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Lee et al.(10) **Pub. No.: US 2017/0054086 A1**(43) **Pub. Date: Feb. 23, 2017**(54) **COMPOUND AND ORGANIC
LIGHT-EMITTING DEVICE INCLUDING
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Im, Yongin-si (KR)(21) Appl. No.: **15/053,629**(22) Filed: **Feb. 25, 2016**(30) **Foreign Application Priority Data**

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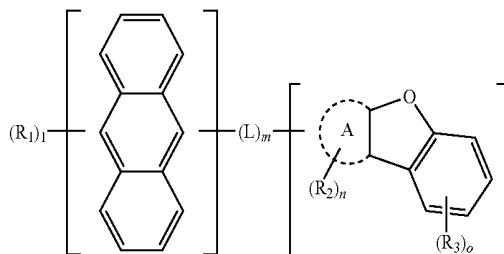
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(57)

ABSTRACT

When a decrease in low-grey level region (e.g., 0 to 80 grey) efficiencies of organic light emitting devices is not constant, deviation among display panels may cause color change and stain in the low luminance region. Aspects of the present disclosure are directed toward a compound to overcome this problem and an organic light-emitting device including the same. The compound may be represented by Formula 1:

Formula 1



Organic light-emitting devices including this compound in the buffer layer were found to have improved efficiencies at low grey levels.

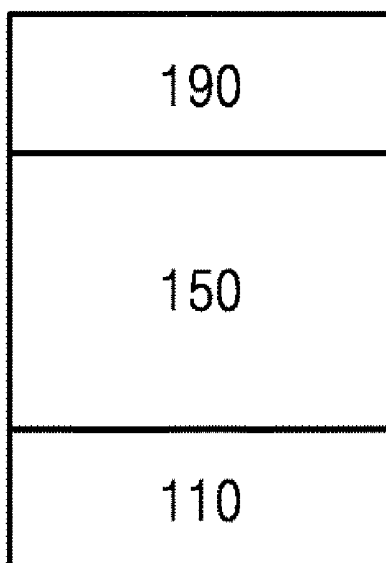
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FIG. 1

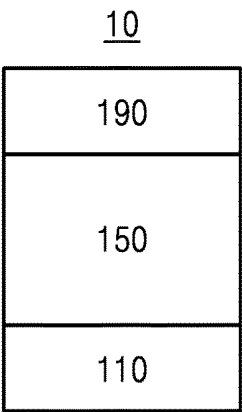


FIG. 2

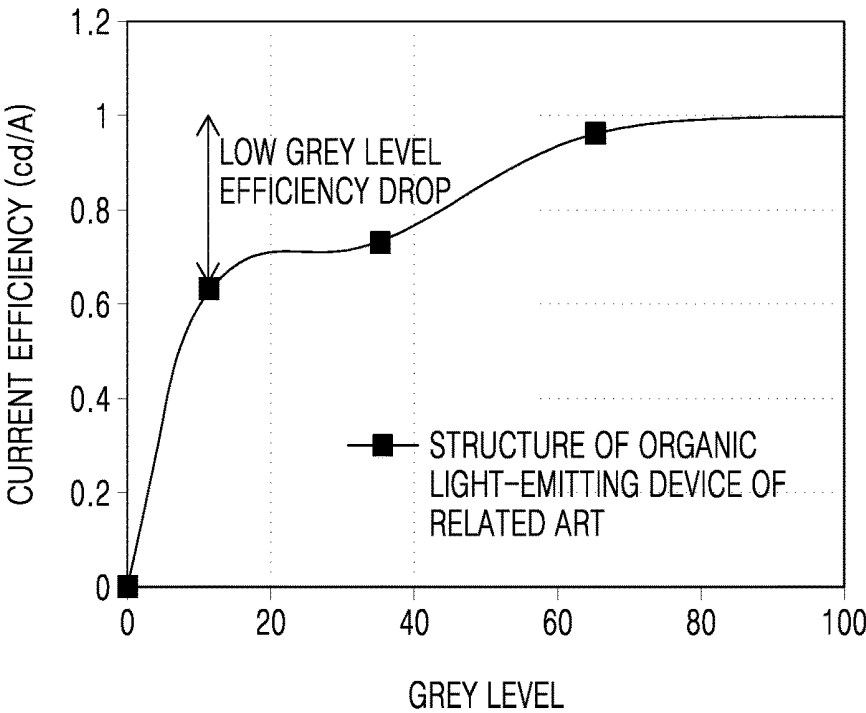


FIG. 3

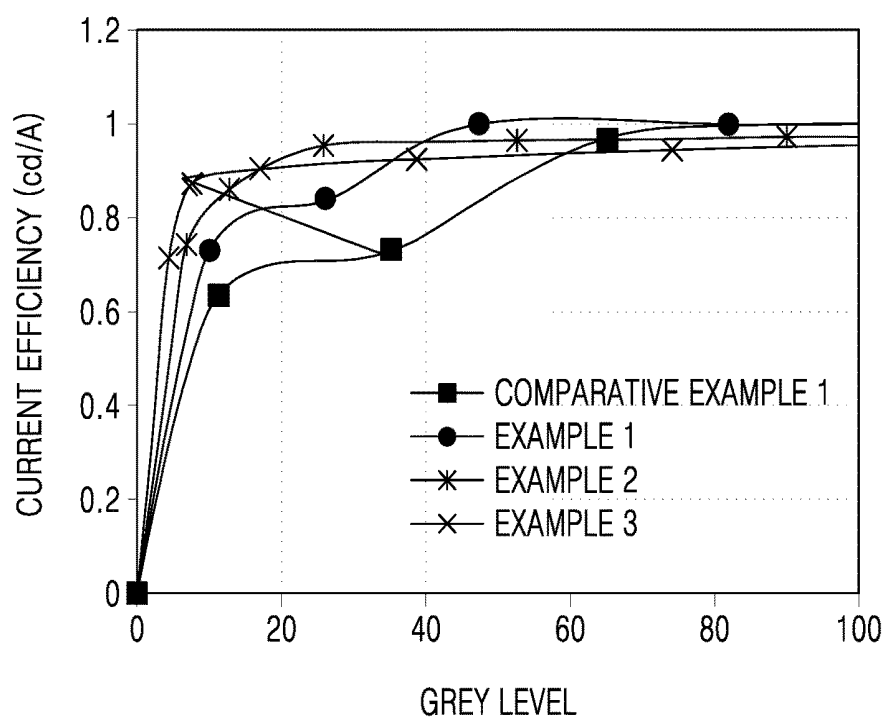
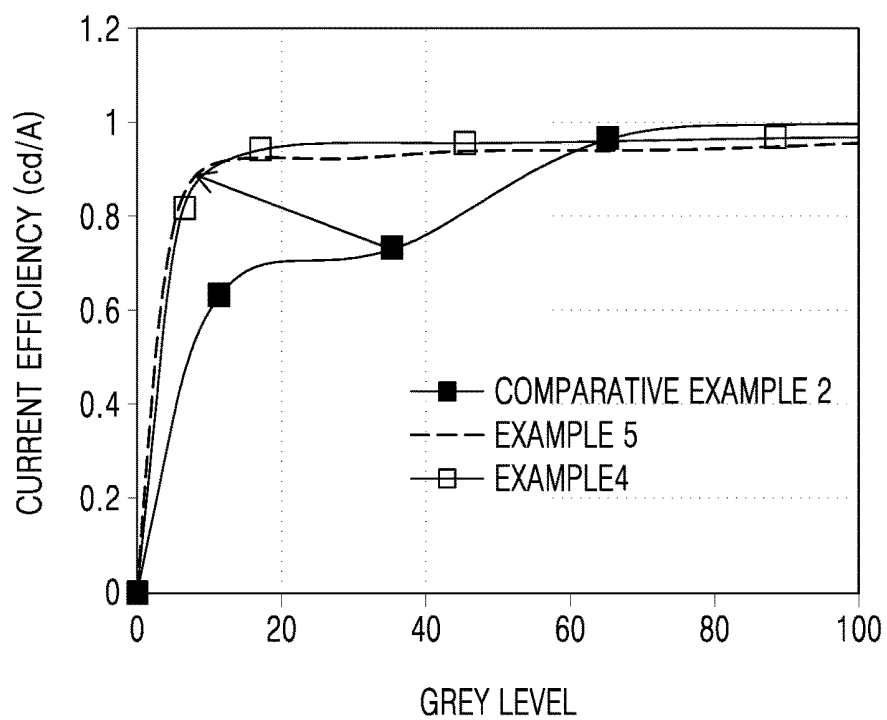


FIG. 4



COMPOUND AND ORGANIC LIGHT-EMITTING DEVICE INCLUDING THE SAME

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to and the benefit of Korean Patent Application No. 10-2015-0118269, filed on Aug. 21, 2015, in the Korean Intellectual Property Office, the entire content of which is incorporated herein by reference.

BACKGROUND

[0002] 1. Field

[0003] One or more aspects of embodiments of the present disclosure relate to a compound and an organic light-emitting device including the same.

[0004] 2. Description of the Related Art

[0005] Organic light-emitting devices are self-emission devices that have wide viewing angles, high contrast ratios, short response times, and excellent brightness, driving voltage, and response speed characteristics, and produce full-color images.

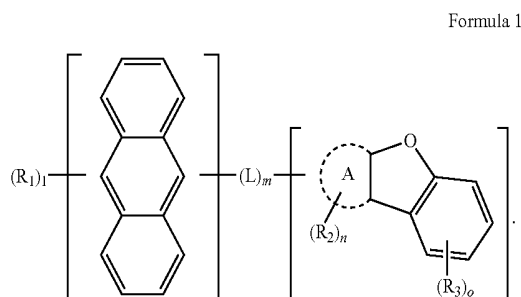
[0006] The organic light-emitting device may include a first electrode on a substrate, and a hole transport region, an emission layer, an electron transport region, and a second electrode sequentially positioned on the first electrode. Holes provided from the first electrode may move toward the emission layer through the hole transport region, and electrons provided from the second electrode may move toward the emission layer through the electron transport region. Charge carriers, such as holes and electrons, recombine in the emission layer to produce excitons. These excitons change (e.g., decay or transition) from an excited state to a ground state, thereby generating light.

SUMMARY

[0007] One or more aspects of example embodiments of the present disclosure are directed toward a material for a buffer layer and an organic light-emitting device using the material.

[0008] Additional aspects will be set forth in part in the description which follows and, in part, will be apparent from the description, or may be learned by practice of the presented embodiments.

[0009] According to one or more example embodiments of the present disclosure, a compound that is the material for the buffer layer is represented by Formula 1:

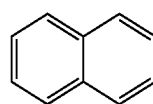


[0010] In Formula 1,

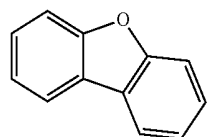
[0011] R_1 to R_3 may each independently be selected from hydrogen, deuterium, a substituted or unsubstituted C_1 - C_{60} alkyl group, a substituted or unsubstituted C_2 - C_{60} alkenyl group, a substituted or unsubstituted C_2 - C_{60} alkynyl group, a substituted or unsubstituted C_1 - C_{60} alkoxy group, a substituted or unsubstituted C_3 - C_{10} cycloalkyl group, a substituted or unsubstituted C_2 - C_{10} heterocycloalkyl group, a substituted or unsubstituted C_3 - C_{10} cycloalkenyl group, a substituted or unsubstituted C_2 - C_{10} heterocycloalkenyl group, a substituted or unsubstituted C_6 - C_{60} aryl group, a substituted or unsubstituted C_6 - C_{60} aryloxy group, a substituted or unsubstituted C_6 - C_{60} arylthio group, and a substituted or unsubstituted monovalent non-aromatic condensed polycyclic group,

[0012] L may be selected from a substituted or unsubstituted C_6 - C_{60} arylene group, and a substituted or unsubstituted divalent non-aromatic condensed polycyclic group,

[0013] A may be a moiety selected from Formula 2a and 2b,



2a



2b

[0014] l may be an integer selected from 1 to 4;

[0015] m may be an integer selected from 0 to 3;

[0016] n may be an integer selected from 1 to 6;

[0017] o may be an integer selected from 1 to 4; and

[0018] at least one substituent of the substituted C_1 - C_{60} alkyl group, substituted C_2 - C_{60} alkenyl group, substituted C_2 - C_{60} alkynyl group, substituted C_1 - C_{60} alkoxy group, substituted C_3 - C_{10} cycloalkyl group, substituted C_2 - C_{10} heterocycloalkyl group, substituted C_3 - C_{10} cycloalkenyl group, substituted C_2 - C_{10} heterocycloalkenyl group, substituted C_6 - C_{60} aryl group, substituted C_6 - C_{60} arylene group, substituted C_6 - C_{60} aryloxy group, substituted C_6 - C_{60} arylthio group, substituted monovalent non-aromatic condensed polycyclic group, and substituted divalent non-aromatic condensed polycyclic group may be selected from:

[0019] deuterium, $-F$, $-Cl$, $-Br$, $-I$, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, $Si(Q_1)(Q_2)(Q_3)$, $P(=O)(Q_4)(Q_5)$, a C_1 - C_{60} alkyl group, a C_2 - C_{60} alkenyl group, a C_2 - C_{60} alkynyl group, and a C_1 - C_{60} alkoxy group;

[0020] a C_1 - C_{60} alkyl group, a C_2 - C_{60} alkenyl group, a C_2 - C_{60} alkynyl group, and a C_1 - C_{60} alkoxy group, each substituted with at least one selected from deuterium, $-F$, $-Cl$, $-Br$, $-I$, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_3 - C_{10} cycloalkyl group, a C_2 - C_{10} heterocycloalkyl group, a C_3 - C_{10} cycloalkenyl

group, a C₂-C₁₀ heterocycloalkenyl group, a C₆-C₆₀ aryl group, a C₆-C₆₀ aryloxy group, a C₆-C₆₀ arylthio group, a monovalent non-aromatic condensed polycyclic group, —N(Q₁₁)(Q₁₂), —Si(Q₁₃)(Q₁₄)(Q₁₅), and —B(Q₁₆)(Q₁₇);

[0021] a C₃-C₁₀ cycloalkyl group, a C₂-C₁₀ heterocycloalkyl group, a C₃-C₁₀ cycloalkenyl group, a C₂-C₁₀ heterocycloalkenyl group, a C₆-C₆₀ aryl group, a C₆-C₆₀ aryloxy group, a C₆-C₆₀ arylthio group, and a monovalent non-aromatic condensed polycyclic group; and

[0022] a C₃-C₁₀ cycloalkyl group, a C₂-C₁₀ heterocycloalkyl group, a C₃-C₁₀ cycloalkenyl group, a C₂-C₁₀ heterocycloalkenyl group, a C₆-C₆₀ aryl group, a C₆-C₆₀ aryloxy group, a C₆-C₆₀ arylthio group, and a monovalent non-aromatic condensed polycyclic group, each substituted with at least one selected from deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C₁-C₆₀ alkyl group, a C₂-C₆₀ alkenyl group, a C₂-C₆₀ alkynyl group, a C₁-C₆₀ alkoxy group, a C₃-C₁₀ cycloalkyl group, a C₂-C₁₀ heterocycloalkyl group, a C₃-C₁₀ cycloalkenyl group, a C₂-C₁₀ heterocycloalkenyl group, a C₆-C₆₀ aryl group, a C₆-C₆₀ aryloxy group, a C₆-C₆₀ arylthio group, a monovalent non-aromatic condensed polycyclic group, —N(Q₂₁)(Q₂₂), —Si(Q₂₃)(Q₂₄)(Q₂₅), and —B(Q₂₆)(Q₂₇),

[0023] wherein Q₁ to Q₅, Q₁₁ to Q₁₇, and Q₂₁ to Q₂₇ may each independently be selected from hydrogen, deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C₁-C₆₀ alkyl group, a C₂-C₆₀ alkenyl group, a C₂-C₆₀ alkynyl group, a C₁-C₆₀ alkoxy group, a C₃-C₁₀ cycloalkyl group, a C₂-C₁₀ heterocycloalkyl group, a C₃-C₁₀ cycloalkenyl group, a C₂-C₁₀ heterocycloalkenyl group, a C₆-C₆₀ aryl group, and a monovalent non-aromatic condensed polycyclic group.

[0024] According to one or more example embodiments of the present disclosure, an organic light-emitting device includes: a first electrode; a second electrode facing the first electrode; and an organic layer between the first electrode and the second electrode and including an emission layer, wherein the organic layer includes the compound of Formula 1.

[0025] According to one or more example embodiments of the present disclosure, a flat panel display apparatus includes the organic light-emitting device, wherein the first electrode of the organic light-emitting device is electrically connected to one selected from a source electrode and a drain electrode of a thin film transistor.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] These and/or other aspects will become apparent and more readily appreciated from the following description of the example embodiments, taken in conjunction with the accompanying drawings in which:

[0027] FIG. 1 is a schematic view of an organic light-emitting device according to one or more embodiments of the present disclosure;

[0028] FIG. 2 is a graph of efficiency with respect to grey level in an organic light-emitting device of the related art;

[0029] FIG. 3 is a graph of efficiency with respect to grey level in an organic light-emitting device according to one or more embodiments of the present disclosure; and

[0030] FIG. 4 is a graph of efficiency with respect to grey level in an organic light-emitting device according to one or more embodiments of the present disclosure.

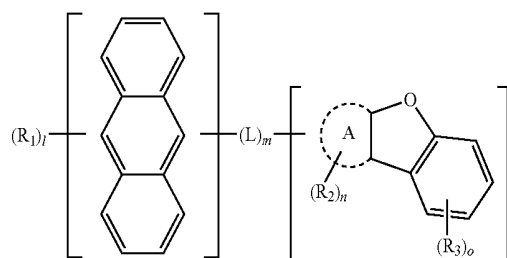
DETAILED DESCRIPTION

[0031] Reference will now be made in more detail to example embodiments, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to like elements throughout. In this regard, the present example embodiments may have different forms and should not be construed as being limited to the descriptions set forth herein. Accordingly, the example embodiments are merely described below, by referring to the drawings, to explain aspects of the present description. As used herein, the term “and/or” includes any and all combinations of one or more of the associated listed items. Expressions such as “at least one of”, “one of”, “at least one selected from”, and “one selected from” when preceding a list of elements, modify the entire list of elements and do not modify the individual elements of the list.

[0032] In the drawings, the thickness of layers, films, panels, regions, etc., may be exaggerated for clarity. Like reference numerals designate like elements throughout the specification. It will be understood that when an element such as a layer, film, region, or substrate is referred to as being “on” another element, it can be directly on the other element or intervening element(s) may also be present. In contrast, when an element is referred to as being “directly on” another element, no intervening elements are present.

[0033] One or more aspects of embodiments of the present disclosure provides a compound represented by Formula 1:

Formula 1

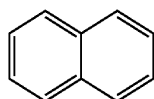


[0034] In Formula 1,

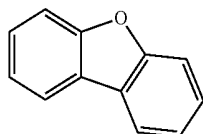
[0035] R₁ to R₃ may each independently be selected from hydrogen, deuterium, a substituted or unsubstituted C₁-C₆₀ alkyl group, a substituted or unsubstituted C₂-C₆₀ alkenyl group, a substituted or unsubstituted C₂-C₆₀ alkynyl group, a substituted or unsubstituted C₁-C₆₀ alkoxy group, a substituted or unsubstituted C₃-C₁₀ cycloalkyl group, a substituted or unsubstituted C₂-C₁₀ heterocycloalkyl group, a substituted or unsubstituted C₃-C₁₀ cycloalkenyl group, a substituted or unsubstituted C₂-C₁₀ heterocycloalkenyl group, a substituted or unsubstituted C₆-C₆₀ aryl group, a substituted or unsubstituted C₆-C₆₀ aryloxy group, a substituted or unsubstituted C₆-C₆₀ arylthio group, and a substituted or unsubstituted monovalent non-aromatic condensed polycyclic group,

[0036] L may be selected from a substituted or unsubstituted C_6 - C_{60} arylene group and a substituted or unsubstituted divalent non-aromatic condensed polycyclic group,

[0037] A may be a moiety selected from Formula 2a and 2b:



2a



2b

[0038] l may be an integer selected from 1 to 4;

[0039] m may be an integer selected from 0 to 3;

[0040] n may be an integer selected from 1 to 6;

[0041] o may be an integer selected from 1 to 4; and

[0042] at least one substituent of the substituted C_1 - C_{60} alkyl group, substituted C_2 - C_{60} alkenyl group, substituted C_2 - C_{60} alkynyl group, substituted C_1 - C_{60} alkoxy group, substituted C_3 - C_{10} cycloalkyl group, substituted C_2 - C_{10} heterocycloalkyl group, substituted C_3 - C_{10} cycloalkenyl group, substituted C_2 - C_{10} heterocycloalkenyl group, substituted C_6 - C_{60} aryl group, substituted C_6 - C_{60} arylene group, substituted C_6 - C_{60} aryloxy group, substituted C_6 - C_{60} arylthio group, substituted monovalent non-aromatic condensed polycyclic group, and substituted divalent non-aromatic condensed polycyclic group may be selected from:

[0043] deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, $Si(Q_1)(Q_2)(Q_3)$, $P(=O)(Q_4)(Q_5)$, a C_1 - C_{60} alkyl group, a C_2 - C_{60} alkenyl group, a C_2 - C_{60} alkynyl group, and a C_1 - C_{60} alkoxy group;

[0044] a C_1 - C_{60} alkyl group, a C_2 - C_{60} alkenyl group, a C_2 - C_{60} alkynyl group, and a C_1 - C_{60} alkoxy group, each substituted with at least one selected from deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_3 - C_{10} cycloalkyl group, a C_2 - C_{10} heterocycloalkyl group, a C_3 - C_{10} cycloalkenyl group, a C_2 - C_{10} heterocycloalkenyl group, a C_6 - C_{60} aryl group, a C_6 - C_{60} aryloxy group, a C_6 - C_{60} arylthio group (arylthio), a monovalent non-aromatic condensed polycyclic group, $-N(Q_{11})(Q_{12})$, $-Si(Q_{13})(Q_{14})(Q_{15})$, and $-B(Q_{16})(Q_{17})$;

[0045] a C_3 - C_{10} cycloalkyl group, a C_2 - C_{10} heterocycloalkyl group, a C_3 - C_{10} cycloalkenyl group, a C_2 - C_{10} heterocycloalkenyl group, a C_6 - C_{60} aryl group, a C_6 - C_{60} aryloxy group, a C_6 - C_{60} arylthio group, and a monovalent non-aromatic condensed polycyclic group; and

[0046] a C_3 - C_{10} cycloalkyl group, a C_2 - C_{10} heterocycloalkyl group, a C_3 - C_{10} cycloalkenyl group, a C_2 - C_{10} heterocycloalkenyl group, a C_6 - C_{60} aryl group, a C_6 - C_{60} aryloxy group, a C_6 - C_{60} arylthio group, and a monovalent non-aromatic condensed polycyclic group, each substituted with at least one selected from deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1 - C_{60} alkyl group, a C_2 - C_{60} alkenyl group, a C_2 - C_{60} alkynyl group, a C_1 - C_{60} alkoxy group, a C_3 - C_{10} cycloalkyl group, a C_2 - C_{10} heterocycloalkyl group, a C_3 - C_{10} cycloalkenyl group, a C_2 - C_{10} heterocycloalkenyl group, a C_6 - C_{60} aryl group, a C_6 - C_{60} aryloxy group, a C_6 - C_{60} arylthio group, a monovalent non-aromatic condensed polycyclic group, $-N(Q_{21})(Q_{22})$, $-Si(Q_{23})(Q_{24})(Q_{25})$, and $-B(Q_{26})(Q_{27})$,

[0047] wherein Q_1 to Q_5 , Q_{11} to Q_{17} , and Q_{21} to Q_{27} may each independently be selected from hydrogen, deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1 - C_{60} alkyl group, a C_2 - C_{60} alkenyl group, a C_2 - C_{60} alkynyl group, a C_1 - C_{60} alkoxy group, a C_3 - C_{10} cycloalkyl group, a C_2 - C_{10} heterocycloalkyl group, a C_3 - C_{10} cycloalkenyl group, a C_2 - C_{10} heterocycloalkenyl group, a C_6 - C_{60} aryl group, and a monovalent non-aromatic condensed polycyclic group.

[0048] FIG. 2 is a graph of efficiency with respect to grey level of an organic light-emitting device of the related art.

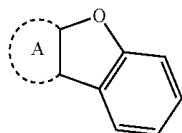
[0049] Referring to the efficiency curve with respect to grey level of an organic light-emitting device of the related art, as shown in FIG. 2, the efficiency in a low-grey level region (e.g., 0 to 80 grey) is lowered up to 40%. Also, the decrease in efficiency is not constant, which may lead to deviation among display panels. This may cause color change and stain in the low luminance region, making it difficult to produce high-quality organic light-emitting devices.

[0050] However, these problems may be overcome by using the compound of Formula 1 according to an embodiment of the present disclosure.

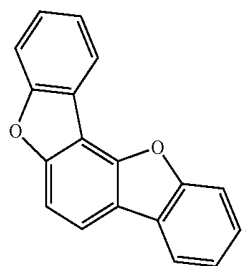
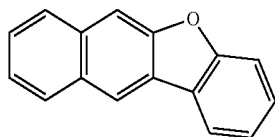
[0051] For example, the compound of Formula 1 according to an embodiment of the present disclosure may be used alone in a buffer layer between an electron transport layer and an emission layer, and/or used together with a dopant in the buffer layer.

[0052] Substituents of Formula 1 will now be described in more detail.

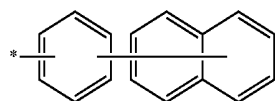
[0053] In some embodiments, the



moiety in Formula 1 may be selected from Formula 3a and Formula 3b:

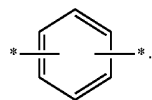


[0054] In some embodiments, R_1 in Formula 1 may be Formula 4a below:



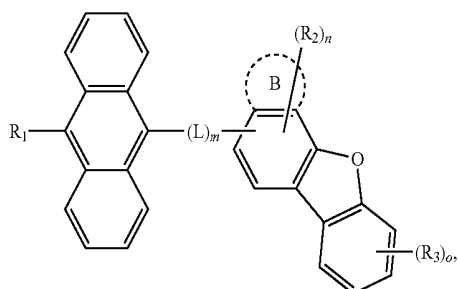
[0055] In Formula 4a, * indicates a binding site.

[0056] In some embodiments, L in Formula 1 may be Formula 5a below:



[0057] In Formula 5a, * indicates a binding site.

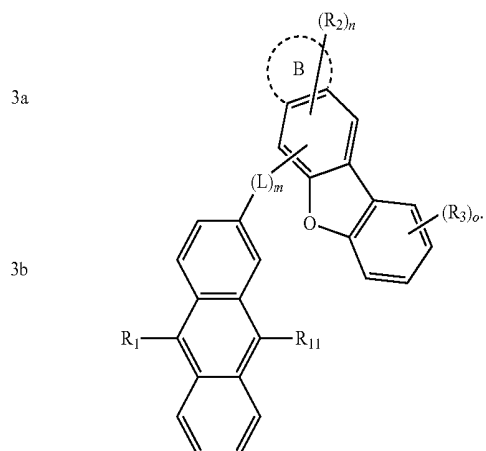
[0058] In some embodiments, Formula 1 may be further represented by Formula 2 or 3 below:



Formula 2

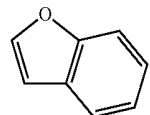
-continued

Formula 3



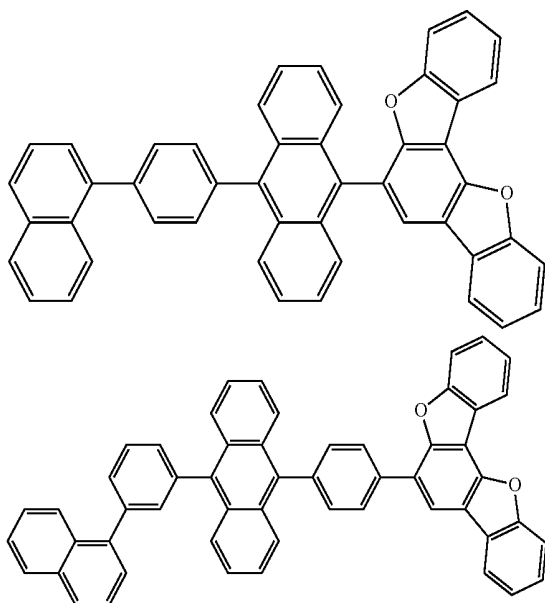
[0059] In Formulae 2 and 3, R_{11} may be the same as described earlier herein in connection with R_1 , and

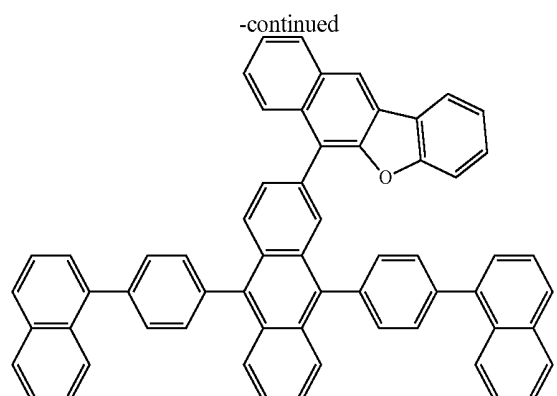
[0060] B may be a moiety selected from Formula 6a and 6b:



[0061] Definitions of the remaining substituents and symbols may be the same as described earlier herein.

[0062] In some embodiments, the compound of Formula 1 may be one selected from compounds illustrated below:





[0063] As used herein, the term “organic layer” may refer to a single layer and/or a plurality of layers between the first electrode and the second electrode of an organic light-emitting device. The material included in the “organic layer” is not limited to being an organic material.

[0064] FIG. 1 is a schematic cross-sectional view of an organic light-emitting device 10 according to an embodiment of the present disclosure. The organic light-emitting device 10 includes a first electrode 110, an organic layer 150, and a second electrode 190.

[0065] Hereinafter, the structure of an organic light-emitting device according to an embodiment and a method of manufacturing an organic light-emitting device according to an embodiment of the present disclosure will be described in connection with FIG. 1.

[0066] In FIG. 1, a substrate may be under the first electrode 110 or above the second electrode 190. The substrate may be a glass substrate and/or transparent plastic substrate, each with excellent mechanical strength, thermal stability, transparency, surface smoothness, ease of handling, and/or water-resistance.

[0067] The first electrode 110 may be formed by depositing and/or sputtering a material for forming the first electrode 110 on the substrate. When the first electrode 110 is an anode, the material for the first electrode 110 may be selected from materials with a high work function to facilitate hole injection. The first electrode 110 may be a reflective electrode, a semi-transmissive electrode, and/or a transmissive electrode. The material for the first electrode 110 may be a transparent and highly conductive material, and non-limiting examples of such a material may include indium tin oxide (ITO), indium zinc oxide (IZO), tin oxide (SnO₂), and zinc oxide (ZnO). When the first electrode 110 is a semi-transmissive electrode and/or a reflective electrode, at least one selected from magnesium (Mg), aluminum (Al), aluminum-lithium (Al—Li), calcium (Ca), magnesium-indium (Mg—In), and magnesium-silver (Mg—Ag) may be used as a material for forming the first electrode 110.

[0068] The first electrode 110 may have a single-layer structure and/or a multi-layer structure including two or more layers. For example, the first electrode 110 may have a three-layered structure of ITO/Ag/ITO, but the structure of the first electrode 110 is not limited thereto.

[0069] The organic layer 150 is on the first electrode 110. The organic layer 150 may include an emission layer.

[0070] The organic layer 150 may further include a hole transport region between the first electrode and the emission layer, and/or an electron transport region between the emission layer and the second electrode.

[0071] The hole transport region may include at least one selected from a hole transport layer (HTL), a hole injection layer (HIL), and an electron blocking layer, and the electron transport region may include a buffer layer, and at least one selected from an electron transport layer (ETL) and an electron injection layer (EIL). However, the structures of the hole transport region and the electron transport region are not limited thereto.

[0072] The hole transport region may have a single-layered structure formed of a single material, a single-layered structure formed of a plurality of different materials, and/or a multi-layered structure having a plurality of layers formed of a plurality of different materials.

[0073] For example, the hole transport region may have a single-layered structure formed of a plurality of different materials, a structure of hole injection layer/hole transport layer, and/or a structure of hole injection layer/hole transport layer/electron blocking layer, wherein layers of each structure are sequentially stacked on the first electrode 110 in this stated order. However, the structure of the hole transport region is not limited thereto.

[0074] When the hole transport region includes a hole injection layer, the hole injection layer may be formed on the first electrode 110 using one or more suitable methods selected from vacuum deposition, spin coating, casting, a Langmuir-Blodgett (LB) method, ink-jet printing, laser-printing, and laser-induced thermal imaging.

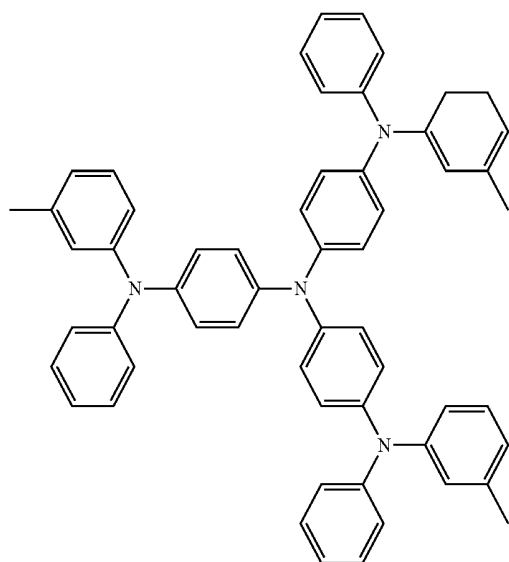
[0075] When a hole injection layer is formed by vacuum deposition, for example, the vacuum deposition may be performed at a temperature of a deposition temperature of about 100 to about 500° C., at a vacuum degree of about 10⁻⁸ to about 10⁻³ torr, and at a deposition rate of about 0.01 to about 100 Å/sec, depending on the compound to be deposited and the structure to be formed.

[0076] When a hole injection layer is formed by spin coating, the spin coating may be performed at a coating rate of about 2000 rpm to about 5000 rpm, and at a temperature of about 80° C. to 200° C., depending on the compound to be deposited and the structure to be formed.

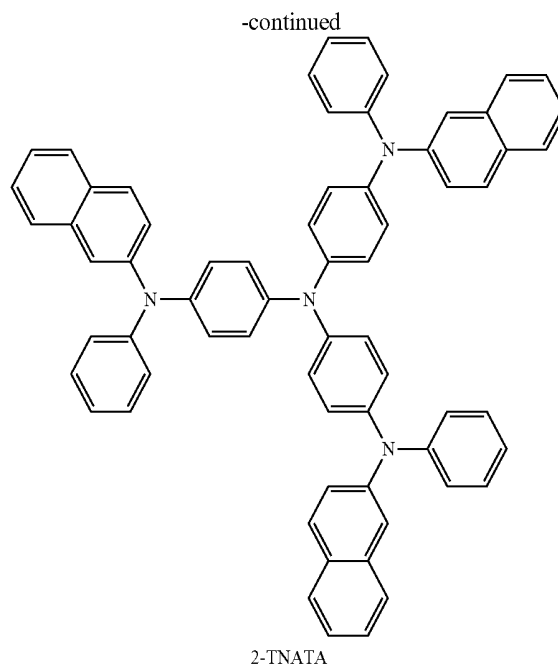
[0077] When the hole transport region includes a hole transport layer, the hole transport layer may be formed on the first electrode 110 and/or the hole injection layer using one or more suitable methods selected from vacuum deposition, spin coating, casting, an LB method, ink-jet printing, laser-printing, and laser-induced thermal imaging. When the hole transport layer is formed by vacuum deposition and/or spin coating, the deposition and coating conditions used for the hole transport layer may be substantially the same as the deposition and coating conditions used for the hole injection layer.

[0078] The hole transport region may include at least one selected from m-MTDATA, TDATA, 2-TNATA, NPB, β-NPB, TPD, Spiro-TPD, Spiro-NPB, α-NPB, TAPC, HMTDP, 4,4',4''-tris(N-carbazolyl)triphenylamine (TCTA), polyaniline/dodecylbenzenesulfonic acid (PANI/DBSA), poly(3,4-ethylenedioxythiophene)/poly(4-styrenesulfonate)

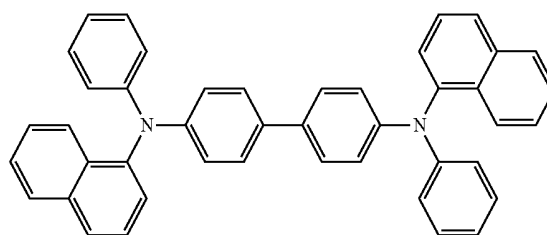
(PEDOT/PSS), polyaniline/camphor sulfonic acid (PANI/CSA), (polyaniline)/poly(4-styrenesulfonate) (PANI/PSS), a compound represented by Formula 201 below, and a compound represented by Formula 202 below:



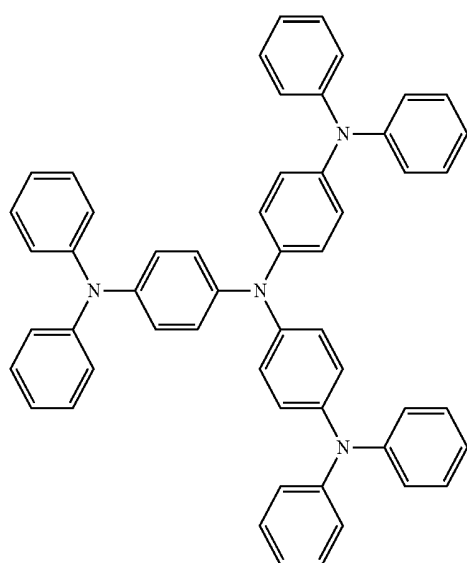
m-MTDATA



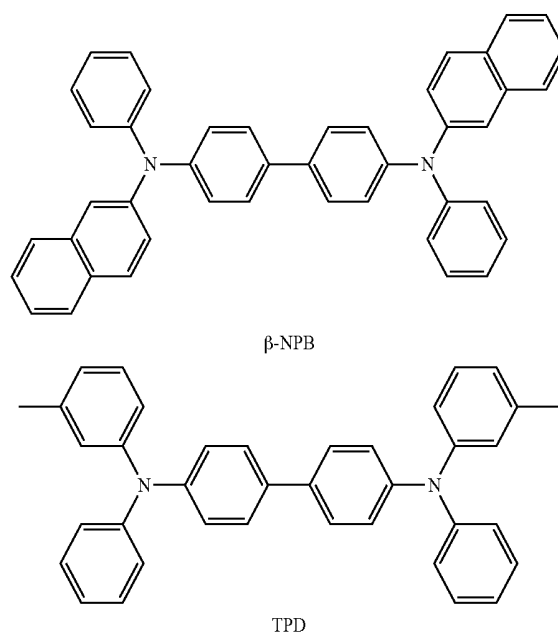
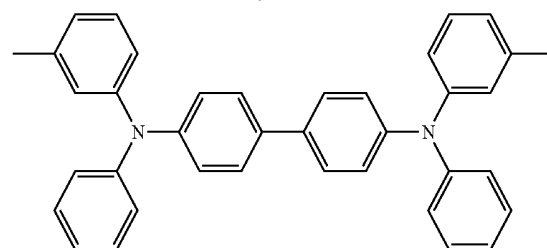
2-TNATA



NPB

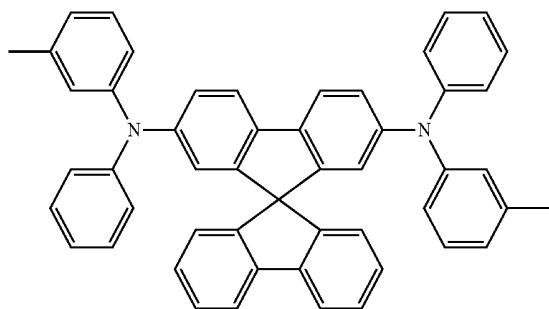


TDATA

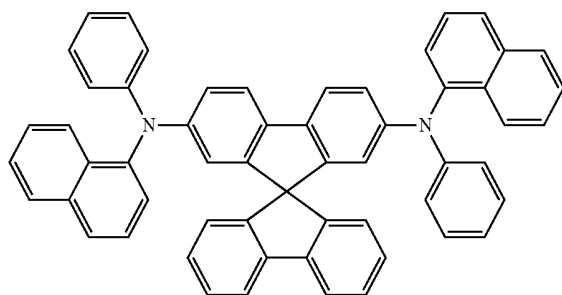
 β -NPB

TPD

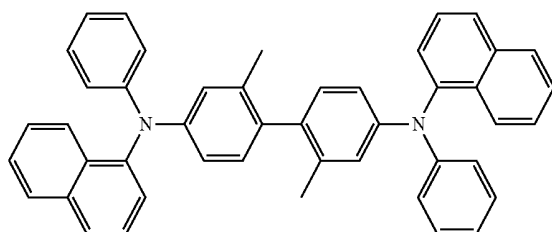
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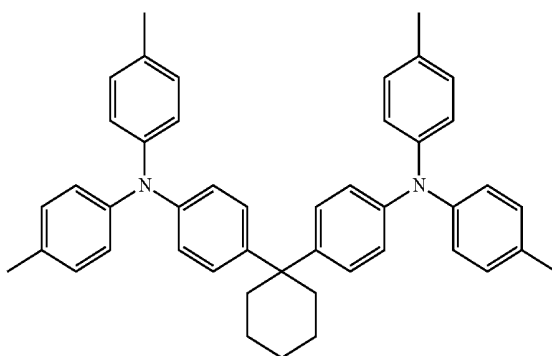
Spiro-TPD



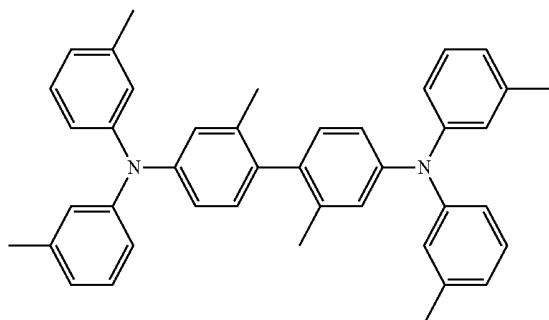
Spiro-NPD



methylated NPB

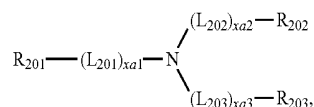


TAPC

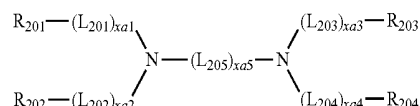


HMTPD

-continued



Formula 201



Formula 202

[0079] In Formulae 201 and 202,

[0080] L_{201} to L_{205} may each independently be selected from a substituted or unsubstituted $\text{C}_6\text{-C}_{60}$ arylene group, a substituted or unsubstituted $\text{C}_1\text{-C}_{60}$ heteroarylene group, a substituted or unsubstituted divalent non-aromatic condensed polycyclic group, and a substituted or unsubstituted divalent non-aromatic condensed heteropolycyclic group,

[0081] xa1 to xa4 may each independently be selected from 0, 1, 2, and 3,

[0082] xa5 may be selected from 1, 2, 3, 4, and 5, and

[0083] R_{201} to R_{204} may each independently be selected from a substituted or unsubstituted $\text{C}_3\text{-C}_{10}$ cycloalkyl group, a substituted or unsubstituted $\text{C}_2\text{-C}_{10}$ heterocycloalkyl group, a substituted or unsubstituted $\text{C}_3\text{-C}_{10}$ cycloalkenyl group, a substituted or unsubstituted $\text{C}_2\text{-C}_{10}$ heterocycloalkenyl group, a substituted or unsubstituted $\text{C}_6\text{-C}_{60}$ aryl group, a substituted or unsubstituted $\text{C}_6\text{-C}_{60}$ aryloxy group, a substituted or unsubstituted $\text{C}_6\text{-C}_{60}$ arylthio group, a substituted or unsubstituted $\text{C}_1\text{-C}_{60}$ heteroaryl group, a substituted or unsubstituted monovalent non-aromatic condensed polycyclic group, and a substituted or unsubstituted monovalent non-aromatic condensed heteropolycyclic group.

[0084] For example, in Formulae 201 and 202,

[0085] L_{201} to L_{205} may each independently be selected from:

[0086] a phenylene group, a naphthylene group, a fluorenylene group, a spiro-fluorenylene group, a benzofluorene group, a dibenzofluorene group, a phenanthrenylene group, an anthracenylene group, a pyrenylene group, a chrysenylene group, a pyridinylene group, a pyrazinylene group, a pyrimidinylene group, a pyridazinylene group, a quinolinylene group, an isoquinolinylene group, a quinoxalinylene group, a quinazolinylene group, a carbazolinylene group, and a triazinylene group; and

[0087] a phenylene group, a naphthylene group, a fluorenylene group, a spiro-fluorenylene group, a benzofluorene group, a dibenzofluorene group, a phenanthrenylene group, an anthracenylene group, a pyrenylene group, a chrysenylene group, a pyridinylene group, a pyrazinylene group, a pyrimidinylene group, a pyridazinylene group, a quinolinylene group, an isoquinolinylene group, a quinoxalinylene group, a quinazolinylene group, a carbazolinylene group, and a triazinylene group, each substituted with at least one selected from deuterium, $-\text{F}$, $-\text{Cl}$, $-\text{Br}$, $-\text{I}$, a hydroxyl group, a cyano group, a nitro group, an amino group, an imidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a $\text{C}_1\text{-C}_{20}$ alkyl group, a $\text{C}_1\text{-C}_{20}$ alkoxy group, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzo-fluorenyl group, a dibenzofluorenyl group, a phenanthrenyl

group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, a quinoliny group, an isoquinoliny group, a quinoxaliny group, a quinazoliny group, a carbazolyl group, and a triazinyl group,

[0088] x_{a1} to x_{a4} may each independently be 0, 1, or 2,

[0089] x_{a5} may be 1, 2, or 3,

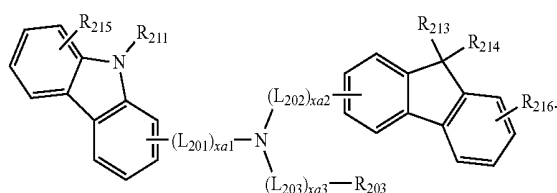
[0090] R_{201} to R_{204} may each independently be selected from:

[0091] a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinoliny group, an isoquinoliny group, a quinoxaliny group, a quinazoliny group, a carbazolyl group, and a triazinyl group; and

[0092] a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinoliny group, an isoquinoliny group, a quinoxaliny group, a quinazoliny group, a carbazolyl group, and a triazinyl group, each substituted with at least one selected from deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1 - C_{20} alkyl group, a C_1 - C_{20} alkoxy group, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, an azuleny group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinoliny group, an isoquinoliny group, a quinoxaliny group, a carbazolyl group, and a triazinyl group, but embodiments of the present disclosure are not limited thereto.

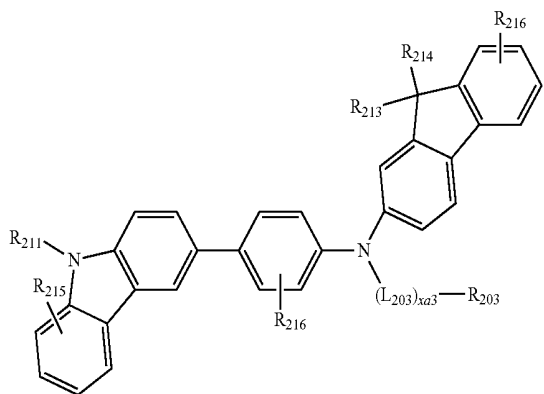
[0093] The compound represented by Formula 201 may be further represented by Formula 201A:

Formula 201A



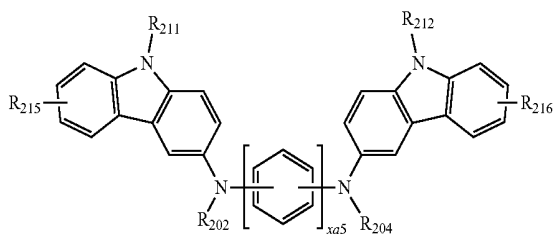
[0094] For example, the compound represented by Formula 201 may be further represented by Formula 201A-1 below, but embodiments of the present disclosure are not limited thereto:

Formula 201A-1



[0095] For example, the compound represented by Formula 202 may be further represented by Formula 202A below, but embodiments of the present disclosure are not limited thereto:

Formula 202A



[0096] In Formulae 201A, 201A-1, and 202A, L_{201} to L_{203} , x_{a1} to x_{a3} , x_{a5} , and R_{202} to R_{204} may be the same as described earlier herein, R_{211} may be the same as described herein in connection with R_{203} , and R_{213} to R_{216} may each independently be selected from hydrogen, deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1 - C_{60} alkyl group, a C_2 - C_{60} alkenyl group, a C_2 - C_{60} alkynyl group, a C_1 - C_{60} alkoxy group, a C_3 - C_{10} cycloalkyl group, a C_2 - C_{10} heterocycloalkyl group, a C_3 - C_{10} cycloalkenyl group, a C_2 - C_{10} heterocycloalkenyl group, a C_6 - C_{60} aryl group, a C_6 - C_{60} aryloxy group, a C_6 - C_{60} arylthio group, a C_1 - C_{60} heteroaryl group, a monovalent non-aromatic condensed polycyclic group, and a monovalent non-aromatic condensed heteropolycyclic group.

[0097] For example, in Formulae 201A, 201A-1, and 202A,

[0098] L_{201} to L_{203} may each independently be selected from:

[0099] a phenylene group, a naphthylene group, a fluorenylene group, a spiro-fluorenylene group, a benzofluorenylene group, a dibenzofluorenylene group, a phenanthrenylene group, an anthracenylene group, a pyrenylene group, a chrysenylene group, a pyridinylene group, a pyrazinylene group, a pyrimidinylene group, a pyridazinylene group, a quinolinylene group, an isoquinolinylene group, a quinox-

group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, and a triazinyl group;

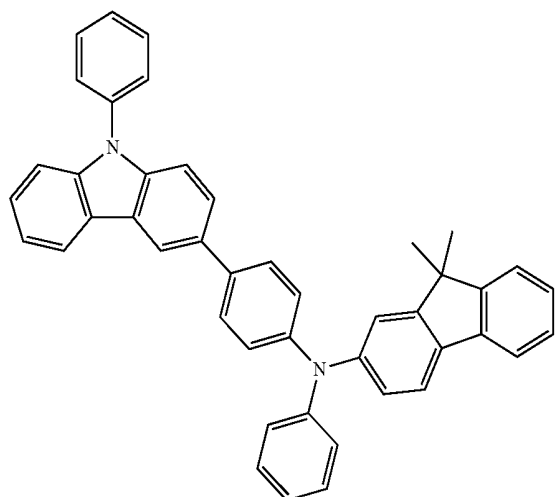
[0113] a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, and a triazinyl group; and

[0114] a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, and a triazinyl group, each substituted with at least one selected from deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1 - C_{20} alkyl group, a C_1 - C_{20} alkoxy group, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, and a triazinyl group, and

[0115] xa5 may be selected from land 2.

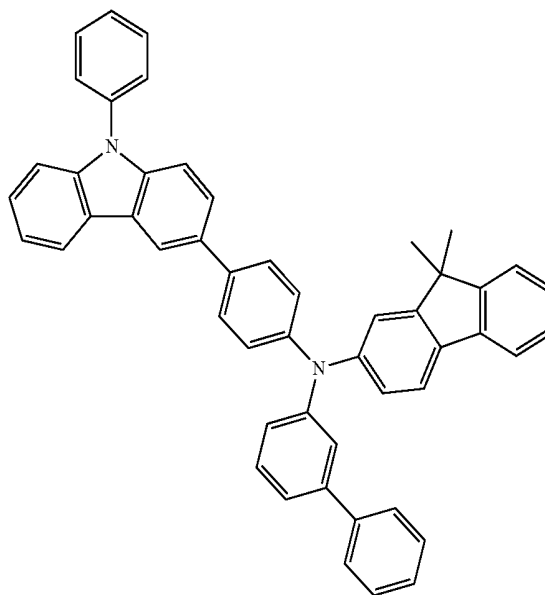
[0116] R_{213} and R_{214} in Formulae 201A and 201A-1 may be linked (e.g., coupled) to each other to form a saturated and/or unsaturated ring.

[0117] The compound represented by Formula 201 and the compound represented by Formula 202 may each include one selected from compounds HT1 to HT20 illustrated below, but embodiments of the present disclosure are not limited thereto:

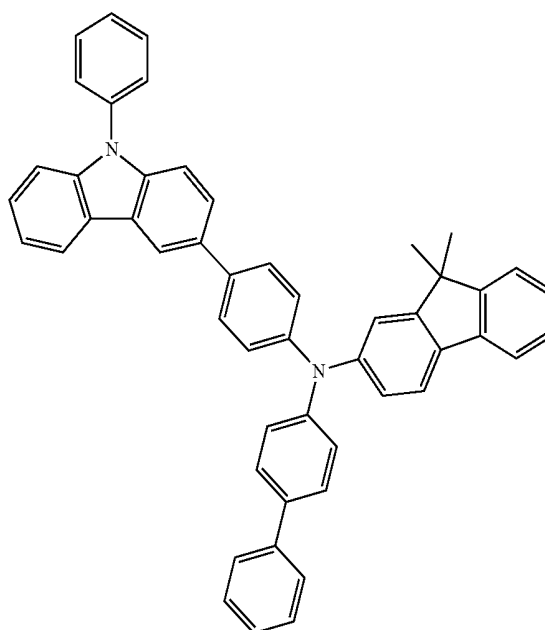


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HT2

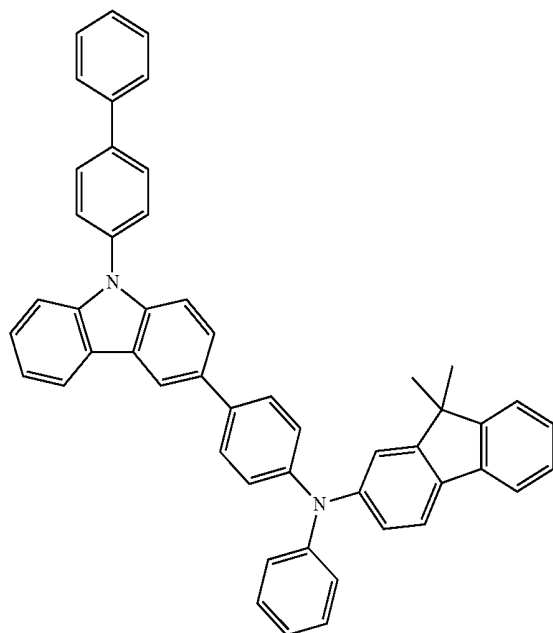


HT3



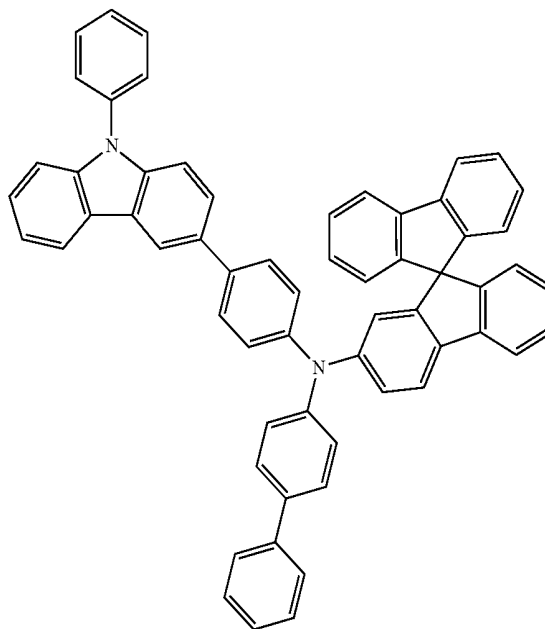
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HT4

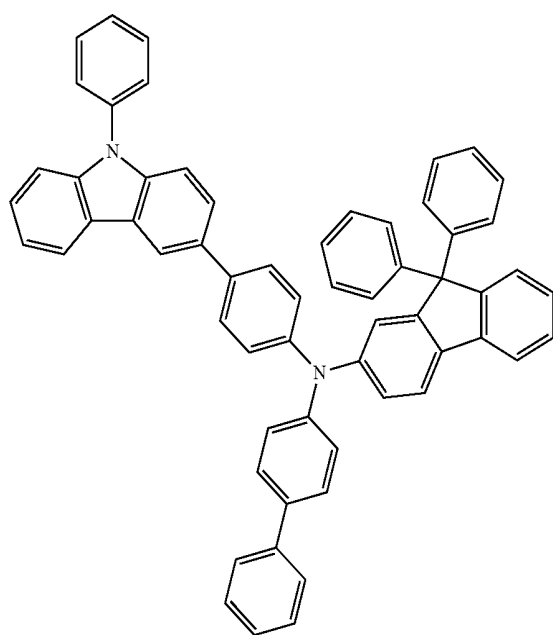


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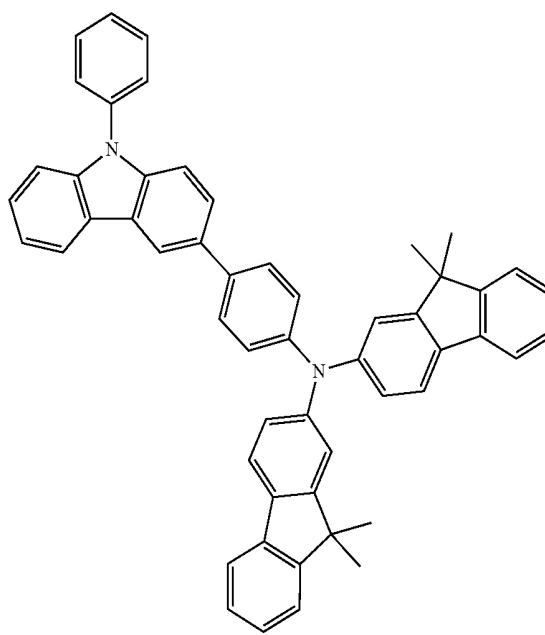
HT6



HT5

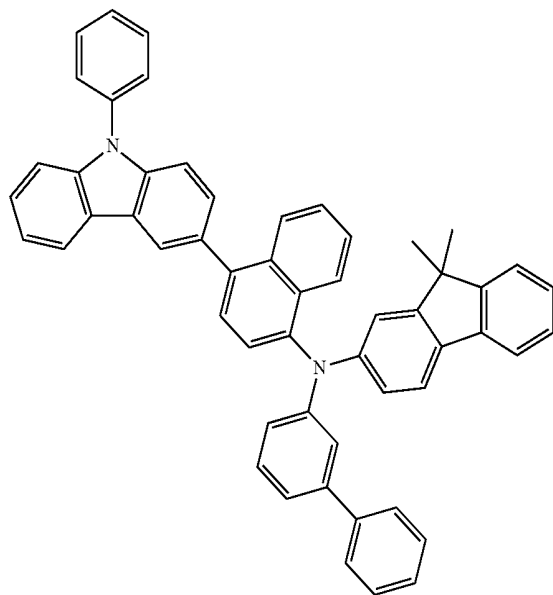


HT7



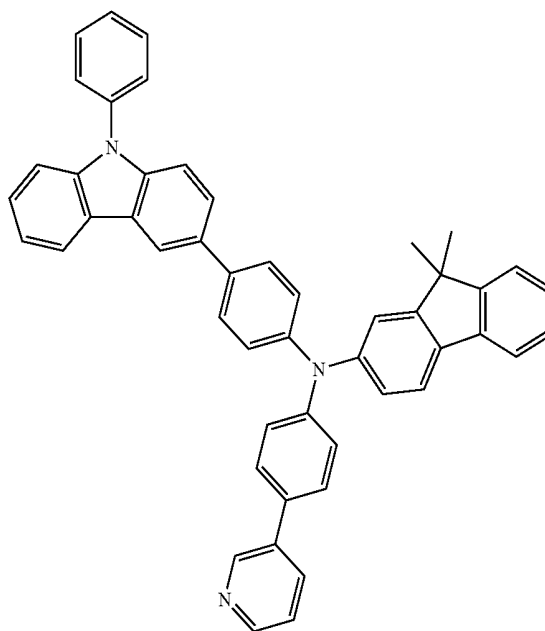
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HT8

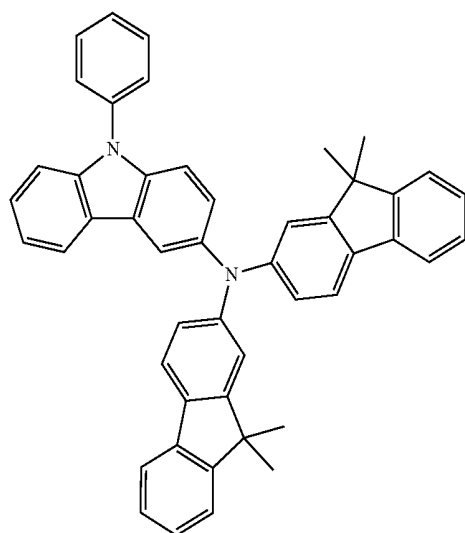


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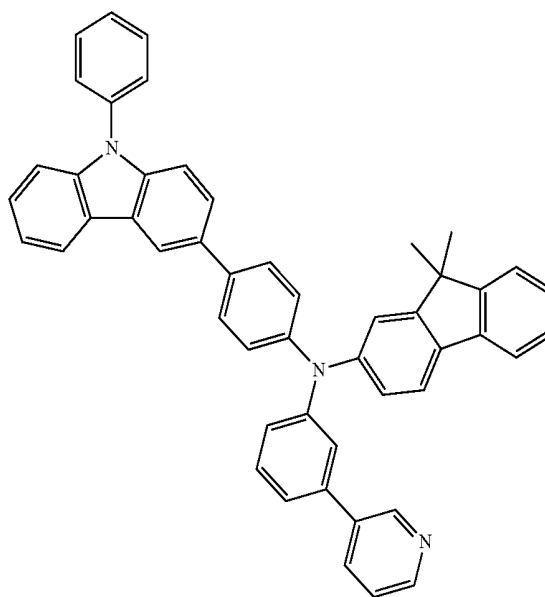
HT10



HT9

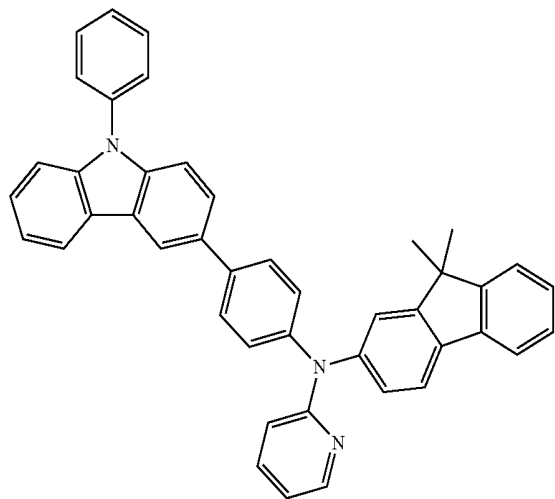


HT11



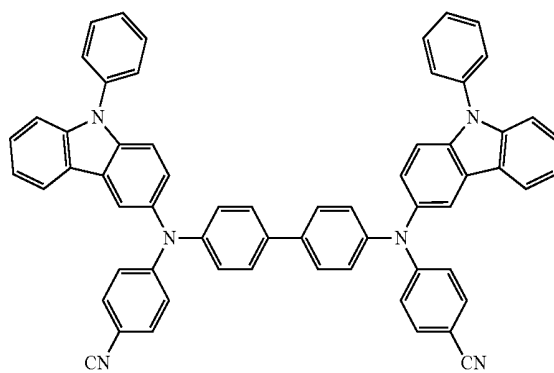
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HT12

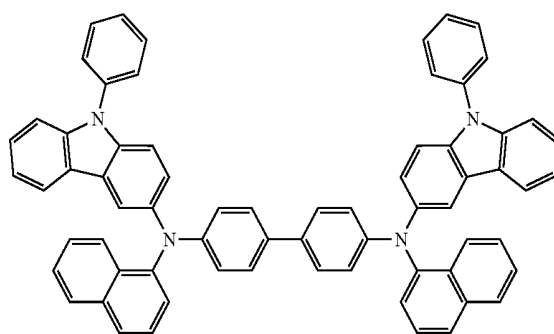


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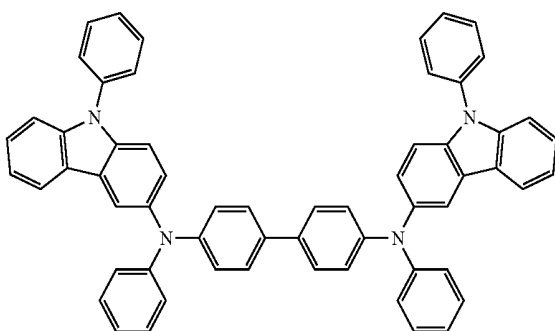
HT16



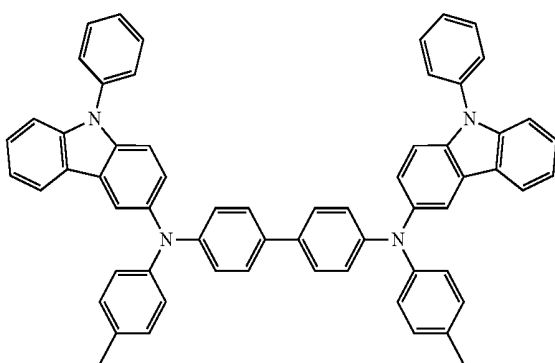
HT17



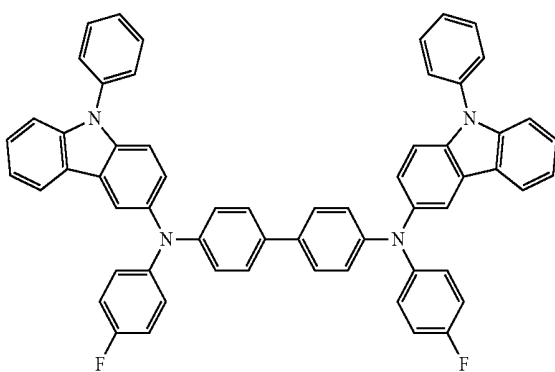
HT13



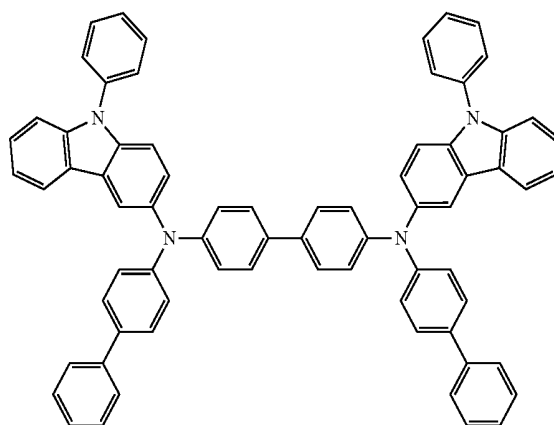
HT14



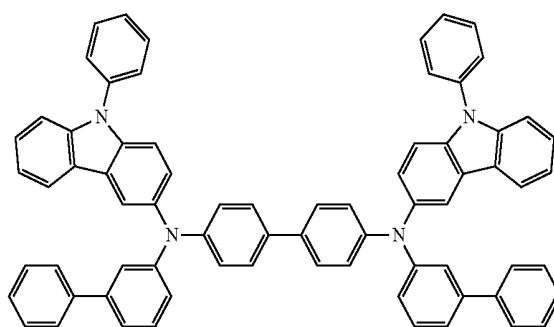
HT15



HT18

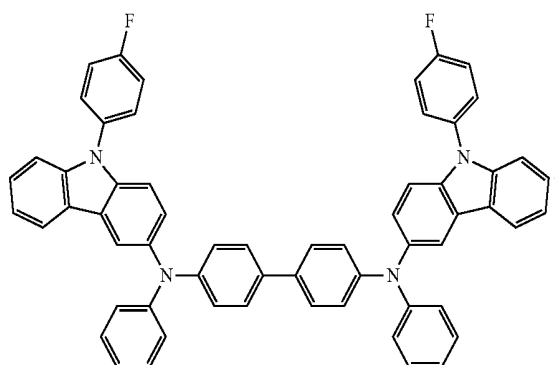


HT19



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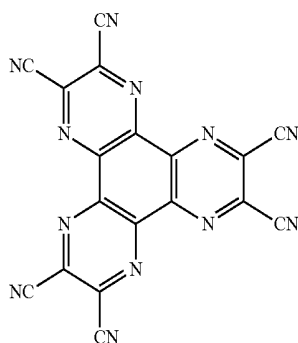
HT20



[0118] A thickness of the hole transport region may be about 100 Å to about 10,000 Å, and in some embodiments, about 100 Å to about 1,000 Å. When the hole transport region includes a hole injection layer and a hole transport layer, the thickness of the hole injection layer may be about 100 Å to about 10,000 Å, and in some embodiments, about 100 Å to about 1,000 Å; the thickness of the hole transport layer may be about 50 Å to about 2,000 Å, and in some embodiments, about 100 Å to about 1500 Å. When the thicknesses of the hole transport region, the hole injection layer, and the hole transport layer are within these ranges, satisfactory hole transporting characteristics may be obtained without a substantial increase in driving voltage.

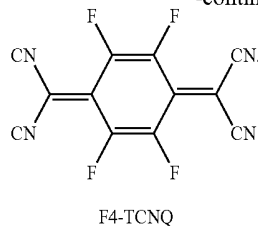
[0119] The hole transport region may further include a charge-generation material for the improvement of conductive properties. The charge-generation material may be homogeneously and/or inhomogeneously dispersed in the hole transport region.

[0120] The charge-generation material may be, for example, a p-dopant. The p-dopant may be one selected from a quinone derivative, a metal oxide, and a cyano group-containing compound, but embodiments of the present disclosure are not limited thereto. For example, non-limiting examples of the p-dopant may include a quinone derivative (such as tetracyanoquinonodimethane (TCNQ) and/or 2,3,5,6-tetrafluoro-tetracyano-1,4-benzoquinonodimethane (F4-TCNQ)); a metal oxide (such as a tungsten oxide and/or a molybdenum oxide), and Compound HT-D1 illustrated below:



Compound HT-D1

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F4-TCNQ

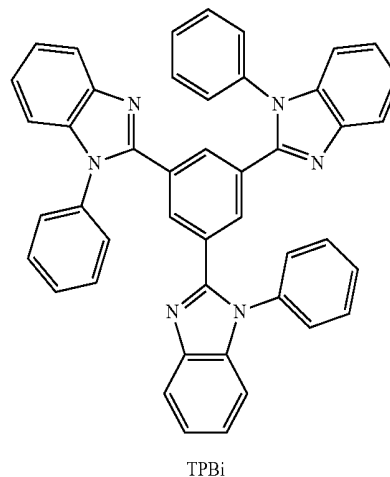
[0121] The hole transport region may further include a buffer layer in addition to an electron blocking layer, a hole injection layer, and/or a hole transport layer. Since the buffer layer may compensate for an optical resonance distance according to a wavelength of light emitted from the emission layer (e.g., be used to adjust the optical resonance distance to match the wavelength of light emitted from the emission layer), the light-emission efficiency of an organic light-emitting device may be improved. For use as a material included in the buffer layer, materials that are included in the hole transport region may be used. The electron blocking layer prevents or reduces injection of electrons from the electron transport region.

[0122] An emission layer may be formed on the first electrode 110 and/or the hole transport region using one or more suitable methods selected from vacuum deposition, spin coating, casting, an LB method, ink-jet printing, laser-printing, and laser-induced thermal imaging. When an emission layer is formed by vacuum deposition and/or spin coating, the deposition and coating conditions used for the emission layer may be substantially the same as those used for the hole injection layer.

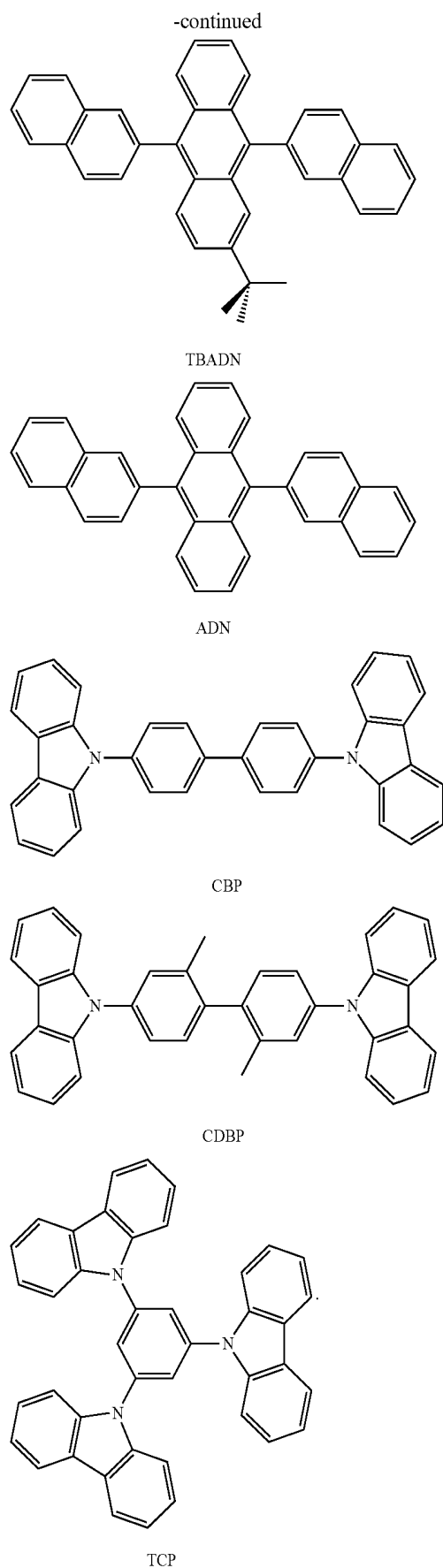
[0123] When the organic light-emitting device 10 is a full color organic light-emitting device, the emission layer may be patterned into a red emission layer, a green emission layer, and/or a blue emission layer, according to a sub-pixel. In some embodiments, the emission layer may have a stacked structure of a red emission layer, a green emission layer, and/or a blue emission layer, and/or may include a red-light emission material, a green-light emission material, and a blue-light emission material, which are mixed with each other in a single layer to emit white light.

[0124] The emission layer may include a host and/or a dopant.

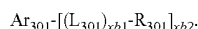
[0125] For example, the host may include at least one selected from TPBi, TBADN, ADN (also referred to as "DNA"), CBP, CDBP, and TCP:



TPBi



[0126] In some embodiments, the host may include a compound represented by Formula 301 below:



Formula 301

[0127] In Formula 301,

[0128] Ar_{301} may be selected from:

[0129] a naphthalene, a heptalene, a fluorene, a spiro-fluorene, a benzo-fluorene, a dibenzofluorene, a phenalene, a phenanthrene, an anthracene, a fluoranthene, a triphenylene, a pyrene, a chrysene, a naphthacene, a picene, a perylene, a pentaphene, and an indenoanthracene; and

[0130] a naphthalene, a heptalene, a fluorene, a spiro-fluorene, a benzo-fluorene, a dibenzofluorene, a phenalene, a phenanthrene, an anthracene, a fluoranthene, a triphenylene, a pyrene, a chrysene, a naphthacene, a picene, a perylene, a pentaphene, and an indenoanthracene, each substituted with at least one selected from deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an am idino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a $\text{C}_1\text{-C}_{60}$ alkyl group, a $\text{C}_2\text{-C}_{60}$ alkenyl group, a $\text{C}_2\text{-C}_{60}$ alkynyl group, a $\text{C}_1\text{-C}_{60}$ alkoxy group, a $\text{C}_3\text{-C}_{10}$ cycloalkyl group, a $\text{C}_2\text{-C}_{10}$ heterocycloalkyl group, a $\text{C}_3\text{-C}_{10}$ cycloalkenyl group, a $\text{C}_2\text{-C}_{10}$ heterocycloalkenyl group, a $\text{C}_6\text{-C}_{60}$ aryl group, a $\text{C}_6\text{-C}_{60}$ aryloxy group, a $\text{C}_6\text{-C}_{60}$ arylthio group, a $\text{C}_1\text{-C}_{60}$ heteroaryl group, a monovalent non-aromatic condensed polycyclic group, a monovalent non-aromatic condensed heteropolycyclic group, and —Si(Q_{301})(Q_{302})(Q_{303}) (wherein Q_{301} to Q_{303} may each independently be selected from hydrogen, a $\text{C}_1\text{-C}_{60}$ alkyl group, a $\text{C}_2\text{-C}_{60}$ alkenyl group, a $\text{C}_6\text{-C}_{60}$ aryl group, and a $\text{C}_1\text{-C}_{60}$ heteroaryl group).

[0131] L_{301} may be selected from a phenylene group, a naphthylene group, a fluorenylene group, a spiro-fluorenylene group, a benzo-fluorenylene group, a dibenzofluorenylene group, a phenanthrenylene group, an anthracenylene group, a pyrenylene group, a chrysene group, a pyridinylene group, a pyrazinylene group, a pyrimidinylene group, a pyridazinylene group, a quinolinylene group, an isoquinolinylene group, a quinoxalinylene group, a quinazolinylene group, a carbazolinylene group, and a triazinylene group; and

[0132] a phenylene group, a naphthylene group, a fluorenylene group, a spiro-fluorenylene group, a benzo-fluorenylene group, a dibenzofluorenylene group, a phenanthrenylene group, an anthracenylene group, a pyrenylene group, a chrysene group, a pyridinylene group, a pyrazinylene group, a pyrimidinylene group, a pyridazinylene group, a quinolinylene group, an isoquinolinylene group, a quinoxalinylene group, a quinazolinylene group, a carbazolinylene group, and a triazinylene group, each substituted with at least one selected from deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an am idino group, a hydrazine group, a hydrazine group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a $\text{C}_1\text{-C}_{20}$ alkyl group, a $\text{C}_1\text{-C}_{20}$ alkoxy group, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzo-fluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, a quinolinyl

group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, and a triazinyl group,

[0133] R_{301} may be selected from:

[0134] a C_1 - C_{20} alkyl group and a C_1 - C_{20} alkoxy group;

[0135] a C_1 - C_{20} alkyl group and a C_1 - C_{20} alkoxy group, each substituted with at least one selected from deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzo-fluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, and a triazinyl group;

[0136] a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzo-fluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, and a triazinyl group; and

[0137] a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzo-fluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, and a triazinyl group, each substituted with at least one selected from deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1 - C_{20} alkyl group, a C_1 - C_{20} alkoxy group, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzo-fluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, and a triazinyl group,

[0138] x_{b1} may be selected from 0, 1, 2, and 3, and

[0139] x_{b2} may be selected from 1, 2, 3, and 4.

[0140] For example, in Formula 301,

[0141] L_{301} may be selected from a phenylene group, a naphthylene group, a fluorenylene group, a spiro-fluorenylene group, a benzo-fluorenylene group, a dibenzofluorenylene group, a phenanthrenylene group, an anthracenylene group, a pyrenylene group, and a chrysenylene group; and

[0142] a phenylene group, a naphthylene group, a fluorenylene group, a spiro-fluorenylene group, a benzo-fluorenylene group, a dibenzofluorenylene group, a phenanthrenylene group, an anthracenylene group, a pyrenylene group, and a chrysenylene group, each substituted with at least one selected from deuterium, —F, —Cl, —Br, —I, a hydroxyl

group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1 - C_{20} alkyl group, a C_1 - C_{20} alkoxy group, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzo-fluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, and a chrysenyl group, and

[0143] R_{301} may be selected from:

[0144] a C_1 - C_{20} alkyl group and a C_1 - C_{20} alkoxy group;

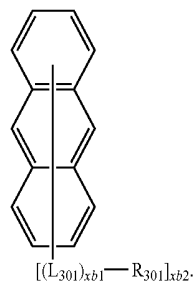
[0145] a C_1 - C_{20} alkyl group and a C_1 - C_{20} alkoxy group, each substituted with at least one selected from deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzo-fluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, and a chrysenyl group;

[0146] a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzo-fluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, and a chrysenyl group; and

[0147] a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzo-fluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, and a chrysenyl group, each substituted with at least one selected from deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1 - C_{20} alkyl group, a C_1 - C_{20} alkoxy group, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzo-fluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, and a chrysenyl group, but embodiments of the present disclosure are not limited thereto.

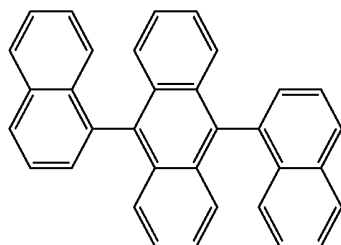
[0148] For example, the host may include a compound represented by Formula 301A below:

Formula 301A

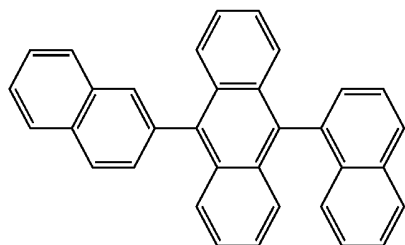


[0149] Descriptions of substituents of Formula 301A may be the same as provided earlier herein in connection with Formula 301.

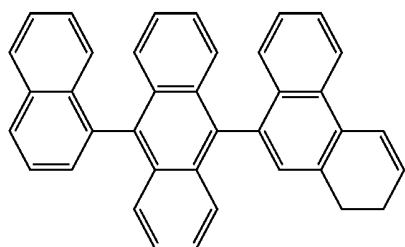
[0150] The compound represented by Formula 301 may include at least one selected from Compounds H1 to H42, but embodiments of the present disclosure are not limited thereto:



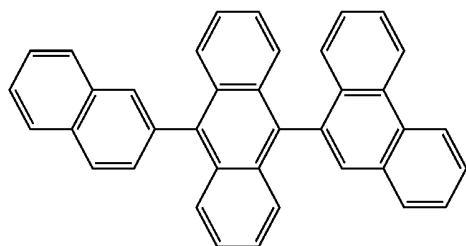
H1



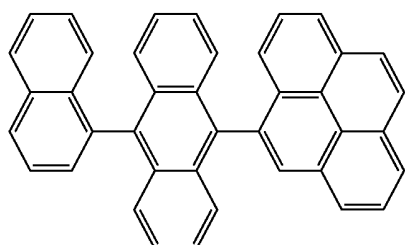
H2



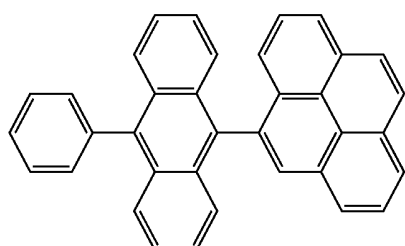
H3



H4

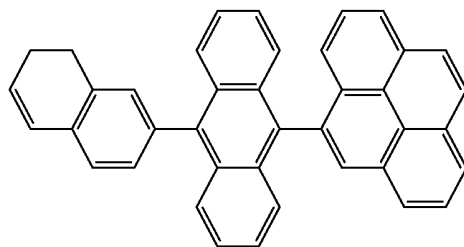


H5

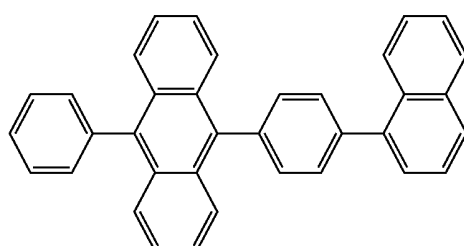


H6

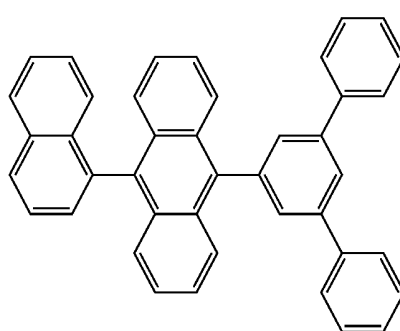
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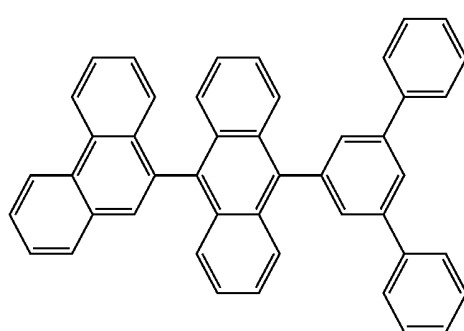
H7



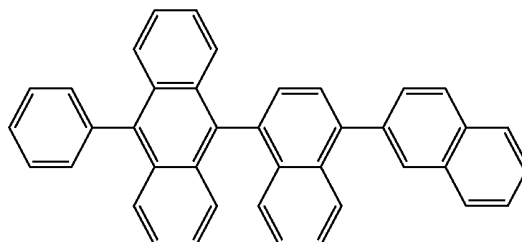
H8



H9

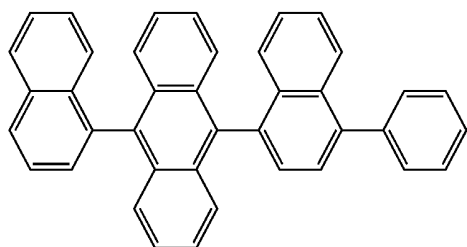


H10



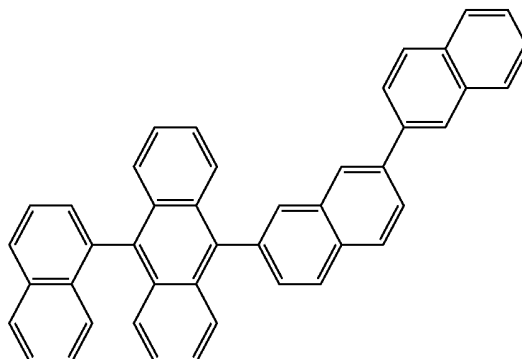
H11

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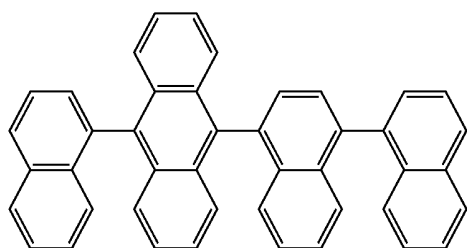


H12

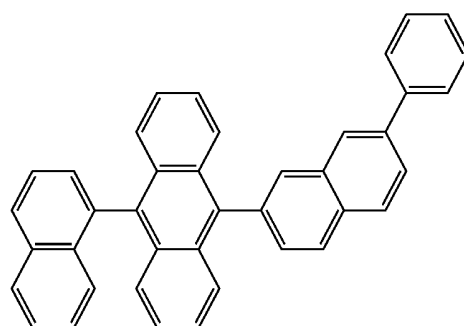
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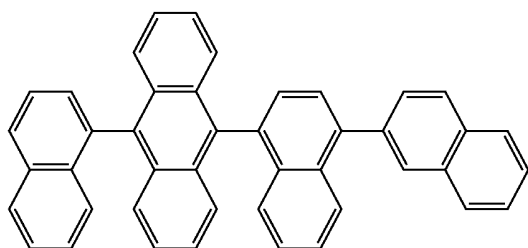
H17



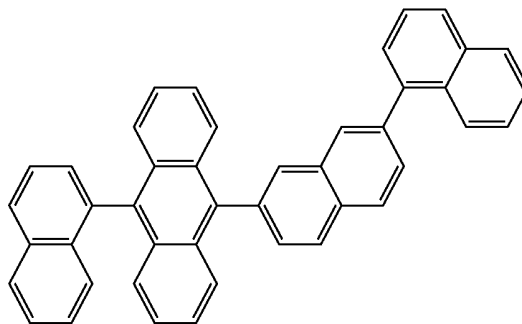
H13



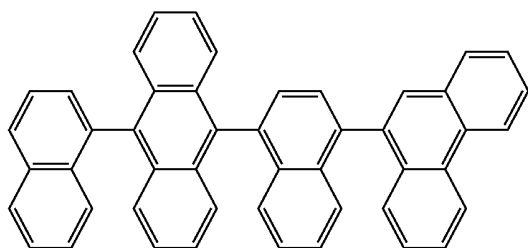
H18



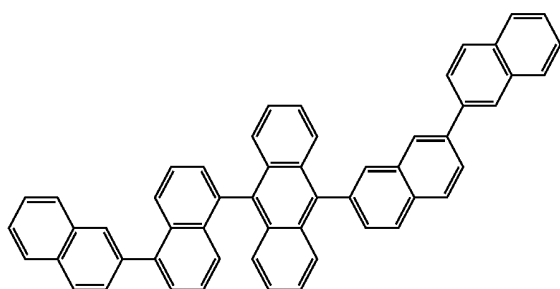
H14



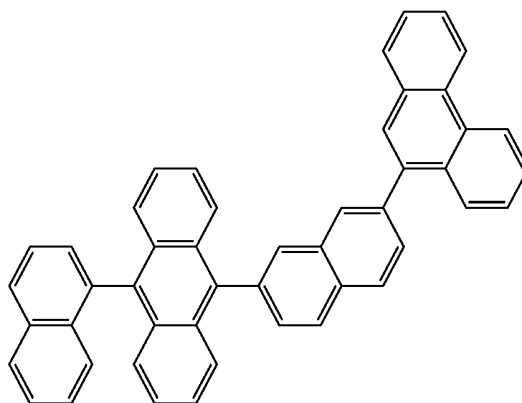
H19



H15

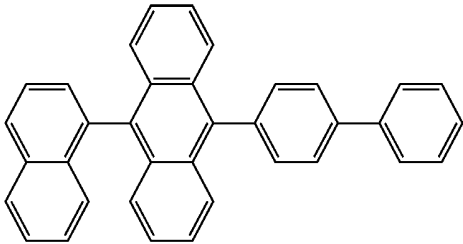


H16

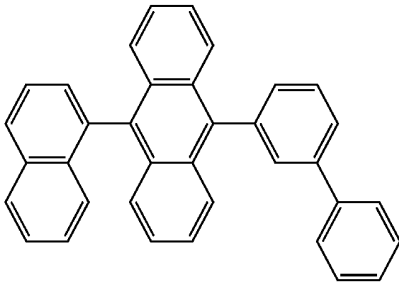


H20

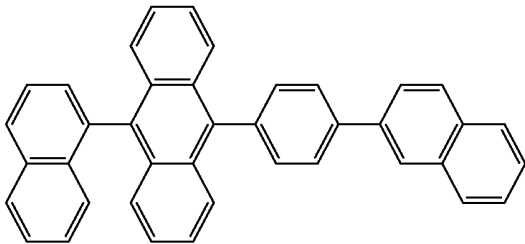
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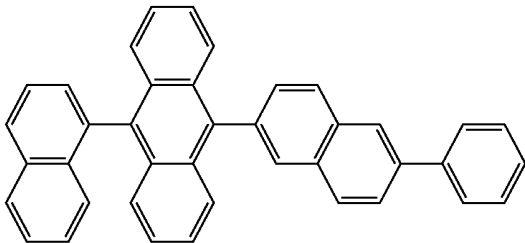
H21



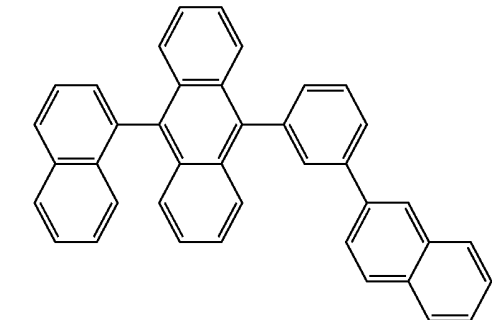
H22



H23

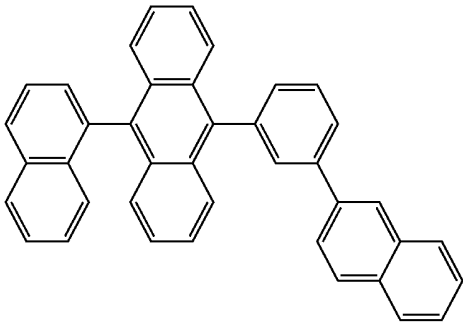


H24

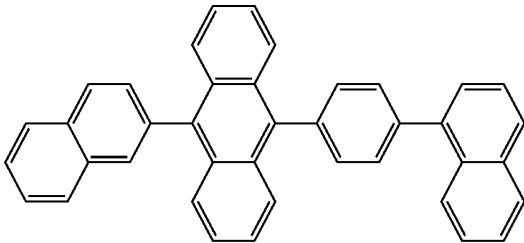


H25

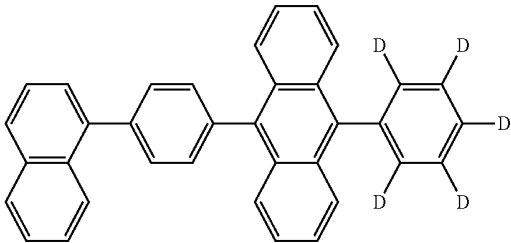
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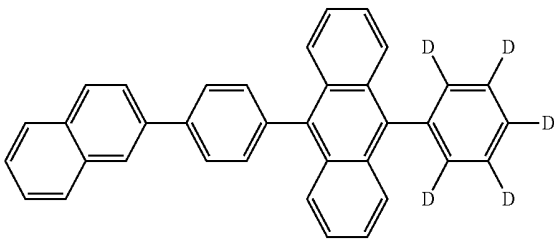
H26



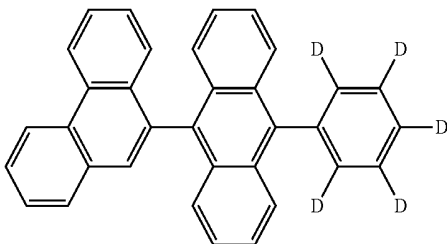
H27



H28



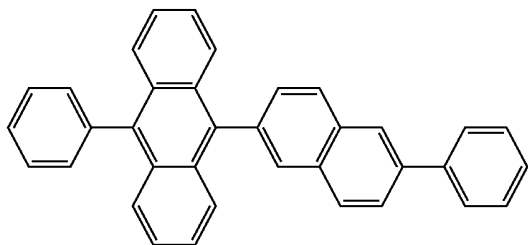
H29



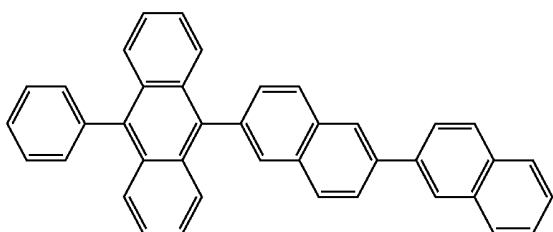
H30

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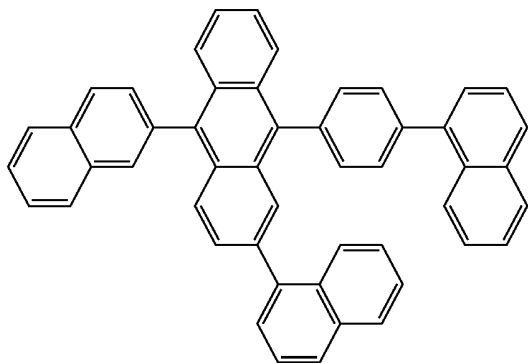
H31



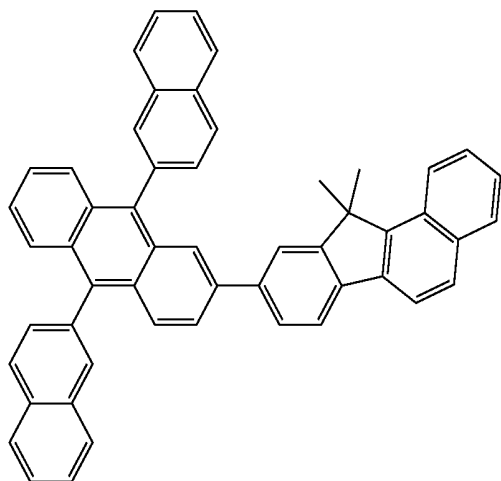
H32



H33

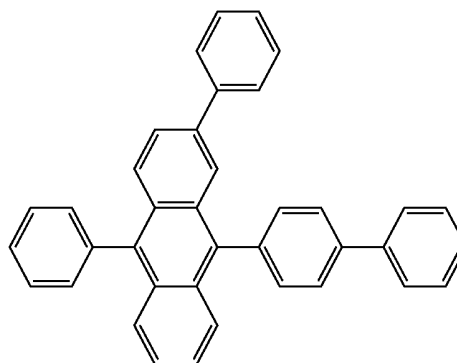


H34

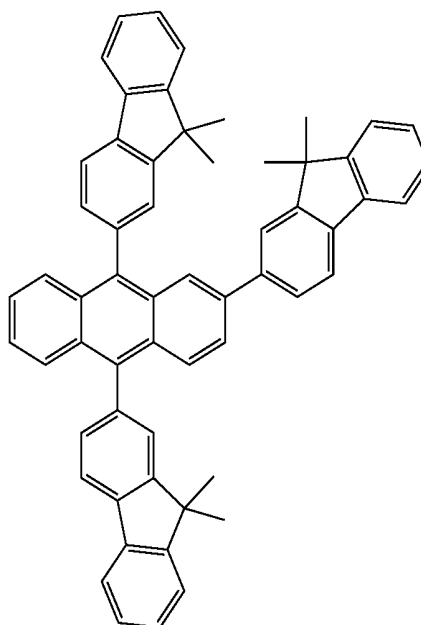


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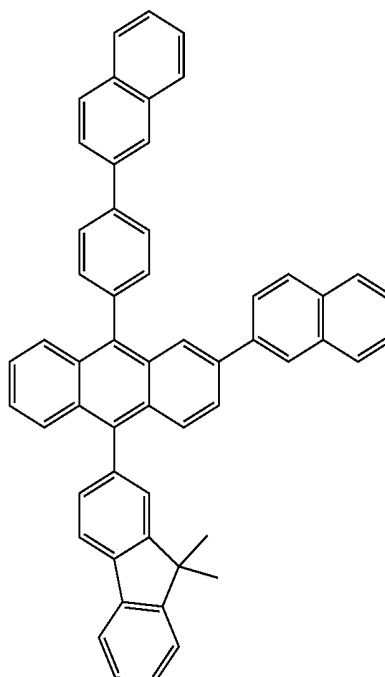
H35



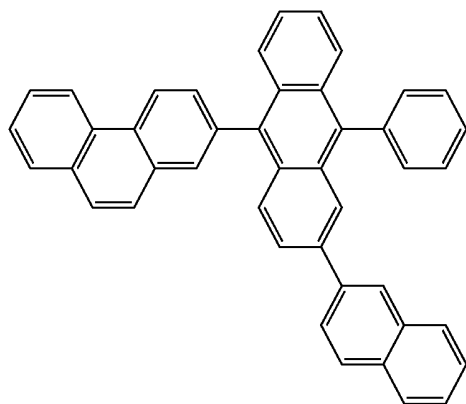
H36



H37

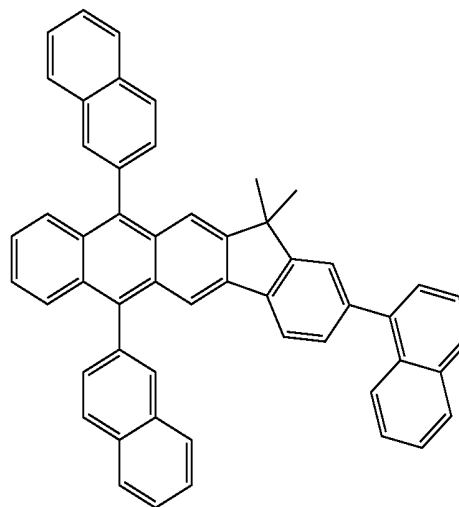


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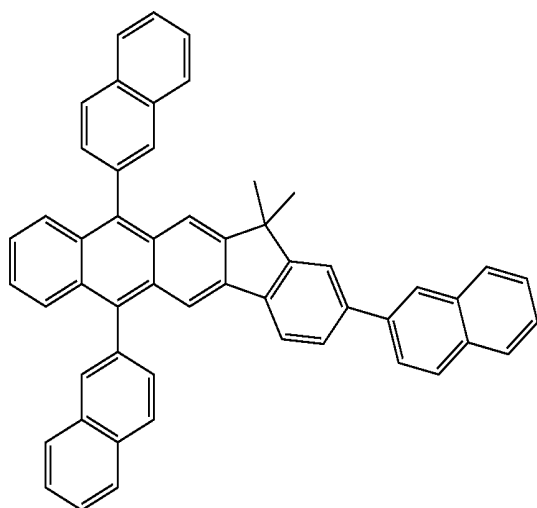
H38

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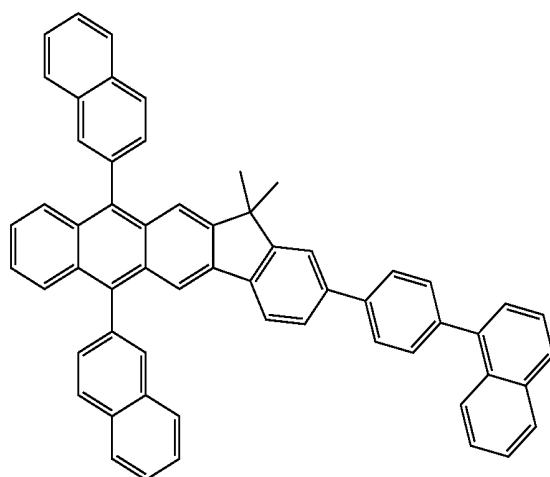


H41

H39

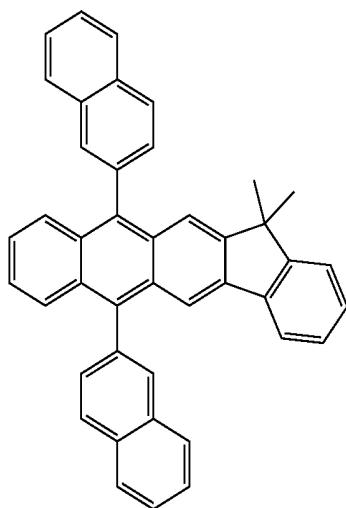


H42

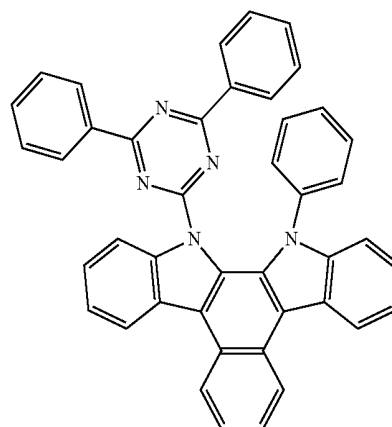


[0151] In some embodiments, the host may include at least one selected from Compounds H43 to H49 below, but embodiments of the present disclosure are not limited thereto:

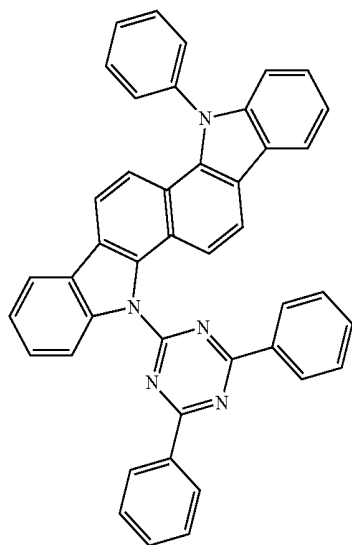
H40



H43

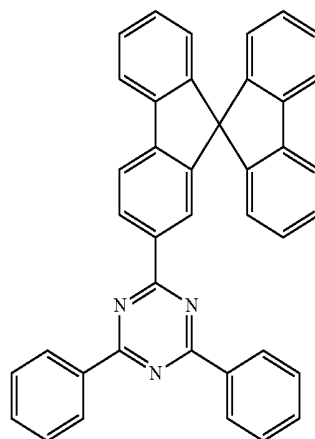


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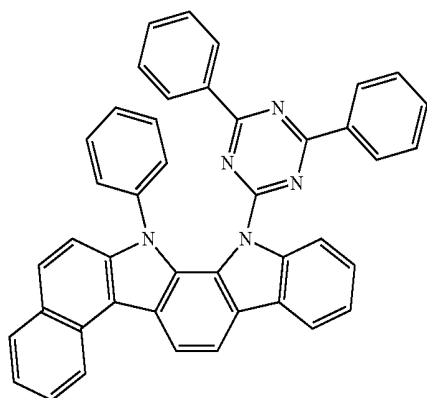


H44

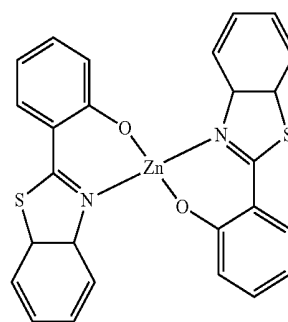
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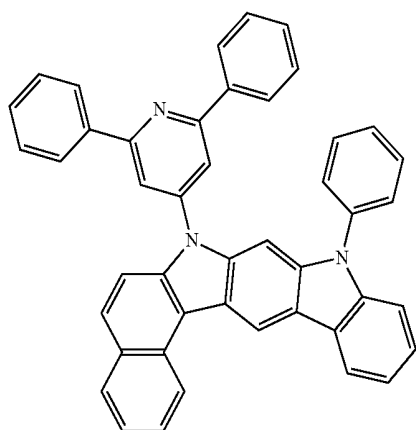
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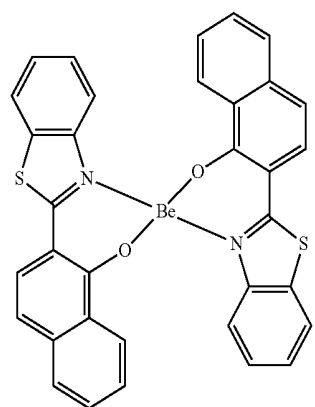
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H48



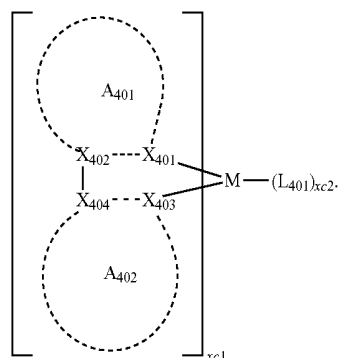
H46



H49

[0152] The dopant may be at least one selected from a suitable fluorescent dopant and a suitable phosphorescent dopant.

[0153] The phosphorescent dopant may include an organometallic complex represented by Formula 401 below:



Formula 401

[0154] In Formula 401,

[0155] M may be selected from iridium (Ir), platinum (Pt), osmium (Os), titanium (Ti), zirconium (Zr), hafnium (Hf), europium (Eu), terbium (Tb), and thulium (Tm),

[0156] X₄₀₁ to X₄₀₄ may each independently be selected from nitrogen and carbon,

[0157] A₄₀₁ and A₄₀₂ rings may each independently be selected from a substituted or unsubstituted benzene, a substituted or unsubstituted naphthalene, a substituted or unsubstituted fluorene, a substituted or unsubstituted spiro-fluorene, a substituted or unsubstituted indene, a substituted or unsubstituted pyrrole, a substituted or unsubstituted thiophene, a substituted or unsubstituted furan, a substituted or unsubstituted imidazole, a substituted or unsubstituted pyrazole, a substituted or unsubstituted thiazole, a substituted or unsubstituted isothiazole, a substituted or unsubstituted oxazole, a substituted or unsubstituted isoxazole, a substituted or unsubstituted pyridine, a substituted or unsubstituted pyrazine, a substituted or unsubstituted pyrimidine, a substituted or unsubstituted pyridazine, a substituted or unsubstituted quinoline, a substituted or unsubstituted isoquinoline, a substituted or unsubstituted benzoquinoline, a substituted or unsubstituted quinoxaline, a substituted or unsubstituted quinazoline, a substituted or unsubstituted carbazole, a substituted or unsubstituted benzimidazole, a substituted or unsubstituted benzofuran, a substituted or unsubstituted benzothiophene, a substituted or unsubstituted isobenzothiophene, a substituted or unsubstituted benzoxazole, a substituted or unsubstituted isobenzoxazole, a substituted or unsubstituted triazole, a substituted or unsubstituted oxadiazole, a substituted or unsubstituted triazine, a substituted or unsubstituted dibenzofuran, and a substituted or unsubstituted dibenzothiophene,

[0158] at least one substituent of the substituted benzene, substituted naphthalene, substituted fluorene, substituted spiro-fluorene, substituted indene, substituted pyrrole, substituted thiophene, substituted furan, substituted imidazole, substituted pyrazole, substituted thiazole, substituted isothiazole, substituted oxazole, substituted isoxazole, substituted pyridine, substituted pyrazine, substituted pyrimidine, substituted pyridazine, substituted quinoline, substituted isoquinoline, substituted benzoquinoline, substituted quinoxaline, substituted quinazoline, substituted carbazole, substituted benzimidazole, substituted benzofuran, substituted benzothiophene, substituted isobenzothiophene, sub-

stituted benzoxazole, substituted isobenzoxazole, substituted triazole, substituted oxadiazole, substituted triazine, substituted dibenzofuran, and substituted dibenzothiophene may be selected from:

[0159] deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C₁-C₆₀ alkyl group, a C₂-C₆₀ alkenyl group, a C₂-C₆₀ alkynyl group, and a C₁-C₆₀ alkoxy group;

[0160] a C₁-C₆₀ alkyl group, a C₂-C₆₀ alkenyl group, a C₂-C₆₀ alkynyl group, and a C₁-C₆₀ alkoxy group, each substituted with at least one selected from deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C₃-C₁₀ cycloalkyl group, a C₁-C₁₀ heterocycloalkyl group, a C₃-C₁₀ cycloalkenyl group, a C₂-C₁₀ heterocycloalkenyl group, a C₆-C₆₀ aryl group, a C₆-C₆₀ aryloxy group, a C₆-C₆₀ arylthio group, a C₂-C₆₀ heteroaryl group, a monovalent non-aromatic condensed polycyclic group, a monovalent non-aromatic condensed heteropolycyclic group, —N(Q₄₀₁)(Q₄₀₂), —Si(Q₄₀₃)(Q₄₀₄)(Q₄₀₅), and —B(Q₄₀₆)(Q₄₀₇);

[0161] a C₃-C₁₀ cycloalkyl group, a C₂-C₁₀ heterocycloalkyl group, a C₃-C₁₀ cycloalkenyl group, a C₂-C₁₀ heterocycloalkenyl group, a C₆-C₆₀ aryl group, a C₆-C₆₀ aryloxy group, a C₆-C₆₀ arylthio group, a C₁-C₆₀ heteroaryl group, a monovalent non-aromatic condensed polycyclic group, and a monovalent non-aromatic condensed heteropolycyclic group;

[0162] a C₃-C₁₀ cycloalkyl group, a C₂-C₁₀ heterocycloalkyl group, a C₃-C₁₀ cycloalkenyl group, a C₂-C₁₀ heterocycloalkenyl group, a C₆-C₆₀ aryl group, a C₆-C₆₀ aryloxy group, a C₆-C₆₀ arylthio group, a C₁-C₆₀ heteroaryl group, a monovalent non-aromatic condensed polycyclic group, and a monovalent non-aromatic condensed heteropolycyclic group, each substituted with at least one selected from deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C₁-C₆₀ alkyl group, a C₂-C₆₀ alkenyl group, a C₁-C₆₀ alkynyl group, a C₁-C₆₀ alkoxy group, a C₃-C₁₀ cycloalkyl group, a C₂-C₁₀ heterocycloalkyl group, a C₃-C₁₀ cycloalkenyl group, a C₂-C₁₀ heterocycloalkenyl group, a C₆-C₆₀ aryl group, a C₆-C₆₀ aryloxy group, a C₆-C₆₀ arylthio group, a C₁-C₆₀ heteroaryl group, a monovalent non-aromatic condensed polycyclic group, a monovalent non-aromatic condensed heteropolycyclic group, —N(Q₄₁₁)(Q₄₁₂), —Si(Q₄₁₃)(Q₄₁₄)(Q₄₁₅), and —B(Q₄₁₆)(Q₄₁₇); and

[0163] —N(Q₄₂₁)(Q₄₂₂), —Si(Q₄₂₃)(Q₄₂₄)(Q₄₂₅), and —B(Q₄₂₆)(Q₄₂₇).

[0164] L₄₀₁ may be an organic ligand,

[0165] xc1 may be selected from 1, 2, and 3, and

[0166] xc2 may be selected from 0, 1, 2, and 3.

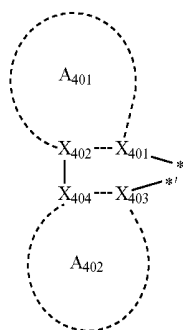
[0167] L₄₀₁ may be a monovalent, divalent, or trivalent organic ligand. For example, L₄₀₁ may be selected from a halogen ligand (for example, Cl and/or F), a diketone ligand (for example, acetylacetonate, 1,3-diphenyl-1,3-propandionate, 2,2,6,6-tetramethyl-3,5-heptandionate, and/or

hexafluoroacetate), a carboxylic acid ligand (for example, picolinate, dimethyl-3-pyrazolecarboxylate, and/or benzoate), a carbon monoxide ligand, an isonitrile ligand, a cyano ligand, and a phosphorous ligand (for example, phosphine, and/or phosphite), but embodiments of the present disclosure are not limited thereto.

[0168] When A_{401} in Formula 401 has two or more substituents, the substituents of A_{401} may be linked (e.g., coupled) to each other to form a saturated or unsaturated ring.

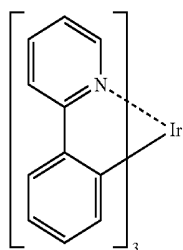
[0169] When A_{402} in Formula 402 has two or more substituents, the substituents of A_{402} may be linked (e.g., coupled) to each other to form a saturated or unsaturated ring.

[0170] When $xc1$ in Formula 401 is two or more, a plurality of ligands



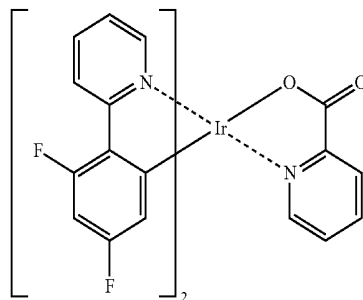
in Formula 401 may be identical to or different from each other. When $xc1$ in Formula 401 is two or more, A_{401} and A_{402} may be respectively directly connected to A_{401} and A_{402} of other neighboring ligands with or without a linker (for example, a C_1 - C_5 alkylene group, $-N(R')$ —(wherein R' may be a C_1 - C_{10} alkyl group or a C_6 - C_{20} aryl group), and/or $C(=O)$ —) therebetween.

[0171] The phosphorescent dopant may include at least one selected from Compounds PD1 to PD74 below, but embodiments of the present disclosure are not limited thereto:

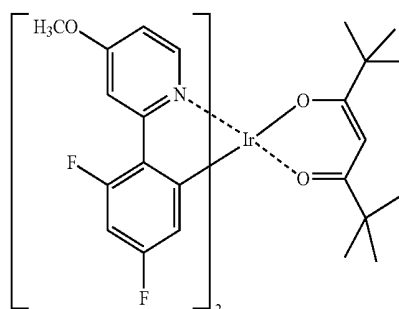


PD1

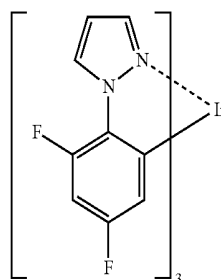
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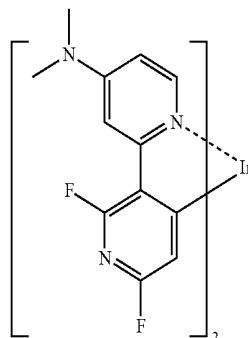
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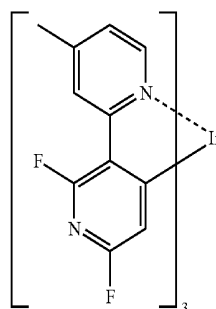
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PD4

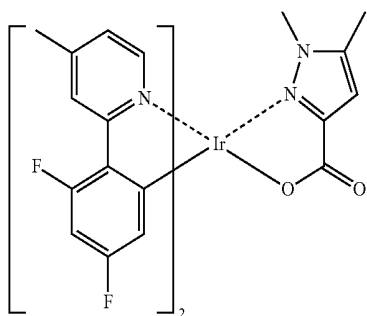
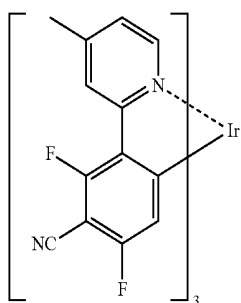
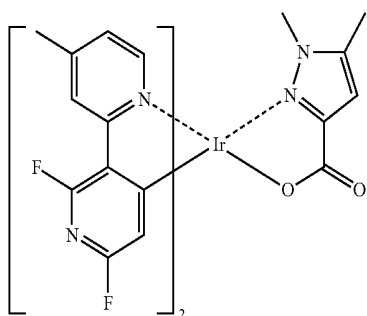
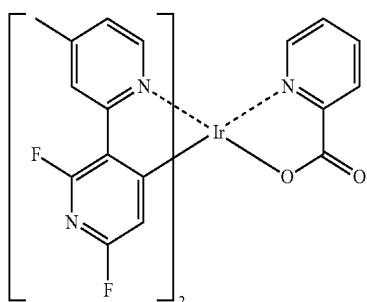
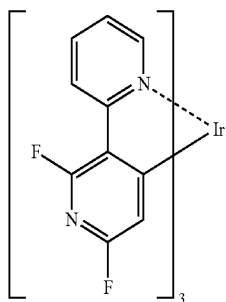


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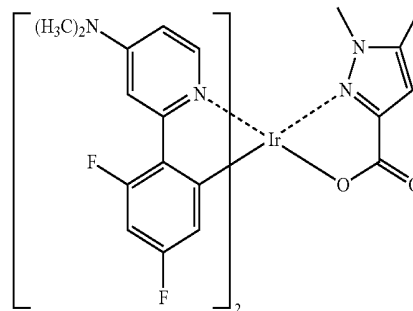
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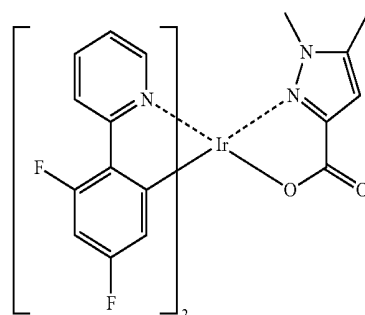
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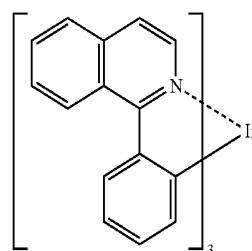
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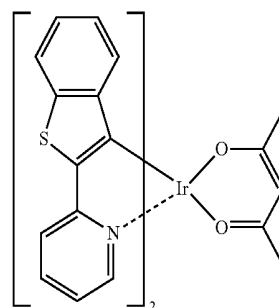
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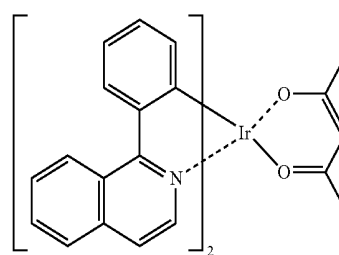
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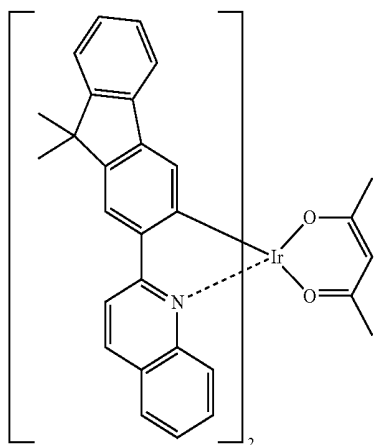
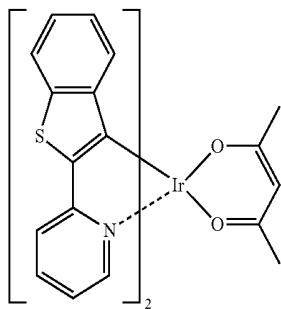
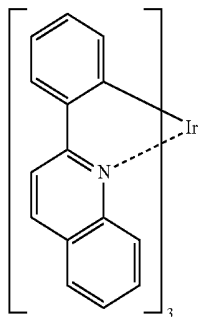
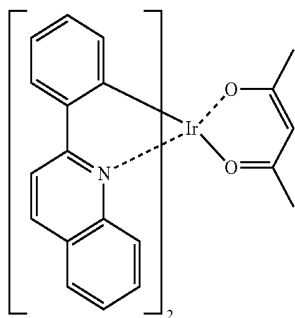
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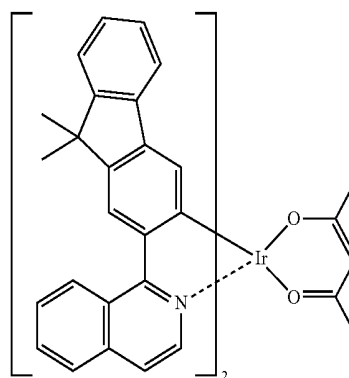
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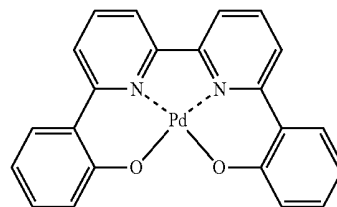
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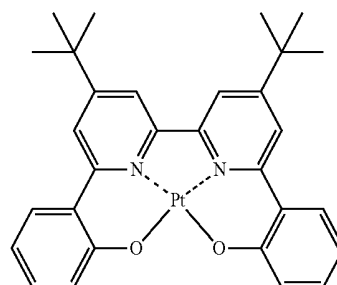
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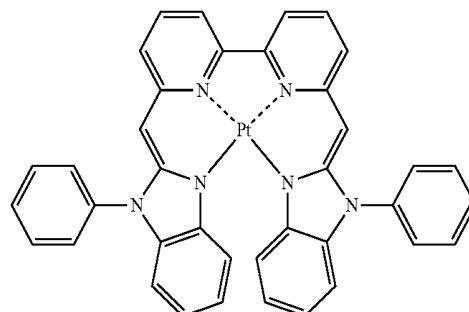
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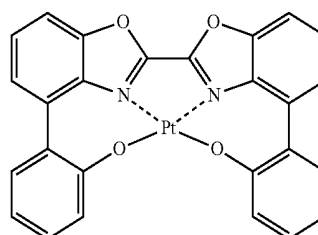


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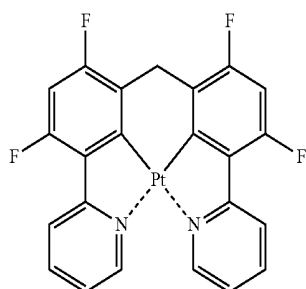
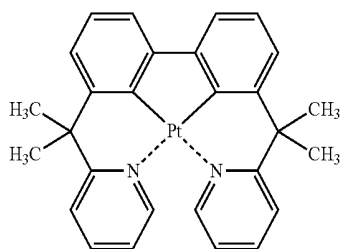
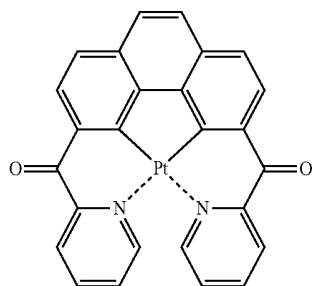
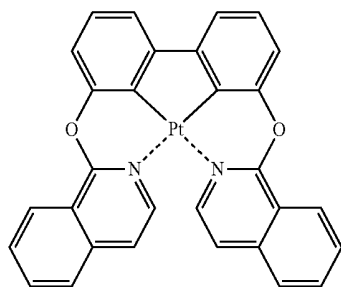
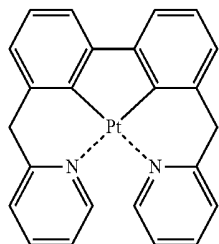


PD24



PD25

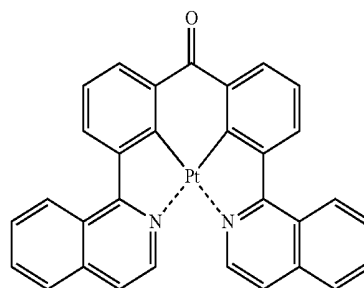
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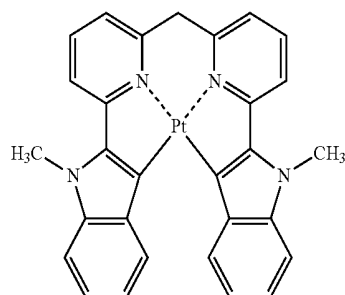
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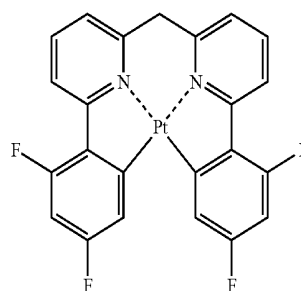
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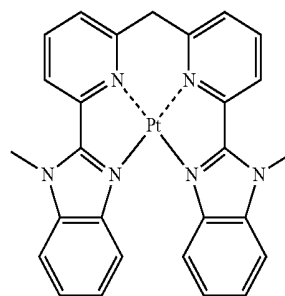
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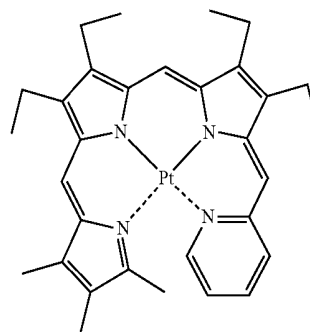
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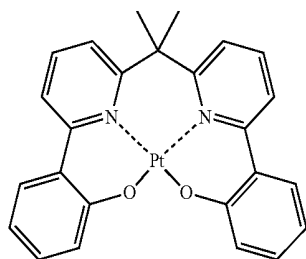


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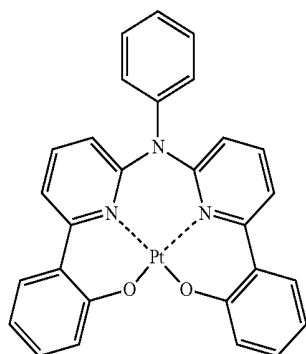
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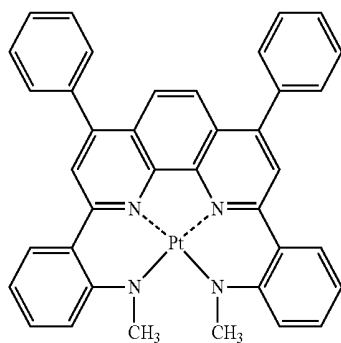
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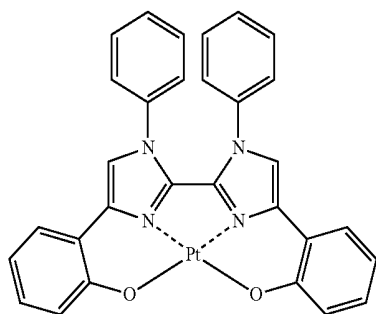
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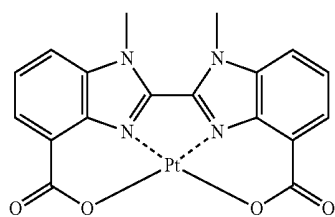
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PD38

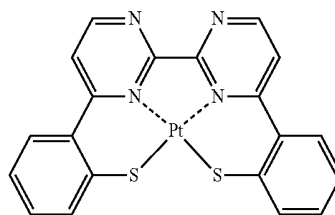


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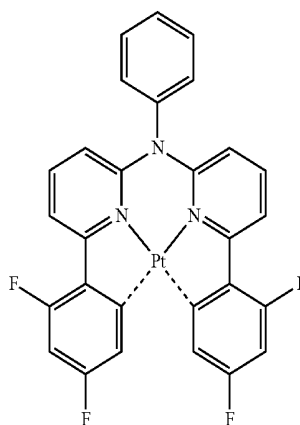


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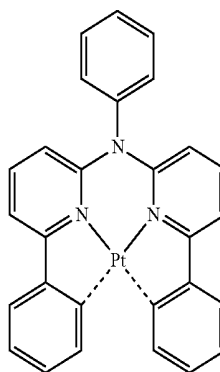
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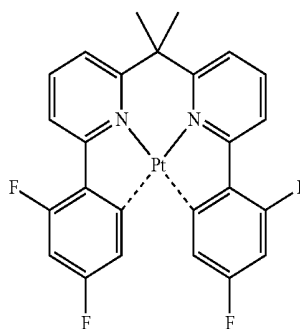
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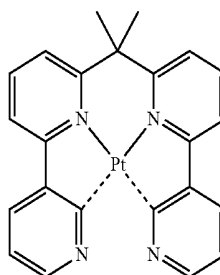
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PD43

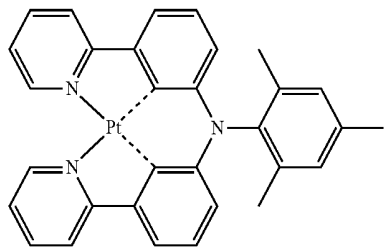
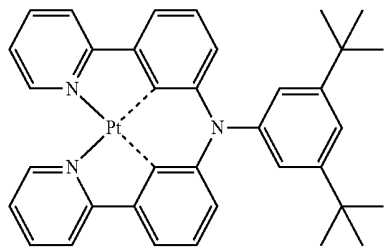
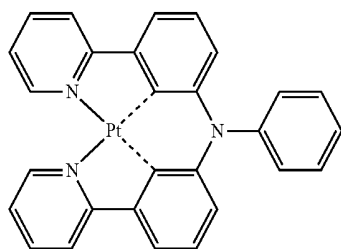
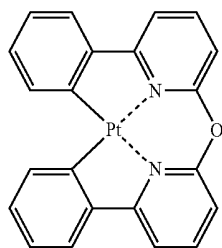
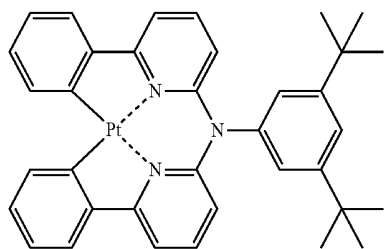
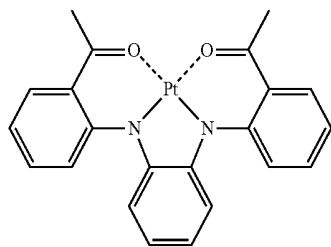


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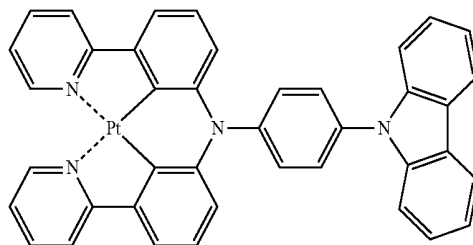
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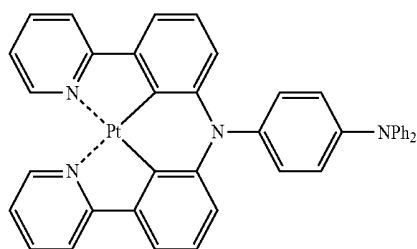
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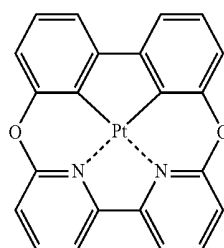
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PD47



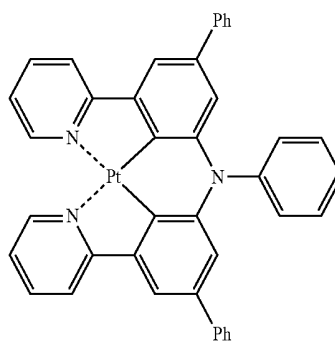
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PD48



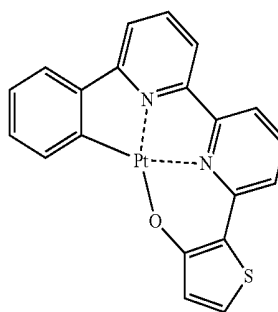
PD54

PD49



PD55

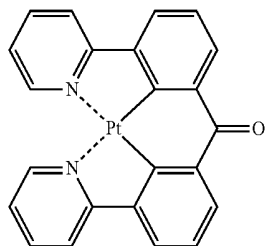
PD50



PD56

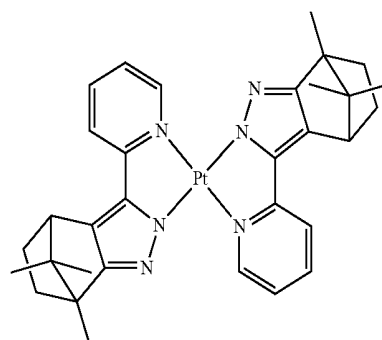
PD51

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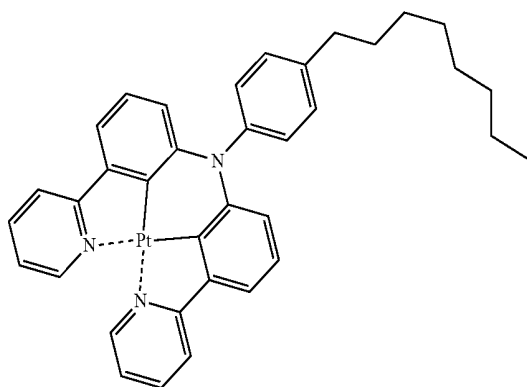
PD57

-continued

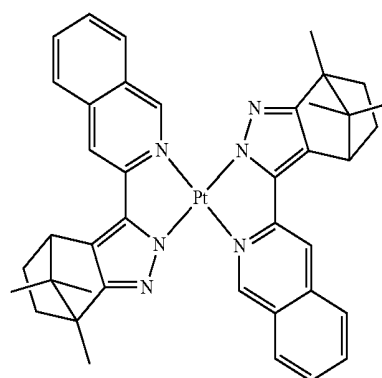


PD62

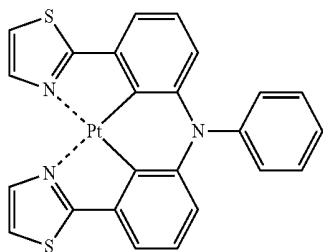
PD58



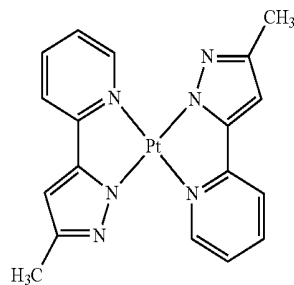
PD63



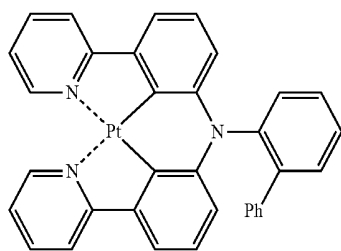
PD59



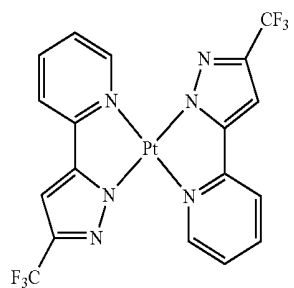
PD64



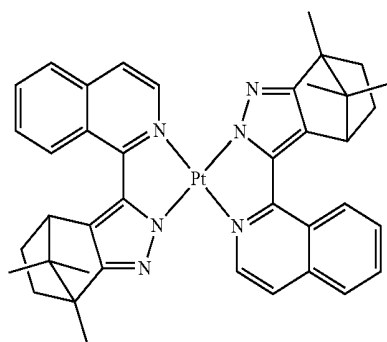
PD60



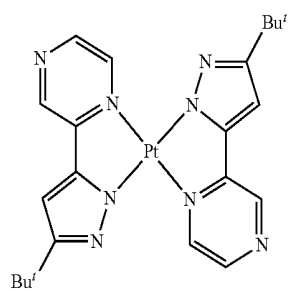
PD65



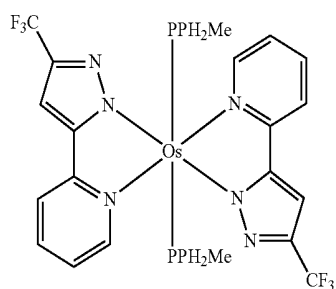
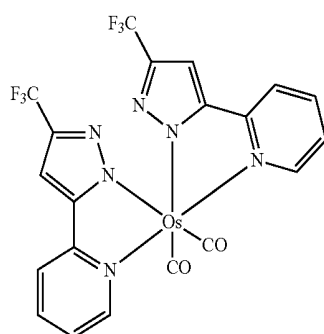
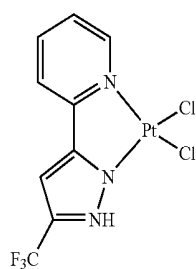
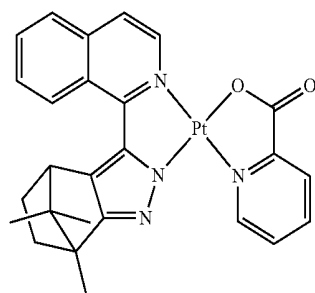
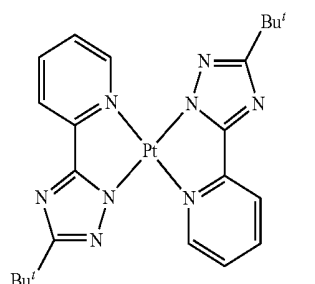
PD61



PD66

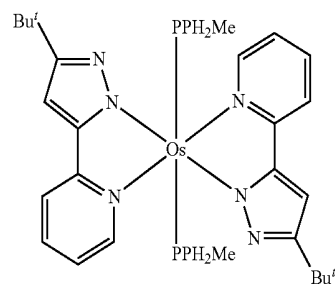


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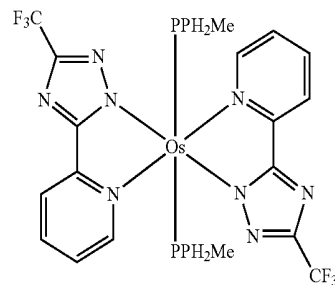
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PD67



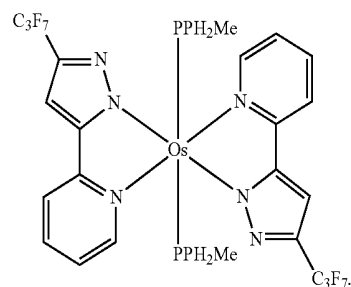
PD72

PD68



PD73

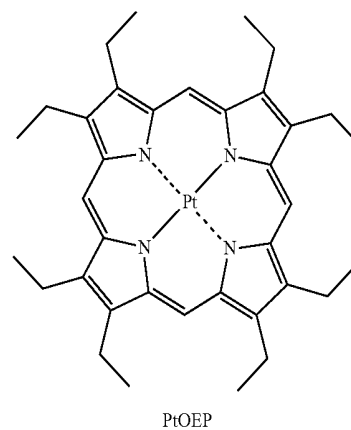
PD69



PD74

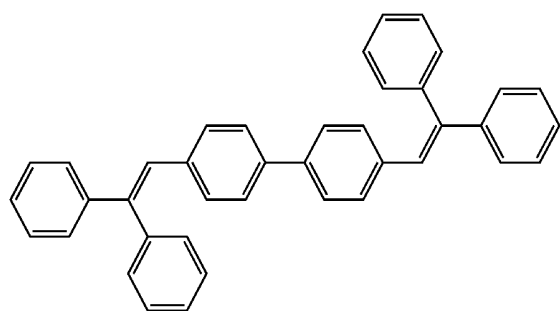
PD70

[0172] In some embodiments the phosphorescent dopant may include PtOEP:

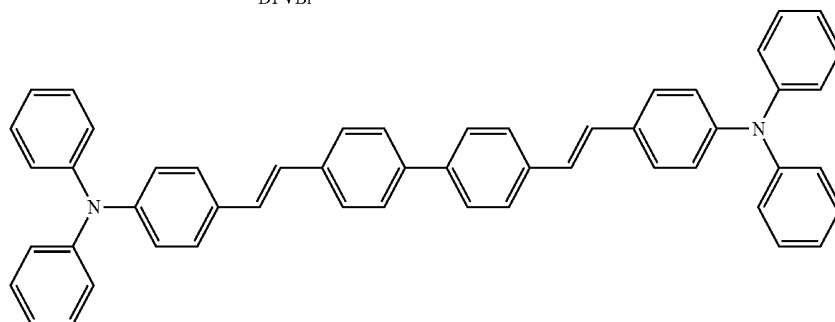


PD71

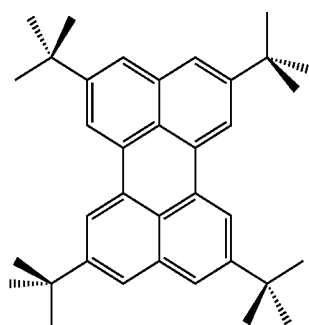
[0173] The fluorescent dopant may include at least one selected from DPVBi, DPAVBi, TBPe, DCM, DCJTb, Coumarin 6, and C545T.



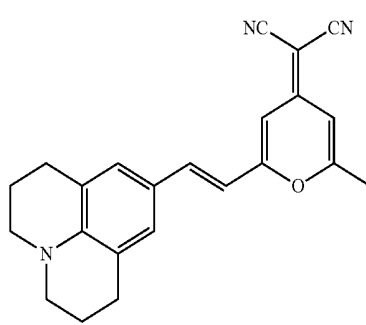
DPVBi



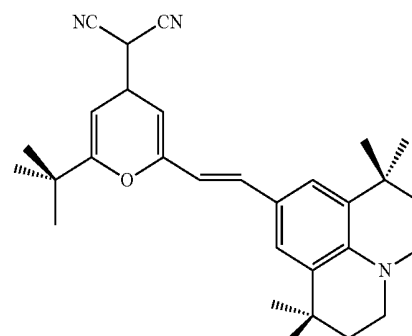
DPAVB



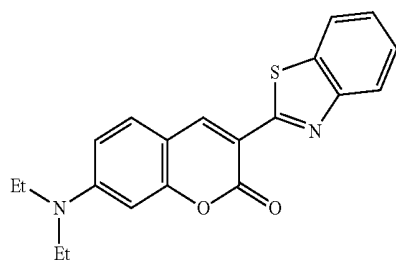
TBPe



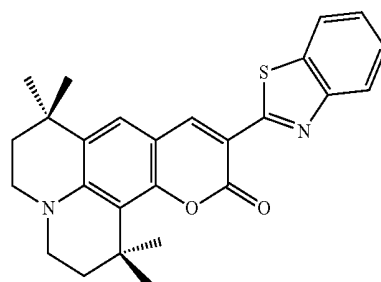
DCM



DCJTb

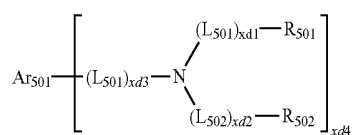


Coumarin 6



C545T

[0174] In some embodiments, the fluorescent dopant may include a compound represented by Formula 501 below:



Formula 501

[0175] In Formula 501,

[0176] Ar_{501} may be selected from:

[0177] a naphthalene, a heptalene, a fluorene, a spirofluorene, a benzofluorene, a dibenzofluorene, a phenalene, a phenanthrene, an anthracene, a fluoranthene, a triphenylene, a pyrene, a chrysene, a naphthacene, a picene, a perylene, a pentaphene, and an indenoanthracene; and

[0178] a naphthalene, a heptalene, a fluorene, a spirofluorene, a benzofluorene, a dibenzofluorene, a phenalene, a phenanthrene, an anthracene, a fluoranthene, a triphenylene, a pyrene, a chrysene, a naphthacene, a picene, a perylene, a

pentaphene, and an indenoanthracene, each substituted with at least one selected from deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an am idino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1 - C_{60} alkyl group, a C_2 - C_{60} alkenyl group, a C_2 - C_{60} alkynyl group, a C_1 - C_{60} alkoxy group, a C_3 - C_{10} cycloalkyl group, a C_2 - C_{10} heterocycloalkyl group, a C_3 - C_{10} cycloalkenyl group, a C_2 - C_{10} heterocycloalkenyl group, a C_6 - C_{60} aryl group, a C_6 - C_{60} aryloxy group, a C_6 - C_{60} arylthio group, a C_1 - C_{60} heteroaryl group, a monovalent non-aromatic condensed polycyclic group, a monovalent non-aromatic condensed heteropolycyclic group, and —Si(Q_{501})(Q_{502})(Q_{503}) (wherein Q_{501} to Q_{503} may each independently be selected from hydrogen, a C_1 - C_{60} alkyl group, a C_2 - C_{60} alkenyl group, a C_6 - C_{60} aryl group, and a C_1 - C_{60} heteroaryl group),

[0179] descriptions of L_{501} to L_{503} may be the same as the descriptions provided earlier herein in connection with L_{301} ,

[0180] R_{501} and R_{502} may each independently be selected from:

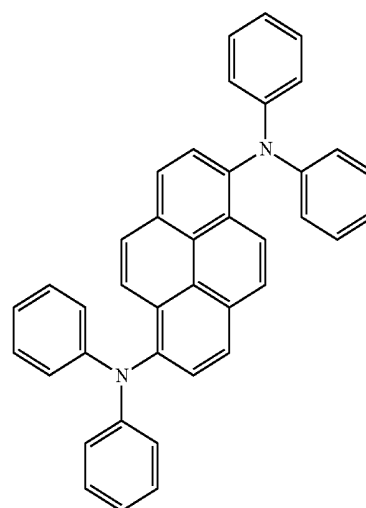
[0181] a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazol group, a triazinyl group, a dibenzofuran group, and a dibenzothiophenyl group; and

[0182] a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, a triazinyl group, a dibenzofuran group, and a dibenzothiophenyl group, each substituted with at least one selected from deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an am idino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a C_1 - C_{20} alkyl group, a C_1 - C_{20} alkoxy group, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, a triazinyl group, a dibenzofuran group, and a dibenzothiophenyl group,

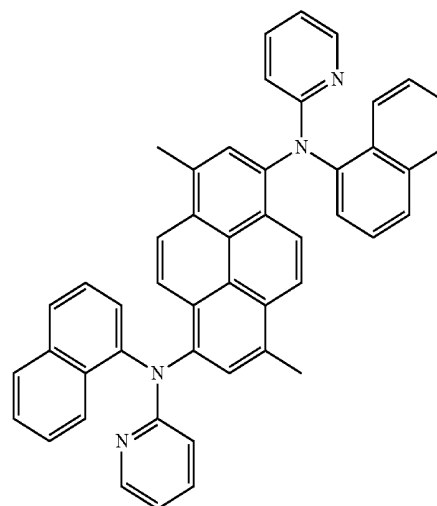
[0183] $xd1$ to $xd3$ may each independently be selected from 0, 1, 2, and 3, and

[0184] $xd4$ may be selected from 1, 2, 3, and 4.

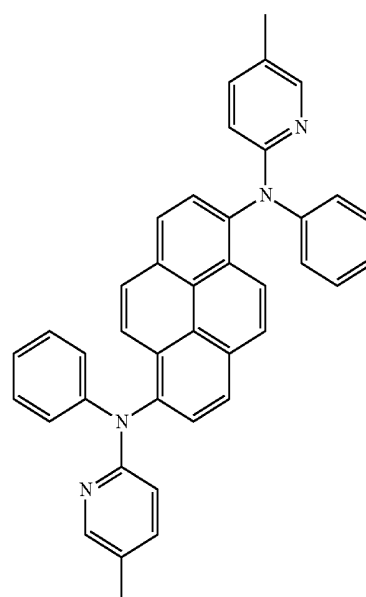
[0185] The fluorescent dopant may include at least one selected from Compounds FD1 to FD8:



FD1



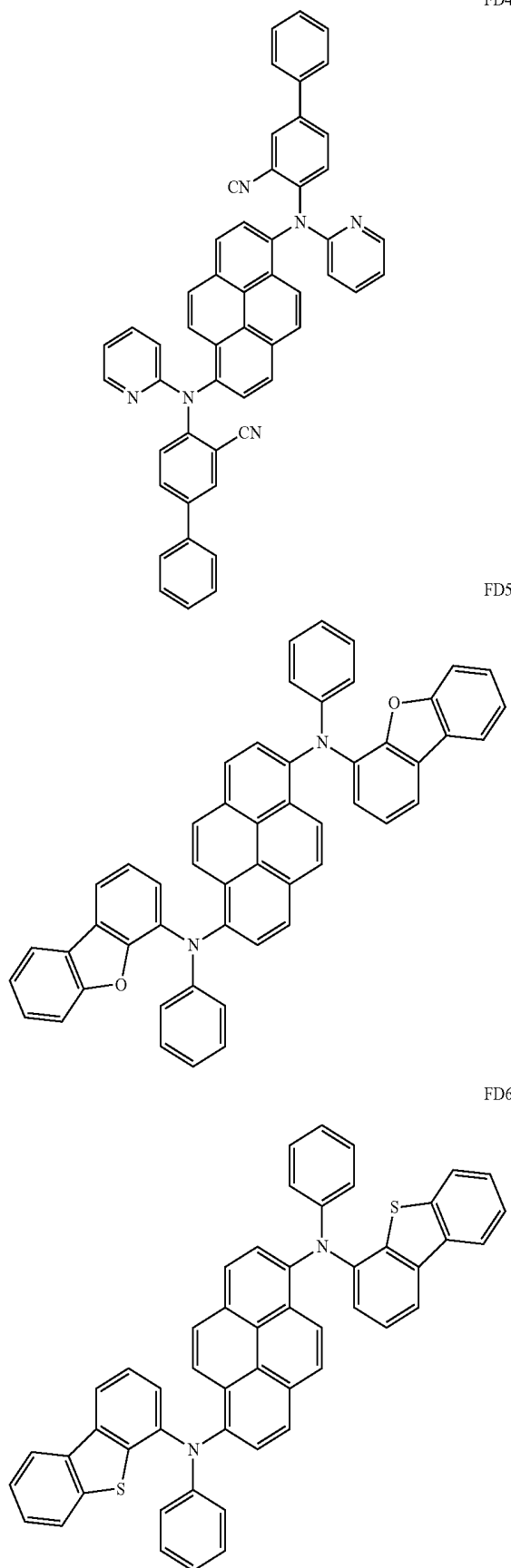
FD2



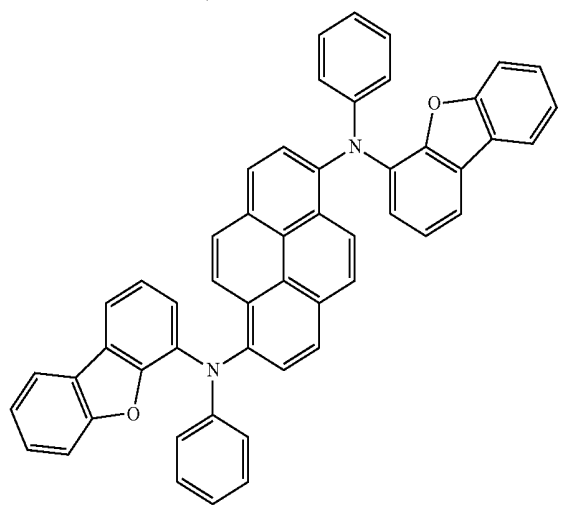
FD3

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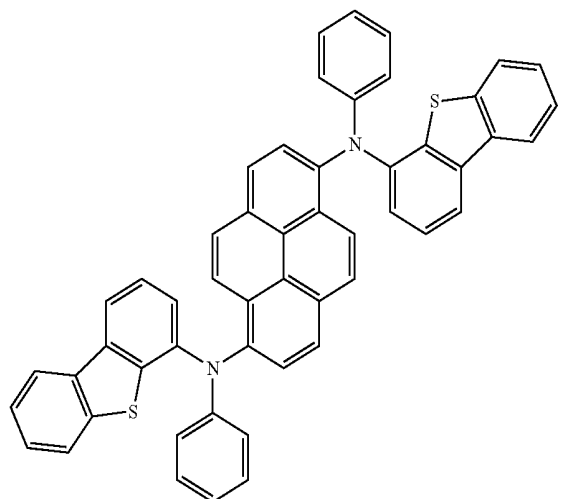
FD4



FD5

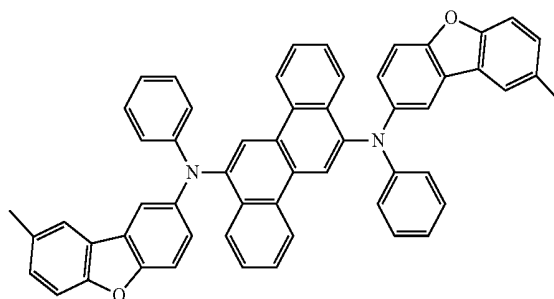


FD6

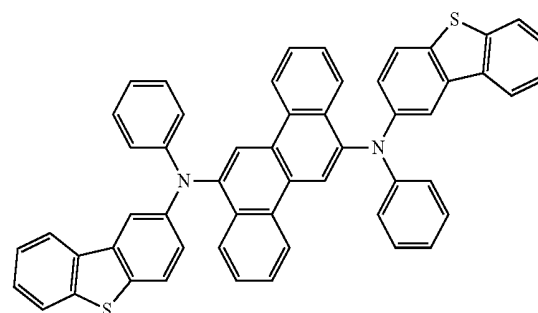


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FD7



FD8



[0186] An amount of the dopant in the emission layer may be about 0.01 to about 15 parts by weight based on about 100 parts by weight of the host, but embodiments of the present disclosure are not limited thereto.

[0187] A thickness of the emission layer may be about 100 Å to about 1,000 Å, and in some embodiments, about 200 Å to about 600 Å. When the thickness of the emission layer is within this range, excellent light-emission characteristics may be obtained without a substantial increase in driving voltage.

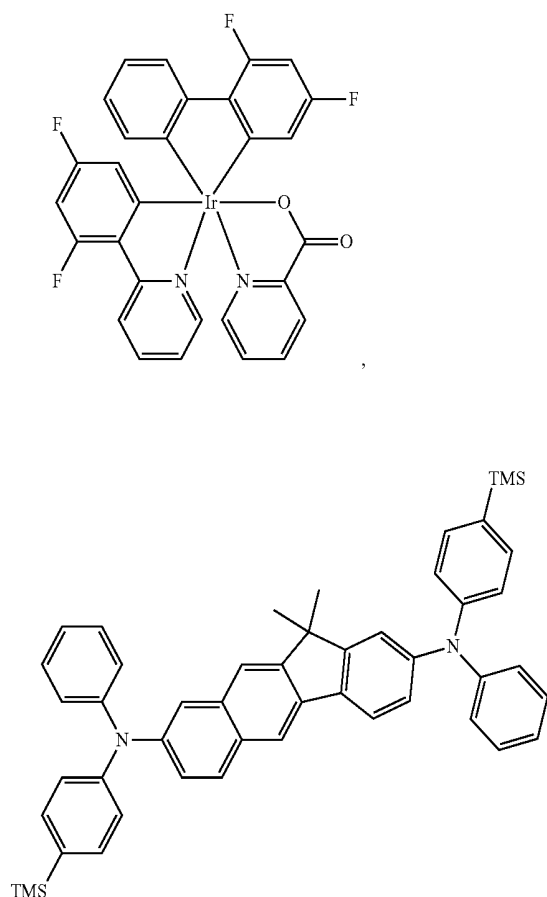
[0188] An electron transport region may be on the emission layer.

[0189] The electron transport region may include a buffer layer and at least one selected from an electron transport layer (ETL) and an electron injection layer, but embodiments of the present disclosure are not limited thereto.

[0190] The buffer layer may include only the compound represented by Formula 1 according to an embodiment of the present disclosure. The buffer layer may include the compound represented by Formula 1 according to an embodiment of the present disclosure and a dopant.

[0191] The dopant may be a metal complex including Ir, Pt, Os, Au, Cu, Re, and/or Ru, and/or a benzofluorene derivative compound.

[0192] The dopant may be, for example, and/or



[0193] A thickness of the buffer layer may be about 10 Å to about 150 Å, and in some embodiments, about 10 Å to about 100 Å. When the thickness of the buffer layer is within this range, a low gradient efficiency drop may be improved.

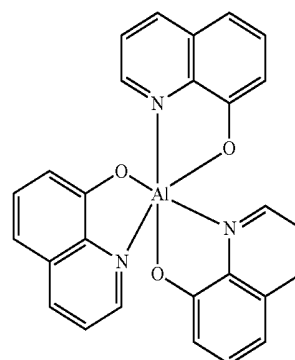
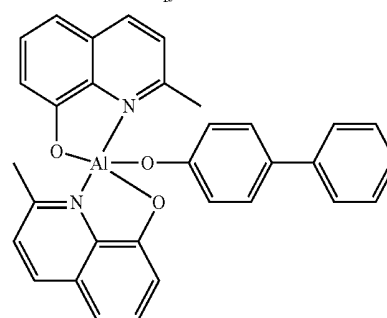
[0194] In the case of a device having a thickness of 10 Å or less, the low gradient efficiency improvement effects may not occur due to tunneling effects of electrons and/or holes.

[0195] Even with a thickness of 150 Å, the dopant produces effects. This result shows that the compound of Formula 1 according to an embodiment of the present disclosure may also be used as a blue host material.

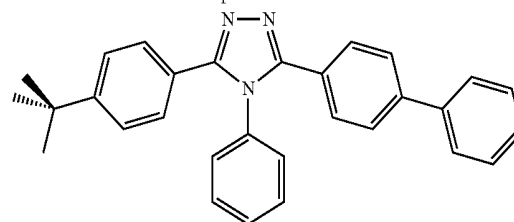
[0196] For example, the electron transport region may have a structure of buffer layer/electron transport layer/electron injection layer sequentially stacked from an emission layer in the stated order, but the structure thereof is not limited thereto.

[0197] In some embodiments, the organic layer 150 of the organic light-emitting device includes an electron transport region between the emission layer and the second electrode 190, and the electron transport region may include an electron transport layer. The electron transport layer may include a plurality of layers. For example, the electron transport layer may include a first electron transport layer and/or a second electron transport layer.

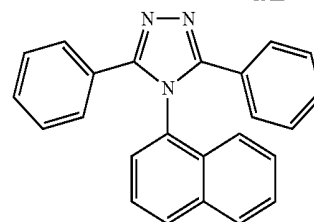
[0198] The electron transport layer may further include at least one selected from BCP, Bahen, Alq₃, Balq, TAZ, and NTAZ.

Alq₃

BAIq

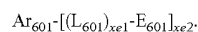


TAZ



NTAZ

[0199] In some embodiments, the electron transport layer may include at least one compound selected from a compound represented by Formula 601 and a compound represented by Formula 602, illustrated below:



Formula 601

[0200] In Formula 601,

[0201] Ar₆₀₁ may be selected from:

[0202] a naphthalene, a heptalene, a fluorene, a spiro-fluorene, a benzofluorene, a dibenzofluorene, a phenalene, a phenanthrene, an anthracene, a fluoranthene, a triphenylene, a pyrene, a chrysene, a naphthacene, a picene, a perylene, a pentaphene, and an indenoanthracene; and

[0203] a naphthalene, a heptalene, a fluorene, a spiro-fluorene, a benzofluorene, a dibenzofluorene, a phenalene, a phenanthrene, an anthracene, a fluoranthene, a triphenylene,

a pyrene, a chrysene, a naphthacene, a picene, a perylene, a pentaphene, and an indenoanthracene, each substituted with at least one selected from deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C₁-C₆₀ alkyl group, a C₂-C₆₀ alkenyl group, a C₂-C₆₀ alkynyl group, a C₁-C₆₀ alkoxy group, a C₃-C₁₀ cycloalkyl group, a C₃-C₁₀ heterocycloalkyl group, a C₃-C₁₀ cycloalkenyl group, a C₃-C₁₀ heterocycloalkenyl group, a C₆-C₆₀ aryl group, a C₆-C₆₀ aryloxy group, a C₆-C₆₀ arylthio group, a C₁-C₆₀ heteroaryl group, a monovalent non-aromatic condensed polycyclic group, a monovalent non-aromatic condensed heteropolycyclic group, and —Si(Q₃₀₁)(Q₃₀₂)(Q₃₀₃) (wherein Q₃₀₁ to Q₃₀₃ may each independently be selected from hydrogen, a C₁-C₆₀ alkyl group, a C₂-C₆₀ alkenyl group, a C₆-C₆₀ aryl group, and a C₁-C₆₀ heteroaryl group),

[0204] L₆₀₁ may be the same as described earlier herein in connection with L₃₀₁,

[0205] E₆₀₁ may be selected from:

[0206] a pyrrolyl group, a thiophenyl group, a furanyl group, an imidazolyl group, a pyrazolyl group, a thiazolyl group, an isothiazolyl group, an oxazolyl group, an isoxazolyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, an indolyl group, an indazolyl group, a furinyl group, a quinolinyl group, an isoquinolinyl group, a benzoquinolinyl group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, a quinazolinyl group, a cinnolinyl group, a carbazolyl group, a phenanthridinyl group, an acridinyl group, a phenanthrolinyl group, a phenazinyl group, a benzoimidazolyl group, a benzofuranyl group, a benzothiophenyl group, an isobenzothiazolyl group, a benzoxazolyl group, an isobenzoxazolyl group, a triazolyl group, a tetrazolyl group, an oxadiazolyl group, a triazinyl group, a dibenzofuranyl group, a dibenzothiophenyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a thiadiazolyl group, an imidazopyridinyl group, and an imidazopyrimidinyl group; and

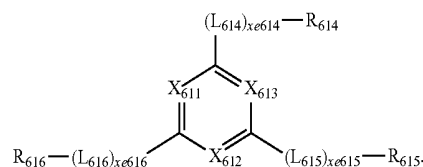
[0207] a pyrrolyl group, a thiophenyl group, a furanyl group, an imidazolyl group, a pyrazolyl group, a thiazolyl group, an isothiazolyl group, an oxazolyl group, an isoxazolyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, an indolyl group, an indazolyl group, a purinyl group, a quinolinyl group, an isoquinolinyl group, a benzoquinolinyl group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, a quinazolinyl group, a cinnolinyl group, a carbazolyl group, a phenanthridinyl group, an acridinyl group, a phenanthrolinyl group, a phenazinyl group, a benzoimidazolyl group, a benzofuranyl group, a benzothiophenyl group, an isobenzothiazolyl group, a benzoxazolyl group, an isobenzoxazolyl group, a triazolyl group, a tetrazolyl group, an oxadiazolyl group, a triazinyl group, a dibenzofuranyl group, a dibenzothiophenyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a thia-

diazolyl group, an imidazopyridinyl group, and an imidazopyrimidinyl group, each substituted with at least one selected from deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C₁-C₂₀ alkyl group, a C₁-C₂₀ alkoxy group, a cyclopentyl group, a cyclohexyl group, a cycloheptyl group, a cyclopentenyl group, a cyclohexenyl group, a phenyl group, a pentalenyl group, an indenyl group, a naphthyl group, an azulenyl group, a heptalenyl group, an indacenyl group, an acenaphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenalenyl group, a phenanthrenyl group, an anthracenyl group, a fluoranthenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a naphthacenyl group, a picenyl group, a perylenyl group, a pentaphenyl group, a hexacenyl group, a pentacenyl group, a rubicenyl group, a coronenyl group, an ovalenyl group, a pyrrolyl group, a thiophenyl group, a furanyl group, an imidazolyl group, a pyrazolyl group, a thiazolyl group, an isothiazolyl group, an oxazolyl group, an isoxazolyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, an indolyl group, an indazolyl group, a purinyl group, a quinolinyl group, an isoquinolinyl group, a benzoquinolinyl group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, a quinazolinyl group, a cinnolinyl group, a carbazolyl group, a phenanthridinyl group, an acridinyl group, a phenanthrolinyl group, a phenazinyl group, a benzoimidazolyl group, a benzofuranyl group, a benzothiophenyl group, an isobenzothiazolyl group, a benzoxazolyl group, an isobenzoxazolyl group, a triazolyl group, a tetrazolyl group, an oxadiazolyl group, a triazinyl group, a dibenzofuranyl group, a dibenzothiophenyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a thiadiazolyl group, an imidazopyridinyl group, and an imidazopyrimidinyl group,

[0208] xe1 may be selected from 0, 1, 2, and 3, and

[0209] xe2 may be selected from 1, 2, 3, and 4.

Formula 602



[0210] In Formula 602,

[0211] X₆₁₁ may be selected from N and C-(L₆₁₁)_{xe611}-R₆₁₁, X₆₁₂ may be selected from N and C-(L₆₁₂)_{xe612}-R₆₁₂, X₆₁₃ may be selected from N and C-(L₆₁₃)_{xe613}-R₆₁₃, and at least one selected from X₆₁₁ to X₆₁₃ may be N,

[0212] L₆₁₁ to L₆₁₆ may be the same as described herein in connection with L₃₀₁,

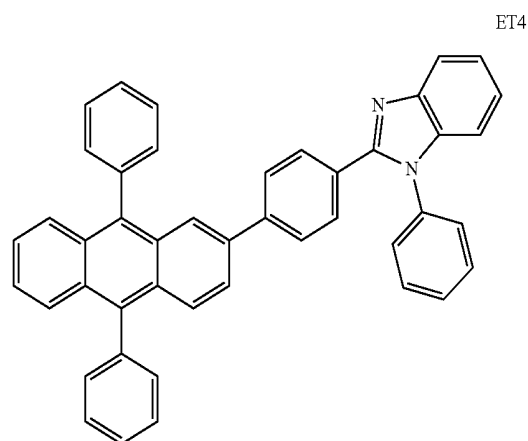
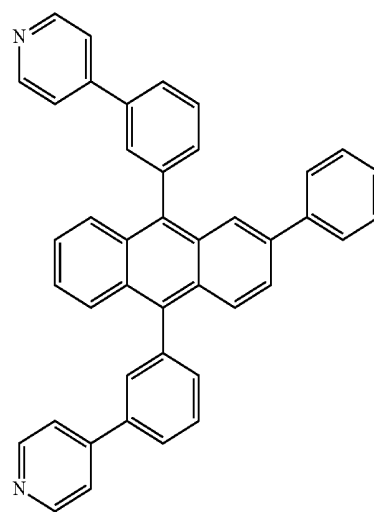
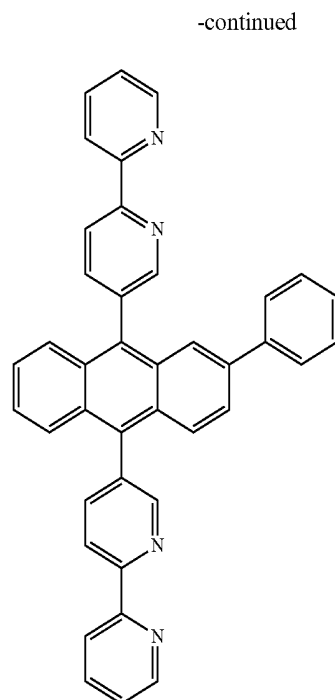
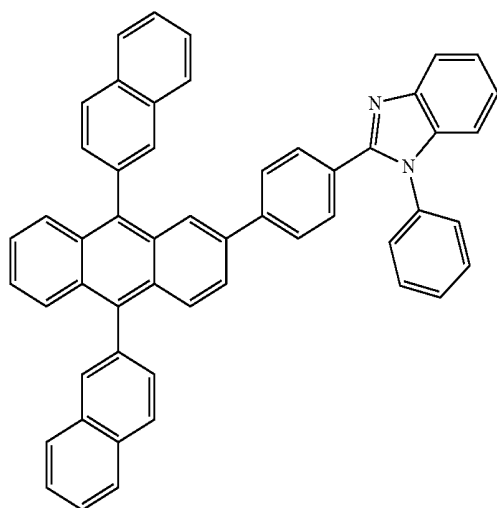
[0213] R_{611} to R_{616} may each independently be selected from:

[0214] a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, and a triazinyl group; and

[0215] a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, and a triazinyl group, each substituted with at least one selected from deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1 - C_{20} alkyl group, a C_1 - C_{20} alkoxy group, a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, and a triazinyl group, and

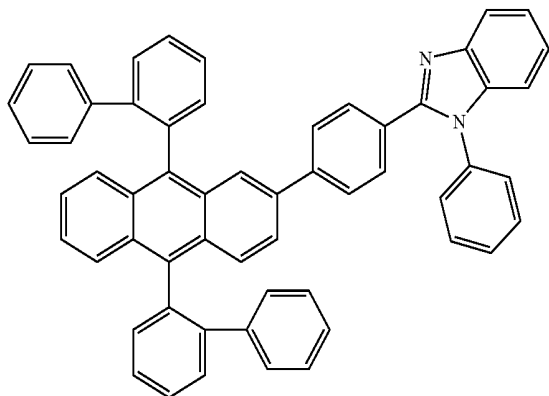
[0216] xe_{611} to xe_{616} may each independently be selected from 0, 1, 2, and 3.

[0217] The compound represented by Formula 601 and the compound represented by Formula 602 may each be independently selected from Compounds ET1 to ET15 illustrated below:



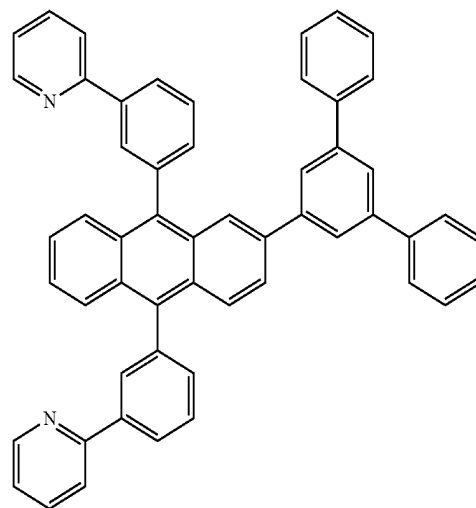
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ET5

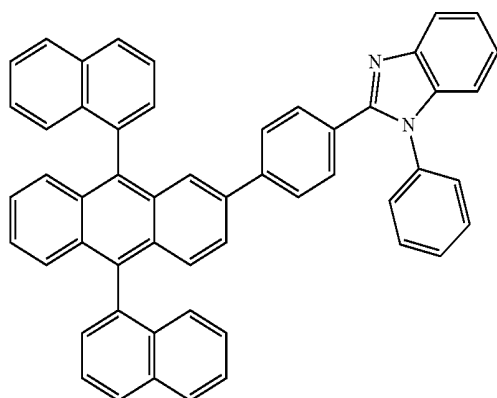


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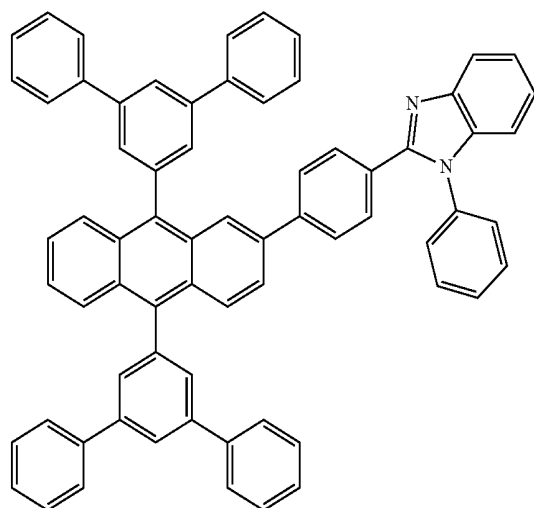
ET8



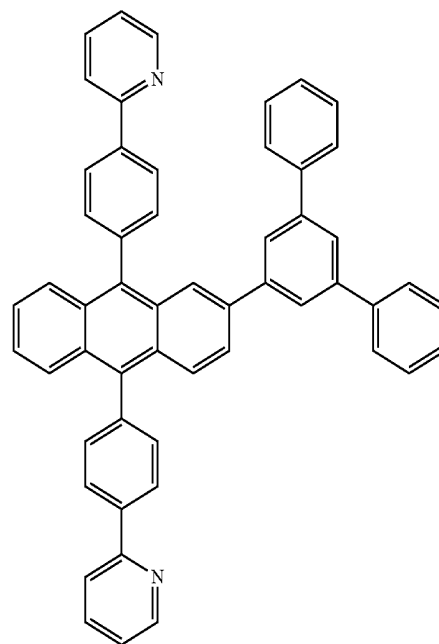
ET6



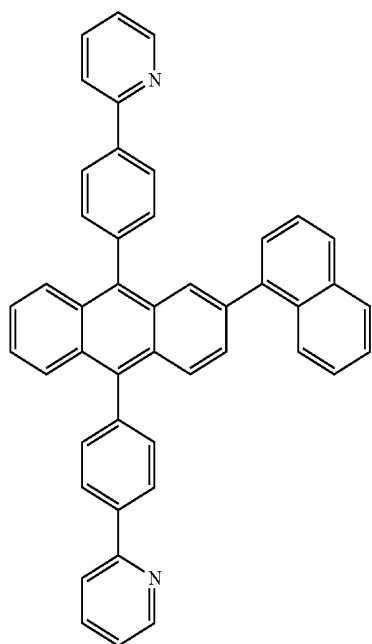
ET7



ET9

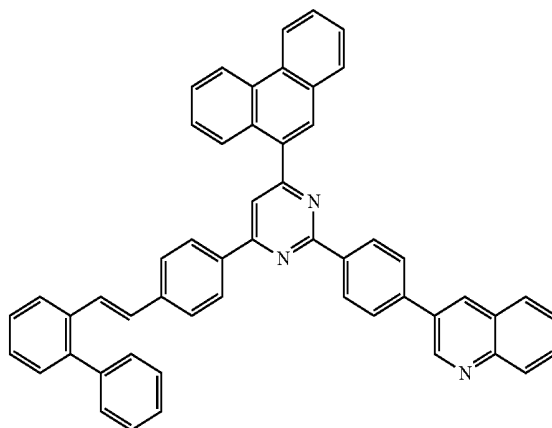


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ET10

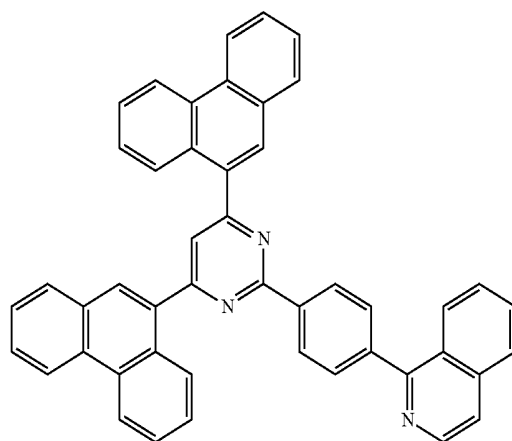
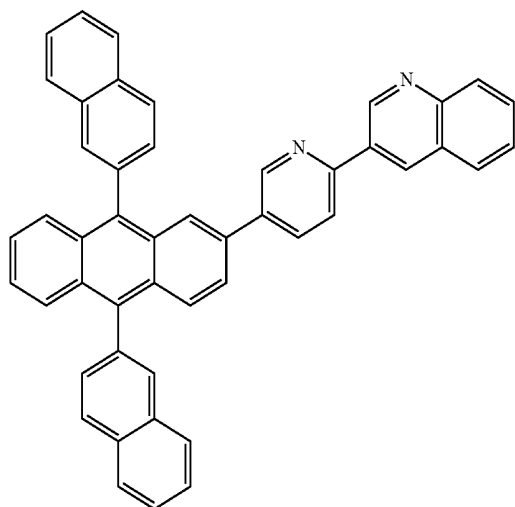
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ET13

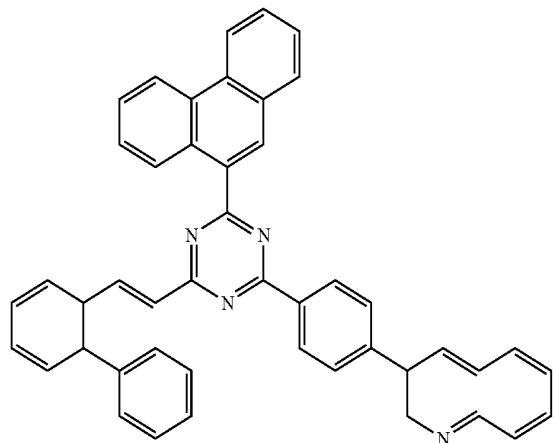
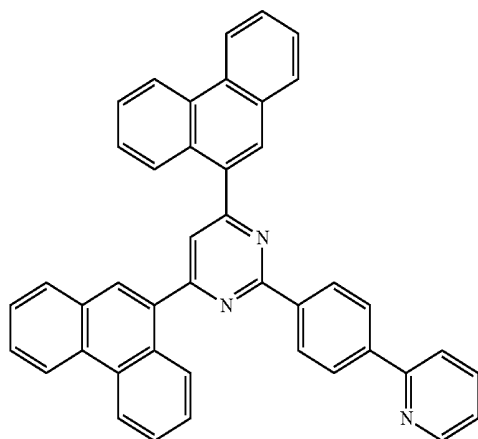
ET14

ET11



ET15

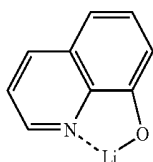
ET12



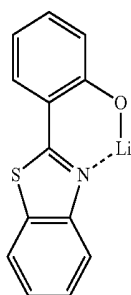
[0218] A thickness of the electron transport layer may be about 100 Å to about 1,000 Å, for example, about 150 Å to about 500 Å. When the thickness of the electron transport layer is within the range described above, the electron transport layer may have satisfactory electron transport characteristics without a substantial increase in driving voltage.

[0219] The electron transport layer may further include a metal-containing material (for example, a metal complex).

[0220] The metal-containing material may include a Li complex. The Li complex may include for example, compound ET-D1 (lithium quinolate, LiQ) and/or ET-D2.



ET-D1



ET-D2

[0221] The electron transport region may include an electron injection layer that facilitates the injection of electrons from the second electrode 190.

[0222] The electron injection layer may be formed on the electron transport layer using one or more suitable methods selected from vacuum deposition, spin coating, casting, an LB method, ink-jet printing, laser-printing, and laser-induced thermal imaging. When an electron injection layer is formed by vacuum deposition and/or spin coating, the deposition and coating conditions used for the electron injection layer may be the same as those used for the hole injection layer.

[0223] The electron injection layer may include at least one selected from LiF, NaCl, CsF, Li₂O, BaO, and LiQ.

[0224] A thickness of the electron injection layer may be about 1 Å to about 100 Å, for example, about 3 Å to about 90 Å. When the thickness of the electron injection layer is within the range described above, the electron injection layer may have satisfactory electron injection characteristics without a substantial increase in driving voltage.

[0225] The second electrode 190 may be on the organic layer 150 having such a structure. The second electrode 190 may be a cathode which is an electron injection electrode, and in this regard, a material for the second electrode 190 may be selected from metal, an alloy, an electrically conductive compound, and a mixture thereof, which have a relatively low work function. Non-limiting examples of the second electrode 190 may include lithium (Li), magnesium (Mg), aluminum (Al), aluminum-lithium (Al—Li), calcium (Ca), magnesium-indium (Mg—In), and magnesium-silver (Mg—Ag). In some embodiments, the material for forming the second electrode 190 may be ITO and/or IZO. The second electrode 190 may be a reflective electrode, a semi-transmissive electrode, and/or a transmissive electrode.

[0226] Also, an organic layer according to an embodiment of the present disclosure may be formed by depositing the compound according to an embodiment of the present disclosure, or may be formed by using a wet method in which the compound according to an embodiment of the

present disclosure is prepared in the form of solution and then the solution of the compound is used for coating.

[0227] An organic light-emitting device according to an embodiment of the present disclosure may be used in one or more flat panel display apparatuses, such as a passive matrix organic light-emitting display apparatus and/or an active matrix organic light-emitting display apparatus. For example, when the organic light-emitting device is included in an active matrix organic light-emitting display apparatus, a first electrode on a substrate acts as a pixel electrode and may be electrically connected to a source electrode and/or a drain electrode of a thin film transistor. In some embodiments, the organic light-emitting device may be included in a flat panel display apparatus that emits light in opposite directions.

[0228] Hereinbefore, the organic light-emitting device has been described with reference to FIG. 1, but embodiments of the present disclosure are not limited thereto.

[0229] Hereinafter, definitions of substituents of compounds used herein will be presented. The number of carbon atoms used to restrict a substituent is not limited, and does not limit the properties of the substituent, and unless defined otherwise, the definition of the substituent is consistent with a general definition thereof).

[0230] The term “C₁-C₆₀ alkyl group” as used herein refers to a linear or branched aliphatic hydrocarbon monovalent group having 1 to 60 carbon atoms, and non-limiting examples thereof may include a methyl group, an ethyl group, a propyl group, an isobutyl group, a sec-butyl group, a tert-butyl group, a pentyl group, an iso-amyl group, and a hexyl group. The term “C₁-C₆₀ alkylene group” as used herein refers to a divalent group having substantially the same structure as the C₁-C₆₀ alkyl group.

[0231] The term “C₁-C₆₀ alkoxy group” as used herein refers to a monovalent group represented by —O-A₁₀₁ (wherein A₁₀₁ is the C₁-C₆₀ alkyl group), and non-limiting examples thereof may include a methoxy group, an ethoxy group, and an isopropoxy group.

[0232] The term “C₂-C₆₀ alkenyl group” as used herein refers to a hydrocarbon group having at least one carbon double bond in the body (e.g., the middle) or at the terminus of the C₂-C₆₀ alkyl group, and non-limiting examples thereof may include an ethenyl group, a propenyl group, and a butenyl group. The term “C₂-C₆₀ alkenylene group” as used herein refers to a divalent group having substantially the same structure as the C₂-C₆₀ alkenyl group.

[0233] The term “C₂-C₆₀ alkynyl group” as used herein refers to a hydrocarbon group having at least one carbon triple bond in the body (e.g., the middle) or at the terminus of the C₂-C₆₀ alkyl group, and non-limiting examples thereof may include an ethynyl group and a propynyl group. The term “C₂-C₆₀ alkynylene group” as used herein refers to a divalent group having substantially the same structure as the C₂-C₆₀ alkynyl group.

[0234] The term “C₃-C₁₀ cycloalkyl group” as used herein refers to a monovalent saturated hydrocarbon monocyclic group having 3 to 10 carbon atoms, and non-limiting examples thereof may include a cyclopropyl group, a cyclobutyl group, a cyclopentyl group, a cyclohexyl group, and a cycloheptyl group. The term “C₃-C₁₀ cycloalkylene group” as used herein refers to a divalent group having substantially the same structure as the C₃-C₁₀ cycloalkyl group.

[0235] The term “C₁-C₁₀ heterocycloalkyl group” as used herein refers to a monovalent monocyclic group having at least one hetero atom selected from N, O, P, and S as a ring-forming atom and 1 to 10 carbon atoms, and non-limiting examples thereof may include a tetrahydrofuranlyl group and a tetrahydrothiophenyl group. The term “C₂-C₁₀ heterocycloalkylene group” as used herein refers to a divalent group having substantially the same structure as the C₂-C₁₀ heterocycloalkyl group.

[0236] The term “C₃-C₁₀ cycloalkenyl group” as used herein refers to a monovalent monocyclic group that has 3 to 10 carbon atoms and at least one double bond in the ring thereof and does not have aromaticity (e.g., is non-aromatic), and non-limiting examples thereof may include a cyclopentenyl group, a cyclohexenyl group, and a cycloheptenyl group. The term “C₃-C₁₀ cycloalkenylene group” as used herein refers to a divalent group having substantially the same structure as the C₃-C₁₀ cycloalkenyl group.

[0237] The term “C₂-C₁₀ heterocycloalkenyl group” as used herein refers to a monovalent monocyclic group that has at least one hetero atom selected from N, O, P, and S as a ring-forming atom, 2 to 10 carbon atoms, and at least one double bond in its ring. Non-limiting examples of the C₂-C₁₀ heterocycloalkenyl group may include a 2,3-hydrofuranlyl group and a 2,3-hydrothiophenyl group. The term “C₂-C₁ heterocycloalkenylene group” as used herein refers to a divalent group having substantially the same structure as the C₂-C₁₀ heterocycloalkenyl group.

[0238] The term “C₆-C₆₀ aryl group” as used herein refers to a monovalent group having a carbocyclic aromatic system having 6 to 60 carbon atoms, and the term “C₆-C₆₀ arylene group” as used herein refers to a divalent group having a carbocyclic aromatic system having 6 to 60 carbon atoms. Non-limiting examples of the C₆-C₆₀ aryl group may include a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, an anthracenyl group, a phenanthrenyl group, a pyrenyl group, and a chrysenyl group. When the C₆-C₆₀ aryl group and the C₆-C₆₀ arylene group each include two or more rings, the rings may be fused to each other.

[0239] The term “C₁-C₆₀ heteroaryl group” as used herein refers to a monovalent group having a carbocyclic aromatic system that has at least one hetero atom selected from N, O, P, and S as a ring-forming atom, and 2 to 60 carbon atoms. The term “C₁-C₆₀ heteroarylene group” as used herein refers to a divalent group having a carbocyclic aromatic system that has at least one hetero atom selected from N, O, P, and S as a ring-forming atom, and 2 to 60 carbon atoms. Non-limiting examples of the C₁-C₆₀ heteroaryl group may include a pyridinyl group, a pyrimidinyl group, a pyrazinyl group, a pyridazinyl group, a triazinyl group, a quinolinyl group, and an isoquinolinyl group. When the C₁-C₆₀ heteroaryl group and the C₁-C₆₀ heteroarylene group each include two or more rings, the rings may be fused to each other.

[0240] The term “C₆-C₆₀ aryloxy group” as used herein indicates —O-A₁₀₂ (wherein A₁₀₂ is a C₆-C₆₀ aryl group), and the term “C₆-C₆₀ arylthio group” as used herein indicates S-A₁₀₃ (wherein A₁₀₃ is a C₆-C₆₀ aryl group).

[0241] The term “monovalent non-aromatic condensed polycyclic group” as used herein refers to a monovalent group (for example, having 8 to 60 carbon atoms) that has two or more rings condensed to each other, only carbon atoms as a ring forming atom, and non-aromaticity in the entire molecular structure (e.g., is non-aromatic). A non-

limiting example of a monovalent non-aromatic condensed polycyclic group may include a fluorenyl group. The term “divalent non-aromatic condensed polycyclic group” as used herein refers to a divalent group having substantially the same structure as the monovalent non-aromatic condensed polycyclic group.

[0242] The term “monovalent non-aromatic condensed heteropolycyclic group” as used herein refers to a monovalent group (for example, having 2 to 60 carbon atoms) that has two or more rings condensed to each other, has a heteroatom selected from N, O, P, and S as a ring forming atom, other than carbon atoms, and has non-aromaticity in the entire molecular structure (e.g., is non-aromatic). The term “divalent non-aromatic condensed heteropolycyclic group” as used herein refers to a divalent group having substantially the same structure as the monovalent non-aromatic condensed heteropolycyclic group.

[0243] In the present specification, at least one substituent of the substituted C₃-C₁₀ cycloalkylene group, substituted C₂-C₁₀ heterocycloalkylene group, substituted C₃-C₁₀ cycloalkenylene group, substituted C₂-C₁₀ heterocycloalkenylene group, substituted C₆-C₆₀ arylene group, substituted C₁-C₆₀ heteroarylene group, substituted divalent non-aromatic condensed polycyclic group, substituted divalent non-aromatic condensed heteropolycyclic group, substituted C₁-C₆₀ alkyl group, substituted C₂-C₆₀ alkenyl group, substituted C₂-C₆₀ alkynyl group, substituted C₁-C₆₀ alkoxy group, substituted C₃-C₁₀ cycloalkyl group, substituted C₂-C₁₀ heterocycloalkyl group, substituted C₃-C₁ cycloalkenyl group, substituted C₂-C₁₀ heterocycloalkenyl group, substituted C₆-C₆₀ aryl group, substituted C₆-C₆₀ aryloxy group, substituted C₆-C₆₀ arylthio group, substituted C₁-C₆₀ heteroaryl group, substituted monovalent non-aromatic condensed polycyclic group, and substituted monovalent non-aromatic condensed heteropolycyclic group may be selected from:

[0244] deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C₁-C₆₀ alkyl group, a C₂-C₆₀ alkenyl group, a C₂-C₆₀ alkynyl group, and a C₁-C₆₀ alkoxy group;

[0245] a C₁-C₆₀ alkyl group, a C₂-C₆₀ alkenyl group, a C₂-C₆₀ alkynyl group, and a C₁-C₆₀ alkoxy group, each substituted with at least one selected from deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C₃-C₁₀ cycloalkyl group, a C₁-C₁₀ heterocycloalkyl group, a C₃-C₁₀ cycloalkenyl group, a C₂-C₁₀ heterocycloalkenyl group, a C₆-C₆₀ aryl group, a C₆-C₆₀ aryloxy group, a C₆-C₆₀ arylthio group, a C₂-C₆₀ heteroaryl group, a monovalent non-aromatic condensed polycyclic group, a monovalent non-aromatic condensed heteropolycyclic group, —N(Q₁₁)(Q₁₂), —Si(Q₁₃)(Q₁₄)(Q₁₅), and —B(Q₁₆)(Q₁₇),

[0246] a C₃-C₁₀ cycloalkyl group, a C₂-C₁₀ heterocycloalkyl group, a C₃-C₁₀ cycloalkenyl group, a C₂-C₁₀ heterocycloalkenyl group, a C₆-C₆₀ aryl group, a C₆-C₆₀ aryloxy group, a C₆-C₆₀ arylthio group, a C₁-C₆₀ heteroaryl

group, a monovalent non-aromatic condensed polycyclic group, and a monovalent non-aromatic condensed heteropolycyclic group;

[0247] a C₃-C₁₀ cycloalkyl group, a C₂-C₁₀ heterocycloalkyl group, a C₃-C₁₀ cycloalkenyl group, a C₂-C₁₀ heterocycloalkenyl group, a C₆-C₆₀ aryl group, a C₆-C₆₀ aryloxy group, a C₆-C₆₀ arylthio group, a C₂-C₆₀ heteroaryl group, a monovalent non-aromatic condensed polycyclic group, and a monovalent non-aromatic condensed heteropolycyclic group, each substituted with at least one selected from deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C₁-C₆₀ alkyl group, a C₂-C₆₀ alkenyl group, a C₁-C₆₀ alkynyl group, a C₁-C₆₀ alkoxy group, a C₃-C₁₀ cycloalkyl group, a C₂-C₁₀ heterocycloalkyl group, a C₃-C₁₀ cycloalkenyl group, a C₂-C₁₀ heterocycloalkenyl group, a C₆-C₆₀ aryl group, a C₆-C₆₀ aryloxy group, a C₆-C₆₀ arylthio group, a C₁-C₆₀ heteroaryl group, a monovalent non-aromatic condensed polycyclic group, a monovalent non-aromatic condensed heteropolycyclic group, —N(Q₂₁)(Q₂₂), —Si(Q₂₃)(Q₂₄)(Q₂₅), and —B(Q₂₆)(Q₂₇), and

[0248] —N(Q₃₁)(Q₃₂), —Si(Q₃₃)(Q₃₄)(Q₃₅), and —B(Q₃₆)(Q₃₇),

[0249] wherein Q₁₁ to Q₁₇, Q₂₁ to Q₂₇, and Q₃₁ to Q₃₇ may each independently be selected from hydrogen, deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C₁-C₆₀ alkyl group, a C₂-C₆₀ alkenyl group, a C₂-C₆₀ alkynyl group, a C₁-C₆₀ alkoxy group, a C₃-C₁₀ cycloalkyl group, a C₂-C₁₀ heterocycloalkyl group, a C₃-C₁₀ cycloalkenyl group, a C₂-C₁₀ heterocycloalkenyl group, a C₆-C₆₀ aryl group, a C₁-C₆₀ heteroaryl group, a monovalent non-aromatic condensed polycyclic group, and a monovalent non-aromatic condensed heteropolycyclic group.

[0250] For example, at least one substituent of the substituted C₃-C₁₀ cycloalkylene group, substituted C₂-C₁₀ heterocycloalkylene group, substituted C₃-C₁₀ cycloalkenylene group, substituted C₂-C₁₀ heterocycloalkenylene group, substituted C₆-C₆₀ arylene group, substituted C₁-C₆₀ heteroarylene group, substituted divalent non-aromatic condensed polycyclic group, substituted divalent non-aromatic condensed heteropolycyclic group, substituted C₁-C₆₀ alkyl group, substituted C₂-C₆₀ alkenyl group, substituted C₂-C₆₀ alkynyl group, substituted C₁-C₆₀ alkoxy group, substituted C₃-C₁₀ cycloalkyl group, substituted C₂-C₁₀ heterocycloalkyl group, substituted C₃-C₁₀ cycloalkenyl group, substituted C₂-C₁₀ heterocycloalkenyl group, substituted C₆-C₆₀ aryl group, substituted C₆-C₆₀ aryloxy group, substituted C₆-C₆₀ arylthio group, substituted C₁-C₆₀ heteroaryl group, substituted monovalent non-aromatic condensed polycyclic group, and substituted monovalent non-aromatic condensed heteropolycyclic group may be selected from:

[0251] deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt

thereof, a phosphoric acid group or a salt thereof, a C₁-C₆₀ alkyl group, a C₂-C₆₀ alkenyl group, a C₂-C₆₀ alkynyl group, and a C₁-C₆₀ alkoxy group;

[0252] a C₁-C₆₀ alkyl group, a C₂-C₆₀ alkenyl group, a C₂-C₆₀ alkynyl group, and a C₁-C₆₀ alkoxy group, each substituted with at least one selected from deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a cyclopentyl group, a cyclohexyl group, a cycloheptyl group, a cyclopentenyl group, a cyclohexenyl group, a phenyl group, a pentalenyl group, an indenyl group, a naphthyl group, an azulenyl group, a heptalenyl group, an indacenyl group, an acenaphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenalenyl group, a phenanthrenyl group, an anthracenyl group, a fluoranthenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a naphthacenyl group, a picenyl group, a perylenyl group, a pentaphenyl group, a hexacenyl group, a pentacenyl group, a rubicenyl group, a coronenyl group, an ovalenyl group, a pyrrolyl group, a thiophenyl group, a furanyl group, an imidazolyl group, a pyrazolyl group, a thiazolyl group, an isothiazolyl group, an oxazolyl group, an isoxazolyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, an indolyl group, an indazolyl group, a purinyl group, a quinolinyl group, an isoquinolinyl group, a benzoquinolinyl group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, a quinazolinyl group, a cinnolinyl group, a carbazolyl group, a phenanthridinyl group, an acridinyl group, a phenanthroli-nyl group, a phenazinyl group, a benzoimidazolyl group, a benzofuranyl group, a benzothiophenyl group, an isobenzothiazolyl group, a benzoxazolyl group, an isobenzoxazolyl group, a triazolyl group, a tetrazolyl group, an oxadiazolyl group, a triazinyl group, a dibenzofuranyl group, a dibenzothiophenyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a thiadiazolyl group, an imidazopyridinyl group, an imidazopyrimidinyl group, —N(Q₁₁)(Q₁₂), —Si(Q₁₃)(Q₁₄)(Q₁₅), and —B(Q₁₆)(Q₁₇);

[0253] a cyclopentyl group, a cyclohexyl group, a cycloheptyl group, a cyclopentenyl group, a cyclohexenyl group, a phenyl group, a pentalenyl group, an indenyl group, a naphthyl group, an azulenyl group, a heptalenyl group, an indacenyl group, an acenaphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzo-fluorenyl group, a phenalenyl group, a phenanthrenyl group, an anthracenyl group, a fluoranthenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a naphthacenyl group, a picenyl group, a perylenyl group, a pentaphenyl group, a hexacenyl group, a pentacenyl group, a rubicenyl group, a coronenyl group, an ovalenyl group, a pyrrolyl group, a thiophenyl group, a furanyl group, an imidazolyl group, a pyrazolyl group, a thiazolyl group, an isothiazolyl group, an oxazolyl group, an isoxazolyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, an indolyl group, an indazolyl group, a purinyl group, a quinolinyl group, an isoquinolinyl group, a benzoquinolinyl group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, a quinazolinyl group, a cinnolinyl group, a carbazolyl group, a phenanthridinyl group, an acridinyl group, a phenanthroli-nyl group, a phenazinyl group, a benzoimidazolyl group, a benzofura-

nyl group, a benzothiophenyl group, an isobenzothiazolyl group, a benzoxazolyl group, an isobenzoxazolyl group, a triazolyl group, a tetrazolyl group, an oxadiazolyl group, a triazinyl group, a dibenzofuranyl group, a dibenzothiophenyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a thiadiazolyl group, an imidazopyridinyl group, and an imidazopyrimidinyl group;

[0254] a cyclopentyl group, a cyclohexyl group, a cycloheptyl group, a cyclopentenyl group, a cyclohexenyl group, a phenyl group, a pentalenyl group, an indenyl group, a naphthyl group, an azulenyl group, a heptalenyl group, an indacenyl group, an acenaphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenalenyl group, a phenanthrenyl group, an anthracenyl group, a fluoranthenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a naphthacenyl group, a picenyl group, a perylenyl group, a pentaphenyl group, a hexacenyl group, a pentacenyl group, a rubicenyl group, a coronenyl group, an ovalenyl group, a pyrrolyl group, a thiophenyl group, a furanyl group, an imidazolyl group, a pyrazolyl group, a thiazolyl group, an isothiazolyl group, an oxazolyl group, an isoxazolyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, an indolyl group, an indazolyl group, a purinyl group, a quinoliny group, an isoquinoliny group, a benzoquinoliny group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, a quinazolinyl group, a cinnoliny group, a carbazolyl group, a phenanthridinyl group, an acridinyl group, a phenanthrolinyl group, a phenazinyl group, a benzoimidazolyl group, a benzofuranyl group, a benzothiophenyl group, an isobenzothiazolyl group, a benzoxazolyl group, an isobenzoxazolyl group, a triazolyl group, a tetrazolyl group, an oxadiazolyl group, a triazinyl group, a dibenzofuranyl group, a dibenzothiophenyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a thiadiazolyl group, an imidazopyridinyl group, and an imidazopyrimidinyl group, each substituted with at least one selected from deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1 - C_{60} alkyl group, a C_2 - C_{60} alkenyl group, a C_2 - C_{60} alkynyl group, a C_1 - C_{60} alkoxy group, a cyclopentyl group, a cyclohexyl group, a cycloheptyl group, a cyclopentenyl group, a cyclohexenyl group, a phenyl group, a pentalenyl group, an indenyl group, a naphthyl group, an azulenyl group, a heptalenyl group, an indacenyl group, an acenaphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenalenyl group, a phenanthrenyl group, an anthracenyl group, a fluoranthenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a naphthacenyl group, a picenyl group, a perylenyl group, a pentaphenyl group, a hexacenyl group, a pentacenyl group, a rubicenyl group, a coronenyl group, an ovalenyl group, a pyrrolyl group, a thiophenyl group, a furanyl group, an imidazolyl group, a pyrazolyl group, a thiazolyl group, an isothiazolyl group, an oxazolyl group, an isoxazolyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, an indolyl group, an indazolyl group, a purinyl group, a quinoliny group, an isoquinoliny group, a benzoquinoliny group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, a quinazolinyl group, a

cinnoliny group, a carbazolyl group, a phenanthridinyl group, an acridinyl group, a phenanthrolinyl group, a phenazinyl group, a benzoimidazolyl group, a benzofuranyl group, a benzothiophenyl group, an isobenzothiazolyl group, a benzoxazolyl group, an isobenzoxazolyl group, a triazolyl group, a tetrazolyl group, an oxadiazolyl group, a triazinyl group, a dibenzofuranyl group, a dibenzothiophenyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a thiadiazolyl group, an imidazopyridinyl group, an imidazopyrimidinyl group, —N(Q_{21})(Q_{22}), —Si(Q_{23})(Q_{24})(Q_{25}), and —B(Q_{26})(Q_{27}); and

[0255] —N(Q_{31})(Q_{32}), —Si(Q_{33})(Q_{34})(Q_{35}), and —B(Q_{36})(Q_{37}).

[0256] wherein Q_{11} to Q_{17} , Q_{21} to Q_{27} , and Q_{31} to Q_{37} may each independently be selected from hydrogen, deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1 - C_{60} alkyl group, a C_2 - C_{60} alkenyl group, a C_2 - C_{60} alkynyl group, a C_1 - C_{60} alkoxy group, a cyclopentyl group, a cyclohexyl group, a cycloheptyl group, a cyclopentenyl group, a cyclohexenyl group, a phenyl group, a pentalenyl group, an indenyl group, a naphthyl group, an azulenyl group, a heptalenyl group, an indacenyl group, an acenaphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenalenyl group, a phenanthrenyl group, an anthracenyl group, a fluoranthenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a naphthacenyl group, a picenyl group, a perylenyl group, a pentaphenyl group, a hexacenyl group, a pentacenyl group, a rubicenyl group, a coronenyl group, an ovalenyl group, a pyrrolyl group, a thiophenyl group, a furanyl group, an imidazolyl group, a pyrazolyl group, a thiazolyl group, an isothiazolyl group, an oxazolyl group, an isoxazolyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, an indolyl group, an indazolyl group, a purinyl group, a quinoliny group, an isoquinoliny group, a benzoquinoliny group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, a quinazolinyl group, a cinnoliny group, a carbazolyl group, a phenanthridinyl group, an acridinyl group, a phenanthrolinyl group, a phenazinyl group, a benzoimidazolyl group, a benzofuranyl group, a benzothiophenyl group, an isobenzothiazolyl group, a benzoxazolyl group, an isobenzoxazolyl group, a triazolyl group, a tetrazolyl group, an oxadiazolyl group, a triazinyl group, a dibenzofuranyl group, a dibenzothiophenyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a thiadiazolyl group, an imidazopyridinyl group, and an imidazopyrimidinyl group.

[0257] The term “Ph” as used herein refers to a phenyl group, the term “Me” as used herein refers to a methyl group, the term “Et” as used herein refers to an ethyl group, and the term “ter-Bu” or “Bu” as used herein refers to a tert-butyl group.

[0258] Hereinafter, an organic light-emitting device according to an embodiment of the present disclosure will be described in more detail with reference to Synthesis Examples and Examples.

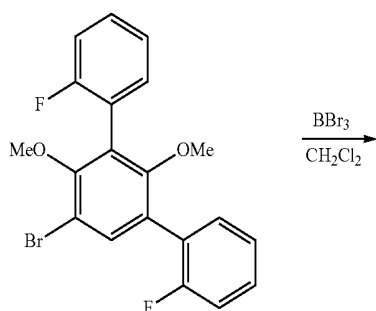
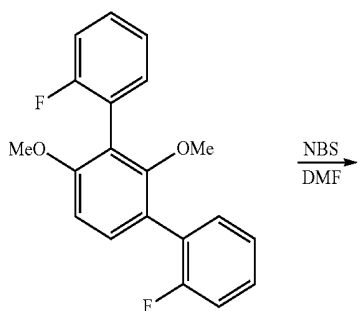
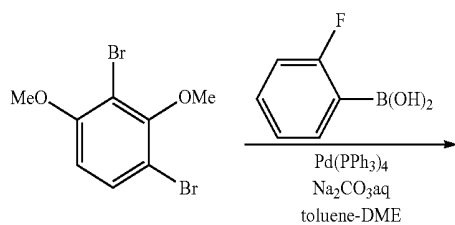
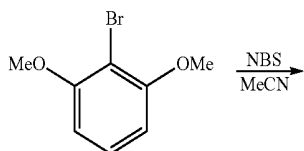
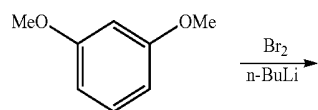
SYNTHESIS EXAMPLE

[0259] Compound 1, 2, and 3 were synthesized using the schemes below, respectively:

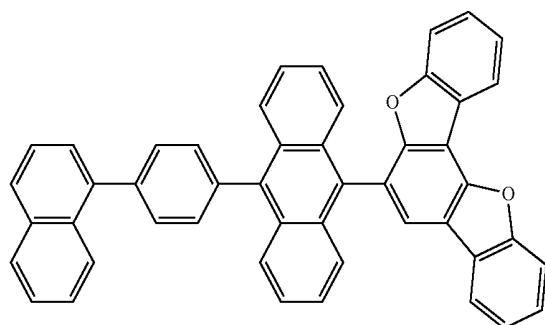
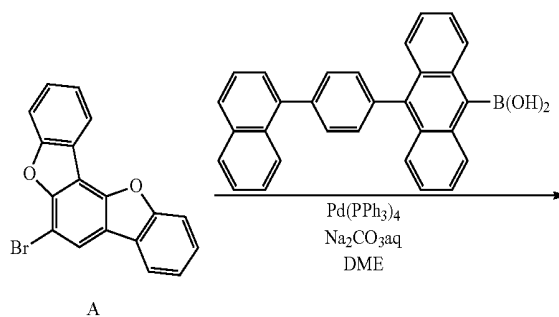
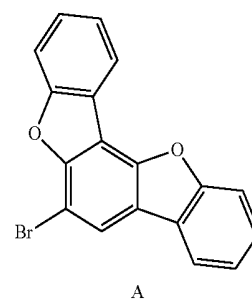
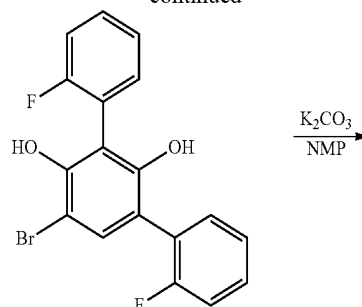
Synthesis Example 1

Synthesis of Compound 1

[0260]



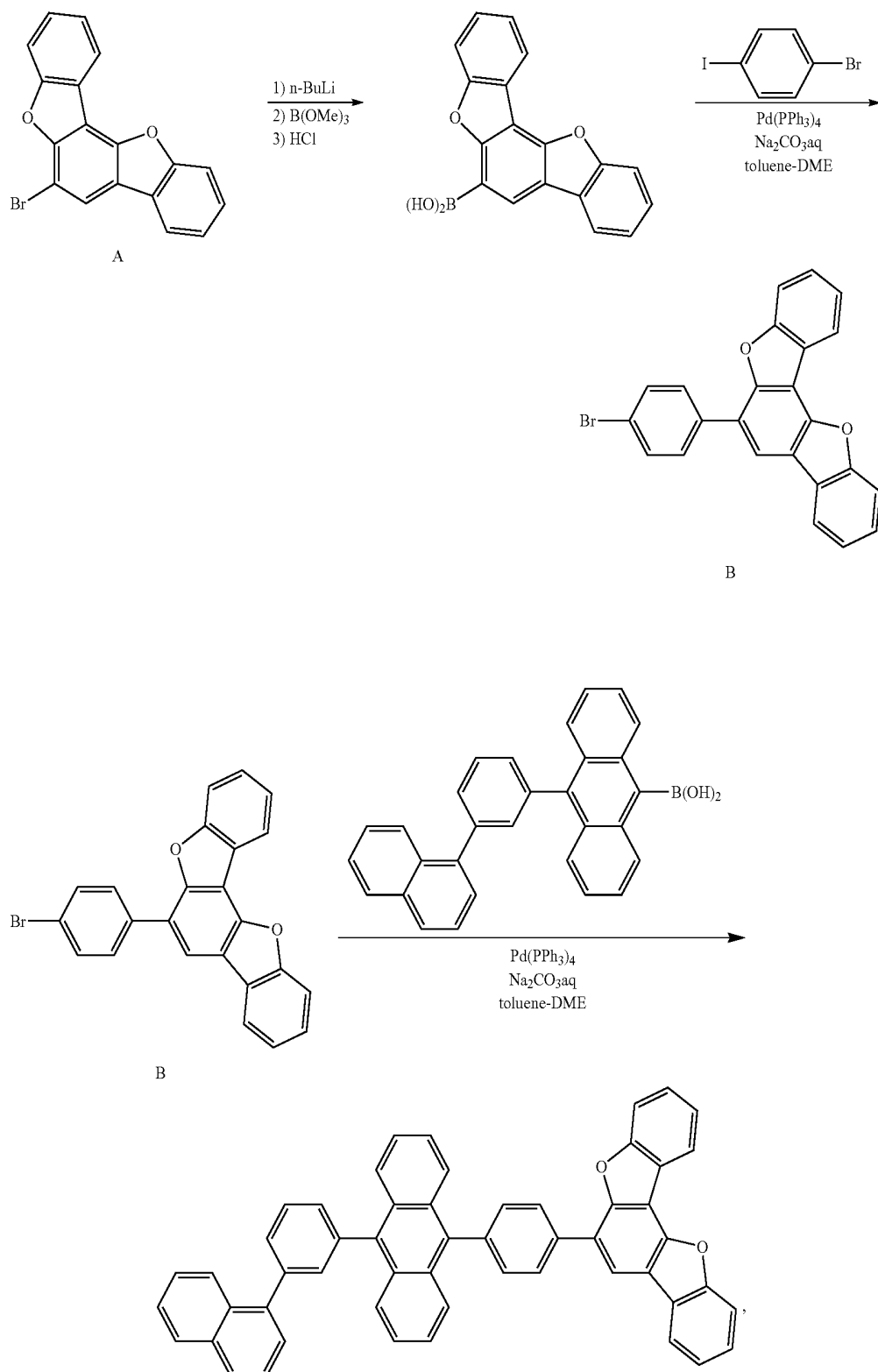
-continued



1

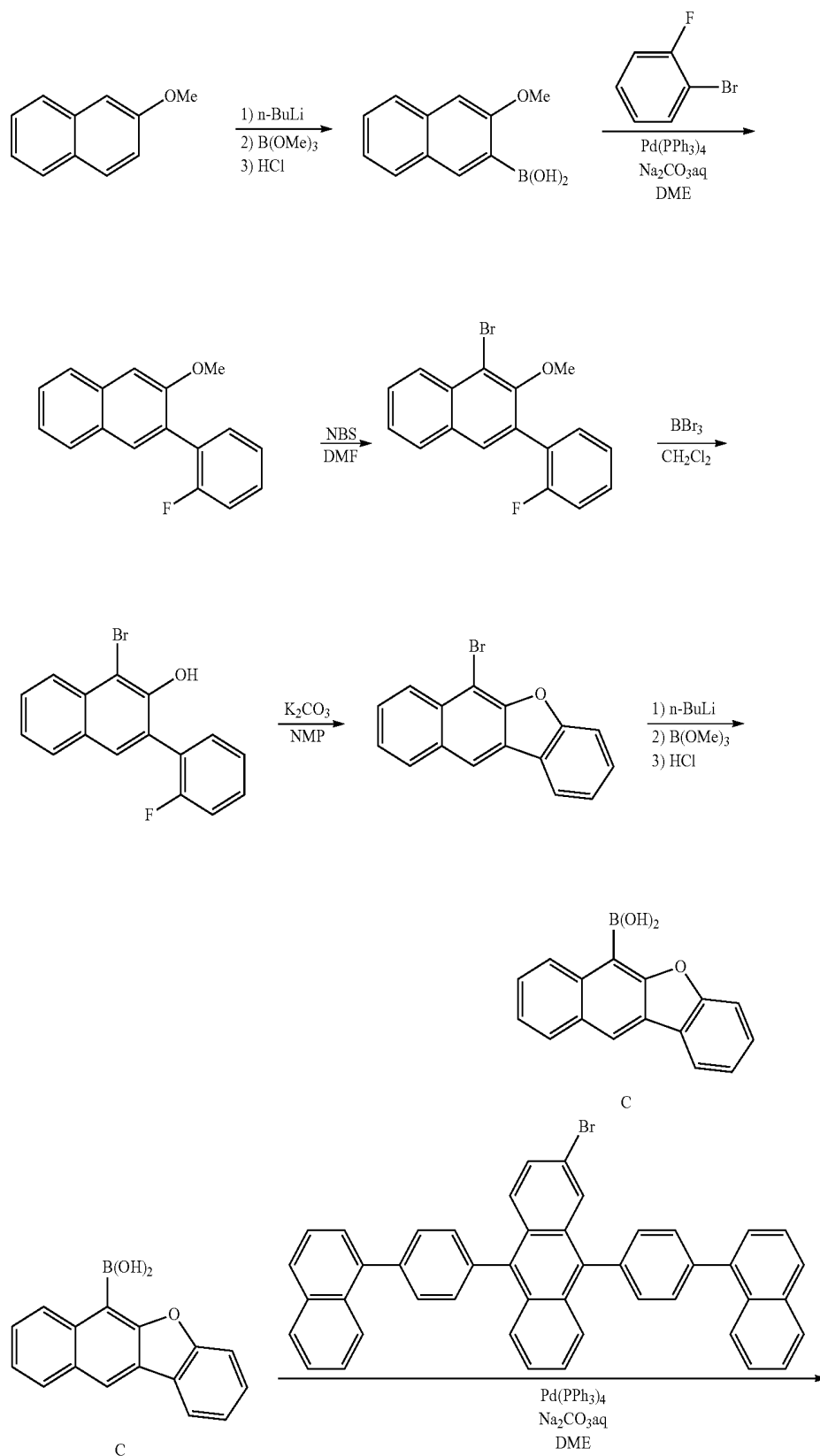
Synthesis Example 2
Synthesis of Compound 2

[0261]

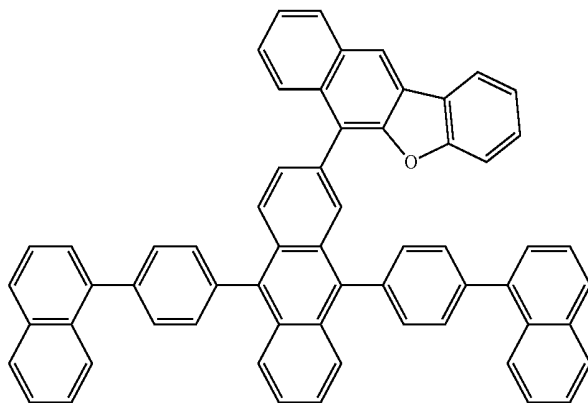


Synthesis Example 3
Synthesis of Compound 3

[0262]



-continued



3

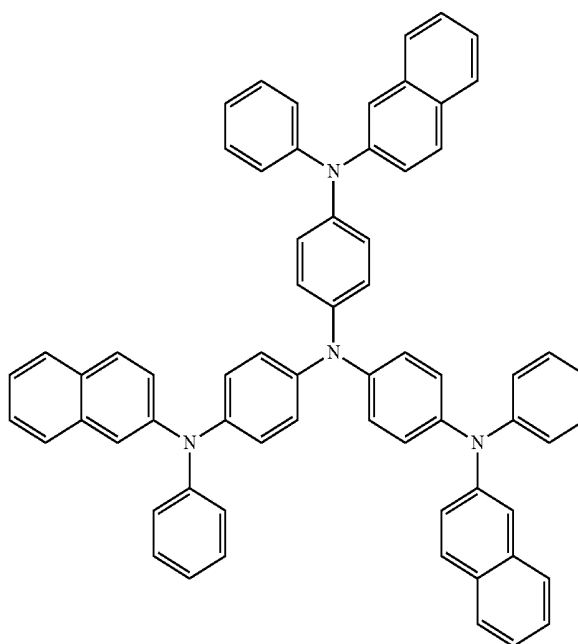
EXAMPLE

Example 1

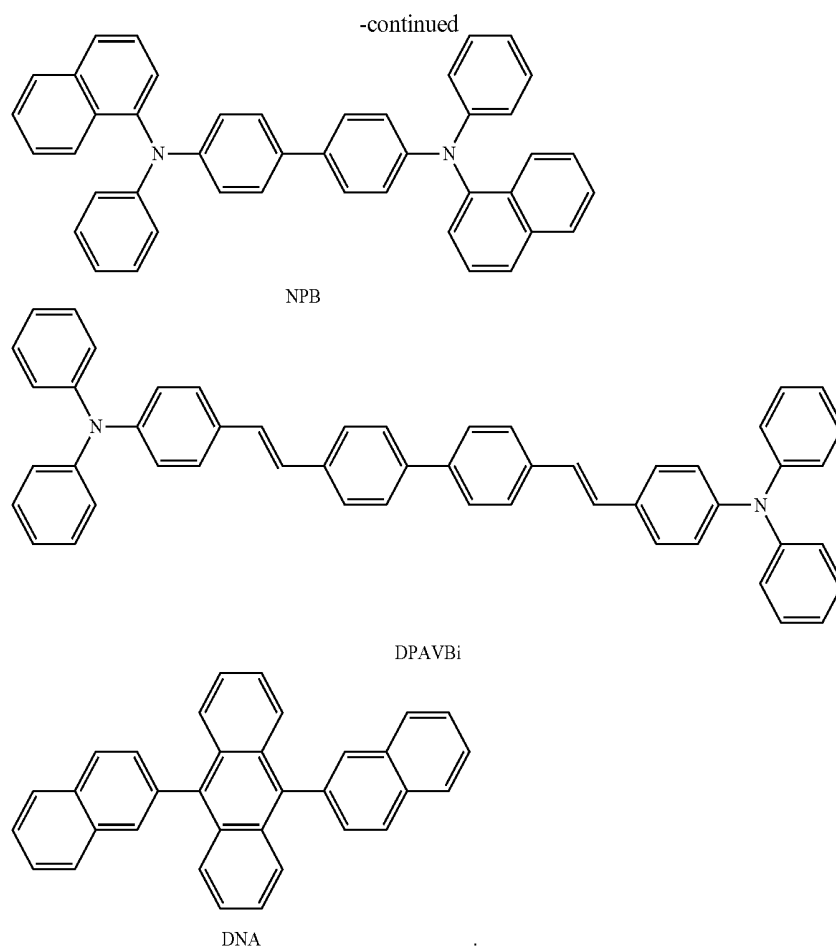
[0263] A Corning 15 Ohms per square centimeter (Ω/cm^2) (1200 Å) ITO glass substrate was cut to a size of 50 millimeters (mm)×50 mm×0.7 mm, sonicated using isopropyl alcohol and deionized water for 5 minutes, respectively, cleaned by irradiating ultraviolet rays for 30 minutes, and exposed to ozone so as to use the glass substrate as an anode. Then, the glass substrate was mounted to a vacuum deposition device.

[0264] 2-TNATA was vacuum-deposited on the glass substrate to form a hole injection layer having a thickness of about 600 Å. Thereafter, a hole transporting material, 4,4'-bis[N-(1-naphthyl)-N-phenylamino]biphenyl (hereinafter referred to as "NPB") was vacuum-deposited on the hole injection layer to form a hole transport layer having a thickness of about 300 Å.

[0265] On the hole transport layer, DNA (a blue fluorescent host) and 4,4'-bis[2-(4-(N,N-diphenylamino)phenyl)vinyl]biphenyl (hereinafter referred to as "DPAVB"), a blue fluorescent dopant) were co-deposited in a weight ratio of about 98:2 to form an emission layer having a thickness of about 300 Å.



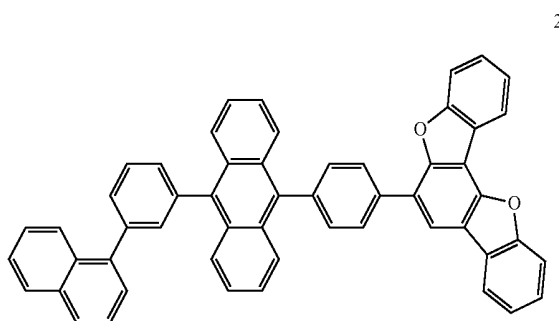
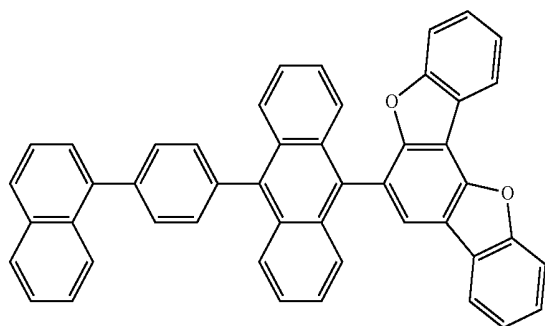
2-TNATA



[0266] Compound 1 was then deposited on the emission layer to form a buffer layer having a thickness of about 10 Å.

Example 2

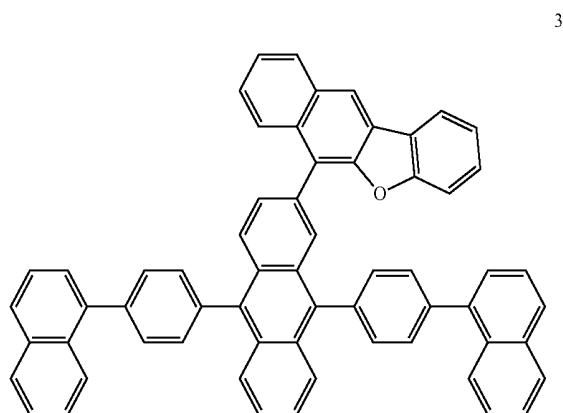
[0268] An organic light-emitting device was manufactured in substantially the same manner as in Example 1, except that Compound 2 was used instead of Compound 1 to form a buffer layer having a thickness of about 30 Å.



[0267] Afterwards, Alq₃ was deposited on the buffer layer to form an electron transport layer having a thickness of about 300 Å. LiF, an alkali metal halide, was then deposited on the electron transport layer to form an electron injection layer having a thickness of about 10 Å. Next, aluminum (Al) was vacuum-deposited on the electron injection layer to form a cathode having a thickness of about 3,000 Å, thereby forming a LiF/Al electrode to complete the manufacture of an organic light-emitting device.

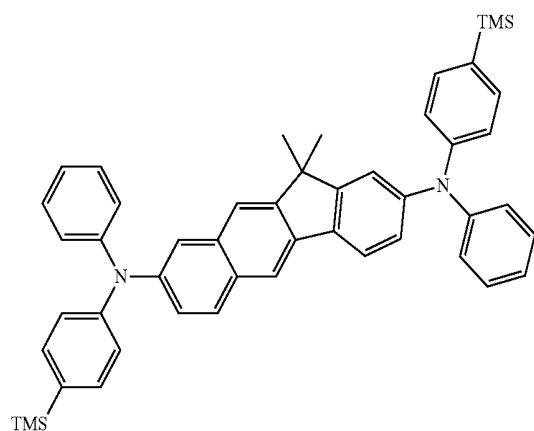
Example 3

[0269] An organic light-emitting device was manufactured in substantially the same manner as in Example 1, except that Compound 3 was used instead of Compound 1 to form a buffer layer having a thickness of about 50 Å.



Comparative Example 1

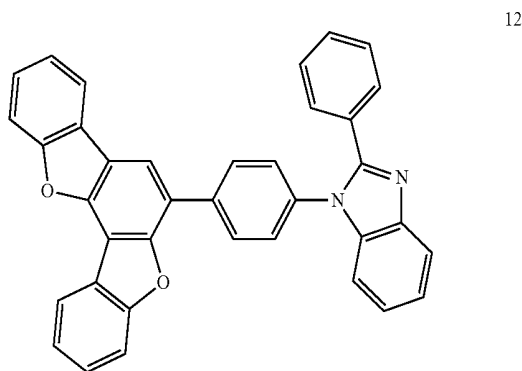
[0270] An organic light-emitting device was manufactured in substantially the same manner as in Example 1, except that Compound 12 was used instead of Compound 1 to form a buffer layer.



instead of Compound 1, were co-deposited in a weight ratio of 97:3 to form a buffer layer having a thickness of about 50 Å.

Example 5

[0274] An organic light-emitting device was manufactured in substantially the same manner as in Example 4, except that Compound 3 and dopant

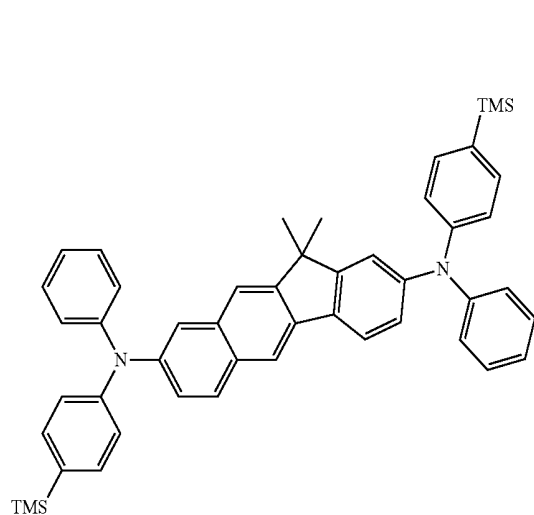


[0271] For comparison, a graph of grey level versus current efficiency (cd/A) of the organic light-emitting devices of Examples 1 to 3 and Comparative Example 1 is shown in FIG. 3.

[0272] Referring to FIG. 3, the organic light-emitting devices of Examples 1 to 3 were found to have improved efficiencies at low grey levels, as compared to the organic light-emitting device of Comparative Example 1.

Example 4

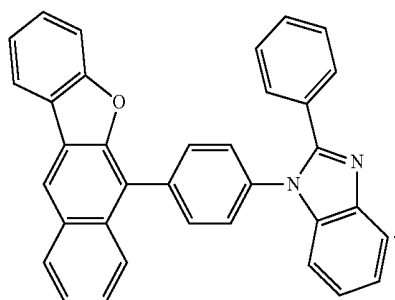
[0273] An organic light-emitting device was manufactured in substantially the same manner as in Example 1, except that Compound 2 and dopant



instead of Compound 1, were co-deposited in a weight ratio of 97:3 to form a buffer layer having a thickness of about 100 Å.

Comparative Example 2

[0275] An organic light-emitting device was manufactured in substantially the same manner as in Example 4, except that Compound 11 was used instead of Compound 1 to form a buffer layer.



[0276] For comparison, a graph of grey level versus current efficiency (cd/A) of the organic light-emitting devices of Examples 4 and 5 and Comparative Example 2 is shown in FIG. 4.

[0277] Referring to FIG. 4, the organic light-emitting devices of Examples 4 and 5 were found to have improved efficiencies at low grey levels, as compared to the organic light-emitting device of Comparative Example 2.

[0278] A compound represented by Formula 1 according to embodiments of the present disclosure is used in a buffer layer to reduce efficiency drops in a low grey level (e.g., grey level of 0 to 80).

[0279] It should be understood that the example embodiments described herein should be considered in a descriptive sense only and not for purposes of limitation. Descriptions of features or aspects within each example embodiment should typically be considered as available for other similar features or aspects in other example embodiments.

[0280] As used herein, the terms “use”, “using”, and “used” may be considered synonymous with the terms “utilize”, “utilizing”, and “utilized”, respectively. Further, the use of “may” when describing embodiments of the present disclosure refers to “one or more embodiments of the present disclosure”.

[0281] As used herein, the terms “substantially”, “about”, and similar terms are used as terms of approximation and not as terms of degree, and are intended to account for the inherent deviations in measured or calculated values that would be recognized by those of ordinary skill in the art.

[0282] Also, any numerical range recited herein is intended to include all subranges of the same numerical precision subsumed within the recited range. For example, a range of “1.0 to 10.0” is intended to include all subranges between (and including) the recited minimum value of 1.0 and the recited maximum value of 10.0, that is, having a minimum value equal to or greater than 1.0 and a maximum value equal to or less than 10.0, such as, for example, 2.4 to 7.6. Any maximum numerical limitation recited herein is intended to include all lower numerical limitations subsumed therein and any minimum numerical limitation recited in this specification is intended to include all higher numerical limitations subsumed therein. Accordingly, Applicant reserves the right to amend this specification, including the claims, to expressly recite any sub-range subsumed within the ranges expressly recited herein.

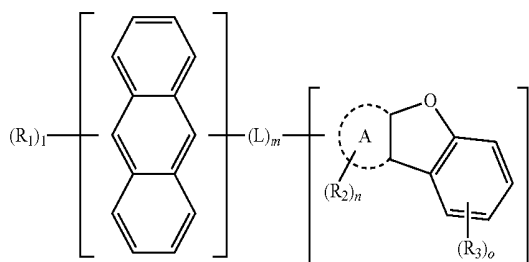
[0283] While one or more example embodiments have been described with reference to the drawings, it will be understood by those of ordinary skill in the art that various changes in form and details may be made therein without

departing from the spirit and scope as defined by the following claims and equivalents thereof.

What is claimed is:

1. A compound represented by Formula 1:

Formula 1

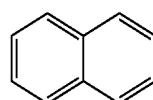


wherein, in Formula 1,

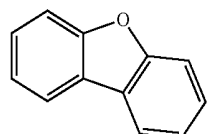
R₁ to R₃ are each independently selected from hydrogen, deuterium, a substituted or unsubstituted C₁-C₆₀ alkyl group, a substituted or unsubstituted C₂-C₆₀ alkenyl group, a substituted or unsubstituted C₂-C₆₀ alkynyl group, a substituted or unsubstituted C₁-C₆₀ alkoxy group, a substituted or unsubstituted C₃-C₁₀ cycloalkyl group, a substituted or unsubstituted C₂-C₁₀ heterocycloalkyl group, a substituted or unsubstituted C₃-C₁₀ cycloalkenyl group, a substituted or unsubstituted C₂-C₁₀ heterocycloalkenyl group, a substituted or unsubstituted C₆-C₆₀ aryl group, a substituted or unsubstituted C₆-C₆₀ aryloxy group, a substituted or unsubstituted C₆-C₆₀ arylthio group, and a substituted or unsubstituted monovalent non-aromatic condensed polycyclic group,

L is selected from a substituted or unsubstituted C₆-C₆₀ arylene group, and a substituted or unsubstituted divalent non-aromatic condensed polycyclic group,

A is a moiety selected from Formula 2a and 2b,



2a



2b

l is an integer selected from 1 to 4,

m is an integer selected from 0 to 3,

n is an integer selected from 1 to 6,

o is an integer selected from 1 to 4, and

at least one substituent of the substituted C₁-C₆₀ alkyl group, substituted C₂-C₆₀ alkenyl group, substituted C₂-C₆₀ alkynyl group, substituted C₁-C₆₀ alkoxy group, substituted C₃-C₁₀ cycloalkyl group, substituted C₂-C₁₀ heterocycloalkyl group, substituted C₃-C₁₀ cycloalkenyl group, substituted C₂-C₁₀ heterocycloalkenyl group, substituted C₆-C₆₀ aryl group, substituted C₆-C₆₀ arylene group, substituted C₆-C₆₀ aryloxy

group, substituted C_6-C_{60} arylthio group, substituted monovalent non-aromatic condensed polycyclic group, and substituted divalent non-aromatic condensed polycyclic group is selected from:

deuterium, $-F$, $-Cl$, $-Br$, $-I$, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, $Si(Q_1)(Q_2)(Q_3)$, $P(=O)(Q_4)(Q_5)$, a C_1-C_{60} alkyl group, a C_2-C_{60} alkenyl group, a C_2-C_{60} alkynyl group, and a C_1-C_{60} alkoxy group;

a C_1-C_{60} alkyl group, a C_2-C_{60} alkenyl group, a C_2-C_{60} alkynyl group, and a C_1-C_{60} alkoxy group, each substituted with at least one selected from deuterium, $-F$, $-Cl$, $-Br$, $-I$, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_3-C_{10} cycloalkyl group, a C_2-C_{10} heterocycloalkyl group, a C_3-C_{10} cycloalkenyl group, a C_2-C_{10} heterocycloalkenyl group, a C_6-C_{60} aryl group, a C_6-C_{60} aryloxy group, a C_6-C_{60} arylthio group, a monovalent non-aromatic condensed polycyclic group, $-N(Q_{11})(Q_{12})$, $-Si(Q_{13})(Q_{14})(Q_{16})$, and $-B(Q_{16})(Q_{17})$;

a C_3-C_{10} cycloalkyl group, a C_2-C_{10} heterocycloalkyl group, a C_3-C_{10} cycloalkenyl group, a C_2-C_{10} heterocycloalkenyl group, a C_6-C_{60} aryl group, a C_6-C_{60} aryloxy group, a C_6-C_{60} arylthio group, and a monovalent non-aromatic condensed polycyclic group; and

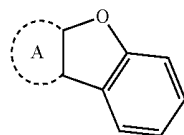
a C_3-C_{10} cycloalkyl group, a C_2-C_{10} heterocycloalkyl group, a C_3-C_{10} cycloalkenyl group, a C_2-C_{10} heterocycloalkenyl group, a C_6-C_{60} aryl group, a C_6-C_{60} aryloxy group, a C_6-C_{60} arylthio group, and a monovalent non-aromatic condensed polycyclic group, each substituted with at least one selected from deuterium, $-F$, $-Cl$, $-Br$, $-I$, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{60} alkyl group, a C_2-C_{60} alkenyl group, a C_2-C_{60} alkynyl group, a C_1-C_{60} alkoxy group, a C_3-C_{10} cycloalkyl group, a C_2-C_{10} heterocycloalkyl group, a C_3-C_{10} cycloalkenyl group, a C_2-C_{10} heterocycloalkenyl group, a C_6-C_{60} aryl group, a C_6-C_{60} aryloxy group, a C_6-C_{60} arylthio group, a monovalent non-aromatic condensed polycyclic group, $-N(Q_{21})(Q_{22})$, $-Si(Q_{23})(Q_{24})(Q_{26})$, and $-B(Q_{26})(Q_{27})$,

wherein Q_1 to Q_5 , Q_{11} to Q_{17} , and Q_{21} to Q_{27} are each independently selected from hydrogen, deuterium, $-F$, $-Cl$, $-Br$, $-I$, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{60} alkyl group, a C_2-C_{60} alkenyl group, a C_2-C_{60} alkynyl group, a C_1-C_{60} alkoxy group, a C_3-C_{10} cycloalkyl group, a C_2-C_{10} heterocycloalkyl group, a

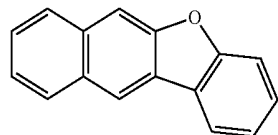
C_3-C_{10} cycloalkenyl group, a C_2-C_{10} heterocycloalkenyl group, a C_6-C_{60} aryl group, and a monovalent non-aromatic condensed polycyclic group.

2. The compound of claim 1, wherein:

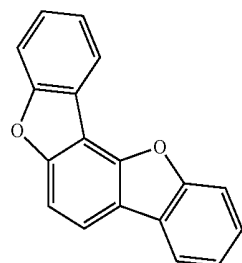
a



moiety in Formula 1 is selected from Formula 3a and Formula 3b:

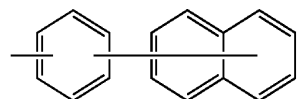


3a



3b

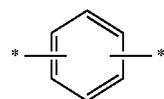
3. The compound of claim 1, wherein R_1 in Formula 1 is Formula 4a:



4a

wherein $*$ in Formula 4a indicates a binding site.

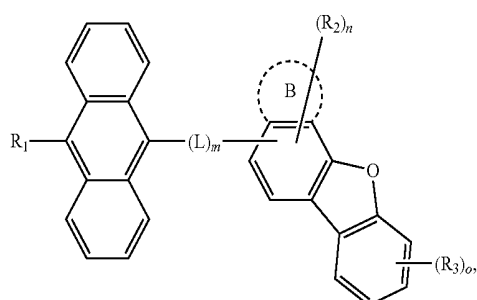
4. The compound of claim 1, wherein L in Formula 1 is Formula 5a:



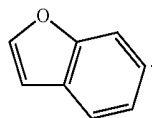
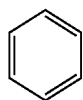
5a

wherein $*$ in Formula 5a indicates a binding site.

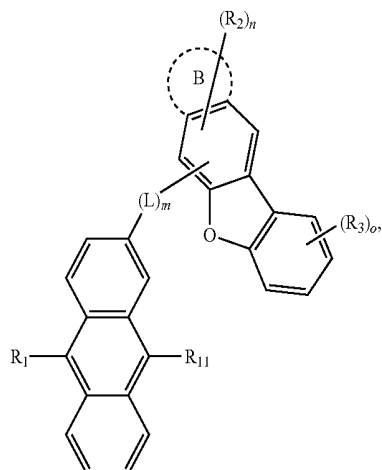
5. The compound of claim 1, wherein Formula 1 is further represented by Formula 2:



wherein B in Formula 2 is a moiety selected from Formula 6a and 6b:

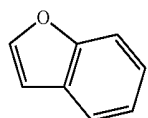


6. The compound of claim 1, wherein Formula 1 is further represented by Formula 3:

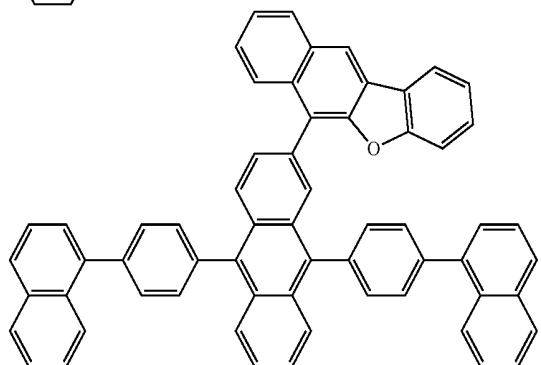
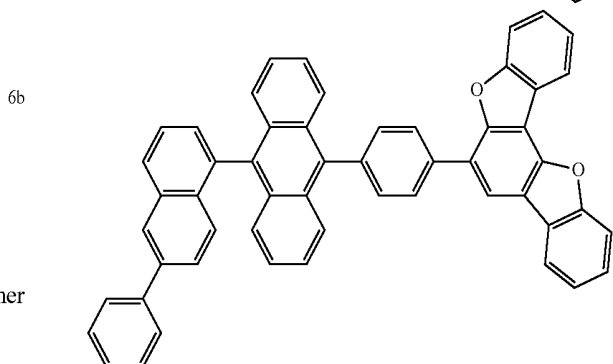
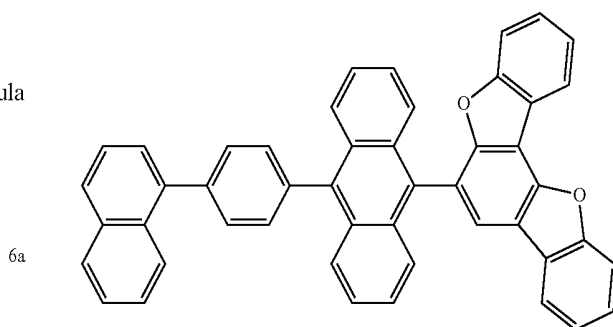


wherein, in Formula 3, R₁₁ is the same as described herein in connection with R₁, and

B indicates a moiety selected from Formula 6a and 6b:



7. The compound of claim 1, wherein the compound of Formula 1 is selected from compounds illustrated below:



8. An organic light-emitting device comprising:
a first electrode;
a second electrode facing the first electrode; and
an organic layer between the first electrode and the second electrode, the organic layer comprising an emission layer,
wherein the organic layer comprises the compound of claim 1.

9. The organic light-emitting device of claim 8, wherein: the first electrode is an anode, the second electrode is a cathode, and the organic layer comprises:

- i) a hole transport region between the first electrode and the emission layer, the hole transport region comprising at least one selected from a hole injection layer, a hole transport layer, and an electron blocking layer, and
- ii) an electron transport region between the emission layer and the second electrode, the electron transport region comprising a buffer layer, and at least one selected from an electron transport layer and an electron injection layer.

10. The organic light-emitting device of claim 9, wherein the buffer layer comprises the compound of claim 1.

11. The organic light-emitting device of claim 9, wherein the buffer layer comprises the compound of claim 1 and a dopant.

12. The organic light-emitting device of claim 11, wherein the dopant is a metal complex.

13. The organic light-emitting device of claim 11, wherein the dopant is a benzofluorene derivative compound.

14. The organic light-emitting device of claim 9, wherein a thickness of the buffer layer is 10 Å to 150 Å.

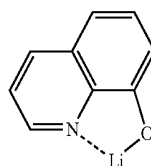
15. The organic light-emitting device of claim 9, wherein the hole transport region comprises a charge-generation material.

16. The organic light-emitting device of claim 15, wherein the charge-generation material is a p-dopant.

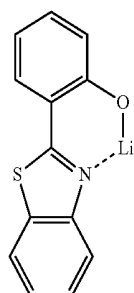
17. The organic light-emitting device of claim 16, wherein the p-dopant is one selected from a quinone derivative, a metal oxide, and a cyano-containing compound.

18. The organic light-emitting device of claim 9, wherein the electron transport region comprises a Li complex.

19. The organic light-emitting device of claim 9, wherein the electron transport region comprises at least one selected from ET-D1 and ET-D2:



ET-D1



ET-D2

20. A display device comprising the organic light-emitting device of claim 8, wherein the first electrode of the organic light-emitting device is electrically connected to one selected from a source electrode and a drain electrode.

* * * * *

专利名称(译)	包括其的化合物和有机发光装置		
公开(公告)号	US20170054086A1	公开(公告)日	2017-02-23
申请号	US15/053629	申请日	2016-02-25
[标]申请(专利权)人(译)	三星显示有限公司		
申请(专利权)人(译)	三星DISPLAY CO. , LTD.		
当前申请(专利权)人(译)	三星DISPLAY CO. , LTD.		
[标]发明人	LEE YOUNGTAK IM JAHYUN		
发明人	LEE, YOUNGTAK IM, JAHYUN		
IPC分类号	H01L51/00 C07D493/04 C07D307/77 H01L27/32		
CPC分类号	H01L51/0073 H01L27/3248 H01L51/0058 H01L51/0094 H01L51/0077 C07D493/04 H01L51/006 H01L51/0072 H01L2251/558 H01L51/0054 H01L51/5076 H01L51/5008 H01L51/506 C07D307/77 C09K11/06 H01L51/508 H01L2251/308		
优先权	1020150118269 2015-08-21 KR		
其他公开文献	US10014481		
外部链接	Espacenet USPTO		

摘要(译)

当有机发光装置的低灰度级区域(例如, 0至80灰度)效率的降低不恒定时, 显示面板之间的偏差可能导致低亮度区域中的颜色变化和污点。本公开的方面涉及克服该问题的化合物和包含该化合物的有机发光装置。该化合物可由式1表示: 发现在缓冲层中包括该化合物的有机发光器件在低灰度级下具有改进的效率。

190
150
110