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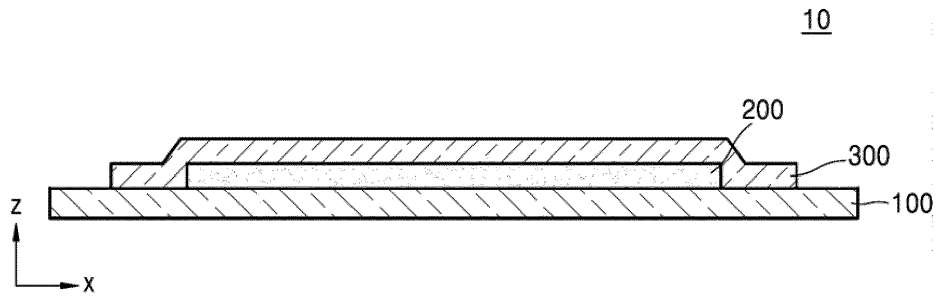
(54) ORGANIC LIGHT-EMITTING DISPLAY APPARATUS

(57) An organic light-emitting display apparatus includes a substrate, an organic light-emitting device disposed above the substrate, and an encapsulation unit disposed above the organic light-emitting device and sealing the organic light-emitting device, wherein the encapsulation unit includes a compound represented by Formula 1.

Formula 1

$$[R_1\text{-}(L_1)_{a1}]_{b1}\text{-}(Ar_1)_{c1}\text{-}[(L_2)_{a2}\text{-}R_2]_{b2}$$

FIG. 1



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Description

BACKGROUND

1. Field

[0001] One or more embodiments relate to an organic light-emitting display apparatus.

2. Description of the Related Art

[0002] An organic light-emitting display apparatus is a self-emission device and includes an organic light-emitting device, which includes a hole injection electrode, an electron injection electrode, and an organic emission layer between the hole injection electrode and the electron injection electrode. Holes provided from the hole injection electrode and electrons provided from the electron injection electrode recombine in the organic emission layer to produce excitons. These excitons transit from an excited state to a ground state, thereby generating light.

[0003] Because the organic light-emitting display apparatus, which is a self-emission device, does not require a separate light source, the organic light-emitting display apparatus may be driven at a low voltage and configured to be lightweight and thin. Also, because of excellent characteristics in terms of a viewing angle, contrast, response time, and/or the like, the applications of the organic light-emitting display apparatus have expended from personal portable devices (such as MP3 players or mobile phones) to televisions.

[0004] However, if ultraviolet rays or the like are introduced from the outside into the organic light-emitting display apparatus, or if ultraviolet rays are introduced in the process of manufacturing the organic light-emitting display apparatus and penetrate into the organic light-emitting display apparatus, an emission layer, an insulating film, and/or the like including an organic material may be particularly seriously damaged.

SUMMARY

[0005] Aspects of the present disclosure are directed toward an organic light-emitting display apparatus capable of reducing an amount of ultraviolet rays transmitting through the organic light-emitting display apparatus.

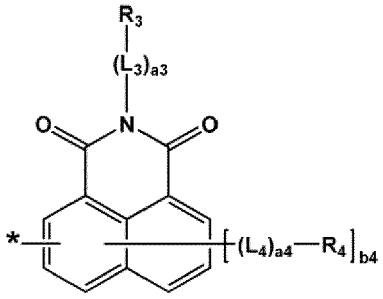
[0006] Additional aspects will be set forth in part in the description which follows and, in part, will be apparent from the description, or may be learned by practice of the presented embodiments.

[0007] According to an embodiment of the present disclosure, an organic light-emitting display apparatus includes:

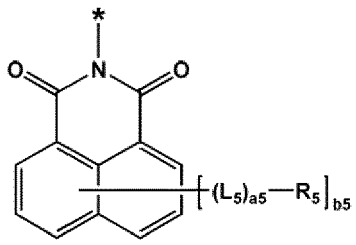
a substrate;
an organic light-emitting device on the substrate; and
an encapsulation unit on the organic light-emitting device and configured to seal the organic light-emitting device,
wherein the encapsulation unit includes a first compound represented by Formula 1:

Formula 1 $[R_1\text{-}(L_1)_{a1}]_{b1}\text{-}(Ar_1)_{c1}\text{-}[(L_2)_{a2}\text{-}R_2]_{b2}$

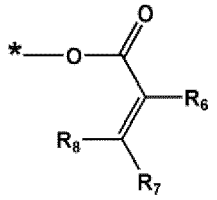
Formula 2-1



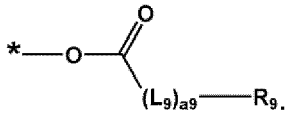
Formula 2-2



Formula 2-3



Formula 2-4



[0008] In Formulae 1 and 2-1 to 2-4,

Ar_1 is a C_5-C_{60} carbocyclic group or a C_2-C_{30} heterocyclic group,
c1 is 0 or 1,
L_1 to L_5 and L_9 are each independently selected from *-$N(R_{11})$-*', *-$B(R_{11})$-*', *-$P(R_{11})$-*', *-$Si(R_{11})(R_{12})$-*', *-S-*', *-Se-*', *-O-*', *-C(=O)-*' *-S(=O)-*' *-$S(=O)_2$-*', *-$C(R_{11})$=*', *-C(=S)-*', a substituted or unsubstituted C_1-C_{60} alkylene group, a substituted or unsubstituted C_2-C_{60} alkenylene group, a substituted or unsubstituted C_2-C_{60} alkynylene group, a substituted or unsubstituted C_3-C_{10} cycloalkylene group, a substituted or unsubstituted C_1-C_{10} heterocycloalkylene group, a substituted or unsubstituted C_3-C_{10} cycloalkenylene group, a substituted or unsubstituted C_1-C_{10} heterocycloalkenylene group, a substituted or unsubstituted C_6-C_{60} arylene group, a substituted or unsubstituted C_1-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,
a1 to a5 and a9 are each independently an integer from 0 to 10,
R_1 is a group represented by Formula 2-1 or a group represented by Formula 2-2,
R_2 to R_5 are each independently selected from a group represented by Formula 2-3, a group represented by Formula 2-4, hydrogen, deuterium, -F, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, a hydrazono group, 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_{60} cycloalkoxy group, a substituted or unsubstituted C_3-C_{10} cycloalkyl group, a substituted or unsubstituted C_1-C_{10} heterocycloalkyl group, a substituted or unsubstituted C_3-C_{10} cycloalkenyl group, a substituted or unsubstituted C_1-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, a substituted or unsubstituted C_1-C_{60} heteroaryl group, a substituted or unsubstituted monovalent non-aromatic condensed polycyclic group, a substituted or unsubstituted monovalent non-aromatic condensed heteropolycyclic group, $Si(Q_1)(Q_2)(Q_3)$, $-N(Q_1)(Q_2)$, $-B(Q_1)(Q_2)$, $-C(=O)(Q_1)$, $-S(=O)_2(Q_1)$, and $-P(=O)(Q_1)(Q_2)$,
R_6 to R_9, R_{11}, and R_{12} are each independently selected from hydrogen, deuterium, -F, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, a hydrazono group, 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_{60} cycloalkoxy group, a substituted or unsubstituted C_3-C_{10} cycloalkyl group, a substituted or unsubstituted C_1-C_{10} heterocycloalkyl group, a substituted or unsubstituted C_3-C_{10} cycloalkenyl group, a substituted or unsubstituted C_1-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, a substituted or unsubstituted C_1-C_{60} heteroaryl group, a substituted or unsubstituted monovalent non-aromatic condensed polycyclic group, a substituted or unsubstituted monovalent non-aromatic condensed heteropolycyclic group, $Si(Q_4)(Q_5)(Q_6)$, $-N(Q_4)(Q_5)$, $-B(Q_4)(Q_5)$, $-C(=O)(Q_4)$, $-S(=O)_2(Q_4)$, and $-P(=O)(Q_4)(Q_5)$,
b1 is an integer from 1 to 10, wherein, when b1 is two or more, two or more *-$(L_1)_{a1}$-R_1(s) are identical to or different from each other,
b2 is an integer from 1 to 10, wherein, when b2 is two or more, two or more *-$(L_2)_{a2}$-R_2(s) are identical to or different from each other,
b4 is an integer from 0 to 5, wherein, when b4 is two or more, two or more *-$(L_4)_{a4}$-R_4(s) are identical to or different from each other,
b5 is an integer from 0 to 6, wherein, when b5 is two or more, two or more *-$(L_5)_{a5}$-R_5(s) are identical to or different from each other,
at least one substituent of the substituted C_1-C_{60} alkylene group, the substituted C_2-C_{60} alkenylene group, the substituted C_2-C_{60} alkynylene group, the substituted C_3-C_{10} cycloalkylene group, the substituted C_1-C_{10} heterocycloalkylene group, the substituted C_3-C_{10} cycloalkenylene group, the substituted C_1-C_{10} heterocycloalkenylene group, the substituted C_6-C_{60} arylene group, the substituted C_1-C_{60} heteroarylene group, the substituted divalent non-aromatic condensed polycyclic group, the substituted divalent non-aromatic condensed heteropolycyclic group,

the substituted C_1-C_{60} alkyl group, the substituted C_2-C_{60} alkenyl group, the substituted C_2-C_{60} alkynyl group, the substituted C_1-C_{60} alkoxy group, the substituted C_3-C_{60} cycloalkoxy group, the substituted C_3-C_{10} cycloalkyl group, the substituted C_1-C_{10} heterocycloalkyl group, the substituted C_3-C_{10} cycloalkenyl group, the substituted C_1-C_{10} heterocycloalkenyl group, the substituted C_6-C_{60} aryl group, the substituted C_6-C_{60} aryloxy group, the substituted C_6-C_{60} arylthio group, the substituted C_1-C_{60} heteroaryl group, the substituted monovalent non-aromatic condensed polycyclic group, and the substituted monovalent non-aromatic condensed heteropolycyclic group is selected from:

deuterium, -F, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, a hydrazono group, 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, and a C_3-C_{60} cycloalkoxy group;

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, and a C_3-C_{60} cycloalkoxy group, each substituted with at least one selected from deuterium, -F, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, a hydrazono group, a C_3-C_{10} cycloalkyl group, a C_1-C_{10} heterocycloalkyl group, a C_3-C_{10} cycloalkenyl group, a C_1-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,-$Si(Q_{11})(Q_{12})(Q_{13})$, -$N(Q_{11})(Q_{12})$, -$B(Q_{11})(Q_{12})$, -$C(=O)(Q_{11})$, -$S(=O)_2(Q_{11})$, and-$P(=O)(Q_{11})(Q_{12})$;

a C_3-C_{10} cycloalkyl group, a C_1-C_{10} heterocycloalkyl group, a C_3-C_{10} cycloalkenyl group, a C_1-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, a biphenyl group, and a terphenyl group;

a C_3-C_{10} cycloalkyl group, a C_1-C_{10} heterocycloalkyl group, a C_3-C_{10} cycloalkenyl group, a C_1-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, each substituted with at least one selected from deuterium, -F, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, a hydrazono group, 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_{60} cycloalkoxy group, a C_3-C_{10} cycloalkyl group, a C_1-C_{10} heterocycloalkyl group, a C_3-C_{10} cycloalkenyl group, a C_1-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,-$Si(Q_{21})(Q_{22})(Q_{23})$, -$N(Q_{21})(Q_{22})$, -$B(Q_{21})(Q_{22})$, -$C(=O)(Q_{21})$, -$S(=O)_2(Q_{21})$, and-$P(=O)(Q_{21})(Q_{22})$; and

-$Si(Q_{31})(Q_{32})(Q_{33})$, -$N(Q_{31})(Q_{32})$, -$B(Q_{31})(Q_{32})$, -$C(=O)(Q_{31})$, -$S(=O)_2(Q_{31})$, and -$P(=O)(Q_{31})(Q_{32})$,

Q_1 to Q_6, Q_{11} to Q_{13}, Q_{21} to Q_{23}, and Q_{31} to Q_{33} may each independently be selected from hydrogen, deuterium, -F, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, a hydrazono group, 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_{60} cycloalkoxy group, a C_3-C_{10} cycloalkyl group, a C_1-C_{10} heterocycloalkyl group, a C_3-C_{10} cycloalkenyl group, a C_1-C_{10} heterocycloalkenyl group, a C_6-C_{60} aryl group, a C_6-C_{60} aryl group substituted with a C_1-C_{60} alkyl group, a C_6-C_{60} aryl group substituted with a C_6-C_{60} aryl group, a terphenyl group, a C_1-C_{60} heteroaryl group, a C_1-C_{60} heteroaryl group substituted with a C_1-C_{60} alkyl group, a C_1-C_{60} heteroaryl group substituted with a C_6-C_{60} aryl group, a monovalent non-aromatic condensed polycyclic group, a monovalent non-aromatic condensed heteropolycyclic group, a biphenyl group, and a terphenyl group, and

* and *' each indicate a binding site to a neighboring atom.

[0009] According to another embodiment, an organic light-emitting display apparatus includes:

a substrate;

an organic emission unit on the substrate and including a plurality of organic light-emitting devices; and

an encapsulation unit on the organic emission unit and sealing the organic emission unit,

wherein the encapsulation unit includes a first compound represented by Formula 1.

[0010] At least some of the above and other features of the invention are set out in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] These and/or other aspects will become apparent and more readily appreciated from the following description of the embodiments, taken in conjunction with the accompanying drawings in which:

FIG. 1 is a schematic cross-sectional view of an organic light-emitting display apparatus according to an embodiment; and

FIG. 2 is a schematic cross-sectional view of an organic light-emitting display apparatus according to another embodiment.

DETAILED DESCRIPTION

[0012] The present disclosure will now be described more fully with reference to embodiments. The disclosure may, however, be embodied in many different forms and should not be construed as being limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the concept of the disclosure to those skilled in the art. Enhancements and features of the present invention and how to achieve them will become apparent by reference to the embodiment that will be described later in more detail, together with the accompanying drawings. This invention may, however, be embodied in many different forms and should not be limited to the embodiments.

[0013] Hereinafter, embodiments are described in more detail by referring to the accompanying drawings. In the drawings, like reference numerals denote like elements, and a redundant explanation thereof will not be provided herein.

[0014] It will be understood that when a layer, film, region, or plate is referred to as being "formed on" another layer, film, region, or plate, it can be directly or indirectly formed on the other layer, film, region, or plate. That is, for example, intervening layers, films, regions, or plates may be present. In addition, sizes of components in the drawings may be exaggerated for convenience of explanation. In other words, because sizes and thicknesses of components in the drawings are arbitrarily illustrated for convenience of explanation, the following embodiments of the present disclosure are not limited thereto.

[0015] Hereinafter, the terms "first, second, etc.," are used only for the purpose of distinguishing one element from another.

[0016] In the following Examples, the x-axis and the z-axis are not limited to two axes on the rectangular coordinate system, and may be interpreted in a broader sense. For example, the x-axis and the z-axis may cross each other at right angles, but they may also refer to different directions that the axes do not cross each other at right angles.

[0017] FIG. 1 is a schematic cross-sectional view of an organic light-emitting display apparatus according to an embodiment.

[0018] In FIG. 1, an organic light-emitting display apparatus 10 according to an embodiment includes a substrate 100, an organic light-emitting device 200, and an encapsulation unit 300.

[0019] The substrate 100 may be any one of various suitable substrates that are utilized in an organic light-emitting display apparatus in the related art, and may be an inorganic substrate or an organic substrate, each having high mechanical strength, thermal stability, transparency, surface smoothness, ease of handling, and/or water repellency.

[0020] For example, the substrate may be an inorganic substrate made of a transparent glass material including SiO_2 as a main component, but embodiments of the present disclosure are not limited thereto.

[0021] In one or more embodiments, the substrate may be an organic substrate having an insulating property. An organic material having the insulating property may be selected from, for example, polyethersulphone (PES), polyacrylate (PAR), polyetherimide (PEI), polyethylene naphthalate (PEN), polyethyleneterephthalate (PET), polyphenylene sulfide (PPS), polyallylate, polyimide, polycarbonate (PC), cellulose triacetate (TAC), and cellulose acetate propionate (CAP), but embodiments of the present disclosure are not limited thereto.

[0022] The organic light-emitting device 200 is disposed on the substrate 100. The organic light-emitting device 200 may include a first electrode, an intermediate layer including an emission layer, and a second electrode.

[0023] The first electrode may be formed by, for example, depositing or sputtering a material for forming the first electrode on the substrate. When the first electrode is an anode, the material for forming the first electrode may be selected from materials with a high work function to facilitate hole injection.

[0024] The first electrode may be a reflective electrode, a semi-transmissive electrode, or a transmissive electrode. When the first electrode is a transmissive electrode, a material for forming the first electrode may be selected from indium tin oxide (ITO), indium zinc oxide (IZO), tin oxide (SnO_2), zinc oxide (ZnO), and any combinations thereof, but embodiments of the present disclosure are not limited thereto. In one or more embodiments, when the first electrode is a semi-transmissive electrode or a reflective electrode, a material for forming the first electrode may be selected from magnesium (Mg), silver (Ag), aluminium (Al), aluminium-lithium (Al-Li), calcium (Ca), magnesium-indium (Mg-In), magnesium-silver (Mg-Ag), and any combinations thereof, but embodiments of the present disclosure are not limited thereto.

[0025] The first electrode may have a single-layered structure, or a multi-layered structure including two or more layers. For example, the first electrode may have a three-layered structure of ITO/Ag/ITO, but the structure of the first electrode is not limited thereto.

[0026] On the first electrode, an interlayer including an emission layer may be disposed.

[0027] The interlayer may further include a hole transport region between the first electrode and the emission layer,

and an electron transport region between the emission layer and the second electrode.

[0028] On the interlayer, the second electrode may be disposed. The second electrode may be a cathode that is an electron injection electrode, and in this regard, a metal for forming the second electrode may be a material having a low work function, such as a metal, an alloy, an electrically conductive compound, or a mixture thereof.

[0029] The second electrode may include at least one selected from lithium (Li), silver (Ag), magnesium (Mg), aluminium (Al), aluminium-lithium (Al-Li), calcium (Ca), magnesium-indium (Mg-In), magnesium-silver (Mg-Ag), ITO, and IZO, but embodiments of the present disclosure are not limited thereto. The second electrode may be a transmissive electrode, a semi-transmissive electrode, or a reflective electrode.

[0030] The first electrode may have a single-layered structure, or a multi-layered structure including two or more layers.

[0031] On the organic light-emitting device 200, the encapsulation unit 300 may be disposed.

[0032] The encapsulation unit 300 includes a first compound represented by Formula 1 below:

Formula 1 $$[R_1\text{-}(L_1)_{a1}]_{b1}\text{-}(Ar_1)_{c1}\text{-}(L_2)_{a2}\text{-}R_2]_{b2}$$

[0033] In Formula 1, Ar_1 is a C_5-C_{60} carbocyclic group or a C_2-C_{30} heterocyclic group. For the avoidance of doubt, the C_5-C_{60} carbocyclic group or a C_2-C_{30} heterocyclic group is unsubstituted.

[0034] For example, Ar_1 may be a C_5-C_{30} carbocyclic group or a C_2-C_{30} heterocyclic group. For example, Ar_1 may be a C_6-C_{30} carbocyclic group or a C_2-C_{20} heterocyclic group. For example, Ar_1 may be a C_6-C_{20} carbocyclic group or a C_2-C_{20} heterocyclic group. For example, Ar_1 may be a C_6-C_{14} carbocyclic group or a C_2-C_{12} heterocyclic group. For example, Ar_1 may be a C_6-C_{14} carbocyclic group or a C_3-C_{12} heterocyclic group.

[0035] For example, Ar_1 may be selected from a benzene group, a naphthalene group, an anthracene group, a phenanthrene group, a pyrene group, a chrysene group, a triphenylene group, an indene group, a fluorene group, a benzofluorene group, a spiro-bifluorene group, a carbazole group, a dibenzofuran group, a dibenzothiophene group, a pyridine group, a pyrazine group, a pyrimidine group, a pyridazine group, a pyrrole group, an imidazole group, a quinoline group, an isoquinoline group, a quinoxaline group, a quinazoline group, a triazine group, an indeno pyrazine group, an indeno pyridine group, a phenanthroline group, and a phenanthridine group.

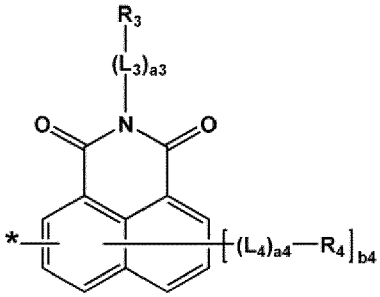
[0036] In one embodiment, Ar_1 may be selected from a benzene group, a naphthalene group, an anthracene group, a fluorene group, a spiro-bifluorene group, a carbazole group, a dibenzofuran group, a dibenzothiophene group, a pyridine group, a pyrazine group, a pyrimidine group, a pyridazine group, and a triazine group.

[0037] In one or more embodiments, Ar_1 may be selected from a benzene group, a naphthalene group, an anthracene group, a dibenzofuran group, a dibenzothiophene group, a pyridine group, and a triazine group, but embodiments of the present disclosure are not limited thereto.

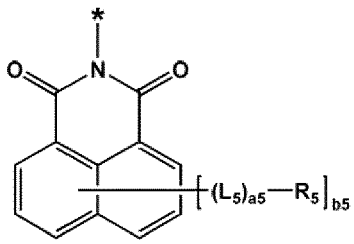
[0038] In Formula 1, c1 is 0 or 1. c1 indicates the number of Ar_1, and when c1 is 0, *-Ar_1-*' is a single bond.

[0039] In Formula 1, R_1 is a group represented by Formula 2-1 or a group represented by Formula 2-2:

Formula 2-1



Formula 2-2

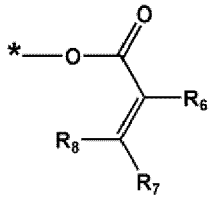


[0040] In Formulae 2-1 and 2-2, L_3 to L_5, a3 to a5, R_3 to R_5, b4, and b5 are the same as described above and below, and * indicates a binding site to a neighboring atom.

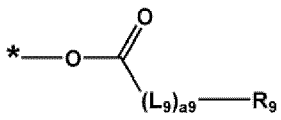
[0041] In Formulae 1, 2-1, and 2-2, R_2 to R_5 are each independently selected from: a group represented by Formula 2-3, a group represented by Formula 2-4, hydrogen, deuterium, -F, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, a hydrazono group, a substituted or unsubstituted C_1-C_{60} (*e.g.* C_1-C_{20}) alkyl group, a substituted or unsubstituted C_2-C_{60} (*e.g.* C_2-C_{20}) alkenyl group, a substituted or unsubstituted C_2-C_{60} (*e.g.* C_2-C_{20}) alkynyl group, a substituted or unsubstituted C_1-C_{60} (*e.g.* C_1-C_{20}) alkoxy group, a substituted or unsubstituted C_3-C_{60} (*e.g.* C_3-C_{20}) cycloalkoxy group, a substituted or unsubstituted C_3-C_{10} cycloalkyl group, a substituted or unsubstituted C_1-C_{10} heterocycloalkyl group, a substituted or unsubstituted C_3-C_{10} cycloalkenyl group, a substituted or unsubstituted C_1-C_{10} heterocycloalkenyl group, a substituted or unsubstituted C_6-C_{60} (*e.g.* C_6-C_{30}) aryl group, a substituted or unsubstituted C_6-C_{60} (*e.g.* C_6-C_{30}) aryloxy group, a substituted or unsubstituted C_6-C_{60} (*e.g.* C_6-C_{30}) arylthio

group, a substituted or unsubstituted C_1-C_{60} (*e.g.* C_1-C_{20}) heteroaryl group, a substituted or unsubstituted monovalent non-aromatic condensed polycyclic group, a substituted or unsubstituted monovalent non-aromatic condensed heteropolycyclic group, $Si(Q_1)(Q_2)(Q_3)$, $-N(Q_1)(Q_2)$, $-B(Q_1)(Q_2)$,$-C(=O)(Q_1)$, $-S(=O)_2(Q_1)$, and $-P(=O)(Q_1)(Q_2)$:

Formula 2-3



Formula 2-4



[0042] Q_1 to Q_3, L_9, a9, and R_6 to R_9 are the same as described above and below, and * indicates a binding site to a neighboring atom.

[0043] In Formulae 1, 2-1, 2-2, and 2-4, L_1 to L_5 and L_9 are each independently be selected from $*-N(R_{11})-*'$, $*-B(R_{11})-*'$, $*-P(R_{11})-*'$, $*-Si(R_{11})(R_{12})-*'$, *-S-*', *-Se-*', *-O-*', $*-C(=O)-*'$, $*-S(=O)-*'$, $*-S(=O)_2-*'$, $*-C(R_{11})=*'$, $*-C(=S)-*'$, a substituted or unsubstituted C_1-C_{60} (*e.g.* C_1-C_{20}) alkylene group, a substituted or unsubstituted C_2-C_{60} (*e.g.* C_2-C_{20}) alkenylene group, a substituted or unsubstituted C_2-C_{60} (*e.g.* C_2-C_{20}) alkynylene group, a substituted or unsubstituted C_3-C_{10} cycloalkylene group, a substituted or unsubstituted C_1-C_{10} heterocycloalkylene group, a substituted or unsubstituted C_3-C_{10} cycloalkenylene group, a substituted or unsubstituted C_1-C_{10} heterocycloalkenylene group, a substituted or unsubstituted C_6-C_{60} (*e.g.* C_6-C_{30}) arylene group, a substituted or unsubstituted C_1-C_{60} (*e.g.* C_1-C_{30}) heteroarylene group, a substituted or unsubstituted divalent non-aromatic condensed polycyclic group, and a substituted or unsubstituted divalent non-aromatic condensed heteropolycyclic group.

[0044] For example, L_1 to L_5 and L_9 may each independently be selected from: *-S-*', *-O-*', $*-C(=O)-*'$, $*-S(=O)-*'$, $*-S(=O)_2-*'$, a substituted or unsubstituted C_1-C_{20} alkylene group, a substituted or unsubstituted C_2-C_{20} alkenylene group, a substituted or unsubstituted C_2-C_{20} alkynylene group, a substituted or unsubstituted C_6-C_{30} arylene group and a substituted or unsubstituted C_1-C_{30} (*e.g.* C_1-C_{20}) heteroarylene group.

[0045] For example, L_1 to L_5 and L_9 may each independently be selected from:

-S-', *-O-*', $*-C(=O)-*'$, $*-S(=O)-*'$, $*-S(=O)_2-*'$, a C_1-C_{20} alkylene group, a C_2-C_{20} alkenylene group, a C_2-C_{20} alkynylene group, a phenylene group, a pentalenylene group, an indenylene group, a naphthylene group, an azulenylene group, an indacenylene group, an acenaphthylene group, a fluorenylene group, a spiro-bifluorenylene group, a spiro-benzofluorene-fluorenylene group, a benzofluorenylene group, a dibenzofluorenylene group, a phenalenylene group, a phenanthrenylene group, an anthracenylene group, a fluoranthenylene group, a triphenylenylene group, a pyrenylene group, a chrysenylene group, a perylenylene group, a pentaphenylene group, a pyrrolylene group, a thiophenylene group, a furanylene group, a silolylene group, an imidazolylene group, a pyrazolylene group, a thiazolylene group, an isothiazolylene group, an oxazolylene group, an isoxazolylene group, a pyridinylene group, a pyrazinylene group, a pyrimidinylene group, a pyridazinylene group, an indolylene group, an isoindolylene group, an indazolylene group, a purinylene group, a quinolinylene group, an isoquinolinylene group, a benzoquinolinylene group, a phthalazinylene group, a naphthyridinylene group, a quinoxalinylene group, a quinazolinylene group, a cinnolinylene group, a phenanthridinylene group, an acridinylene group, a phenanthrolinylene group, a phenazinylene group, a benzimidazolylene group, a benzofuranylene group, a benzothiophenylene group, a benzosilolylene group, an isobenzothiazolylene group, a benzoxazolylene group, an isobenzoxazolylene group, a triazolylene group, a tetrazolylene group, an oxadiazolylene group, a triazinylene group, a dibenzofuranylene group, a dibenzothiophenylene group, a dibenzosilolylene group, a carbazolylene group, a benzocarbazolylene group, a dibenzocarbazolylene group, a thiadiazolylene group, an imidazopyridinylene group, an imidazopyrimidinylene group, an oxazolopyridinylene group, a thiazolopyridinylene group, a benzonaphthyridinylene group, an azafluorenylene group, an azaspiro-bifluorenylene group, an azacarbazolylene group, an azadibenzofuranylene group, an azadibenzothiophenylene group, and an azadibenzosilolylene group; and

a C_1-C_{20} alkylene group, a C_2-C_{20} alkenylene group, a C_2-C_{20} alkynylene group, a phenylene group, a pentalenylene group, an indenylene group, a naphthylene group, an azulenylene group, an indacenylene group, an acenaphthylene group, a fluorenylene group, a spiro-bifluorenylene group, a spiro-benzofluorene-fluorenylene group, a benzofluorenylene group, a dibenzofluorenylene group, a phenalenylene group, a phenanthrenylene group, an anthracenylene group, a fluoranthenylene group, a triphenylenylene group, a pyrenylene group, a chrysenylene group, a perylenylene group, a pentaphenylene group, a pyrrolylene group, a thiophenylene group, a furanylene group, a silolylene group, an imidazolylene group, a pyrazolylene group, a thiazolylene group, an isothiazolylene group, an oxazolylene group, an isoxazolylene group, a pyridinylene group, a pyrazinylene group, a pyrimidinylene group, a

pyridazinylene group, an indolylene group, an isoindolylene group, an indazolylene group, a purinylene group, a quinolinylene group, an isoquinolinylene group, a benzoquinolinylene group, a phthalazinylene group, a naphthyridinylene group, a quinoxalinylene group, a quinazolinylene group, a cinnolinylene group, a phenanthridinylene group, an acridinylene group, a phenanthrolinylene group, a phenazinylene group, a benzimidazolylene group, a benzofuranylene group, a benzothiophenylene group, a benzosilolylene group, an isobenzothiazolylene group, a benzoxazolylene group, an isobenzoxazolylene group, a triazolylene group, a tetrazolylene group, an oxadiazolylene group, a triazinylene group, a dibenzofuranylene group, a dibenzothiophenylene group, a dibenzosilolylene group, a carbazolylene group, a benzocarbazolylene group, a dibenzocarbazolylene group, a thiadiazolylene group, an imidazopyridinylene group, an imidazopyrimidinylene group, an oxazolopyridinylene group, a thiazolopyridinylene group, a benzonaphthyridinylene group, an azafluorenylene group, an azaspiro-bifluorenylene group, an azacarbazolylene group, an azadibenzofuranylene group, an azadibenzothiophenylene group, and an azadibenzosilolylene group, each substituted with at least one selected from deuterium, -F, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, a hydrazono group, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a C_3-C_{20} cycloalkoxy group, a C_3-C_{10} cycloalkyl group, a C_1-C_{10} heterocycloalkyl group, a C_3-C_{10} cycloalkenyl group, a C_1-C_{10} heterocycloalkenyl group, a C_6-C_{60} (*e.g.* C_6-C_{30}) aryl group, a C_1-C_{60} (*e.g.* C_1-C_{20}) heteroaryl group, a monovalent non-aromatic condensed polycyclic group, a monovalent non-aromatic condensed heteropolycyclic group, a biphenyl group, a terphenyl group, and-$Si(Q_{31})(Q_{32})(Q_{33})$,

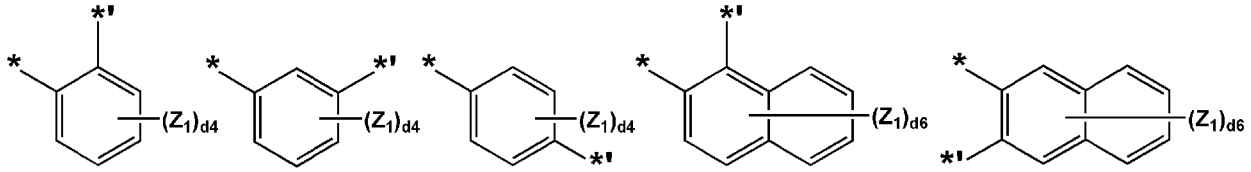
[0046] Q_{31} to Q_{33} may each independently be selected from:

a C_1-C_{10} alkyl group, a C_1-C_{10} alkoxy group, a C_3-C_{10} cycloalkoxy group, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a pyridinyl group, a pyrimidinyl group, a pyrazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, and a quinazolinyl group; and

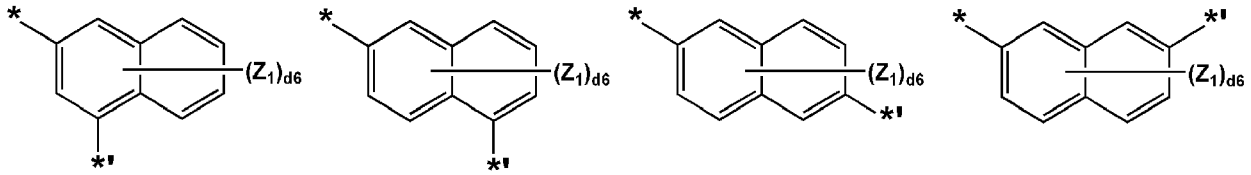
a C_1-C_{10} alkyl group, a C_1-C_{10} alkoxy group, a C_3-C_{10} cycloalkoxy group, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a pyridinyl group, a pyrimidinyl group, a pyrazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, and a quinazolinyl group, each substituted with at least one selected from a C_1-C_{10} alkyl group, a C_1-C_{10} alkoxy group, a C_3-C_{10} cycloalkoxy group, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a pyridinyl group, a pyrimidinyl group, a pyrazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, and a quinazolinyl group, and

* and *' each indicate a binding site to a neighboring atom.

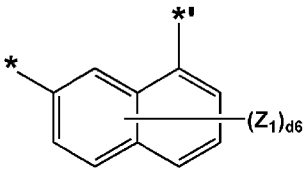
[0047] In one embodiment, L_1 to L_5 and L_9 may each independently be selected from *-S-*', *-O-*', *-C(=O)-*', *-S(=O)-*', *-$S(=O)_2$-*', *-$[C(Z_1)(Z_2)]_{n1}$-*', and groups represented by Formulae 3-1 to 3-75, but embodiments of the present disclosure are not limited thereto:



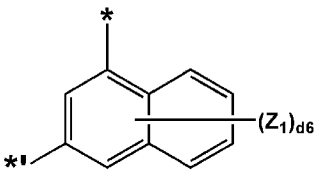
Formula 3-1 Formula 3-2 Formula 3-3 Formula 3-4 Formula 3-5



Formula 3-6 Formula 3-7 Formula 3-8 Formula 3-9



Formula 3-10



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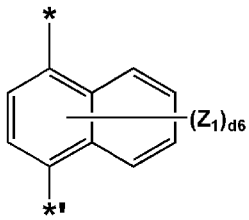

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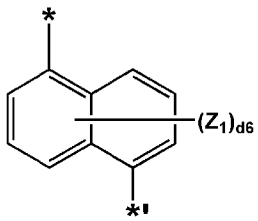

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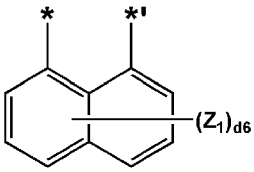

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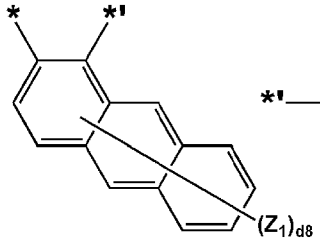

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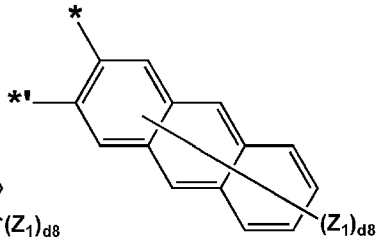
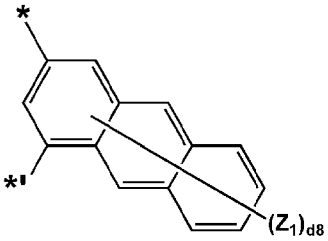


Formula 3-16



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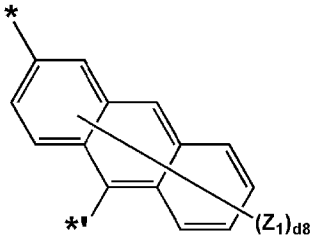

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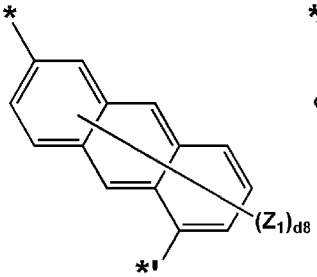

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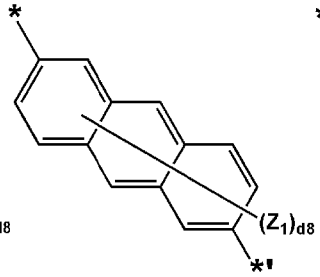

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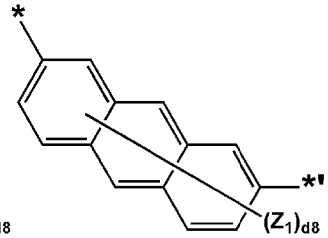

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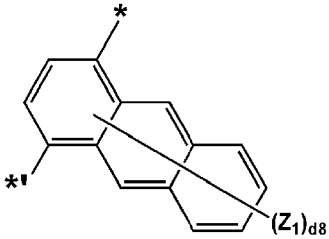

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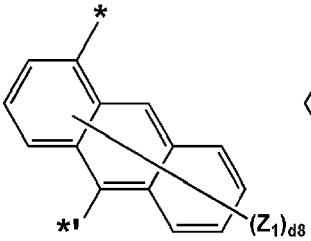

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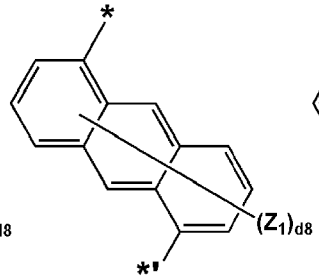

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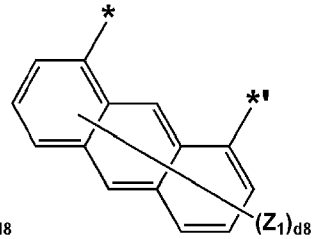

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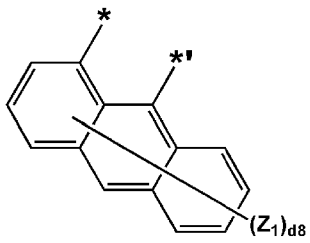

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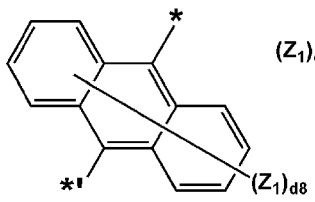

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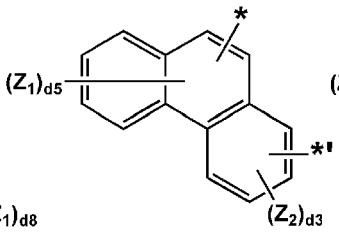

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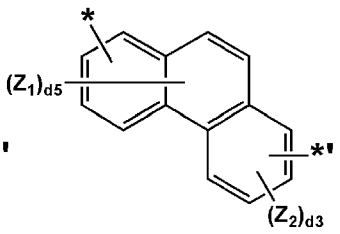
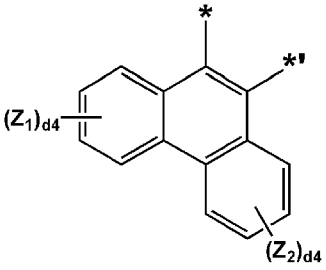
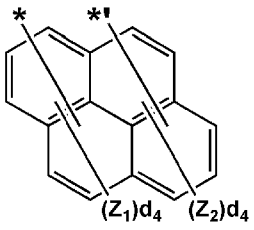


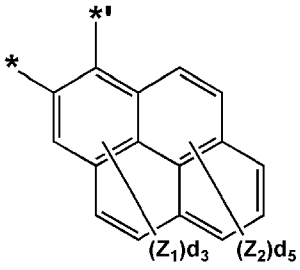
Formula 3-29



Formula 3-30



Formula 3-31



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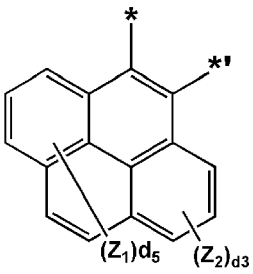

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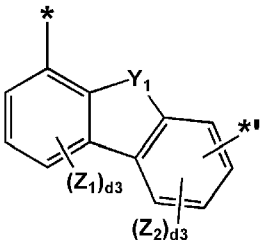

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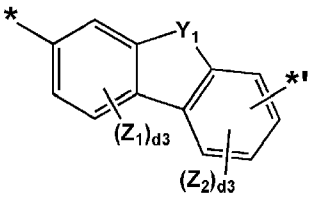

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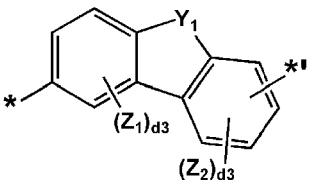

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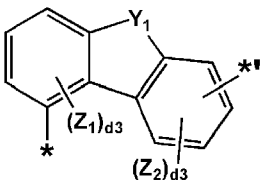

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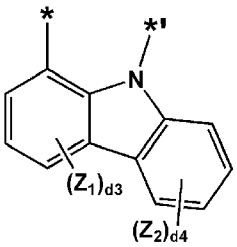
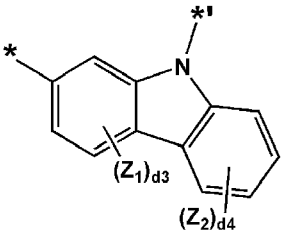
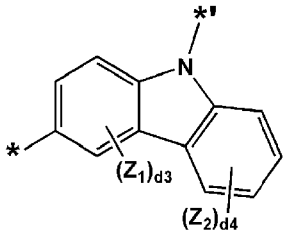


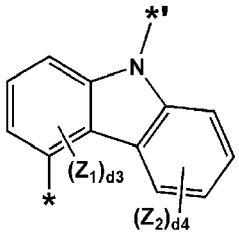
Formula 3-38



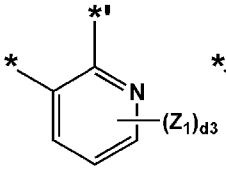
Formula 3-39



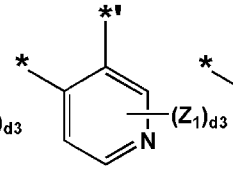
Formula 3-40



Formula 3-41



Formula 3-42



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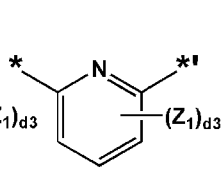

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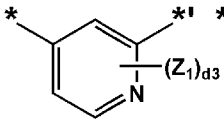

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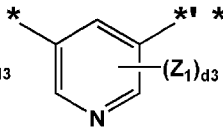
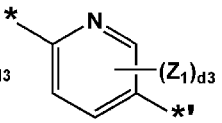
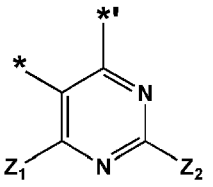


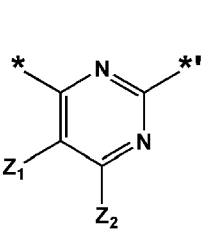
Formula 3-46



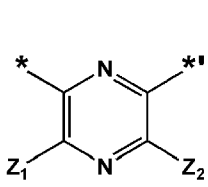
Formula 3-47



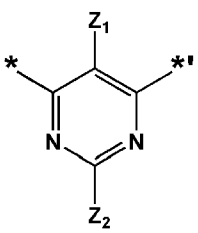
Formula 3-48



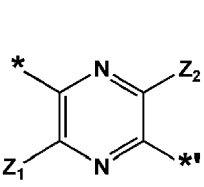
Formula 3-49



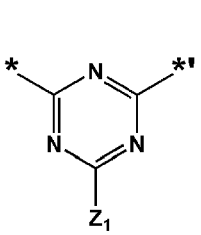
Formula 3-50



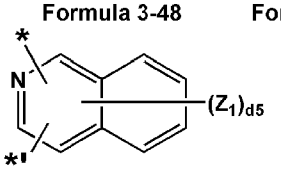
Formula 3-51



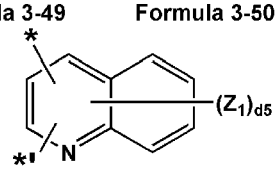
Formula -52



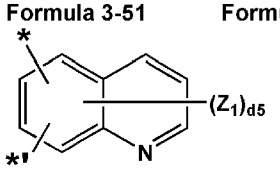
Formula 3-53



Formula 3-54



Formula 3-55



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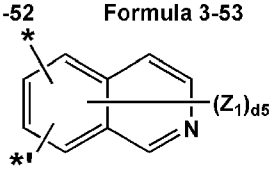

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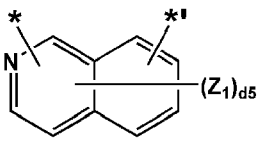
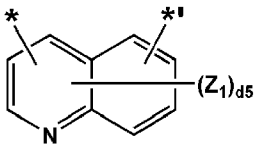
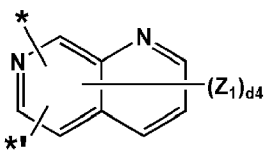


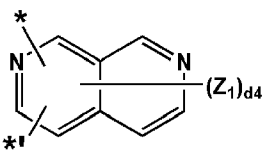
Formula 3-58



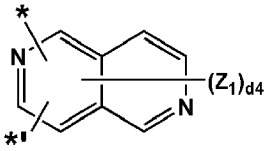
Formula 3-59



Formula 3-60



Formula 3-61



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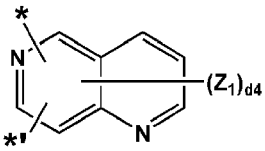
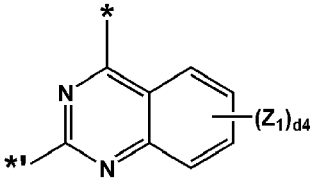
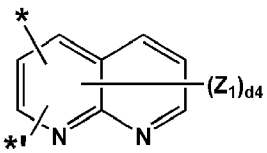


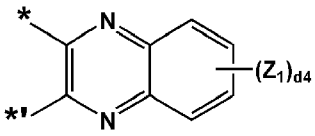
Formula 3-63



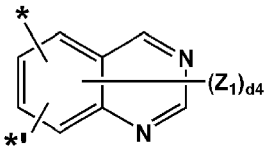
Formula 3-64



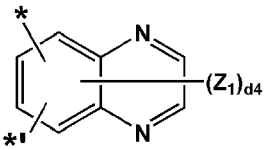
Formula 3-65



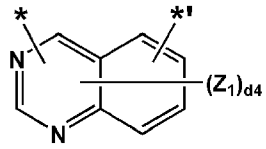
Formula 3-66



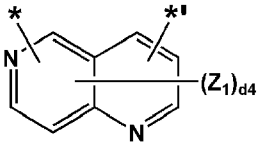
Formula 3-67



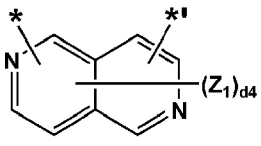
Formula 3-68



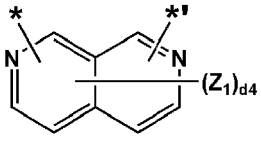
Formula 3-69



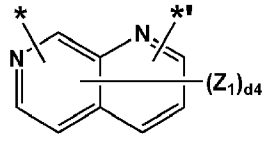
Formula 3-70



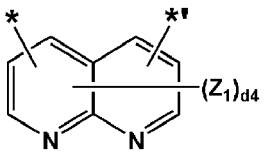
Formula 3-71



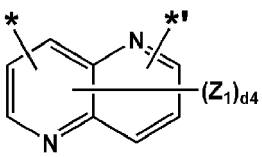
Formula 3-72



Formula 3-73



Formula 3-74



Formula 3-75

[0048] In Formulae 3-1 to 3-75,

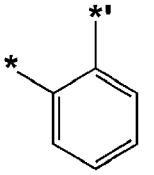
Y_1 is O, S, $C(Z_3)(Z_4)$, $N(Z_3)$, or $Si(Z_3)(Z_4)$,
Z_1 to Z_4 are each independently selected from hydrogen, deuterium, -F, $-CF_3$, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, a hydrazono group, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a C_3-C_{20} cycloalkoxy group, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a fluorenyl group, a spiro-bifluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a triazinyl group, and $-Si(Q_{31})(Q_{32})(Q_{33})$,
Q_{31} to Q_{33} may each independently be selected from a C_1-C_{10} alkyl group, a C_1-C_{10} alkoxy group, a C_3-C_{20} cycloalkoxy group, a phenyl group, a biphenyl group, a terphenyl group, and a naphthyl group,
d3 is an integer from 1 to 3,
d4 is an integer from 1 to 4,
d5 is an integer from 1 to 5,
d6 is an integer from 1 to 6,
d8 is an integer from 1 to 8,
n1 is an integer from 1 to 20, and
* and *' each indicate a binding site to a neighboring atom.
a1 to a5 and a9 in Formulae 1, 2-1, 2-2, and 2-4 are each independently an integer from 0 to 10. a1 indicates the number of L_1(s), wherein, when a1 is zero, *-L_1-*' is a single bond, and when a1 is two or more, two or more L_1(s) are identical to or different from each other.

[0049] For example, a1 to a5 and a9 may each independently be an integer from 0 to 6.

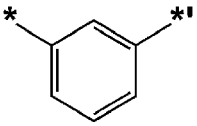
[0050] In one embodiment, a1 to a5 and a9 may each independently be an integer from 0 to 3.

[0051] In one or more embodiments, a1 to a5 and a9 may each independently be 0, 1, or 2, but embodiments of the present disclosure are not limited thereto.

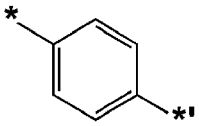
[0052] In one embodiment, Ar_1 in Formula 1 may be selected from groups represented by Formulae 4-1 to 4-59, and L_1 to L_5 and L_9 in Formulae 1, 2-1, 2-2, and 2-4 may each independently be selected from *-O-*', *-C(=O)-*', *-CH_2-*', *-$(CH_2)_2$-*', *-$(CH_2)_3$-*', *-$(CH_2)_4$-*', *-$(CH_2)_5$-*', and groups represented by Formulae 4-1 to 4-58 and 4-60, but embodiments of the present disclosure are not limited thereto:



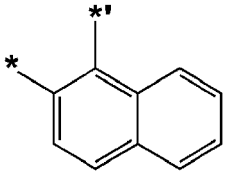
Formula 4-1



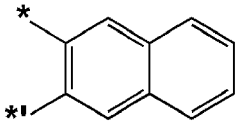
Formula 4-2



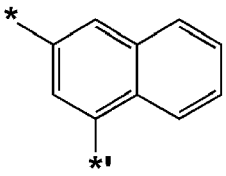
Formula 4-3



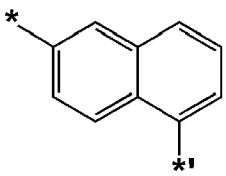
Formula 4-4



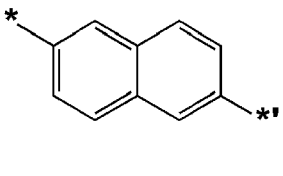
Formula 4-5



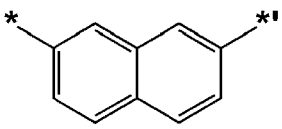
Formula 4-6



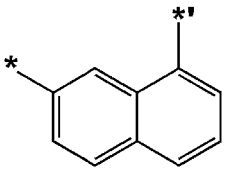
Formula 4-7



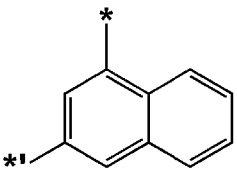
Formula 4-8



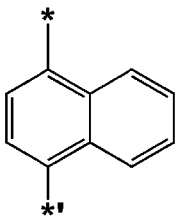
Formula 4-9



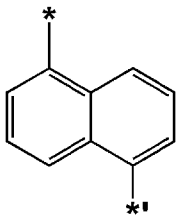
Formula 4-10



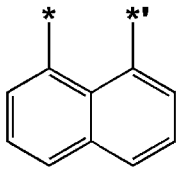
Formula 4-11



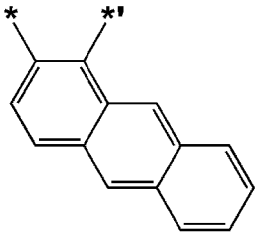
Formula 4-12



Formula 4-13



Formula 4-14



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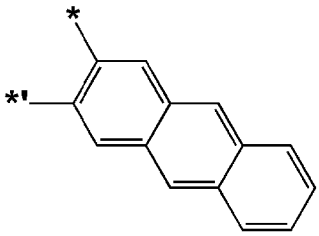

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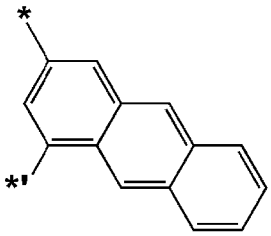

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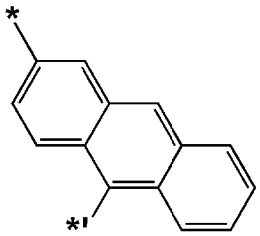

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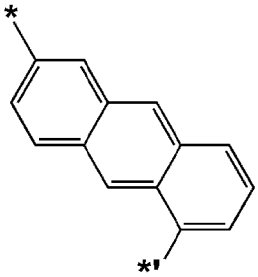

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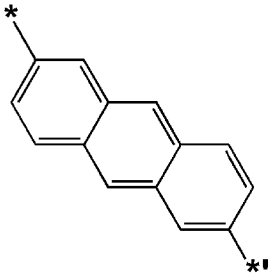

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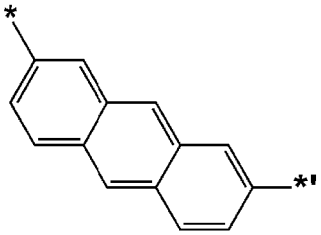

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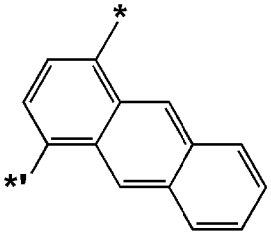

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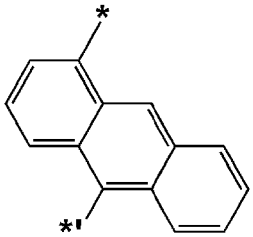

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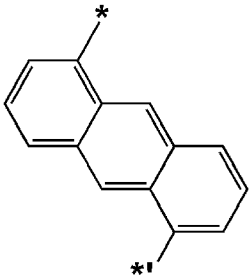

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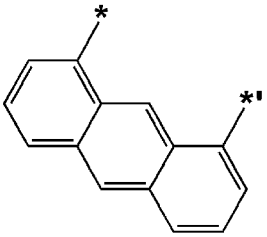

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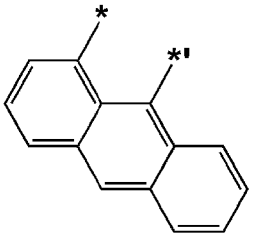

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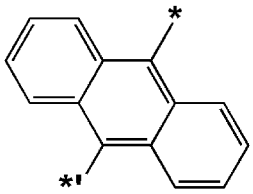

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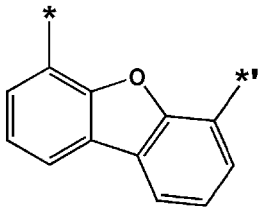

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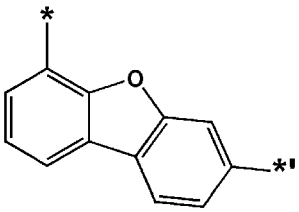

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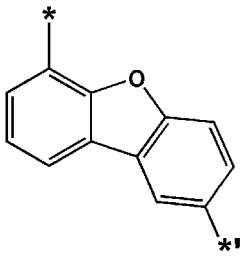

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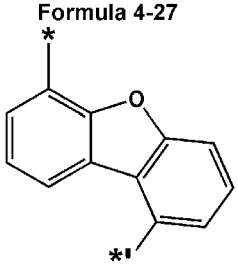

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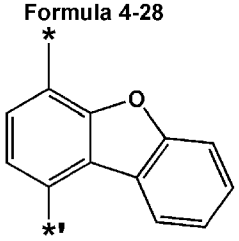

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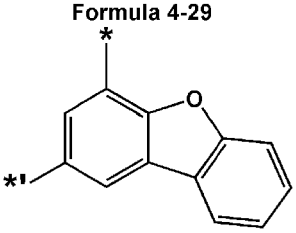

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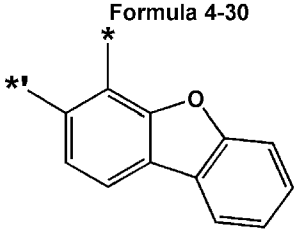

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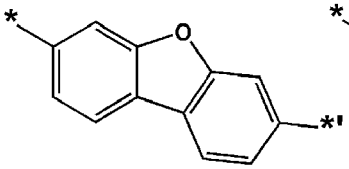

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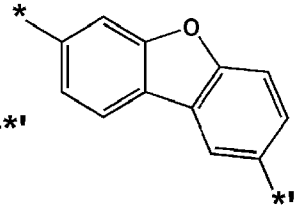

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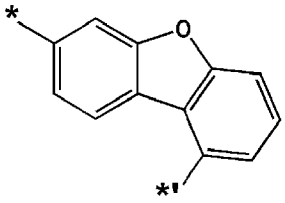

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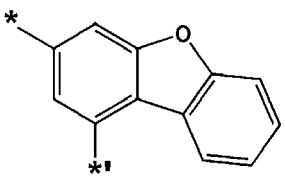

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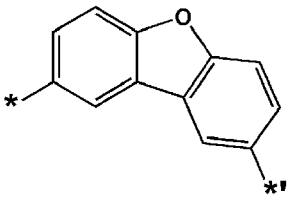

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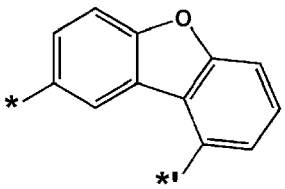

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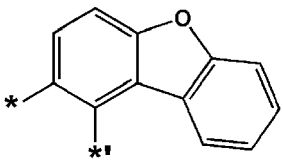

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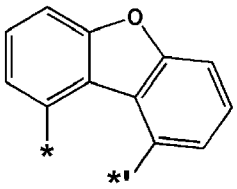

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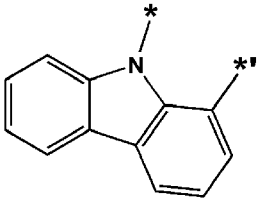

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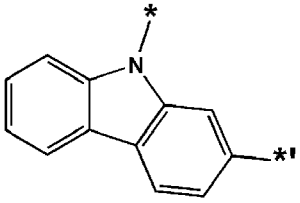

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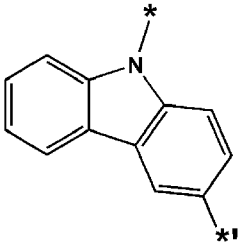

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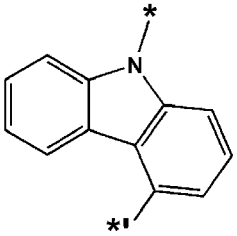

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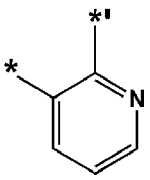
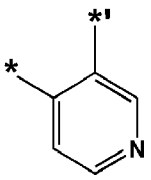
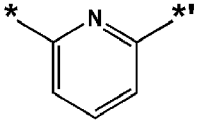


Formula 4-47



Formula 4-48



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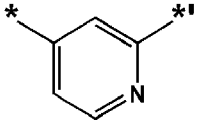

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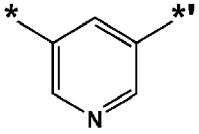
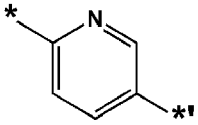
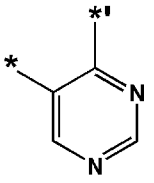


Formula 4-51



Formula 4-52



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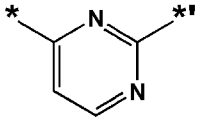
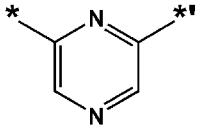


Formula 4-54



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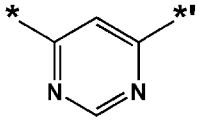
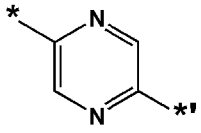
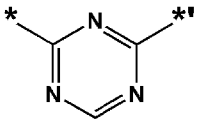


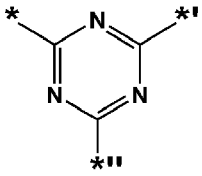
Formula 4-56



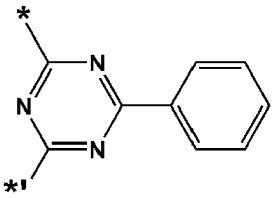
Formula 4-57



Formula 4-58



Formula 4-59



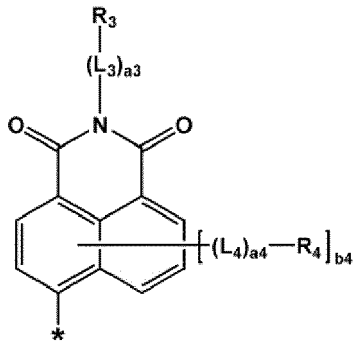
Formula 4-60

*, *', and *'' in Formulae 4-1 to 4-60 each indicate a binding site to a neighboring atom.

[0053] R_1 in Formula 1 is a group represented by Formula 2-1 or a group represented by Formula 2-2.

[0054] For example, the group represented by Formula 2-1 may be a group represented by Formula 2-1A, but embodiments of the present disclosure are not limited thereto:

Formula 2-1A



[0055] In Formula 2-1A, L_3, L_4, a3, a4, R_3, R_4, and b4 are the same as described above, and * indicates a binding site to a neighboring atom.

[0056] In one embodiment, in Formulae 1, 2-1, and 2-2, R_2 to R_5 may each independently be selected from:

a group represented by Formula 2-3, a group represented by Formula 2-4, hydrogen, deuterium, -F, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, a hydrazono group, $Si(Q_1)(Q_2)(Q_3)$, a C_1-C_{20} alkyl group, a C_3-C_{10} cycloalkyl group, a C_1-C_{10} heterocycloalkyl group, a C_1-C_{20} alkoxy group, and a C_3-C_{20} cycloalkoxy group;

a C_1-C_{20} alkyl group, a C_3-C_{10} cycloalkyl group, a C_1-C_{10} heterocycloalkyl group, a C_1-C_{20} alkoxy group, and a C_3-C_{20} cycloalkoxy group, each substituted with at least one selected from deuterium, -F, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, and a hydrazono group;

a cyclopentyl group, a cyclohexyl group, a cycloheptyl group, a cyclopentenyl group, a cyclohexenyl group, a phenyl group, a biphenyl group, a terphenyl group, a pentalenyl group, an indenyl group, a naphthyl group, an azulenyl group, an indacenyl group, an acenaphthyl group, a fluorenyl group, a spiro-bifluorenyl group, a spiro-benzofluorene-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 perylenyl group, a pentaphenyl group, a pyrrolyl group, a thiophenyl group, a furanyl group, a silolyl 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 indolyl group, an isoindolyl 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 phenanthridinyl group, an acridinyl group, a phenanthrolinyl group, a phenazinyl group, a benzimidazolyl group, a benzofuranyl group, a benzothiophenyl group, a benzosilolyl 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 dibenzosilolyl group, a carbazolyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a thiadiazolyl group, an imidazopyridinyl group, an imidazopyrimidinyl group, an oxazolopyridinyl group, a thiazolopyridinyl group, a benzonaphthyridinyl group, an azafluorenyl group, an azaspiro-bifluorenyl group, an azacarbazolyl group, an azadibenzofuranyl group, an azadibenzothiophenyl group, and an azadibenzosilolyl group; and
a cyclopentyl group, a cyclohexyl group, a cycloheptyl group, a cyclopentenyl group, a cyclohexenyl group, a phenyl group, a biphenyl group, a terphenyl group, a pentalenyl group, an indenyl group, a naphthyl group, an azulenyl group, an indacenyl group, an acenaphthyl group, a fluorenyl group, a spiro-bifluorenyl group, a spiro-benzofluorene-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 perylenyl group, a pentaphenyl group, a pyrrolyl group, a thiophenyl group, a furanyl group, a silolyl 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 indolyl group, an isoindolyl 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 phenanthridinyl group, an acridinyl group, a phenanthrolinyl group, a phenazinyl group, a benzimidazolyl group, a benzofuranyl group, a benzothiophenyl group, a benzosilolyl 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 dibenzosilolyl group, a carbazolyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a thiadiazolyl group, an imidazopyridinyl group, an imidazopyrimidinyl group, an oxazolopyridinyl group, a thiazolopyridinyl group, a benzonaphthyridinyl group, an azafluorenyl group, an azaspiro-bifluorenyl group, an azacarbazolyl group, an azadibenzofuranyl group, an azadibenzothiophenyl group, and an azadibenzosilolyl group, each substituted with at least one selected from deuterium, -F, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, a hydrazono group, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a C_3-C_{20} cycloalkoxy group, a C_3-C_{10} cycloalkyl group, a C_1-C_{10} heterocycloalkyl group, a C_3-C_{10} cycloalkenyl group, a C_1-C_{10} heterocycloalkenyl group, a C_6-C_{60} (*e.g.* C_6-C_{30}) aryl group, a C_1-C_{60} (*e.g.* C_1-C_{20}) heteroaryl group, a monovalent non-aromatic condensed polycyclic group, a monovalent non-aromatic condensed heteropolycyclic group, a biphenyl group, a terphenyl group and -Si(Q_{31})(Q_{32})(Q_{33}), and
Q_1 to Q_3 and Q_{31} to Q_{33} may each independently be selected from:

a C_1-C_{10} alkyl group, a C_1-C_{10} alkoxy group, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a pyridinyl group, a pyrimidinyl group, a pyrazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, and a quinazolinyl group; and
a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a pyridinyl group, a pyrimidinyl group, a pyrazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, and a quinazolinyl group, each substituted with at least one selected from a C_1-C_{10} alkyl group, a C_1-C_{10} alkoxy group, and a phenyl group.

[0057] In one embodiment, R_2 to R_5 may each independently be selected from:

a group represented by Formula 2-3, a group represented by Formula 2-4, hydrogen, deuterium, -F, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, a hydrazono group, a C_1-C_{20} alkyl group, a C_3-C_{10} cycloalkyl group, a C_1-C_{20} alkoxy group, a C_3-C_{20} cycloalkoxy group, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a fluorenyl group, a spiro-bifluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a carbazolyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a furanyl group, a benzofuranyl group, a dibenzofuranyl group, a thiophenyl group, a benzothiophenyl group, a dibenzothiophenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a triazinyl group, and -Si(Q_1)(Q_2)(Q_3); and
a C_1-C_{20} alkyl group, a C_3-C_{10} cycloalkyl group, a C_1-C_{20} alkoxy group, a C_3-C_{20} cycloalkoxy group, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a fluorenyl group, a spiro-bifluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a carbazolyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a furanyl group, a benzofuranyl group, a dibenzofuranyl group, a thiophenyl group, a benzothiophenyl group, a dibenzothiophenyl

group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl 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 amidino group, a hydrazino group, a hydrazono group, a C_1-C_{20} alkyl group, a C_3-C_{10} cycloalkyl group, a C_1-C_{20} alkoxy group, a C_3-C_{20} cycloalkoxy group, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a fluorenyl group, a spiro-bifluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a carbazolyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a furanyl group, a benzofuranyl group, a dibenzofuranyl group, a thiophenyl group, a benzothiophenyl group, a dibenzothiophenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a triazinyl group, and-$Si(Q_{31})(Q_{32})(Q_{33})$, and
Q_1 to Q_3 and Q_{31} to Q_{33} may each independently be selected from a C_1-C_{10} alkyl group, a C_1-C_{10} alkoxy group, a phenyl group, a biphenyl group, a terphenyl group, and a naphthyl group.

[0058] In one or more embodiments, R_2 to R_5 may each independently be selected from a group represented by Formula 2-3, a group represented by Formula 2-4, hydrogen, deuterium, -F, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, a hydrazono group, a C_1-C_{20} alkyl group, a C_3-C_{10} cycloalkyl group, a C_1-C_{20} alkoxy group, a C_3-C_{20} cycloalkoxy group, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, an anthracenyl group, a carbazolyl group, a dibenzofuranyl group, a dibenzothiophenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a triazinyl group, and-$Si(Q_1)(Q_2)(Q_3)$; and
a C_1-C_{20} alkyl group, a C_3-C_{10} cycloalkyl group, a C_1-C_{20} alkoxy group, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, an anthracenyl group, a carbazolyl group, a dibenzofuranyl group, a dibenzothiophenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl 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 amidino group, a hydrazino group, a hydrazono group, a C_1-C_{20} alkyl group, a C_3-C_{10} cycloalkyl group, a C_1-C_{20} alkoxy group, a C_3-C_{20} cycloalkoxy group, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, an anthracenyl group, a carbazolyl group, a dibenzofuranyl group, a dibenzothiophenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a triazinyl group, and -$Si(Q_{31})(Q_{32})(Q_{33})$, and
Q_1 to Q_3 and Q_{31} to Q_{33} may each independently be selected from a C_1-C_{10} alkyl group, a C_1-C_{10} alkoxy group, a phenyl group, a biphenyl group, a terphenyl group, and a naphthyl group, but embodiments of the present disclosure are not limited thereto.

[0059] In Formulae 1, 2-3, and 2-4, R_6 to R_9, R_{11}, and R_{12} are each independently selected from hydrogen, deuterium, -F, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, a hydrazono group, a substituted or unsubstituted C_1-C_{60} (*e.g.* C_1-C_{20}) alkyl group, a substituted or unsubstituted C_2-C_{60} (*e.g.* C_2-C_{20}) alkenyl group, a substituted or unsubstituted C_2-C_{60} (*e.g.* C_2-C_{20}) alkynyl group, a substituted or unsubstituted C_1-C_{60} (*e.g.* C_1-C_{20}) alkoxy group, a substituted or unsubstituted C_3-C_{60} (*e.g.* C_3-C_{20}) cycloalkoxy group, a substituted or unsubstituted C_3-C_{10} cycloalkyl group, a substituted or unsubstituted C_1-C_{10} heterocycloalkyl group, a substituted or unsubstituted C_3-C_{10} cycloalkenyl group, a substituted or unsubstituted C_1-C_{10} heterocycloalkenyl group, a substituted or unsubstituted C_6-C_{60} (*e.g.* C_6-C_{30}) aryl group, a substituted or unsubstituted C_6-C_{60} (*e.g.* C_6-C_{30}) aryloxy group, a substituted or unsubstituted C_6-C_{60} (*e.g.* C_6-C_{30}) arylthio group, a substituted or unsubstituted C_1-C_{60} (*e.g.* C_1-C_{20}) heteroaryl group, a substituted or unsubstituted monovalent non-aromatic condensed polycyclic group, a substituted or unsubstituted monovalent non-aromatic condensed heteropolycyclic group, $Si(Q_4)(Q_5)(Q_6)$,-$N(Q_4)(Q_5)$, -$B(Q_4)(Q_5)$, -$C(=O)(Q_4)$, -$S(=O)_2(Q_4)$, and -$P(=O)(Q_4)(Q_5)$, and
Q_4 to Q_6 are the same as described above.

[0060] For example, R_6 to R_9, R_{11}, and R_{12} may each independently be selected from:

hydrogen, deuterium, -F, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, a hydrazono group, $Si(Q_4)(Q_5)(Q_6)$, a C_1-C_{20} alkyl group, a C_3-C_{10} cycloalkyl group, a C_1-C_{10} heterocycloalkyl group, a C_1-C_{20} alkoxy group, and a C_3-C_{20} cycloalkoxy group;
a C_1-C_{20} alkyl group, a C_3-C_{10} cycloalkyl group, a C_1-C_{10} heterocycloalkyl group, a C_1-C_{20} alkoxy group, and a C_3-C_{20} cycloalkoxy group, each substituted with at least one selected from deuterium, -F, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, and a hydrazono group;
a cyclopentyl group, a cyclohexyl group, a cycloheptyl group, a cyclopentenyl group, a cyclohexenyl group, a phenyl group, a biphenyl group, a terphenyl group, a pentalenyl group, an indenyl group, a naphthyl group, an azulenyl group, an indacenyl group, an acenaphthyl group, a fluorenyl group, a spiro-bifluorenyl group, a spiro-benzofluorene-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 perylenyl group, a pentaphenyl group, a pyrrolyl group, a thiophenyl group, a furanyl group, a silolyl 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 indolyl group, an isoindolyl 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 phenanthridinyl group, an acridinyl group, a phenanthrolinyl group, a phenazinyl group, a benzimidazolyl group, a benzofuranyl group, a benzothiophenyl group, a benzosilolyl 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 dibenzosilolyl group, a carbazolyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a thiadiazolyl group, an imidazopyridinyl group, an imidazopyrimidinyl group, an oxazolopyridinyl group, a thiazolopyridinyl group, a benzonaphthyridinyl group, an azafluorenyl group, an azaspiro-bifluorenyl group, an azacarbazolyl group, an azadibenzofuranyl group, an azadibenzothiophenyl group, and an azadibenzosilolyl group; and

a cyclopentyl group, a cyclohexyl group, a cycloheptyl group, a cyclopentenyl group, a cyclohexenyl group, a phenyl group, a biphenyl group, a terphenyl group, a pentalenyl group, an indenyl group, a naphthyl group, an azulenyl group, an indacenyl group, an acenaphthyl group, a fluorenyl group, a spiro-bifluorenyl group, a spiro-benzofluorene-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 perylenyl group, a pentaphenyl group, a pyrrolyl group, a thiophenyl group, a furanyl group, a silolyl 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 indolyl group, an isoindolyl 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 phenanthridinyl group, an acridinyl group, a phenanthrolinyl group, a phenazinyl group, a benzimidazolyl group, a benzofuranyl group, a benzothiophenyl group, a benzosilolyl 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 dibenzosilolyl group, a carbazolyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a thiadiazolyl group, an imidazopyridinyl group, an imidazopyrimidinyl group, an oxazolopyridinyl group, a thiazolopyridinyl group, a benzonaphthyridinyl group, an azafluorenyl group, an azaspiro-bifluorenyl group, an azacarbazolyl group, an azadibenzofuranyl group, an azadibenzothiophenyl group, and an azadibenzosilolyl group, each substituted with at least one selected from deuterium, -F, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, a hydrazono group, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a C_3-C_{20} cycloalkoxy group, a C_3-C_{10} cycloalkyl group, a C_1-C_{10} heterocycloalkyl group, a C_3-C_{10} cycloalkenyl group, a C_1-C_{10} heterocycloalkenyl group, a C_6-C_{60} (*e.g.* C_6-C_{30}) aryl group, a C_1-C_{60} (*e.g.* C_1-C_{20}) heteroaryl group, a monovalent non-aromatic condensed polycyclic group, a monovalent non-aromatic condensed heteropolycyclic group, a biphenyl group, a terphenyl group, and -Si(Q_{31})(Q_{32})(Q_{33}), and

Q_4 to Q_6 and Q_{31} to Q_{33} may each independently be selected from:

a C_1-C_{10} alkyl group, a C_1-C_{10} alkoxy group, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a pyridinyl group, a pyrimidinyl group, a pyrazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, and a quinazolinyl group; and

a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a pyridinyl group, a pyrimidinyl group, a pyrazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, and a quinazolinyl group, each substituted with at least one selected from a C_1-C_{10} alkyl group, a C_1-C_{10} alkoxy group, and a phenyl group.

[0061] In one embodiment, R_6 to R_9, R_{11}, and R_{12} may each independently be selected from:

hydrogen, deuterium, -F, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, a hydrazono group, a C_1-C_{20} alkyl group, a C_3-C_{10} cycloalkyl group, a C_1-C_{20} alkoxy group, a C_3-C_{20} cycloalkoxy group, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a fluorenyl group, a spiro-bifluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a carbazolyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a furanyl group, a benzofuranyl group, a dibenzofuranyl group, a thiophenyl group, a benzothiophenyl group, a dibenzothiophenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a triazinyl group, and-Si(Q_4)(Q_5)(Q_6); and

a C_1-C_{20} alkyl group, a C_3-C_{10} cycloalkyl group, a C_1-C_{20} alkoxy group, a C_3-C_{20} cycloalkoxy group, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a fluorenyl group, a spiro-bifluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a carbazolyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a furanyl group, a benzofuranyl group, a dibenzofuranyl group, a thiophenyl group, a benzothiophenyl group, a dibenzothiophenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl 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 amidino group, a hydrazino group, a hydrazono group, a C_1-C_{20} alkyl group, a C_3-C_{10} cycloalkyl group, a C_1-C_{20} alkoxy group, a C_3-C_{20} cycloalkoxy group, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a fluorenyl group, a spiro-bifluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a carbazolyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a furanyl group, a benzofuranyl group, a dibenzofuranyl group, a thiophenyl group, a benzothiophenyl group, a dibenzothiophenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a triazinyl group and $-Si(Q_{31})(Q_{32})(Q_{33})$, and

Q_4 to Q_6 and Q_{31} to Q_{33} may each independently be selected from a C_1-C_{10} alkyl group, a C_1-C_{10} alkoxy group, a phenyl group, a biphenyl group, a terphenyl group, and a naphthyl group.

[0062] In one or more embodiments, R_6 to R_9, R_{11}, and R_{12} may each independently be selected from hydrogen, deuterium, -F, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, a hydrazono group, a C_1-C_{20} alkyl group, a C_3-C_{10} cycloalkyl group, a C_1-C_{20} alkoxy group, a C_3-C_{20} cycloalkoxy group, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, an anthracenyl group, a carbazolyl group, a dibenzofuranyl group, a dibenzothiophenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a triazinyl group and $-Si(Q_4)(Q_5)(Q_6)$; and

a C_1-C_{20} alkyl group, a C_3-C_{10} cycloalkyl group, a C_1-C_{20} alkoxy group, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, an anthracenyl group, a carbazolyl group, a dibenzofuranyl group, a dibenzothiophenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl 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 amidino group, a hydrazino group, a hydrazono group, a C_1-C_{20} alkyl group, a C_3-C_{10} cycloalkyl group, a C_1-C_{20} alkoxy group, a C_3-C_{20} cycloalkoxy group, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, an anthracenyl group, a carbazolyl group, a dibenzofuranyl group, a dibenzothiophenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a triazinyl group and $-Si(Q_{31})(Q_{32})(Q_{33})$, and

[0063] Q_4 to Q_6 and Q_{31} to Q_{33} may each independently be selected from a C_1-C_{10} alkyl group, a C_1-C_{10} alkoxy group, a phenyl group, a biphenyl group, a terphenyl group, and a naphthyl group, but embodiments of the present disclosure are not limited thereto.

[0064] b1 in Formula 1 is an integer from 1 to 10. b1 indicates the number of $*-(L_1)_{a1}-R_1$(s), wherein, when b1 is two or more, two or more $*-(L_1)_{a1}-R_1$(s) are identical to or different from each other.

[0065] In one embodiment, b1 may be an integer from 1 to 5.

[0066] In one or more embodiments, b1 may be 1, 2, or 3.

[0067] In one or more embodiments, b1 may be 1 or 2, but embodiments of the present disclosure are not limited thereto.

[0068] b2 in Formula 1 is an integer from 1 to 10. b2 indicates the number of $*-(L_2)_{a2}-R_2$(s), wherein, when b2 is two or more, two or more $*-(L_2)_{a2}-R_2$(s) are identical to or different from each other.

[0069] In one embodiment, b2 may be an integer from 1 to 5.

[0070] In one or more embodiments, b2 may be 1, 2, or 3.

[0071] In one or more embodiments, b2 may be 1 or 2, but embodiments of the present disclosure are not limited thereto.

[0072] b4 in Formula 2-1 is an integer from 0 to 5. b4 indicates the number of $*-(L_4)_{a4}-R_4$(s), wherein, when b4 is two or more, two or more $*-(L_4)_{a4}-R_4$(s) are identical to different from each other.

[0073] In one embodiment, b4 may be 0, 1, or 2.

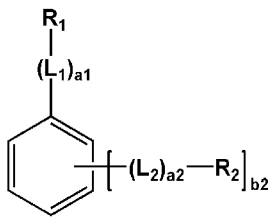
[0074] In one or more embodiments, b4 may be 0 or 1, but embodiments of the present disclosure are not limited thereto.

[0075] b5 in Formula 2-2 is an integer from 0 to 6. b5 indicates the number of $*-(L_5)_{a5}-R_5$(s), wherein, when b5 is two or more, two or more $*-(L_5)_{a5}-R_5$(s) are identical to or different from each other.

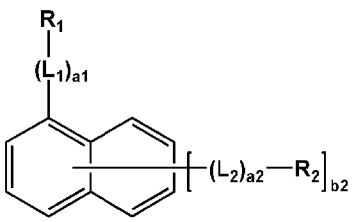
[0076] In one embodiment, b5 may be 0, 1, 2, or 3.

[0077] In one or more embodiments, b5 may be 0, 1, or 2, but embodiments of the present disclosure are not limited thereto.

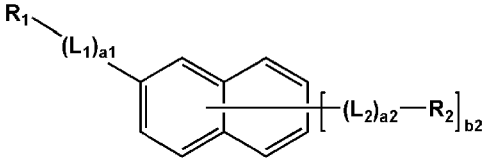
[0078] In one embodiment, the first compound may be represented by one of Formulae 1A to 1P:



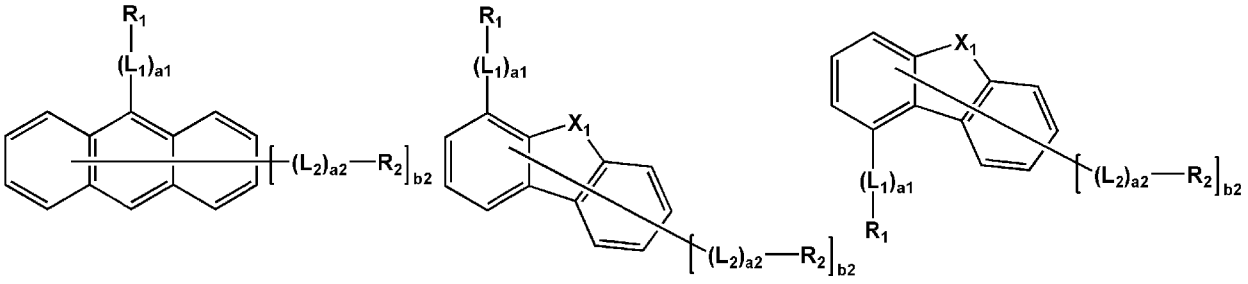
Formula 1A



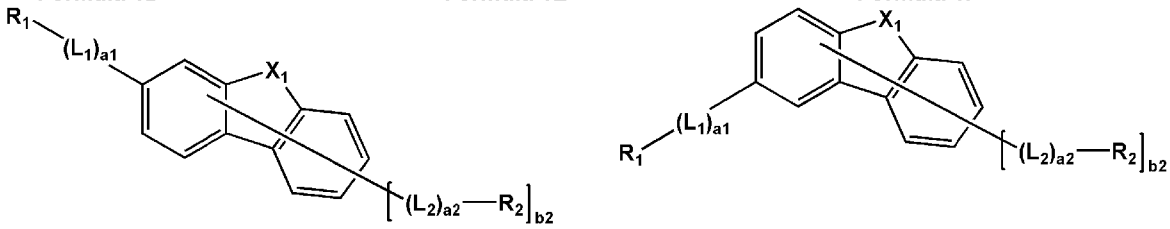
Formula 1B



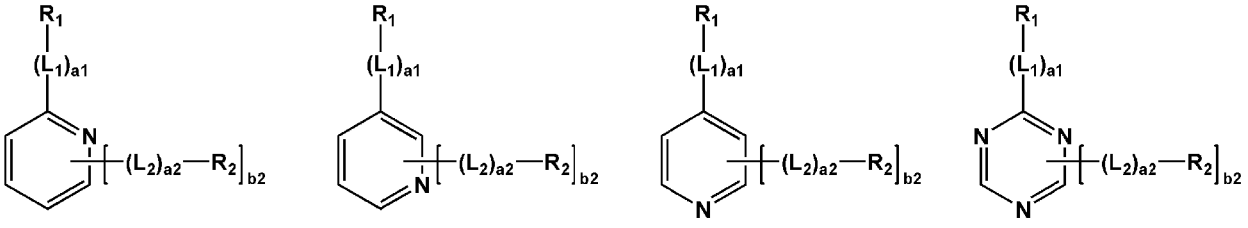
Formula 1C



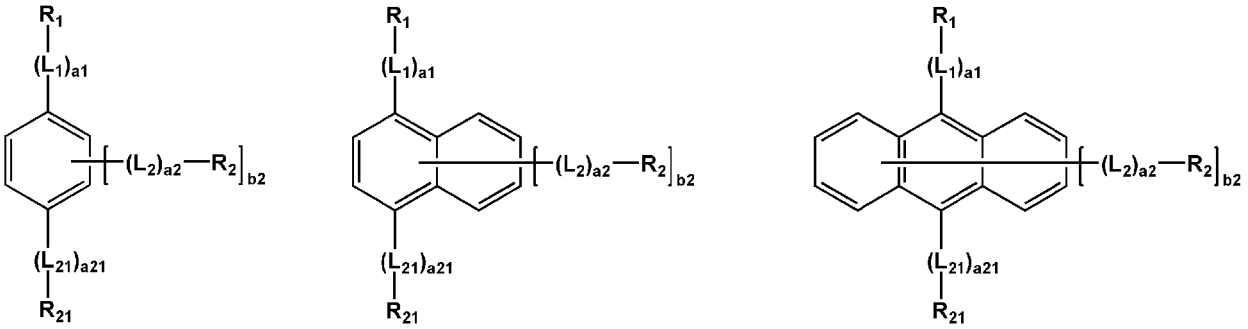
Formula 1D Formula 1E Formula 1F



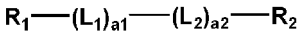
Formula 1G Formula 1H



Formula 1I Formula 1J Formula 1K Formula 1L



Formula 1M Formula 1N Formula 1O



Formula 1P

[0079] In Formulae 1A to 1P, X_1 may be O, S, C or N, L_1, L_2, a1, a2, R_1, R_2, and b2 are the same as described herein in connection with Formula 1, and L_{21}, a21, and R_{21} are the same as described in connection with L_1, a1, and R_1, respectively.

[0080] For example, L_1, L_2, and L_{21} in Formula 1A to 1P may each independently be selected from *-S-*', *-O-*', *-C(=O)-*', *-S(=O)-*', *-$S(=O)_2$-*', *-$[C(Z_1)(Z_2)]_{n1}$-*', and groups represented by Formulae 3-1 to 3-75.

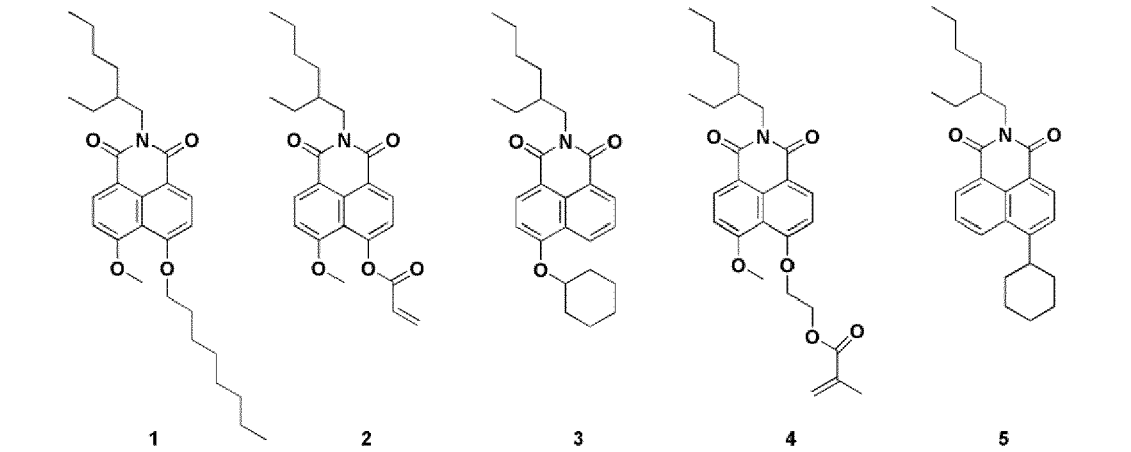
[0081] In one or more embodiments, L_1, L_2, and L_{21} in Formulae 1A to 1P may each independently be selected from *-O-*', *-C(=O)-*', *-CH_2-*', *-$(CH_2)_2$-*', *-$(CH_2)_3$-*', *-$(CH_2)_4$-*', *-$(CH_2)_5$-*', and groups represented by Formulae 4-1 to 4-58 and 4-60.

[0082] In one or more embodiments, R_1 and R_{21} in Formulae 1A to 1P may each independently be a group represented by Formula 2-1A or a group represented by Formula 2-2.

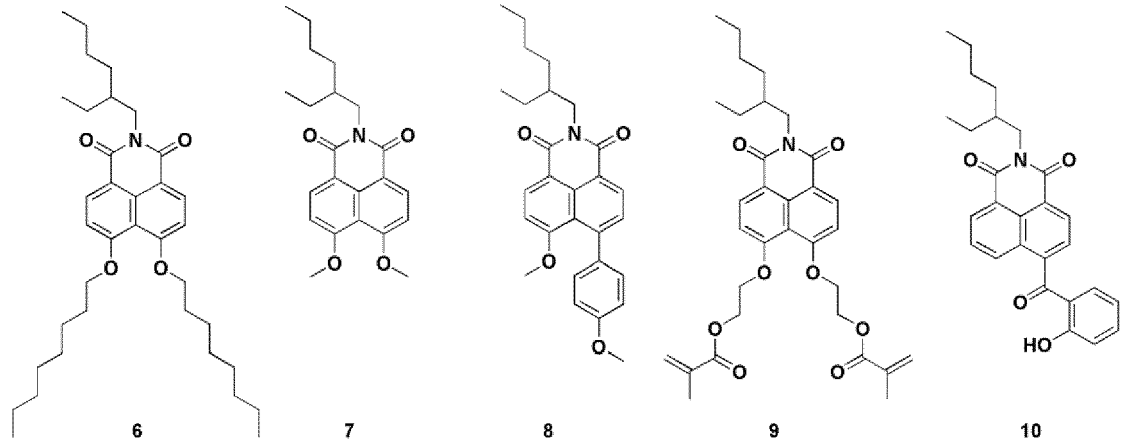
[0083] In one or more embodiments, R_1 and R_{21} in Formulae 1M to 1O may each be a group represented by Formula 2-1. For example, R_1 and R_{21} in Formulae 1M to 1O may each be a group represented by Formula 2-1A.

[0084] In one or more embodiments, R_1 and R_{21} in Formulae 1M to 1O may each be a group represented by Formula 2-2.

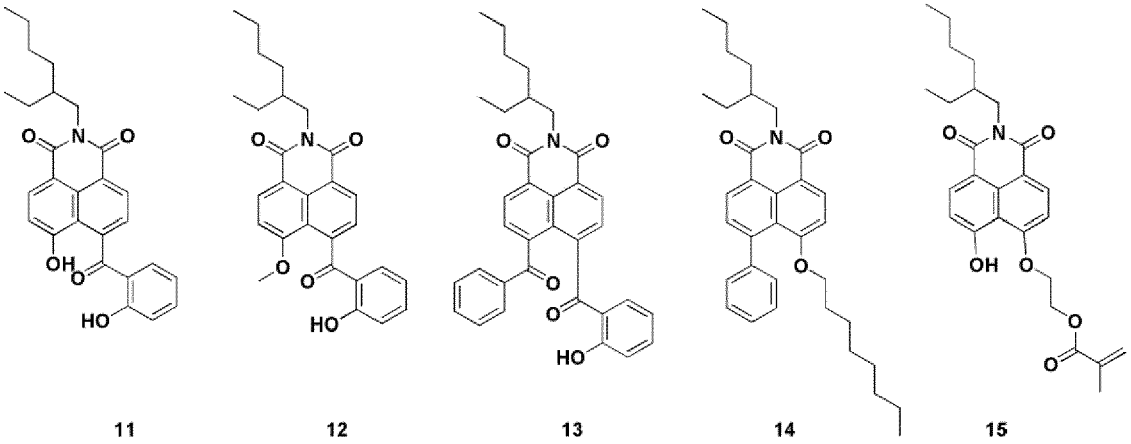
[0085] The first compound may be one of Compounds 1 to 205, but embodiments of the present disclosure are not limited thereto:



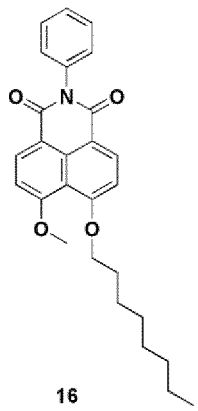
1 2 3 4 5



6 7 8 9 10



11 12 13 14 15



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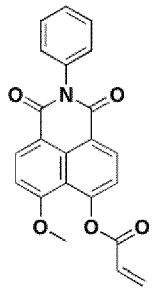

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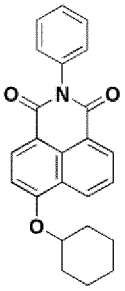

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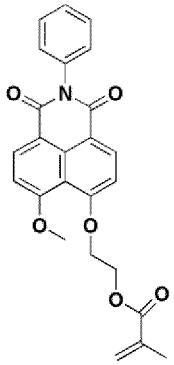

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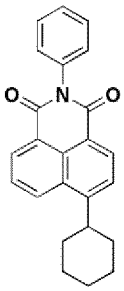

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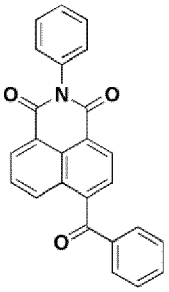

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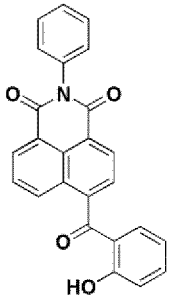

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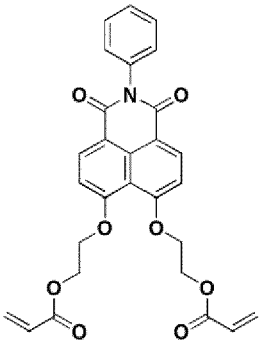

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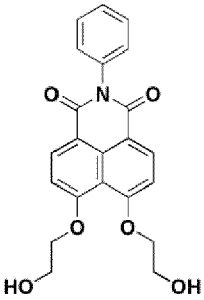

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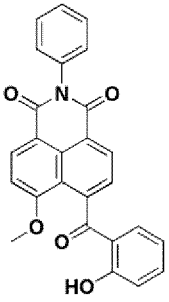

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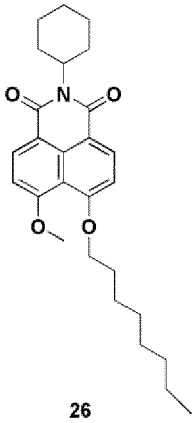

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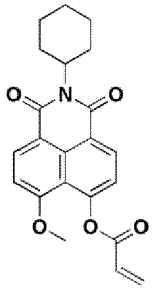

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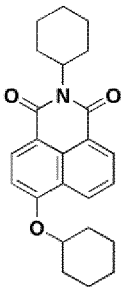

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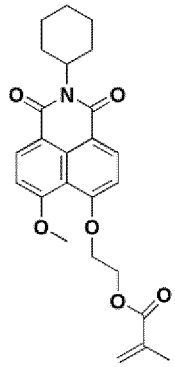

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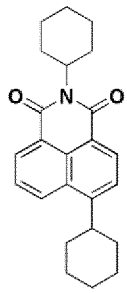

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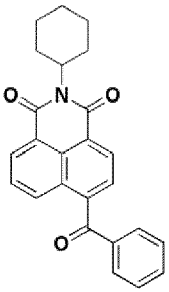

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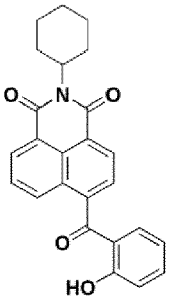

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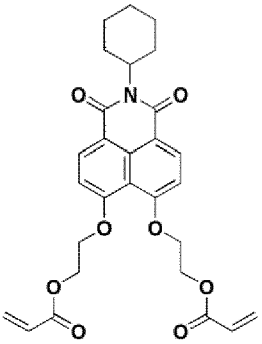

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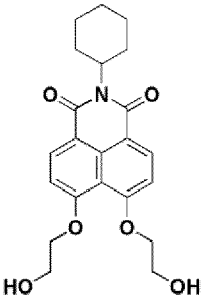

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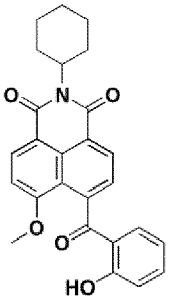

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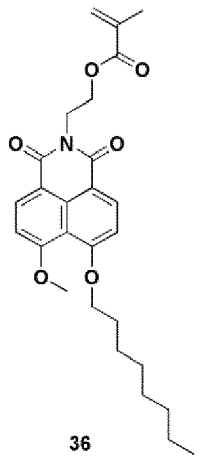

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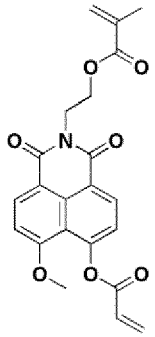

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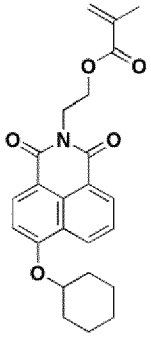

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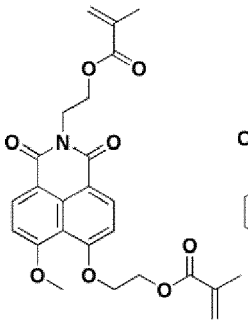

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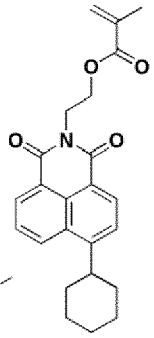

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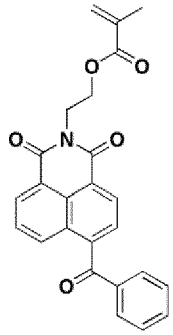

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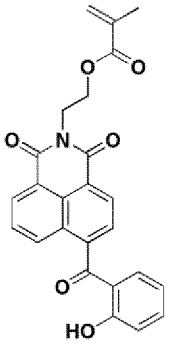

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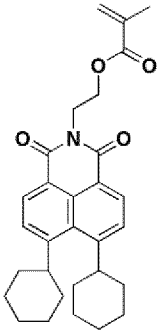

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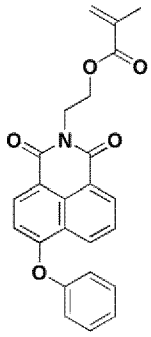

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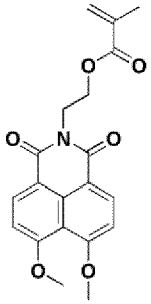

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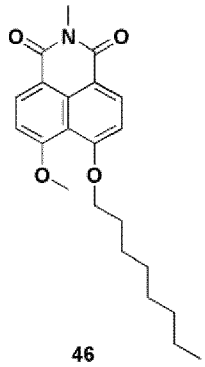

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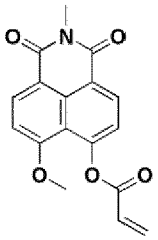

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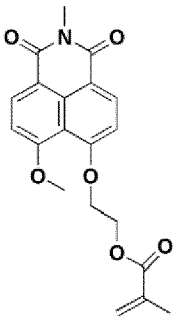

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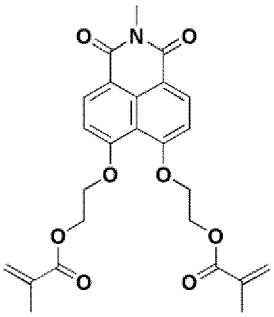

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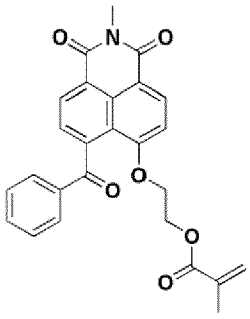

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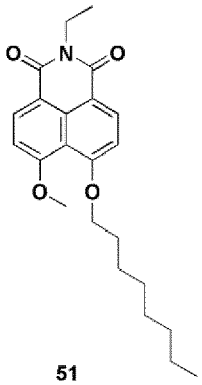

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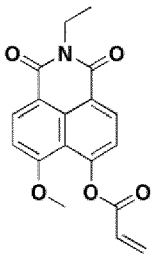

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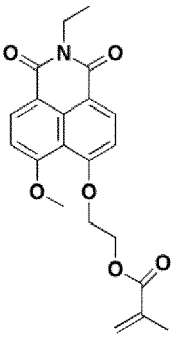

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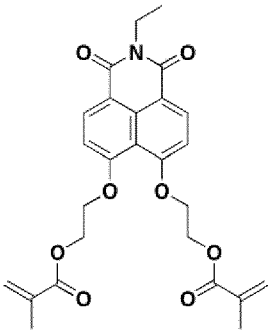

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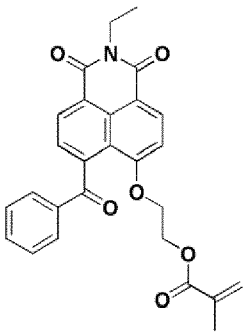

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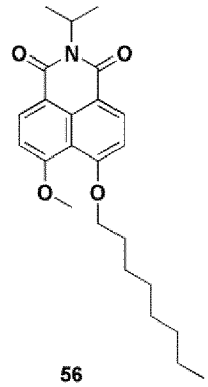

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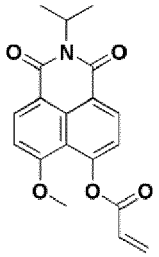

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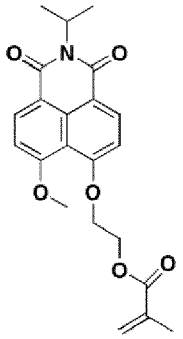

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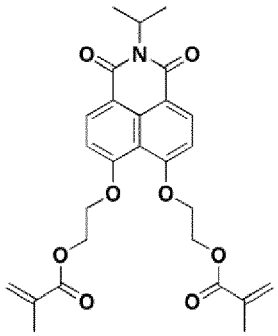

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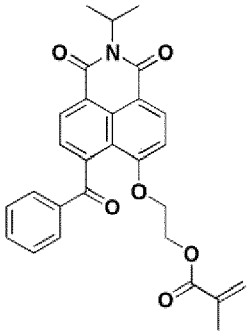

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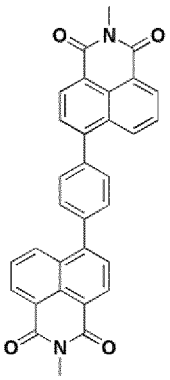

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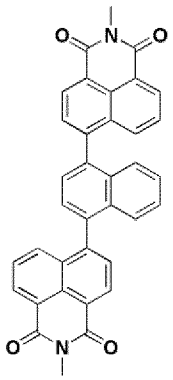

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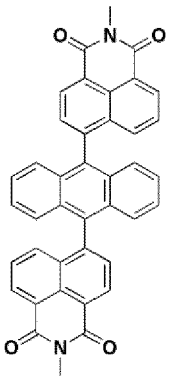

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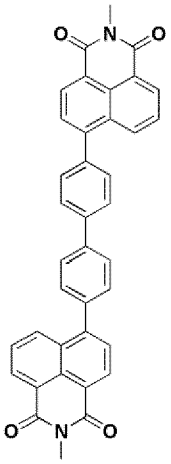

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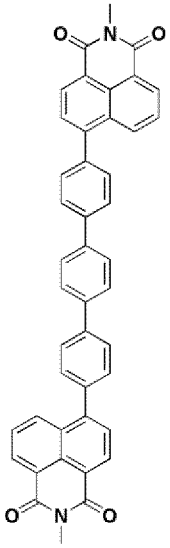

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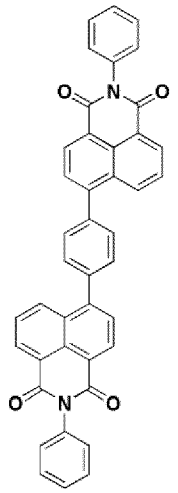

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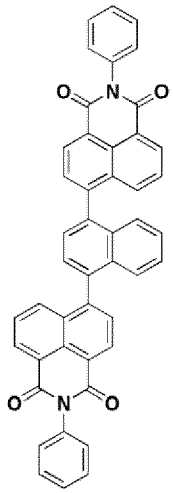

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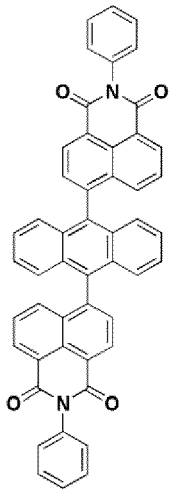

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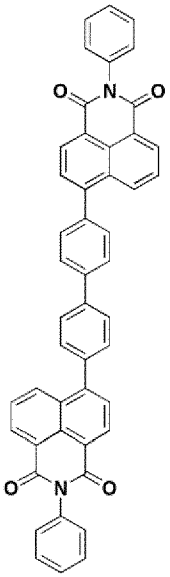

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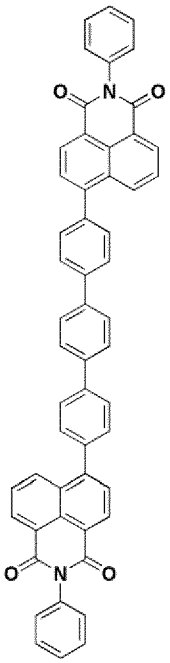

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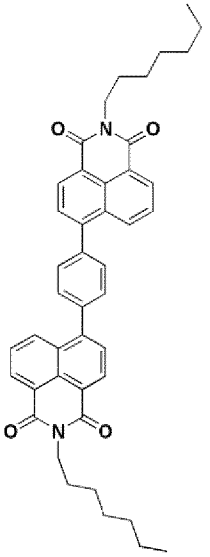

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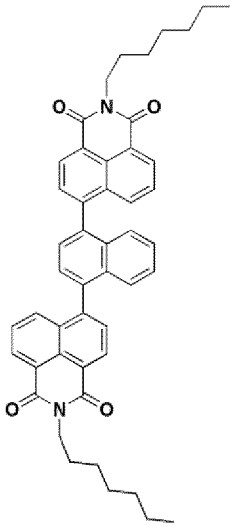

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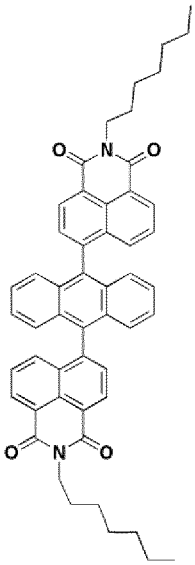

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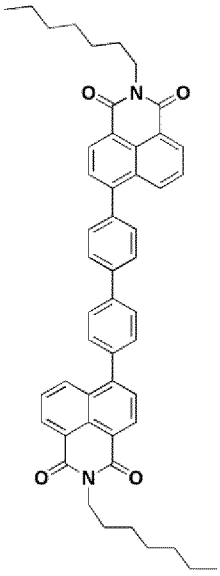

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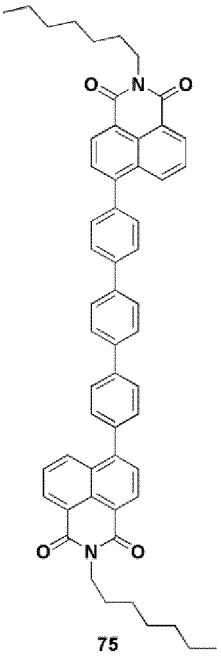

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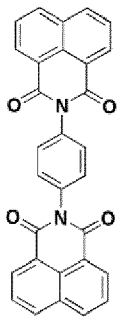

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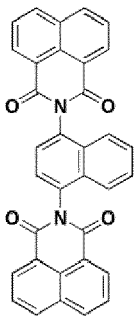

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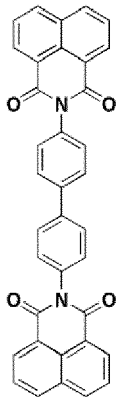

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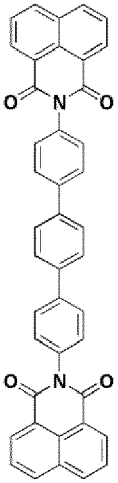

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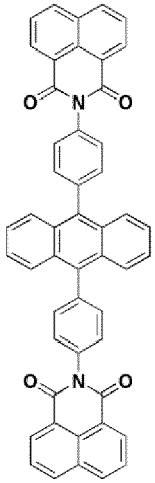

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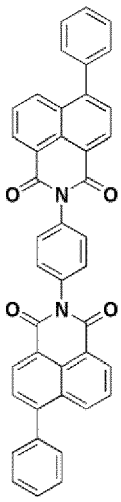

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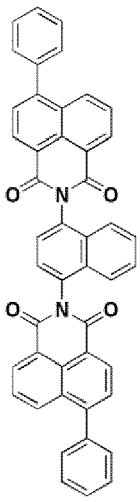

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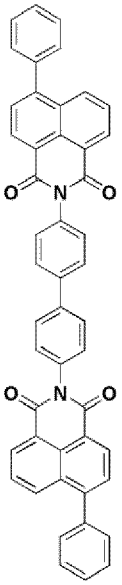

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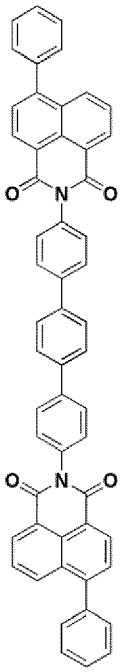

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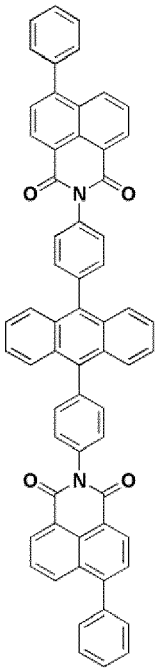

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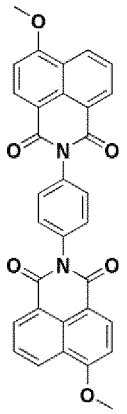

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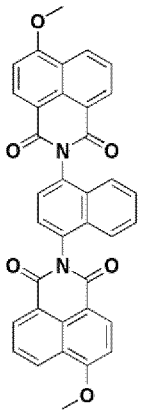

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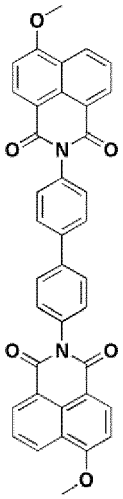

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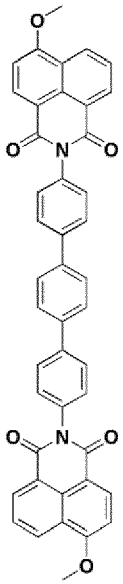

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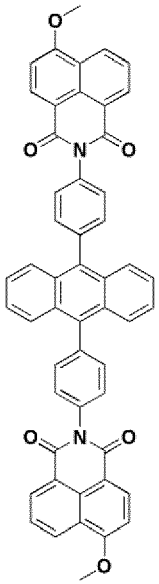

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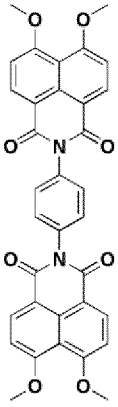

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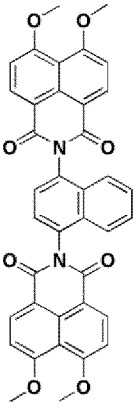

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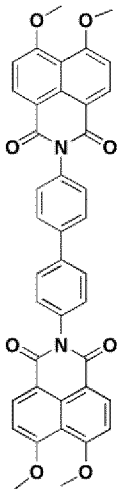

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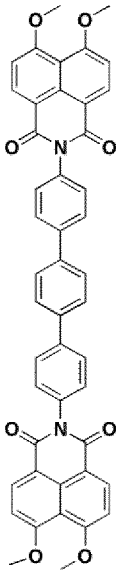

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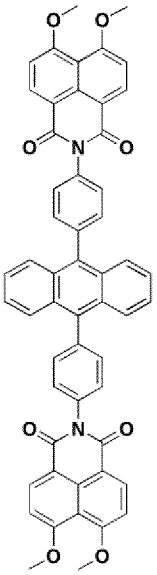

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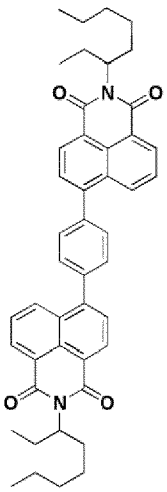

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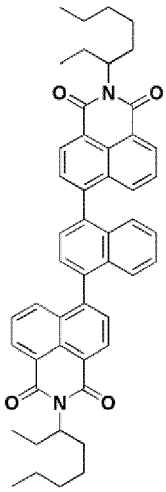

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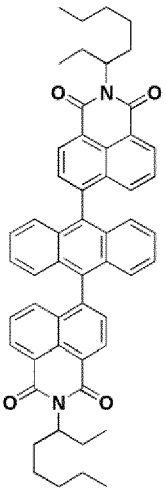

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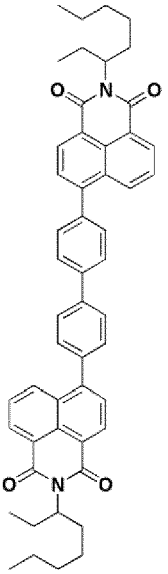

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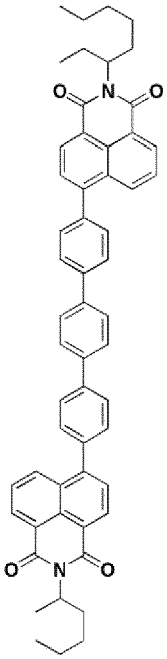

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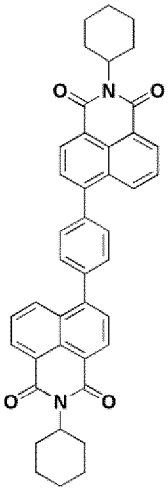

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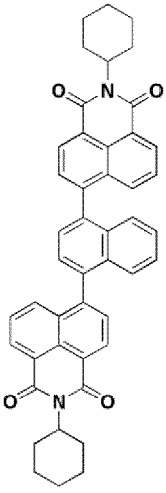

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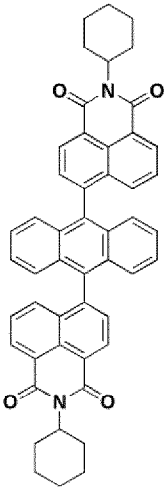

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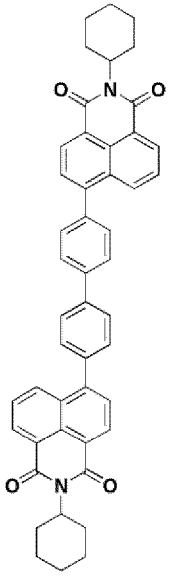

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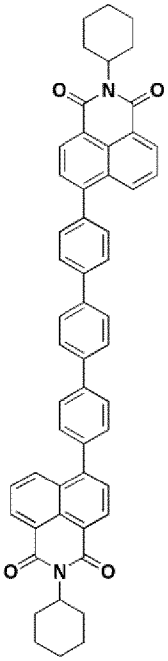

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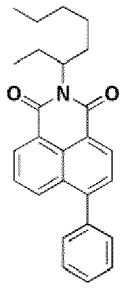

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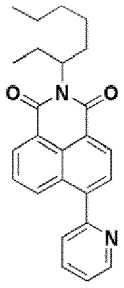

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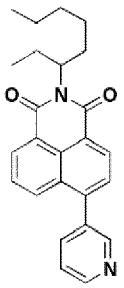

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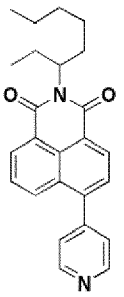

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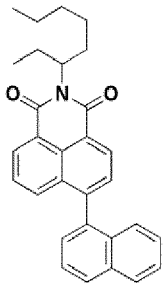

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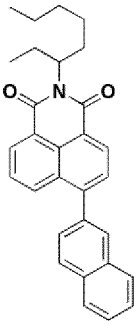

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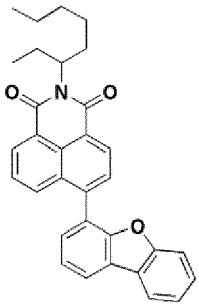

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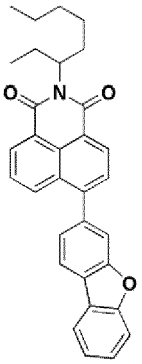

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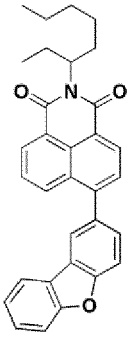

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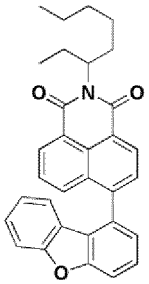

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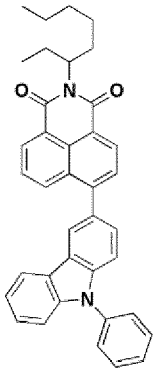

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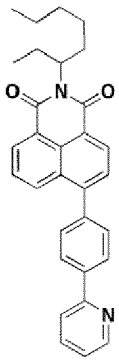

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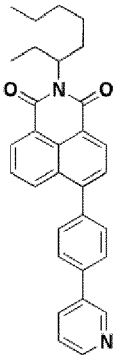

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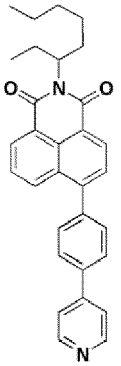

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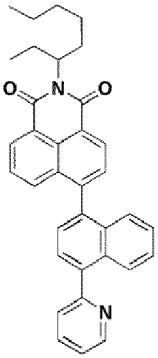

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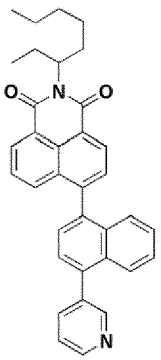

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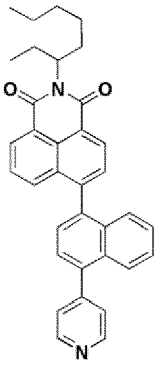

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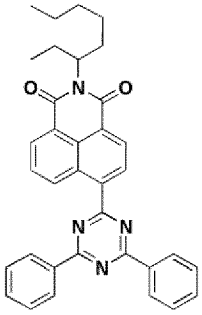

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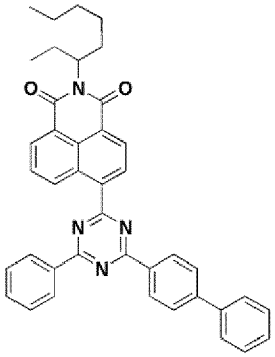

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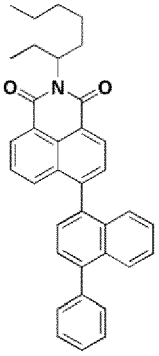

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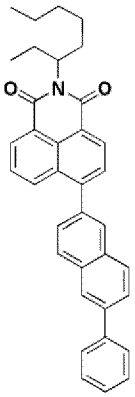

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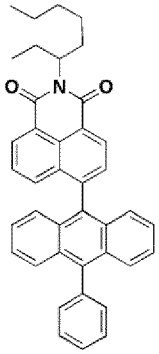

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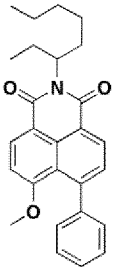

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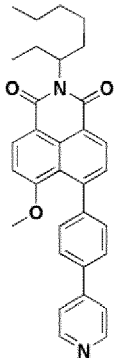

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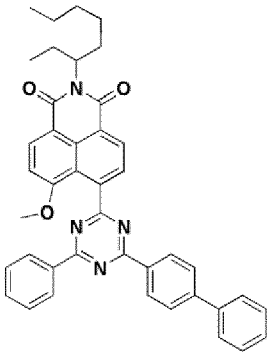

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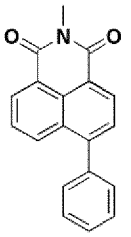

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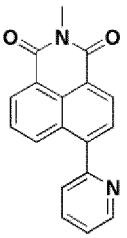

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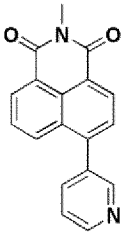

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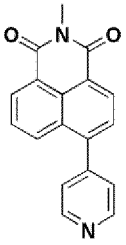

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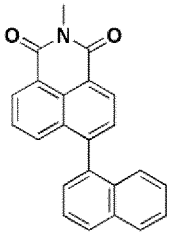

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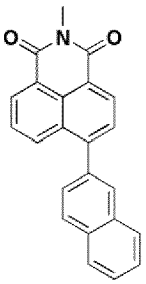

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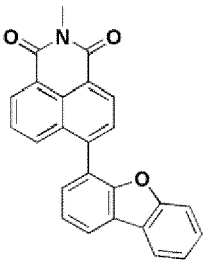

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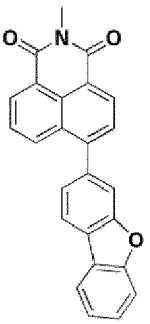

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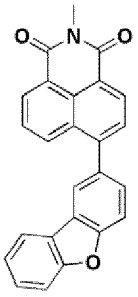

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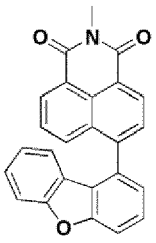

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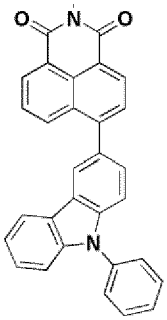

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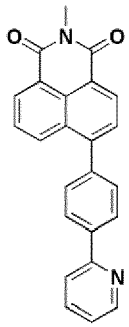

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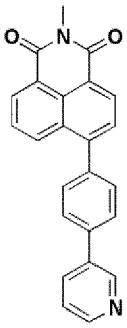

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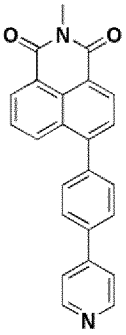

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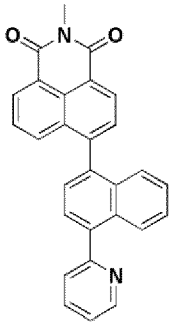

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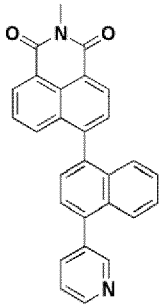

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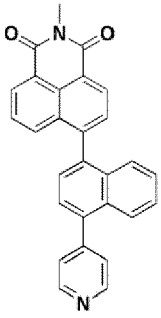

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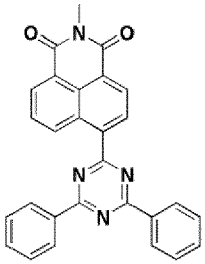

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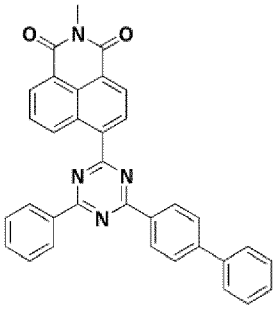

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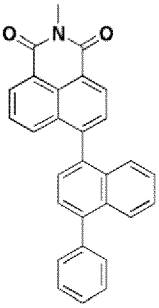

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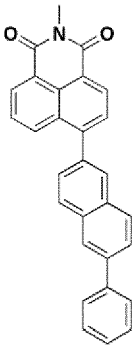

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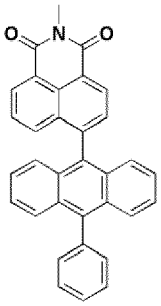

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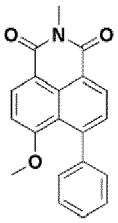

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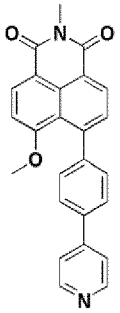

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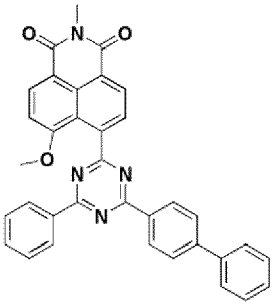

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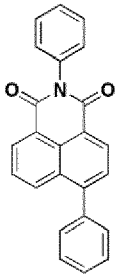

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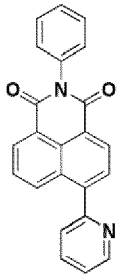

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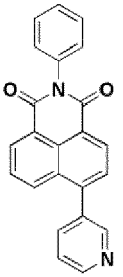

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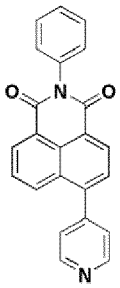

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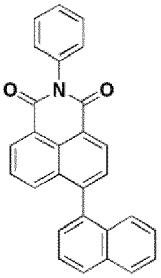

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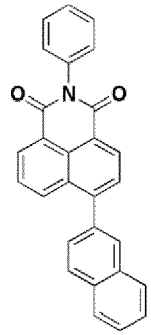

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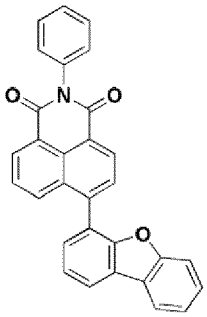

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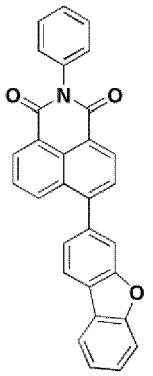

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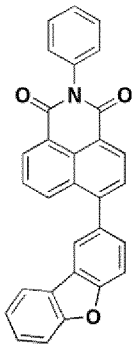

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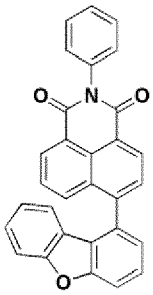

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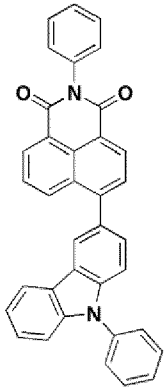

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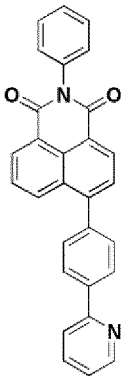

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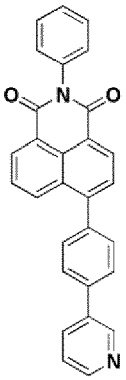

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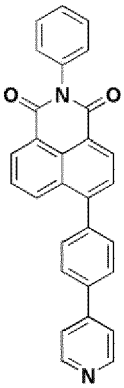

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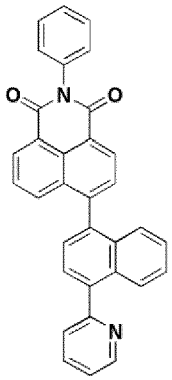

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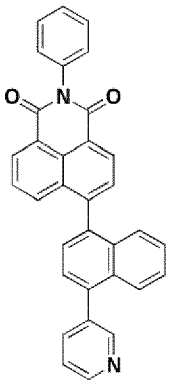

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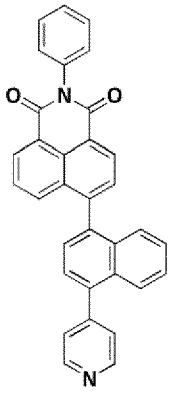

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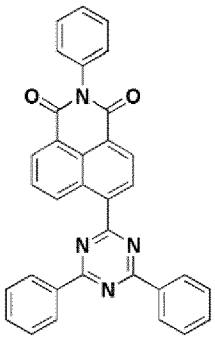

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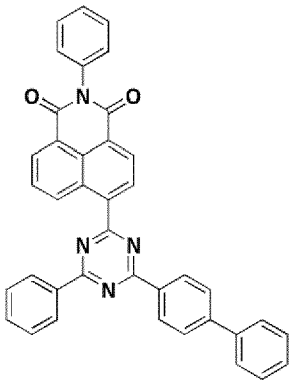

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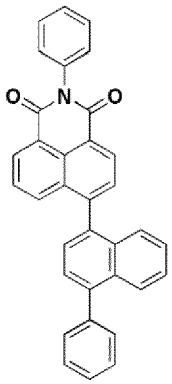

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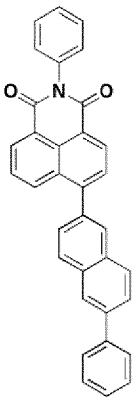

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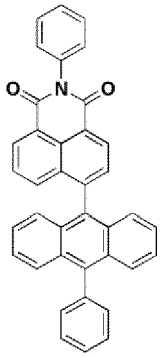

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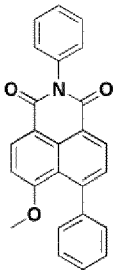

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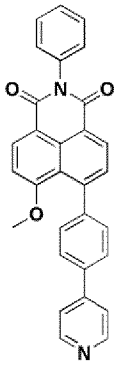

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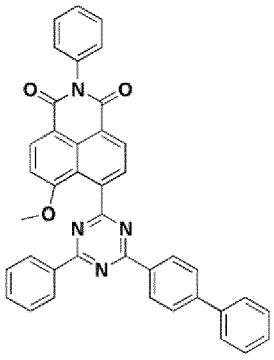

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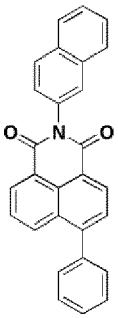

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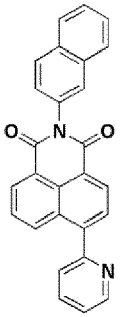

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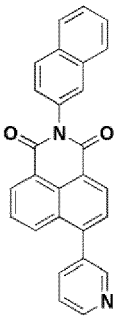

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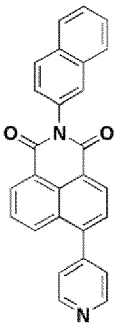

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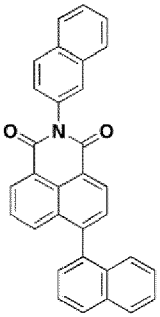

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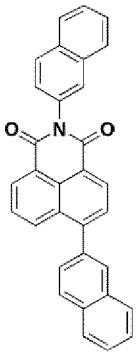

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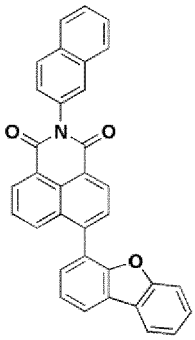

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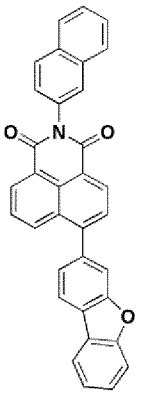

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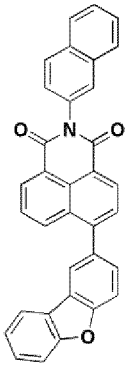

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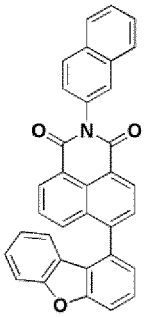

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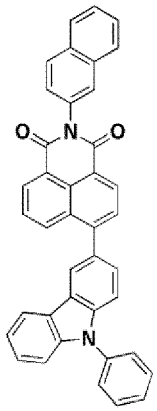

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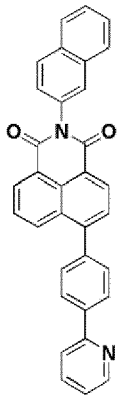

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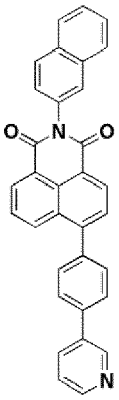

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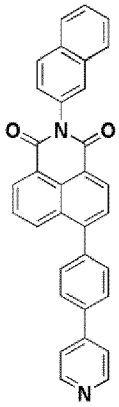

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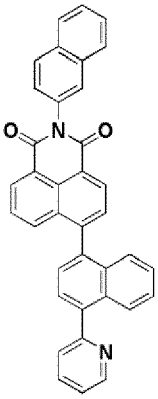

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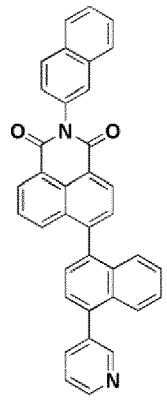

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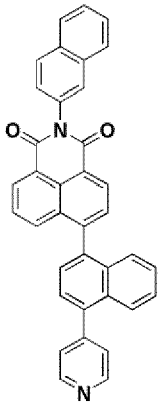

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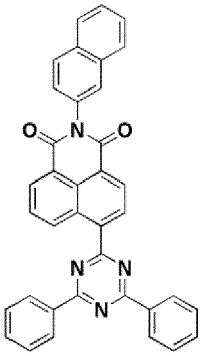

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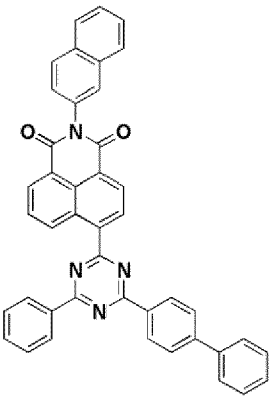

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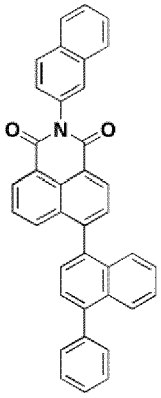

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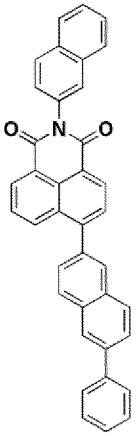

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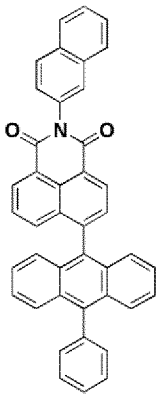

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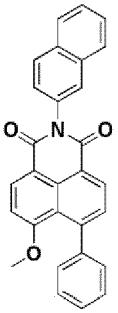

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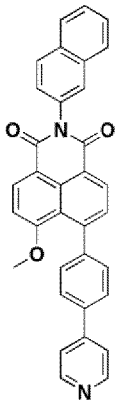

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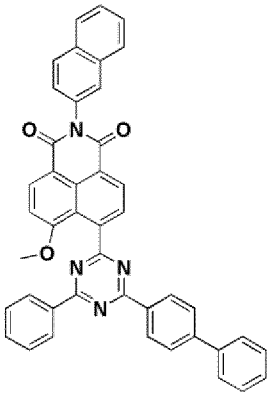

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[0086] The first compound absorbs ultraviolet rays to prevent or substantially prevent the ultraviolet rays from transmitting through the organic light-emitting device 200. Therefore, the organic light-emitting display apparatus 10, in which the first compound is included in the encapsulation unit 300, may prevent or substantially prevent the emission layer, the insulating film, and/or the like (including the organic material) from being damaged by the ultraviolet rays. For example, the first compound may absorb light having a wavelength of about 400 nm to about 410 nm.

[0087] In one embodiment, a first compound solution in a solvent (e.g., the first compound dissolved in a solvent, for example, toluene) has a transmittance of about 10% or less (for example, about 8% or less) with respect to light having

a wavelength of about 400 nm to about 410 nm (for example, about 405 nm).

[0088] In one or more embodiments, the first compound solution in the solvent (for example, toluene) has a transmittance of about 20% or more (for example, about 25% or more) with respect to light having a wavelength of about 425 nm to about 435 nm (for example, about 430 nm).

[0089] In one embodiment, the encapsulation unit 300 may further include a second compound that is different from the first compound, and a wavelength range of light absorbed by the first compound may be different from a wavelength range of light absorbed by the second compound.

[0090] For example, the second compound may include one selected from a benzophenone-based compound, a benzotriazole-based compound, a benzoate-based compound, a cyanoacrylate-based compound, a triazine-based compound, an oxanilide-based compound, and a salicylate-based compound.

[0091] The benzophenone-based compound may include, for example, 2,4-dihydroxybenzophenone, 2-hydroxy-4-methoxybenzophenone, 2-hydroxy-4-octylbenzophenone, 4-dodecyloxy-2-hydroxybenzophenone, 4-benzyloxy-2-hydroxybenzophenone, 2,2',4,4'-tetrahydroxybenzophenone, and 2,2'-dihydroxy-4,4'-dimethoxybenzophenone.

[0092] The benzotriazole-based compound may include, for example, 2-(5-methyl-2-hydroxyphenyl)benzotriazole, 2-[2-hydroxy-3,5-bis(α,α-dimethylbenzyl)phenyl]-2H-benzotriazole, 2-(3,5-di-t-butyl-2-hydroxyphenyl)benzotriazole, 2-(3-t-butyl-5-methyl-2-hydroxyphenyl)-5-chlorobenzotriazole, 2-(3,5-di-t-butyl-2-hydroxyphenyl)-5-chlorobenzotriazole, 2-(3,5-di-t-acyl-2-hydroxyphenyl)benzotriazole, and 2-(2'-hydroxy-5'-t-octylphenyl)benzotriazole.

[0093] The benzoate-based compound may include, for example, 2,4-di-t-butylphenyl-3',5'-di-t-butyl-4-hydroxybenzoate.

[0094] The triazine-based compound may include, for example, 2-[4-[(2-hydroxy-3-dodecyloxypropyl)oxy]-2-hydroxyphenyl]-4,6-bis(2,4-dimethylphenyl)-1,3,5-triazine, and the like.

[0095] The salicylate-based compound may include, for example, phenylsalicylate, 4-t-butylphenylsalicylate, and the like.

[0096] A mixing ratio of the first compound to the second compound may be appropriately selected by taking into account device characteristics, the degree of ultraviolet absorption, and/or the like.

[0097] In one embodiment, the encapsulation unit 300 may further include a third compound that is different from the first compound, and the first compound may be dispersed in the third compound. In one embodiment, the first compound may be simply dispersed in the third compound. In another embodiment, the first compound may be cross-linked to the third compound. For example, the first compound may include a group represented by Formula 2-3, and the first compound may be cross-linked to the third compound.

[0098] In one embodiment, the encapsulation unit 300 may further include a metal, a metal halide, a metal nitride, a metal oxide, a metal oxynitride, a silicon nitride, a silicon oxide, and/or a silicon oxynitride.

[0099] For example, the encapsulation unit 300 may include at least one selected from MgF_2, LiF, AlF_3, NaF, a silicon oxide, a silicon nitride, a silicon oxynitride, an aluminium oxide, an aluminium nitride, an aluminium oxynitride, a titanium oxide, a titanium nitride, a tantalum oxide, a tantalum nitride, a hafnium oxide, a hafnium nitride, a zirconium oxide, a zirconium nitride, a cerium oxide, a cerium nitride, a tin oxide, a tin nitride, and a magnesium oxide, but embodiments of the present disclosure are not limited thereto.

[0100] In one embodiment, the encapsulation unit 300 may include at least one organic film and at least one inorganic film, and the at least one organic film may include the first compound.

[0101] For example, the at least one organic film may consist of the first compound.

[0102] In one or more embodiments, the at least one organic film may further include, in addition to the first compound, the second compound. The second compound is the same as described above.

[0103] In one or more embodiments, the at least one organic film may further include, in addition to the first compound, the third compound, and the first compound may be dispersed in the third compound. Here, the first compound may be simply dispersed in the third compound, or the first compound may be cross-linked to the third compound.

[0104] For example, the third compound may be a polymer resin. The polymer resin may include, for example, an acryl-based resin, a methacryl-based resin, an isoprene-based resin, a vinyl-based resin, an epoxy-resin resin, a urethane-based resin, a cellulose-based resin, a perylene-based resin, and/or an imide-based resin, but embodiments of the present disclosure are not limited thereto.

[0105] A mixing ratio of the first compound to the third compound may be appropriately selected by taking into account device characteristics, the degree of ultraviolet absorption, and/or the like.

[0106] In one or more embodiments, the at least one organic film may further include the second compound and the third compound in addition to the first compound.

[0107] The at least one organic film may be formed in a certain region utilizing various suitable methods, such as vacuum deposition, spin coating, casting, Langmuir-Blodgett (LB) deposition, ink-jet printing, laser-printing, and laser-induced thermal imaging. The number and thickness of organic films may be appropriately selected by taking into account productivity, device characteristics, and/or the like.

[0108] In one embodiment, the at least one inorganic film may include a metal, a metal halide, a metal nitride, a metal

oxide, a metal oxynitride, a silicon nitride, a silicon oxide, and/or a silicon oxynitride.

[0109] For example, the inorganic film may include at least one selected from MgF_2, LiF, AlF_3, NaF, a silicon oxide, a silicon nitride, a silicon oxynitride, an aluminium oxide, an aluminium nitride, an aluminium oxynitride, a titanium oxide, a titanium nitride, a tantalum oxide, a tantalum nitride, a hafnium oxide, a hafnium nitride, a zirconium oxide, a zirconium nitride, a cerium oxide, a cerium nitride, a tin oxide, a tin nitride, and a magnesium oxide, but embodiments of the present disclosure are not limited thereto.

[0110] The at least one inorganic film may be formed in a certain region utilizing various suitable methods, such as chemical vapor deposition (CVD), plasma-enhanced chemical vapor deposition (PECVD), sputtering, atomic layer deposition (ALD), and thermal evaporation. The number and thickness of inorganic films may be appropriately selected by taking into account productivity, device characteristics, and/or the like.

[0111] In one embodiment, the at least one organic film may include a first organic film, the at least one inorganic film may include a first inorganic film, and the first organic film may be disposed between the organic light-emitting device 200 and the first inorganic film. For example, the at least one organic film may include a first organic film, the at least one inorganic film may include a first inorganic film, and the first organic film and the second inorganic film may be sequentially stacked from the organic light-emitting device 200 in this stated order. It should be understood that the expression "sequentially stacked" does not exclude a case where another film is disposed between the organic light-emitting device 200 and the first organic film, and/or between the first organic film and the first inorganic film.

[0112] In one or more embodiments, the at least one organic film may include a first organic film, the at least one inorganic film may include a first inorganic film, and the first inorganic film may be disposed between the organic light-emitting device 200 and the first organic film. For example, the at least one organic film may include a first organic film, the at least one inorganic film may include a first inorganic film, and the first inorganic film and the first organic film may be sequentially stacked from the organic light-emitting device 200 in this stated order.

[0113] In one or more embodiments, the at least one organic film may include a first organic film, the at least one inorganic film may include a first inorganic film and a second inorganic film, and the first inorganic film, the first organic film, and the second inorganic film may be sequentially stacked from the organic light-emitting device 200 in this stated order.

[0114] In one or more embodiments, the at least one organic film may include a first organic film and a second organic film, the at least one inorganic film may include a first inorganic film, and the first organic film, the first inorganic film, and the second organic film may be sequentially stacked from the organic light-emitting device 200 in this stated order.

[0115] In one or more embodiments, the at least one organic film may include a first organic film and a second organic film, the at least one inorganic film may include a first inorganic film and a second inorganic film, and the first inorganic film, the first organic film, the second inorganic film, and the second organic film may be sequentially stacked from the organic light-emitting device 200 in this stated order.

[0116] In one or more embodiments, the at least one organic film may include a first organic film and a second organic film, the at least one inorganic film may include a first inorganic film and a second inorganic film, and the first organic film, the first inorganic film, the second organic film, and the second inorganic film may be sequentially stacked from the organic light-emitting device 200 in this stated order.

[0117] In one or more embodiments, the at least one organic film may include a first organic film and a second organic film, the at least one inorganic film may include a first inorganic film and a second inorganic film, and the first inorganic film, the second inorganic film, the first organic film, and the second organic film may be sequentially stacked from the organic light-emitting device 200 in this stated order.

[0118] In one or more embodiments, the at least one organic film may include a first organic film and a second organic film, the at least one inorganic film may include a first inorganic film and a second inorganic film, and the first organic film, the second organic film, the first inorganic film, and the second inorganic film may be sequentially stacked from the organic light-emitting device 200 in this stated order.

[0119] In one or more embodiments, the at least one organic film may include a first organic film and a second organic film, the at least one inorganic film may include a first inorganic film, a second inorganic film, and a third inorganic film, and the first inorganic film, the first organic film, the second inorganic film, the second organic film, and the third inorganic film may be sequentially stacked from the organic light-emitting device 200 in this stated order.

[0120] In one or more embodiments, the at least one organic film may include a first organic film, a second organic film, and a third organic film, the at least one inorganic film may include a first inorganic film and a second inorganic film, and the first organic film, the first inorganic film, the second organic film, the second inorganic film, and the third organic film, may be sequentially stacked from the organic light-emitting device 200 in this stated order, but embodiments of the present disclosure are not limited thereto. The number of organic films, the number of inorganic films, and the stacking order of the inorganic films and the organic films may be appropriately changed according to design.

[0121] The organic light-emitting display apparatus 10 may include a plurality of organic light-emitting devices 200. According to an embodiment, an organic light-emitting display apparatus 10 includes: a substrate; an organic emission unit disposed above the substrate and including a plurality of organic light-emitting devices 200; and an encapsulation

unit 300 disposed above the organic emission unit and sealing the organic emission unit, wherein the encapsulation unit 300 includes the first compound represented by Formula 1. The first compound is the same as described above.

[0122] For example, the encapsulation unit 300 may further include the second compound and/or the third compound in addition to the first compound. The second compound and the third compound are the same as described above.

[0123] In one or more embodiments, the encapsulation unit 300 may further include, in addition to the first compound, a metal, a metal halide, a metal nitride, a metal oxide, a metal oxynitride, a silicon nitride, a silicon oxide, and/or a silicon oxynitride.

[0124] In one or more embodiments, the encapsulation unit 300 may include at least one organic film and at least one inorganic film, and the at least one organic film may include the first compound. The at least one organic film and the at least one inorganic film are the same as described above.

[0125] FIG. 2 is a schematic cross-sectional view of an organic light-emitting display apparatus according to an embodiment

[0126] Referring to FIG. 2, a back plane is formed. The back plane may be understood as including a substrate 100, a plurality of first electrodes 210R, 210G, and 210B above the substrate 100, and a pixel defining film 180 exposing at least a part of a central portion of each of the plurality of first electrodes 210R, 210G, and 210B. The pixel defining film 180 may have a shape protruding more (e.g., higher) than the plurality of first electrodes 210R, 210G, and 210B (+z direction) with respect to the substrate 100.

[0127] The plurality of first electrodes 210R, 210G, and 210B may be understood as pixel electrodes. Among the pixel electrodes, the pixel electrode 210B, the pixel electrode 210R, and the pixel electrode 210G may be understood as a first pixel electrode, a second pixel electrode, and a third pixel electrode, respectively. This is because intermediate layers formed on the first to third pixel electrodes may be different from one another. Hereinafter, for convenience, the terms "pixel electrode 210R", "pixel electrode 210G", and "pixel electrode 210B" are utilized instead of the first pixel electrode, the second pixel electrode, and the third pixel electrode. The description of the pixel electrodes are substantially the same as the description of the first electrode.

[0128] The pixel defining film 180 has an opening corresponding to each sub-pixel, that is, an opening exposing the central portions of the pixel electrodes 210R, 210G, and 210B or the entire portions of the pixel electrodes 210R, 210G, and 210B, and thus may serve to define pixels. Also, the pixel defining film 180 increases a distance between ends of the pixel electrodes 210R, 210G, and 210B and a second electrode (not illustrated) above the pixel electrodes 210R, 210G, and 210B, thus preventing or reducing occurrence of arc at the ends of the pixel electrodes 210R, 210G, and 210B.

[0129] If necessary, the back plane may further include various elements. For example, as illustrated in FIG. 2, a thin film transistor TFT or a capacitor Cap may be formed on the substrate 100. The back plane may include other elements, such as a buffer layer 110 for preventing or substantially preventing impurities from penetrating into a semiconductor layer of the thin film transistor TFT, a gate insulating film 130 for insulating the semiconductor layer of the thin film transistor TFT from a gate electrode thereof, an interlayer insulating layer 150 for insulating a source electrode and a drain electrode of the thin film transistor TFT from the gate electrode thereof, and a planarization film 170 covering the thin film transistor TFT and having a substantially flat upper surface.

[0130] After the back plane is formed, intermediate layers 220R, 220G, and 220B are formed. The intermediate layers 220R, 220G, and 220B may have a multi-layered structure including an emission layer. In this case, unlike that illustrated in FIG. 2, some of the intermediate layers 220R, 220G, and 220B may be a common layer substantially corresponding to the entire surface of the substrate 100, and others thereof may be pattern layers patterned corresponding to the pixel electrodes 210R, 210G, and 210B.

[0131] After the intermediate layers 220R, 220G, and 220B, a second electrode 230 is formed on the intermediate layers 220R, 220G, and 220B.

[0132] After the second electrode 230 is formed, an encapsulation unit 300 is formed so as to protect the organic light-emitting devices 200 including the pixel electrodes 210R, 210G, and 210B, the intermediate layers 220R, 220G, and 220B, and the second electrode 230 from impurities such as external oxygen and/or moisture.

[0133] The encapsulation unit 300 may extend to not only the upper surface but also the side surface of the organic light-emitting device 200 and contact a part of the substrate 100. Therefore, it is possible to effectively prevent or substantially prevent external oxygen and moisture from penetrating into the organic light-emitting device 200.

[0134] The encapsulation unit 300 includes the first compound represented by Formula 1.

[0135] The term "C_1-C_{60} alkyl group" as used herein refers to a linear or branched saturated aliphatic hydrocarbon monovalent group having 1 to 60 carbon atoms, and examples thereof 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 "C_1-C_{60} alkylene group" as used herein refers to a divalent group having the same (e.g., substantially the same) structure as the C_1-C_{60} alkyl group. Corresponding definitions apply to other ranges given for the number of carbon atoms in an alkyl/alkylene group.

[0136] The term "C_2-C_{60} alkenyl group" as used herein refers to a hydrocarbon group having at least one carbon-carbon double bond in the middle or at the terminus of the C_2-C_{60} alkyl group, and examples thereof include an ethenyl

group, a propenyl group, and a butenyl group. The term "C_2-C_{60} alkenylene group" as used herein refers to a divalent group having the same (e.g., substantially the same) structure as the C_2-C_{60} alkenyl group. Corresponding definitions apply to other ranges given for the number of carbon atoms in an alkenyl/alkenylene group.

[0137] The term "C_2-C_{60} alkynyl group" as used herein refers to a hydrocarbon group having at least one carbon-carbon triple bond in the middle or at the terminus of the C_2-C_{60} alkyl group, and examples thereof include an ethynyl group, and a propynyl group. The term "C_2-C_{60} alkynylene group" as used herein refers to a divalent group having the same (e.g., substantially the same) structure as the C_2-C_{60} alkynyl group. Corresponding definitions apply to other ranges given for the number of carbon atoms in an alkynyl/alkynylene group.

[0138] The term "C_1-C_{60} alkoxy group" as used herein refers to a monovalent group represented by $-OA_{101}$ (wherein A_{101} is the C_1-C_{60} alkyl group), and examples thereof include a methoxy group, an ethoxy group, and an isopropyloxy group. Corresponding definitions apply to other ranges given for the number of carbon atoms in an alkoxy group.

[0139] The term "C_3-C_{10} cycloalkyl group" as used herein refers to a monovalent saturated hydrocarbon monocyclic group having 3 to 10 carbon atoms, and examples thereof include a cyclopropyl group, a cyclobutyl group, a cyclopentyl group, a cyclohexyl group, and a cycloheptyl group. The term "C_3-C_{10} cycloalkylene group" as used herein refers to a divalent group having the same (e.g., substantially the same) structure as the C_3-C_{10} cycloalkyl group.

[0140] The term "C_1-C_{10} heterocycloalkyl group" as used herein refers to a monovalent monocyclic group having at least one heteroatom selected from N, O, Si, P, and S as a ring-forming atom and 1 to 10 carbon atoms, and examples thereof include a 1,2,3,4-oxatriazolidinyl group, a tetrahydrofuranyl group, and a tetrahydrothiophenyl group. The term "C_1-C_{10} heterocycloalkylene group" as used herein refers to a divalent group having the same (e.g., substantially the same) structure as the C_1-C_{10} heterocycloalkyl group.

[0141] The term "C_3-C_{10} cycloalkenyl group" as used herein refers to a monovalent monocyclic group that has 3 to 10 carbon atoms and at least one carbon-carbon double bond in the ring thereof and no aromaticity, and examples thereof include a cyclopentenyl group, a cyclohexenyl group, and a cycloheptenyl group. The term "C_3-C_{10} cycloalkenylene group" as used herein refers to a divalent group having the same (e.g., substantially the same) structure as the C_3-C_{10} cycloalkenyl group.

[0142] The term "C_1-C_{10} heterocycloalkenyl group" as used herein refers to a monovalent monocyclic group that has at least one heteroatom selected from N, O, Si, P, and S as a ring-forming atom, 1 to 10 carbon atoms, and at least one carbon-carbon double bond in its ring. Non-limiting examples of the C_1-C_{10} heterocycloalkenyl group include a 4,5-dihydro-1,2,3,4-oxatriazolyl group, a 2,3-dihydrofuranyl group, and a 2,3-dihydrothiophenyl group. The term "C_1-C_{10} heterocycloalkenylene group" as used herein refers to a divalent group having the same (e.g., substantially the same) structure as the C_1-C_{10} heterocycloalkenyl group.

[0143] The term "C_6-C_{60} aryl group" as used herein refers to a monovalent group having a carbocyclic aromatic system having 6 to 60 carbon atoms, and the term "C_6-C_{60} arylene group" as used herein refers to a divalent group having a carbocyclic aromatic system having 6 to 60 carbon atoms. Examples of the C_6-C_{60} aryl group are a phenyl group, a naphthyl group, an anthracenyl group, a phenanthrenyl group, a pyrenyl group, and a chrysenyl group. When the C_6-C_{60} aryl group and the C_6-C_{60} arylene group each include two or more rings, the rings may be fused to each other. Corresponding definitions apply to other ranges given for the number of carbon atoms in an aryl/arylene group.

[0144] The term "C_1-C_{60} heteroaryl group" as used herein refers to a monovalent group having a carbocyclic aromatic system that has at least one heteroatom selected from N, O, Si, P, and S as a ring-forming atom, in addition to 1 to 1 carbon atoms. The term "C_1-C_{60} heteroarylene group" as used herein refers to a divalent group having a carbocyclic aromatic system that has at least one heteroatom selected from N, O, Si, P, and S as a ring-forming atom, in addition to 1 to 60 carbon atoms. Examples of the C_1-C_{60} heteroaryl group are a pyridinyl group, a pyrimidinyl group, a pyrazinyl group, a pyridazinyl group, a triazinyl group, a quinolinyl group, and an isoquinolinyl group. When the C_1-C_{60} heteroaryl group and the C_1-C_{60} heteroarylene group each include two or more rings, the rings may be fused to each other. Corresponding definitions apply to other ranges given for the number of carbon atoms in an heteroaryl/heteroarylene group.

[0145] The term "C_6-C_{60} aryloxy group" as used herein refers to a group represented by $-OA_{102}$ (wherein A_{102} is the C_6-C_{60} aryl group), and the term "C_6-C_{60} arylthio group" as used herein refers to a group represented by $-SA_{103}$ (wherein A_{103} is the C_6-C_{60} aryl group). Corresponding definitions apply to other ranges given for the number of carbon atoms in an aryloxy group and an arylthio group.

[0146] The term "monovalent non-aromatic condensed polycyclic group" as used herein refers to a monovalent group (for example, having 8 to 60 carbon atoms) having two or more rings condensed with each other, only carbon atoms as ring-forming atoms, and no aromaticity in its entire molecular structure. An example of the monovalent non-aromatic condensed polycyclic group is a fluorenyl group. The term "divalent non-aromatic condensed polycyclic group" as used herein refers to a divalent group having the same (e.g., substantially the same) structure as the monovalent non-aromatic condensed polycyclic group.

[0147] The term "monovalent non-aromatic condensed heteropolycyclic group" as used herein refers to a monovalent group (for example, having 1 to 60 carbon atoms) having two or more rings condensed to each other, at least one

heteroatom selected from N, O, Si, P, and S, other than carbon atoms, as a ring-forming atom, and no aromaticity in its entire molecular structure. An example of the monovalent non-aromatic condensed heteropolycyclic group is a carbazolyl group. The term "divalent non-aromatic condensed heteropolycyclic group" as used herein refers to a divalent group having the same (e.g., substantially the same) structure as the monovalent non-aromatic condensed heteropolycyclic group.

[0148] The term "C_5-C_{60} carbocyclic group" as used herein refers to a monocyclic or polycyclic group having 5 to 60 carbon atoms in which the ring-forming atoms are carbon atoms only. The C_5-C_{60} carbocyclic group may be an aromatic carbocyclic group or a non-aromatic carbocyclic group. The C_5-C_{50} carbocyclic group may be a ring (such as benzene), a monovalent group (such as a phenyl group), or a divalent group (such as a phenylene group). In one or more embodiments, depending on the number of substituents connected to the C_5-C_{60} carbocyclic group, the C_5-C_{60} carbocyclic group may be a trivalent group or a quadrivalent group. Corresponding definitions apply to other ranges given for the number of carbon atoms in a carbocyclic group.

[0149] The term "C_1-C_{60} heterocyclic group" as used herein refers to a group having the same (e.g., substantially the same) structure as the C_5-C_{60} carbocyclic group, except that as a ring-forming atom, at least one heteroatom selected from N, O, Si, P, and S is utilized in addition to carbon (the number of carbon atoms may be in a range of 1 to 60). Corresponding definitions apply to other ranges given for the number of carbon atoms in a heterocyclic group.

[0150] At least one substituent of the substituted C_1-C_{60} alkylene group, the substituted C_2-C_{60} alkenylene group, the substituted C_2-C_{60} alkynylene group, the substituted C_3-C_{10} cycloalkylene group, the substituted C_1-C_{10} heterocycloalkylene group, the substituted C_3-C_{10} cycloalkenylene group, the substituted C_1-C_{10} heterocycloalkenylene group, the substituted C_6-C_{60} (*e.g.* C_6-C_{30}) arylene group, the substituted C_1-C_{60} (*e.g.* C_1-C_{20}) heteroarylene group, the substituted divalent non-aromatic condensed polycyclic group, the substituted divalent non-aromatic condensed heteropolycyclic group, the substituted C_1-C_{60} (*e.g.* C_1-C_{20}) alkyl group, the substituted C_2-C_{60} (*e.g.* C_2-C_{20}) alkenyl group, the substituted C_2-C_{60} (*e.g.* C_2-C_{20}) alkynyl group, the substituted C_1-C_{60} alkoxy group, the substituted C_3-C_{60} (*e.g.* C_3-C_{20}) cycloalkoxy group, the substituted C_3-C_{10} cycloalkyl group, the substituted C_1-C_{10} heterocycloalkyl group, the substituted C_3-C_{10} cycloalkenyl group, the substituted C_1-C_{10} heterocycloalkenyl group, the substituted C_6-C_{60} (*e.g.* C_1-C_{20}) aryl group, the substituted C_6-C_{60} (*e.g.* C_1-C_{20}) aryloxy group, the substituted C_6-C_{60} (*e.g.* C_1-C_{20}) arylthio group, the substituted C_1-C_{60} (*e.g.* C_1-C_{20}) heteroaryl group, the substituted monovalent non-aromatic condensed polycyclic group, and the substituted monovalent non-aromatic condensed heteropolycyclic group may be selected from:

deuterium (-D), -F, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, a hydrazono group, a C_1-C_{60} (*e.g.* C_1-C_{20}) alkyl group, a C_2-C_{60} (*e.g.* C_2-C_{20}) alkenyl group, a C_2-C_{60} (*e.g.* C_2-C_{20}) alkynyl group, a C_1-C_{60} (*e.g.* C_1-C_{20}) alkoxy group, and a C_3-C_{60} (*e.g.* C_3-C_{20}) cycloalkoxy group;

a C_1-C_{60} (*e.g.* C_1-C_{20}) alkyl group, a C_2-C_{60} (*e.g.* C_2-C_{20}) alkenyl group, a C_2-C_{60} (*e.g.* C_2-C_{20}) alkynyl group, a C_1-C_{60} (*e.g.* C_1-C_{20}) alkoxy group, and a C_3-C_{60} (*e.g.* C_3-C_{20}) cycloalkoxy group, each substituted with at least one selected from deuterium, -F, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, a hydrazono group, a C_3-C_{10} cycloalkyl group, a C_1-C_{10} heterocycloalkyl group, a C_3-C_{10} cycloalkenyl group, a C_1-C_{10} heterocycloalkenyl group, a C_6-C_{60} (*e.g.* C_6-C_{30}) aryl group, a C_6-C_{60} (*e.g.* C_6-C_{30}) aryloxy group, a C_6-C_{60} (*e.g.* C_6-C_{30}) arylthio group, a C_1-C_{60} (*e.g.* C_1-C_{20}) heteroaryl group, a monovalent non-aromatic condensed polycyclic group, a monovalent non-aromatic condensed heteropolycyclic group, $-Si(Q_{11})(Q_{12})(Q_{13})$, $-N(Q_{11})(Q_{12})$, $-B(Q_{11})(Q_{12})$, $-C(=O)(Q_{11})$, $-S(=O)_2(Q_{11})$, and $-P(=O)(Q_{11})(Q_{12})$;

a C_3-C_{10} cycloalkyl group, a C_1-C_{10} heterocycloalkyl group, a C_3-C_{10} cycloalkenyl group, a C_1-C_{10} heterocycloalkenyl group, a C_6-C_{60} (*e.g.* C_6-C_{30}) aryl group, a C_6-C_{60} (*e.g.* C_6-C_{30}) aryloxy group, a C_6-C_{60} (*e.g.* C_6-C_{30}) arylthio group, a C_1-C_{60} (*e.g.* C_1-C_{20}) heteroaryl group, a monovalent non-aromatic condensed polycyclic group, and a monovalent non-aromatic condensed heteropolycyclic group;

a C_3-C_{10} cycloalkyl group, a C_1-C_{10} heterocycloalkyl group, a C_3-C_{10} cycloalkenyl group, a C_1-C_{10} heterocycloalkenyl group, a C_6-C_{60} (*e.g.* C_6-C_{30}) aryl group, a C_6-C_{60} (*e.g.* C_6-C_{30}) aryloxy group, a C_6-C_{60} (*e.g.* C_6-C_{30}) arylthio group, a C_1-C_{60} (*e.g.* C_1-C_{20}) 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 amidino group, a hydrazino group, a hydrazono group, a C_1-C_{60} (*e.g.* C_1-C_{20}) alkyl group, a C_2-C_{60} (*e.g.* C_2-C_{20}) alkenyl group, a C_2-C_{60} (*e.g.* C_2-C_{20}) alkynyl group, a C_1-C_{60} (*e.g.* C_1-C_{20}) alkoxy group, a C_3-C_{60} (*e.g.* C_3-C_{20}) cycloalkoxy group, a C_3-C_{10} cycloalkyl group, a C_1-C_{10} heterocycloalkyl group, a C_3-C_{10} cycloalkenyl group, a C_1-C_{10} heterocycloalkenyl group, a C_6-C_{60} (*e.g.* C_6-C_{30}) aryl group, a C_6-C_{60} (*e.g.* C_6-C_{30}) aryloxy group, a C_6-C_{60} (*e.g.* C_6-C_{30}) arylthio group, a C_1-C_{60} (*e.g.* C_1-C_{20}) heteroaryl group, a monovalent non-aromatic condensed polycyclic group, a monovalent non-aromatic condensed heteropolycyclic group,$-Si(Q_{21})(Q_{22})(Q_{23})$, $-N(Q_{21})(Q_{22})$, $-B(Q_{21})(Q_{22})$, $-C(=O)(Q_{21})$, $-S(=O)_2(Q_{21})$, and$-P(=O)(Q_{21})(Q_{22})$; and $-Si(Q_{31})(Q_{32})(Q_{33})$, $-N(Q_{31})(Q_{32})$, $-B(Q_{31})(Q_{32})$, $-C(=O)(Q_{31})$, $-S(=O)_2(Q_{31})$, and $-P(=O)(Q_{31})(Q_{32})$, and

Q_{11} to Q_{13}, Q_{21} to Q_{23}, and Q_{31} to Q_{33} may each independently be selected from hydrogen, deuterium, -F, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, a hydrazono group, a C_1-C_{60}

(*e.g.* C_1-C_{20}) alkyl group, a C_2-C_{60} (*e.g.* C_2-C_{20}) alkenyl group, a C_2-C_{60} (*e.g.* C_2-C_{20}) alkynyl group, a C_1-C_{60} (*e.g.* C_1-C_{20}) alkoxy group, a C_3-C_{60} (*e.g.* C_3-C_{20}) cycloalkoxy group, a C_3-C_{10} cycloalkyl group, a C_1-C_{10} heterocycloalkyl group, a C_3-C_{10} cycloalkenyl group, a C_1-C_{10} heterocycloalkenyl group, a C_6-C_{60} (*e.g.* C_6-C_{30}) aryl group, a C_1-C_{60} (*e.g.* C_1-C_{20}) heteroaryl group, a monovalent non-aromatic condensed polycyclic group, a monovalent non-aromatic condensed heteropolycyclic group, a biphenyl group, and a terphenyl group.

[0151] The term "Ph" as used herein represents a phenyl group, the term "Me" as used herein represents a methyl group, the term "Et" as used herein represents an ethyl group, the term "ter-Bu" or "Bu^t" as used herein represents a tert-butyl group, and the term "OMe" as used herein represents a methoxy group.

[0152] The term "biphenyl group" as used herein refers to a "phenyl group substituted with a phenyl group. The "biphenyl group" is a "substituted phenyl group" having a "C_6-C_{60} aryl group" as a substituent.

[0153] The term "terphenyl group" as used herein refers to a "phenyl group substituted with a biphenyl group. The "terphenyl group" is a "phenyl group" having, as a substituent, a "C_6-C_{60} aryl group substituted with a C_6-C_{60} aryl group."

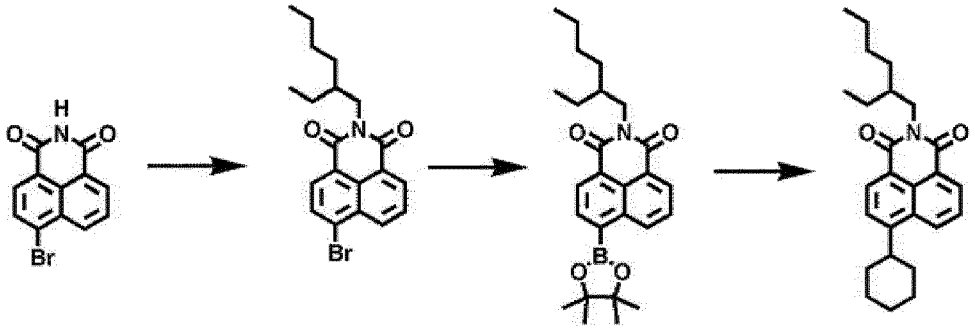
[0154] * and *' as used herein, unless defined otherwise, each refer to a binding site to a neighboring atom in a corresponding formula.

[0155] Hereinafter, a compound according to embodiments and an organic light-emitting device according to embodiments will be described in more detail with reference to Synthesis Examples and Examples. The expression "B was utilized instead of A" utilized in describing Synthesis Examples refers to that an identical number of molar equivalents of B was utilized in place of molar equivalents of A.

[Examples]

Synthesis Example 1: Synthesis of Compound 5

[0156]



Synthesis of Intermediate 5-1

[0157] 5 g of Intermediate A (6-bromo-1H-benzo[de]isoquinoline-1,3(2H)-dione) was dissolved in dimethylformamide (DMF), and 5 g of K_2CO_3 and 4 g of 3-(bromomethyl)hexane were added thereto. The mixture was stirred at a temperature of 50°C for 24 hours, and the reaction was terminated by water. An extraction process was performed thereon three times utilizing ethyl acetate, a drying process was performed thereon utilizing anhydrous magnesium sulfate, and a filtering process was performed thereon under reduced pressure. Then, the residue obtained therefrom was separated and purified by column chromatography to obtain 5.6 g (80%) of Intermediate 5-1.

Synthesis of Intermediate 5-2

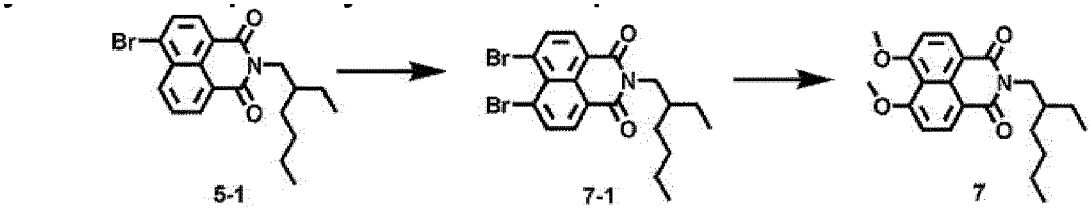
[0158] 5.6 g of Intermediate 5-1 was diluted in toluene, and 5 g of KOAc, 4.6 g of bis(pinacolato)diboron, and 0.5 g of $Pd(dppf)_2Cl_2$ were added thereto and stirred under reflux. After 17 hours, the mixture was cooled to room temperature, and the reaction was terminated by water. An extraction process was performed thereon three times utilizing ethyl acetate, a drying process was performed thereon utilizing anhydrous magnesium sulfate, and a filtering process was performed thereon under reduced pressure. Then, the residue obtained therefrom was separated and purified by column chromatography to obtain 5.1g (81%) of Intermediate 5-2.

Synthesis of Compound 5

[0159] 5.1 g of Intermediate 5-2, 2.56 g of bromocyclohexane, 8 g of Cs_2CO_3, and 0.8 g of $Pd(PPh_3)_4$ were diluted in toluene and stirred under reflux. After 20 hours, the mixture was cooled to room temperature, and the reaction was terminated by water. An extraction process was performed thereon three times utilizing ethyl acetate, a drying process was performed thereon utilizing anhydrous magnesium sulfate, and a filtering process was performed thereon under reduced pressure. Then, the residue obtained therefrom was separated and purified by column chromatography to obtain 3.0 g (70%) of Compound 5.

Synthesis Example 2: Synthesis of Compound 7

[0160]



Synthesis of Intermediate 7-1

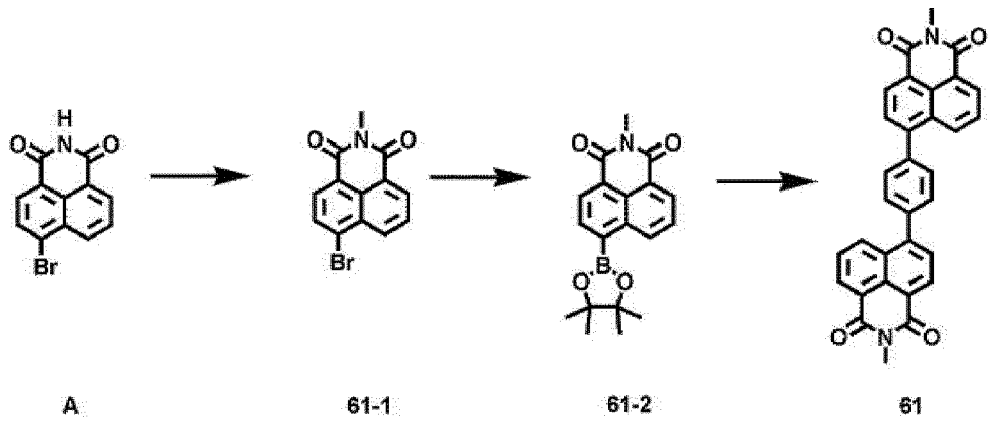
[0161] 1.8 g of Intermediate 5-1 was diluted in methylene chloride (MC) and 900 mg of NBS was added dropwise thereto. The mixture was stirred for 15 hours, and the reaction was terminated by water. An extraction process was performed thereon three times, a drying process was performed thereon utilizing anhydrous magnesium sulfate, and a filtering process was performed thereon under reduced pressure. Then, the residue obtained therefrom was separated and purified by column chromatography to obtain 2 g (93%) of Intermediate 7-1. The obtained compound was confirmed by LC-MS. $C_{20}H_{21}Br_2NO_2$: M+ 465.2.

Synthesis of Compound 7

[0162] 2 g of Compound 7-1 was diluted in DMSO and 2 g of NaOMe was added dropwise thereto. The reaction vessel was stirred at a temperature of 60°C and slowly cooled to room temperature after 6 hours. The reaction was terminated by water, and the residue obtained therefrom was filtered under reduced pressure to obtain 1.4 g (88%) of Compound 7.

Synthesis Example 3: Synthesis of Compound 61

[0163]



Synthesis of Intermediate 61-1

[0164] 5 g of Intermediate A was dissolved in DMF, and 5 g of K_2CO_3 and 3 g of iodomethane were added thereto.

The mixture was stirred at a temperature of 50°C for 24 hours, and the reaction was terminated by water. An extraction process was performed thereon three times utilizing ethyl acetate, a drying process was performed thereon utilizing anhydrous magnesium sulfate, and a filtering process was performed thereon under reduced pressure. Then, the residue obtained therefrom was separated and purified by column chromatography to obtain 4.6 g (88%) of Intermediate 61-1. The obtained compound was confirmed by LC-MS. $C_{19}H_{15}Br$: M+ 324.2.

Synthesis of Intermediate 61-2

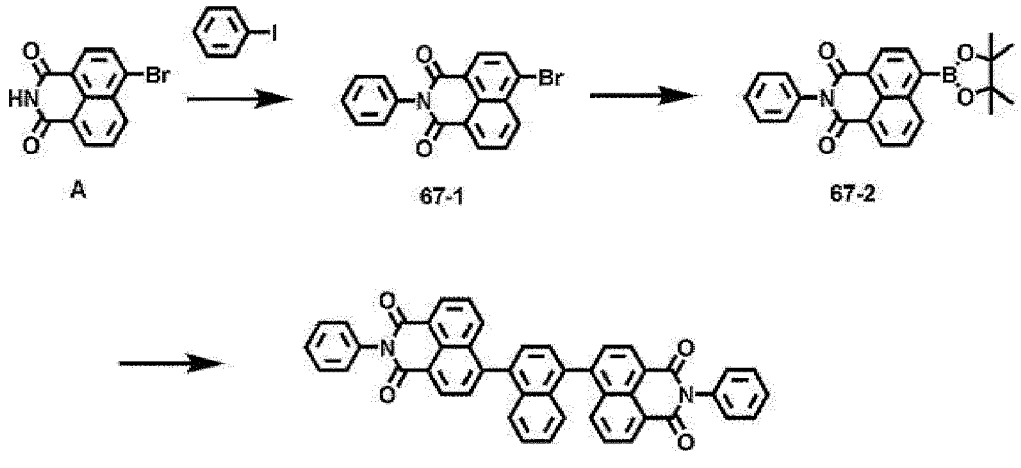
[0165] 4.6 g of Intermediate 61-1 was diluted in toluene, and 5 g of KOAc, 4.6 g of bis(pinacolato)diboron, and 0.5 g of $Pd(dppf)_2Cl_2$ were added thereto and stirred under reflux. After 17 hours, the mixture was cooled to room temperature, and the reaction was terminated by water. An extraction process was performed thereon three times utilizing ethyl acetate, a drying process was performed thereon utilizing anhydrous magnesium sulfate, and a filtering process was performed thereon under reduced pressure. Then, the residue obtained therefrom was separated and purified by column chromatography to obtain 4.3 g (81%) of Intermediate 61-2. The obtained compound was confirmed by LC-MS. $C_{19}H_{15}Br$: M+ 324.2.

Synthesis of Compound 61

[0166] 4.3 g of Intermediate 61-2, 2 g of 1,4-dibromobenzene, 8 g of Cs_2CO_3, and 0.8 g of $Pd(PPh_3)_4$ were diluted in toluene and stirred under reflux. After 20 hours, the mixture was cooled to room temperature, and the reaction was terminated by water. An extraction process was performed thereon three times utilizing ethyl acetate, a drying process was performed thereon utilizing anhydrous magnesium sulfate, and a filtering process was performed thereon under reduced pressure. Then, the residue obtained therefrom was separated and purified by column chromatography to obtain 2.8 g (76%) of Compound 61.

Synthesis Example 4: Synthesis of Compound 67

[0167]



Synthesis of Intermediate 67-1

[0168] 2.8 g of Intermediate A, 2.1 g of iodobenzene, 5.4 g of KOtBu, 0.2 g of $P(tBu)_3$, and 0.4 g of $Pd_2(dba)_3$ were diluted in toluene and stirred under reflux. After 20 hours, the mixture was cooled to room temperature, and the reaction was terminated by water. An extraction process was performed thereon three times utilizing ethyl acetate, a drying process was performed thereon utilizing anhydrous magnesium sulfate, and a filtering process was performed thereon under reduced pressure. Then, the residue obtained therefrom was separated and purified by column chromatography to obtain 2.9 g (80%) of Intermediate 67-1. The obtained compound was confirmed by LC-MS. $C_{18}H_{10}BrNO_2$: M+ 351.0.

Synthesis of Intermediate 67-2

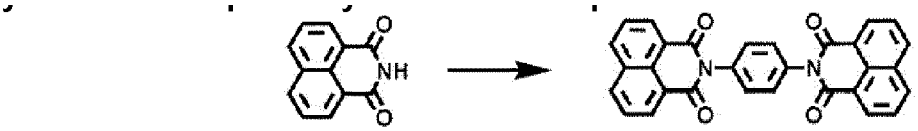
[0169] 2.8 g (84%) of Intermediate 67-2 was synthesized in the same (e.g., substantially the same) manner as in Synthesis of Intermediate 61-2, except that 2.9 g of Intermediate 67-1 was utilized. The obtained compound was confirmed by LC-MS. $C_{24}H_{22}BNO_4$: M+ 399.2.

Synthesis of Compound 67

[0170] 2.1 g (45%) of Compound 67 was synthesized in the same (e.g., substantially the same) manner as in Synthesis of Compound 61, except that 2.8 g of Intermediate 67-2 and 1 g of 1,4-dibromonaphthalene were utilized.

Synthesis Example 5: Synthesis of Compound 76

[0171]

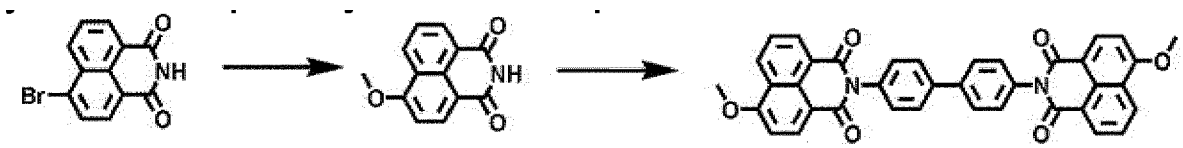


76-1 76

[0172] 2.99 g (63%) of Compound 76 was synthesized in the same (e.g., substantially the same) manner as in Synthesis of Compound 67-1, except that Compound 76-1 and 1,4-dibromobenzene were utilized.

Synthesis Example 6: Synthesis of Compound 88

[0173]



A 88-1 88

Synthesis of Intermediate 88-1

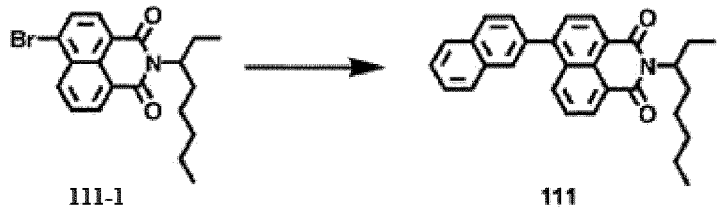
[0174] 2 g of Compound A was diluted in DMSO and 2 g of NaOMe was added dropwise thereto. The reaction vessel was stirred at a temperature of 60°C and slowly cooled to room temperature after 6 hours. The reaction was terminated by water, and the residue obtained therefrom was filtered under reduced pressure to obtain 1.3 g (79%) of Intermediate 88-1. The obtained compound was confirmed by LC-MS. $C_{13}H_9NO_3$: M+ 227.1.

Synthesis of Compound 88

[0175] 2 g (58%) of Compound 88 was synthesized in the same (e.g., substantially the same) manner as in Synthesis of Compound 61, except that 1.3 g of Intermediate 88-1 and 0.89 g of 4,4'-dibromo-1,1'-biphenyl were utilized.

Synthesis Example 7: Synthesis of Compound 111

[0176]

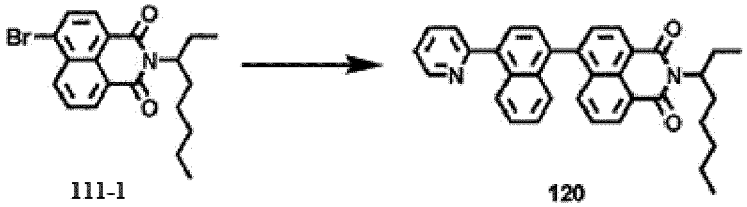


111-1 111

[0177] 1.6 g (80%) of Compound 111 was synthesized in the same (e.g., substantially the same) manner as in Synthesis of Compound 61, except that 1.8 g of Intermediate 111-1 and 1 g of naphthalen-2-yl boronic acid were utilized.

Synthesis Example 8: Synthesis of Compound 120

[0178]

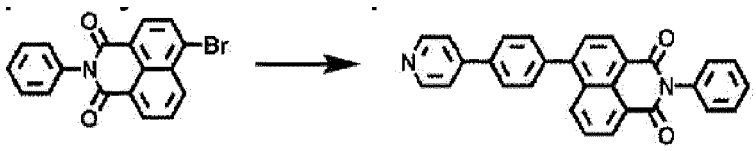


111-1 120

[0179] 1.1 g (42%) of Compound 120 was synthesized in the same (e.g., substantially the same) manner as in Synthesis of Compound 61, except that 2 g of Intermediate 111-1 and 1.7 g of (4-(pyridin-2-yl)naphthalen-1-yl)boronic acid were utilized.

Synthesis Example 9: Synthesis of Compound 169

[0180]

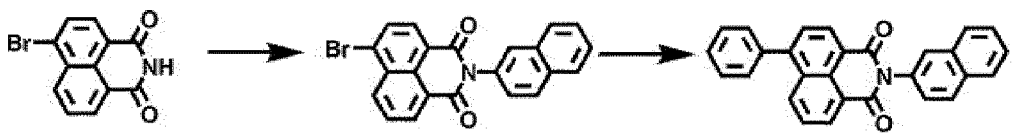


67-1 169

[0181] 1.4 g (49%) of Compound 169 was synthesized in the same (e.g., substantially the same) manner as in Synthesis of Compound 61, except that 2.3 g of Intermediate 67-1 and 1.7 g of (4-(pyridin-4-yl)phenyl)boronic acid were utilized.

Synthesis Example 10: Synthesis of Compound 181

[0182]



A 181-1 181

Synthesis of Intermediate 181-1

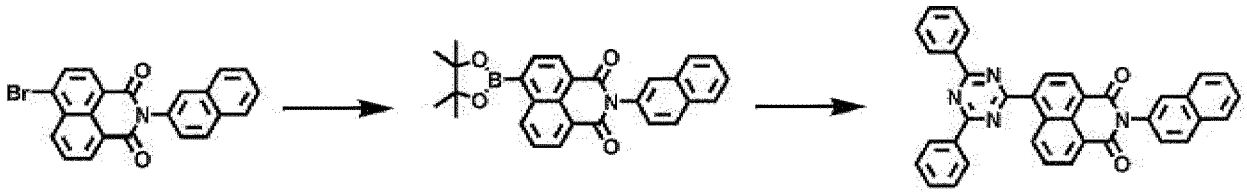
[0183] 1.6 g (73%) of Intermediate 181-1 was synthesized in the same (e.g., substantially the same) manner as in Synthesis of Intermediate 67-1, except that 1.5 g of Intermediate A and 1.5 g of 2-iodonaphthalene were utilized. The obtained compound was confirmed by LC-MS. $C_{22}H_{12}BrNO_2$: M+ 401.0

Synthesis of Compound 181

[0184] 1.2 g (78%) of Compound 181 was synthesized in the same (e.g., substantially the same) manner as in Synthesis of Compound 61, except that 1.6 g of Intermediate 181-1 and 1.3 g of phenylboronic acid were utilized.

Synthesis Example 11: Synthesis of Compound 198

[0185]



181-1 198-1 198

Synthesis of Intermediate 198-1

[0186] 1.9 g (87%) of Intermediate 198-1 was synthesized in the same (e.g., substantially the same) manner as in Synthesis of Intermediate 67-2, except that 2 g of Intermediate 181-1 was utilized. The obtained compound was confirmed by LC-MS. $C_{28}H_{24}BNO_4$: M+ 449.2.

Synthesis of Compound 198

[0187] 1.5 g (62%) of Compound 198 was synthesized in the same (e.g., substantially the same) manner as in Synthesis of Compound 61, except that 1.9 g of Intermediate 198-1 and 1.3 g of 2-chloro-4,6-diphenyl-1,3,5-triazine were utilized.

[0188] ^{1}H NMR and LC-MS of the synthesized Compounds are shown in Table 1. Methods of synthesizing compounds other than Compounds shown in Table 1 should be readily apparent to those of ordinary skill in the art by referring to the synthesis mechanisms and source materials described above.

Table 1

Compound	^{1}H NMR ($CDCl_3$, 400MHz)	LC-MS	
		found	Calc
5	8.48-8.33(m, 3H), 7.88(m, 1H), 7.11 (m, 1 H) 3.12(d, 2H), 2.72(m, 1H), 1.92-0.88 (m, 25H)	391.2	391.2
7	8.69(d, 2H), 6.95(d, 2H), 4.03(s, 6H), 3.68(m, 2H), 2.11 (m, 1H), 1.45-1.20(m, 8H), 0.87(t, 6H)	465.0	465.0
61	8.59(d, 2H), 8.22(d, 2H), 8.12(d, 2H), 7.85(m, 2H), 7.75(m, 4H), 7.70(m, 2H), 3.48 (s, 6H)	469.2	496.1
67	8.43-8.40(m, 2H), 8.22(m, 2H),8.11 (dd, 2H), 8.05(br, 2H), 7.71-7.40(m, 16H), 7.00 (m, 2H)	670.7	670.7
76	8.41 (dd, 4H) 8.24 (dd, 4H), 8. 74-7.69(m, 8H)	468.6	468.5
88	8.55-8.42(m, 6H) 7.63-7.55(m, 6H), 7.23-7.18(m, 4H), 6.83(d, 2H), 4.02(s, 6H)	604.6	604.6
111	8.51 (d, 1H), 8.18-8.08(m, 2H), 7.99-7.88(m, 3H), 7.69-7.52(m, 4H), 7.32(d, 1H), 5.01 (m, 1H), 2.20(2H), 1.97-1.89(m, 2H), 1.71-1.52(m, 2H), 1.36-1.24(m, 2H), 1.04 (m, 2H), 0.93-0.83(m, 6H)	435.2	435.2
120	8.72(d, 1H), 8.47(d, 1H), 8.18-8.08(m, 2H), 7.82-7.67(m, 5H), 7.46-7.44(m, 1H), 7.38(m, 1H), 7.25-7.23(m, 2H), 7.06-7.02(d, 1H), 5.01 (m, 1H), 2.20(2H), 1.97-1.89 (m, 2H), 1.71-1.52(m, 2H), 1.36-1.24(m, 2H), 1.04(m, 2H), 0.93-0.83(m, 6H)	512.7	512.7
169	8.73-8.70(m, 2H), 8.48(dd, 1H), 8.16 (td, 2H), 7.81-7.63(m, 6H), 7.52-7.40(m, 7H)	426.5	426.5

(continued)

Compound	^{1}H NMR ($CDCl_3$, 400MHz)	LC-MS	
		found	Calc
181	8.53(d, 1H), 8.33(m, 1H), 8.24(d, 1H), 8.22-8.12(m, 4H), 7.88-7.65(m, 5H), 7.53-7.28(m, 6H)	399.4	399.4
198	8.86-8.80(m, 4H), 8.72(d, 1H), 8.52(d, 1H), 8.46(dd, 1H), 8.45-8.40(m, 1H), 8.33 (m, 1H), 7.92(m, 1H), 7.86(m, 1H), 7.80(m, 1H), 7.63-7.58(m, 5H), 7.51-7.46(m, 2H), 7.42-7.36(m, 4H), 7.33-7.30(m, 1H)	554.2	554.2

Evaluation Example 1

[0189] UV transmittance of Compounds prepared according to Synthesis Examples 1 to 11 was measured at a concentration of 10^{-5} M in a toluene solvent (i.e., in toluene) utilizing Shimazu UV-1800, and results thereof are shown in Table 2.

Table 2

	UV absorber	Solubility (in toluene)	Transmittance (@ 405 nm)	Transmittance (@ 430 nm)
Comparative Example 1	UV POL	-	1.8	30.00
Example 1	5	10 wt%	3.38	40.18
Example 2	7	11 wt%	7.54	75.15
Example 3	61	5 wt%	1.68	29.47
Example 4	67	6 wt%	4.12	48.21
Example 5	76	8 wt%	4.54	50.52
Example 6	88	6 wt%	2.54	33.56
Example 7	111	9 wt%	3.98	52.52
Example 8	120	7 wt%	1.55	32.56
Example 9	169	5 wt%	2.99	42.52
Example 10	181	4 wt%	4.02	52.11
Example 11	198	3wt%	3.32	45.11

[0190] As can be confirmed from Table 2, the first compound represented by Formula 1 has a low transmittance in an optical wavelength of about 405 nm. Therefore, an organic light-emitting display apparatus, in which the first compound represented by Formula 1 is included in an encapsulation unit, may prevent or substantially prevent an emission layer, an insulating film, and/or the like including an organic material from being damaged by ultraviolet rays.

[0191] It should be understood that embodiments described herein should be considered in a descriptive sense only and not for purposes of limitation. Descriptions of features or aspects within each embodiment should typically be considered as available for other similar features or aspects in other embodiments.

[0192] While one or more embodiments have been described with reference to the figures, 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 scope as defined by the following claims, and equivalents thereof.

Claims

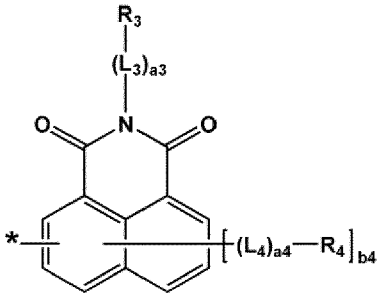
1. An organic light-emitting display apparatus comprising:

a substrate;

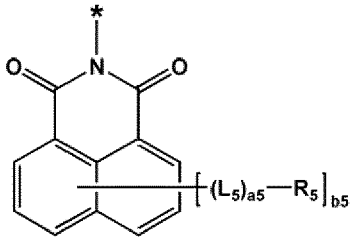
an organic light-emitting device on the substrate; and
an encapsulation unit on the organic light-emitting device and configured to seal the organic light-emitting device, wherein the encapsulation unit comprises a first compound represented by Formula 1:

Formula 1 $[R_1-(L_1)_{a1}]_{b1}-(Ar_1)_{c1}-[(L_2)_{a2}-R_2]_{b2}$

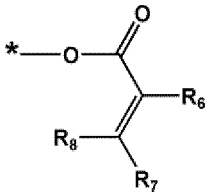
Formula 2-1



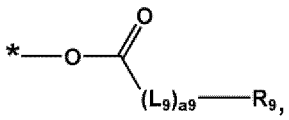
Formula 2-2



Formula 2-3



Formula 2-4



wherein, in Formulae 1 and 2-1 to 2-4,
Ar_1 is a C_5-C_{60} carbocyclic group or a C_2-C_{30} heterocyclic group,
c1 is 0 or 1,
L_1 to L_5 and L_9 are each independently selected from *-$N(R_{11})$-*', *-$B(R_{11})$-*', *-$P(R_{11})$-*', *-$Si(R_{11})(R_{12})$-*', *-S-*', *-Se-*', *-O-*', *-C(=O)-*', *-S(=O)-*', *-$S(=O)_2$-*', *-$C(R_{11})$=*', *-C(=S)-*', a substituted or unsubstituted C_1-C_{60} alkylene group, a substituted or unsubstituted C_2-C_{60} alkenylene group, a substituted or unsubstituted C_2-C_{60} alkynylene group, a substituted or unsubstituted C_3-C_{10} cycloalkylene group, a substituted or unsubstituted C_1-C_{10} heterocycloalkylene group, a substituted or unsubstituted C_3-C_{10} cycloalkenylene group, a substituted or unsubstituted C_1-C_{10} heterocycloalkenylene group, a substituted or unsubstituted C_6-C_{60} arylene group, a substituted or unsubstituted C_1-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,
a1 to a5 and a9 are each independently an integer from 0 to 10,
R_1 is a group represented by Formula 2-1 or a group represented by Formula 2-2,
R_2 to R_5 are each independently selected from a group represented by Formula 2-3, a group represented by Formula 2-4, hydrogen, deuterium, -F, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, a hydrazono group, 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_{60} cycloalkoxy group, a substituted or unsubstituted C_3-C_{10} cycloalkyl group, a substituted or unsubstituted C_1-C_{10} heterocycloalkyl group, a substituted or unsubstituted C_3-C_{10} cycloalkenyl group, a substituted or unsubstituted C_1-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, a substituted or unsubstituted C_1-C_{60} heteroaryl group, a substituted or unsubstituted monovalent non-aromatic condensed polycyclic group, a substituted or unsubstituted monovalent non-aromatic condensed heteropolycyclic group, $Si(Q_1)(Q_2)(Q_3)$, $-N(Q_1)(Q_2)$, $-B(Q_1)(Q_2)$, $-C(=O)(Q_1)$, $-S(=O)_2(Q_1)$, and $-P(=O)(Q_1)(Q_2)$,
R_6 to R_9, R_{11}, and R_{12} are each independently selected from hydrogen, deuterium, -F, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, a hydrazono group, 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_{60} cycloalkoxy group, a substituted or unsubstituted C_3-C_{10} cycloalkyl group, a substituted or unsubstituted C_1-C_{10} heterocycloalkyl group, a substituted or unsubstituted C_3-C_{10} cycloalkenyl group, a substituted or unsubstituted C_1-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, a substituted or unsubstituted C_1-C_{60} heteroaryl group, a substituted or unsubstituted monovalent non-aromatic condensed polycyclic group, a substituted or unsubstituted monovalent non-aromatic condensed heteropolycyclic group, $Si(Q_4)(Q_5)(Q_6)$, $-N(Q_4)(Q_5)$, $-B(Q_4)(Q_5)$, $-C(=O)(Q_4)$, $-S(=O)_2(Q_4)$, and $-P(=O)(Q_4)(Q_5)$,

b1 is an integer from 1 to 10, wherein, when b1 is two or more, two or more $*-(L_1)_{a1}-R_1$(s) are identical to or different from each other,

b2 is an integer from 1 to 10, wherein, when b2 is two or more, two or more $*-(L_2)_{a2}-R_2$(s) are identical to or different from each other,

b4 is an integer from 0 to 5, wherein, when b4 is two or more, two or more $*-(L_4)_{a4}-R_4$(s) are identical to or different from each other,

b5 is an integer from 0 to 6, wherein, when b5 is two or more, two or more $*-(L_5)_{a5}-R_5$(s) are identical to or different from each other,

at least one substituent of the substituted C_1-C_{60} alkylene group, the substituted C_2-C_{60} alkenylene group, the substituted C_2-C_{60} alkynylene group, the substituted C_3-C_{10} cycloalkylene group, the substituted C_1-C_{10} heterocycloalkylene group, the substituted C_3-C_{10} cycloalkenylene group, the substituted C_1-C_{10} heterocycloalkenylene group, the substituted C_6-C_{60} arylene group, the substituted C_1-C_{60} heteroarylene group, the substituted divalent non-aromatic condensed polycyclic group, the substituted divalent non-aromatic condensed heteropolycyclic group, the substituted C_1-C_{60} alkyl group, the substituted C_2-C_{60} alkenyl group, the substituted C_2-C_{60} alkynyl group, the substituted C_1-C_{60} alkoxy group, the substituted C_3-C_{60} cycloalkoxy group, the substituted C_3-C_{10} cycloalkyl group, the substituted C_1-C_{10} heterocycloalkyl group, the substituted C_3-C_{10} cycloalkenyl group, the substituted C_1-C_{10} heterocycloalkenyl group, the substituted C_6-C_{60} aryl group, the substituted C_6-C_{60} aryloxy group, the substituted C_6-C_{60} arylthio group, the substituted C_1-C_{60} heteroaryl group, the substituted monovalent non-aromatic condensed polycyclic group, and the substituted monovalent non-aromatic condensed heteropolycyclic group is selected from:

deuterium, -F, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, a hydrazono group, 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, and a C_3-C_{60} cycloalkoxy group;

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, and a C_3-C_{60} cycloalkoxy group, each substituted with at least one selected from deuterium, -F, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, a hydrazono group, a C_3-C_{10} cycloalkyl group, a C_1-C_{10} heterocycloalkyl group, a C_3-C_{10} cycloalkenyl group, a C_1-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,$-Si(Q_{11})(Q_{12})(Q_{13})$, $-N(Q_{11})(Q_{12})$, $-B(Q_{11})(Q_{12})$, $-C(=O)(Q_{11})$, $-S(=O)_2(Q_{11})$, and-$P(=O)(Q_{11})(Q_{12})$;

a C_3-C_{10} cycloalkyl group, a C_1-C_{10} heterocycloalkyl group, a C_3-C_{10} cycloalkenyl group, a C_1-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, a biphenyl group, and a terphenyl group;

a C_3-C_{10} cycloalkyl group, a C_1-C_{10} heterocycloalkyl group, a C_3-C_{10} cycloalkenyl group, a C_1-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, each substituted with at least one selected from deuterium, -F, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, a hydrazono group, 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_{60} cycloalkoxy group, a C_3-C_{10} cycloalkyl group, a C_1-C_{10} heterocycloalkyl group, a C_3-C_{10} cycloalkenyl group, a C_1-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,$-Si(Q_{21})(Q_{22})(Q_{23})$, $-N(Q_{21})(Q_{22})$, $-B(Q_{21})(Q_{22})$, $-C(=O)(Q_{21})$, $-S(=O)_2(Q_{21})$, and-$P(=O)(Q_{21})(Q_{22})$; and

$-Si(Q_{31})(Q_{32})(Q_{33})$, $-N(Q_{31})(Q_{32})$, $-B(Q_{31})(Q_{32})$, $-C(=O)(Q_{31})$, $-S(=O)_2(Q_{31})$, and-$P(=O)(Q_{31})(Q_{32})$,

Q_1 to Q_6, Q_{11} to Q_{13}, Q_{21} to Q_{23}, and Q_{31} to Q_{33} are each independently selected from hydrogen, deuterium, -F, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, a hydrazono group, 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_{60} cycloalkoxy group, a C_3-C_{10} cycloalkyl group, a C_1-C_{10} heterocycloalkyl group, a C_3-C_{10} cycloalkenyl group, a C_1-C_{10} heterocycloalkenyl group, a C_6-C_{60} aryl group, a C_6-C_{60} aryl group substituted with a C_1-C_{60} alkyl group, a C_6-C_{60} aryl group substituted with a C_6-C_{60} aryl group, a terphenyl group, a C_1-C_{60} heteroaryl group, a C_1-C_{60} heteroaryl group substituted with a C_1-C_{60} alkyl group, a C_1-C_{60} heteroaryl group substituted with a C_6-C_{60} aryl group, a monovalent non-aromatic condensed polycyclic group, a monovalent non-aromatic condensed heteropolycyclic group, a biphenyl group, and a terphenyl group, and * and *' each indicate a binding site to a neighboring atom.

2. An organic light-emitting display apparatus according to claim 1, wherein Ar_1 is selected from a benzene group, a naphthalene group, an anthracene group, a phenanthrene group, a pyrene group, a chrysene group, a triphenylene group, an indene group, a fluorene group, a benzofluorene group, a spiro-bifluorene group, a carbazole group, a dibenzofuran group, a dibenzothiophene group, a pyridine group, a pyrazine group, a pyrimidine group, a pyridazine group, a pyrrole group, an imidazole group, a quinoline group, an isoquinoline group, a quinoxaline group, a quinazoline group, a triazine group, an indeno pyrazine group, an indeno pyridine group, a phenanthroline group, and a phenanthridine group.

3. An organic light-emitting display apparatus according to claim 1 or claim 2, wherein
L_1 to L_5 and L_9 are each independently selected from:

-S-', *-O-*', *-C(=O)-*', *-S(=O)-*', *-$S(=O)_2$-*', a C_1-C_{20} alkylene group, a C_2-C_{20} alkenylene group, a C_2-C_{20} alkynylene group, a phenylene group, a pentalenylene group, an indenylene group, a naphthylene group, an azulenylene group, an indacenylene group, an acenaphthylene group, a fluorenylene group, a spiro-bifluorenylene group, a spiro-benzofluorene-fluorenylene group, a benzofluorenylene group, a dibenzofluorenylene group, a phenalenylene group, a phenanthrenylene group, an anthracenylene group, a fluoranthenylene group, a triphenylenylene group, a pyrenylene group, a chrysenylene group, a perylenylene group, a pentaphenylene group, a pyrrolylene group, a thiophenylene group, a furanylene group, a silolylene group, an imidazolylene group, a pyrazolylene group, a thiazolylene group, an isothiazolylene group, an oxazolylene group, an isoxazolylene group, a pyridinylene group, a pyrazinylene group, a pyrimidinylene group, a pyridazinylene group, an indolylene group, an isoindolylene group, an indazolylene group, a purinylene group, a quinolinylene group, an isoquinolinylene group, a benzoquinolinylene group, a phthalazinylene group, a naphthyridinylene group, a quinoxalinylene group, a quinazolinylene group, a cinnolinylene group, a phenanthridinylene group, an acridinylene group, a phenanthrolinylene group, a phenazinylene group, a benzimidazolylene group, a benzofuranylene group, a benzothiophenylene group, a benzosilolylene group, an isobenzothiazolylene group, a benzoxazolylene group, an isobenzoxazolylene group, a triazolylene group, a tetrazolylene group, an oxadiazolylene group, a triazinylene group, a dibenzofuranylene group, a dibenzothiophenylene group, a dibenzosilolylene group, a carbazolylene group, a benzocarbazolylene group, a dibenzocarbazolylene group, a thiadiazolylene group, an imidazopyridinylene group, an imidazopyrimidinylene group, an oxazolopyridinylene group, a thiazolopyridinylene group, a benzonaphthyridinylene group, an azafluorenylene group, an azaspiro-bifluorenylene group, an azacarbazolylene group, an azadibenzofuranylene group, an azadibenzothiophenylene group, and an azadibenzosilolylene group; and

a C_1-C_{20} alkylene group, a C_2-C_{20} alkenylene group, a C_2-C_{20} alkynylene group, a phenylene group, a pentalenylene group, an indenylene group, a naphthylene group, an azulenylene group, an indacenylene group, an acenaphthylene group, a fluorenylene group, a spiro-bifluorenylene group, a spiro-benzofluorene-fluorenylene group, a benzofluorenylene group, a dibenzofluorenylene group, a phenalenylene group, a phenanthrenylene group, an anthracenylene group, a fluoranthenylene group, a triphenylenylene group, a pyrenylene group, a chrysenylene group, a perylenylene group, a pentaphenylene group, a pyrrolylene group, a thiophenylene group, a furanylene group, a silolylene group, an imidazolylene group, a pyrazolylene group, a thiazolylene group, an isothiazolylene group, an oxazolylene group, an isoxazolylene group, a pyridinylene group, a pyrazinylene group, a pyrimidinylene group, a pyridazinylene group, an indolylene group, an isoindolylene group, an indazolylene group, a purinylene group, a quinolinylene group, an isoquinolinylene group, a benzoquinolinylene group, a phthalazinylene group, a naphthyridinylene group, a quinoxalinylene group, a quinazolinylene group, a cinnolinylene group, a phenanthridinylene group, an acridinylene group, a phenanthrolinylene group, a phenazinylene group, a benzimidazolylene group, a benzofuranylene group, a benzothiophenylene group, a benzosilolylene group, an isobenzothiazolylene group, a benzoxazolylene group, an isobenzoxazolylene group, a triazolylene group, a tetrazolylene group, an oxadiazolylene group, a triazinylene group, a dibenzofuranylene group, a dibenzothiophenylene group, a dibenzosilolylene group, a carbazolylene group, a benzocarbazolylene group, a dibenzocarbazolylene group, a thiadiazolylene group, an imidazopyridinylene group, an imidazopyrimidinylene group, an oxazolopyridinylene group, a thiazolopyridinylene group, a ben-

zonaphthyridinylene group, an azafluorenylene group, an azaspiro-bifluorenylene group, an azacarbazolylene group, an azadibenzofuranylene group, an azadibenzothiophenylene group, and an azadibenzosilolylene group, each substituted with at least one selected from deuterium, -F, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, a hydrazono group, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a C_3-C_{20} cycloalkoxy group, a C_3-C_{10} cycloalkyl group, a C_1-C_{10} heterocycloalkyl group, a C_3-C_{10} cycloalkenyl group, a C_1-C_{10} heterocycloalkenyl group, a C_6-C_{60} aryl group, a C_1-C_{60} heteroaryl group, a monovalent non-aromatic condensed polycyclic group, a monovalent non-aromatic condensed heteropolycyclic group, a biphenyl group, a terphenyl group, and -Si(Q_{31})(Q_{32})(Q_{33}),

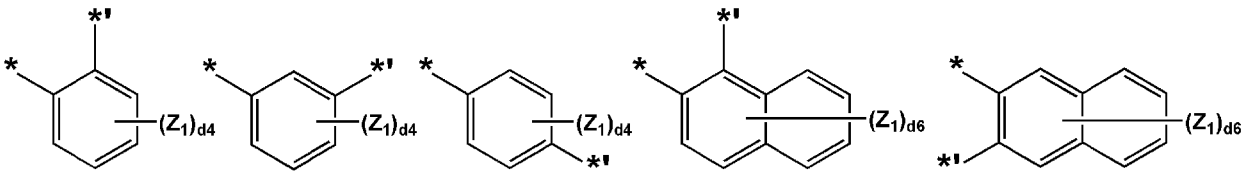
Q_{31} to Q_{33} are each independently selected from:

a C_1-C_{10} alkyl group, a C_1-C_{10} alkoxy group, a C_3-C_{10} cycloalkoxy group, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a pyridinyl group, a pyrimidinyl group, a pyrazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, and a quinazolinyl group; and

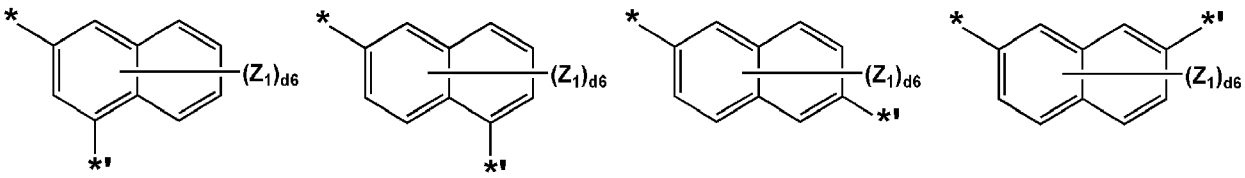
a C_1-C_{10} alkyl group, a C_1-C_{10} alkoxy group, a C_3-C_{10} cycloalkoxy group, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a pyridinyl group, a pyrimidinyl group, a pyrazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, and a quinazolinyl group, each substituted with at least one selected from a C_1-C_{10} alkyl group, a C_1-C_{10} alkoxy group, a C_3-C_{10} cycloalkoxy group, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a pyridinyl group, a pyrimidinyl group, a pyrazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, and a quinazolinyl group, and

* and *' each indicate a binding site to a neighboring atom

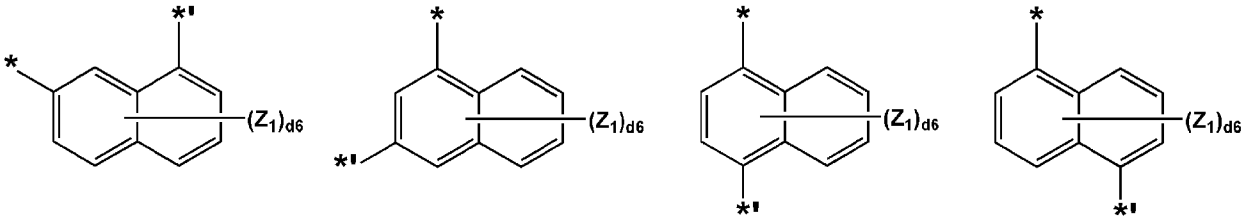
wherein, preferably, L_1 to L_5 and L_9 are each independently selected from *-S-*', *-O-*', *-C(=O)-*', *-S(=O)-*', *-$S(=O)_2$-*', *-$[C(Z_1)(Z_2)]_{n1}$-*', and groups represented by Formulae 3-1 to 3-75:



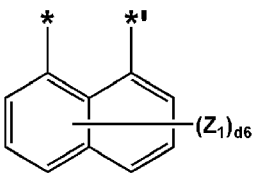
Formula 3-1 Formula 3-2 Formula 3-3 Formula 3-4 Formula 3-5



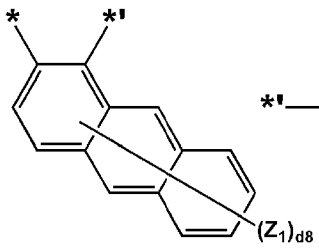
Formula 3-6 Formula 3-7 Formula 3-8 Formula 3-9



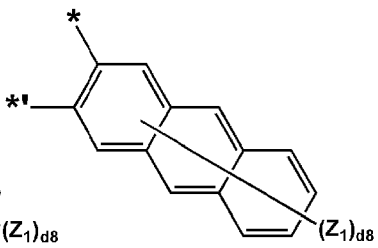
Formula 3-10 Formula 3-11 Formula 3-12 Formula 3-13



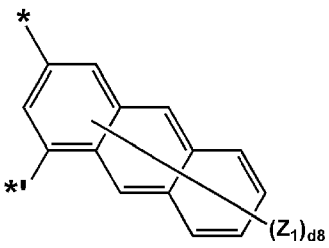
Formula 3-14



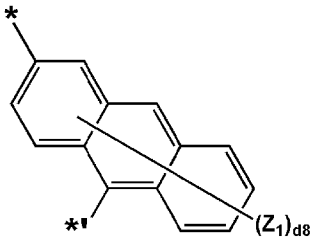
Formula 3-15



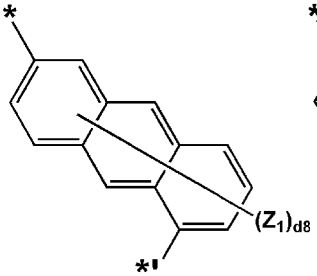
Formula 3-16



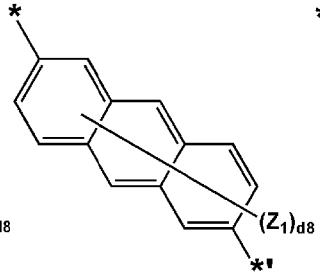
Formula 3-17



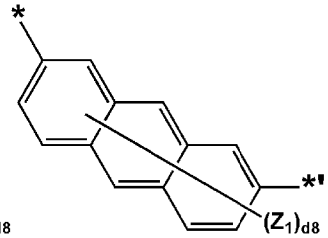
Formula 3-18



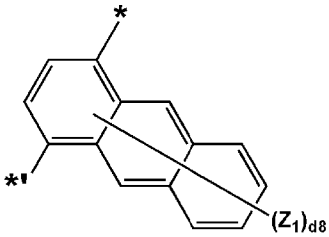
Formula 3-19



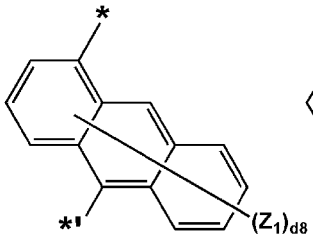
Formula 3-20



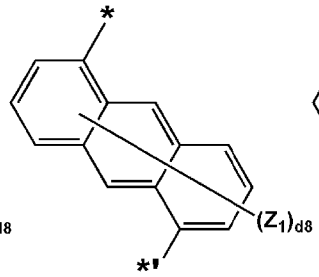
Formula 3-21



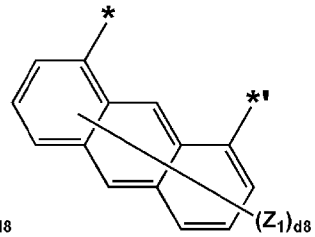
Formula 3-22



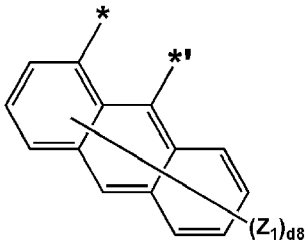
Formula 3-23



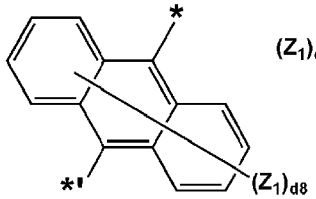
Formula 3-24



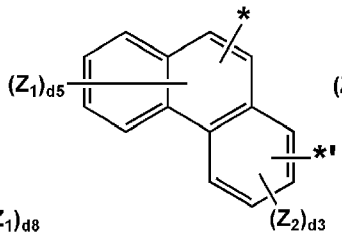
Formula 3-25



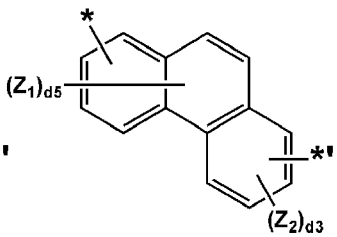
Formula 3-26



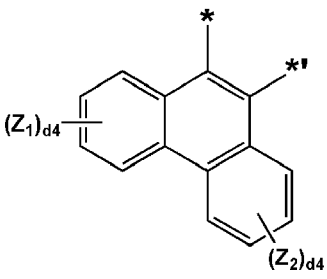
Formula 3-27



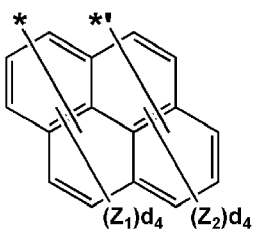
Formula 3-28



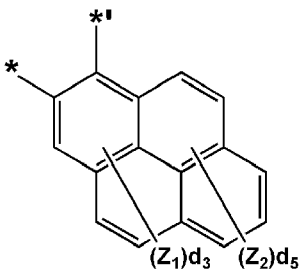
Formula 3-29



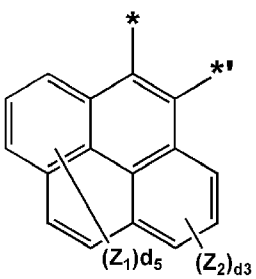
Formula 3-30



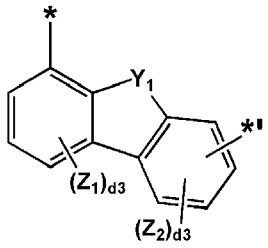
Formula 3-31



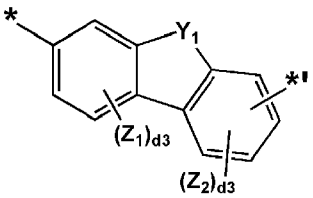
Formula 3-32



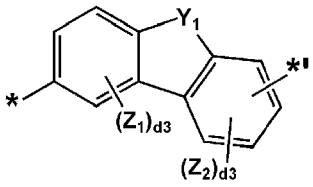
Formula 3-33



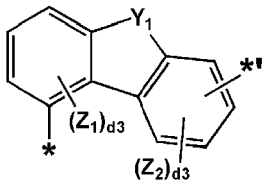
Formula 3-34



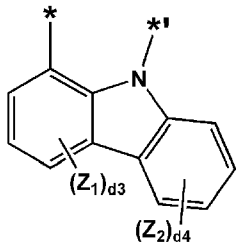
Formula 3-35



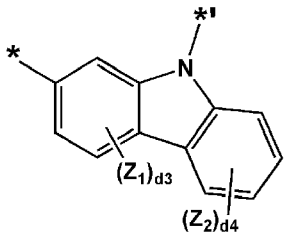
Formula 3-36



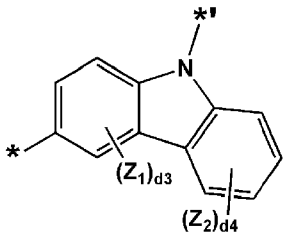
Formula 3-37



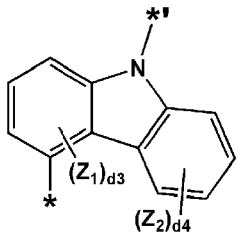
Formula 3-38



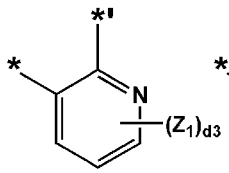
Formula 3-39



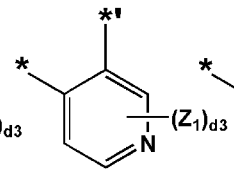
Formula 3-40



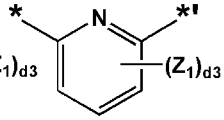
Formula 3-41



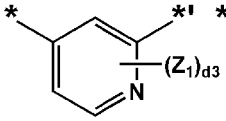
Formula 3-42



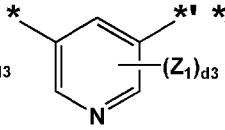
Formula 3-43



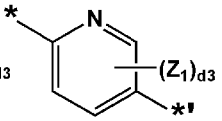
Formula 3-44



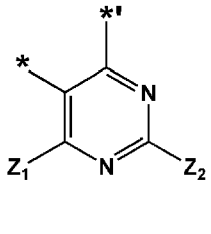
Formula 3-45



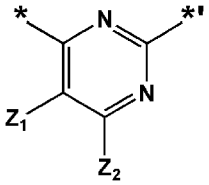
Formula 3-46



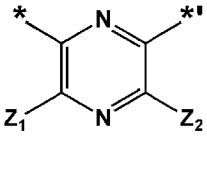
Formula 3-47



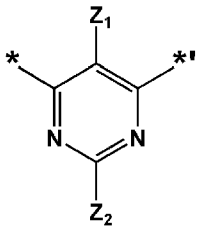
Formula 3-48



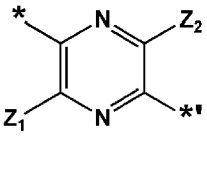
Formula 3-49



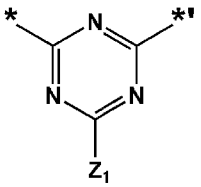
Formula 3-50



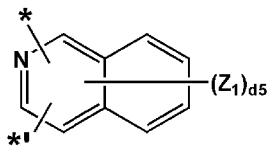
Formula 3-51



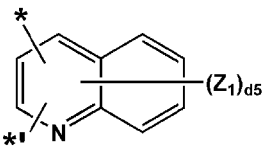
Formula -52



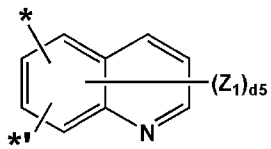
Formula 3-53



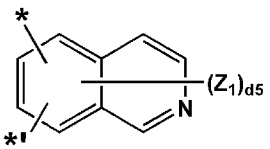
Formula 3-54



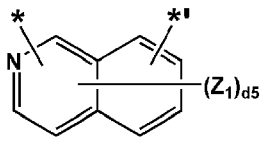
Formula 3-55



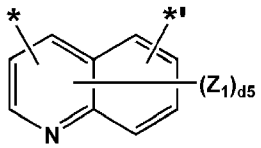
Formula 3-56



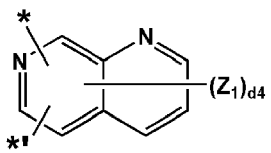
Formula 3-57



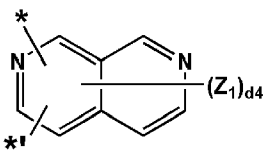
Formula 3-58



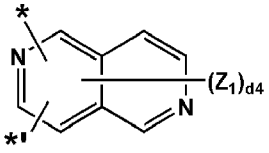
Formula 3-59



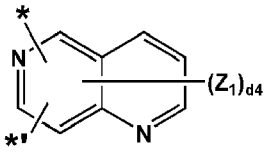
Formula 3-60



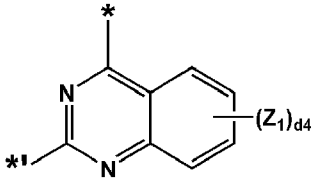
Formula 3-61



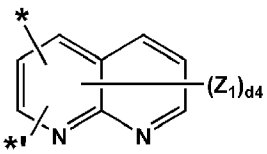
Formula 3-62



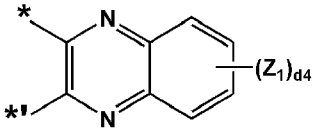
Formula 3-63



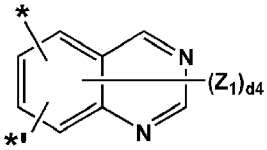
Formula 3-64



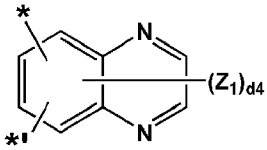
Formula 3-65



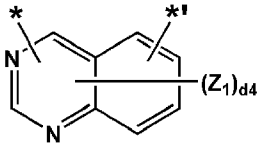
Formula 3-66



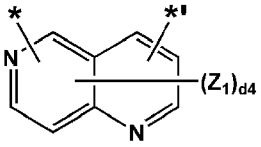
Formula 3-67



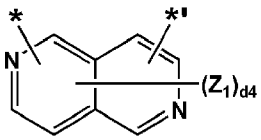
Formula 3-68



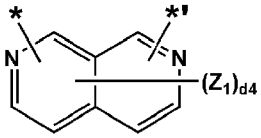
Formula 3-69



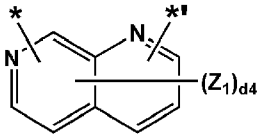
Formula 3-70



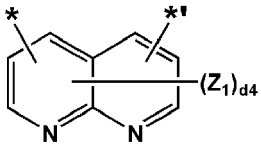
Formula 3-71



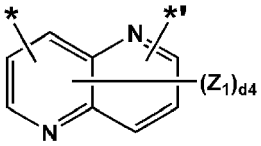
Formula 3-72



Formula 3-73



Formula 3-74



Formula 3-75

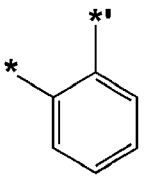
,

wherein, in Formulae 3-1 to 3-75,

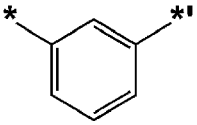
Y_1 is O, S, $C(Z_3)(Z_4)$, $N(Z_3)$, or $Si(Z_3)(Z_4)$,
Z_1 to Z_4 are each independently selected from hydrogen, deuterium, -F, $-CF_3$,-Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, a hydrazono group, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a C_3-C_{20} cycloalkoxy group, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a fluorenyl group, a spiro-bifluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a triazinyl group, and $-Si(Q_{31})(Q_{32})(Q_{33})$,
Q_{31} to Q_{33} are each independently selected from a C_1-C_{10} alkyl group, a C_1-C_{10} alkoxy group, a C_3-C_{20} cycloalkoxy group, a phenyl group, a biphenyl group, a terphenyl group, and a naphthyl group,
d3 is an integer from 1 to 3,
d4 is an integer from 1 to 4,
d5 is an integer from 1 to 5,
d6 is an integer from 1 to 6,
d8 is an integer from 1 to 8,
n1 is an integer from 1 to 20, and
* and *' each indicate a binding site to a neighboring atom.

4. An organic light-emitting display apparatus according to any one of claims 1 to 3, wherein
Ar_1 is selected from groups represented by Formulae 4-1 to 4-59, and L_1 to L_5 and L_9 are each independently selected from *-O-*', *-C(=O)-*', *-CH_2-*', *-$(CH_2)_2$-*', *-$(CH_2)_3$-*', *-$(CH_2)_4$-*', *-$(CH_2)_5$-*', and groups represented

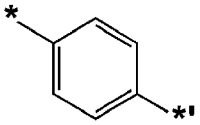
by Formulae 4-1 to 4-58 and 4-60:



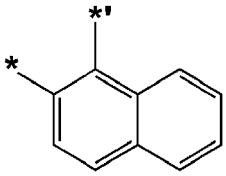
Formula 4-1



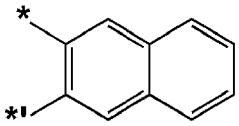
Formula 4-2



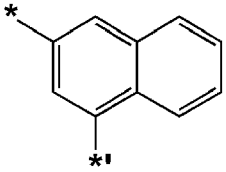
Formula 4-3



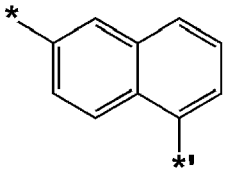
Formula 4-4



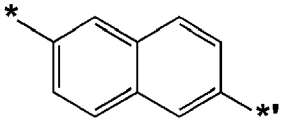
Formula 4-5



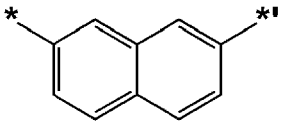
Formula 4-6



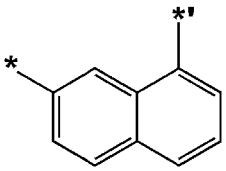
Formula 4-7



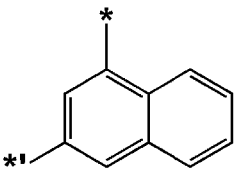
Formula 4-8



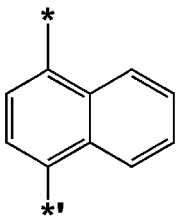
Formula 4-9



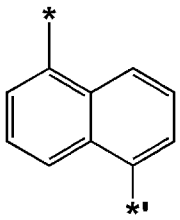
Formula 4-10



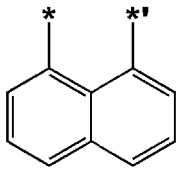
Formula 4-11



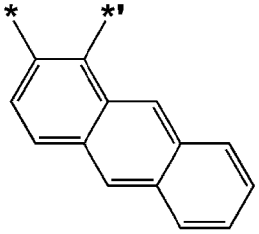
Formula 4-12



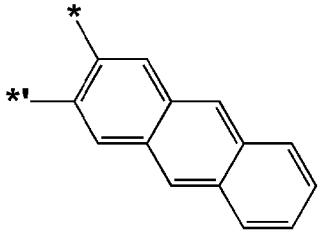
Formula 4-13



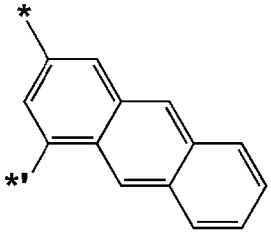
Formula 4-14



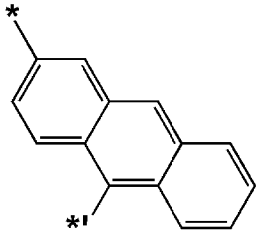
Formula 4-15



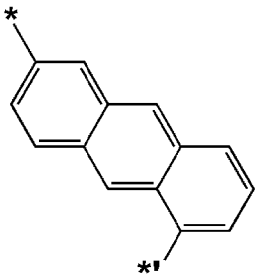
Formula 4-16



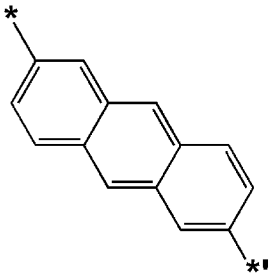
Formula 4-17



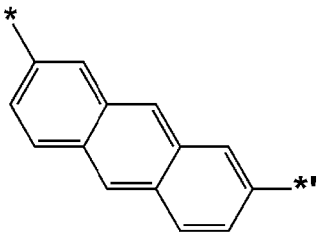
Formula 4-18



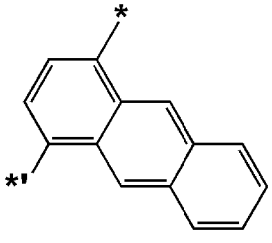
Formula 4-19



Formula 4-20



Formula 4-21



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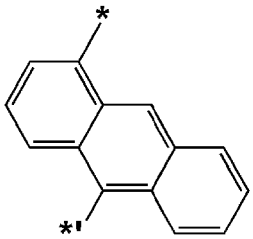
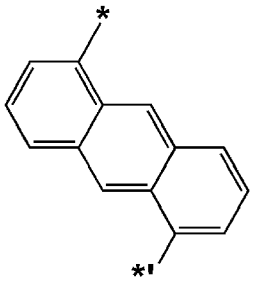
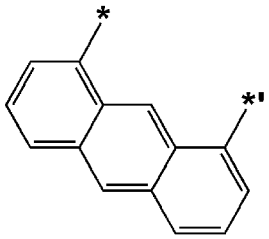


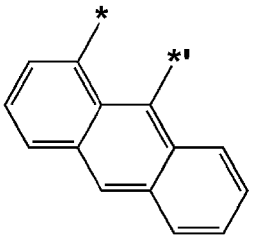
Formula 4-23



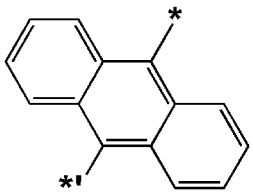
Formula 4-24



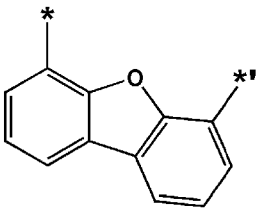
Formula 4-25



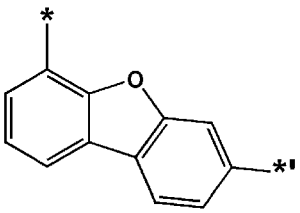
Formula 4-26



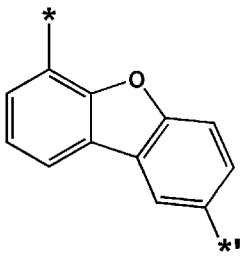
Formula 4-27



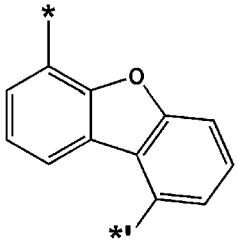
Formula 4-28



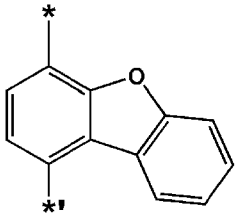
Formula 4-29



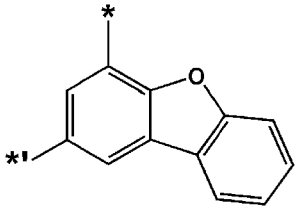
Formula 4-30



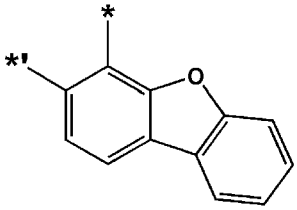
Formula 4-31



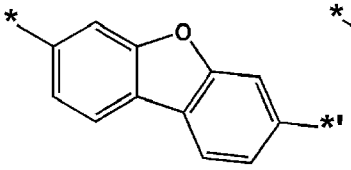
Formula 4-32



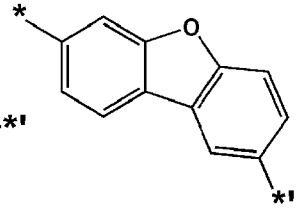
Formula 4-33



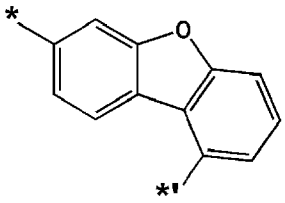
Formula 4-34



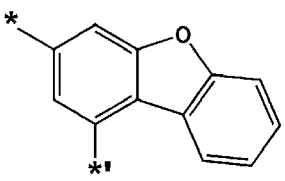
Formula 4-35



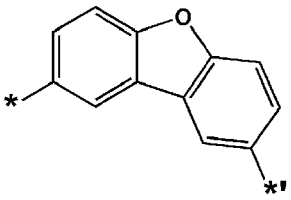
Formula 4-36



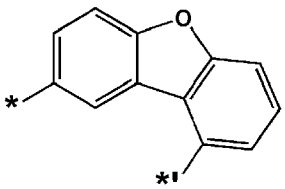
Formula 4-37



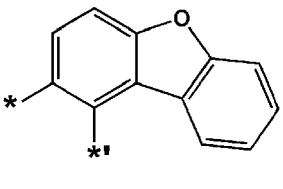
Formula 4-38



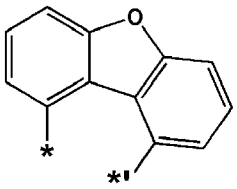
Formula 4-39



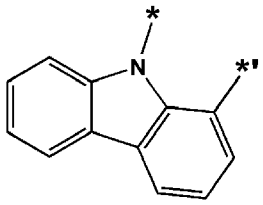
Formula 4-40



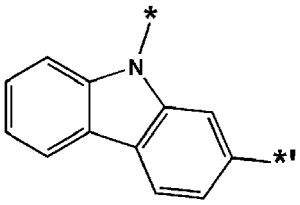
Formula 4-41



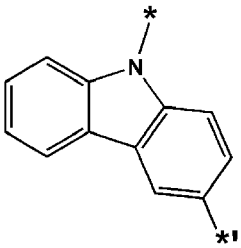
Formula 4-42



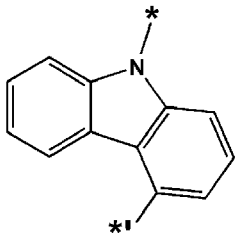
Formula 4-43



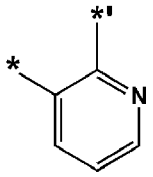
Formula 4-44



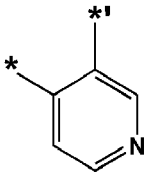
Formula 4-45



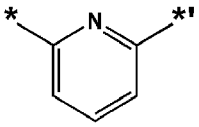
Formula 4-46



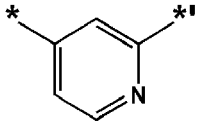
Formula 4-47



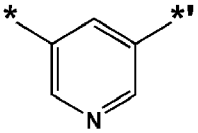
Formula 4-48



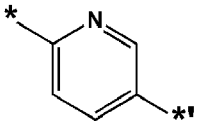
Formula 4-49



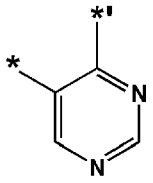
Formula 4-50



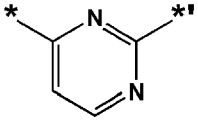
Formula 4-51



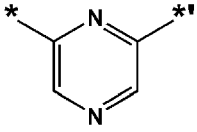
Formula 4-52



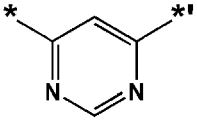
Formula 4-53



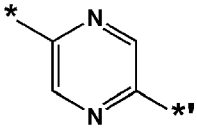
Formula 4-54



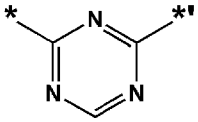
Formula 4-55



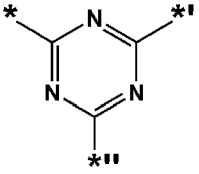
Formula 4-56



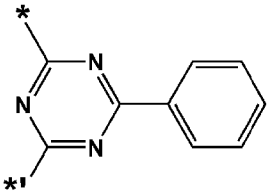
Formula 4-57



Formula 4-58



Formula 4-59

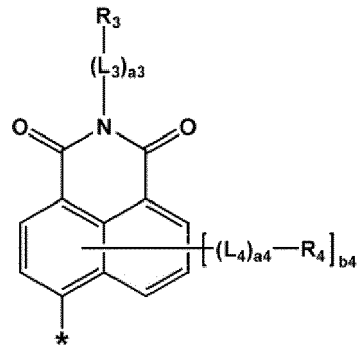


Formula 4-60 ,

wherein *, *', and *" in Formulae 4-1 to 4-60 each indicate a binding site to a neighboring atom.

5. An organic light-emitting display apparatus according to any one of claims 1 to 4, wherein the group represented by Formula 2-1 is represented by Formula 2-1A:

Formula 2-1A



,

wherein, in Formula 2-1A, L_3, L_4, a3, a4, R_3, R_4, and b4 are the same as described in claim 1, and * indicates a binding site to a neighboring atom.

6. An organic light-emitting display apparatus according to any one of claims 1 to 5, wherein
R_2 to R_5 are each independently selected from:

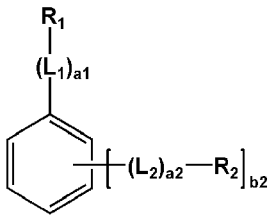
a group represented by Formula 2-3, a group represented by Formula 2-4, hydrogen, deuterium, -F, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, a hydrazono group, a C_1-C_{20} alkyl group, a C_3-C_{10} cycloalkyl group, a C_1-C_{20} alkoxy group, a C_3-C_{20} cycloalkoxy group, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a fluorenyl group, a spiro-bifluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a carbazolyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a furanyl group, a benzofuranyl group, a dibenzofuranyl group, a thiophenyl group, a benzothiophenyl group, a dibenzothiophenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a triazinyl group, and $-Si(Q_1)(Q_2)(Q_3)$; and
a C_1-C_{20} alkyl group, a C_3-C_{10} cycloalkyl group, a C_1-C_{20} alkoxy group, a C_3-C_{20} cycloalkoxy group, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a fluorenyl group, a spiro-bifluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a carbazolyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a furanyl group, a benzofuranyl group, a dibenzofuranyl group, a thiophenyl group, a benzothiophenyl group, a dibenzothiophenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl 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 amidino group, a hydrazino group, a hydrazono group, a C_1-C_{20} alkyl group, a C_3-C_{10} cycloalkyl group, a C_1-C_{20} alkoxy group, a C_3-C_{20} cycloalkoxy group, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a fluorenyl group, a spiro-bifluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a carbazolyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a furanyl group, a benzofuranyl group, a dibenzofuranyl group, a thiophenyl group, a benzothiophenyl group, a dibenzothiophenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a triazinyl group, and $-Si(Q_{31})(Q_{32})(Q_{33})$, and
Q_1 to Q_3 and Q_{31} to Q_{33} are each independently selected from a C_1-C_{10} alkyl group, a C_1-C_{10} alkoxy group, a phenyl group, a biphenyl group, a terphenyl group, and a naphthyl group.

7. An organic light-emitting display apparatus according to any one of claims 1 to 6, wherein
R_6 to R_9, R_{11}, and R_{12} are each independently selected from:

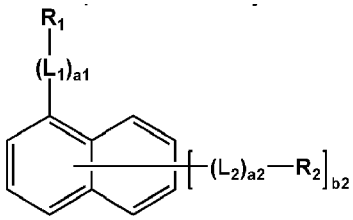
hydrogen, deuterium, -F, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, a hydrazono group, a C_1-C_{20} alkyl group, a C_3-C_{10} cycloalkyl group, a C_1-C_{20} alkoxy group, a C_3-C_{20} cycloalkoxy group, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a fluorenyl group, a spiro-bifluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a carbazolyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a furanyl group, a benzofuranyl group, a dibenzofuranyl group, a thiophenyl group, a benzothiophenyl group, a dibenzothiophenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a triazinyl group, and-$Si(Q_4)(Q_5)(Q_6)$; and
a C_1-C_{20} alkyl group, a C_3-C_{10} cycloalkyl group, a C_1-C_{20} alkoxy group, a C_3-C_{20} cycloalkoxy group, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a fluorenyl group, a spiro-bifluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a carbazolyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a furanyl group, a benzofuranyl group, a dibenzofuranyl group, a thiophenyl group, a benzothiophenyl group, a dibenzothiophenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a triazinyl 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 amidino group, a hydrazino group, a hydrazono group, a C_1-C_{20} alkyl group, a C_3-C_{10} cycloalkyl group, a C_1-C_{20} alkoxy group, a C_3-C_{20} cycloalkoxy group, a phenyl group, a biphenyl group, a terphenyl group, a naphthyl group, a fluorenyl group, a spiro-bifluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a carbazolyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a furanyl group, a benzofuranyl group, a dibenzofuranyl group, a thiophenyl group, a benzothiophenyl group, a dibenzothiophenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a triazinyl group, and

$-Si(Q_{31})(Q_{32})(Q_{33})$, and
Q_4 to Q_6 and Q_{31} to Q_{33} are each independently selected from a C_1-C_{10} alkyl group, a C_1-C_{10} alkoxy group, a phenyl group, a biphenyl group, a terphenyl group, and a naphthyl group.

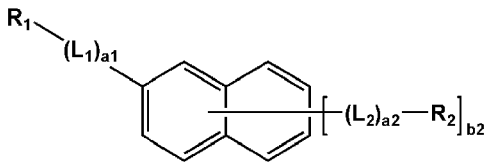
8. An organic light-emitting display apparatus according to any one of claims 1 to 7, wherein the first compound is represented by one of Formulae 1A to 1P:



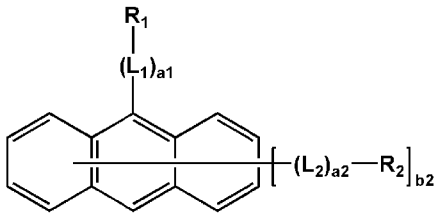
Formula 1A



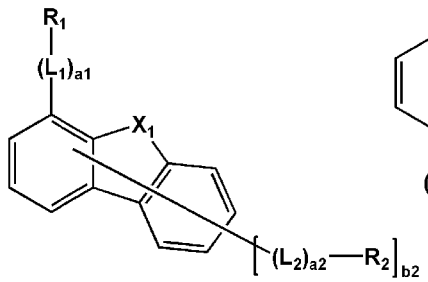
Formula 1B



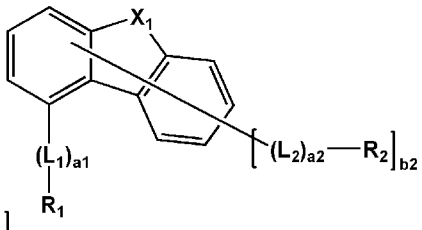
Formula 1C



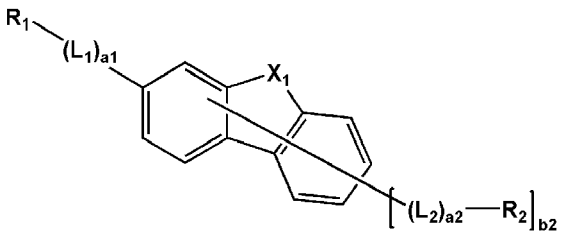
Formula 1D



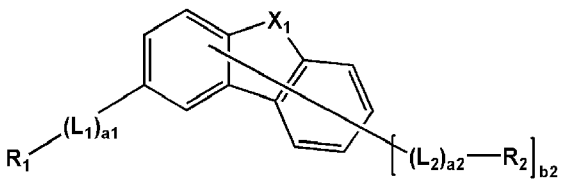
Formula 1E



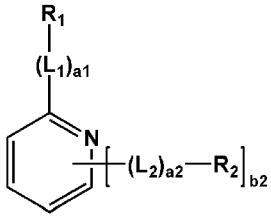
Formula 1F



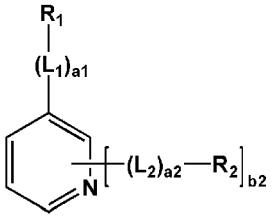
Formula 1G



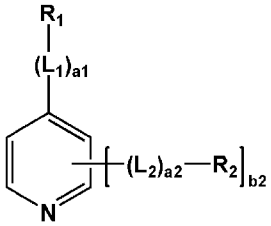
Formula 1H



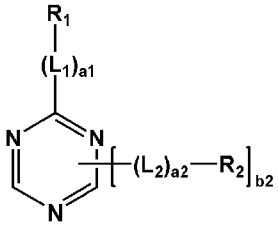
Formula 1I



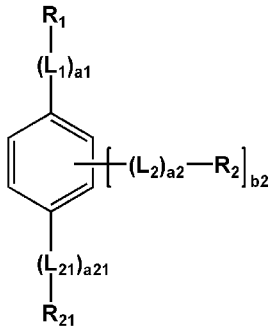
Formula 1J



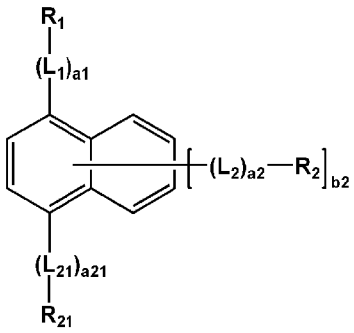
Formula 1K



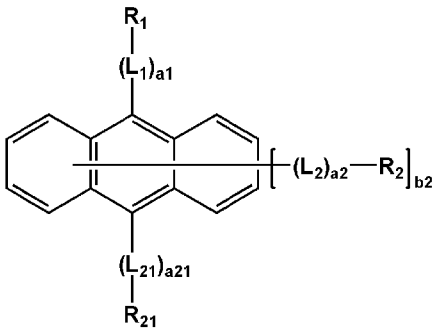
Formula 1L



Formula 1M



Formula 1N



Formula 1O

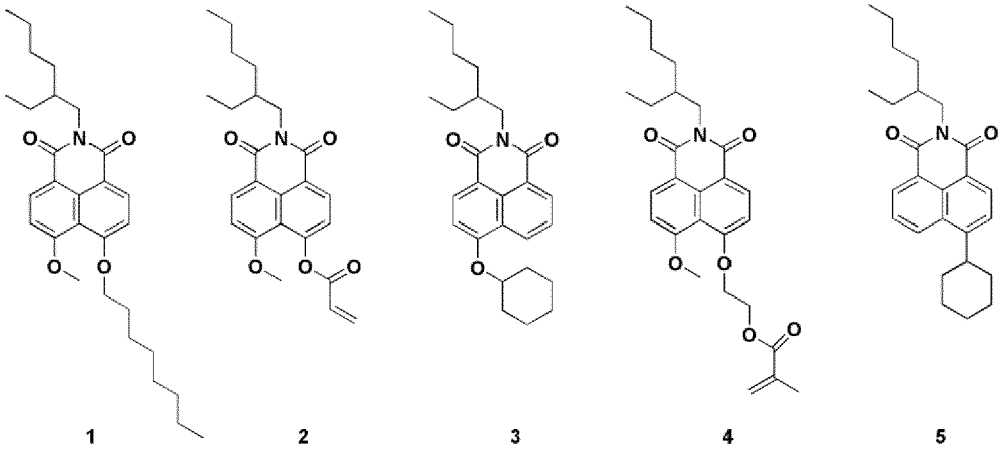
Formula 1P

,

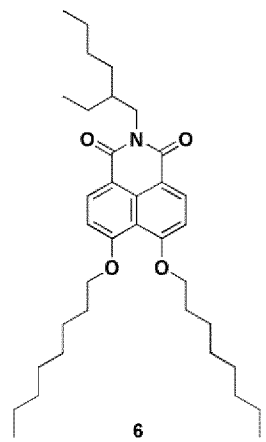
wherein, in Formulae 1A to 1P,

X_1 is O, S, C or N,
L_1, L_2, a1, a2, R_1, R_2, and b2 are the same as described in claim 1, and
L_{21}, a21, and R_{21} are the same as described in connection with L_1, a1, and R_1.

9. An organic light-emitting display apparatus according to claim 1, wherein the first compound is one of Compounds 1 to 205:



1 2 3 4 5



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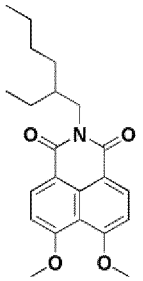

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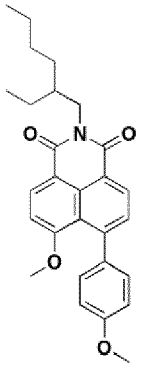

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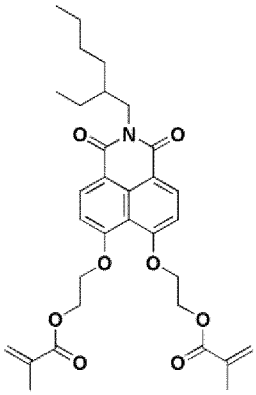

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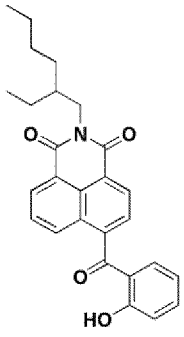

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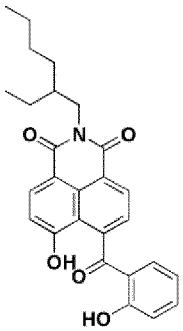

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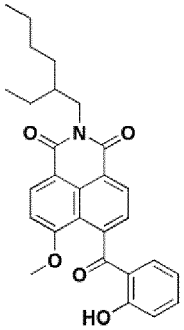

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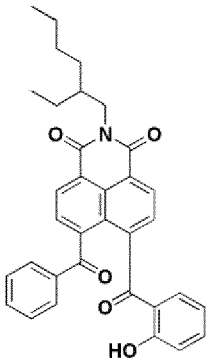

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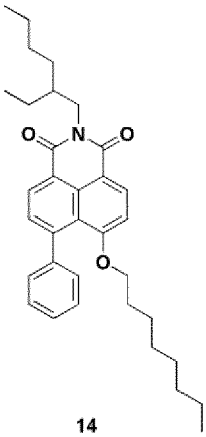

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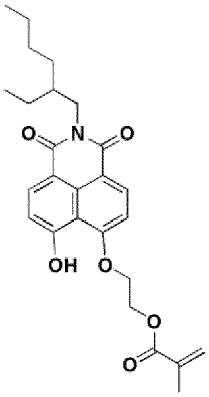

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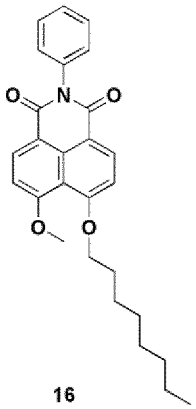

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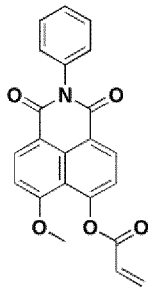

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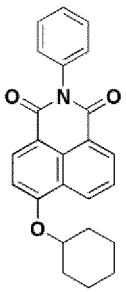

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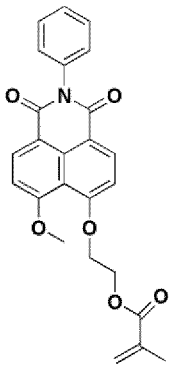

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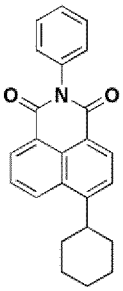

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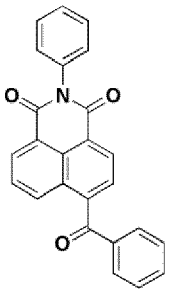

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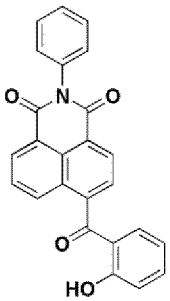

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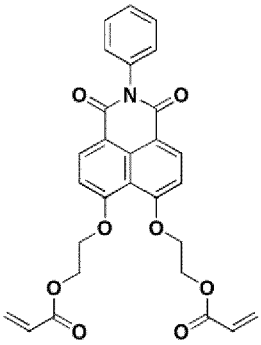

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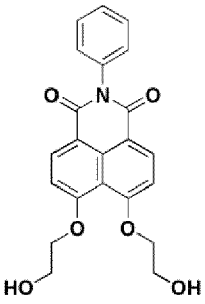

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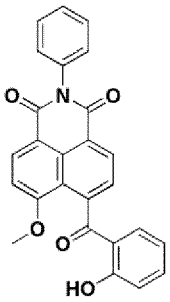

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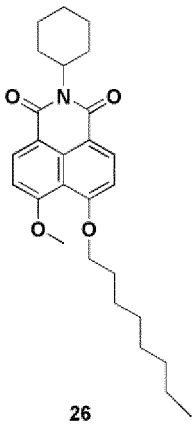

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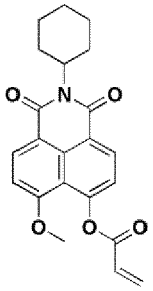

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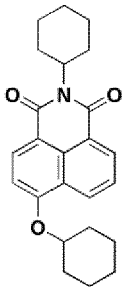

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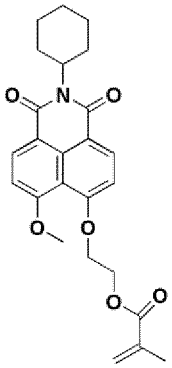

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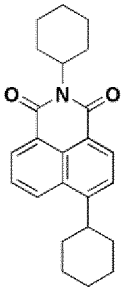

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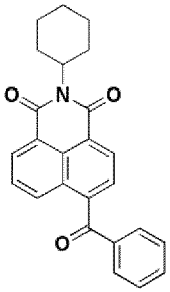

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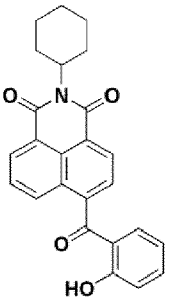

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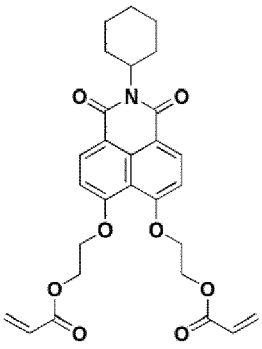

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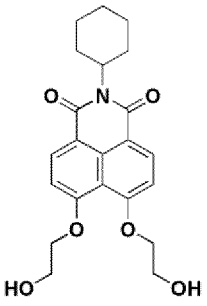

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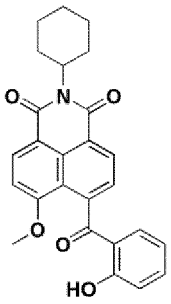

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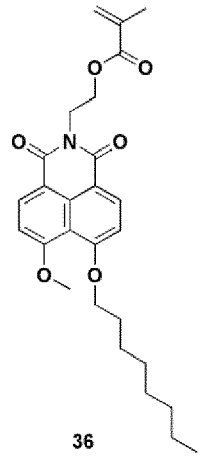

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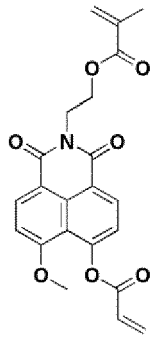

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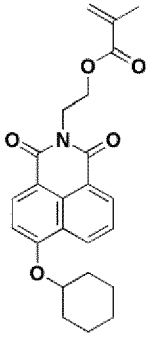

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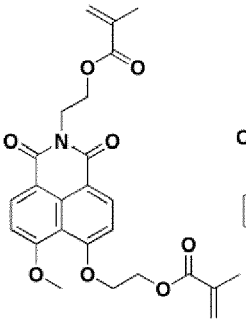

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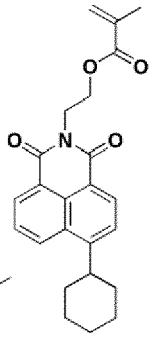

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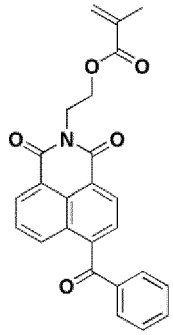

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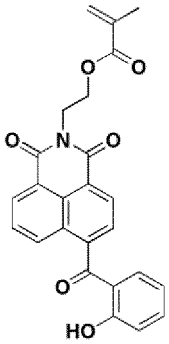

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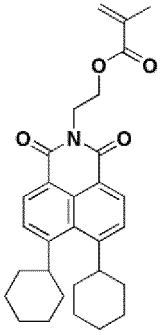

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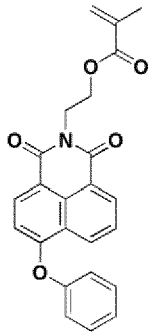

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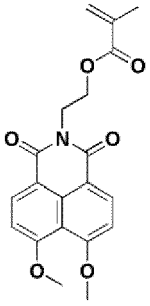

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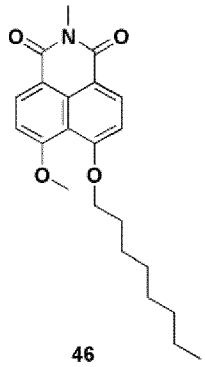

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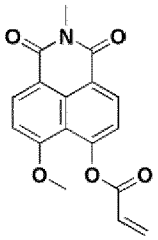

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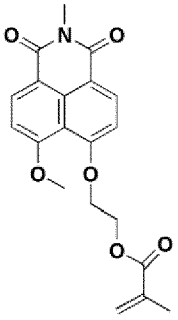

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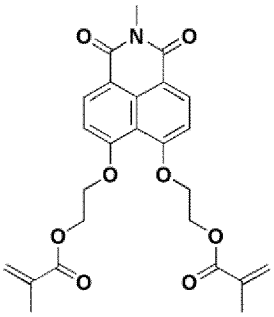

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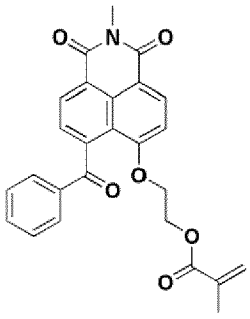

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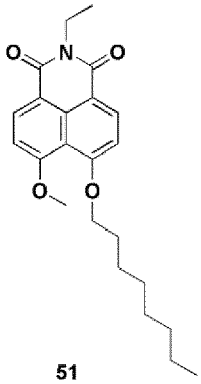

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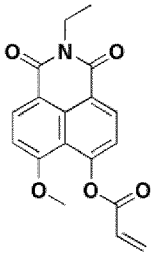

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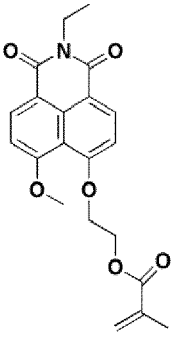

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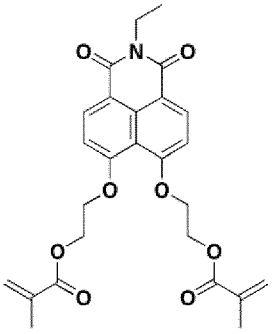

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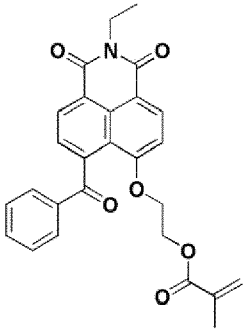

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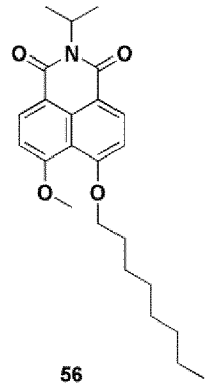

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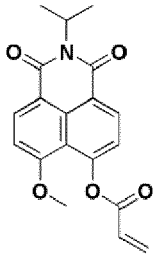

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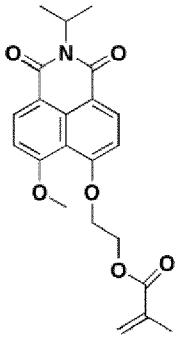

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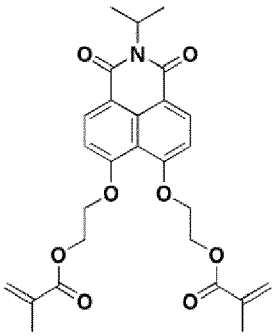

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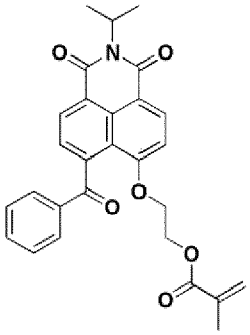

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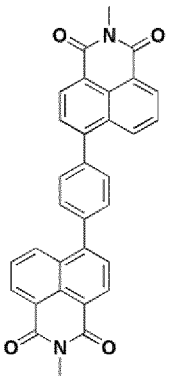

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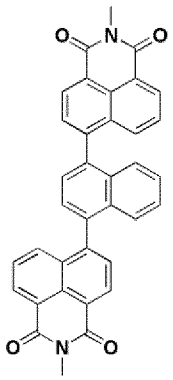

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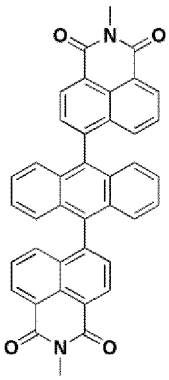

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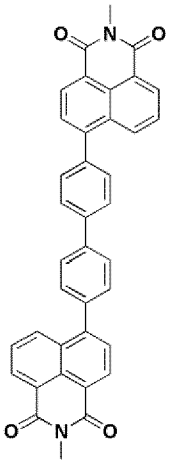

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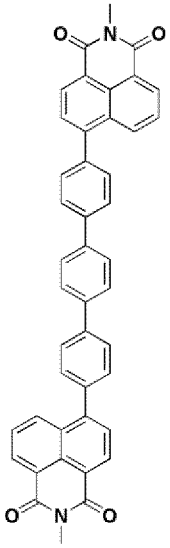

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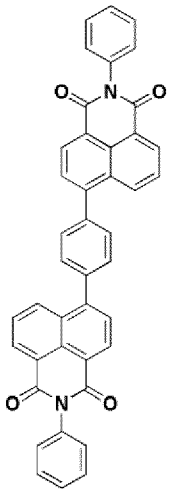

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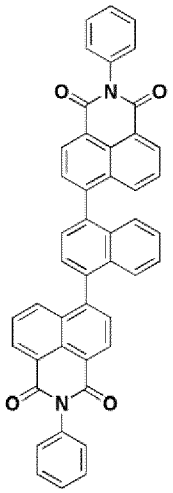

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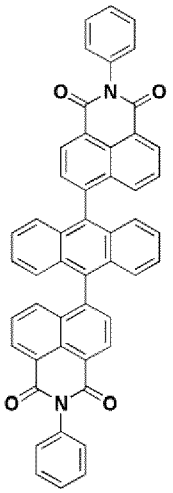

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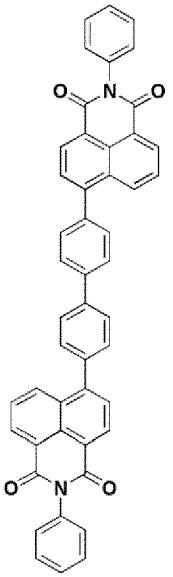

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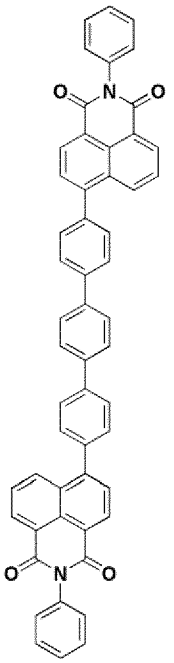

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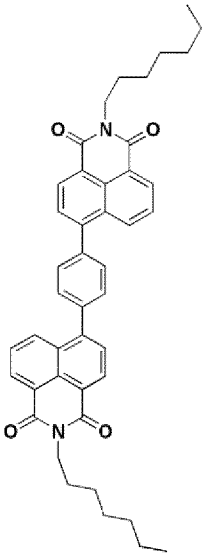

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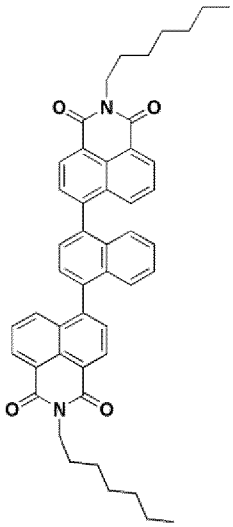

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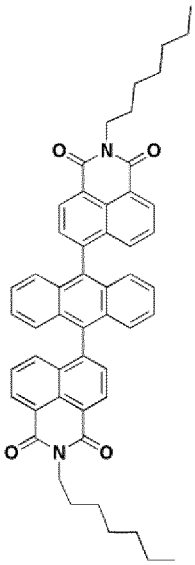

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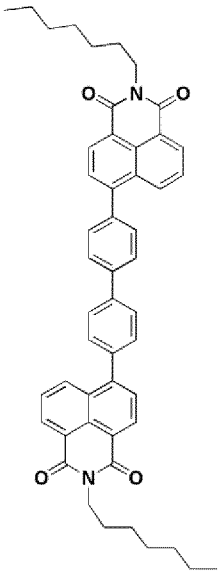

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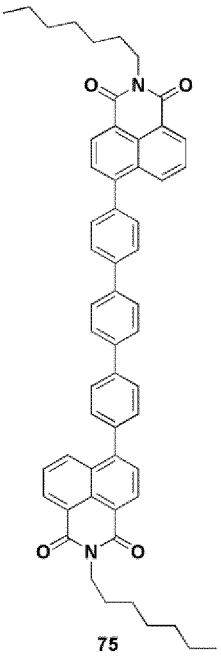

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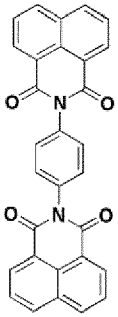

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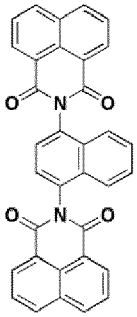

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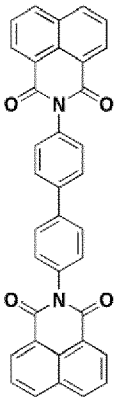

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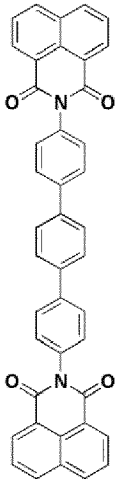

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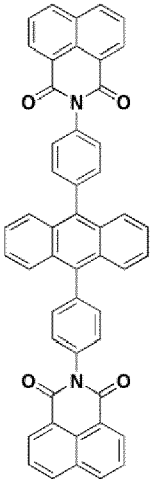

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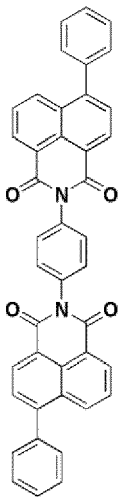

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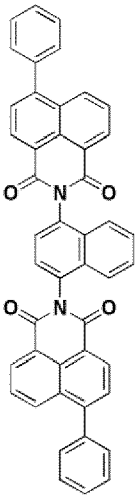

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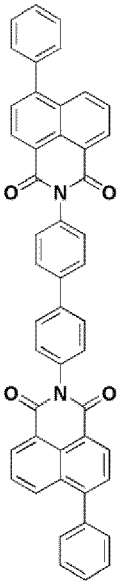

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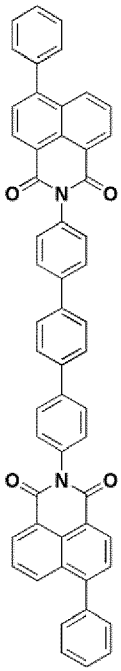

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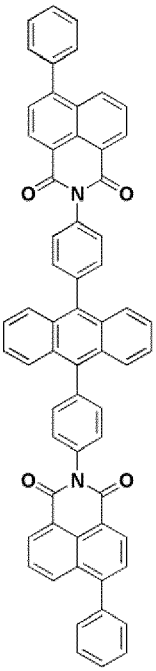

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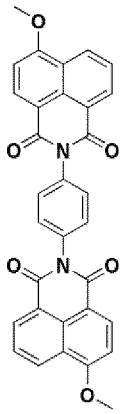

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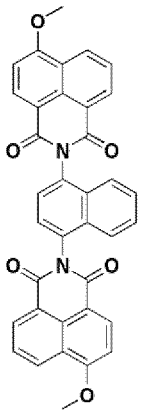

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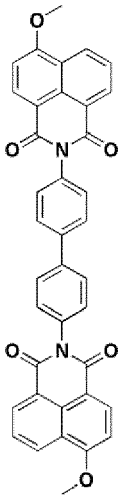

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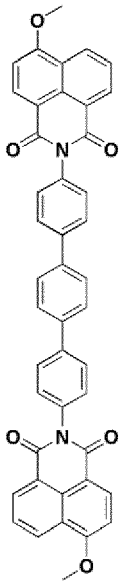

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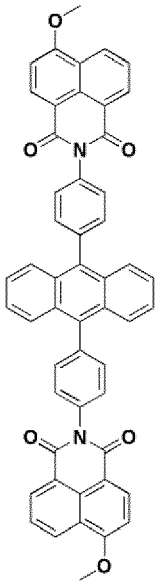

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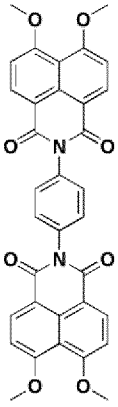

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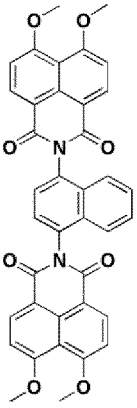

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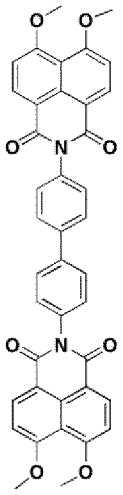

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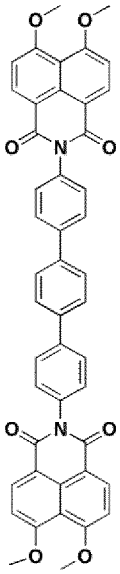

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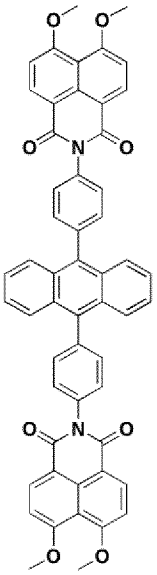

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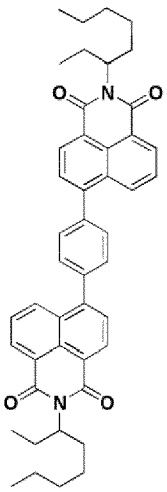

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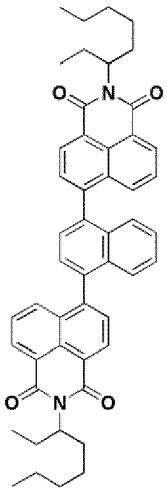

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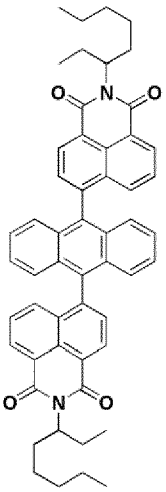

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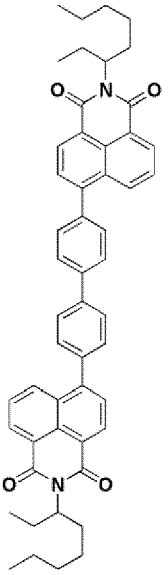

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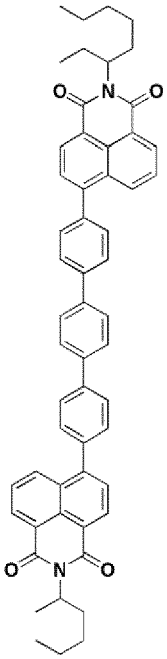

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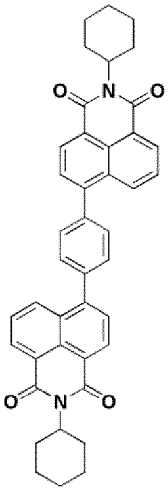

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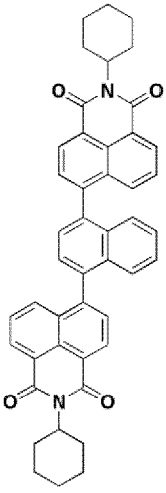

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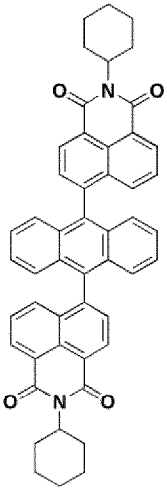

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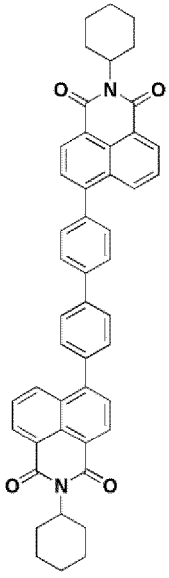

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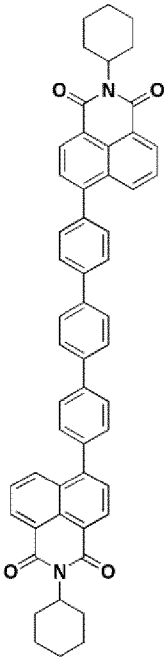

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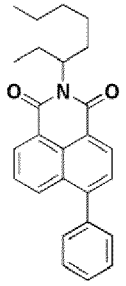

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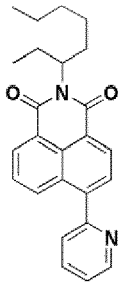

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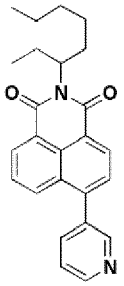

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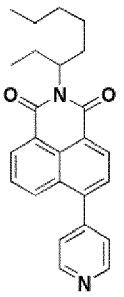

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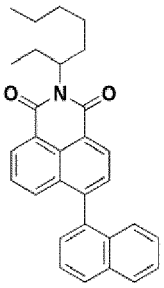

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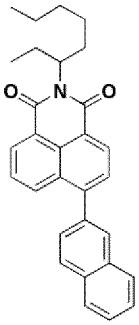

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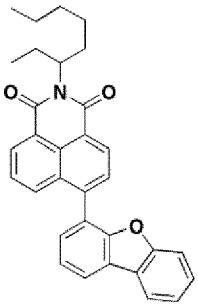

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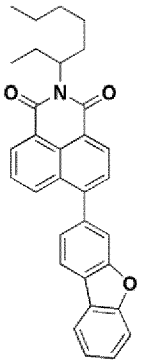

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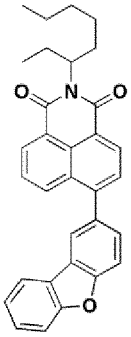

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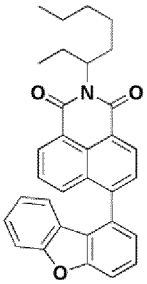

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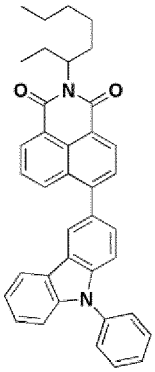

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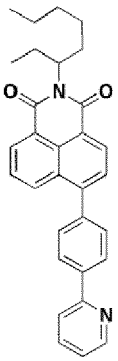

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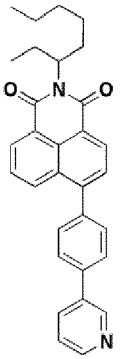

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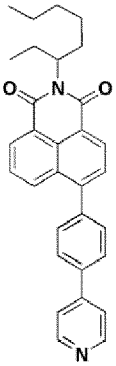

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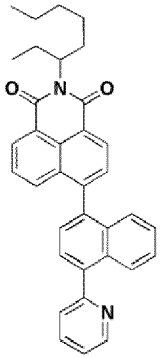

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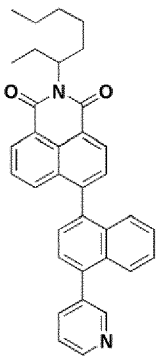

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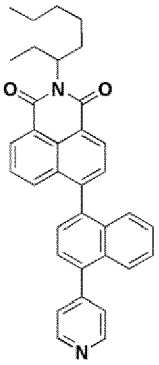

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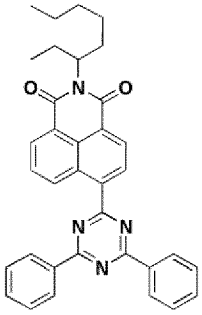

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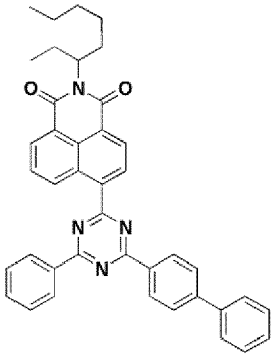

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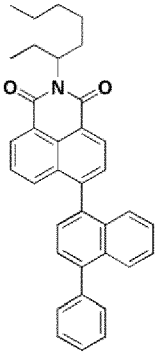

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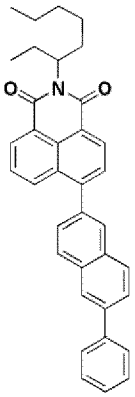

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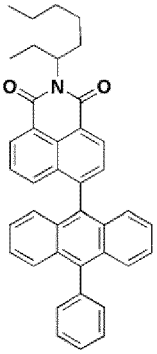

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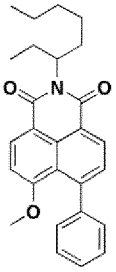

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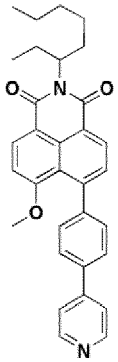

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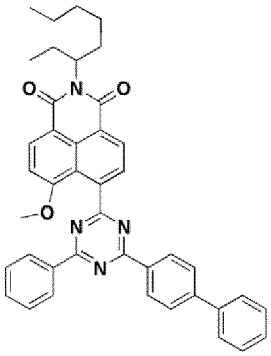

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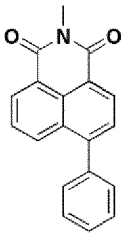

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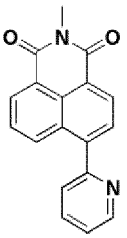

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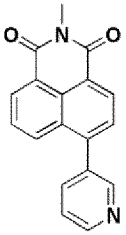

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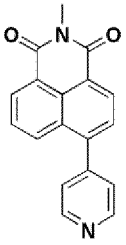

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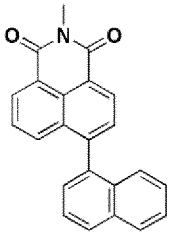

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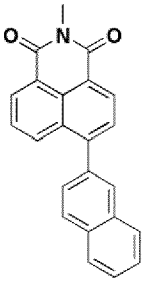

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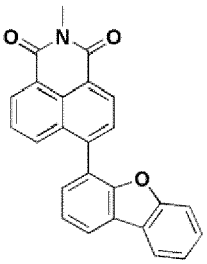

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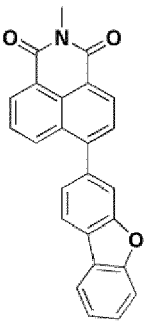

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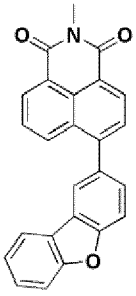

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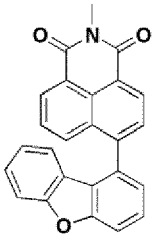

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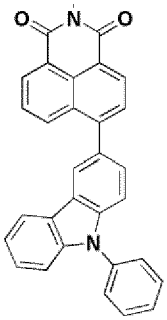

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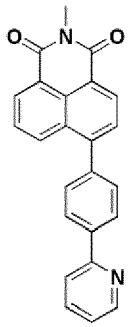

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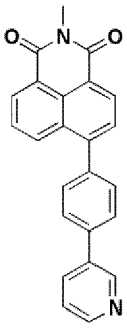

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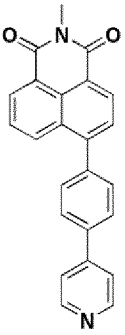

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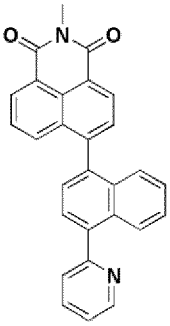

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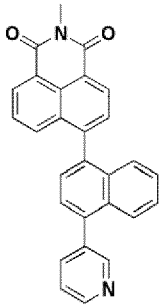

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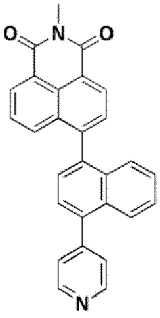

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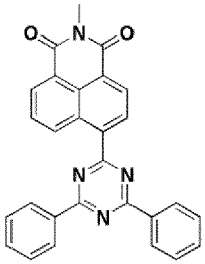

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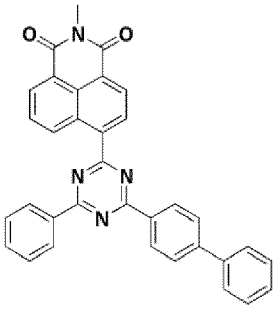

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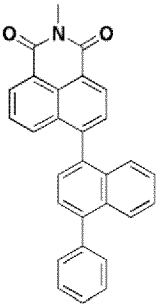

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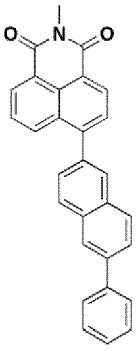

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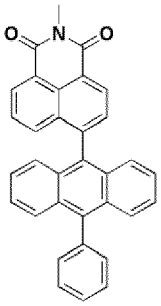

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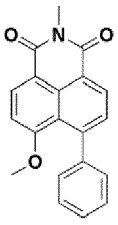

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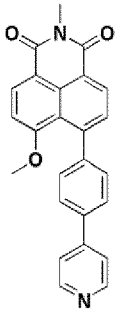

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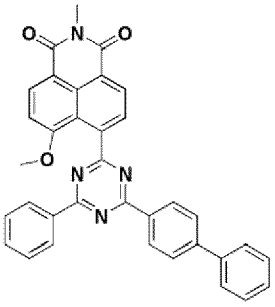

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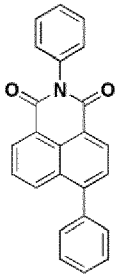

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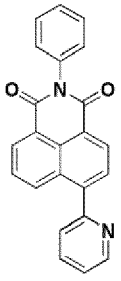

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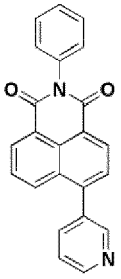

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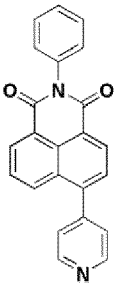

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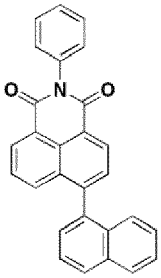

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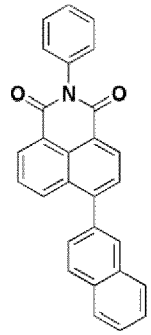

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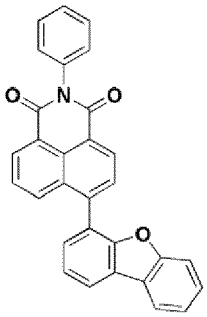

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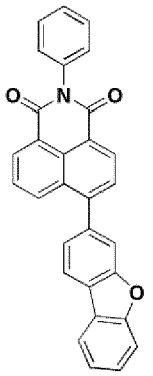

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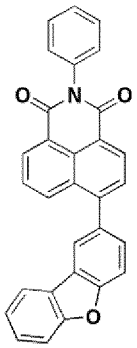

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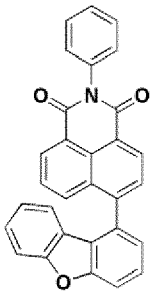

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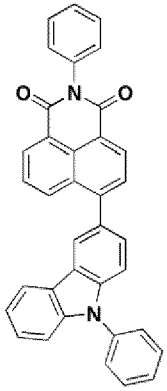

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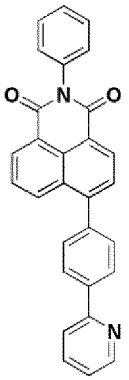

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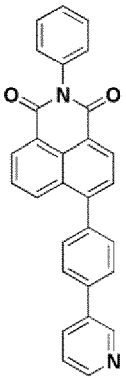

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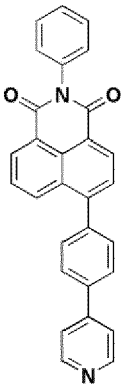

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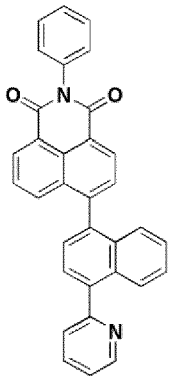

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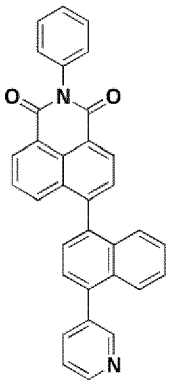

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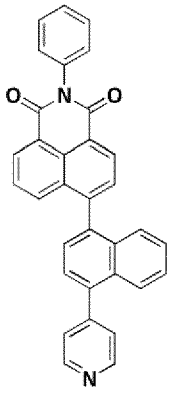

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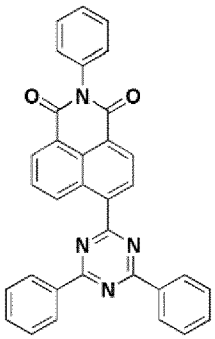

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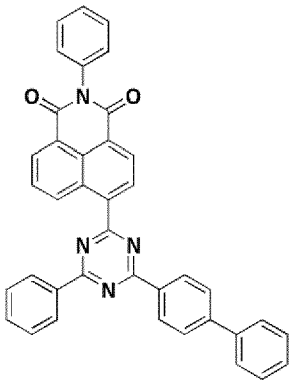

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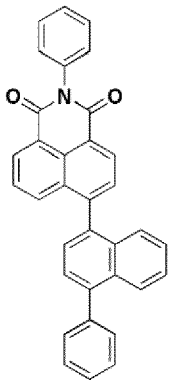

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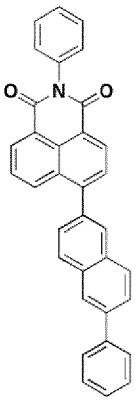

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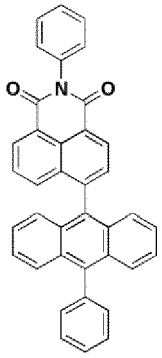

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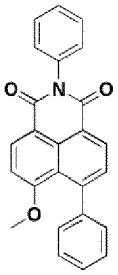

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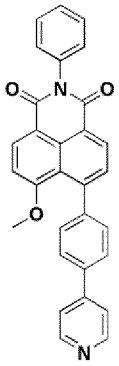

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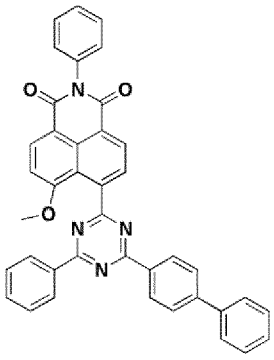

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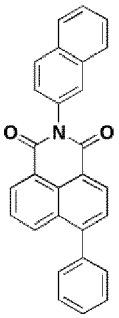

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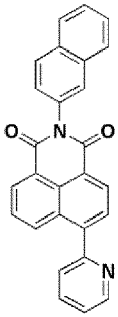

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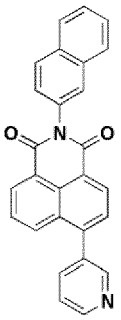

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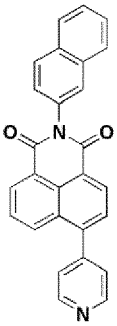

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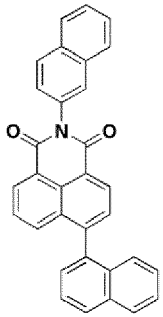

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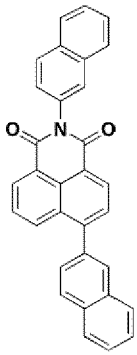

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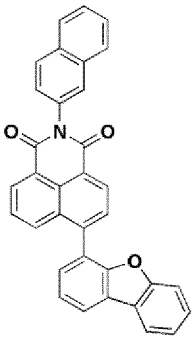

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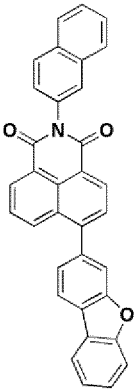

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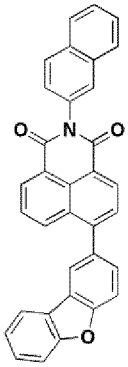

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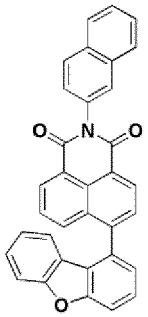

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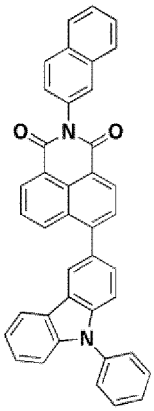

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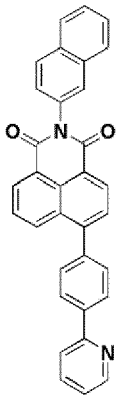

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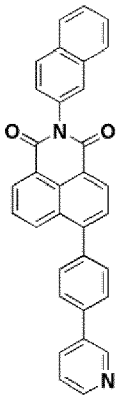

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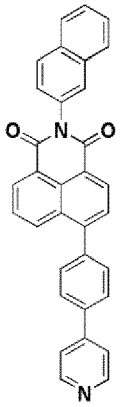

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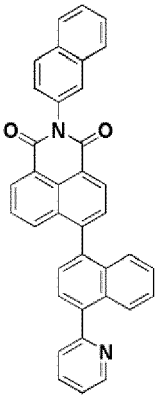

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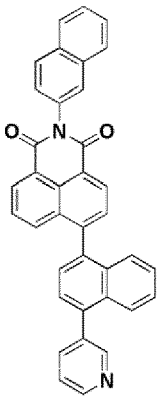

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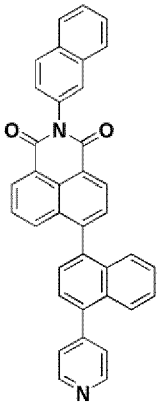

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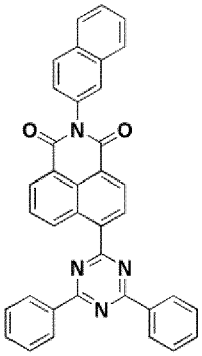

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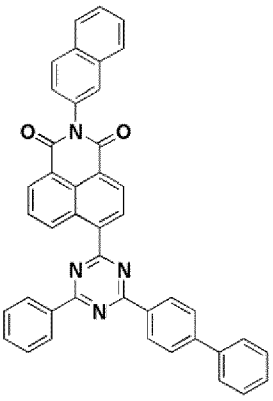

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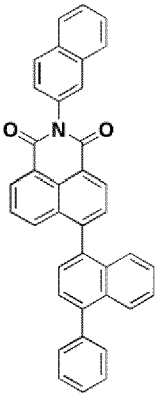

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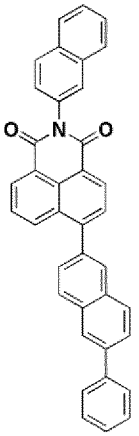

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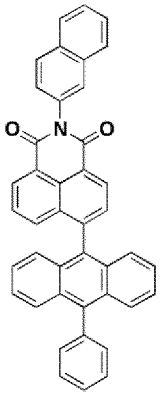

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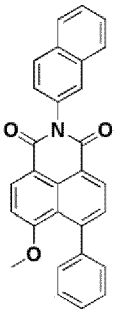

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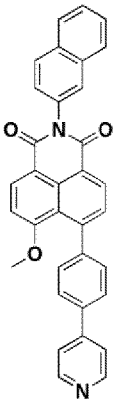

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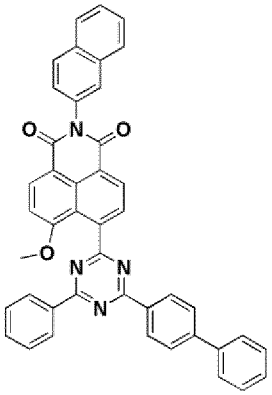

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10. An organic light-emitting display apparatus according to any one of claims 1 to 9, wherein the first compound is configured to absorb light having a wavelength of about 400 nm to about 410 nm.

11. An organic light-emitting display apparatus according to any one of claims 1 to 10, wherein the encapsulation unit further comprises a second compound different from the first compound, and a wavelength range of light absorbed by the first compound is different from a wavelength range of light absorbed by the second compound.

12. An organic light-emitting display apparatus according to any one of claims 1 to 11, wherein the encapsulation unit further comprises a third compound different from the first compound, and the first compound is dispersed in the third compound,
wherein the first compound is preferably cross-linked to the third compound.

13. An organic light-emitting display apparatus according to any one of claims 1 to 12, wherein the encapsulation unit further comprises a metal, a metal halide, a metal nitride, a metal oxide, a metal oxynitride, a silicon nitride, a silicon oxide, and/or a silicon oxynitride.

14. An organic light-emitting display apparatus according to any one of claims 1 to 13, wherein the encapsulation unit comprises at least one organic film and at least one inorganic film, and the at least one organic film consists of the first compound,
wherein the at least one inorganic film preferably comprises at least one selected from the group consisting of a metal, a metal halide, a metal nitride, a metal oxide, a metal oxynitride, a silicon nitride, a silicon oxide, and a silicon oxynitride.

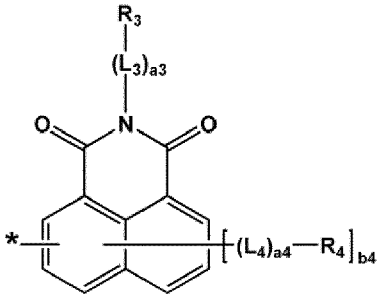
15. An organic light-emitting display apparatus according to claim 14, wherein the at least one organic film comprises a first organic film,
the at least one inorganic film comprises a first inorganic film, and
the first organic film is between the organic light-emitting device and the first inorganic film, or
the first inorganic film is between the organic light-emitting device and the first organic film.

16. An organic light-emitting display apparatus comprising:

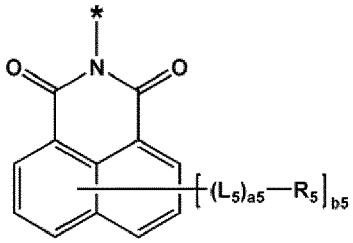
a substrate;
an organic emission unit on the substrate and comprising a plurality of organic light-emitting devices; and
an encapsulation unit on the organic emission unit and configured to seal the organic emission unit,
wherein the encapsulation unit comprises a first compound represented by Formula 1:

Formula 1 $[R_1\text{-}(L_1)_{a1}]_{b1}\text{-}(Ar_1)_{c1}\text{-}[(L_2)_{a2}\text{-}R_2]_{b2}$

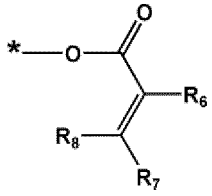
Formula 2-1



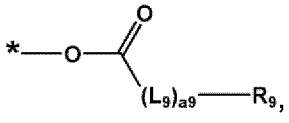
Formula 2-2



Formula 2-3



Formula 2-4



wherein, in Formulae 1 and 2-1 to 2-4,
Ar_1 is a C_5-C_{60} carbocyclic group or a C_2-C_{30} heterocyclic group,
c1 is 0 or 1,

L_1 to L_5 and L_9 are each independently selected from *-$N(R_{11})$-*', *-$B(R_{11})$-*', *-$P(R_{11})$-*', *-$Si(R_{11})(R_{12})$-*', *-S-*', *-Se-*', *-O-*' *-C(=O)-*', *-S(=O)-*', *-$S(=O)_2$-*', *-$C(R_{11})$=*', *-C(=S)-*', a substituted or unsubstituted C_1-C_{60} alkylene group, a substituted or unsubstituted C_2-C_{60} alkenylene group, a substituted or unsubstituted C_2-C_{60} alkynylene group, a substituted or unsubstituted C_3-C_{10} cycloalkylene group, a substituted or unsubstituted C_1-C_{10} heterocycloalkylene group, a substituted or unsubstituted C_3-C_{10} cycloalkenylene group, a substituted or unsubstituted C_1-C_{10} heterocycloalkenylene group, a substituted or unsubstituted C_6-C_{60} arylene group, a substituted or unsubstituted C_1-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,

a1 to a5 and a9 are each independently an integer from 0 to 10,

R_1 is a group represented by Formula 2-1 or a group represented by Formula 2-2,

R_2 to R_5 are each independently selected from a group represented by Formula 2-3, a group represented by Formula 2-4, hydrogen, deuterium, -F, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, a hydrazono group, 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_{60} cycloalkoxy group, a substituted or unsubstituted C_3-C_{10} cycloalkyl group, a substituted or unsubstituted C_1-C_{10} heterocycloalkyl group, a substituted or unsubstituted C_3-C_{10} cycloalkenyl group, a substituted or unsubstituted C_1-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, a substituted or unsubstituted C_1-C_{60} heteroaryl group, a substituted or unsubstituted monovalent non-aromatic condensed polycyclic group, a substituted or unsubstituted monovalent non-aromatic condensed heteropolycyclic group, $Si(Q_1)(Q_2)(Q_3)$, $-N(Q_1)(Q_2)$, $-B(Q_1)(Q_2)$, $-C(=O)(Q_1)$, $-S(=O)_2(Q_1)$, and $-P(=O)(Q_1)(Q_2)$,

R_6 to R_9, R_{11}, and R_{12} are each independently selected from hydrogen, deuterium, -F, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, a hydrazono group, 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_{60} cycloalkoxy group, a substituted or unsubstituted C_3-C_{10} cycloalkyl group, a substituted or unsubstituted C_1-C_{10} heterocycloalkyl group, a substituted or unsubstituted C_3-C_{10} cycloalkenyl group, a substituted or unsubstituted C_1-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, a substituted or unsubstituted C_1-C_{60} heteroaryl group, a substituted or unsubstituted monovalent non-aromatic condensed polycyclic group, a substituted or unsubstituted monovalent non-aromatic condensed heteropolycyclic group, $Si(Q_4)(Q_5)(Q_6)$, $-N(Q_4)(Q_5)$, $-B(Q_4)(Q_5)$, $-C(=O)(Q_4)$, $-S(=O)_2(Q_4)$, and $-P(=O)(Q_4)(Q_5)$,

b1 is an integer from 1 to 10, wherein, when b1 is two or more, two or more *-$(L_1)_{a1}$-R_1(s) are identical to or different from each other,

b2 is an integer from 1 to 10, wherein, when b2 is two or more, two or more *-$(L_2)_{a2}$-R_2(s) are identical to or different from each other,

b4 is an integer from 0 to 5, wherein, when b4 is two or more, two or more *-$(L_4)_{a4}$-R_4(s) are identical to or different from each other,

b5 is an integer from 0 to 6, wherein, when b5 is two or more, two or more *-$(L_5)_{a5}$-R_5(s) are identical to or different from each other,

at least one substituent of the substituted C_1-C_{60} alkylene group, the substituted C_2-C_{60} alkenylene group, the substituted C_2-C_{60} alkynylene group, the substituted C_3-C_{10} cycloalkylene group, the substituted C_1-C_{10} heterocycloalkylene group, the substituted C_3-C_{10} cycloalkenylene group, the substituted C_1-C_{10} heterocycloalkenylene group, the substituted C_6-C_{60} arylene group, the substituted C_1-C_{60} heteroarylene group, the substituted divalent non-aromatic condensed polycyclic group, the substituted divalent non-aromatic condensed heteropolycyclic group, the substituted C_1-C_{60} alkyl group, the substituted C_2-C_{60} alkenyl group, the substituted C_2-C_{60} alkynyl group, the substituted C_1-C_{60} alkoxy group, the substituted C_3-C_{60} cycloalkoxy group, the substituted C_3-C_{10} cycloalkyl group, the substituted C_1-C_{10} heterocycloalkyl group, the substituted C_3-C_{10} cycloalkenyl group, the substituted C_1-C_{10} heterocycloalkenyl group, the substituted C_6-C_{60} aryl group, the substituted C_6-C_{60} aryloxy group, the substituted C_6-C_{60} arylthio group, the substituted C_1-C_{60} heteroaryl group, the substituted monovalent non-aromatic condensed polycyclic group, and the substituted monovalent non-aromatic condensed heteropolycyclic group is selected from:

deuterium, -F, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, a hydrazono group, 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, and a C_3-C_{60} cycloalkoxy group;

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, and a C_3-C_{60} cycloalkoxy group, each substituted with at least one selected from deuterium, -F, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, a hydrazono group, a C_3-C_{10} cycloalkyl group, a C_1-C_{10} heterocycloalkyl group, a C_3-C_{10} cycloalkenyl group, a C_1-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,-$Si(Q_{11})(Q_{12})(Q_{13})$, -$N(Q_{11})(Q_{12})$, -$B(Q_{11})(Q_{12})$, -$C(=O)(Q_{11})$, -$S(=O)_2(Q_{11})$, and-$P(=O)(Q_{11})(Q_{12})$;

a C_3-C_{10} cycloalkyl group, a C_1-C_{10} heterocycloalkyl group, a C_3-C_{10} cycloalkenyl group, a C_1-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, a biphenyl group, and a terphenyl group;

a C_3-C_{10} cycloalkyl group, a C_1-C_{10} heterocycloalkyl group, a C_3-C_{10} cycloalkenyl group, a C_1-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, each substituted with at least one selected from deuterium, -F, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, a hydrazono group, 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_{60} cycloalkoxy group, a C_3-C_{10} cycloalkyl group, a C_1-C_{10} heterocycloalkyl group, a C_3-C_{10} cycloalkenyl group, a C_1-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,-$Si(Q_{21})(Q_{22})(Q_{23})$, -$N(Q_{21})(Q_{22})$, -$B(Q_{21})(Q_{22})$, -$C(=O)(Q_{21})$, -$S(=O)_2(Q_{21})$, and-$P(=O)(Q_{21})(Q_{22})$; and

-$Si(Q_{31})(Q_{32})(Q_{33})$, -$N(Q_{31})(Q_{32})$, -$B(Q_{31})(Q_{32})$, -$C(=O)(Q_{31})$, -$S(=O)_2(Q_{31})$, and-$P(=O)(Q_{31})(Q_{32})$,

Q_1 to Q_6, Q_{11} to Q_{13}, Q_{21} to Q_{23}, and Q_{31} to Q_{33} are each independently selected from hydrogen, deuterium, -F, -Cl, -Br, -I, a hydroxyl group, a cyano group, a nitro group, an amidino group, a hydrazino group, a hydrazono group, 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_{60} cycloalkoxy group, a C_3-C_{10} cycloalkyl group, a C_1-C_{10} heterocycloalkyl group, a C_3-C_{10} cycloalkenyl group, a C_1-C_{10} heterocycloalkenyl group, a C_6-C_{60} aryl group, a C_6-C_{60} aryl group substituted with a C_1-C_{60} alkyl group, a C_6-C_{60} aryl group substituted with a C_6-C_{60} aryl group, a terphenyl group, a C_1-C_{60} heteroaryl group, a C_1-C_{60} heteroaryl group substituted with a C_1-C_{60} alkyl group, a C_1-C_{60} heteroaryl group substituted with a C_6-C_{60} aryl group, a monovalent non-aromatic condensed polycyclic group, a monovalent non-aromatic condensed heteropolycyclic group, a biphenyl group, and a terphenyl group, and

* and *' each indicate a binding site to a neighboring atom.

FIG. 1

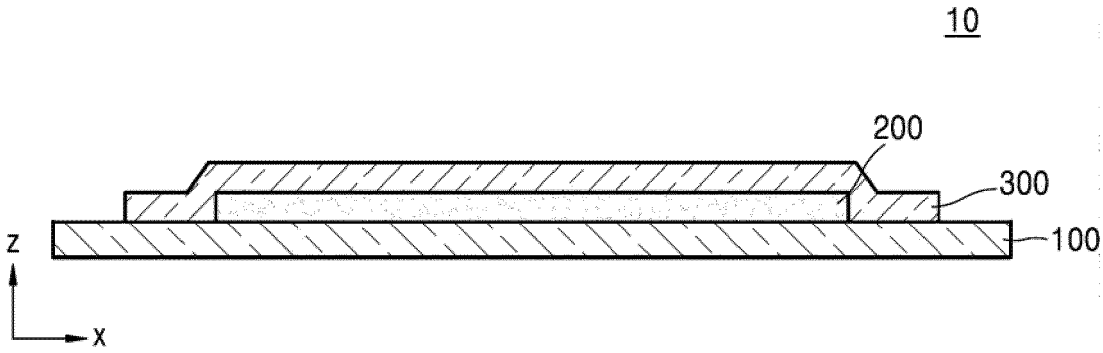
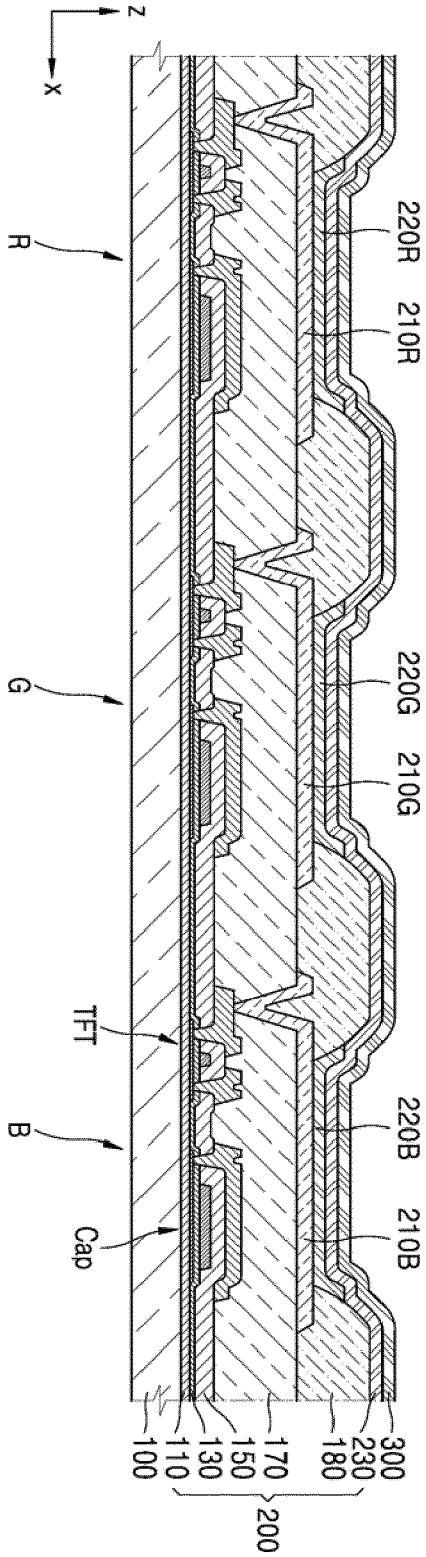


FIG. 2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200

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EUROPEAN SEARCH REPORT

Application Number
EP 18 18 7869

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 2015/098549 A1 (YOKOHAMA RUBBER CO LTD [JP]) 2 July 2015 (2015-07-02) * paragraphs [0001], [0002], [0067]; table 1; compounds D-1 *	1-16	INV. H01L51/54
X	WO 2015/093093 A1 (YOKOHAMA RUBBER CO LTD [JP]) 25 June 2015 (2015-06-25) * paragraphs [0002], [0005], [0027] - [0029]; table 1; compounds D-1 *	1,16	

TECHNICAL FIELDS SEARCHED (IPC)

H01L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	4 December 2018	Fratiloiu, Silvia

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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04-12-2018

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

专利名称(译)	有机发光显示装置		
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[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.		
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IPC分类号	H01L51/54		
CPC分类号	H01L51/5253 C07D221/14 C07D401/10 H01L27/322 H01L27/3244 H01L51/0067 H01L51/0072 H01L51/5237		
优先权	1020170101347 2017-08-09 KR		
外部链接	Espacenet		

摘要(译)

一种有机发光显示装置，包括基板，设置在基板上方的有机发光装置，以及设置在有机发光装置上方并密封有机发光装置的封装单元，其中封装单元包括化合物由式1表示。