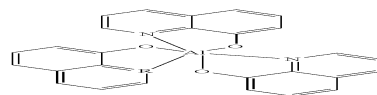
专利名称(译)	有机发光化合物和使用其的有机电致发光器件		
公开(公告)号	US9761813	公开(公告)日	2017-09-12
申请号	US14/420569	申请日	2013-03-27
[标]申请(专利权)人(译)	株式会社斗山		
申请(专利权)人(译)	斗山公司		
当前申请(专利权)人(译)	斗山公司		
[标]发明人	KIM HOE MOON BEAK YOUNG MI KIM TAE HYUNG PARK HO CHEOL LEE CHANG JUN SHIN JIN YONG		
发明人	KIM, HOE MOON BEAK, YOUNG MI KIM, TAE HYUNG PARK, HO CHEOL LEE, CHANG JUN SHIN, JIN YONG		
IPC分类号	H01L51/50 C07D471/22 C09K11/06 C07D495/14 H01L51/00 C07D471/14		
CPC分类号	H01L51/0072 C07D471/14 C07D471/22 C07D495/14 C09K11/06 H01L51/0058 H01L51/0061 H01L51/0067 H01L51/0071 H01L51/0074 C09K2211/1007 C09K2211/1011 C09K2211/1029 C09K2211/1044 C09K2211/1048 C09K2211/1051 C09K2211/1055 C09K2211/1059 C09K2211/1062 C09K2211/1074 C09K2211/1092 H01L51/0085 H01L51/5016 H01L51/5056 H01L51/5088		
代理机构(译)	萨格鲁MION , PLLC		
审查员(译)	CLARK , GREGORY		
优先权	1020120103937 2012-09-19 KR 1020120087997 2012-08-10 KR		
其他公开文献	US20150214490A1		
外部链接	Espacenet USPTO		

摘要(译)

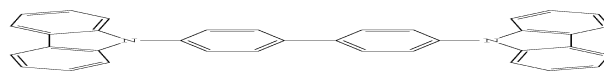
本发明涉及一种具有优异的空穴注入和传输能力，发光性能和其它性能的新型吡啶基化合物，并涉及一种有机电致发光器件，其发光效率，驱动电压，使用寿命等特性得到改善。由于在一个或多个有机材料层中含有化合物。



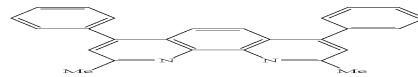
NPB



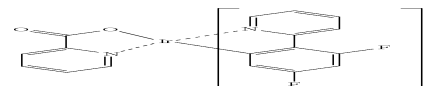
Alq3



CBP



BCP



Purpic