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(54) **CONDENSED CYCLIC COMPOUND AND ORGANIC LIGHT-EMITTING DEVICE INCLUDING THE SAME**

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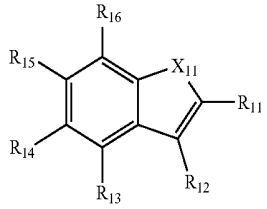
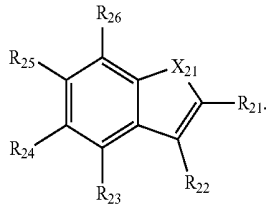
(57) **ABSTRACT**

A condensed cyclic compound and an organic light-emitting device, the condensed cyclic compound being represented by one of the following Formulae 1 or 2:

<Formula 1>



<Formula 2>



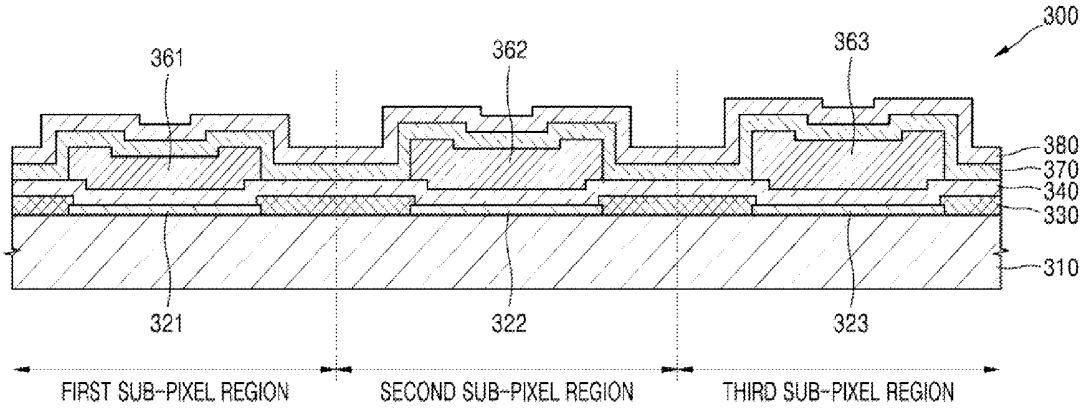


FIG. 1

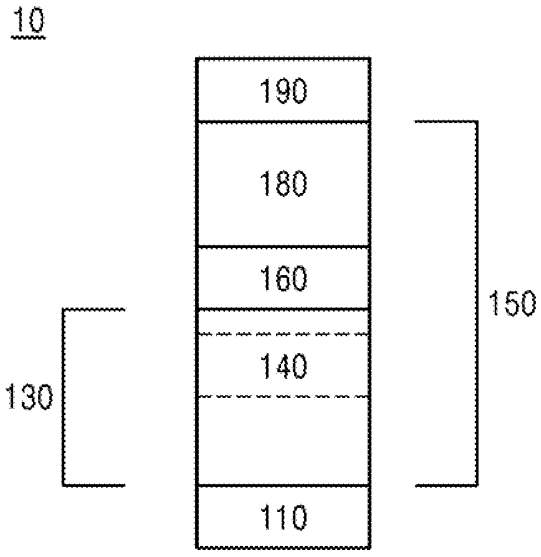


FIG. 2

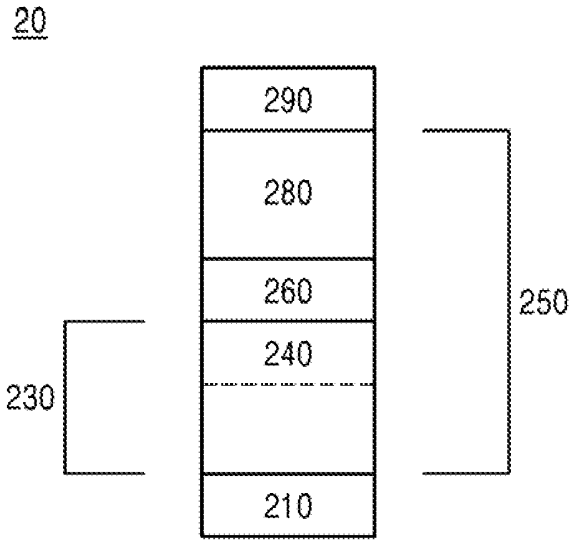
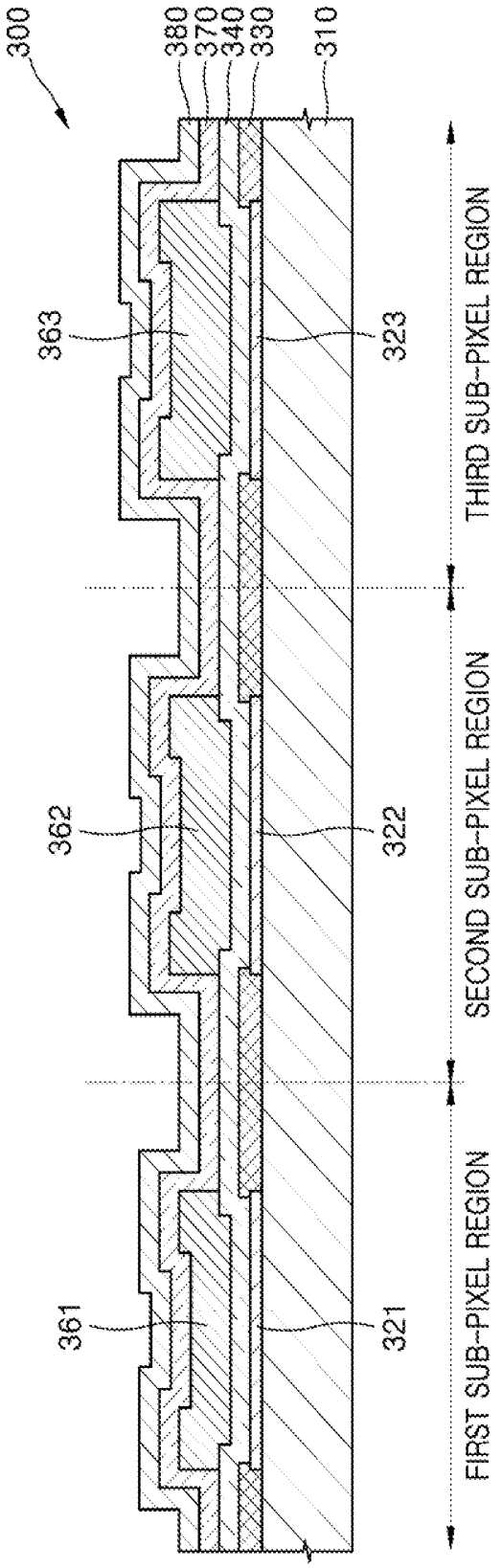


FIG. 3


300
380
370
340
330
310
363
323
362
322
361
321
THIRD SUB-PIXEL REGION
SECOND SUB-PIXEL REGION
FIRST SUB-PIXEL REGION

CONDENSED CYCLIC COMPOUND AND ORGANIC LIGHT-EMITTING DEVICE INCLUDING THE SAME

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] Korean Patent Application Nos. 10-2014-0046934, filed on Apr. 18, 2014, and 10-2015-0048327, filed on Apr. 6, 2015, in the Korean Intellectual Property Office, and entitled: "Condensed Cyclic Compound and Organic Light-Emitting Device Including the Same," are incorporated by reference herein in their entirety.

BACKGROUND

[0002] 1. Field

[0003] Embodiments relate to a condensed cyclic compound and an organic light-emitting device including the same.

[0004] 2. Description of the Related Art

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

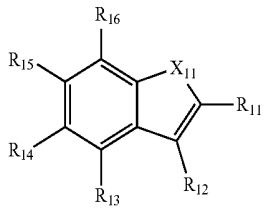
[0006] The organic light-emitting device may include a first electrode disposed on a substrate, and a hole transport region, an emission layer, an electron transport region, and a second electrode, which are sequentially disposed on the first electrode. Holes provided from the first electrode may move toward the emission layer through the hole transport region, and electrons provided from the second electrode may move toward the emission layer through the electron transport region. Carriers, such as holes and electrons, are recombined in the emission layer to produce excitons. These excitons change from an excited state to a ground state, thereby generating light.

SUMMARY

[0007] Embodiments are directed to a condensed cyclic compound and an organic light-emitting device including the same.

[0008] One or more embodiments provide a condensed cyclic compound represented by Formulae 1 or 2:

<Formula 1>



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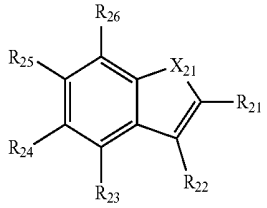

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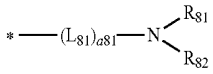
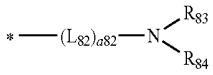
<Formula 8-1>



<Formula 8-2>



[0009] wherein in Formulae 1, 2, 8-1, and 8-2,

[0010] X_{11} is selected from a sulfur (S) atom, an oxygen (O) atom, and $N(R_{17})$;

[0011] X_{21} is selected from a sulfur (S) atom, an oxygen (O) atom, and $N(R_{27})$;

[0012] R_{11}, R_{17}, and R_{27} are each independently selected from a hydrogen, a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a substituted or unsubstituted C_1-C_{60} alkyl group, a substituted or unsubstituted C_2-C_{60} alkenyl group, a substituted or unsubstituted C_2-C_{60} alkynyl group, a substituted or unsubstituted C_1-C_{60} alkoxy group, a substituted or unsubstituted C_3-C_{10} cycloalkyl group, a substituted or unsubstituted C_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, and a substituted or unsubstituted monovalent non-aromatic condensed heteropolycyclic group;

[0013] R_{21} is a group represented by Formula 8-2;

[0014] R_{12} to R_{16} and R_{22} to R_{26} are each independently selected from a group represented by Formula 8-1, a hydrogen, a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a substituted or unsubstituted C_1-C_{60} alkyl group, a substituted or unsubstituted C_2-C_{60} alkenyl group, a substituted or unsubstituted C_2-C_{60} alkynyl group, a substituted or unsubstituted C_1-C_{60} alkoxy group, a substituted or unsubstituted C_3-C_{10} cycloalkyl group, a substituted or unsubstituted 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, and a substituted or unsubstituted monovalent non-aromatic condensed heteropolycyclic group;

[0015] at least one selected from R_{12} to R_{16} is the group represented by Formula 8-1;

[0016] at least one selected from R_{22} to R_{26} is the group represented by Formula 8-1;

[0017] L_{81} and L_{82} may be each independently a substituted or unsubstituted C_3-C_{10} cycloalkylene group, a substituted or

unsubstituted 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_{30} arylene group, a substituted or unsubstituted 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;

[0018] a81 and a82 are each independently selected from 0, 1, 2, and 3;

[0019] R_{81} to R_{84} are each independently selected from a substituted or unsubstituted C_1-C_{60} alkyl group, a substituted or unsubstituted C_2-C_{60} alkenyl group, a substituted or unsubstituted C_2-C_{60} alkynyl group, a substituted or unsubstituted C_1-C_{60} alkoxy group, a substituted or unsubstituted C_3-C_{10} cycloalkyl group, a substituted or unsubstituted C_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, and a substituted or unsubstituted monovalent non-aromatic condensed heteropolycyclic group;

[0020] optionally, N, R_{81}, and R_{82} may form a carbazole;

[0021] optionally, N, R_{83}, and R_{84} may form a carbazole; and

[0022] * indicates a binding site to a neighboring atom.

[0023] One or more embodiments provide an organic light-emitting device including: a first electrode; a second electrode; and an organic layer between the first electrode and the second electrode, the organic layer including an emission layer, wherein the organic layer includes the condensed cyclic compound.

[0024] One or more embodiments provide a substrate having a first sub-pixel region, a second sub-pixel region, and a third sub-pixel region;

[0025] a first electrode disposed on each of the first sub-pixel region, the second sub-pixel region, and the third sub-pixel region of the substrate;

[0026] a second electrode facing the first electrode;

[0027] an emission layer between the first electrode and the second electrode; and

[0028] a hole transport region between the emission layer and the first electrode,

[0029] wherein the hole transport region includes the condensed cyclic compound.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030] Features will be apparent to those of skill in the art by describing in detail exemplary embodiments with reference to the attached drawings in which:

[0031] FIG. **1** illustrates a schematic sectional view of an organic light-emitting device according to an embodiment;

[0032] FIG. **2** illustrates a schematic sectional view of an organic light-emitting device according to another embodiment; and

[0033] FIG. **3** illustrates a schematic sectional view of a full-color organic light-emitting device according to another embodiment.

DETAILED DESCRIPTION

[0034] Example embodiments will now be described more fully hereinafter with reference to the accompanying drawings; however, they may be embodied in different forms and should not be construed as 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 exemplary implementations to those skilled in the art.

[0035] In the drawing figures, the dimensions of layers and regions may be exaggerated for clarity of illustration. Like reference numerals refer to like elements throughout.

[0036] As used herein, the singular forms "a," "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise.

[0037] It will be further understood that variations of the terms "includes," "including," "comprises" and/or "comprising" used herein specify the presence of stated features or components, but do not preclude the presence or addition of one or more other features or components.

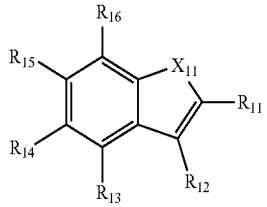
[0038] It will be understood that when a layer, region, or component is referred to as being "on" or "onto" another layer, region, or component, it may be directly or indirectly formed on the other layer, region, or component. F example, intervening layers, regions, or components may be present.

[0039] The wording "an (organic layer) includes a condensed cyclic compound represented by Formulae 1 or 2" used herein may be interpreted as a case in which an "(organic layer) may include either identical condensed cyclic compounds represented by Formulae 1 or 2, or different condensed cyclic compounds represented by Formulae 1 or 2." In this regard, different condensed cyclic compounds may be included in an identical layer (for example, two compounds may all be included in an emission auxiliary layer), or included in different layers (for example, one compound of the two compounds is included in an emission auxiliary layer, and the other compound may be included in a hole transport layer.)

[0040] The term "organic layer" used herein refers to a single layer and/or a plurality of layers disposed between a first electrode and a second electrode of the organic light-emitting device. A material included in the "organic layer" is not limited to an organic material.

[0041] A condensed cyclic compound according to an exemplary embodiment may be represented by one of the following Formulae 1 or 2. In Formula 2, R_{21} may be, e.g., a group represented by the following Formula 8-2. In Formulae 1 and 2, at least one selected from R_{12} to R_{16} may be, e.g., a group represented by Formula 8-1; and at least one selected from R_{22} to R_{26} may be, e.g., a group represented by Formula 8-1.

<Formula 1>



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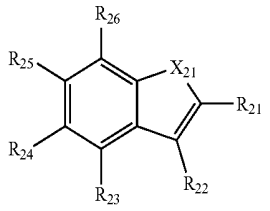
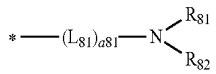
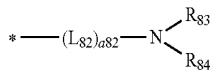
<Formula 2>



<Formula 8-1>



<Formula 8-2>



[0042] X_{11} in Formula 1 may be selected from, e.g., a sulfur (S) atom, an oxygen (O) atom, and $N(R_{17})$, and R_{17} will be explained in detail below.

[0043] In Formula 2, X_{21} may be selected from, e.g., a sulfur atom, an oxygen atom, and $N(R_{27})$, and R_{27} will be explained in detail below.

[0044] R_{11}, R_{17}, and R_{27} in Formulae 1 and 2 may each independently be selected from or include, e.g., a hydrogen, a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a substituted or unsubstituted C_1-C_{60} alkyl group, a substituted or unsubstituted C_2-C_{60} alkenyl group, a substituted or unsubstituted C_2-C_{60} alkynyl group, a substituted or unsubstituted C_1-C_{60} alkoxy group, a substituted or unsubstituted C_3-C_{10} cycloalkyl group, a substituted or unsubstituted C_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, and a substituted or unsubstituted monovalent non-aromatic condensed heteropolycyclic group.

[0045] For example, R_{11}, R_{17}, and R_{27} in Formulae 1 and 2 may each independently be selected from or include a hydrogen, a deuterium, —F, —Cl, —Br, —I, a substituted or unsubstituted C_1-C_{60} alkyl 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_1-C_{60} heteroaryl group, a substituted or unsubstituted monovalent non-aromatic condensed polycyclic group, and a substituted or unsubstituted monovalent non-aromatic condensed heteropolycyclic group.

[0046] In an implementation, R_{11}, R_{17}, and R_{27} in Formulae 1 and 2 may each independently be selected from, e.g.,

[0047] a hydrogen, a deuterium, —F, —Cl, —Br, —I, a methyl group, an ethyl group, a propyl group, a butyl group, pentyl group, a hexyl group, a heptyl group, an octyl group, a nonyl group, a decyl group, a phenyl group, a pentalenyl group, an indenyl group, a naphthyl group, an azulenyl group, a heptalenyl group, an indacenyl group, an acenaphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenalenyl group, a phenanthrenyl group, an anthracenyl group, a fluoranthenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a naphthacenyl group, a picenyl group, a perylenyl group, a pentaphenyl group, a hexacenyl group, a pentacenyl group, a rubicenyl group, a coronenyl group, an ovalenyl group, a pyrrolyl group, a thiophenyl group, a furanyl group, an imidazolyl group, a pyrazolyl group, a thiazolyl group, an isothiazolyl group, an oxazolyl group, an isoxazolyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, an indolyl group, an indazolyl group, a purinyl group, a quinolinyl group, an isoquinolinyl group, a carbazolyl group, a benzoquinolinyl group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, benzoa quinoxalinyl group, a quinazolinyl group, a benzoquinazolinyl 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, 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 benzocarbazolyl group, a dibenzocarbazolyl group, a thiadiazolyl group, an imidazopyridinyl group, and an imidazopyrimidinyl group; and

[0048] a phenyl group, a pentalenyl group, an indenyl group, a naphthyl group, an azulenyl group, a heptalenyl group, an indacenyl group, an acenaphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenalenyl group, a phenanthrenyl group, an anthracenyl group, a fluoranthenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a naphthacenyl group, a picenyl group, a perylenyl group, a pentaphenyl group, a hexacenyl group, a pentacenyl group, a rubicenyl group, a coronenyl group, an ovalenyl group, a pyrrolyl group, a thiophenyl group, a furanyl group, an imidazolyl group, a pyrazolyl group, a thiazolyl group, an isothiazolyl group, an oxazolyl group, an isoxazolyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, an indolyl group, an indazolyl group, a purinyl group, a quinolinyl group, an isoquinolinyl group, a carbazolyl group, a benzoquinolinyl group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, benzoa quinoxalinyl group, a quinazolinyl group, a benzoquinazolinyl 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, 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 benzocarbazolyl group, a dibenzocarbazolyl group, a thiadiazolyl group, an imidazopyridinyl group, and an imidazopyrimidinyl group, each substituted with at least one selected from a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group,

a phenyl group, a biphenyl group, a pentalenyl group, an indenyl group, a naphthyl group, an azulenyl group, a heptalenyl group, an indacenyl group, an acenaphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenalenyl group, a phenanthrenyl group, an anthracenyl group, a fluoranthenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a naphthacenyl group, a picenyl group, a perylenyl group, a pentaphenyl group, a hexacenyl group, a pentacenyl group, a rubicenyl group, a coronenyl group, an ovalenyl group, a pyrrolyl group, a thiophenyl group, a furanyl group, an imidazolyl group, a pyrazolyl group, a thiazolyl group, an isothiazolyl group, an oxazolyl group, an isoxazolyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, an indolyl group, an indazolyl group, a purinyl group, a quinolinyl group, an isoquinolinyl group, a carbazolyl group, a benzoquinolinyl group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, benzoa quinoxalinyl group, a quinazolinyl group, a benzoquinazolinyl group, a cinnolinyl group, a carbazolyl group, a phenanthridinyl group, an acridinyl group, a phenanthrolinyl group, a phenazinyl group, a benzimidazolyl group, a benzofuranyl group, a benzothiophenyl group, an isobenzothiazolyl group, a benzoxazolyl group, an isobenzoxazolyl group, a triazolyl group, a tetrazolyl group, an oxadiazolyl group, a triazinyl group, a dibenzofuranyl group, a dibenzothiophenyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a thiadiazolyl group, an imidazopyridinyl group, an imidazopyrimidinyl group, and —Si(Q_{33})(Q_{34})(Q_{35}); in which Q_{33} to Q_{35} may be each independently selected from a C_1-C_{60} alkyl group and a C_6-C_{60} aryl group.

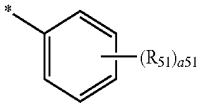
[0049] In an implementation, R_{11}, R_{17}, and R_{27} in Formulae 1 and 2 may each independently be selected from, e.g.,

[0050] a hydrogen, a deuterium, —F, —Cl, —Br, —I, a phenyl group, a naphthyl group, a fluorenyl group, a phenanthrenyl group, an anthracenyl group, a triphenylenyl group, a pyrrolyl group, a thiophenyl group, a furanyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a quinolinyl group, an isoquinolinyl group, a carbazolyl 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 benzofuranyl group, a benzothiophenyl group, a triazinyl group, a dibenzofuranyl group, a dibenzothiophenyl group, and a dibenzosilolyl group; and

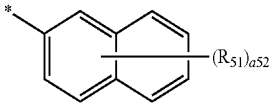
[0051] a phenyl group, a naphthyl group, a fluorenyl group, a phenanthrenyl group, an anthracenyl group, a triphenylenyl group, a pyrrolyl group, a thiophenyl group, a furanyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a quinolinyl group, an isoquinolinyl group, a carbazolyl group, 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 benzofuranyl group, a benzothiophenyl group, a triazinyl group, a dibenzofuranyl group, a dibenzothiophenyl group, and a dibenzosilolyl group, each substituted with at least one selected from a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, a triazinyl group, and —Si(Q_{33})(Q_{34})(Q_{35}), in which Q_{33} to Q_{35} may each independently be selected from a C_1-C_{20} alkyl group and a C_6-C_{60} aryl group.

[0052] In an implementation, R_{11}, R_{17}, and R_{27} in Formulae 1 and 2 may each independently be, e.g., a group represented by one of the following Formulae 5-1 to 5-10.

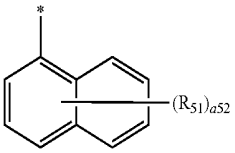
5-1



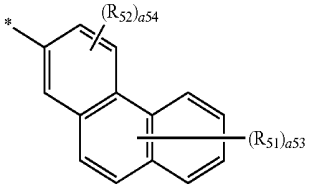
5-2



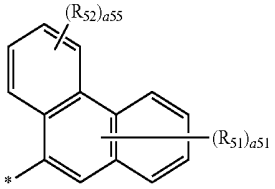
5-3



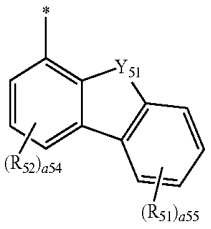
5-4



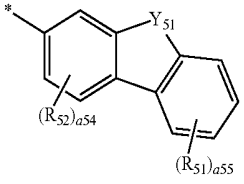
5-5



5-6



5-7



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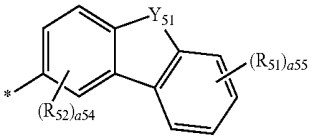
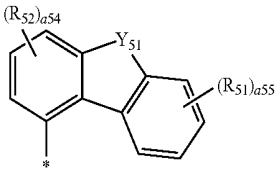
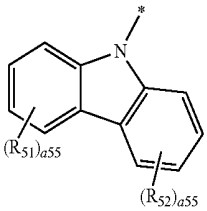
5-8



5-9



5-10



[0053] Wherein, in Formulae 5-1 to 5-10,

[0054] Y_{51} may be selected from, e.g., $C(R_{53})(R_{54})$, $Si(R_{53})(R_{54})$, $N(R_{53})$, O, and S;

[0055] R_{51} to R_{54} may each independently be selected from, e.g., a hydrogen, a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, a triazinyl group, and —$Si(Q_{33})(Q_{34})(Q_{35})$;

[0056] Q_{33} to Q_{35} may each independently be selected from a methyl group, an ethyl group, a tert-butyl group, a phenyl group, and a naphthyl group;

[0057] a51 may be selected from 1, 2, 3, 4, and 5;

[0058] a52 may be selected from 1, 2, 3, 4, 5, 6, and 7;

[0059] a53 may be selected from 1, 2, 3, 4, 5, and 6;

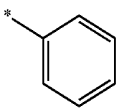
[0060] a54 may be selected from 1, 2, and 3;

[0061] a55 may be selected from 1, 2, 3, and 4; and

[0062] * indicates a binding site to a neighboring atom.

[0063] In an implementation, R_{11}, R_{17}, and R_{27} in Formulae 1 and 2 may each independently be, e.g., a group represented by one of the following Formulae 6-1 to 6-59.

6-1



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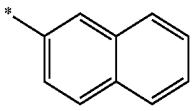
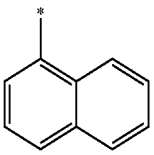
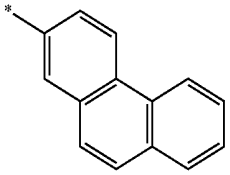
6-2



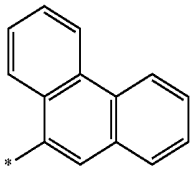
6-3



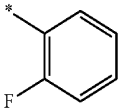
6-4



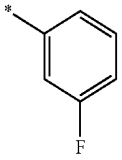
6-5



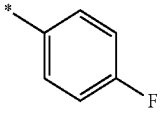
6-6



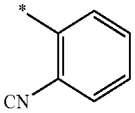
6-7



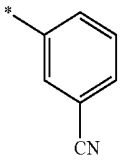
6-8



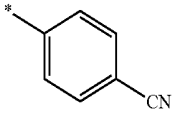
6-9



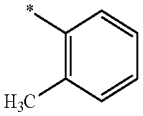
6-10



6-11



6-12



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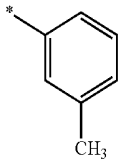
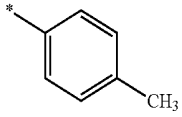
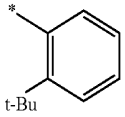
6-13



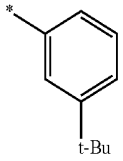
6-14



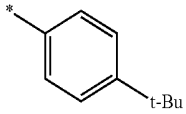
6-15



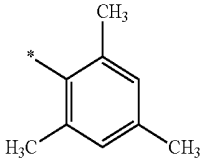
6-16



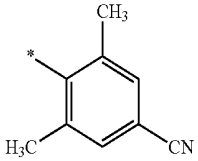
6-17



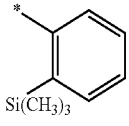
6-18



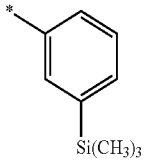
6-19



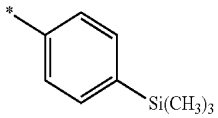
6-20



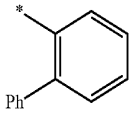
6-21



6-22



6-23



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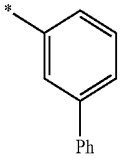
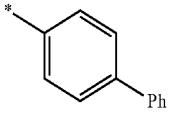
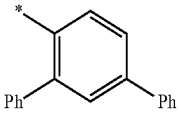
6-24



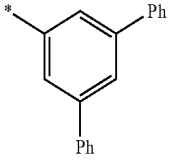
6-25



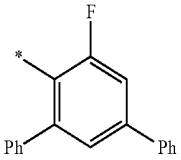
6-26



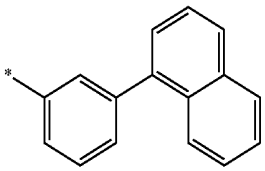
6-27



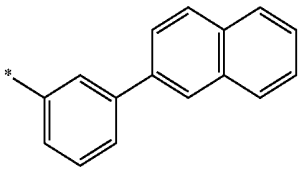
6-28



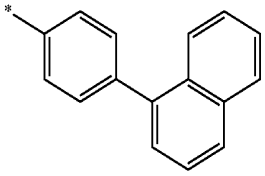
6-29



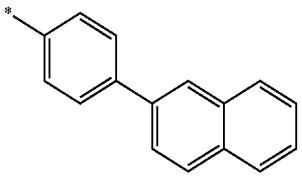
6-30



6-31



6-32



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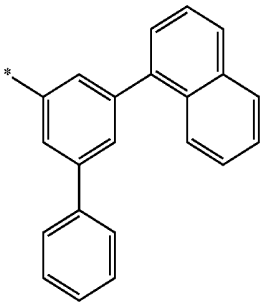
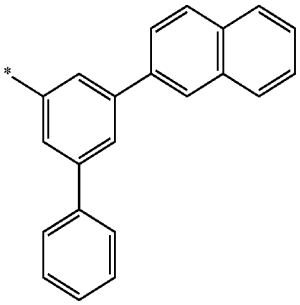
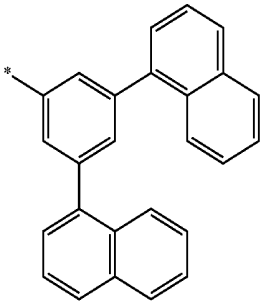
6-33



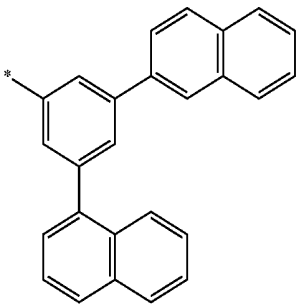
6-34



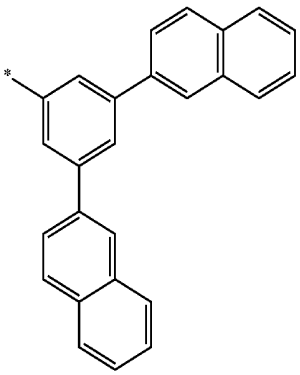
6-35



6-36



6-37



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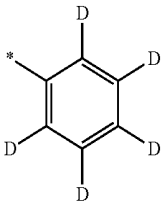

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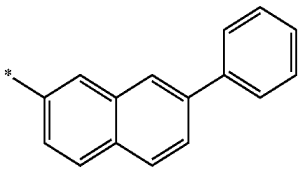

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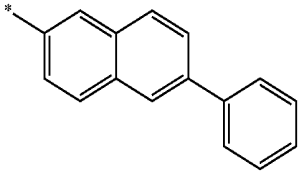

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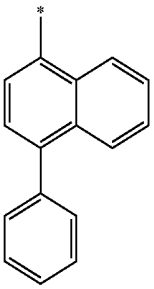

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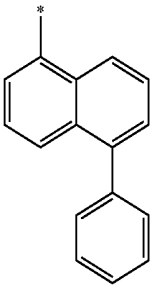

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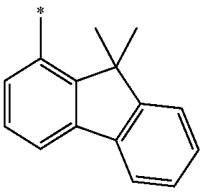

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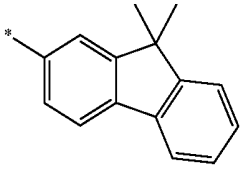

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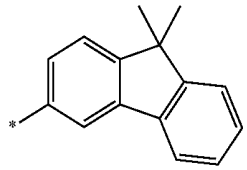

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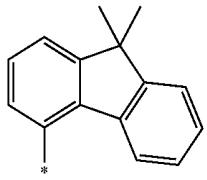

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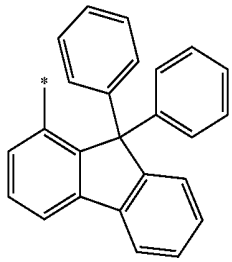

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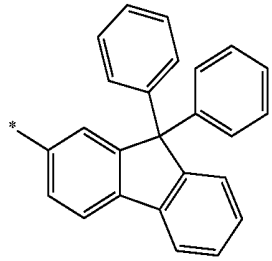

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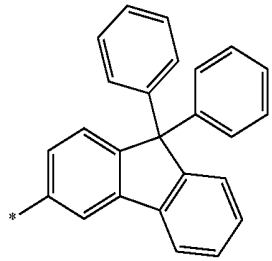

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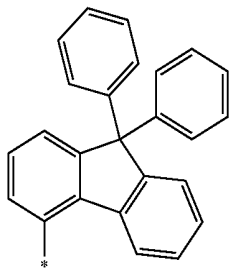

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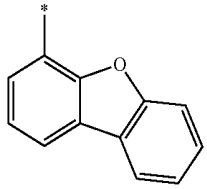

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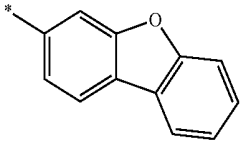

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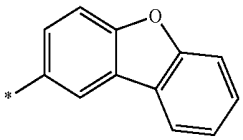

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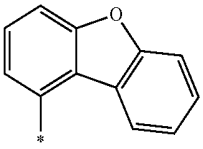

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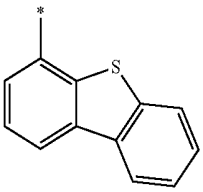

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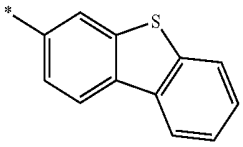

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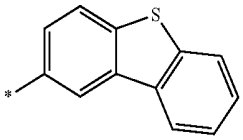

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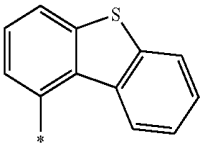

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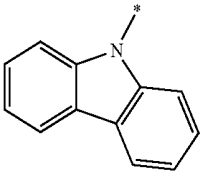


[0064] Wherein, in Formulae 6-1 to 6-59,

[0065] t-Bu indicates a tert-butyl group;

[0066] Ph indicates a phenyl group; and

[0067] * indicates a binding site to a neighboring atom.

[0068] In an implementation, R_{12} to R_{16} and R_{22} to R_{26} in Formulae 1 and 2 may each independently be selected from or include, e.g., a group represented by Formula 8-1, a hydrogen, a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a substituted

or unsubstituted C_1-C_{60} alkyl group, a substituted or unsubstituted C_2-C_{60} alkenyl group, a substituted or unsubstituted C_2-C_{60} alkynyl group, a substituted or unsubstituted C_1-C_{60} alkoxy group, a substituted or unsubstituted C_3-C_{10} cycloalkyl group, a substituted or unsubstituted C_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, and a substituted or unsubstituted monovalent non-aromatic condensed heteropolycyclic group.

[0069] For example, R_{12} to R_{16} and R_{22} to R_{26} in Formulae 1 and 2 may each independently be selected from or include a group represented by Formula 8-1, a hydrogen, a deuterium, —F, —Cl, —Br, —I, a substituted or unsubstituted C_1-C_{60} alkyl 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_1-C_{60} heteroaryl group, a substituted or unsubstituted monovalent non-aromatic condensed polycyclic group, and a substituted or unsubstituted monovalent non-aromatic condensed heteropolycyclic group.

[0070] In an implementation, R_{12} to R_{16} and R_{22} to R_{26} in Formulae 1 and 2 may each independently be selected from, e.g.,

[0071] a group represented by Formula 8-1, a hydrogen, a deuterium, —F, —Cl, —Br, —I, a methyl group, an ethyl group, a propyl group, a butyl group, pentyl group, a hexyl group, a heptyl group, an octyl group, a nonyl group, a decyl group, a phenyl group, a pentalenyl group, an indenyl group, a naphthyl group, an azulenyl group, a heptalenyl group, an indacenyl group, an acenaphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenalenyl group, a phenanthrenyl group, an anthracenyl group, a fluoranthenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a naphthacenyl group, a picenyl group, a perylenyl group, a pentaphenyl group, a hexacenyl group, a pentacenyl group, a rubicenyl group, a coronenyl group, an ovalenyl group, a pyrrolyl group, a thiophenyl group, a furanyl group, an imidazolyl group, a pyrazolyl group, a thiazolyl group, an isothiazolyl group, an oxazolyl group, an isoxazolyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, an indolyl group, an indazolyl group, a purinyl group, a quinolinyl group, an isoquinolinyl group, a carbazolyl group, a benzoquinolinyl group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, benzoa quinoxalinyl group, a quinazolinyl group, a benzoquinazolinyl 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, 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 benzocarbazolyl group, a dibenzocarbazolyl group, a thiadiazolyl group, an imidazopyridinyl group, and an imidazopyrimidinyl group; and

[0072] a phenyl group, a pentalenyl group, an indenyl group, a naphthyl group, an azulenyl group, a heptalenyl group, an indacenyl group, an acenaphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenalenyl group, a phenanthrenyl group, an anthracenyl group, a fluoranthenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a naphthacenyl group, a picenyl group, a perylenyl group, a pentaphenyl group, a hexacenyl group, a pentacenyl group, a rubicenyl group, a coronenyl group, an ovalenyl group, a pyrrolyl group, a thiophenyl group, a furanyl group, an imidazolyl group, a pyrazolyl group, a thiazolyl group, an isothiazolyl group, an oxazolyl group, an isoxazolyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, an indolyl group, an indazolyl group, a purinyl group, a quinolinyl group, an isoquinolinyl group, a carbazolyl group, a benzoquinolinyl group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, benzoa quinoxalinyl group, a quinazolinyl group, a benzoquinazolinyl group, a cinnolinyl group, a carbazolyl group, a phenanthridinyl group, an acridinyl group, a phenanthrolinyl group, a phenazinyl group, a benzimidazolyl group, a benzofuranyl group, a benzothiophenyl group, an isobenzothiazolyl group, a benzoxazolyl group, an isobenzoxazolyl group, a triazolyl group, a tetrazolyl group, an oxadiazolyl group, a triazinyl group, a dibenzofuranyl group, a dibenzothiophenyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a thiadiazolyl group, an imidazopyridinyl group, and an imidazopyrimidinyl group, each substituted with at least one selected from a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a phenyl group, a biphenyl group, a pentalenyl group, an indenyl group, a naphthyl group, an azulenyl group, a heptalenyl group, an indacenyl group, an acenaphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenalenyl group, a phenanthrenyl group, an anthracenyl group, a fluoranthenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a naphthacenyl group, a picenyl group, a perylenyl group, a pentaphenyl group, a hexacenyl group, a pentacenyl group, a rubicenyl group, a coronenyl group, an ovalenyl group, a pyrrolyl group, a thiophenyl group, a furanyl group, an imidazolyl group, a pyrazolyl group, a thiazolyl group, an isothiazolyl group, an oxazolyl group, an isoxazolyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, an indolyl group, an indazolyl group, a purinyl group, a quinolinyl group, an isoquinolinyl group, a carbazolyl group, a benzoquinolinyl group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, benzoa quinoxalinyl group, a quinazolinyl group, a benzoquinazolinyl group, a cinnolinyl group, a carbazolyl group, a phenanthridinyl group, an acridinyl group, a phenanthrolinyl group, a phenazinyl group, a benzimidazolyl group, a benzofuranyl group, a benzothiophenyl group, an isobenzothiazolyl group, a benzoxazolyl group, an isobenzoxazolyl group, a triazolyl group, a tetrazolyl group, an oxadiazolyl group, a triazinyl group, a dibenzofuranyl group, a dibenzothiophenyl group, a benzocarbazolyl group, a

dibenzocarbazolyl group, a thiadiazolyl group, an imidazopyridinyl group, an imidazopyrimidinyl group, and —Si(Q_{33})(Q_{34})(Q_{35}); in which Q_{33} to Q_{35} may each independently be selected from a C_1-C_{60} alkyl group and a C_6-C_{60} aryl group.

[0073] In an implementation, R_{12} to R_{16} and R_{22} to R_{26} in Formulae 1 and 2 may each independently be selected from, e.g.,

[0074] a group represented by Formula 8-1, a hydrogen, a deuterium, —F, —Cl, —Br, —I, a phenyl group, a naphthyl group, a fluorenyl group, a phenanthrenyl group, an anthracenyl group, a triphenylenyl group, a pyrrolyl group, a thiophenyl group, a furanyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a quinolinyl group, an isoquinolinyl group, a carbazolyl 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 benzofuranyl group, a benzothiophenyl group, a triazinyl group, a dibenzofuranyl group, a dibenzothiophenyl group, and a dibenzosilolyl group; and

[0075] a phenyl group, a naphthyl group, a fluorenyl group, a phenanthrenyl group, an anthracenyl group, a triphenylenyl group, a pyrrolyl group, a thiophenyl group, a furanyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a quinolinyl group, an isoquinolinyl group, a carbazolyl 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 benzofuranyl group, a benzothiophenyl group, a triazinyl group, a dibenzofuranyl group, a dibenzothiophenyl group, and a dibenzosilolyl group, each substituted with at least one selected from a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, a triazinyl group, and —Si(Q_{33})(Q_{34})(Q_{35}), in which Q_{33} to Q_{35} may each independently be selected from a C_1-C_{20} alkyl group and a C_6-C_{60} aryl group.

[0076] In an implementation, R_{12} to R_{16} and R_{22} to R_{26} in Formulae 1 and 2 may each independently be selected from, e.g., a group represented by Formula 8-1, a hydrogen, a phenyl group, and a naphthyl group.

[0077] In an implementation, R_{12} to R_{16} and R_{22} to R_{26} in Formulae 1 and 2 may each independently be selected from, e.g., a group represented by Formula 8-1 and a hydrogen.

[0078] For example, R_{12}, R_{13}, R_{14}, R_{15}, or R_{16} in Formula 1 may be a group represented by Formula 8-1.

[0079] In an implementation, R_{12} in Formula 1 may be, e.g., a group represented by Formula 8-1.

[0080] In an implementation, R_{15} in Formula 1 may be, e.g., a group represented by Formula 8-1.

[0081] For example, R_{22}, R_{23}, R_{24}, R_{25}, or R_{26} in Formula 2 may be a group represented by Formula 8-1.

[0082] In an implementation, R_{25} in Formula 2 may be, e.g., a group represented by Formula 8-1.

[0083] L_{81} and L_{82} in Formulae 8-1 and 8-2 may each independently be selected from or include, e.g., 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_{30} arylene group, a substituted or unsubstituted 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.

[0084] For example, L_{81} and L_{82} in Formulae 8-1 and 8-2 may each independently be selected from:

[0085] a phenylene group, a pentalenylene group, an indenylene group, a naphthylene group, an azulenylene group, a heptalenylene group, an indacenylene group, an acenaphthylene group, a fluorenylene group, a spiro-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 naphthacenylene group, a picenylene group, a perylenylene group, a pentaphenylene group, a hexacenylene group, a pentacenylene group, a rubicenylene group, a coronenylene group, an ovalenylene group, a pyrrolylene group, a thiophenylene group, a furanylene 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 isoindolylene group, an indolylene 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 carbazolylene group, a phenanthridinylene group, an acridinylene group, a phenanthrolinylene group, a phenazinylene group, a benzoimidazolylene group, a benzofuranylene group, a benzothiophenylene 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 benzocarbazolylene group, and a dibenzocarbazolylene group; and

[0086] a phenylene group, a pentalenylene group, an indenylene group, a naphthylene group, an azulenylene group, a heptalenylene group, an indacenylene group, an acenaphthylene group, a fluorenylene group, a spiro-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 naphthacenylene group, a picenylene group, a perylenylene group, a pentaphenylene group, a hexacenylene group, a pentacenylene group, a rubicenylene group, a coronenylene group, an ovalenylene group, a pyrrolylene group, a thiophenylene group, a furanylene 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 isoindolylene group, an indolylene 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 carbazolylene group, a phenanthridinylene group, an acridinylene group, a phenanthrolinylene group, a phenazinylene group, a benzoimidazolylene group, a benzofuranylene group, a benzothiophenylene 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 benzocarbazolylene group, and a dibenzocarbazolylene group, each substituted with at least one selected from a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a cyclopentyl group, a cyclohexyl group, a cycloheptyl group, a cyclopentenyl group, a cyclohexenyl group, a phenyl group, a pentalenyl group, an indenyl group, a naphthyl group, an azulenyl group, a heptalenyl group, an indacenyl group, an acenaphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenalenyl group, a phenanthrenyl group, an anthracenyl group, a fluoranthenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a naphthacenyl group, a picenyl group, a perylenyl group, a pentaphenyl group, a hexacenyl group, a pentacenyl group, a rubicenyl group, a coronenyl group, an ovalenyl group, a pyrrolyl group, a thiophenyl group, a furanyl group, an imidazolyl group, a pyrazolyl group, a thiazolyl group, an isothiazolyl group, an oxazolyl group, an isoxazolyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, an indolyl group, an indazolyl group, a purinyl group, a quinolinyl group, an isoquinolinyl group, a benzoquinolinyl group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, a quinazolinyl group, a cinnolinyl group, a carbazolyl group, a phenanthridinyl group, an acridinyl group, a phenanthrolinyl group, a phenazinyl group, a benzoimidazolyl group, a benzofuranyl group, a benzothiophenyl group, an isobenzothiazolyl group, a benzoxazolyl group, an isobenzoxazolyl group, a triazolyl group, a tetrazolyl group, an oxadiazolyl group, a triazinyl group, a dibenzofuranyl group, a dibenzothiophenyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a thiadiazolyl group, and an imidazopyridinyl group.

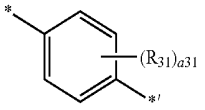
[0087] In an implementation, L_{81} and L_{82} in Formulae 8-1 and 8-2 may each independently be selected from, e.g.,

[0088] a phenylene group, a naphthylene group, a fluorenylene group, a phenanthrenylene group, an anthracenylene group, a triphenylenylene group, a pyrenylene group, a pyrrolylene group, a thiophenylene group, a furanylene group, a pyridinylene group, a pyrazinylene group, a pyrimidinylene group, an indolylene group, a quinolinylene group, an isoquinolinylene group, a benzoquinolinylene group, a naphthyridinylene group, a quinoxalinylene group, a quinazolinylene group, a cinnolinylene group, a carbazolylene group, a phenanthridinylene group, a benzoimidazolylene group, a benzofuranylene group, a benzothiophenylene group, a triazolylene group, a dibenzofuranylene group, and a dibenzothiophenylene group; and

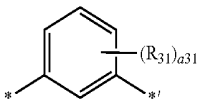
[0089] a phenylene group, a naphthylene group, a fluorenylene group, a phenanthrenylene group, an anthracenylene group, a triphenylenylene group, a pyrenylene group, a pyrrolylene group, a thiophenylene group, a furanylene group, a pyridinylene group, a pyrazinylene group, a pyrimidinylene group, an indolylene group, a quinolinylene group, an isoquinolinylene group, a benzoquinolinylene group, a naphthyridinylene group, a quinoxalinylene group, a quinazolinylene group, a cinnolinylene group, a carbazolylene group, a phenanthridinylene group, a benzoimidazolylene group, a benzofuranylene group, a benzothiophenylene group, a triazolylene group, a dibenzofuranylene group, and a dibenzothiophenylene group, each substituted with at least one selected from a hydrogen, a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group and a triazinyl group.

[0090] In an implementation, L_{81} and L_{82} in Formulae 8-1 and 8-2 may each independently be, e.g., a group represented by one of the following Formulae 3-1 to 3-11.

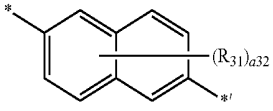
3-1



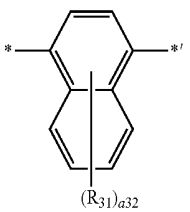
3-2



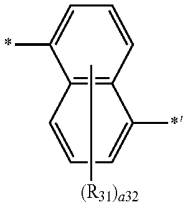
3-3



3-4



3-5



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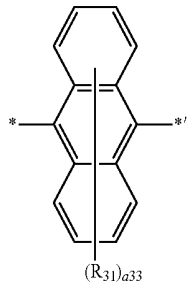
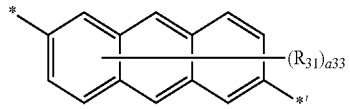
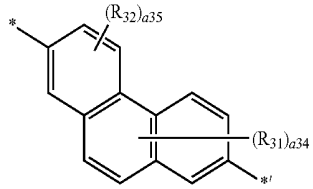
3-6



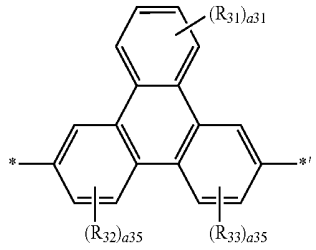
3-7



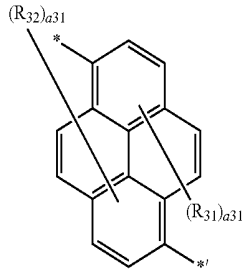
3-8



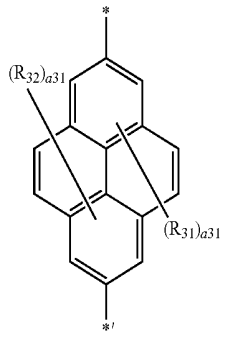
3-9



3-10



3-11



[0091] In Formulae 3-1 to 3-11,

[0092] R_{31} to R_{33} may each independently be selected from, e.g., a hydrogen, a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, and a triazinyl group;

[0093] a31 may be selected from 1, 2, 3, and 4;

[0094] a32 may be selected from 1, 2, 3, 4, 5, and 6;

[0095] a33 may be selected from 1, 2, 3, 4, 5, 6, 7, and 8;

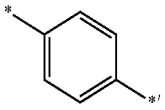
[0096] a34 may be selected from 1, 2, 3, 4, and 5;

[0097] a35 may be selected from 1, 2, and 3;

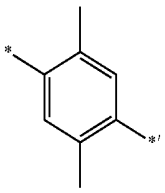
[0098] * and *' each indicate a binding site to a neighboring atom.

[0099] In an implementation, L_{81} and L_{82} in Formulae 8-1 and 8-2 may each independently be, e.g., a group represented by one of the following Formulae 4-1 to 4-14.

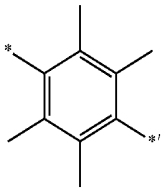
4-1



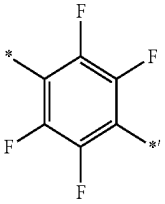
4-2



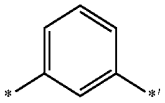
4-3



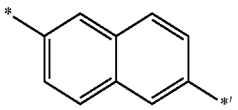
4-4



4-5



4-6



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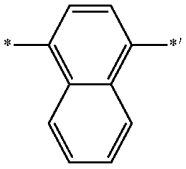
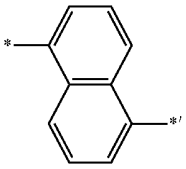
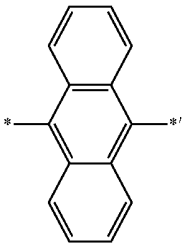
4-7



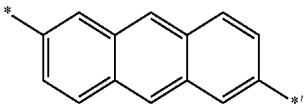
4-8



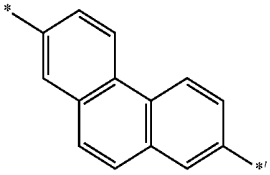
4-9



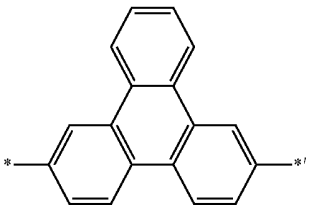
4-10



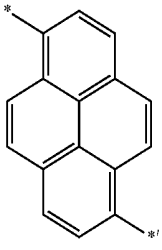
4-11



4-12



4-13



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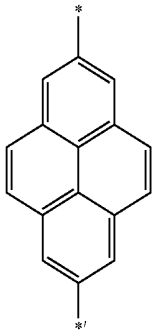
4-14



[0100] In Formulae 4-1 to 4-14, each * and *' indicates a binding site to a neighboring atom.

[0101] a81 in Formula 8-1 indicates the number of L_{81} (s), and may be selected from 0, 1, 2, and 3. When a81 is 0, $(L_{81})_{a8i}$ indicates a single bond. When a81 is 2 or more, a plurality of L_{81} may be identical or different. For example, a81 in Formula 8-1 may be selected from 0 and 1.

[0102] a82 in Formula 8-2 indicates the number of L_{82} (s), and may be selected from 0, 1, 2, and 3. When a82 is 0, $(L_{82})_{a82}$ indicates a single bond. When a82 a81 is 2 or more, a plurality of L_{82} may be identical or different. For example, a82 in Formula 8-2 may be selected from 0 and 1.

[0103] R_{81} to R_{84} in Formulae 8-1 and 8-2 may each independently be selected from or include, e.g., a substituted or unsubstituted C_1-C_{60} alkyl group, a substituted or unsubstituted C_2-C_{60} alkenyl group, a substituted or unsubstituted C_2-C_{60} alkynyl group, a substituted or unsubstituted C_1-C_{60} alkoxy group, a substituted or unsubstituted C_3-C_{10} cycloalkyl group, a substituted or unsubstituted C_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_{60} heteroaryl group, a substituted or unsubstituted monovalent non-aromatic condensed polycyclic group, and a substituted or unsubstituted monovalent non-aromatic condensed heteropolycyclic group.

[0104] For example, R_{81} to R_{84} in Formulae 8-1 and 8-2 may each independently be selected from or include 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_1-C_{60} heteroaryl group, a substituted or unsubstituted monovalent non-aromatic condensed polycyclic group, and a substituted or unsubstituted monovalent non-aromatic condensed heteropolycyclic group.

[0105] In an implementation, R_{81} to R_{84} in Formulae 8-1 and 8-2 may each independently be selected from, e.g.,

[0106] a phenyl group, a pentalenyl group, an indenyl group, a naphthyl group, an azulenyl group, a heptalenyl group, an indacenyl group, an acenaphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenalenyl group, a phenanthrenyl group, an anthracenyl group, a fluoranthenyl group, a triph-

enylenyl group, a pyrenyl group, a chrysenyl group, a naphthacenyl group, a picenyl group, a perylenyl group, a pentaphenyl group, a hexacenyl group, a pentacenyl group, a rubicenyl group, a coronenyl group, an ovalenyl group, a pyrrolyl group, a thiophenyl group, a furanyl group, an imidazolyl group, a pyrazolyl group, a thiazolyl group, an isothiazolyl group, an oxazolyl group, an isoxazolyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, an indolyl group, an indazolyl group, a purinyl group, a quinolinyl group, an isoquinolinyl group, a carbazolyl group, a benzoquinolinyl group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, benzoa quinoxalinyl group, a quinazolinyl group, a benzoquinazolinyl 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, 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 dibenzosililolyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a thiadiazolyl group, an imidazopyridinyl group, and an imidazopyrimidinyl group; and

[0107] a phenyl group, a pentalenyl group, an indenyl group, a naphthyl group, an azulenyl group, a heptalenyl group, an indacenyl group, an acenaphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenalenyl group, a phenanthrenyl group, an anthracenyl group, a fluoranthenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a naphthacenyl group, a picenyl group, a perylenyl group, a pentaphenyl group, a hexacenyl group, a pentacenyl group, a rubicenyl group, a coronenyl group, an ovalenyl group, a pyrrolyl group, a thiophenyl group, a furanyl group, an imidazolyl group, a pyrazolyl group, a thiazolyl group, an isothiazolyl group, an oxazolyl group, an isoxazolyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, an indolyl group, an indazolyl group, a purinyl group, a quinolinyl group, an isoquinolinyl group, a carbazolyl group, a benzoquinolinyl group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, benzoa quinoxalinyl group, a quinazolinyl group, a benzoquinazolinyl 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, 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 dibenzosililolyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a thiadiazolyl group, an imidazopyridinyl group, and an imidazopyrimidinyl group, each substituted with at least one selected from a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a phenyl group, a biphenyl group, a pentalenyl group, an indenyl group, a naphthyl group, an azulenyl group, a heptalenyl group, an indacenyl group, an acenaphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenalenyl group, a phenanthrenyl group, an anthracenyl group, a fluoranthenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a naphthacenyl group, a picenyl group, a perylenyl group, a pentaphenyl group, a hexacenyl group, a pentacenyl group, a rubicenyl group, a coronenyl group, an ovalenyl group, a pyrrolyl group, a thiophenyl group, a furanyl group, an imidazolyl group, a pyrazolyl group, a thiazolyl group, an isothiazolyl group, an oxazolyl group, an isoxazolyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, an indolyl group, an indazolyl group, a purinyl group, a quinolinyl group, an isoquinolinyl group, a carbazolyl group, a benzoquinolinyl group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, benzoa quinoxalinyl group, a quinazolinyl group, a benzoquinazolinyl group, a cinnolinyl group, a carbazolyl group, a phenanthridinyl group, an acridinyl group, a phenanthrolinyl group, a phenazinyl group, a benzimidazolyl group, a benzofuranyl group, a benzothiophenyl group, an isobenzothiazolyl group, a benzoxazolyl group, an isobenzoxazolyl group, a triazolyl group, a tetrazolyl group, an oxadiazolyl group, a triazinyl group, a dibenzofuranyl group, a dibenzothiophenyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a thiadiazolyl group, an imidazopyridinyl group, an imidazopyrimidinyl group, and —Si(Q_{33})(Q_{34})(Q_{35}); in which Q_{33} to Q_{35} may each independently be selected from a C_1-C_{60} alkyl group and a C_6-C_{60} aryl group.

[0108] In an implementation, R_{81} to R_{84} in Formulae 8-1 and 8-2 may each independently be selected from, e.g.,

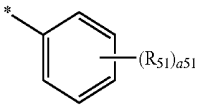
[0109] a phenyl group, a naphthyl group, a fluorenyl group, a phenanthrenyl group, an anthracenyl group, a triphenylenyl group, a pyrrolyl group, a thiophenyl group, a furanyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a quinolinyl group, an isoquinolinyl group, a carbazolyl group, 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 benzofuranyl group, a benzothiophenyl group, a triazinyl group, a dibenzofuranyl group, a dibenzothiophenyl group, and a dibenzosililolyl group; and

[0110] a phenyl group, a naphthyl group, a fluorenyl group, a phenanthrenyl group, an anthracenyl group, a triphenylenyl group, a pyrrolyl group, a thiophenyl group, a furanyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a quinolinyl group, an isoquinolinyl group, a carbazolyl 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 benzofuranyl group, a benzothiophenyl group, a triazinyl group, a dibenzofuranyl group, a dibenzothiophenyl group, and a dibenzosililolyl group, each substituted with at least one selected from a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a phenyl group, a naphthyl group, a fluorenyl group, a Spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, a triazinyl group, and —Si(Q_{33})

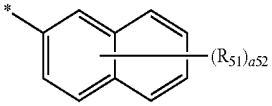
$(Q_{34})(Q_{35})$, in which Q_{33} to Q_{35} may each independently be selected from a C_1-C_{20} alkyl group and a C_6-C_{60} aryl group.

[0111] In an implementation, R_{81} to R_{84} in Formulae 8-1 and 8-2 may each independently be, e.g., a group represented by one of the following Formulae 5-1 to 5-10.

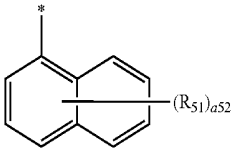
5-1



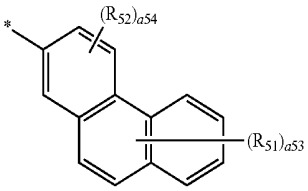
5-2



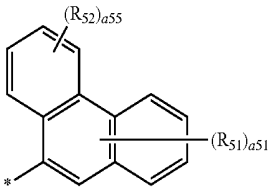
5-3



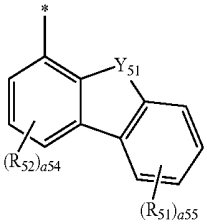
5-4



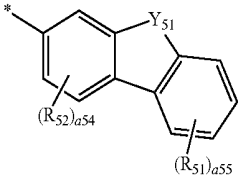
5-5



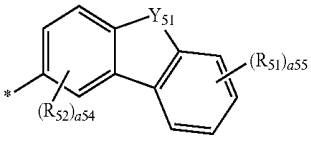
5-6



5-7



5-8



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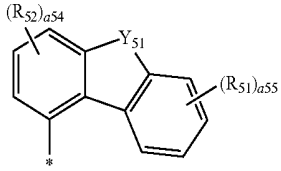
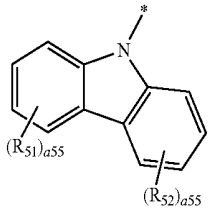
5-9



5-10



[0112] In Formulae 5-1 to 5-10,

[0113] Y_{51} may be selected from, e.g., $C(R_{53})(R_{54})$, $Si(R_{53})(R_{54})$, $N(R_{53})$, O, and S;

[0114] R_{51} to R_{54} may each independently be selected from, e.g., a hydrogen, a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, a triazinyl group, and $—Si(Q_{33})(Q_{34})(Q_{35})$;

[0115] Q_{33} to Q_{35} may each independently be selected from, e.g., a methyl group, an ethyl group, a tert-butyl group, a phenyl group, and a naphthyl group;

[0116] a51 may be selected from, e.g., 1, 2, 3, 4, and 5;

[0117] a52 may be selected from, e.g., 1, 2, 3, 4, 5, 6, and 7;

[0118] a53 may be selected from, e.g., 1, 2, 3, 4, 5, and 6;

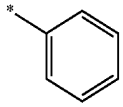
[0119] a54 may be selected from, e.g., 1, 2, and 3;

[0120] a55 may be selected from, e.g., 1, 2, 3, and 4;

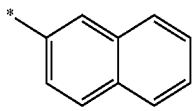
[0121] * indicates a binding site to a neighboring atom.

[0122] In an implementation, R_{81} to R_{84} in Formulae 8-1 and 8-2 may each independently be, e.g., a group represented by one of the following Formulae 6-1 to 6-59.

6-1



6-2



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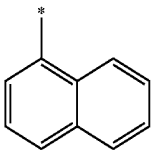
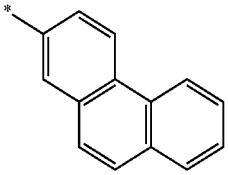
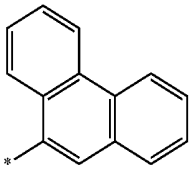
6-3



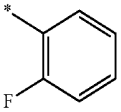
6-4



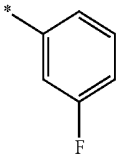
6-5



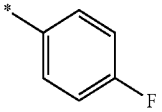
6-6



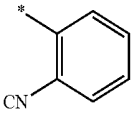
6-7



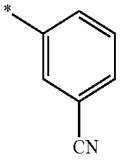
6-8



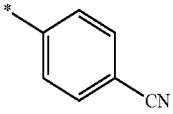
6-9



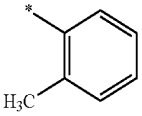
6-10



6-11



6-12



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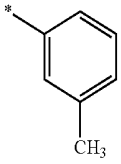
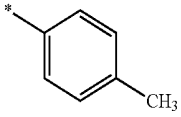
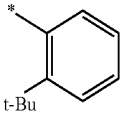
6-13



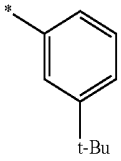
6-14



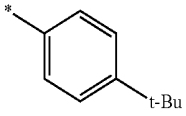
6-15



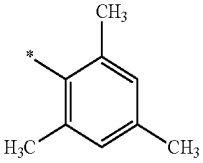
6-16



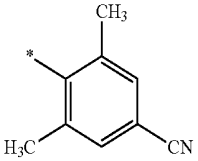
6-17



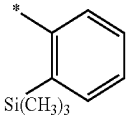
6-18



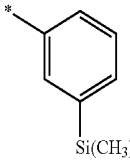
6-19



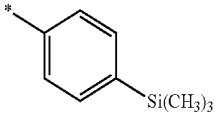
6-20



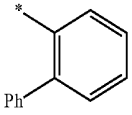
6-21



6-22



6-23



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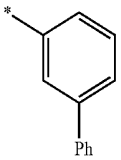
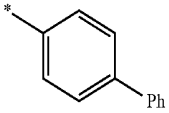
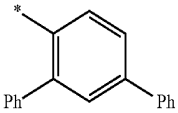
6-24



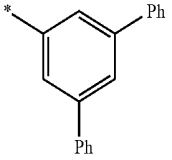
6-25



6-26



6-27



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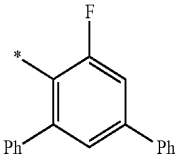

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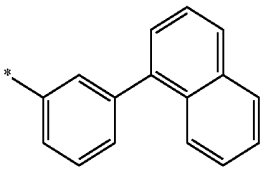

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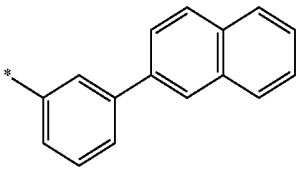

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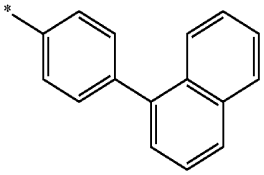

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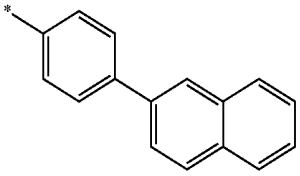

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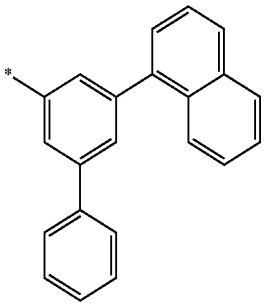

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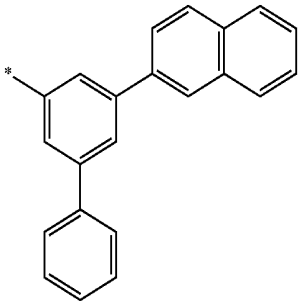

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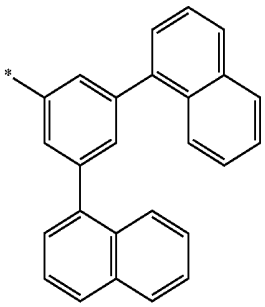

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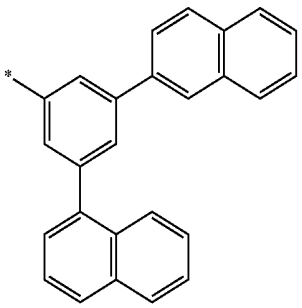

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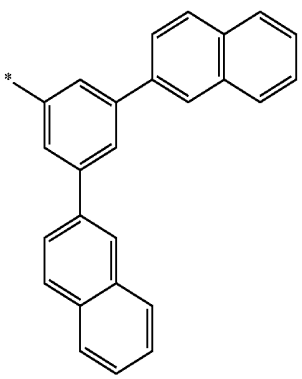

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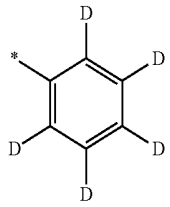

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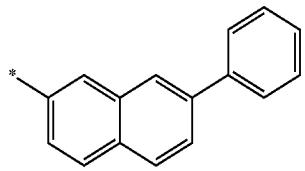

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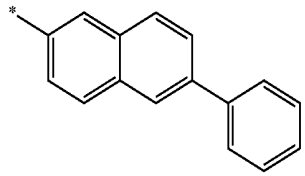

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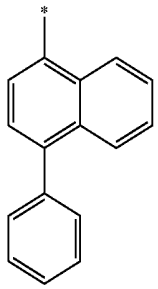

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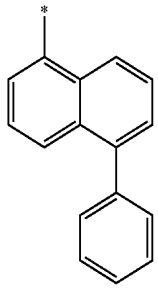

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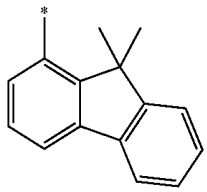

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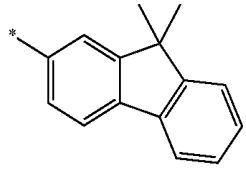

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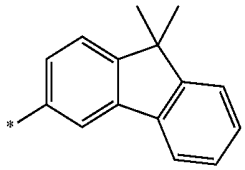

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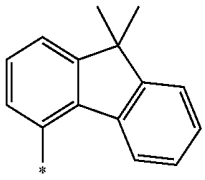

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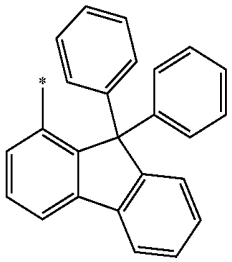

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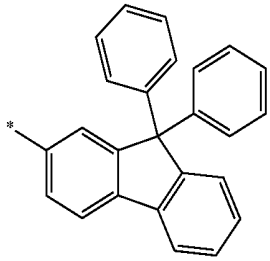

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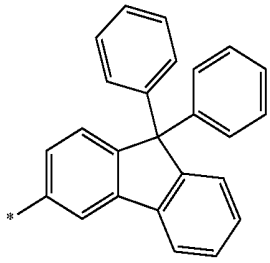

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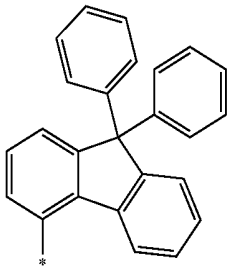

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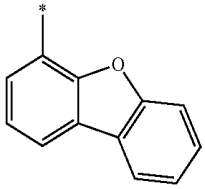

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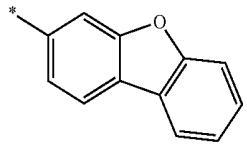

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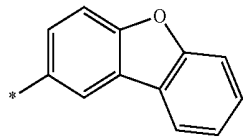

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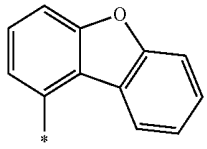

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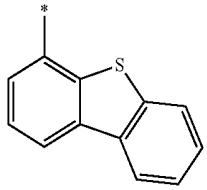

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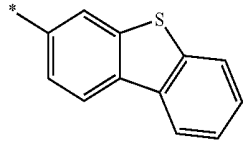

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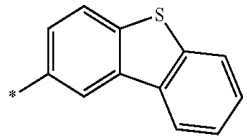

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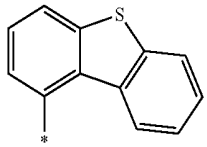

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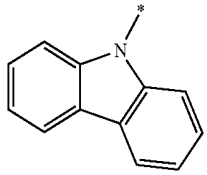


[0123] In Formulae 6-1 to 6-59,

[0124] t-Bu indicates a tert-butyl group;

[0125] Ph indicates a phenyl group; and

[0126] * indicates a binding site to a neighboring atom.

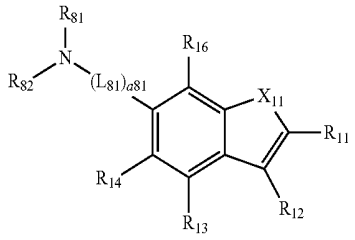
[0127] In an implementation, N, R_{81}, and R_{82} in Formula 8-1 may be bound to form a carbazole group.

[0128] In an implementation, N, R_{83}, and R_{84} in Formula 8-2 may be bound to form a carbazole group.

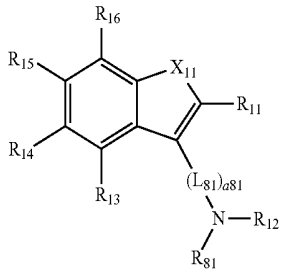
[0129] * in Formulae 8-1 and 8-2 indicates a binding site to a neighboring atom.

[0130] In an implementation, the condensed cyclic compound represented by Formulae 1 or 2 may be, e.g., a compound represented by one of the following Formulae 1-1 to 1-4 and 2-1 to 2-4.

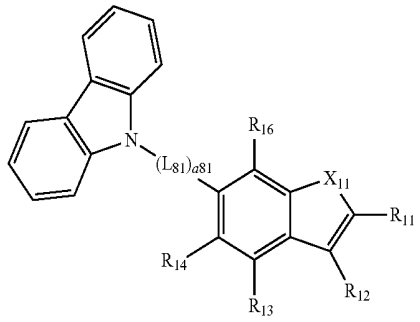
1-1



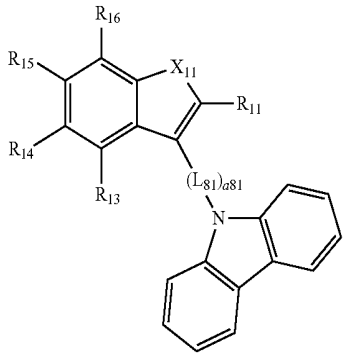
1-2



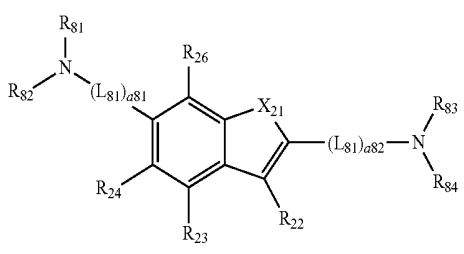
1-3



1-4



2-1



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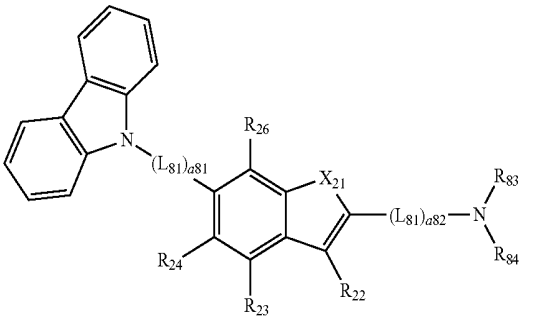
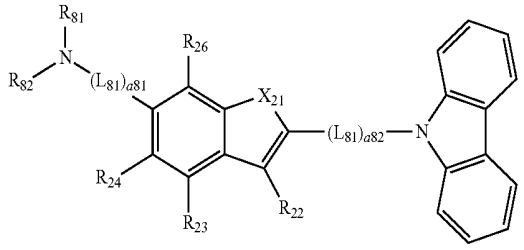
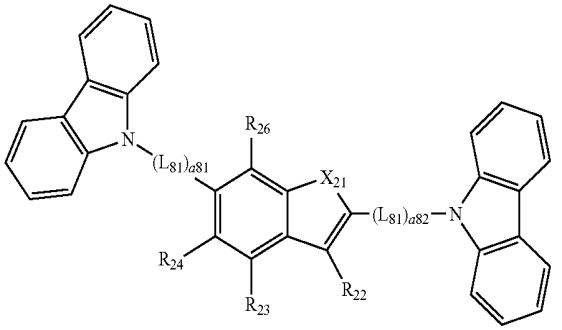
2-2



2-3



2-4



[0131] In Formulae 1-1 to 1-4 and 2-1 to 2-4,

[0132] X_{11} may be selected from, e.g., a sulfur (S) atom, an oxygen (O) atom, and $N(R_{17})$;

[0133] X_{21} may be selected from, e.g., a sulfur (S) atom, an oxygen (O) atom, and $N(R_{27})$;

[0134] R_{11} to R_{16}, R_{17}, R_{22} to R_{24}, R_{26}, and R_{27} may each independently be selected from or include, e.g., a hydrogen, a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a substituted or unsubstituted C_1-C_{60} alkyl group, a substituted or unsubstituted C_2-C_{60} alkenyl group, a substituted or unsubstituted C_2-C_{60} alkynyl group, a substituted or unsubstituted C_1-C_{60} alkoxy group, a substituted or unsubstituted C_3-C_{10} cycloalkyl group, a substituted or unsubstituted 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, and a substituted or unsubstituted monovalent non-aromatic condensed heteropolycyclic group;

[0135] L_{81} and L_{82} may each independently be selected from or include, e.g., 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_{30} arylene group, a substituted or unsubstituted 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;

[0136] a81 and a82 may each independently be selected from, e.g., 0, 1, 2, and 3; and

[0137] R_{81} to R_{84} may each independently be selected from or include, e.g., a substituted or unsubstituted C_1-C_{60} alkyl group, a substituted or unsubstituted C_2-C_{60} alkenyl group, a substituted or unsubstituted C_2-C_{60} alkynyl group, a substituted or unsubstituted C_1-C_{60} alkoxy group, a substituted or unsubstituted C_3-C_{10} cycloalkyl group, a substituted or unsubstituted C_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, and a substituted or unsubstituted monovalent non-aromatic condensed heteropolycyclic group;

[0138] In an implementation, N, R_{81}, and R_{82} may be bound to form a carbazole group.

[0139] In an implementation, N, R_{83}, and R_{84} may be bound to form a carbazole group.

[0140] * indicates a binding site to a neighboring atom.

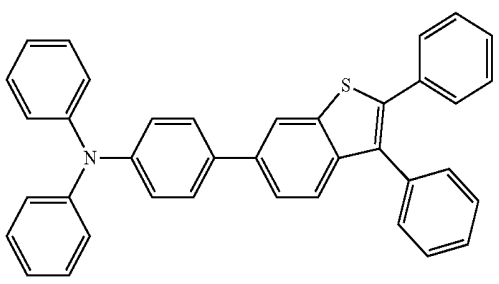
[0141] For example, R_{11} to R_{14}, R_{16}, R_{17}, R_{22} to R_{24}, R_{26}, R_{27}, and R_{81} to R_{84} in Formulae 1-1 to 1-4 and 2-1 to 2-4 may each independently be a group represented by one of Formulae 5-1 to 5-10.

[0142] For example, L_{81} and L_{82} in Formulae 1-1 to 1-4 and 2-1 to 2-4 may each independently be a group represented by one of Formulae 3-1 to 3-11.

[0143] For example, a81 and a82 in Formulae 1-1 to 1-4 and 2-1 to 2-4 may each independently be selected from 0 and 1.

[0144] In an implementation, the condensed cyclic compound represented by Formulae 1 or 2 may be, e.g., one of the following Compounds 1 to 67.

1



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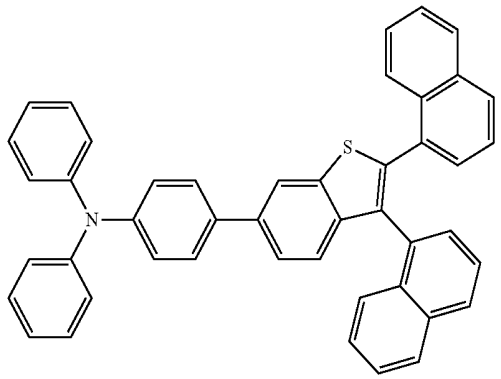
2



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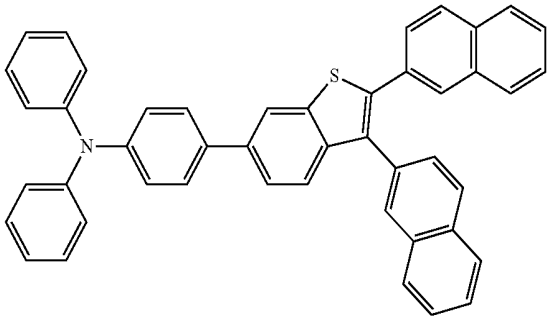

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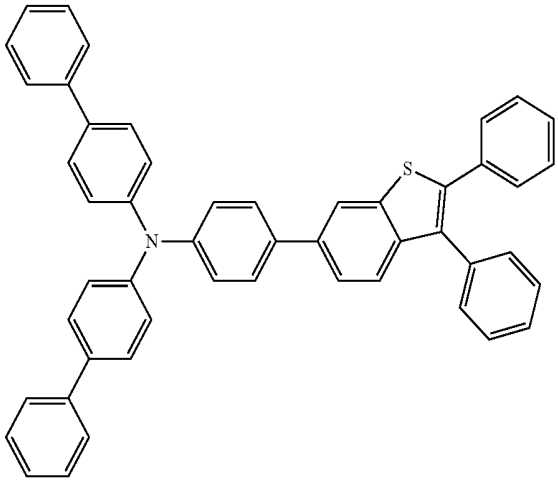

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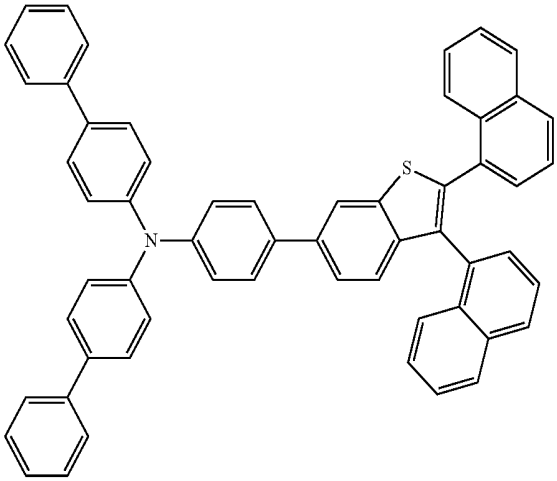

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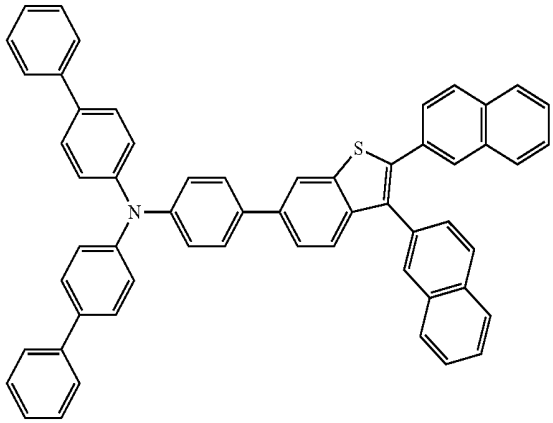

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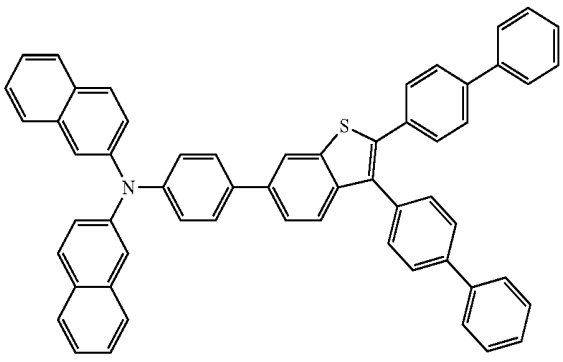

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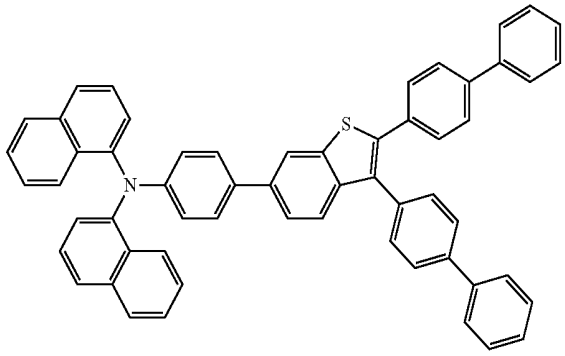

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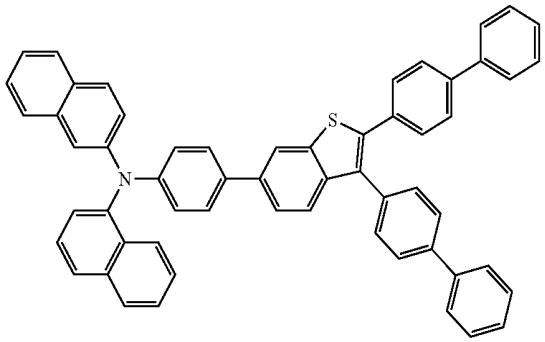

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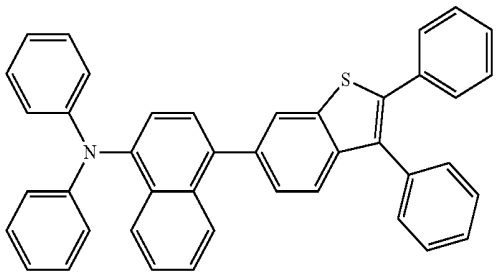

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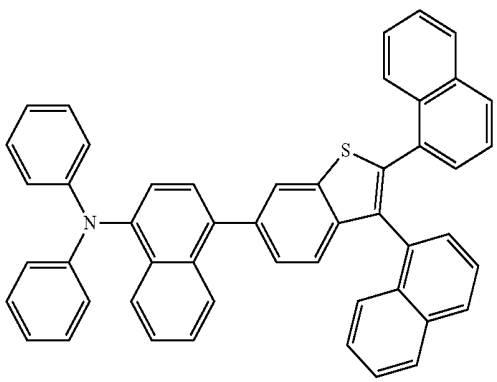

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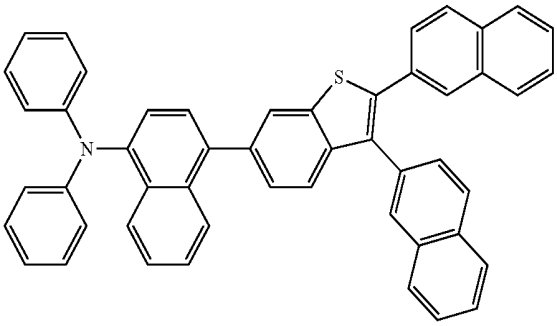

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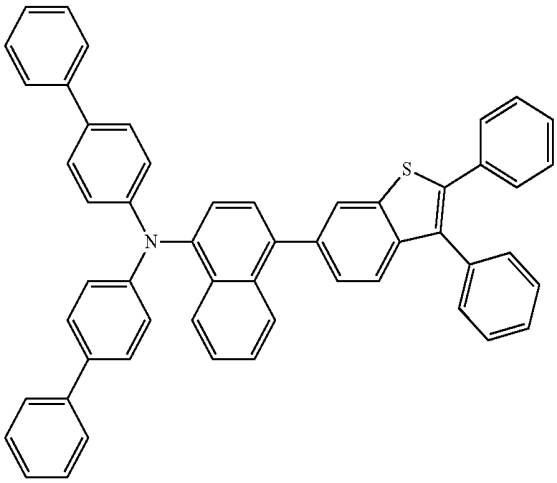

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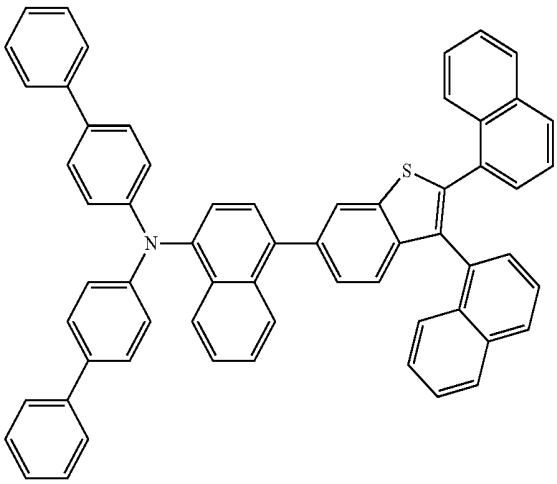

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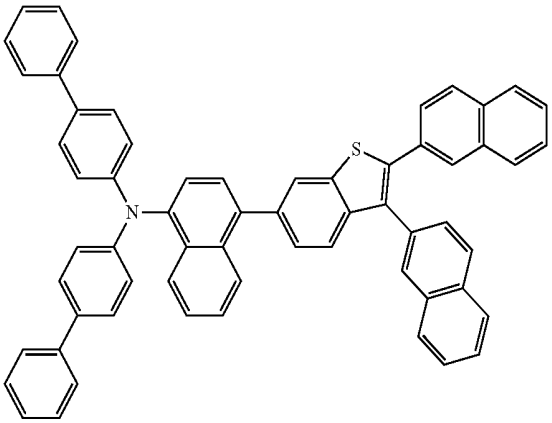

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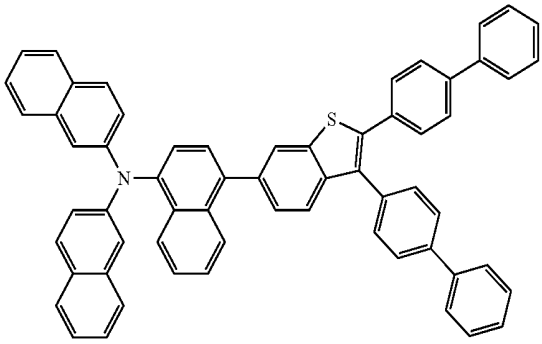

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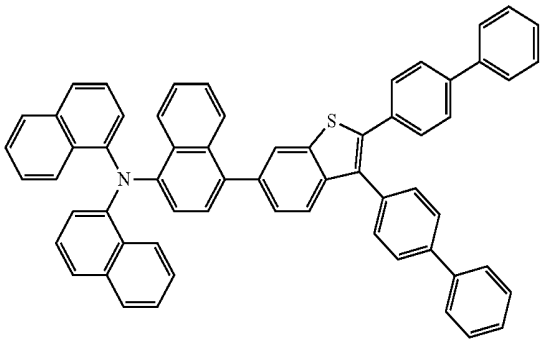

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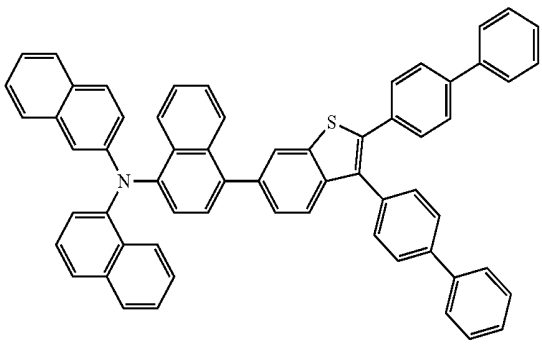

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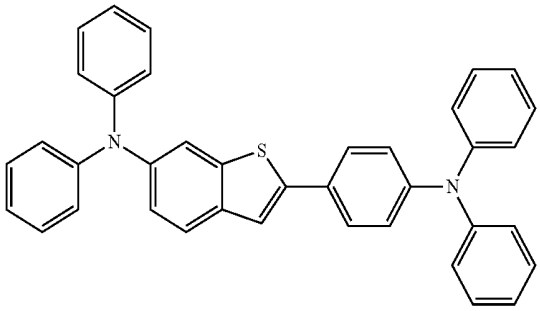

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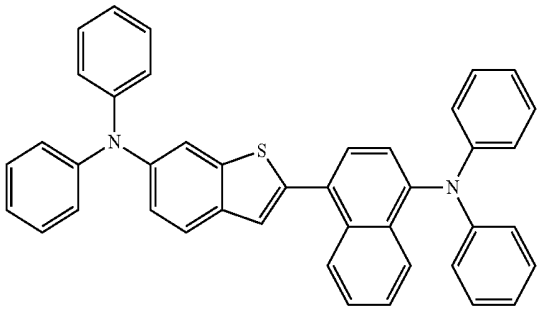

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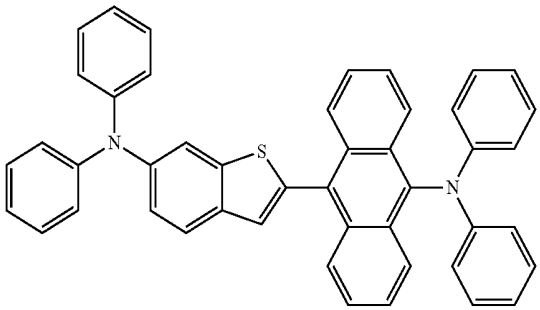

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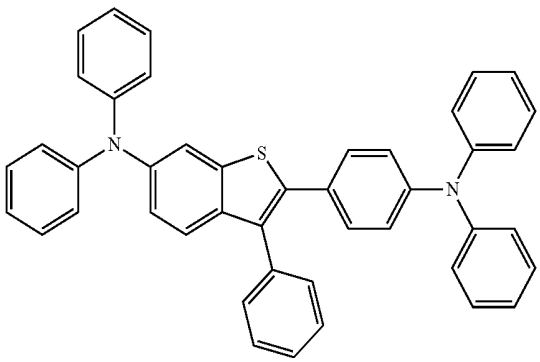

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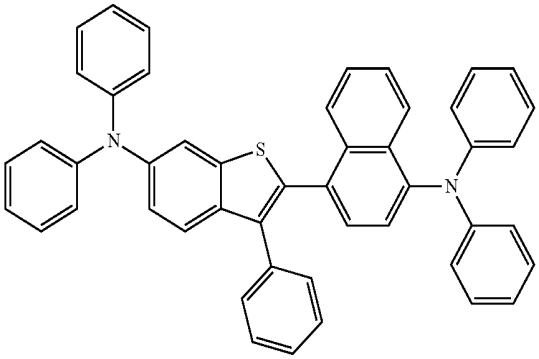

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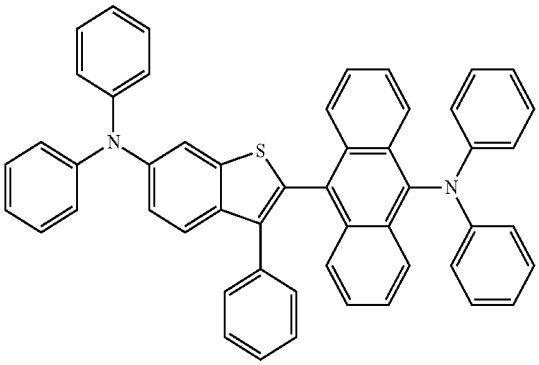

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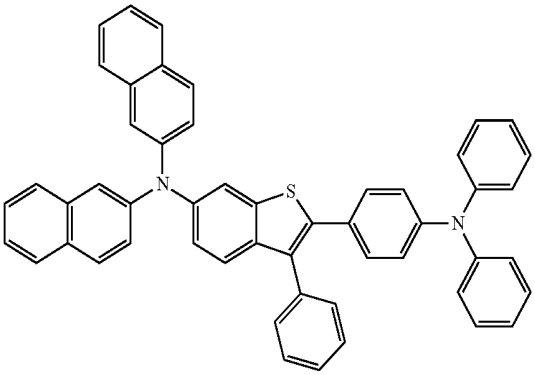

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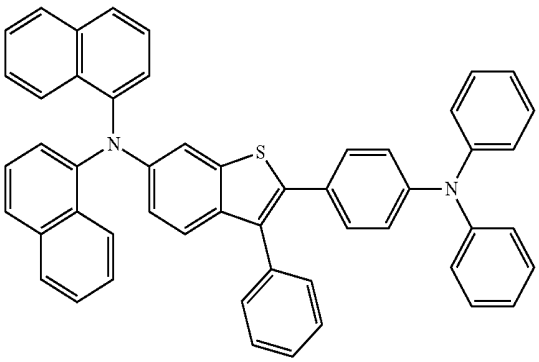

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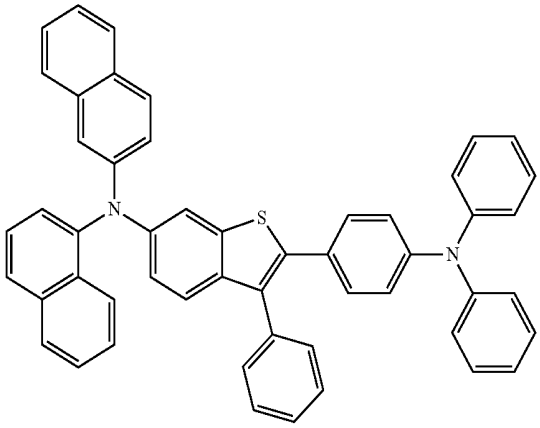

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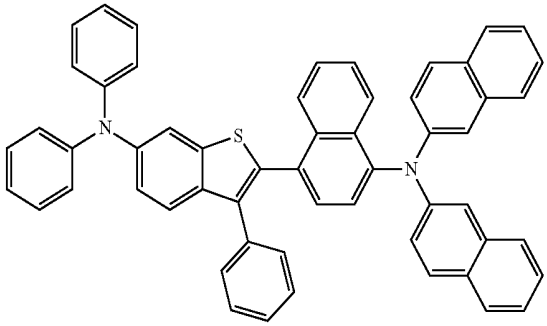

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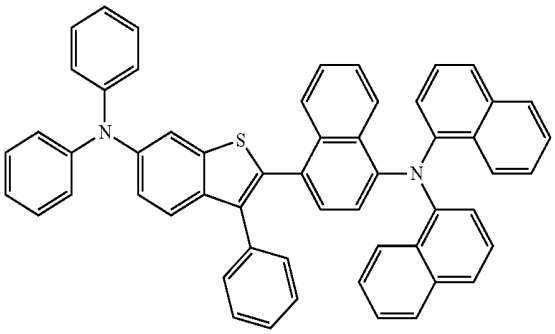

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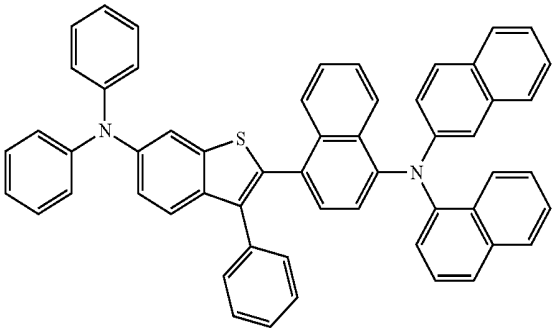

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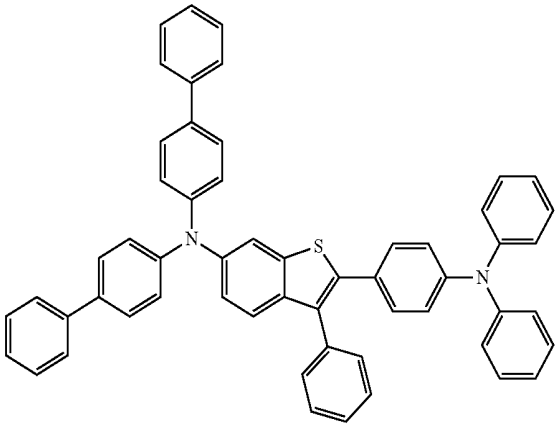

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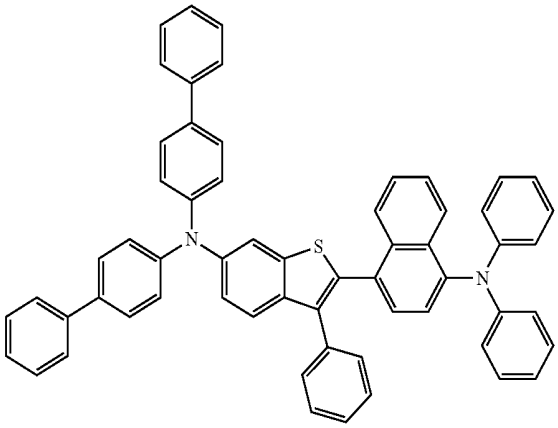

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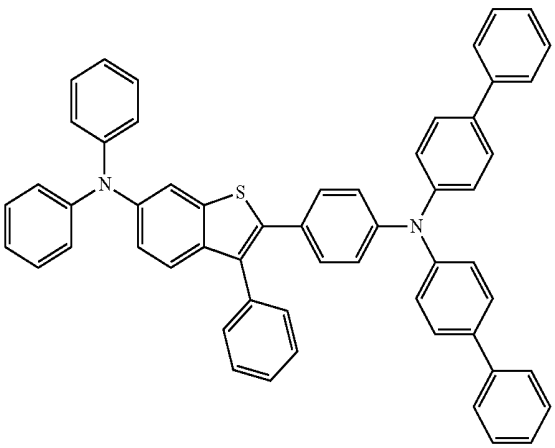

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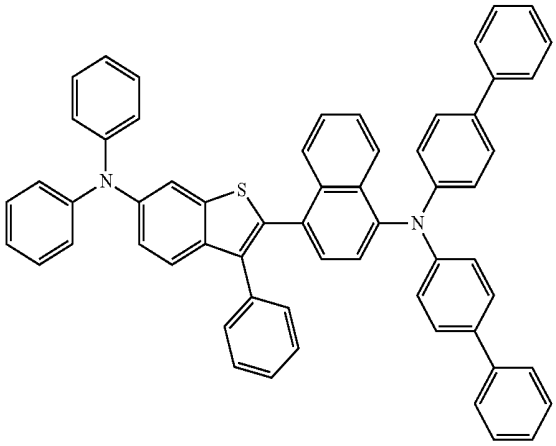

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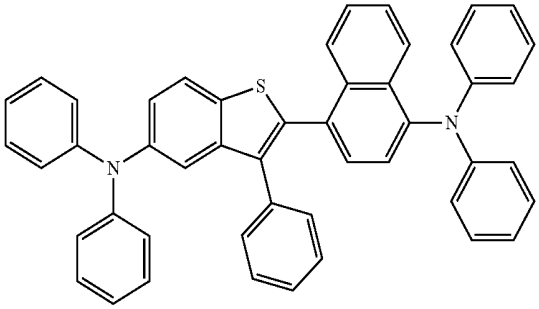

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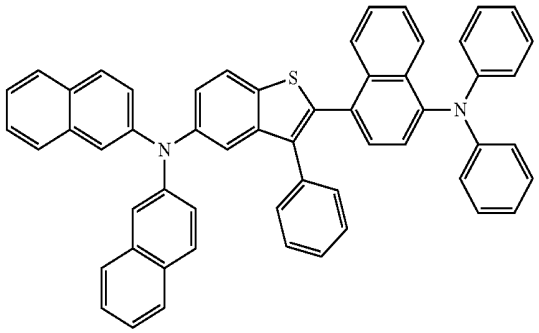

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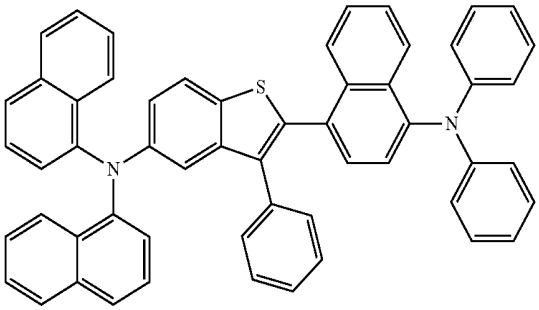

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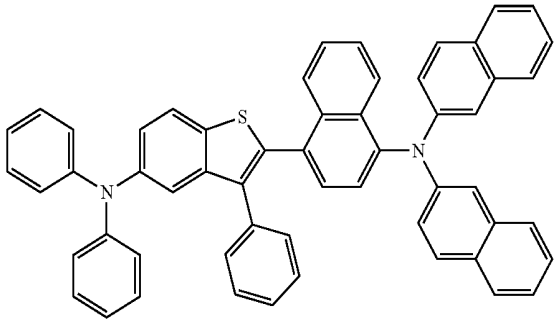

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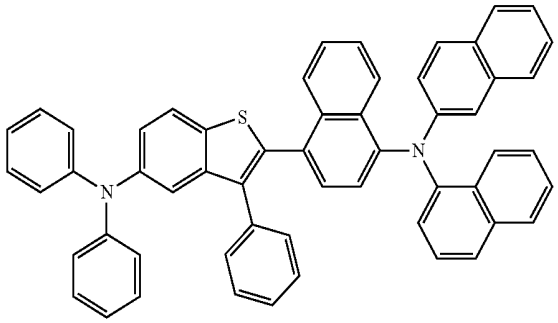

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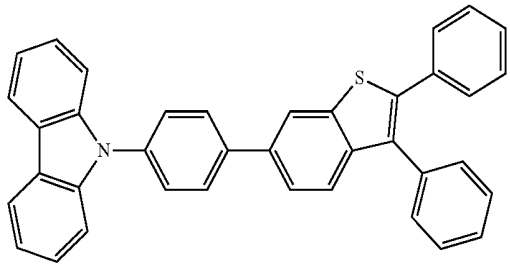

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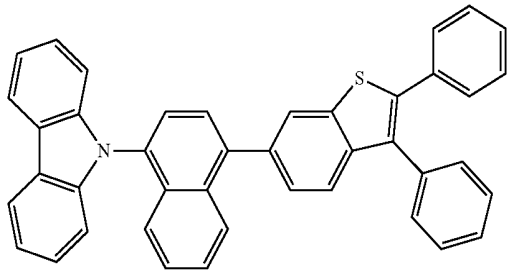

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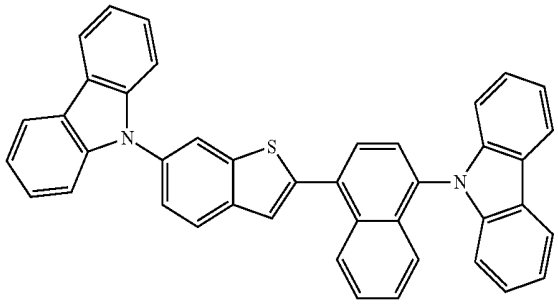

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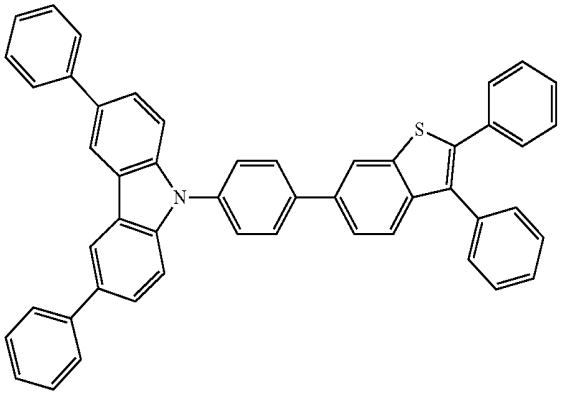

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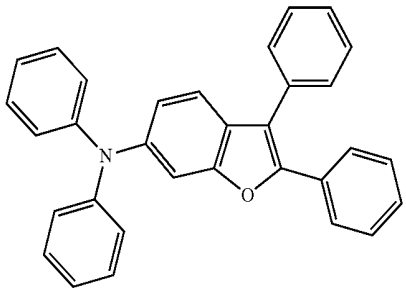

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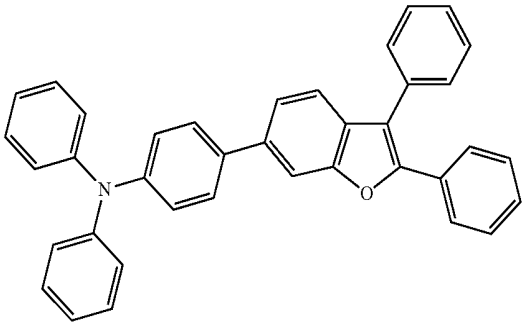

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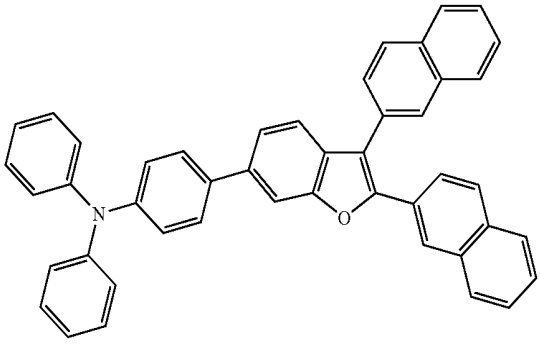

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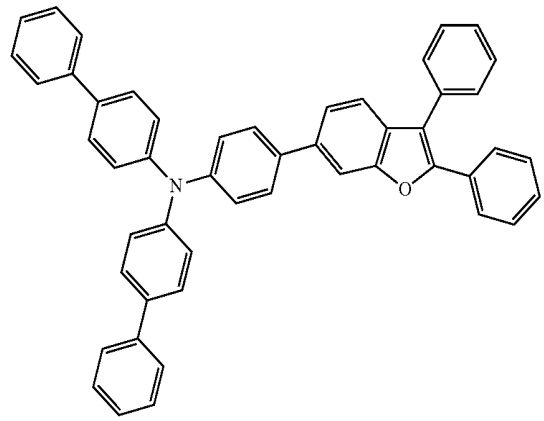

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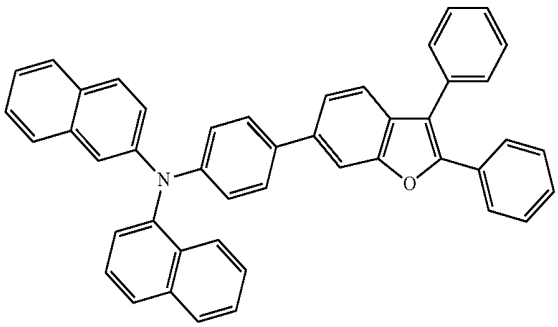

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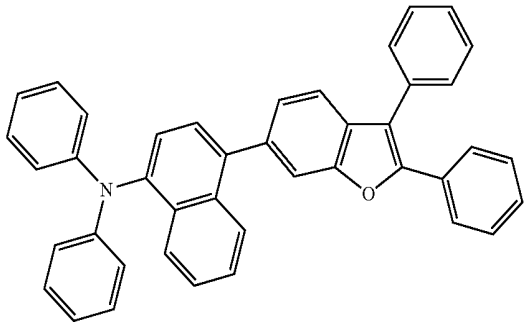

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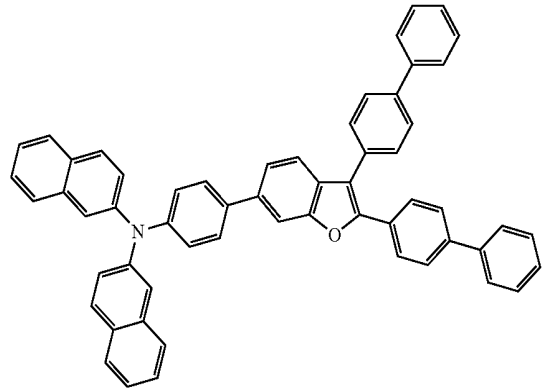

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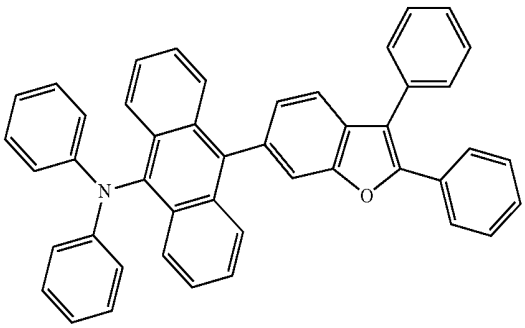

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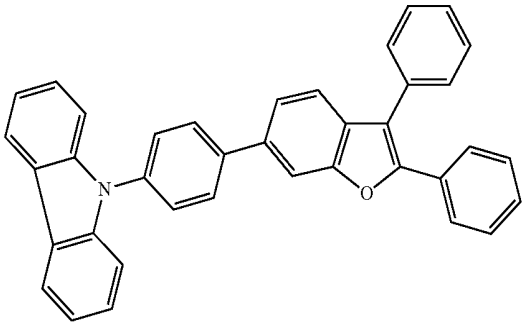

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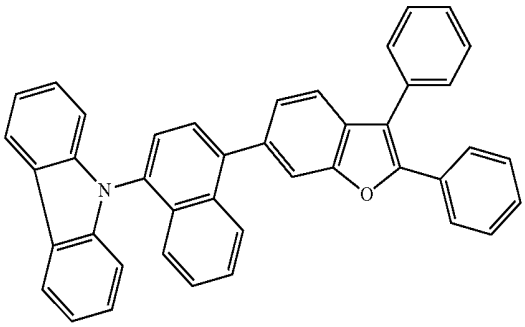

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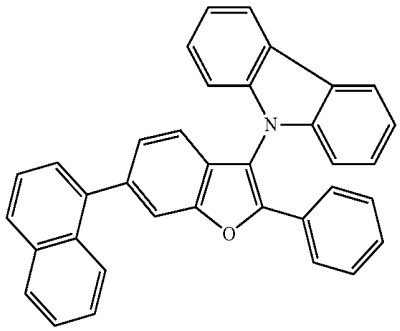

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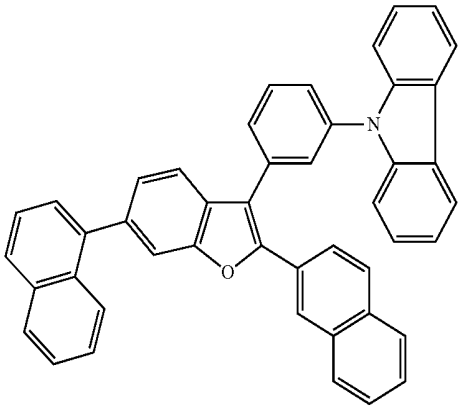

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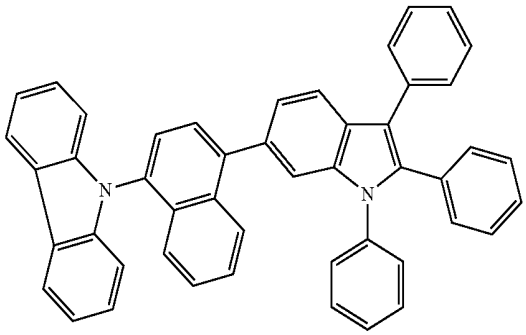

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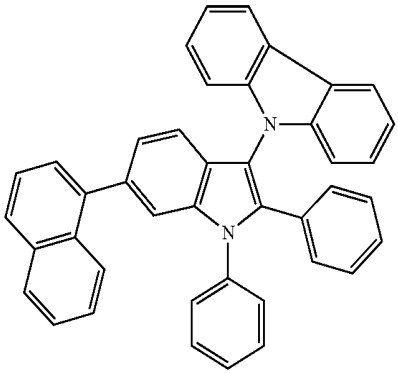

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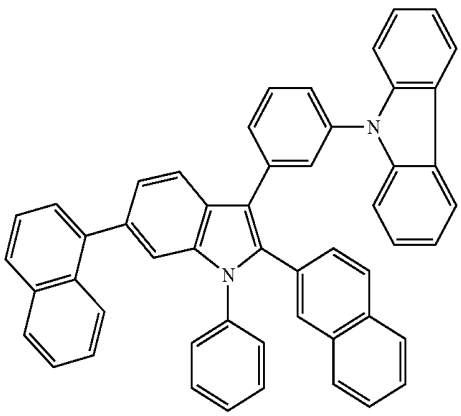

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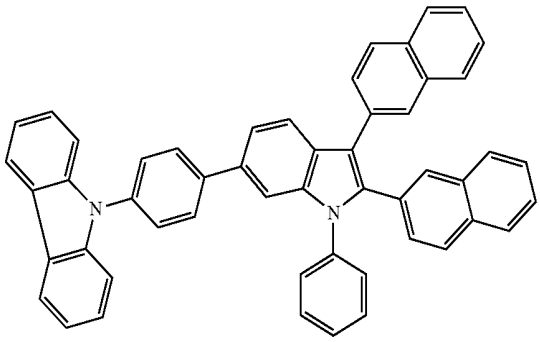

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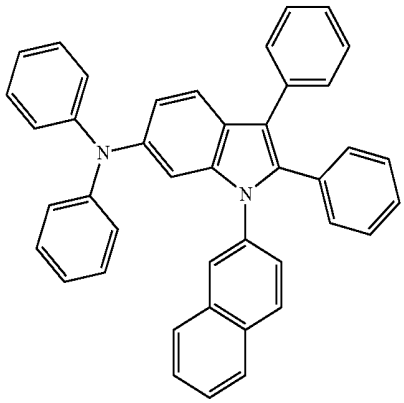

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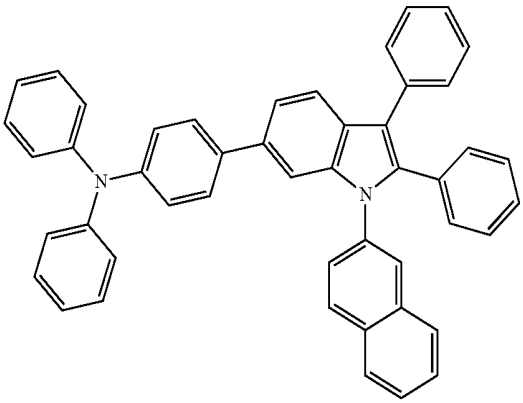

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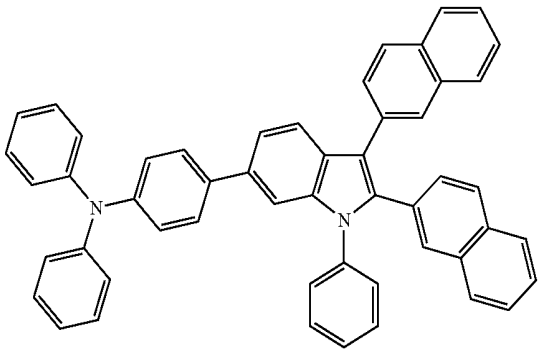

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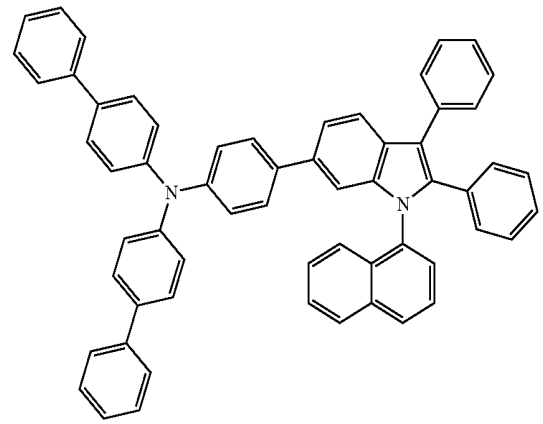

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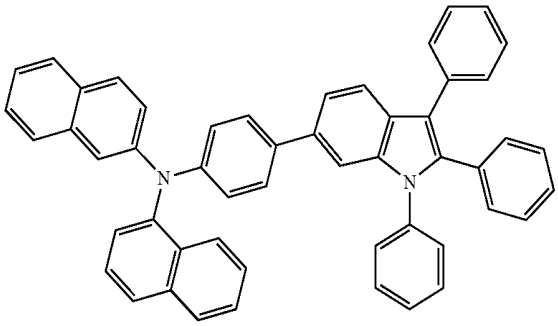

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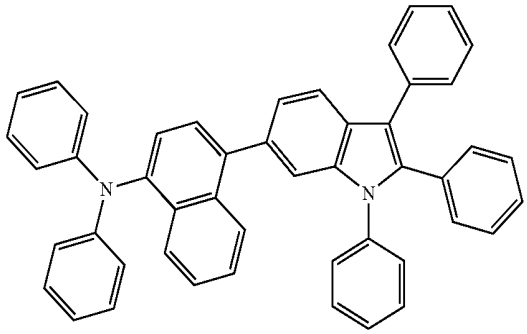

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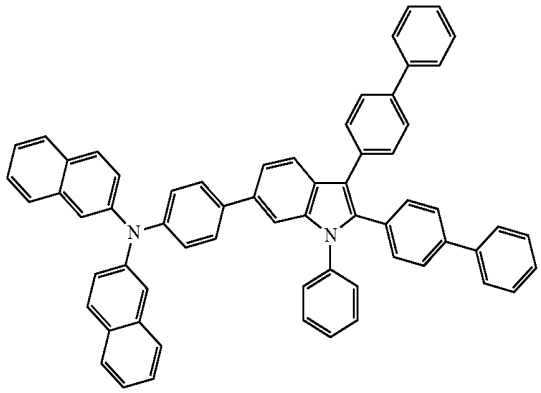

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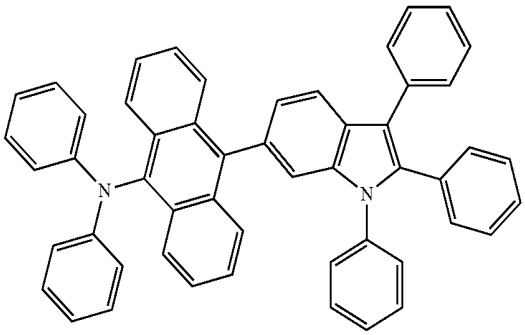
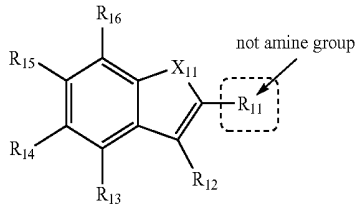


[0145] The condensed cyclic compound represented by Formulae 1 or 2 may have a high electron transport capability and a high hole transport capabiltiy.

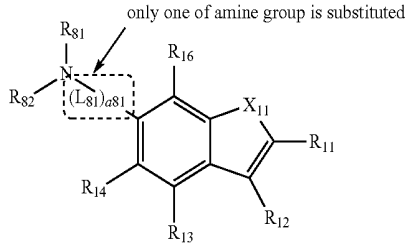
[0146] For example, a second carbon of a benzothiophene, a benzofuran, or an indole may not be substituted with an amine group (see Formula 1'), and the condensed cyclic compound may have high electric stability and high robustness.

<Formula 1'>



[0147] For example, a number of amine groups substituted to a same linker may be controlled to be not greater than one (see Formula 1"), and electric stability of the condensed cyclic compound may be improved.

<Formula 1"'>



[0148] Accordingly, an organic light-emitting device including the condensed cyclic compound represented by Formulae 1 or 2 may have a low driving voltage, high efficiency, high luminance, and a long lifespan.

[0149] The condensed cyclic compound represented by Formulae 1 or 2 may be synthesized by using a suitable organic synthesis method. A synthesis method for the condensed cyclic compound represented by Formulae 1 or 2 may be understood in view of the Examples to be explained below.

[0150] The condensed cyclic compound represented by Formulae 1 or 2 may be used or included between a pair of electrodes included in an organic light-emitting device. An

embodiment may provide an organic light-emitting device including a first electrode; a second electrode; and an organic layer between the first electrode and the second electrode, the organic layer including an emission layer, wherein the organic layer includes at least one of the condensed cyclic compounds represented by Formulae 1 or 2.

[0151] In an implementation, the organic layer may further include a hole transport region between the first electrode and the emission layer; and the hole transport region may include the condensed cyclic compound.

[0152] In an implementation, the organic layer may include a hole transport region between the first electrode and the emission layer; the hole transport region may include a hole transport layer; and the hole transport layer may include the condensed cyclic compound.

[0153] In an implementation; the organic layer may include a hole transport region between the first electrode and the emission layer; the hole transport region may include a hole transport layer and an emission auxiliary layer (that is between the hole transport layer and the emission layer); and the hole transport layer may include the condensed cyclic compound.

[0154] In an implementation, the organic layer may include a hole transport region between the first electrode and the emission layer; the hole transport region may include a hole transport layer and an emission auxiliary layer (that is between the hole transport layer and the emission layer); and the emission auxiliary layer may include the condensed cyclic compound.

[0155] In an implementation, the organic layer may include a hole transport region between the first electrode and the emission layer; the hole transport region may include a hole transport layer and an emission auxiliary layer (that is between the hole transport layer and the emission layer); and each of the hole transport layer and the emission auxiliary layer may include the condensed cyclic compound. In this regard, a condensed cyclic compound included in the hole transport layer may be the same as or different from a condensed cyclic compound the emission auxiliary layer.

[0156] FIG. **1** illustrates a schematic cross-sectional view of an organic light-emitting device **10** according to an embodiment. Hereinafter, the structure of an organic light-emitting device according to an embodiment and a method of manufacturing an organic light-emitting device according to an embodiment will be described in connection with FIG. **1**.

[0157] In FIG. **1**, a substrate may be additionally disposed under the first electrode **110** or above the second electrode **190**. The substrate may be a glass substrate or transparent plastic substrate, each with excellent mechanical strength, thermal stability, transparency, surface smoothness, ease of handling, and water-resistance.

[0158] The first electrode **110** may be formed by depositing or sputtering a material for forming the first electrode on the substrate. When the first electrode **110** is an anode, the material for the first electrode **110** may be selected from materials with a high work function to facilitate hole injection. The first electrode **110** may be a reflective electrode or a transmissive electrode. The material for the first electrode **110** may be a transparent and highly conductive material, and examples of such a material may include indium tin oxide (ITO), indium zinc oxide (IZO), tin oxide (SnO_2), and zinc oxide (ZnO). When the first electrode **110** is a semi-transmissive electrode or a reflective electrode, as a material for forming the first electrode, at least one of magnesium (Mg), aluminum (Al), aluminum-lithium (Al—Li), calcium (Ca), magnesium-indium (Mg—In), magnesium-silver (Mg—Ag) may be used.

[0159] The first electrode **110** may have a single-layer structure, or a multi-layer structure including two or more layers. For example, the first electrode **110** may have a three-layered structure of ITO/Ag/ITO.

[0160] An organic layer **150** may be disposed on the first electrode **110**. The organic layer **150** may include an emission layer **160**.

[0161] The organic layer **150** may further include a hole transport region **130** between the first electrode and the emission layer. The organic layer **150** may further include an electron transport region **180** between the emission layer and the second electrode.

[0162] The hole transport region **130** may include, e.g., at least one selected from a hole injection layer (HIL), a hole transport layer (HTL), an emission auxiliary layer **140**, and an electron blocking layer (EBL). The electron transport region **180** may include, e.g., at least one selected from a hole blocking layer (HBL), an electron transport layer (ETL), and an electron injection layer (EIL).

[0163] The hole transport region may have a single-layered structure formed of a single material, a single-layered structure formed of a plurality of different materials, or a multi-layered structure having a plurality of layers formed of a plurality of different materials.

[0164] For example, the hole transport region may have a single-layered structure formed of a plurality of different materials, or a structure of hole injection layer/hole transport layer, a structure of hole injection layer/hole transport layer/emission auxiliary layer, a structure of hole injection layer/emission auxiliary layer, or a structure of hole transport layer/emission auxiliary layer, wherein layers of each structure are sequentially stacked from the first electrode **110** in this stated order.

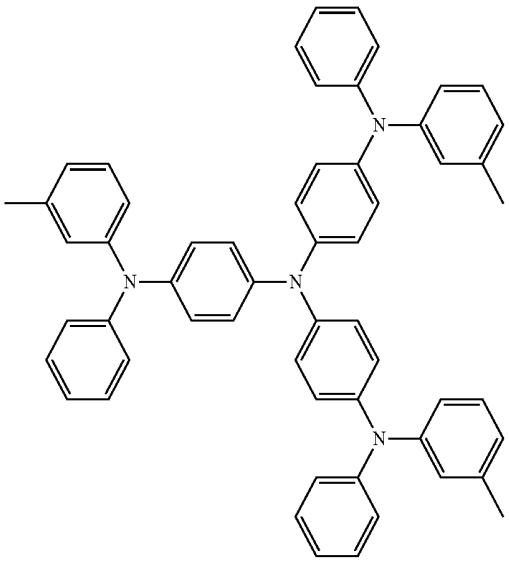
[0165] When the hole transport region includes a hole injection layer, the hole injection layer may be formed on the first electrode **110** by using various methods, e.g., vacuum deposition, spin coating casting, a Langmuir-Blodgett (LB) method, ink-jet printing, laser-printing, or laser-induced thermal imaging.

[0166] When a hole injection layer is formed by vacuum deposition, for example, the vacuum deposition may be performed at a temperature of a deposition temperature of about 100 to about 500° C., at a vacuum degree of about 10^{-8} to about 10^{-3} torr, and/or at a deposition rate of about 0.01 to about 100 Å/sec in consideration of a compound for a hole injection layer to be deposited, and the structure of a hole injection layer to be formed.

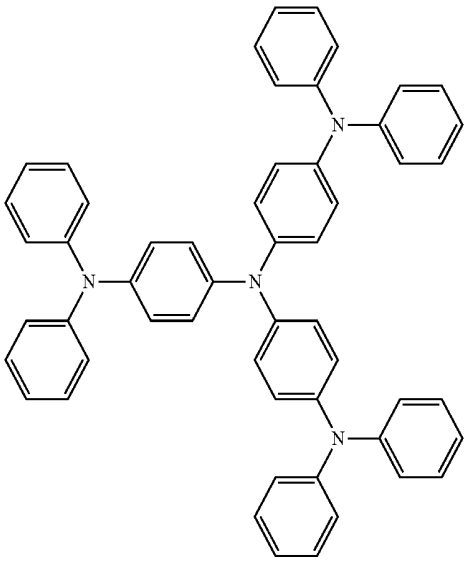
[0167] When a hole injection layer is formed by spin coating, the spin coating may be performed at a coating rate of about 2,000 rpm to about 5,000 rpm, and/or at a temperature of about 80° C. to 200° C. in consideration of a compound for a hole injection layer to be deposited, and the structure of a hole injection layer to be formed.

[0168] When the hole transport region includes a hole transport layer, the hole transport layer may be formed on the first electrode **110** or the hole injection layer by using various methods, e.g., vacuum deposition, spin coating, casting, a LB method, ink-jet printing, laser-printing, or laser-induced thermal imaging. When the hole transport layer is formed by vacuum deposition or spin coating, deposition and coating conditions for the hole transport layer may be the same as the deposition and coating conditions for the hole injection layer.

[0169] The hole transport region may include the compound represented by Formulae 1 or 2 and/or may include at least one selected from m-MTDATA, TDATA, 2-TNATA, NPB, β-NPB, TPD, Spiro-TPD, Spiro-NPB, α-NPB, TAPC, HMTPD, 4,4',4"-tris(N-carbazolyl)triphenylamine (TCTA), polyaniline/dodecylbenzenesulfonic acid (PANI/DBSA), poly(3,4-ethylenedioxythiophene)/poly(4-styrenesulfonate) (PEDOT/PSS), polyaniline/camphor sulfonicacid (PANI/CSA), (polyaniline)/poly(4-styrenesulfonate) (PANI/PSS), a compound represented by Formula 201 below, and a compound represented by Formula 202 below.



m-MTDATA



TDATA

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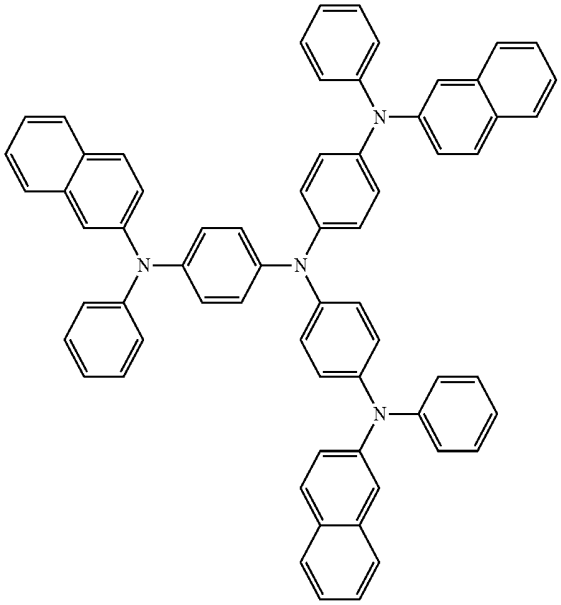
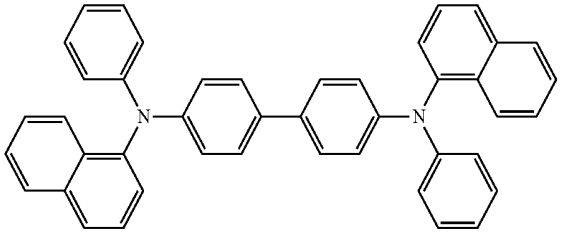
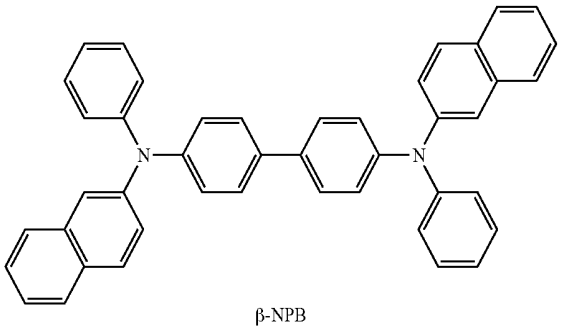


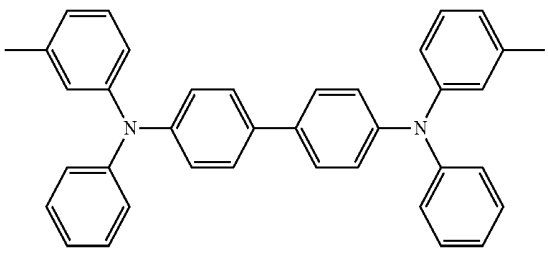
2-TNATA



NPB



β-NPB



TPD

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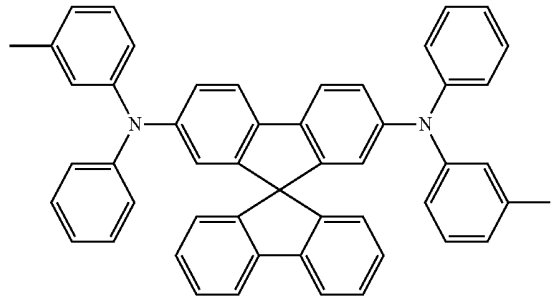
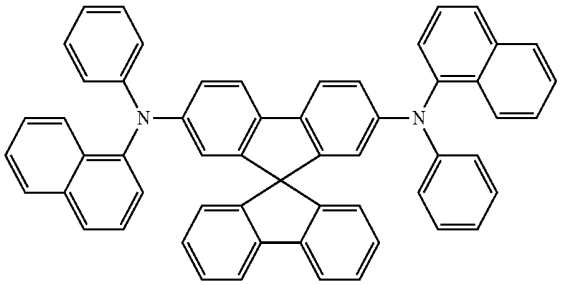
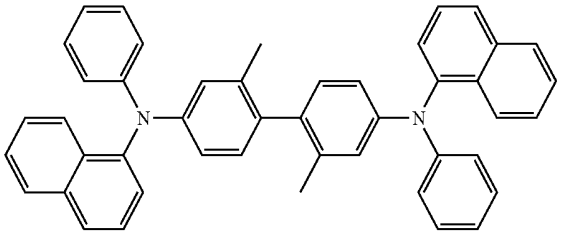


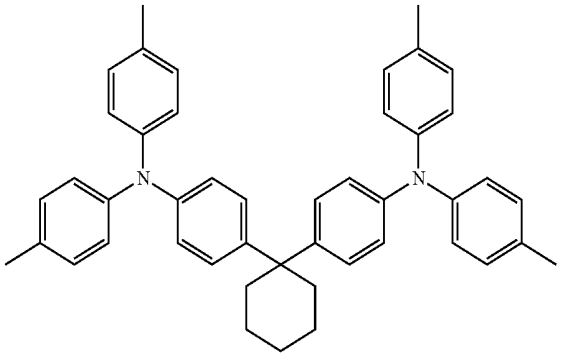
Spiro-TPD



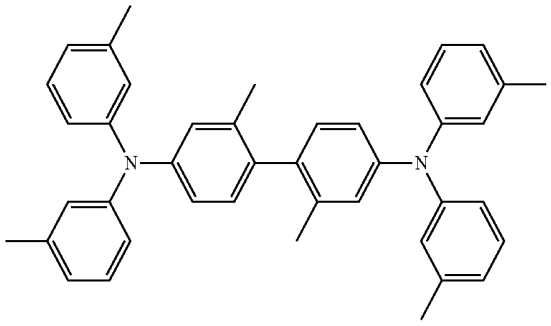
Spiro-NPB



methylated NPB



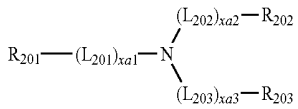
TAPC



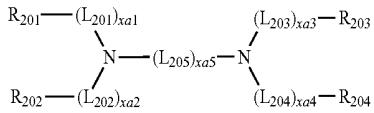
HMTPD

-continued

<Formula 201>



<Formula 202>



[0170] In Formulae 201 and 202,

[0171] L_{201} to L_{205} may be understood by referring to the description provided herein in connection with L_{81};

[0172] xa1 to xa4 may each independently be selected from 0, 1, 2, and 3;

[0173] xa5 may be selected from 1, 2, 3, 4, and 5; and

[0174] R_{201} to R_{205} may be understood by referring to the description provided herein in connection with R_{11};

[0175] In some embodiments, in Formulae 201 and 202,

[0176] L_{201} to L_{205} may each independently be selected from:

[0177] a phenylene group, a naphthylene group, a fluorenylene group, a spiro-fluorenylene group, a benzofluorene group, a dibenzofluorene group, a phenanthrenylene group, an anthracenylene group, a pyrenylene group, a chrysenylene group, a pyridinylene group, a pyrazinylene group, a pyrimidinylene group, a pyridazinylene group, a quinolinylene group, an isoquinolinylene group, a quinoxalinylene group, a quinazolinylene group, a carbazolylene group, and a triazinylene group; and

[0178] a phenylene group, a naphthylenylene group, a fluorenylene group, a spiro-fluorenylene group, a benzofluorenylene group, a dibenzofluorenylene group, a phenanthrenylene group, an anthracenylene group, a pyrenylene group, a chrysenylene group, a pyridinylene group, a pyrazinylene group, a pyrimidinylene group, a pyridazinylene group, a quinolinylene group, an isoquinolinylene group, a quinoxalinylene group, a quinazolinylene group, a carbazolylene group, and a triazinylene group, each substituted with at least one selected from a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, and a triazinyl group;

[0179] xa1 to xa4 may each independently be 0, 1, or 2;

[0180] xa5 may be 1, 2, or 3;

[0181] R_{201} to R_{205} may each independently be selected from:

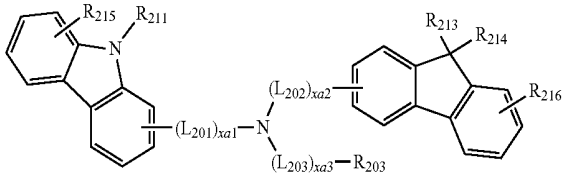
[0182] a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a

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

[0183] a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, and a triazinyl group, each substituted with at least one selected from a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a phenyl group, a naphthyl group, an azulenyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, and a triazinyl group.

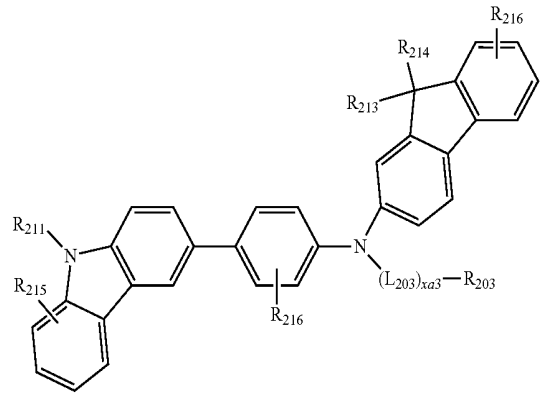
[0184] A first hole transport compound represented by Formula 201 may be represented by Formula 201A.

<Formula 201A>



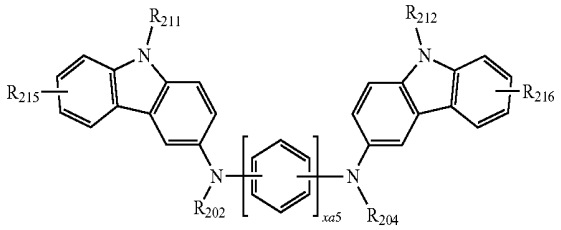
[0185] For example, the first hole transport compound represented by Formula 201 may be represented by Formula 201A-1 below.

<Formula 201A-1>



[0186] For example, the first hole transport compound represented by Formula 202 may be represented by Formula 202A below.

<Formula 202A>



[0187] L_{201} to L_{203}, xa1 to xa3, xa5, and R_{202} to R_{204} in Formulae 201A, 201A-1 and 202A are already described in detail above, and R_{211} and R_{212} may be understood by referring to the description provided herein in connection with R_{203}, and R_{213} to R_{216} may each independently be selected from a hydrogen, a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{60} alkyl group, a C_2-C_{60} alkenyl group, a C_2-C_{60} alkynyl group, a C_1-C_{60} alkoxy group, a C_3-C_{10} cycloalkyl group, a C_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.

[0188] For example, L_{201} to L_{203} in Formulae 201A, 201A-1 and 202A may each independently be selected from:

[0189] a phenylene group, a naphthylenylene group, a fluorenylene group, a spiro-fluorenylene group, a benzofluorenylene group, a dibenzofluolenylene group, a phenanthrenylene group, an anthracenylene group, a pyrenylene group, a chrysenylene group, a pyridinylene group, a pyrazinylene group, a pyrimidinylene group, a pyridazinylene group, a quinolinylene group, an isoquinolinylene group, a quinoxalinylene group, a quinazolinylene group, a carbazolylene group, and a triazinylene group; and

[0190] a phenylene group, a naphthylenylene group, a fluorenylene group, a spiro-fluorenylene group, a benzofluorenylene group, a dibenzofluolenylene group, a phenanthrenylene group, an anthracenylene group, a pyrenylene group, a chrysenylene group, a pyridinylene group, a pyrazinylene group, a pyrimidinylene group, a pyridazinylene group, a quinolinylene group, an isoquinolinylene group, a quinoxalinylene group, a quinazolinylene group, a carbazolylene group, and a triazinylene group, each substituted with at least one selected from a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl

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

[0191] xa1 to xa3 may each independently be 0 or 1;

[0192] R_{203}, R_{211}, and R_{212} may each independently be selected from:

[0193] a methyl group, an ethyl group, an n-propyl group, a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, and a triazinyl group; and

[0194] a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, and a triazinyl group, each substituted with at least one selected from a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, and a triazinyl group; and

[0195] R_{213} and R_{214} may each independently be selected from:

[0196] a C_1-C_{20} alkyl group and a C_1-C_{20} alkoxy group;

[0197] a C_1-C_{20} alkyl group and a C_1-C_{20} alkoxy group, each substituted with at least one selected from a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, and a triazinyl group;

[0198] a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, and a triazinyl group; and

[0199] a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, and a triazinyl group, each substituted with at least one selected from a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, and a triazinyl group; and

[0200] R_{215} and R_{216} may each independently be selected from:

[0201] a hydrogen, a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, and a phosphoric acid group or a salt thereof,

[0202] a C_1-C_{20} alkyl group and a C_1-C_{20} alkoxy group;

[0203] a C_1-C_{20} alkyl group and a C_1-C_{20} alkoxy group, each substituted with at least one selected from a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, and a triazinyl group;

[0204] a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, and a triazinyl group; and

[0205] a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, and a triazinyl group, each substituted with at least one selected from a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl

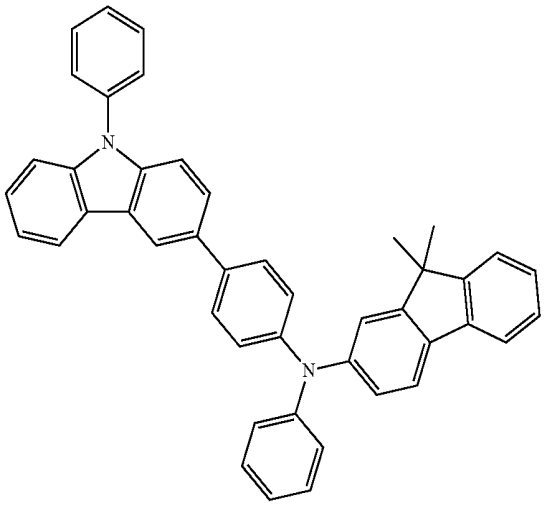
group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, and a triazinyl group; and

[0206] xa5 is 1 or 2.

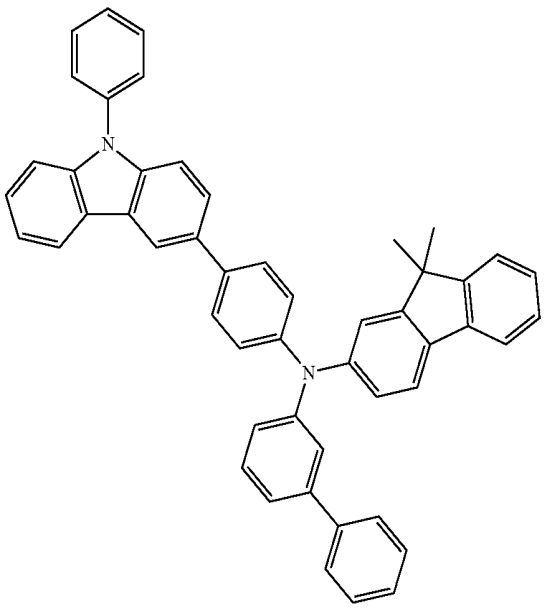
[0207] In an implementation, R_{213} and R_{214} in Formulae 201A, and 201A-1 may bind to each other to form a saturated or unsaturated ring.

[0208] The compound represented by Formula 201, and/or the compound represented by Formula 202 may include compounds HT1 to HT20 illustrated below.

HT1



HT2



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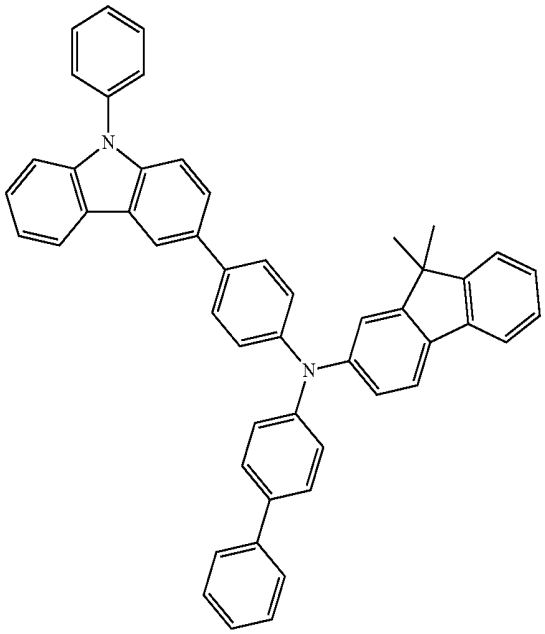
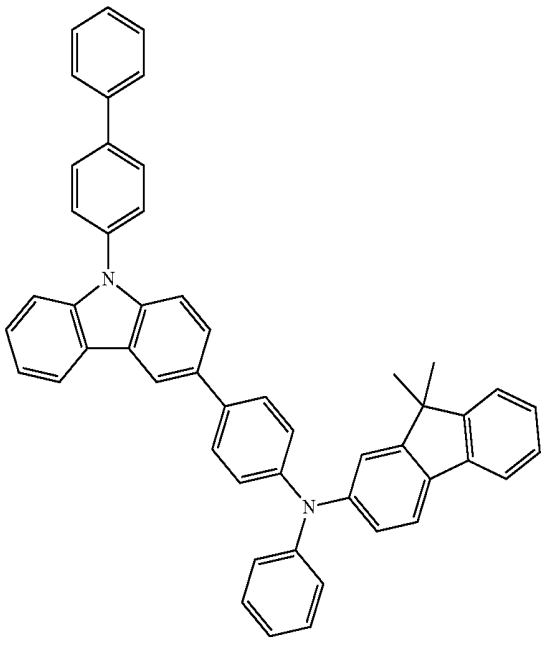
HT3



HT4



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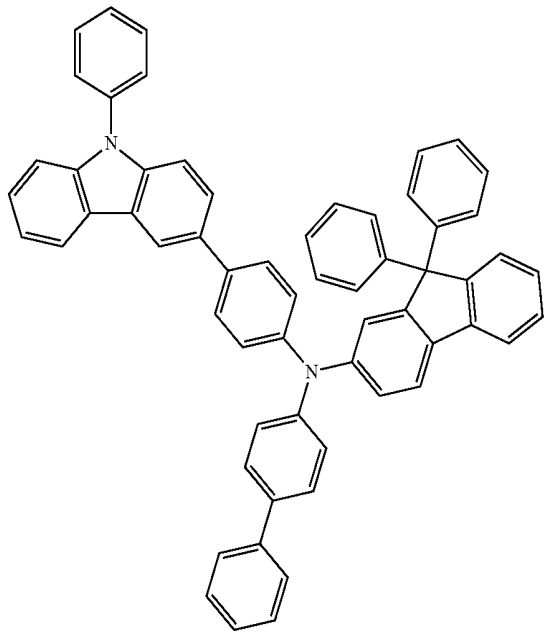
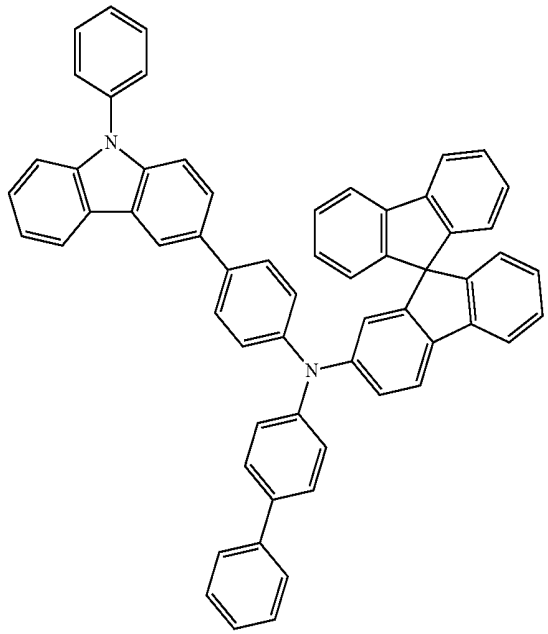
HT5



HT6



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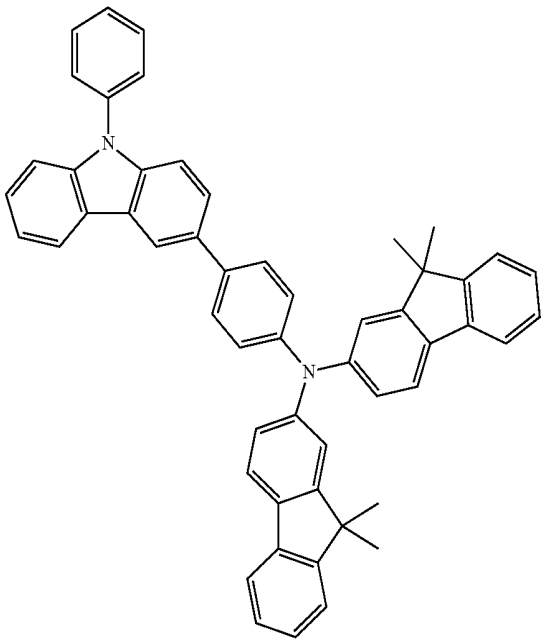
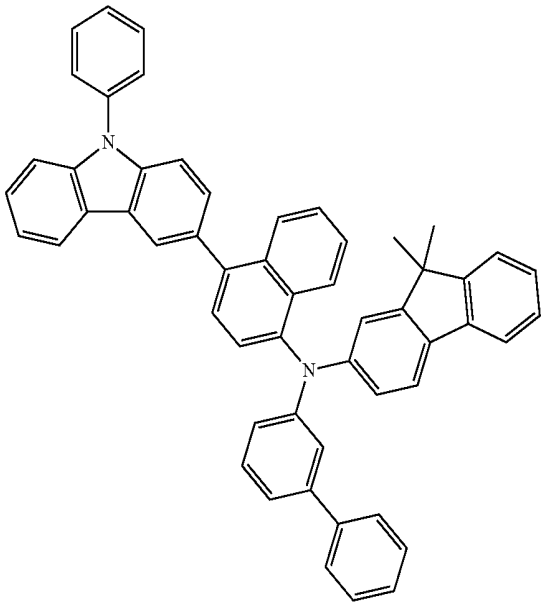
HT7



HT8



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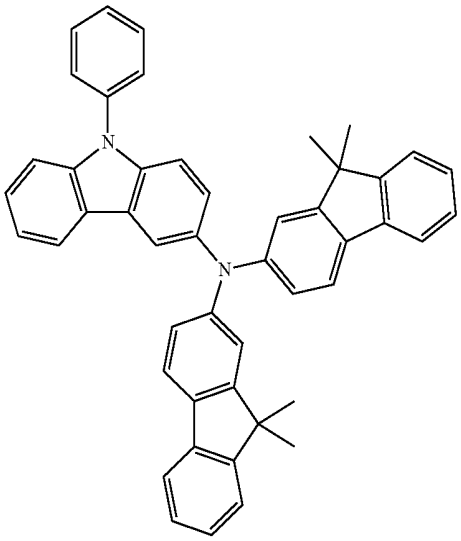
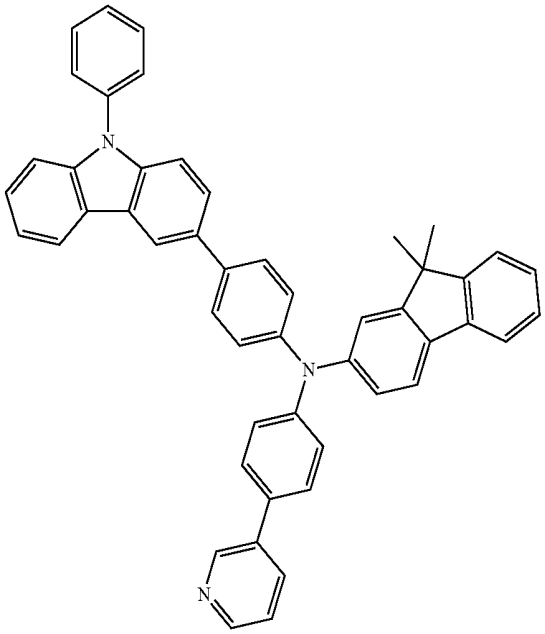
HT9



HT10



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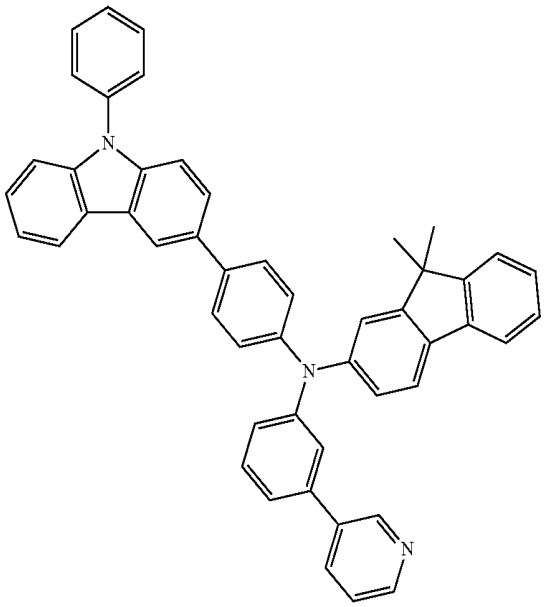
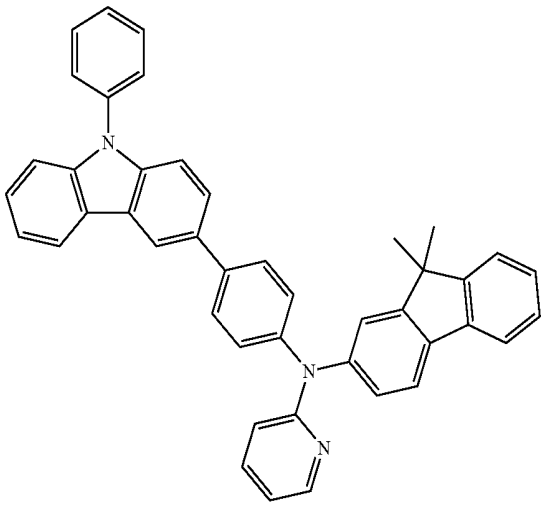
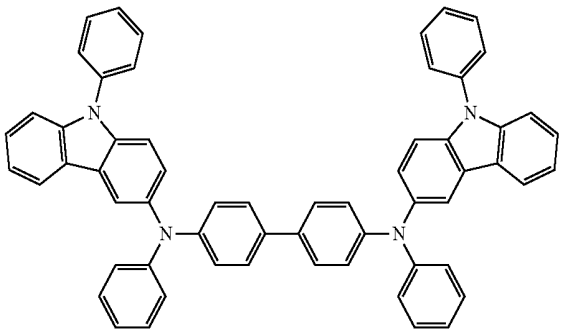
HT11



HT12



HT13



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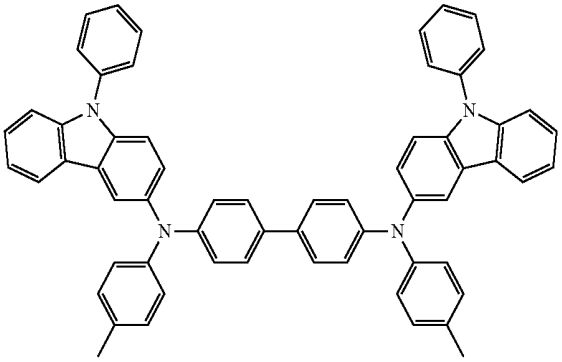
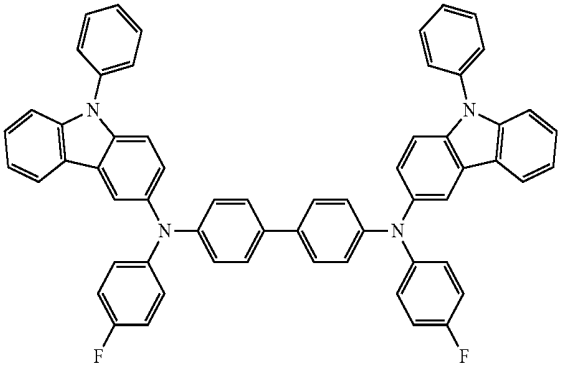
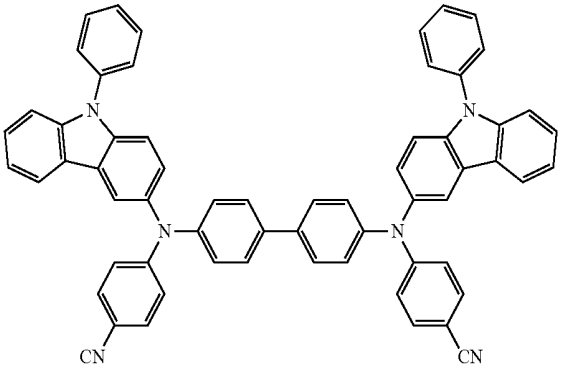
HT14



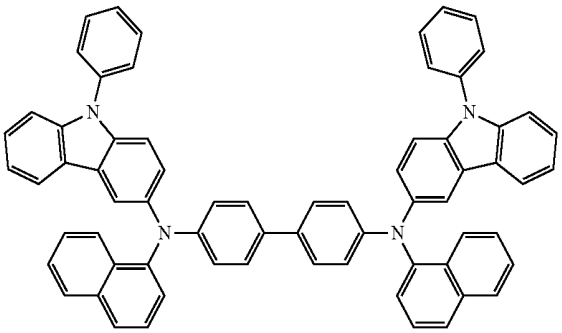
HT15



HT16



HT17



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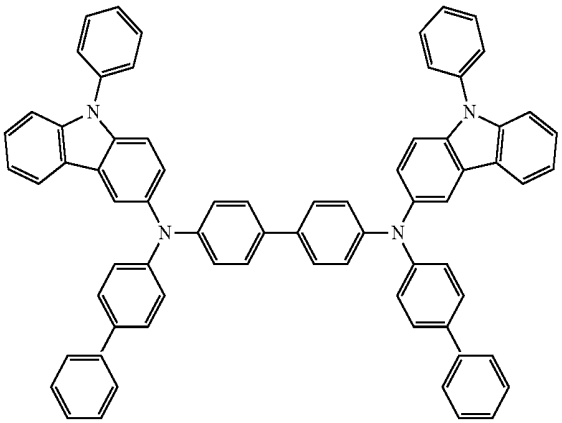
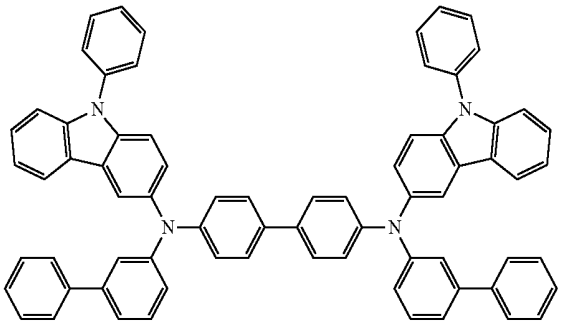
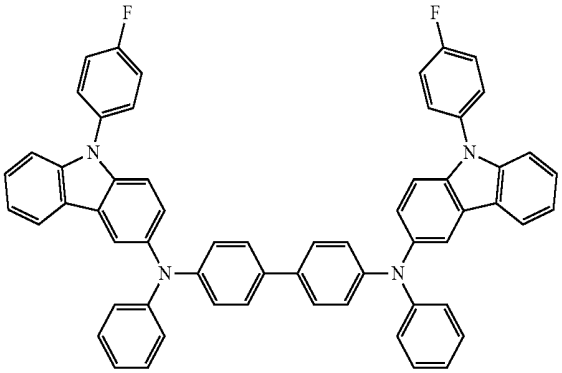
HT18



HT19



HT20

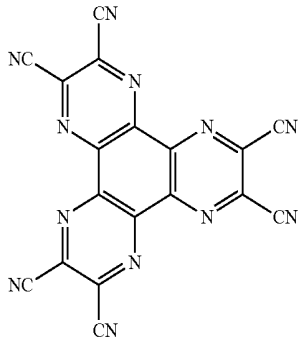


[0209] A thickness of the hole transport region may be in a range of about 100 Å to about 10,000 Å, e.g., about 100 Å to about 1000 Å. When the hole transport region includes both a hole injection layer and a hole transport layer, a thickness of the hole injection layer may be in a range of about 100 Å to about 10,000 Å, e.g., about 100 Å to about 1,000 Å, and a thickness of the hole transport layer may be in a range of about 50 Å to about 2,000 Å, e.g., about 100 Å to about 1,500 Å. When the thicknesses of the hole transport region, the hole injection layer, and the hole transport layer are within these ranges, satisfactory hole transporting characteristics may be obtained without a substantial increase in driving voltage.

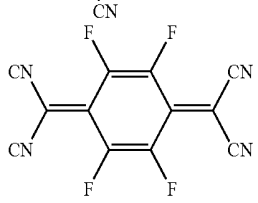
[0210] The hole transport region may further include, in addition to these materials, a charge-generation material for the improvement of conductive properties. The charge-generation material may be homogeneously or unhomogeneously dispersed in the hole transport region.

[0211] The charge-generation material may be, e.g., a p-dopant. The p-dopant may include one selected from a quinone derivative, a metal oxide, and a cyano group-containing compound. Examples of the p-dopant may include a quinone derivative, such as tetracyanoquinonedimethane (TCNQ) or 2,3,5,6-tetrafluoro-tetracyano-1,4-benzoquinonedimethane (F4-TCNQ); a metal oxide, such as a tungsten oxide or a molybdenum oxide, and Compound HT-D1 illustrated below.

<Compound HT-D1>



<F4-TCNQ>



[0212] In an organic light-emitting device, when the number of holes provided into an emission layer is smaller than the number of electrons provided into the emission layer, excitons generated in the emission layer may collide with excess electrons. Accordingly, exciton-polaron quenching may occur in the emission layer and excitons in the emission layer may dissociate, leading to a decrease in efficiency in the organic light-emitting device. Also, at high current, the difference between the number of holes provided and electron provided is futher increased. Accordingly, the higher the current is, the lower efficiency may be obtained. For example, a roll-off phenomenon may occur.

[0213] The condensed cyclic compound represented by Formulae 1 or 2 may facilitate injection of holes into an emission layer from a hole transport region, thereby enhancing a charge balance inside the emission layer. Accordingly, an organic light-emitting device including the condensed cyclic compound represented by Formulae 1 or 2 may have high efficiency and may be less likely to experience the roll-off phenomenon.

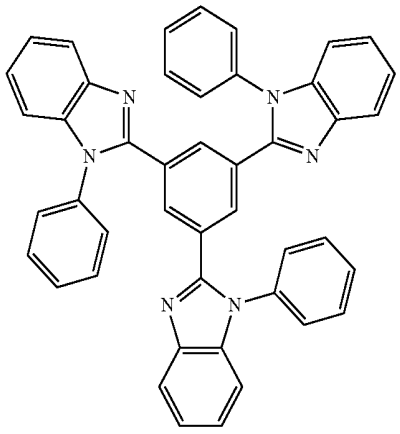
[0214] Also, the condensed cyclic compound represented by Formulae 1 or 2 may have good thermal stability, and the organic light-emitting device including the condensed cyclic compound may have a smaller change in efficiency depending on temperature.

[0215] An emission layer may be formed on the first electrode **110** or the hole transport region by using various methods, e.g., vacuum deposition, spin coating, casting, a LB method, ink-jet printing, laser-printing, or laser-induced thermal imaging. When an emission layer is formed by vacuum deposition or spin coating, deposition and coating conditions for the emission may be the same as those for the hole injection layer.

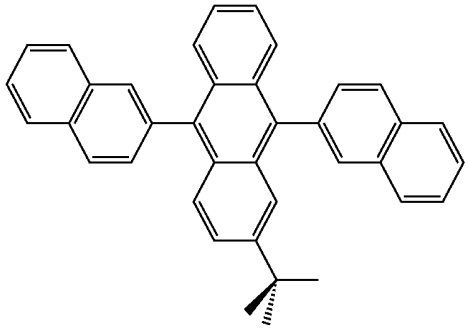
[0216] When the organic light-emitting device **10** is a full color organic light-emitting device, the emission layer may be patterned into a red emission layer, a green emission layer, or a blue emission layer, according to a sub pixel. In some embodiments, the emission layer may have a stacked structure of a red emission layer, a green emission layer, and a blue emission layer, or may include a red-light emission material, a green-light emission material, and a blue-light emission material, which are mixed with each other in a single layer, to emit white light. In some embodiments, the emission layer may be a white emission layer, and may further include a color converting layer or a color filter to turn white light into light of a desired color.

[0217] The emission layer may include a host and a dopant.

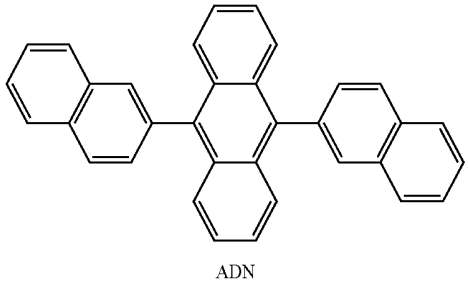
[0218] The host may include at least one selected from TPBi, TBADN, ADN, CBP, CDBP, and TCP:



TPBi



TBADN



ADN

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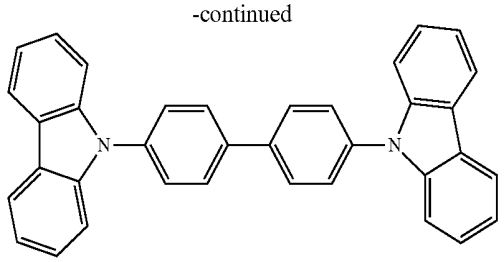
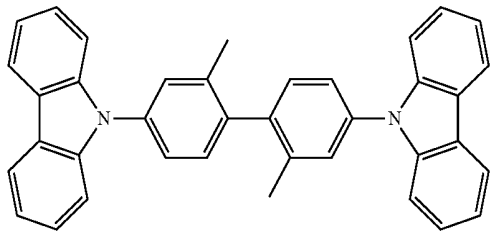
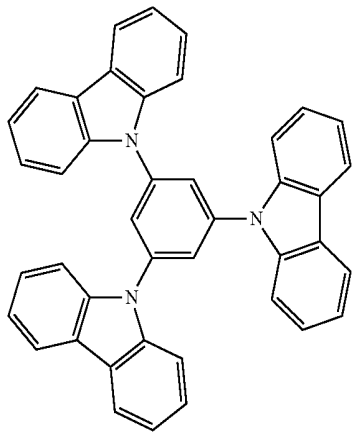


CBP



CDBP



TCP

[0219] In some embodiments, the host may include a compound represented by Formula 301 below.

$$Ar_{301}\text{-}[(L_{301})_{xb1}\text{-}R_{301}]_{xb2}. \quad \text{<Formula 301>}$$

[0220] Ar_{301} in Formula 301 may be selected from:

[0221] a naphthalene, a heptalene, a fluorenene, a Spiro-fluorene, a benzofluorene, a dibenzofluorene, a phenalene, a phenanthrene, an anthracene, a fluoranthene, a triphenylene, a pyrene, a chrysene, a naphthacene, a picene, a perylene, a pentaphene, and an indenoanthracene; and

[0222] a naphthalene, a heptalene, a fluorenene, a spiro-fluorene, a benzofluorene, a dibenzofluorene, a phenalene, a phenanthrene, an anthracene, a fluoranthene, a triphenylene, a pyrene, a chrysene, a naphthacene, a picene, a perylene, a pentaphene, and an indenoanthracene, each substituted with at least one selected from a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{60} alkyl group, a C_2-C_{60} alkenyl group, a C_2-C_{60} alkynyl group, a C_1-C_{60} alkoxy group, a C_3-C_{10} cycloalkyl group, a C_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, monovalent non-aromatic condensed heteropolycyclic group, and —$Si(Q_{301})(Q_{303})(Q_{303})$ (Q_{301} to Q_{303} may be each independently selected from a hydrogen, a C_1-C_{60} alkyl group, a C_2-C_{60} alkenyl group, a C_6-C_{60} aryl group, and a C_1-C_{60} heteroaryl group);

[0223] a description of L_{301} may be understood by referring to the description provided in connection with L_{201};

[0224] R_{301} may be selected from:

[0225] a C_1-C_{20} alkyl group and a C_1-C_{20} alkoxy group;

[0226] a C_1-C_{20} alkyl group and a C_1-C_{20} alkoxy group, each substituted with at least one selected from a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, and a triazinyl group;

[0227] a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazol group, and a triazinyl group; and

[0228] a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group and a triazinyl group, each substituted with at least one selected from a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, and a triazinyl group;

[0229] xb1 may be selected from 0, 1, 2, and 3;

[0230] xb2 may be selected from 1, 2, 3, and 4.

[0231] In Formula 301,

[0232] L_{301} may be selected from:

[0233] a phenylene group, a naphthylene group, a fluorenylene group, a Spiro-fluorenylene group, a benzofluorenylene group, a dibenzofluorenylene group, a phenanthrenylene group, an anthracenylene group, a pyrenylene group, and a chrysenylene group; and

[0234] a phenylene group, a naphthylene group, a fluorenylene group, a spiro-fluorenylene group, a benzofluorenylene group, a dibenzofluorenylene group, a phenanthre-

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

[0235] R_{301} may be selected from:

[0236] a C_1-C_{20} alkyl group and a C_1-C_{20} alkoxy group;

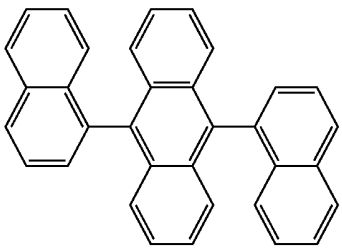
[0237] a C_1-C_{20} alkyl group and a C_1-C_{20} alkoxy group, each substituted with at least one selected from a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a phenyl group, a naphthyl group, a fluorenyl group, a Spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, and a chrysenyl group;

[0238] a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, and a chrysenyl group; and

[0239] a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, and a chrysenyl group, each substituted with at least one selected from a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, and a chrysenyl group.

[0240] The compound represented by Formula 301 may include at least one of Compounds H1 to H42.

H1



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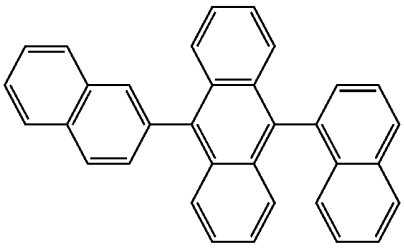

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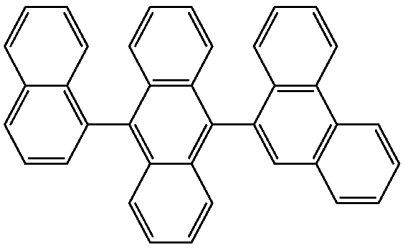

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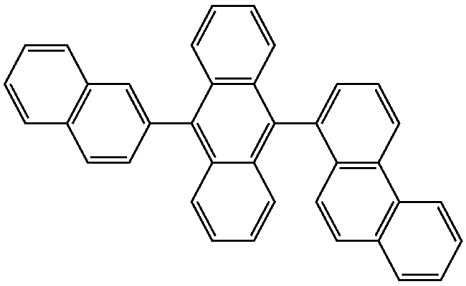

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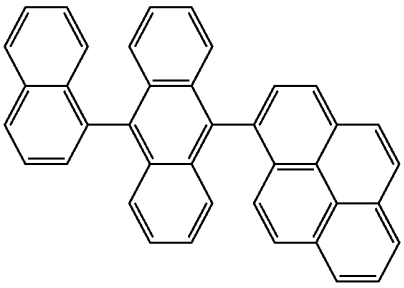

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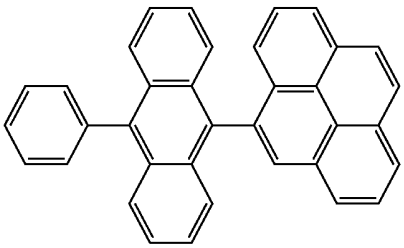

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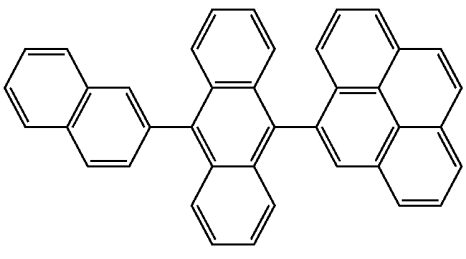

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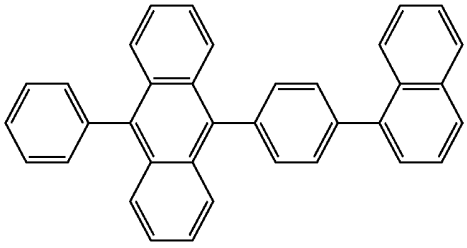

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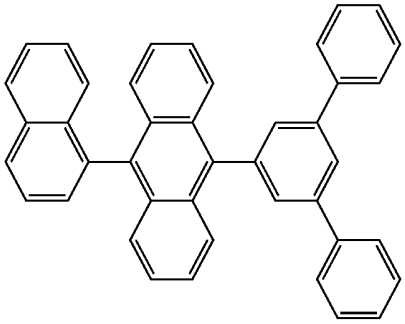

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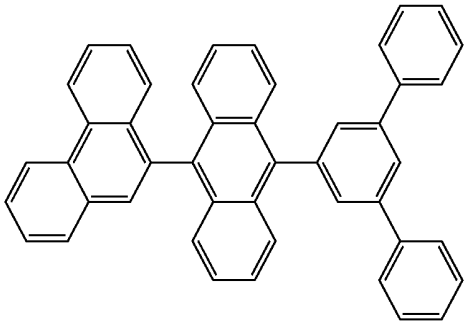

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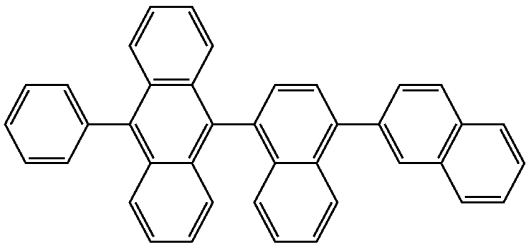

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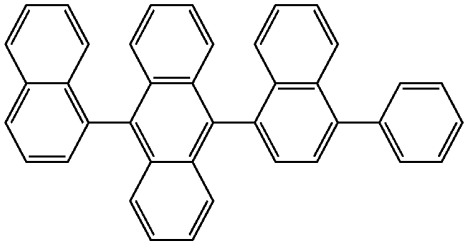

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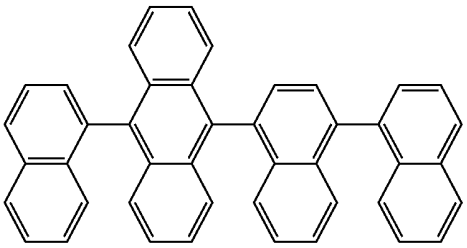

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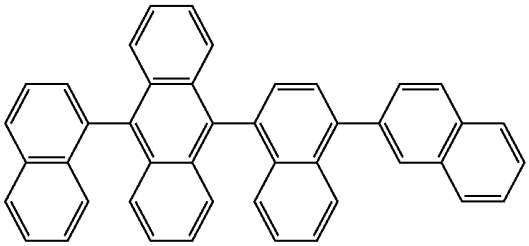

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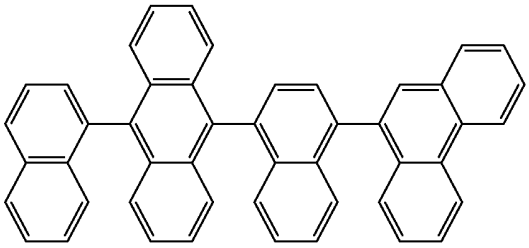

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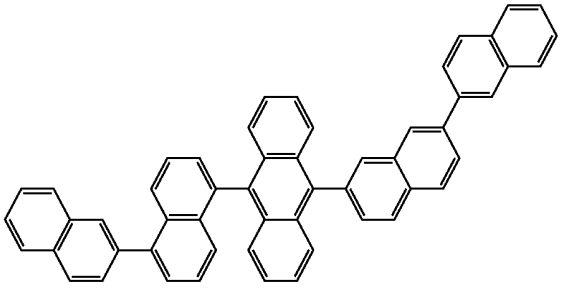

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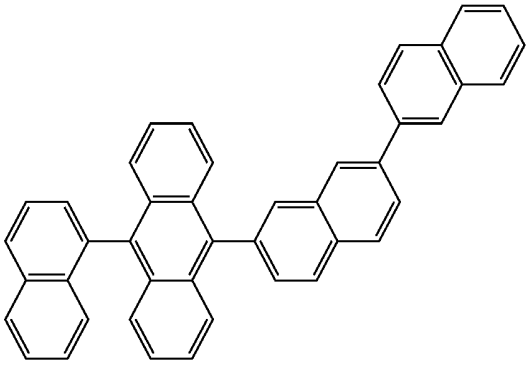

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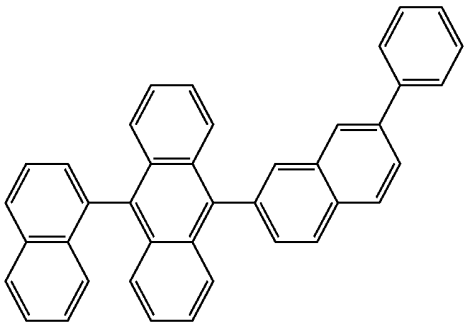

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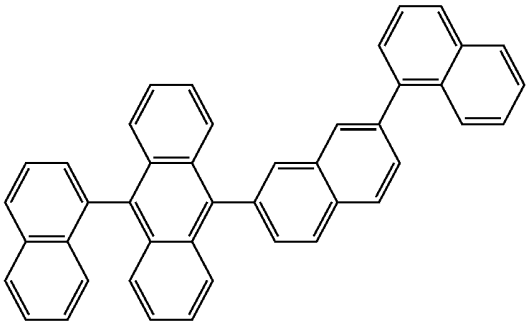

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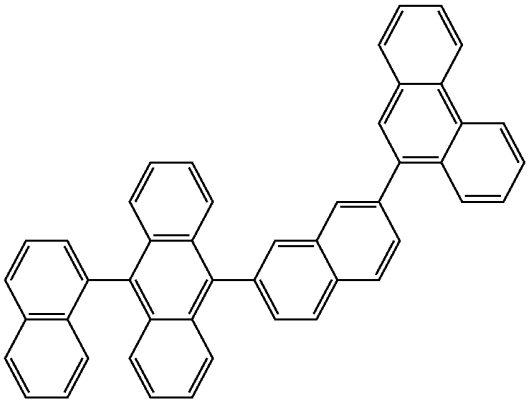

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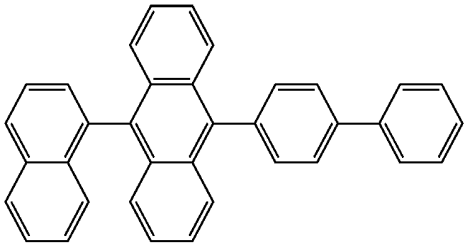

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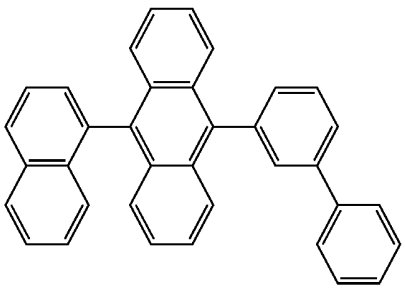

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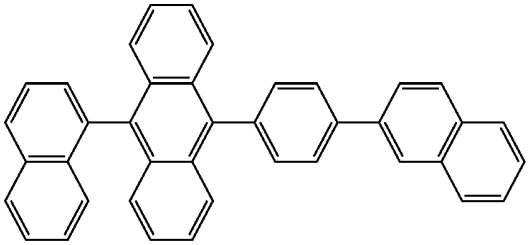

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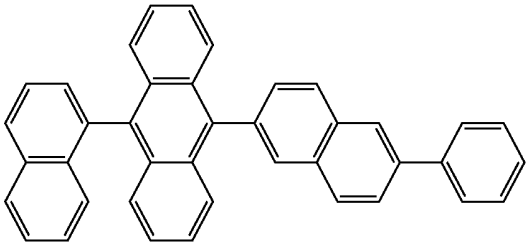

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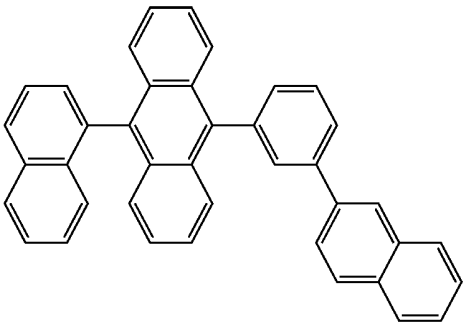

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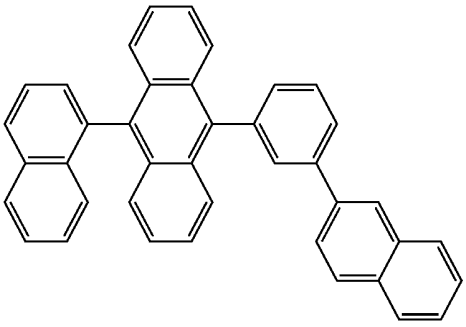

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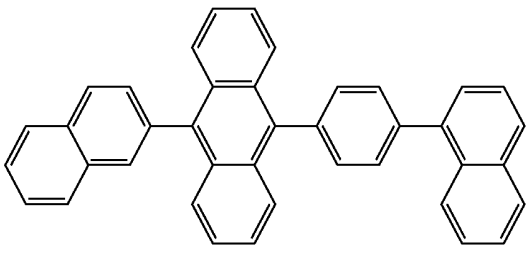

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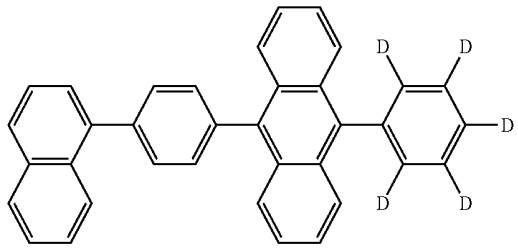

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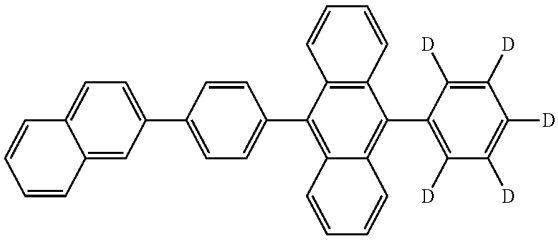

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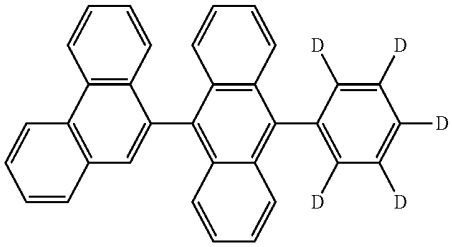

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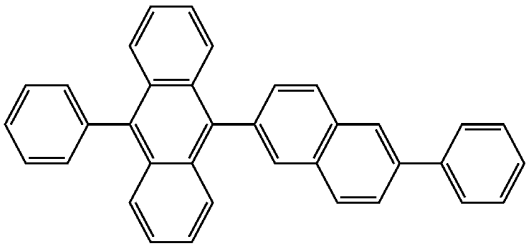

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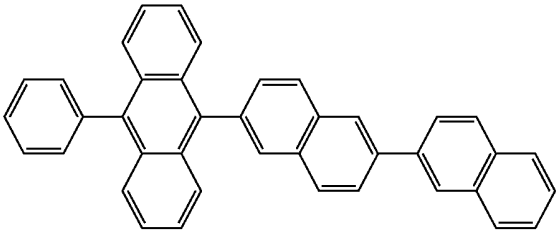

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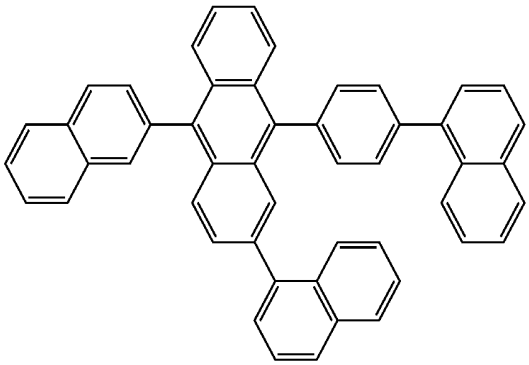

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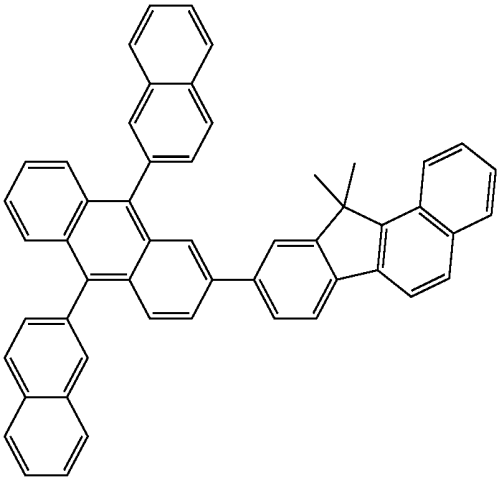

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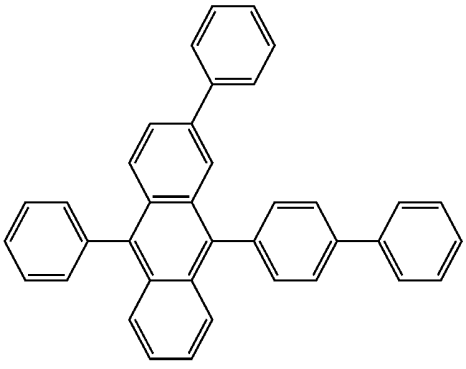

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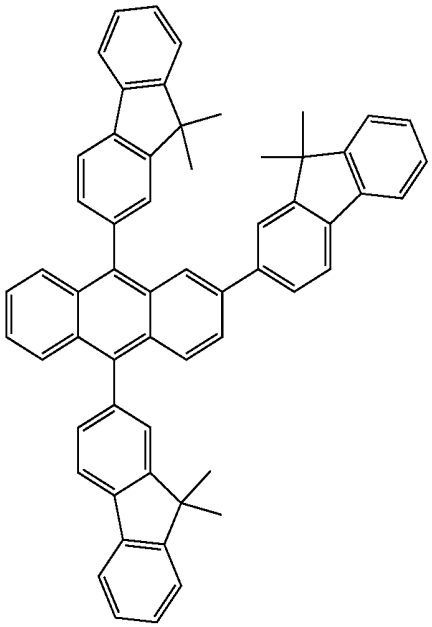

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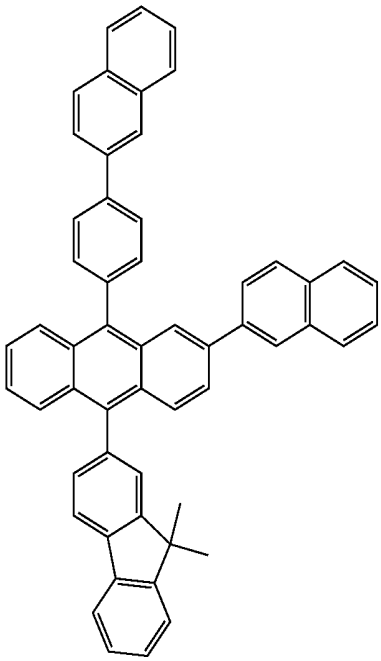

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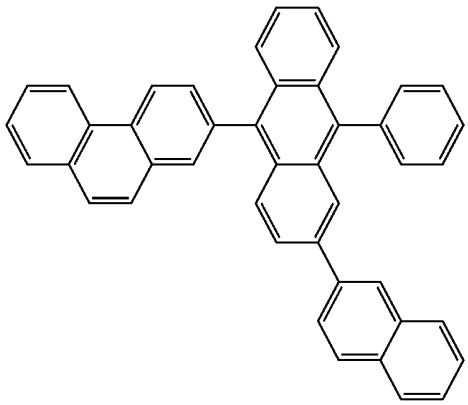

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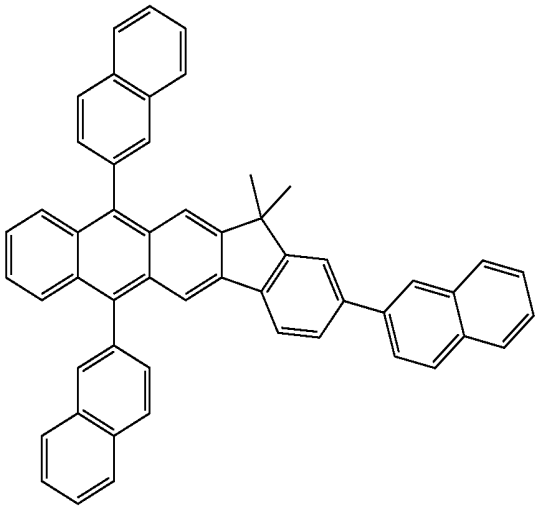

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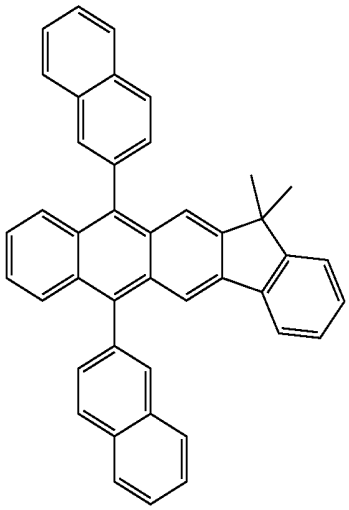

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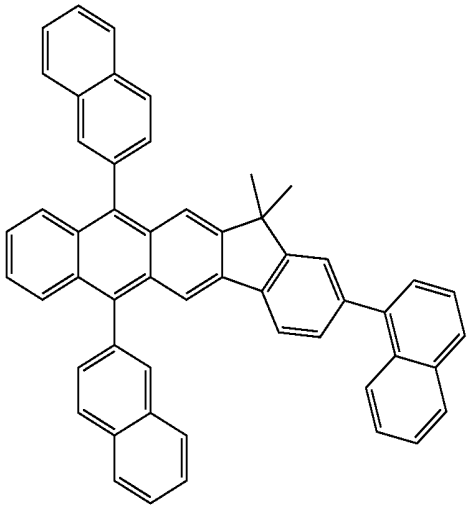

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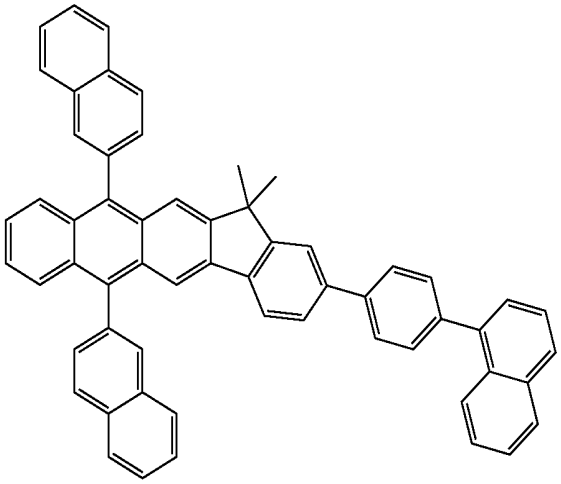

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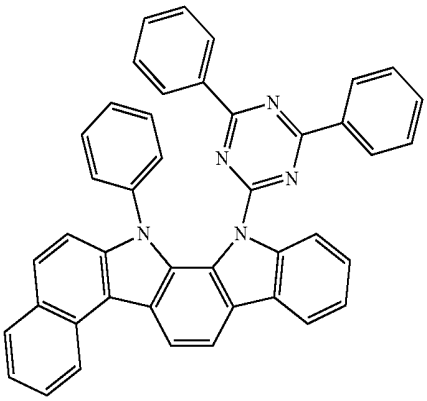
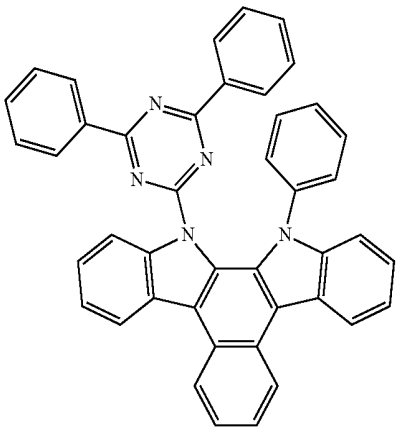


[0241] In some embodiments, the host may include at least one of Compounds H43 to H49 below.

H43



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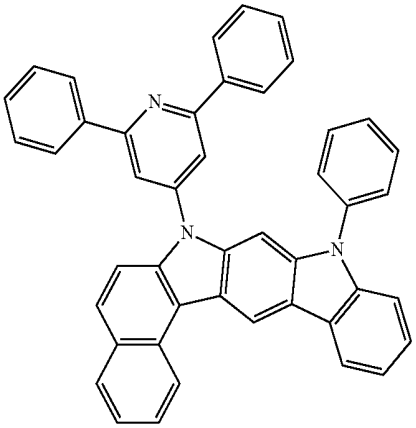

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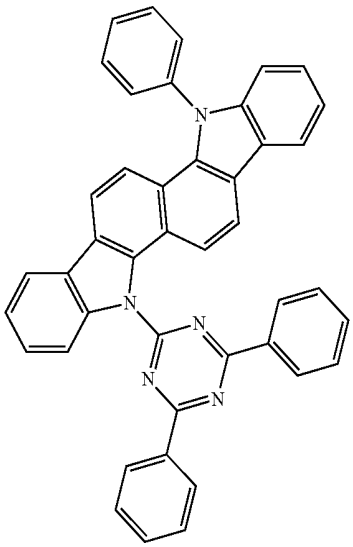

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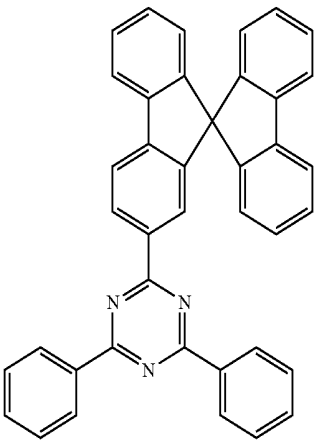

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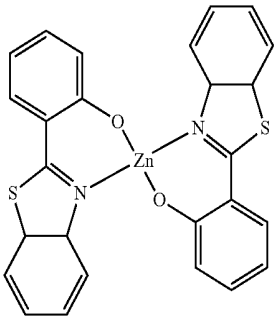

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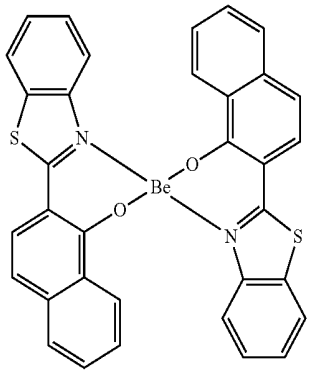
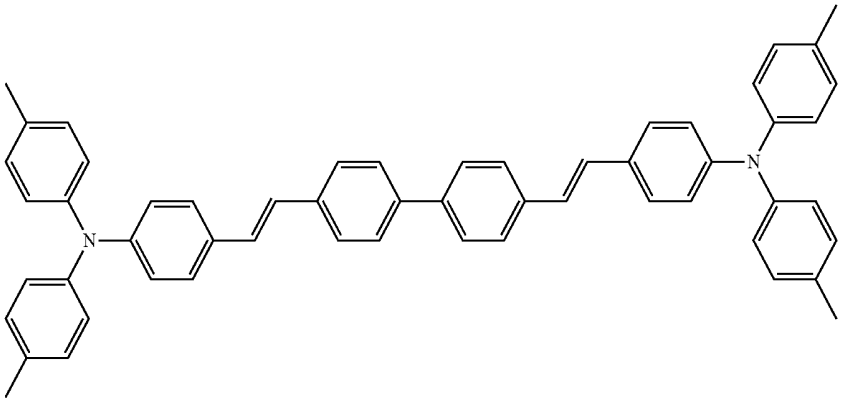
H49

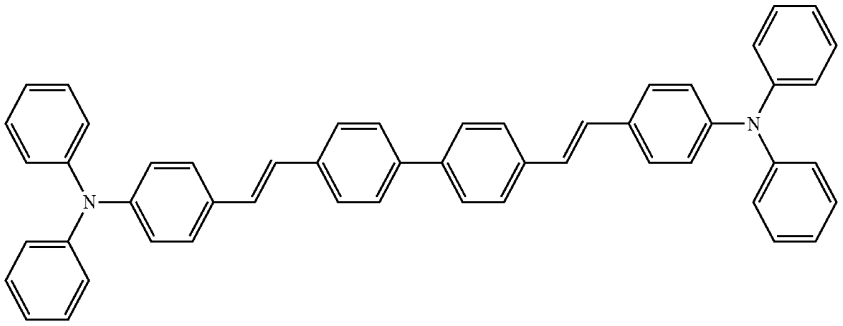


[0242] The dopant may include at least one selected from a fluorescent dopant and a phosphorescent dopant.

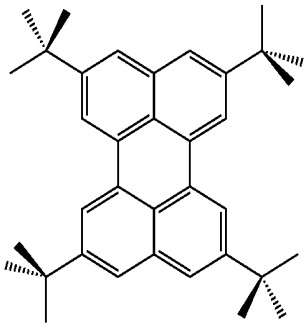
[0243] For example, the fluorescent dopant may include at least one selected from DPAVBi, BDAVBi, TBPe, DCM, DCJTB, Coumarin 6, and C545T.



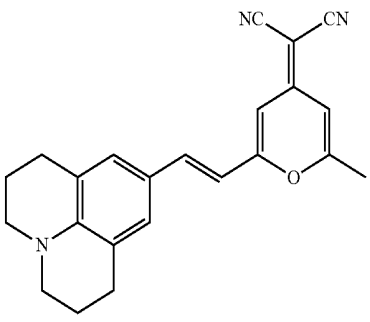
DPAVBi



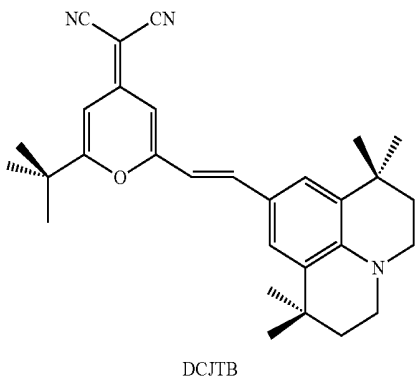
BDAVBi



TBPe



DCM



DCJTB

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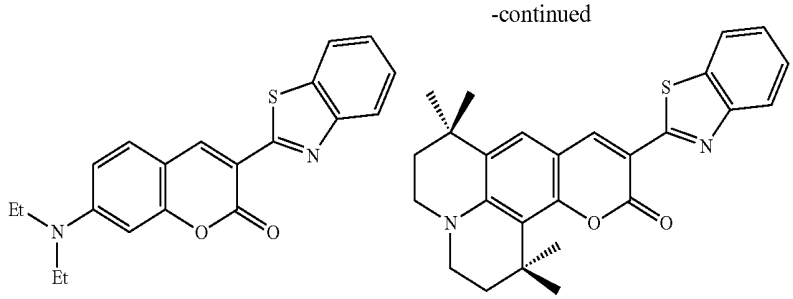
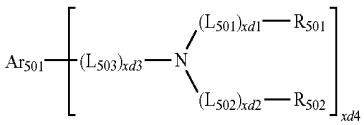


Coumarin 6

C545T

[0244] The fluorescent dopant may include a compound represented by Formula 501 below.

<Formula 501>



[0245] In Formula 501,

[0246] Ar_{501} may be selected from:

[0247] a naphthalene, a heptalene, a fluorenene, a Spiro-fluorene, a benzofluorene, a dibenzofluorene, a phenalene, a phenanthrene, an anthracene, a fluoranthene, a triphenylene, a pyrene, a chrysene, a naphthacene, a picene, a perylene, a pentaphene, and an indenoanthracene; and

[0248] a naphthalene, a heptalene, a fluorenene, a spiro-fluorene, a benzofluorene, a dibenzofluorene, a phenalene, a phenanthrene, an anthracene, a fluoranthene, a triphenylene, a pyrene, a chrysene, a naphthacene, a picene, a perylene, a pentaphene, and an indenoanthracene, each substituted with at least one selected from a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{60} alkyl group, a C_2-C_{60} alkenyl group, a C_2-C_{60} alkynyl group, a C_1-C_{60} alkoxy group, a C_3-C_{10} cycloalkyl group, a C_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, monovalent non-aromatic condensed heteropolycyclic group, and —$Si(Q_{501})(Q_{502})(Q_{503})$ (in which Q_{501} to Q_{503} may be each independently selected from a hydrogen, a C_1-C_{60} alkyl group, a C_2-C_{60} alkenyl group, a C_6-C_{60} aryl group, and a C_1-C_{60} heteroaryl group).

[0249] Descriptions of L_{501} to L_{503} are the same as the descriptions provided herein in connection with L_{201};

[0250] R_{501} and R_{502} may each independently be selected from:

[0251] a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, a triazinyl group, a dibenzofuranyl group, and a dibenzothiophenyl group; and

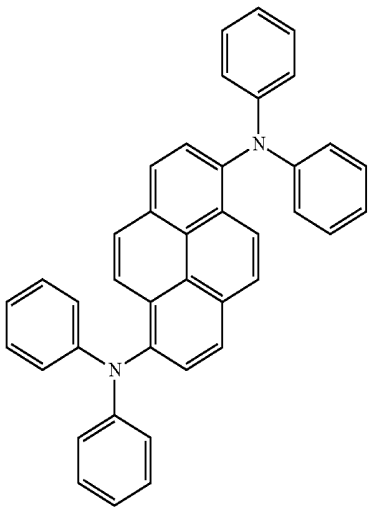
[0252] a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, a triazinyl group, a dibenzofuranyl group, and a dibenzothiophenyl group, each substituted with at least one selected from a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, a triazinyl group, a dibenzofuranyl group, and a dibenzothiophenyl group;

[0253] xd1 to xd3 may each independently be selected from 0, 1, 2, and 3; and

[0254] xd4 may be selected from 1, 2, 3, and 4.

[0255] The fluorescent dopant may include at least one of Compounds FD1 to FD8:

FD1



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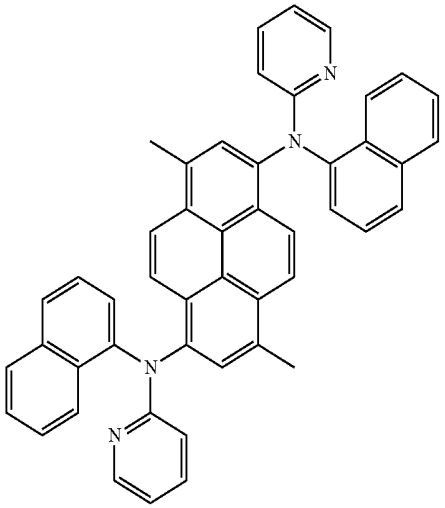
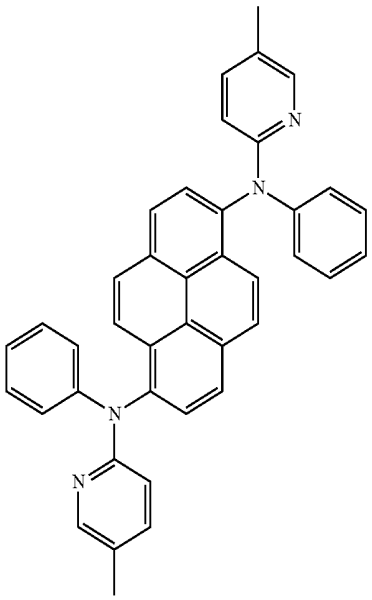
FD2



FD3



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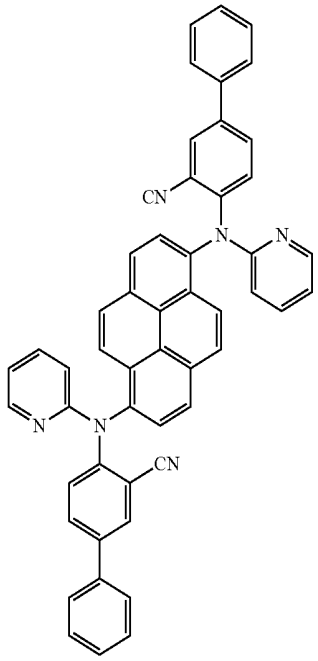
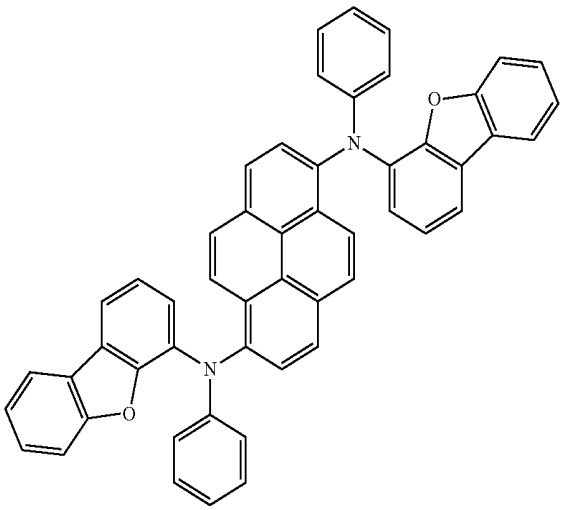
FD4



FD5



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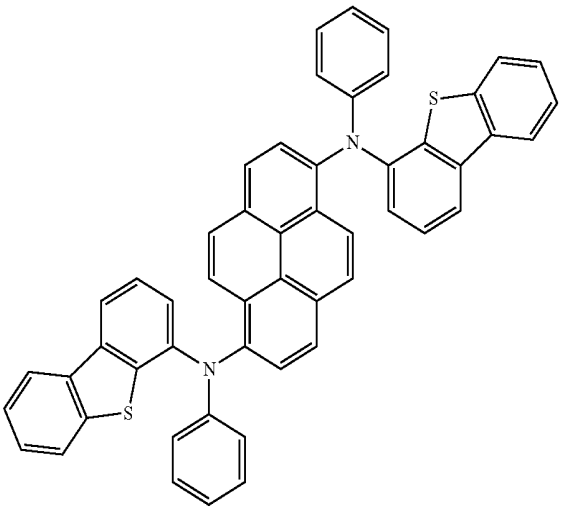
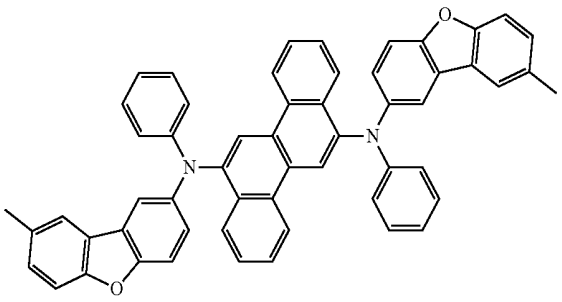
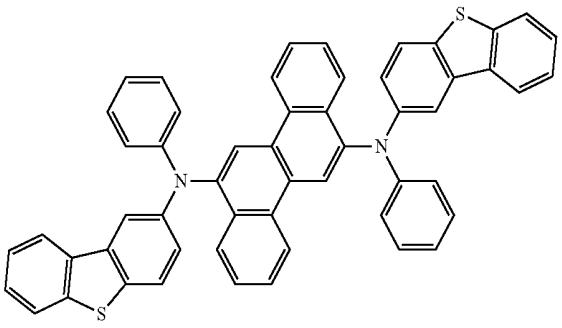
FD6



FD7

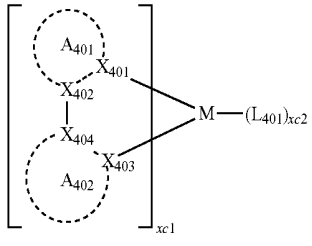


FD8



[0256] For example, the phosphorescent dopant may include an organometallic complex represented by Formula 401 below.

<Formula 401>



[0257] In Formula 401,

[0258] M may be selected from iridium (Ir), platinum (Pt), osmium (Os), titanium (Ti), zirconium (Zr), hafnium (Hf), europium (Eu), terbium (Tb), and thulium (Tm);

[0259] X_{401} to X_{404} may each independently be a nitrogen atom or a carbon atom;

[0260] ring A_{401} and A_{402} may each independently be selected from a substituted or unsubstituted benzene, a substituted or unsubstituted naphthalene, a substituted or unsubstituted fluorenene, a substituted or unsubstituted spiro-fluorenene, a substituted or unsubstituted indene, a substituted or unsubstituted pyrrole, a substituted or unsubstituted thiophene, a substituted or unsubstituted furan, a substituted or unsubstituted imidazole, a substituted or unsubstituted pyrazole, a substituted or unsubstituted thiazole, a substituted or unsubstituted isothiazole, a substituted or unsubstituted oxazole, a substituted or unsubstituted isoxazole, a substituted or unsubstituted pyridine, a substituted or unsubstituted pyrazine, a substituted or unsubstituted pyrimidine, a substituted or unsubstituted pyridazine, a substituted or unsubstituted quinoline, a substituted or unsubstituted isoquinoline, a substituted or unsubstituted benzoquinoline, a substituted or unsubstituted quinoxaline, a substituted or unsubstituted quinazoline, a substituted or unsubstituted carbazol, a substituted or unsubstituted benzoimidazole, a substituted or unsubstituted benzofuran, a substituted or unsubstituted benzothiophene, a substituted or unsubstituted isobenzothiophene, a substituted or unsubstituted benzoxazole, a substituted or unsubstituted isobenzoxazole, a substituted or unsubstituted triazole, a substituted or unsubstituted oxadiazole, a substituted or unsubstituted triazine, a substituted or unsubstituted dibenzofuran, and a substituted or unsubstituted dibenzothiophene; and

[0261] at least one substituent of the substituted benzene, substituted naphthalene, substituted fluorenene, substituted spiro-fluorenene, substituted indene, substituted pyrrole, substituted thiophene, substituted furan, substituted imidazole, substituted pyrazole, substituted thiazole, substituted isothiazole, substituted oxazole, substituted isoxazole, substituted pyridine, substituted pyrazine, substituted pyrimidine, substituted pyridazine, substituted quinoline, substituted isoquinoline, substituted benzoquinoline, substituted quinoxaline, substituted quinazoline, substituted carbazol, substituted benzoimidazole, substituted benzofuran, substituted benzothiophene, substituted isobenzothiophene, substituted benzoxazole, substituted isobenzoxazole, substituted triazole, substituted oxadiazole, substituted triazine, substituted dibenzofuran, and substituted dibenzothiophene may be selected from:

[0262] a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{60} alkyl group, a C_2-C_{60} alkenyl group, a C_2-C_{60} alkynyl group, and a C_1-C_{60} alkoxy group;

[0263] a C_1-C_{60} alkyl group, a C_2-C_{60} alkenyl group, a C_2-C_{60} alkynyl group, or a C_1-C_{60} alkoxy group, each substituted with at least one selected from a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_3-C_{10} cycloalkyl group, a C_1-C_{10} heterocy-

cloalkyl 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, —$N(Q_{401})(Q_{402})$, —$Si(Q_{403})(Q_{404})(Q_{405})$, and —$B(Q_{406})(Q_{407})$;

[0264] 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;

[0265] 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 a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{60} alkyl group, a C_2-C_{60} alkenyl group, a C_2-C_{60} alkynyl group, a C_1-C_{60} alkoxy group, a C_3-C_{10} cycloalkyl group, a C_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, —$N(Q_{411})(Q_{412})$, —$Si(Q_{413})(Q_{414})(Q_{415})$, and —$B(Q_{416})(Q_{417})$; and

[0266] —$N(Q_{421})(Q_{422})$, —$Si(Q_{423})(Q_{424})(Q_{425})$, and —$B(Q_{426})(Q_{427})$;

[0267] L_{401} may be an organic ligand;

[0268] xc1 may be 1, 2, or 3; and

[0269] xc2 may be 0, 1, 2, or 3;

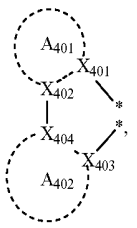
[0270] Q_{401} to Q_{407}, Q_{411} to Q_{417}, and Q_{421} to Q_{427} may each independently be selected from each independently selected from a hydrogen, a C_1-C_{60} alkyl group, a C_2-C_{60} alkenyl group, a C_6-C_{60} aryl group, and a C_1-C_{60} heteroaryl group.

[0271] L_{401} may be a monovalent, divalent, or trivalent organic ligand. For example, L_{401} may be selected from a halogen ligand (for example, Cl or F), a diketone ligand (for example, acetylacetonate, 1,3-diphenyl-1,3-propandionate, 2,2,6,6-tetramethyl-3,5-heptandionate, or hexafluoroacetonate), a carboxylic acid ligand (for example, picolinate, dimethyl-3-pyrazolecarboxylate, or benzoate), a carbon monooxide ligand, an isonitrile ligand, a cyano ligand, and a phosphorous ligand (for example, phosphine, and phosphaite).

[0272] In an implementation, when A_{401} in Formula 401 has two or more substituents, the substituents of A_{401} may bind to each other to form a saturated or unsaturated ring.

[0273] In an implementation, when A_{401} in Formula 402 has two or more substituents, the substituents of A_{402} may bind to each other to form a saturated or unsaturated ring.

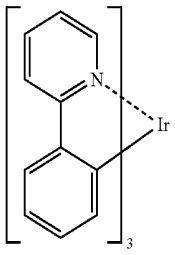
[0274] When xc1 in Formula 401 is two or more, a plurality of ligands



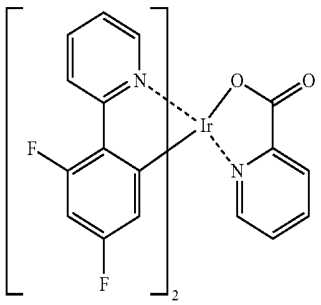
in Formula 401 may be identical or different. When xc1 in Formula 401 is two or more, A_{401} and A_{402} may be respectively directly connected to A_{401} and A_{402} of other neighboring ligands with or without a linker (for example, a C_1-C_5 alkylene group, a C_2-C_5 alkenylene group, or —N(R')— (wherein R' may be a C_1-C_{10} alkyl group or a C_6-C_{20} aryl group) or —C(=O)—) therebetween.

[0275] The phosphorescent dopant may include at least one of Compounds PD1 to PD74 below.

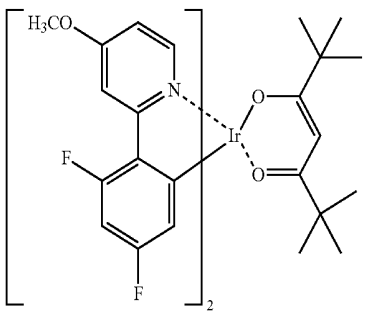
PD1



PD2



PD3



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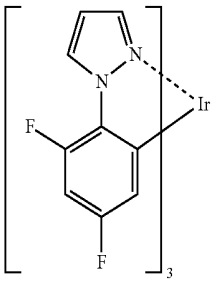
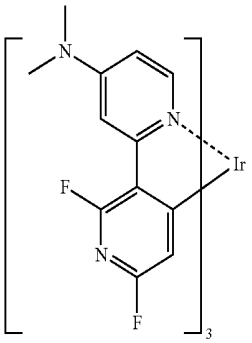
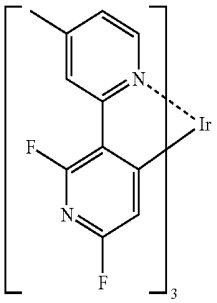
PD4



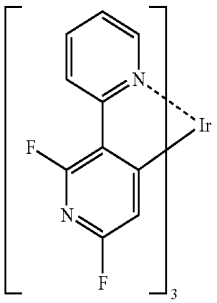
PD5



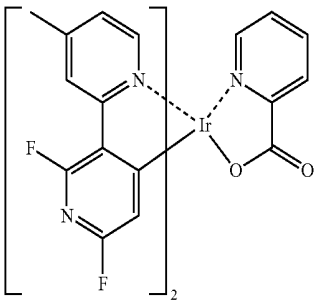
PD6



PD7



PD8



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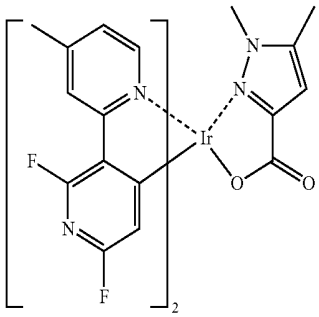
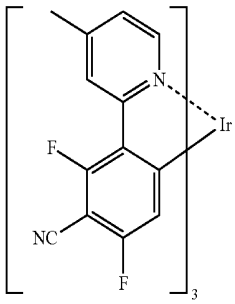
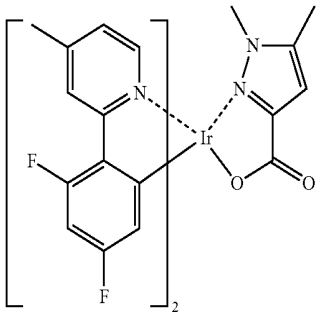
PD9



PD10



PD11



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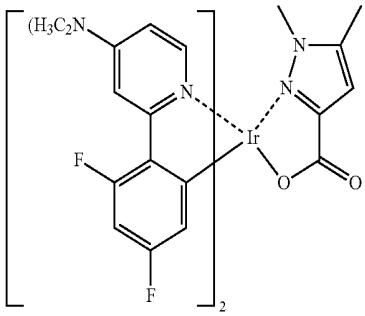

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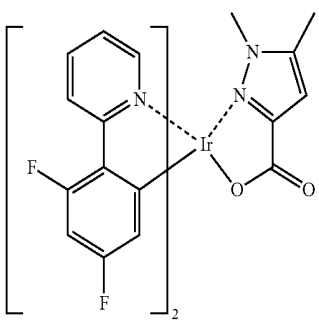

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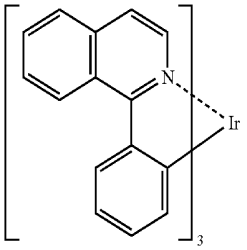
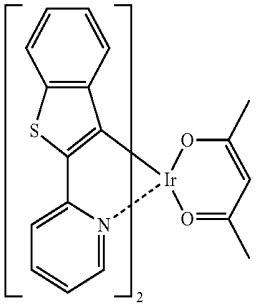
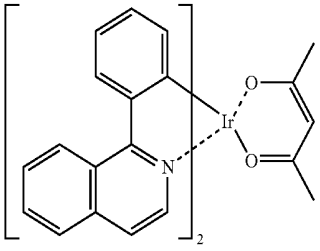
PD14



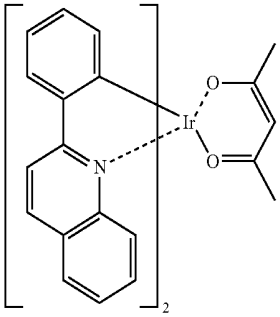
PD15



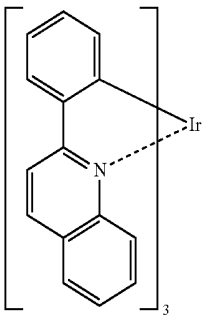
PD16



PD17



PD18



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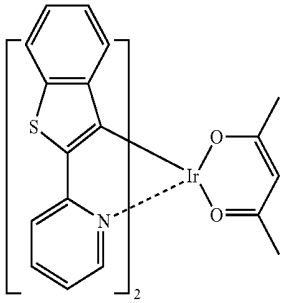
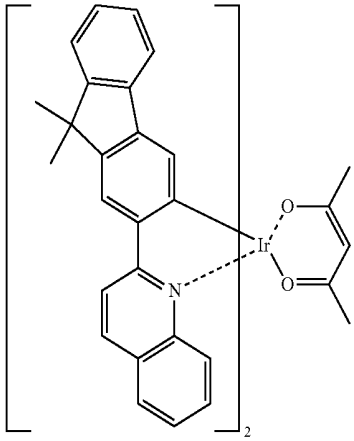
PD19



PD20



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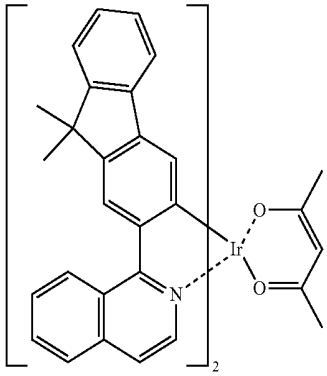

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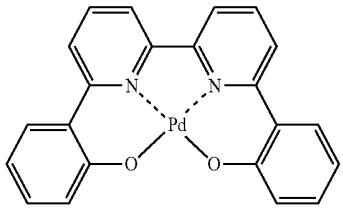

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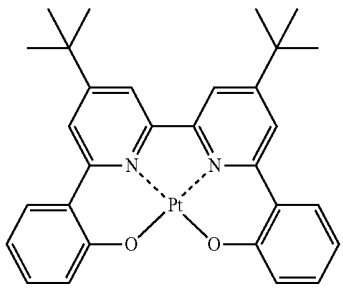

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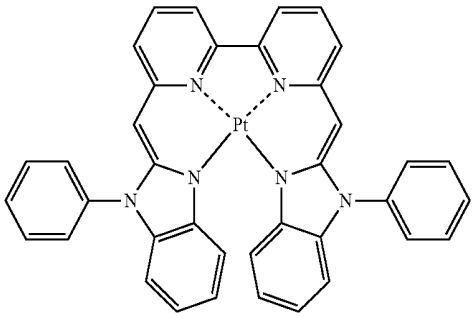

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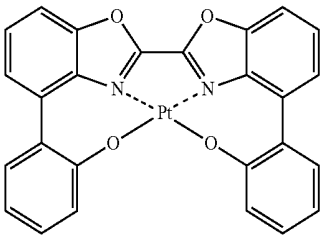

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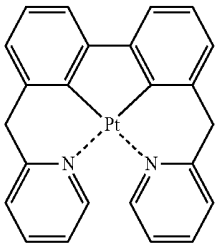

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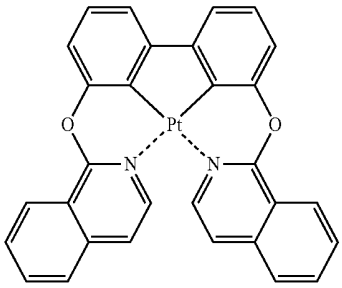

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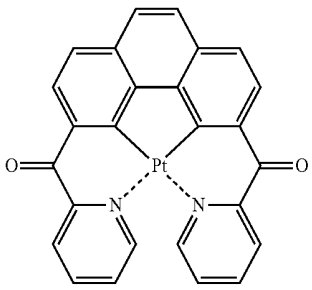

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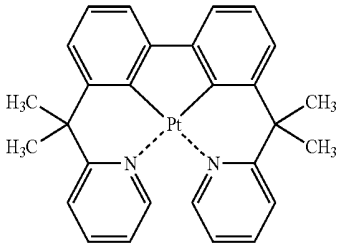

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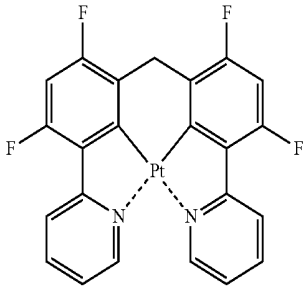

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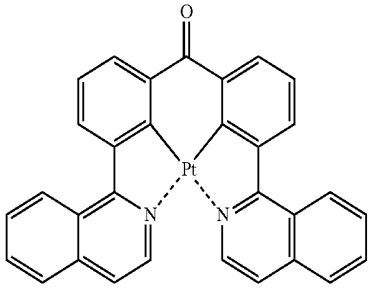

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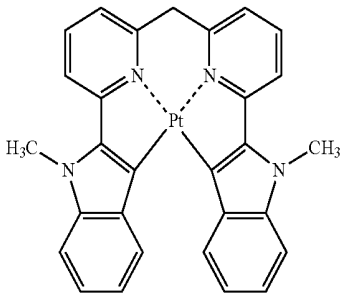

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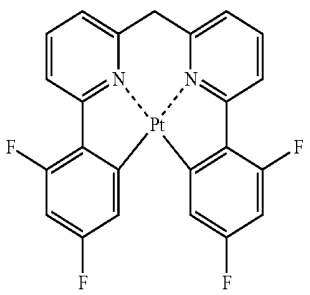

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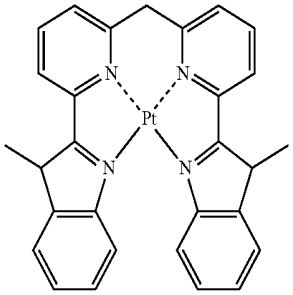

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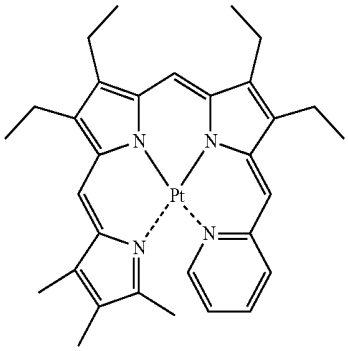

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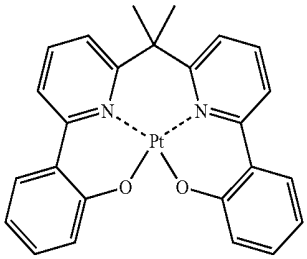

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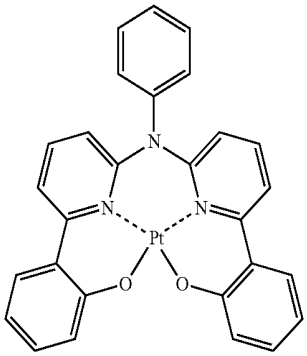

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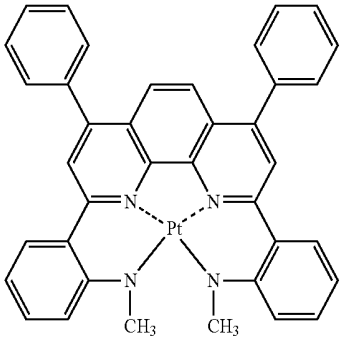

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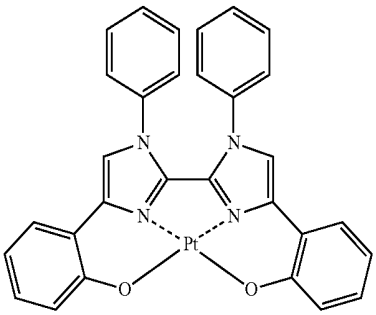

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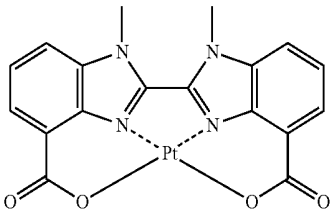

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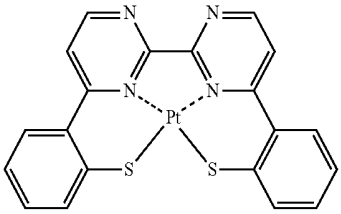

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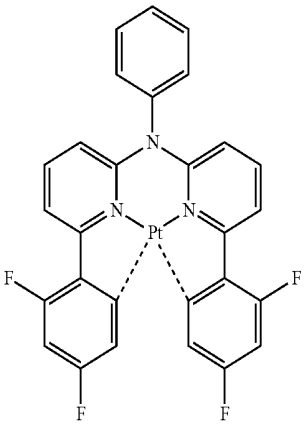

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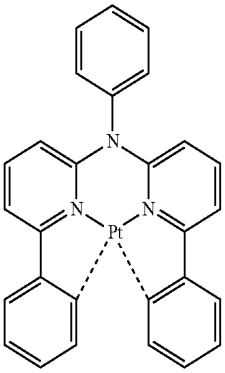

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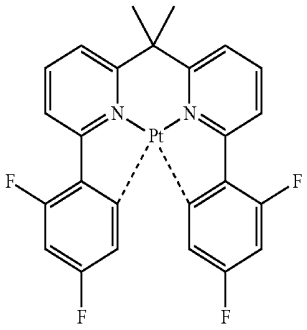

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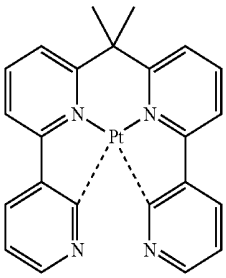

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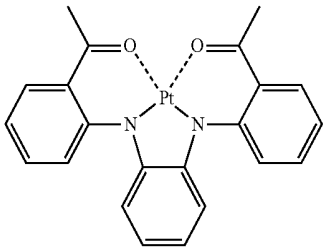

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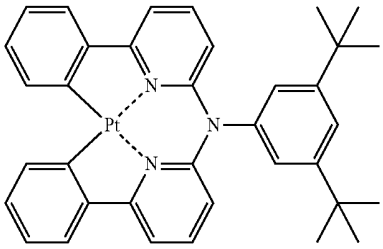

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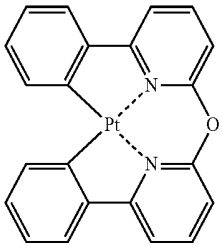

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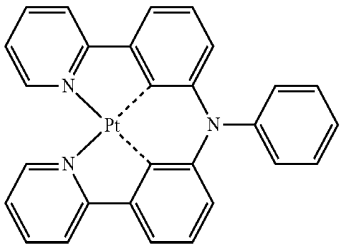

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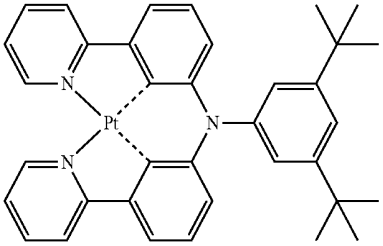

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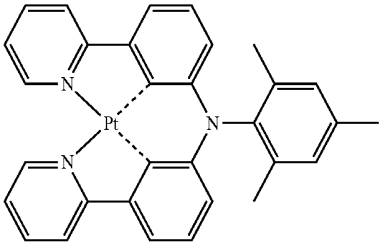

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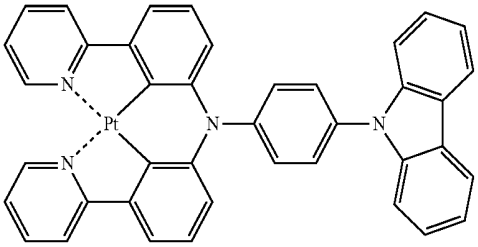

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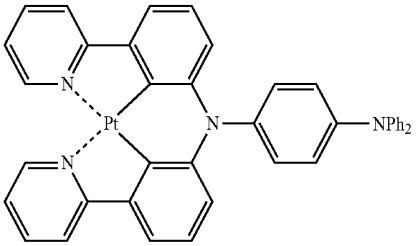

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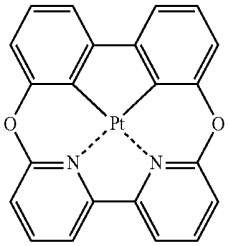

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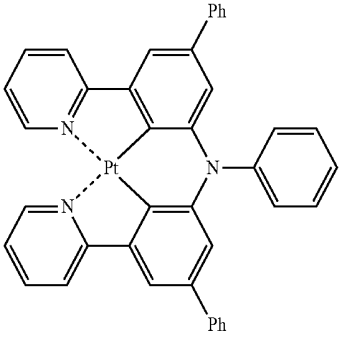

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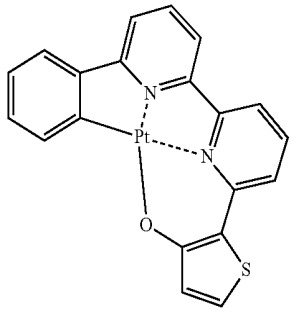

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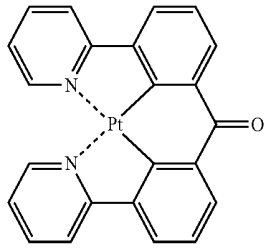

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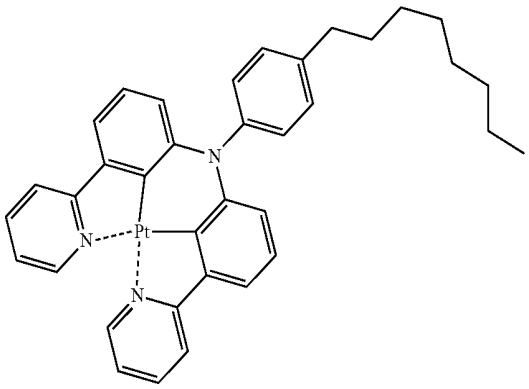

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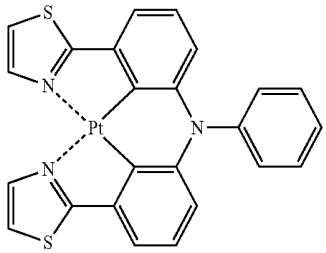

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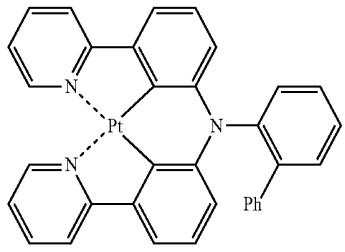

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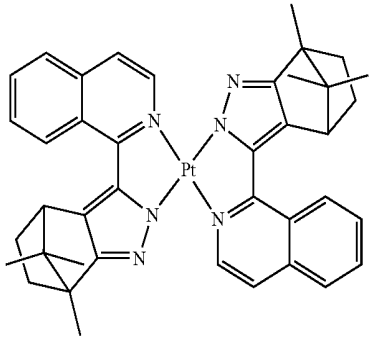

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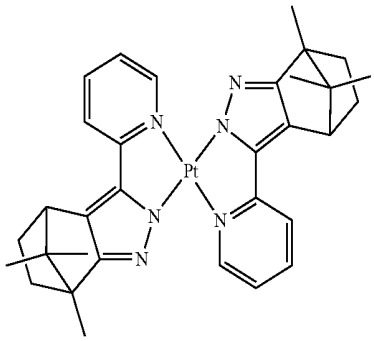

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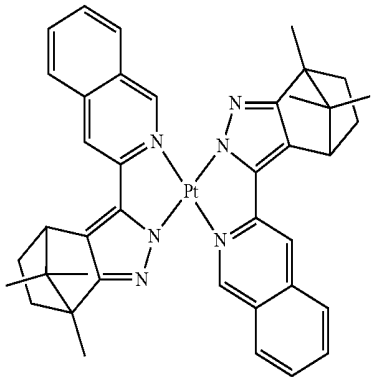

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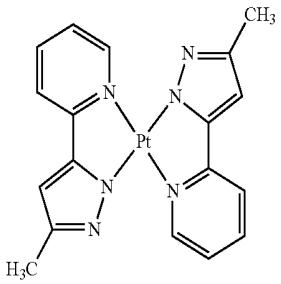

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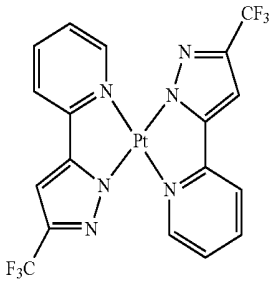

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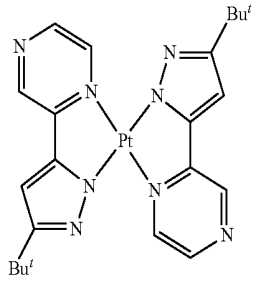

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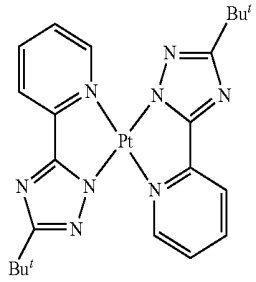

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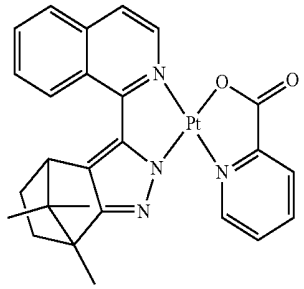

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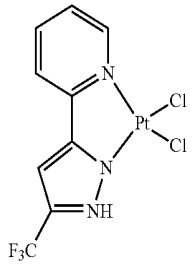

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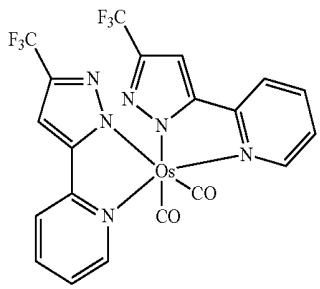

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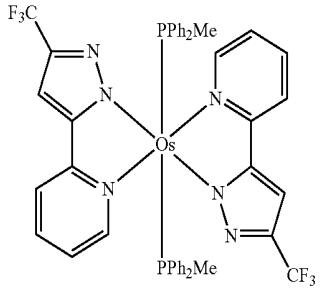

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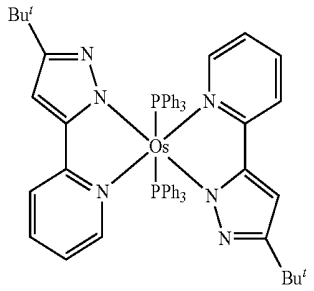

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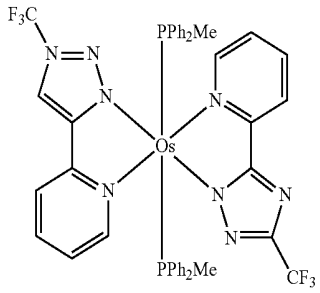

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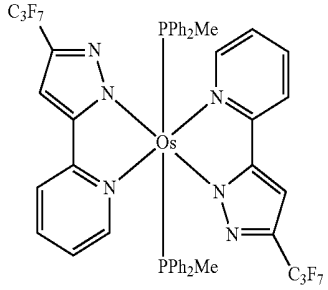
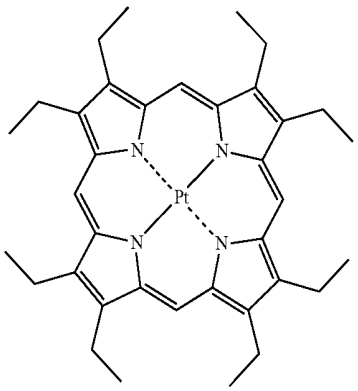


[0276] In some embodiments, the phosphorescent dopant may include PtOEP.



PtOEP

[0277] An amount of the dopant in the emission layer may be, e.g., in a range of about 0.01 to about 15 parts by weight, based on 100 parts by weight of the host.

[0278] A thickness of the emission layer may be in a range of about 100 Å to about 1,000 Å, e.g., about 200 Å to about 600 Å. When the thickness of the emission layer is within this range, excellent light-emission characteristics may be obtained without a substantial increase in driving voltage.

[0279] Then, the electron transport region **180** may be disposed on the emission layer.

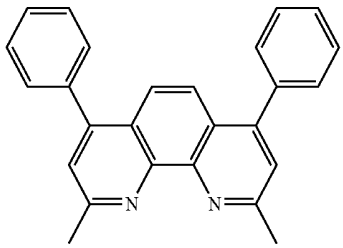
[0280] For example, the electron transport region **180** may include at least one selected from a hole blocking layer, an electron transport layer (ETL), and an electron injection layer.

[0281] For example, the electron transport region **180** may include an electron transport layer alone, or may have a structure of electron transport layer/electron injection layer or a structure of hole blocking layer/electron transport layer/electron injection layer, wherein layers of each structure are sequentially stacked from the emission layer in the stated order.

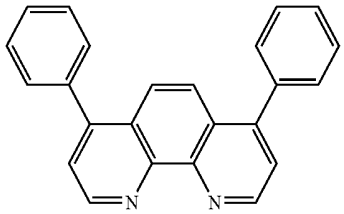
[0282] The electron transport region may include a hole blocking layer. The hole blocking layer may be formed, when the emission layer includes a phosphorescent dopant, to prevent diffusion of excitons or holes into an electron transport layer.

[0283] When the electron transport region includes a hole blocking layer, the hole blocking layer may be formed on the emission layer by using various methods, e.g. vacuum deposition, spin coating casting, a Langmuir-Blodgett (LB) method, ink-jet printing, laser-printing, or laser-induced thermal imaging. When the hole blocking layer is formed by vacuum deposition or spin coating, deposition and coating conditions for the hole blocking layer may be determined by referring to the deposition and coating conditions for the hole injection layer.

[0284] The hole blocking layer may include, e.g., at least one of BCP and Bphen.



BCP

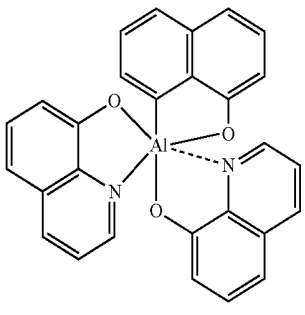


Bphen

[0285] A thickness of the hole blocking layer may be in a range of about 20 Å to about 1,000 Å, e.g., about 30 Å to about 300 Å. When the thickness of the hole blocking layer is within these ranges, the hole blocking layer may have excellent hole blocking characteristics without a substantial increase in driving voltage.

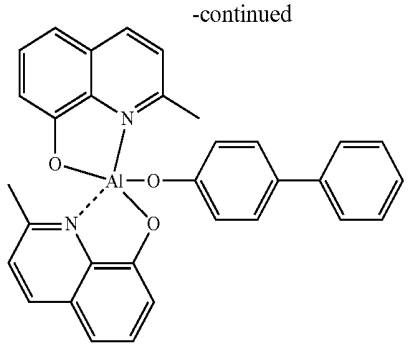
[0286] The electron transport region may include an electron transport layer. The electron transport layer may be formed on the emission layer or the hole blocking layer by using various methods, e.g., vacuum deposition, spin coating casting, a LB method, ink-jet printing, laser-printing, or laser-induced thermal imaging. When an electron transport layer is formed by vacuum deposition or spin coating, deposition and coating conditions for the electron transport layer may be the same as the deposition and coating conditions for the hole injection layer.

[0287] The electron transport layer may further include at least one selected from BCP, Bphen, Alq_3, Balq, TAZ, and NTAZ.

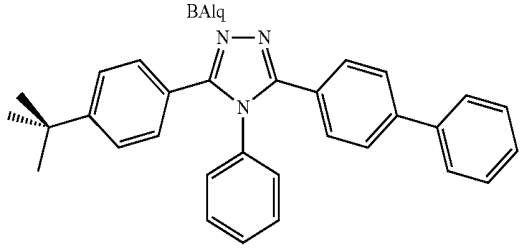


Alq_3

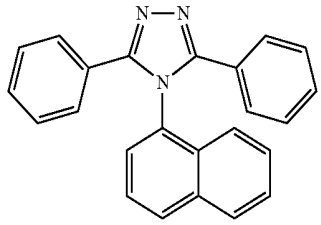
-continued



BAlq



TAZ



NTAZ

[0288] In some embodiments, the electron transport layer may further include at least one of compounds represented by Formula 601 below.

Ar_{601}-$[(L_{601})_{xe1}$-$E_{601}]_{xe2}$ <Formula 601>

[0289] In Formula 601,

[0290] Ar_{601} may be understood by referring to the description provided in connection with Ar_{301};

[0291] a description of L_{601} may be understood by referring to the description provided in connection with L_{201};

[0292] E_{601} may be selected from:

[0293] a pyrrolyl group, a thiophenyl group, a furanyl group, an imidazolyl group, a pyrazolyl group, a thiazolyl group, an isothiazolyl group, an oxazolyl group, an isoxazolyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, an indolyl group, an indazolyl group, a purinyl group, a quinolinyl group, an isoquinolinyl group, a benzoquinolinyl group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, a quinazolinyl group, a cinnolinyl group, carbazolyl, a phenanthridinyl group, an acridinyl group, a phenanthrolinyl group, a phenazinyl group, benzoimidazolyl, a benzofuranyl group, a benzothiophenyl group, isobenzothiazolyl, a benzoxazolyl group, an isobenzoxazolyl group, a triazolyl group, a tetrazolyl group, an oxadiazolyl group, a triazinyl group, a dibenzofuranyl group, a dibenzothiophenyl group, a benzocarbazolyl group, and a dibenzocarbazolyl group; and

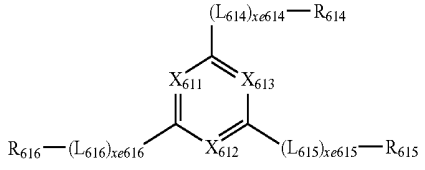
[0294] a pyrrolyl group, a thiophenyl group, a furanyl group, an imidazolyl group, a pyrazolyl group, a thiazolyl group, an isothiazolyl group, an oxazolyl group, an isoxazolyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, an indolyl group, an indazolyl group, a purinyl group, a quinolinyl group, an isoquinolinyl group, a benzoquinolinyl group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, a quinazolinyl group, a cinnolinyl group, a carbazolyl group, a phenanthridinyl group, an acridinyl group, a phenanthrolinyl group, a phenazinyl group, a benzoimidazolyl group, a benzofuranyl group, a benzothiophenyl group, an isobenzothiazolyl group, a benzoxazolyl group, an isobenzoxazolyl group, a triazolyl group, a tetrazolyl group, an oxadiazolyl group, a triazinyl group, a dibenzofuranyl group, a dibenzothiophenyl group, a benzocarbazolyl group, and a dibenzocarbazolyl group, each substituted with at least one selected from a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a phenyl group, a pentalenyl group, an indenyl group, a naphthyl group, an azulenyl group, a heptalenyl group, an indacenyl group, an acenaphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenalenyl group, a phenanthrenyl group, an anthracenyl group, a fluoranthenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a naphthacenyl group, a picenyl group, a perylenyl group, a pentaphenyl group, a hexacenyl group, a pentacenyl group, a rubicenyl group, a coronenyl group, an ovalenyl group, a pyrrolyl group, a thiophenyl group, a furanyl group, an imidazolyl group, a pyrazolyl group, a thiazolyl group, an isothiazolyl group, an oxazolyl group, an isoxazolyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, an indolyl group, an indazolyl group, a purinyl group, a quinolinyl group, an isoquinolinyl group, a benzoquinolinyl group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, a quinazolinyl group, a cinnolinyl group, a carbazolyl group, a phenanthridinyl group, an acridinyl group, a phenanthrolinyl group, a phenazinyl group, a benzoimidazolyl group, a benzofuranyl group, a benzothiophenyl group, an isobenzothiazolyl group, a benzoxazolyl group, an isobenzoxazolyl group, a triazolyl group, a tetrazolyl group, an oxadiazolyl group, a triazinyl group, a dibenzofuranyl group, a dibenzothiophenyl group, a benzocarbazolyl group, and a dibenzocarbazolyl group;

[0295] xe1 may be selected from 0, 1, 2, and 3; and

[0296] xe2 may be selected from 1, 2, 3, and 4.

[0297] In some embodiments, the electron transport layer may further include at least one of compounds represented by Formula 602 below.

<Formula 602>



[0298] In Formula 602,

[0299] X_{611} may be N or C-$(L_{611})_{xe611}$-R_{611}; X_{612} may be N or C-$(L_{612})_{xe612}$-R_{612}, X_{613} may be N or C-$(L_{613})_{xe613}$-R_{613}, and at least one selected from X_{611} to X_{613} may be N;

[0300] L_{611} to L_{616} may be understood by referring to the description provided herein in connection with L_{201};

[0301] R_{611} to R_{616} may each independently be selected from:

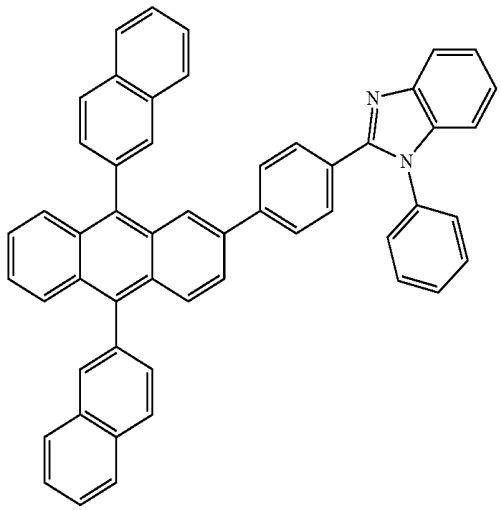
[0302] a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, and a triazinyl group; and

[0303] a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, and a triazinyl group, each substituted with at least one selected from a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a phenyl group, a naphthyl group, an azulenyl group, a fluorenyl group, a Spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, and a triazinyl group; and

[0304] xe611 to xe616 may each independently be selected from 0, 1, 2, and 3.

[0305] The compound represented by Formula 601 and/or the compound represented by Formula 602 may include at least one of Compounds ET1 to ET15 illustrated below.

ET1



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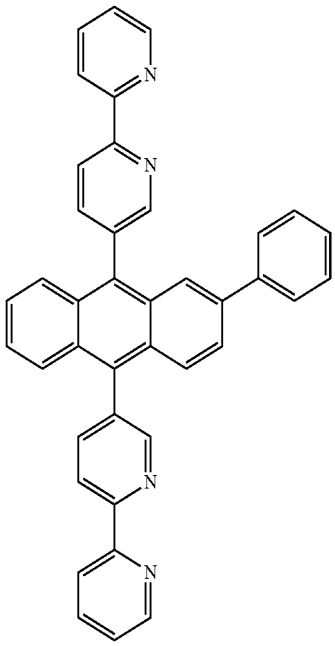
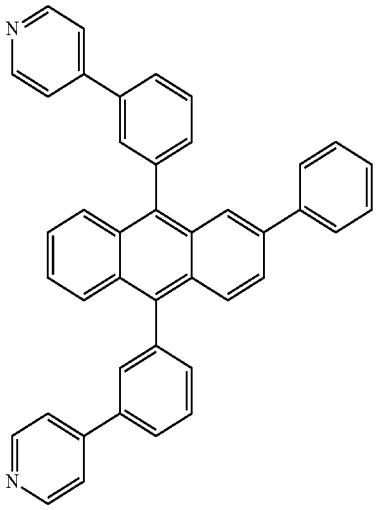
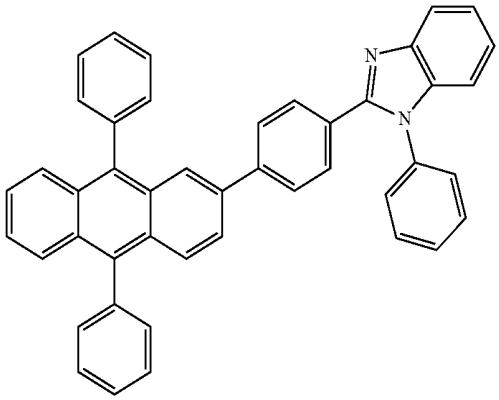
ET2



ET3



ET4



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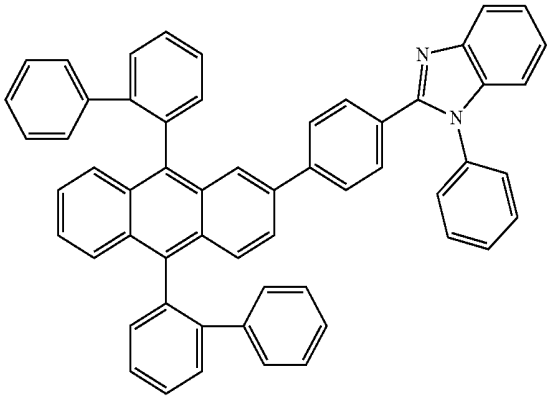
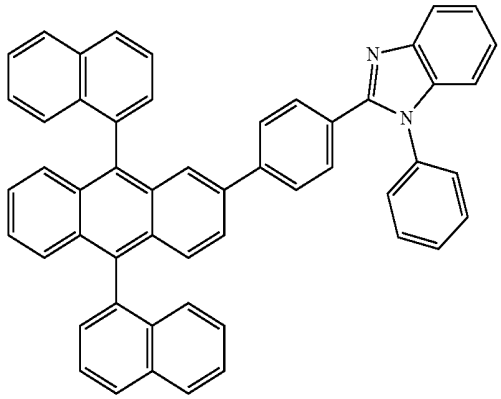
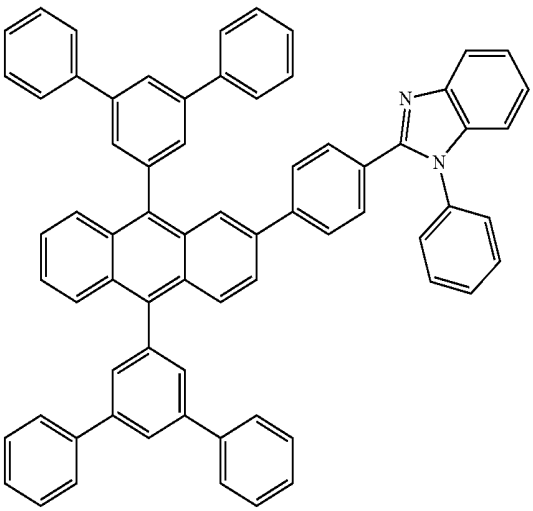
ET5



ET6



ET7



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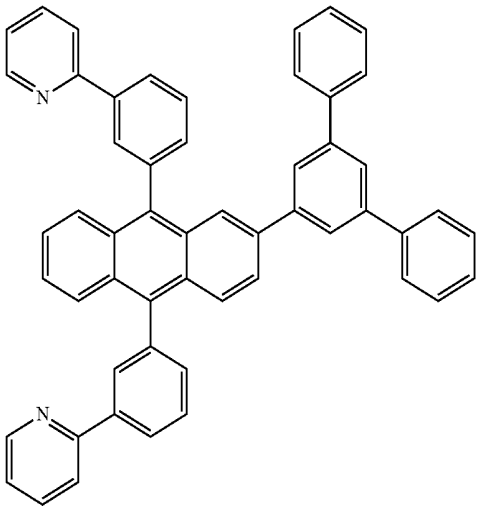
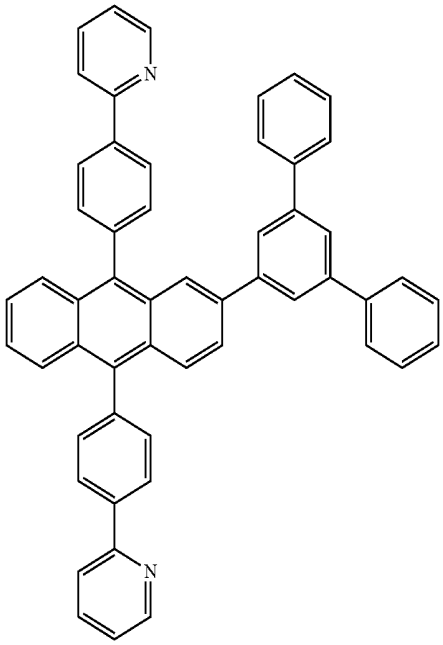
ET8



ET9



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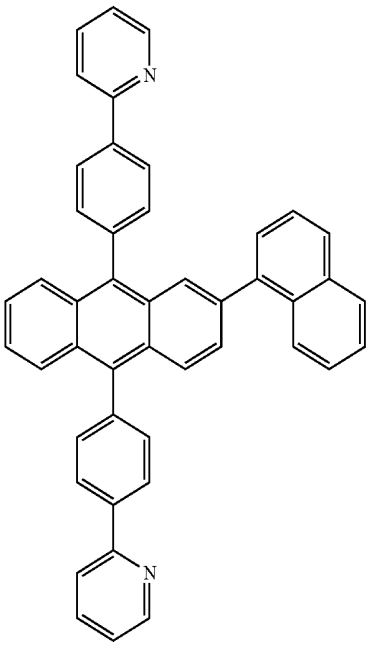
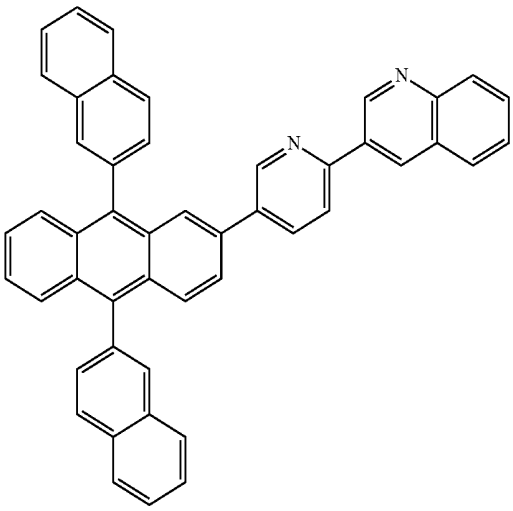
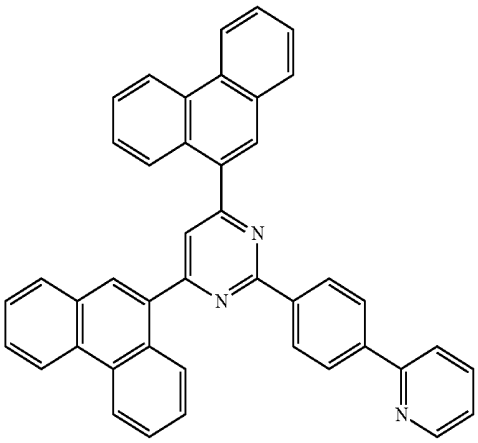
ET10



ET11



ET12



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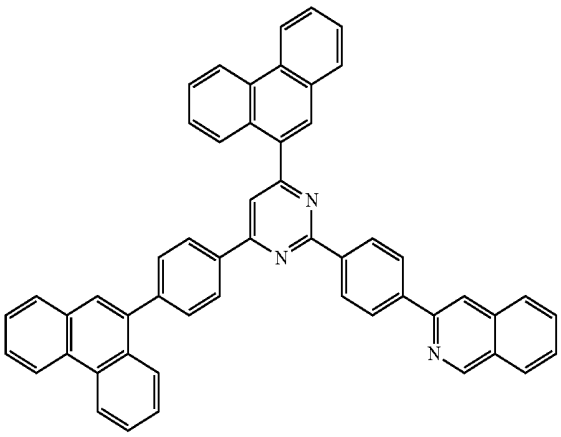
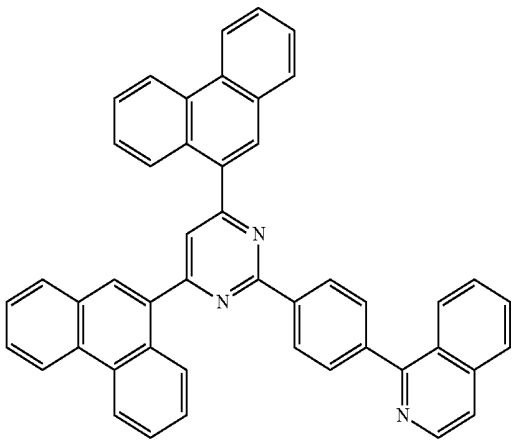
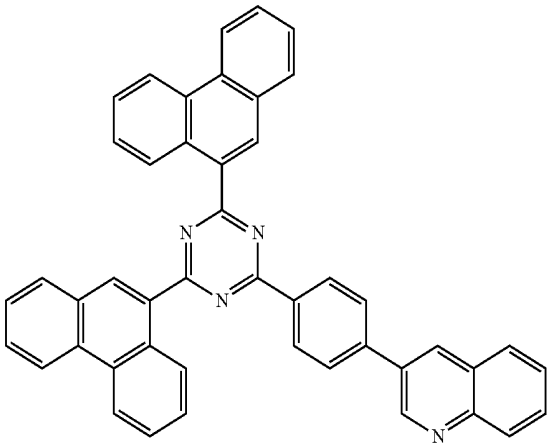
ET13



ET14



ET15

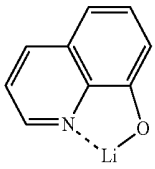


[0306] A thickness of the electron transport layer may be in a range of about 100 Å to about 1,000 Å, e.g., about 150 Å to about 500 Å. When the thickness of the electron transport layer is within the range described above, the electron transport layer may have satisfactory electron transport characteristics without a substantial increase in driving voltage.

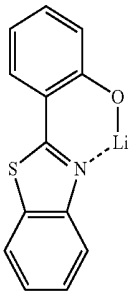
[0307] In an implementation, the electron transport layer may further include, in addition to the materials described above, a metal-containing material.

[0308] The metal-containing material may include a Li complex. The Li complex may include, e.g., Compound ET-D1 (lithium quinolate, LiQ) or ET-D2.

ET-D1



ET-D2



[0309] The electron transport region may include an electron injection layer that facilitates the injection of electrons from the second electrode **190**.

[0310] The electron injection layer may be formed on the electron transport layer by using a suitable method, e.g., vacuum deposition, spin coating casting, a LB method, ink-jet printing, laser-printing, or laser-induced thermal imaging. When an electron injection layer is formed by vacuum deposition or spin coating, deposition and coating conditions for the electron injection layer may be the same as those for the hole injection layer.

[0311] The electron injection layer may include, e.g., at least one selected from LiF, NaCl, CsF, Li_2O, BaO, and LiQ.

[0312] A thickness of the electron injection layer may be in a range of about 1 Å to about 100 Å, e.g., about 3 Å to about 90 Å. When the thickness of the electron injection layer is within the range described above, the electron injection layer may have satisfactory electron injection characteristics without a substantial increase in driving voltage.

[0313] The second electrode **190** may be disposed on the organic layer **150** having such a structure. The second electrode **190** may be a cathode which is an electron injection electrode, and in this regard, a material for the second electrode **190** may be selected from a metal, an alloy, an electrically conductive compound, and a mixture thereof, which have a relatively low work function. Examples of the material for the second electrode **190** may include lithium (Li), magnesium (Mg), aluminum (Al), aluminum-lithium (Al—Li), calcium (Ca), magnesium-indium (Mg—In), or magnesium-silver (Mg—Ag). In some embodiments, the material for forming the second electrode **190** may be ITO or IZO. The second electrode **190** may be a reflective electrode, a semi-transmissive electrode, or a transmissive electrode.

[0314] In an implementation, the location of the emission auxiliary layer **140** in the hole transport region **130** may vary. In this regard, a material included in the emission auxiliary layer may be different from a material included in the hole transport layer.

[0315] Hereinbefore, an organic light-emitting device **10** has been described in connection with FIG. **1**.

[0316] FIG. **2** illustrates a schematic cross-sectional view of an organic light-emitting device **20** according to another embodiment.

[0317] In an implementation, an emission auxiliary layer **240** may be located adjacent to, e.g., directly adjacent to, an emission layer **260**. In this regard, a material included in the emission auxiliary layer **240** may be different from a material included in a hole transport layer.

[0318] Descriptions of a first electrode **210**, a hole transport region **230**, the emission auxiliary layer **240**, an organic layer **250**, the emission layer **260**, an electron transport region **280**, and a second electrode **290** may be the same as provided in connection with FIG. **1**.

[0319] Hereinbefore, the organic light-emitting device **20** has been described with reference to FIG. **2**.

[0320] FIG. **3** illustrates a schematic cross-sectional view of an organic light-emitting device **30** according to an embodiment.

[0321] The organic light-emitting device **300** of FIG. **3** may include a substrate **310**, which may be patterned according to or may include a first sub-pixel region, a second sub-pixel region, and a third sub-pixel region.

[0322] A first sub-pixel may be formed in or on the first sub-pixel region, a second sub-pixel may be formed in or on the second sub-pixel region, and a third sub-pixel may be formed in or on the third sub-pixel region.

[0323] First electrodes **321**, **322**, and **323** may be respectively disposed on the first, second, and third sub-pixel regions of the substrate **310**. For example, one first electrode **321** may be disposed in or on the first sub-pixel region, another first electrode **322** may be disposed in or on the second sub-pixel region, and another first electrode **323** may be disposed in or on the third sub-pixel region.

[0324] A hole transport region **340** may be disposed on the first electrodes **321**, **322**, and **323**. The hole transport region **340** may be formed as a common layer on the first electrodes **321**, **322**, and **323**. The hole transport region **340** may include a first hole transport region corresponding to the first sub-pixel region; a second hole transport region corresponding to the second sub-pixel region; and a third hole transport region corresponding to the third sub-pixel region. The hole transport region **340** may include the condensed cyclic compound represented by Formulae 1 or 2.

[0325] On the hole transport region **340**, an emission layer (including a first emission layer **361**, a second emission layer **362**, and a third emission layer **363**) may be formed. The first emission layer **361** may be disposed in the first sub-pixel region and may emit light of first color, the second emission layer **362** may be disposed in the second sub-pixel region and may emit light of second color, and the third emission layer **363** may be disposed in the third sub-pixel region and may emit light of third color.

[0326] In an implementation, the light of first color may be red, the light of second color may be green, and the light of third color may be blue. In an implementation, the light of first color, the light of second color, and the light of third color may be combined to generate white light.

[0327] The hole transport region **340** may include at least one selected from a hole transport layer and an emission auxiliary layer.

[0328] When the hole transport region **340** includes a hole transport layer and an emission auxiliary layer, the emission

auxiliary layer may be disposed between the hole transport layer and each of the first, second, and third emission layers **361**, **362**, and **363**. The emission auxiliary layer may be located adjacent to, e.g., directly adjacent to, the first, second, and third emission layers **361**, **362**, and **363**.

[0329] In an implementation, the hole transport layer may include the condensed cyclic compound represented by Formulae 1 or 2.

[0330] In an implementation, the emission auxiliary layer may include the condensed cyclic compound represented by Formulae 1 or 2.

[0331] In an implementation, each of the hole transport layer and the emission auxiliary layer may include the condensed cyclic compound represented by Formulae 1 or 2. In this regard, a condensed cyclic compound included in the hole transport layer may be identical to or different from a condensed cyclic compound included in the emission auxiliary layer.

[0332] The emission auxiliary layer may include a first emission auxiliary layer, a second emission auxiliary layer, and a third emission auxiliary layer. The first emission auxiliary layer may be formed in or on the first sub-pixel region, the second emission auxiliary layer may be formed in or on the second sub-pixel region, and the third emission auxiliary layer may be formed in or on the third sub-pixel region.

[0333] An electron transport region **370** may be formed on the first, second, and third emission layers **361**, **362**, and **363**. The electron transport region **370** may be formed as a common layer on the first, second, and third emission layers **361**, **362**, and **363**. The electron transport region **370** may include an electron transport layer and an electron injection layer which are sequentially stacked in this stated order from the first, second, and third emission layers **361**, **362**, and **363**.

[0334] A second electrode may be formed as a common layer on the electron transport region **370**.

[0335] The term "the common layer" used herein refers to a layer that is formed in or on the first sub-pixel region, the second sub-pixel region, and the third sub-pixel region without being patterned according to the first sub-pixel region, the second sub-pixel region, and the third sub-pixel region.

[0336] A pixel insulating film **330** may be formed on edges of the first electrodes **321**, **322**, and **323**. The pixel insulating film **330** may define a pixel region, and may include a suitable organic insulating material or an inorganic insulating material, e.g., a silicon-based material, or an organic/inorganic composite insulating material.

[0337] Descriptions of the first electrodes **321**, **322**, and **323**, the hole transport region **340**, the first, second, and third emission layers **361**,**362**, and **363**, the electron transport region **370**, and the second electrode **380** may be understood by referring to the descriptions provided in connection with FIG. **1**.

[0338] The organic light-emitting device **300** may be included in a flat panel display device including a thin film transistor. The thin film transistor may include a gate electrode, source and drain electrodes, a gate insulating film, and an active layer, and one of the source and drain electrodes may electrically contact the first electrodes **321**, **322**, and **323** of the organic light-emitting device **300**. The active layer may include a crystalline silicon, an amorphous silicon, an organic semiconductor, or an oxide semiconductor.

[0339] A full-color organic light-emitting device has been explained in connection with FIG. **3**. In an implementation, the third emission layer **363** may extend to the first sub-pixel region and the second sub-pixel region, thereby being a common layer. In an implementation, the third auxiliary layer on the third sub-pixel region may be omitted. In an implementation, one of the first auxiliary layer and the second auxiliary layer may be formed.

[0340] A C_1-C_{60} alkyl group used herein refers to a linear or branched aliphatic hydrocarbon monovalent group having 1 to 60 carbon atoms, and detailed examples thereof are a methyl group, an ethyl group, a propyl group, an isobutyl group, a sec-butyl group, a ter-butyl group, a pentyl group, an iso-amyl group, and a hexyl group. A C_1-C_{60} alkylene group used herein refers to a divalent group having the same structure as the C_1-C_{60} alkyl group.

[0341] A C_1-C_{60} alkoxy group used herein refers to a monovalent group represented by $—OA_{101}$ (wherein A_{101} is the C_1-C_{60} alkyl group), and detailed examples thereof are a methoxy group, an ethoxy group, and an isopropyloxy group.

[0342] A C_2-C_{60} alkenyl group used herein refers to a hydrocarbon group formed by substituting at least one carbon double bond in the middle or at the terminal of the C_2-C_{60} alkyl group, and detailed examples thereof are an ethenyl group, a prophenyl group, and a butenyl group. A C_2-C_{60} alkynylene group used herein refers to a divalent group having the same structure as the C_2-C_{60} alkenyl group.

[0343] A C_2-C_{60} alkynyl group used herein refers to a hydrocarbon group having at least one carbon triple bond in the middle or at the terminal of the C_2-C_{60} alkyl group, and detailed examples thereof are an ethynyl group and a propynyl group. A C_2-C_{60} alkynylene group used herein refers to a divalent group having the same structure as the C_2-C_{60} alkynyl group.

[0344] A C_3-C_{10} cycloalkyl group used herein refers to a monovalent hydrocarbon monocyclic group having 3 to 10 carbon atoms, and detailed examples thereof are a cyclopropyl group, a cyclobutyl group, a cyclopentyl group, a cyclohexyl group, and a cycloheptyl group. A C_3-C_{10} cycloalkylene group used herein refers to a divalent group having the same structure as the C_3-C_{10} cycloalkyl group.

[0345] A C_1-C_{10} heterocycloalkyl group used herein refers to a monovalent monocyclic group having at least one hetero atom selected from N, O, P, and S as a ring-forming atom and 1 to 10 carbon atoms, and detailed examples thereof are a tetrahydrofuranyl group, and a tetrahydrothiophenyl group. A C_1-C_{10} heterocycloalkylene group used herein refers to a divalent group having the same structure as the C_1-C_{10} heterocycloalkyl group.

[0346] A C_3-C_{10} cycloalkenyl group used herein refers to a monovalent monocyclic group that has 3 to 10 carbon atoms and at least one double bond in the ring thereof and does not have aromaticity, and detailed examples thereof are a cyclopentenyl group, a cyclohexenyl group, and a cycloheptenyl group. A C_3-C_{10} cycloalkenylene group used herein refers to a divalent group having the same structure as the C_3-C_{10} cycloalkenyl group.

[0347] A C_1-C_{10} heterocycloalkenyl group used herein refers to a monovalent monocyclic group that has at least one hetero atom selected from N, O, P, and S as a ring-forming atom, 1 to 10 carbon atoms, and at least one double bond in its ring. Detailed examples of the C_1-C_{10} heterocycloalkenyl group are a 2,3-hydrofuranyl group and a 2,3-hydrothiophenyl group. A C_1-C_{10} heterocycloalkenylene group used herein refers to a divalent group having the same structure as the C_1-C_{10} heterocycloalkenyl group.

[0348] A C_6-C_{60} aryl group used herein refers to a monovalent group having a carbocyclic aromatic system having 6 to 60 carbon atoms, and a C_6-C_{60} arylene group used herein refers to a divalent group having a carbocyclic aromatic system having 6 to 60 carbon atoms. Detailed 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.

[0349] A C_1-C_{60} heteroaryl group used herein refers to a monovalent group having a carbocyclic aromatic system that has at least one hetero atom selected from N, O, P, and S as a ring-forming atom, and 1 to 60 carbon atoms. A C_1-C_{60} heteroarylene group used herein refers to a divalent group having a carbocyclic aromatic system that has at least one hetero atom selected from N, O, P, and S as a ring-forming atom, and 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.

[0350] A C_6-C_{60} aryloxy group used herein indicates —OA_{102} (wherein A_{102} is the C_6-C_{60} aryl group), and a C_6-C_{60} arylthio group indicates —SA_{103} (wherein A_{103} is the C_6-C_{60} aryl group).

[0351] A monovalent non-aromatic condensed polycyclic group used herein refers to a monovalent group that has two or more rings condensed to each other, only carbon atoms (for example, the number of carbon atoms may be in a range of 8 to 60) as a ring forming atom, and non-aromacity in the entire molecular structure. An example of the monovalent non-aromatic condensed polycyclic group is a fluorenyl group. A divalent non-aromatic condensed polycyclic group used herein refers to a divalent group having the same structure as the monovalent non-aromatic condensed polycyclic group.

[0352] A monovalent non-aromatic condensed heteropolycyclic group used herein refers to a monovalent group that has two or more rings condensed to each other, has a heteroatom selected from N, O P, and S, other than carbon atoms (for example, the number of carbon atoms may be in a range of 2 to 60), as a ring forming atom, and has non-aromacity in the entire molecular structure. An example of the monovalent non-aromatic condensed heteropolycyclic group is a carbazolyl group. A divalent non-aromatic condensed heteropolycyclic group used herein refers to a divalent group having the same structure as the monovalent non-aromatic condensed heteropolycyclic group.

[0353] At least one of substituents of the substituted C_1-C_{60} alkyl group, substituted C_2-C_{60} alkenyl group, substituted C_2-C_{60} alkynyl group, substituted C_1-C_{60} alkoxy group, substituted C_3-C_{10} cycloalkyl group, substituted C_1-C_{10} heterocycloalkyl group, substituted C_3-C_{10} cycloalkenyl group, substituted C_1-C_{10} heterocycloalkenyl group, substituted C_6-C_{60} aryl group, substituted C_6-C_{60} aryloxy group, substituted C_6-C_{60} arylthio group, substituted C_1-C_{60} heteroaryl group, substituted monovalent non-aromatic condensed polycyclic group, substituted monovalent non-aromatic condensed heteropolycyclic group, C_3-C_{10} cycloalkylene group, substituted C_1-C_{10} heterocycloalkylene group, substituted C_3-C_{10} cycloalkenylene group, substituted C_1-C_{10} heterocycloalkenylene group, substituted C_6-C_{30} arylene group, substituted C_1-C_{30} heteroarylene group, substituted a divalent non-aromatic condensed polycyclic group, and a substituted divalent non-aromatic condensed heteropolycyclic group used herein may be selected from

[0354] a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{60} alkyl group, a C_2-C_{60} alkenyl group, a C_2-C_{60} alkynyl group, and a C_1-C_{60} alkoxy group;

[0355] a C_1-C_{60} alkyl group, a C_2-C_{60} alkenyl group, a C_2-C_{60} alkynyl group, and a C_1-C_{60} alkoxy group, each substituted with at least one selected from a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_3-C_{10} cycloalkyl group, a C_1-C_{60} 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_{10} heteroaryl group, a monovalent non-aromatic condensed polycyclic group, a monovalent non-aromatic condensed heteropolycyclic group, and —$Si(Q_{13})(Q_{14})(Q_{15})$;

[0356] 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;

[0357] 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 a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid or a salt thereof, a sulfonic acid or a salt thereof, a phosphoric acid or a salt thereof, a C_1-C_{60} alkyl group, a C_2-C_{60} alkenyl group, a C_2-C_{60} alkynyl group, a C_1-C_{60} alkoxy group, a C_3-C_{10} cycloalkyl group, a C_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, and —$Si(Q_{23})(Q_{24})(Q_{25})$; and

[0358] —$Si(Q_{33})(Q_{34})(Q_{35})$,

[0359] Q_{13} to Q_{15}, Q_{23} to Q_{25}, and Q_{33} to Q_{35} may be each independently selected from a C_1-C_{60} alkyl group, a C_6-C_{60} aryl group, a C_1-C_{60} heteroaryl group, a monovalent non-aromatic condensed polycyclic group, and a monovalent non-aromatic condensed heteropolycyclic group; and

[0360] a C_6-C_{60} aryl 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 a C_6-C_{60} aryl group.

[0361] For example, at least one of substituents of the substituted C_1-C_{60} alkyl group, substituted C_2-C_{60} alkenyl group, substituted C_2-C_{60} alkynyl group, substituted C_1-C_{60} alkoxy group, substituted C_3-C_{10} cycloalkyl group, substituted C_1-C_{10} heterocycloalkyl group, substituted C_3-C_{10} cycloalkenyl group, substituted C_1-C_{10} heterocycloalkenyl group, substituted C_6-C_{60} aryl group, substituted C_6-C_{60} aryloxy

group, substituted C_6-C_{60} arylthio group, substituted C_1-C_{60} heteroaryl group, substituted monovalent non-aromatic condensed polycyclic group, substituted monovalent non-aromatic condensed heteropolycyclic group, C_3-C_{10} cycloalkylene group, substituted C_1-C_{10} heterocycloalkylene group, substituted C_3-C_{10} cycloalkenylene group, substituted C_1-C_{10} heterocycloalkenylene group, substituted C_6-C_{30} aryl ene group, substituted C_1-C_{30} heteroarylene group, substituted a divalent non-aromatic condensed polycyclic group, and a substituted divalent non-aromatic condensed heteropolycyclic group may be selected from

[0362] a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{30} alkyl group, a C_2-C_{30} alkenyl group, a C_2-C_{30} alkynyl group, and a C_1-C_{30} alkoxy group;

[0363] a C_1-C_{30} alkyl group, a C_2-C_{30} alkenyl group, a C_2-C_{30} alkynyl group, and a C_1-C_{30} alkoxy group, each substituted with at least one selected from deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_3-C_{10} cycloalkyl group, a C_1-C_{10} heterocycloalkyl group, a C_3-C_{10} cycloalkenyl group, a C_1-C_{10} heterocycloalkenyl group, a C_6-C_{30} aryl group, a C_6-C_{30} aryloxy group, a C_6-C_{30} arythio group, a C_1-C_{30} heteroaryl group, a monovalent non-aromatic condensed polycyclic group, a monovalent non-aromatic condensed heteropolycyclic group, and —$Si(Q_{13})(Q_{14})(Q_{15})$;

[0364] a phenyl group, a pentalenyl group, an indenyl group, a naphthyl group, an azulenyl group, a heptalenyl group, an indacenyl group, an acenaphthyl group, a fluorenyl group, a spiro-fluorenyl group, a phenalenyl group, a phenanthrenyl group, an anthracenyl group, a fluoranthrenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a naphthacenyl group, a picenyl group, a perylenyl group, a pentaphenyl group, a hexacenyl group, a pyrrolyl group, an imidazolyl group, a pyrazolyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, an indolyl group, an indazolyl group, a purinyl group, a quinolinyl group, an isoquinolinyl group, a benzoquinolinyl group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, a quinazolinyl group, a cinnolinyl group, a carbazolyl group, a phenanthridinyl group, an acridinyl group, a phenanthrolinyl group, a phenazinyl group, a benzoxazolyl group, a benzoimidazolyl group, a furanyl group, a benzofuranyl group, a thiophenyl group, a benzothiophenyl group, a thiazolyl group, an isothiazolyl group, a benzothiazolyl group, an isoxazolyl group, an oxazolyl group, a triazolyl group, a tetrazolyl group, an oxadiazolyl group, a triazinyl group, a dibenzofuranyl group, a dibenzothiophenyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, an imidazopyrimidinyl group, and an imidazopyridinyl group, each substituted with at least one selected from a cyclopentyl group, a cyclohexyl group, a cycloheptyl group, a cyclooctyl group, a cyclopentenyl group, a cyclohexcenyl group, a cycloheptenyl group, a phenyl group, a naphthyl group, an anthracenyl group, a pyrenyl group, a phenanthrenyl group, a fluorenyl group, a carbazolyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a pyridinyl group, a pyrimidinyl group, a pyrazinyl group, a pyridazinyl group, a triazinyl group, a quinolinyl group, an isoquinolinyl group, a phthalazinyl group, a quinoxalinyl group, a cinnolinyl group, and a quinazolinyl group;

[0365] a phenyl group, a pentalenyl group, an indenyl group, a naphthyl group, an azulenyl group, a heptalenyl group, an indacenyl group, an acenaphthyl group, a fluorenyl group, a spiro-fluorenyl group, a phenalenyl group, a phenanthrenyl group, an anthracenyl group, a fluoranthrenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a naphthacenyl group, a picenyl group, a perylenyl group, a pentaphenyl group, a hexacenyl group, a pyrrolyl group, an imidazolyl group, a pyrazolyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, an indolyl group, an indazolyl group, a furinyl group, a quinolinyl group, an isoquinolinyl group, a benzoquinolinyl group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, a quinazolinyl group, a cinnolinyl group, a carbazolyl group, a phenanthridinyl group, an acridinyl group, a phenanthrolinyl group, a phenazinyl group, a benzoxazolyl group, a benzoimidazolyl group, a furanyl group, a benzofuranyl group, a thiophenyl group, a benzothiophenyl group, a thiazolyl group, an isothiazolyl group, a benzothiazolyl group, an isoxazolyl group, an oxazolyl group, a triazolyl group, a tetrazolyl group, an oxadiazolyl group, a triazinyl group, a dibenzofuranyl group, a dibenzothiophenyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, an imidazopyrimidinyl group, and an imidazopyridinyl group, each substituted with at least one selected from

[0366] a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{30} alkyl group, a C_2-C_{30} alkenyl group, a C_2-C_{30} alkynyl group, a C_1-C_{30} alkoxy 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_{30} aryl group, a C_6-C_{30} aryloxy group, a C_6-C_{30} arythio group, a C_1-C_{30} heteroaryl group, a monovalent non-aromatic condensed polycyclic group, a monovalent non-aromatic condensed heteropolycyclic group, and —$Si(Q_{23})(Q_{24})(Q_{25})$; and

[0367] —$Si(Q_{33})(Q_{34})(Q_{35})$,

[0368] wherein Q_{13} to Q_{15}, Q_{23} to Q_{25}, and Q_{33} to Q_{35} may be each independently selected from a phenyl group, a pentalenyl group, an indenyl group, a naphthyl group, an azulenyl group, a heptalenyl group, an indacenyl group, an acenaphthyl group, a fluorenyl group, a spiro-fluorenyl group, a phenalenyl group, a phenanthrenyl group, an anthracenyl group, a fluoranthrenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a naphthacenyl group, a picenyl group, a perylenyl group, a pentaphenyl group, a hexacenyl group, a pyrrolyl group, an imidazolyl group, a pyrazolyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, an indolyl group, an indazolyl group, a furinyl group, a quinolinyl group, an isoquinolinyl group, a benzoquinolinyl group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, a quinazolinyl group, a cinnolinyl group, a carbazolyl group, a phenanthridinyl group, an acridinyl group, a phenan-

throlinyl group, a phenazinyl group, a benzoxazolyl group, a benzoimidazolyl group, a furanyl group, a benzofuranyl group, a thiophenyl group, a benzothiophenyl group, a thiazolyl group, an isothiazolyl group, a benzothiazolyl group, an isoxazolyl group, an oxazolyl group, a triazolyl group, a tetrazolyl group, an oxadiazolyl group, a triazinyl group, a dibenzofuranyl group, a dibenzothiophenyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, an imidazopyrimidinyl group, and an imidazopyridinyl group, each substituted with at least one selected from a hydrogen, a C_1-C_{30} alkyl group, a C_2-C_{30} alkenyl group, a C_2-C_{30} alkynyl group, a C_1-C_{30} alkoxy group, a cyclopentyl group, a cyclohexyl group, a cycloheptyl group, a cyclooctyl group, a cyclopentenyl group, a cyclohepcenyl group, a cyclohepcenyl group, a phenyl group, a naphthyl group, an anthracenyl group, a pyrenyl group, a phenanthrenyl group, a fluorenyl group, a carbazolyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a pyridinyl group, a pyrimidinyl group, a pyrazinyl group, a pyridazinyl group, a triazinyl group, a quinolinyl group, an isoquinolinyl group, a phthalazinyl group, a quinoxalinyl group, a cinnolinyl group, and a quinazolinyl group.

[0369] The term "Ph" used herein refers to phenyl group, the term "Me" used herein refers to methyl group, the term "Et" used herein refers to ethyl group, and the term "ter-Bu" or "But" used herein refers to tert-butyl.

[0370] Hereinafter, an organic light-emitting device according to an embodiment will be described in detail with reference to Synthesis Examples and Examples. The wording "B was used instead of A" used in describing Synthesis Examples means that a molar equivalent of A was identical to a molar equivalent of B.

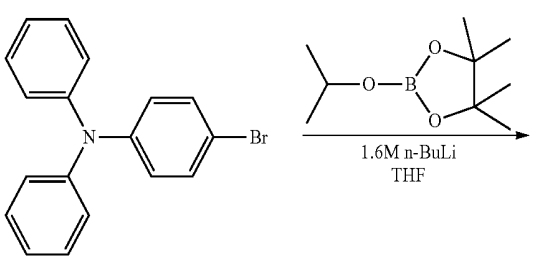
[0371] The following Examples and Comparative Examples are provided in order to highlight characteristics of one or more embodiments, but it will be understood that the Examples and Comparative Examples are not to be construed as limiting the scope of the embodiments, nor are the Comparative Examples to be construed as being outside the scope of the embodiments. Further, it will be understood that the embodiments are not limited to the particular details described in the Examples and Comparative Examples.

EXAMPLES

Synthesis Example 1

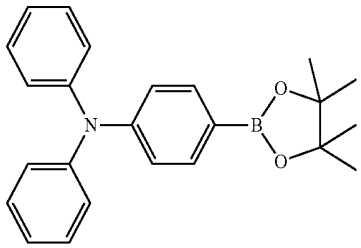
Synthesis of Compound 1

[0372]

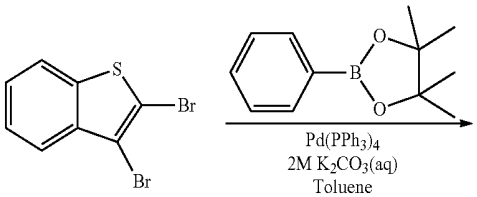


I-1

-continued



I-2



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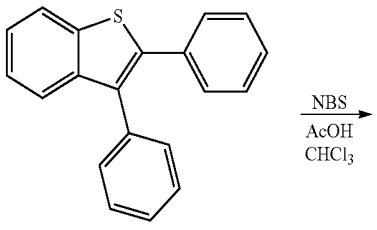
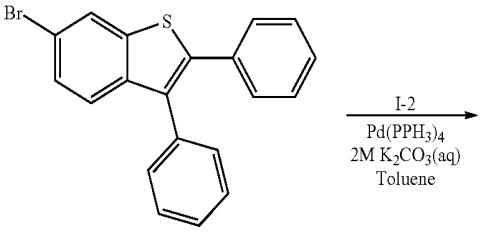
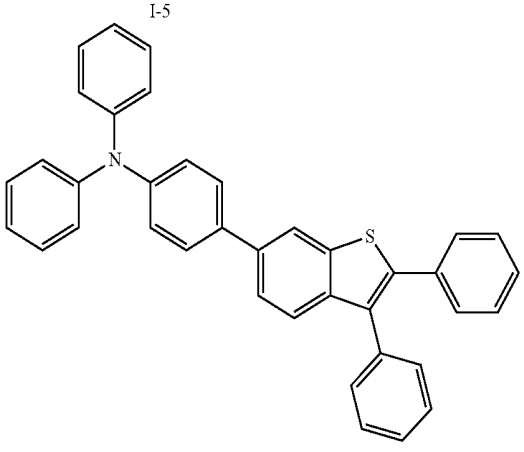


I-4



I-5



1

1) Synthesis of Intermediate I-2

[0373] 10 g (30.84 mmol) of Compound I-1 was dissolved in 170 ml of tetrahydrofuran, and then, stirred at a temperature of −78° C. 20.24 ml (32.39 mmol) of 1.6 M n-BuLi was slowly added thereto, and at a temperature of −78° C., the result was stirred for 30 minutes. 7.55 ml (37.01 mmol) of isopropoxy-4,4,5,5-tetramethyl[1,3,2]dioxaborolane was slowly added thereto, and stirred at a temperature of −78° C. for 6 hours. Once the reaction was complete, 100 ml of distilled water was added thereto, and then an extraction process was performed thereon by using ethyl acetate. The result was dried by using magnesium sulfate, filtered, and a solvent was removed therefrom by evaporation. Thereafter, column chromatography was performed thereon to obtain 8.24 g (yield of 72%) of Intermediate I-2 (N,N-diphenyl-4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolane-2-yl)aniline).

2) Synthesis of Intermediate I-4

[0374] 5 g (17.12 mmol) of Compound I-3, 4.19 g (20.54 mmol) of 4,4,5,5-tetramethyl-2-phenyl-1,3,2-dioxaborolane, and 989 mg (0.86 mmol) of tetrakis(triphenylphosphine)palladium(0) were dissolved in 43 ml of 2 M K_2CO_3 (aqueous solution) and 50 ml of toluene, and then, the result was stirred at a temperature of 110° C. for 8 hours while refluxing. Once the reaction was complete, 40 ml of cold distilled water was added thereto, and then an extraction process was performed thereon by using ethyl acetate. The result was dried by using magnesium sulfate, filtered, and a solvent was removed therefrom by evaporation. Thereafter, column chromatography was performed thereon to obtain 3.37 g (yield of 69%) of Intermediate I-4 (2,3-diphenylbenzo[b]thiophene).

3) Synthesis of Intermediate I-5

[0375] 3 g (10.48 mmol) of Intermediate I-4 was dissolved in 30 ml of an acetic acid and 30 ml of chloroform, and then, 1.96 g (11.00 mmol) of N-bromosuccinimide was added thereto, and the result was stirred at ambient temperature for 1 hour. Once the reaction was complete, 30 ml of cold distilled water was added thereto, and then, saturated Na_2CO_3 solution was added thereto to neutralize the reaction solution, which was then subjected to an extraction process using thyl acetate. The result was dried by using magnesium sulfate, filtered, and then, a solvent was removed therefrom by evaporation. Then, column chromatography was performed thereon to obtain 3.45 g (yield of 90%) of Intermediate I-5 (6-bromo-2,3-diphenylbenzo[b]thiophene).

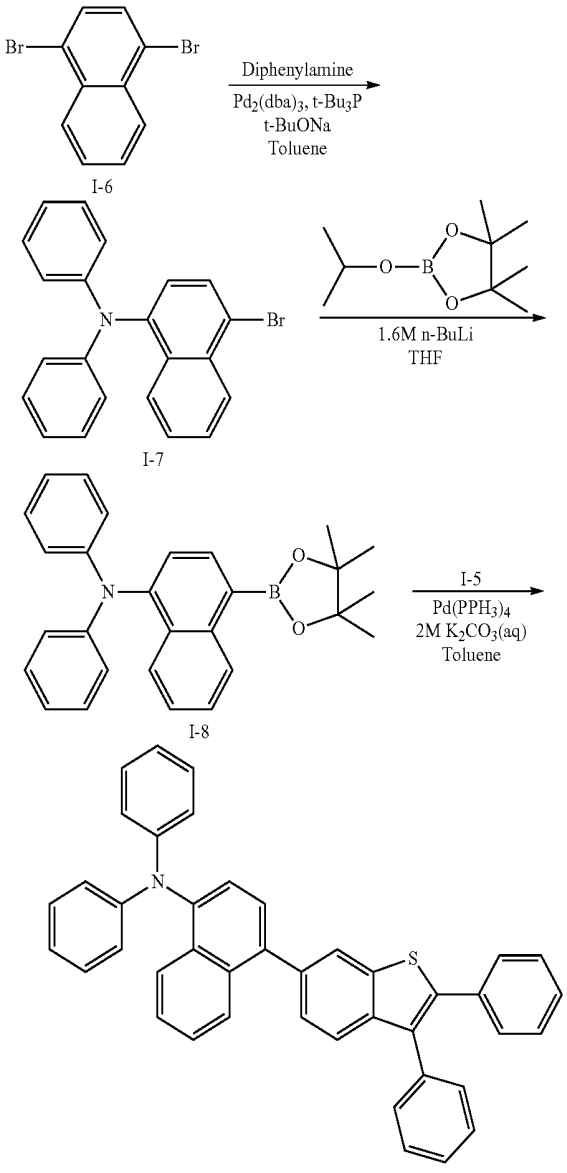
4) Synthesis of Compound 1

[0376] 3 g (8.21 mmol) of Intermediate I-5, 3.66 g (9.86 mmol) of Intermediate I-2, and 475 mg (0.41 mmol) of tetrakis(triphenylphosphine)palladium(0) were dissolved in 21 ml of 2 M K_2CO_3 (aqueous solution) and 30 ml of toluene, and then, the result was stirred at a temperature of 110° C. for 8 hours while refluxing. Once the reaction was complete, 24 ml of cold distilled water was added thereto, and then an extraction process was performed thereon by using ethyl acetate. The result was dried by using magnesium sulfate, filtered, and then, a solvent was removed therefrom by evaporation. Thereafter, column chromatography was performed thereon to obtain 3.88 g (yield of 89%) of Compound 1 (4-(2,3-diphenyl diphenylbenzo[b]thiophene-6-yl)-N,N-diphenylaniline).

Synthesis Example 2

Synthesis of Compound 10

[0377]



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Synthesis of Intermediate I-7

[0378] 160.1 mg (0.17 mmol) of $Pd_2(dba)_3$ and 70.7 mg (0.35 mmol) of t-Bu_3P were dissolved in 50 ml of o-xylene, and then, the result was stirred for 10 minutes at ambient temperature. 5 g (17.48 mmol) of Compound I-6, 3.25 g (19.23 mmol) of diphenylamine, and 1 g (10.49 mmol) of t-BuONa were added thereto, and the result was stirred at a temperature of 160° C. for 48 hours while refluxing. Once the reaction was complete, 20 ml of cold distilled water was added thereto, and then an extraction process was performed thereon by using ethyl acetate. The result was dried by using magnesium sulfate, filtered, and a solvent was removed therefrom by evaporation. Then, column chromatography was per-

formed thereon to obtain 3.21 g (yield of 49%) of Intermediate I-7 (4-bromo-N,N-diphenylnaphthalene-1-amine).

2) Synthesis of Intermediate I-8

[0379] 3.5 g (9.35 mmol) of Intermediate I-7 was dissolved in 60 ml of tetrahydrofuran, and then stirred at a temperature of −78° C. 6.14 ml (9.82 mmol) of 1.6M n-BuLi was slowly added thereto, and at a temperature of −78° C., the result was stirred for 30 minutes. 2.29 ml (11.22 mmol) of isopropoxy-4,4,5,5-tetramethyl[1,3,2]dioxaborolane was slowly added thereto, and stirred at a temperature of −78° C. for 6 hours. Once the reaction was complete, 100 ml of distilled water was added thereto, and then an extraction process was performed thereon by using ethyl acetate. The result was dried by using magnesium sulfate, filtered, and a solvent was removed therefrom by evaporation. Thereafter, column chromatography was performed thereon to obtain 3.15 g (yield of 80%) of Intermediate I-8 (N,N-diphenyl-4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolane-2-yl)naphthalene-1-amine).

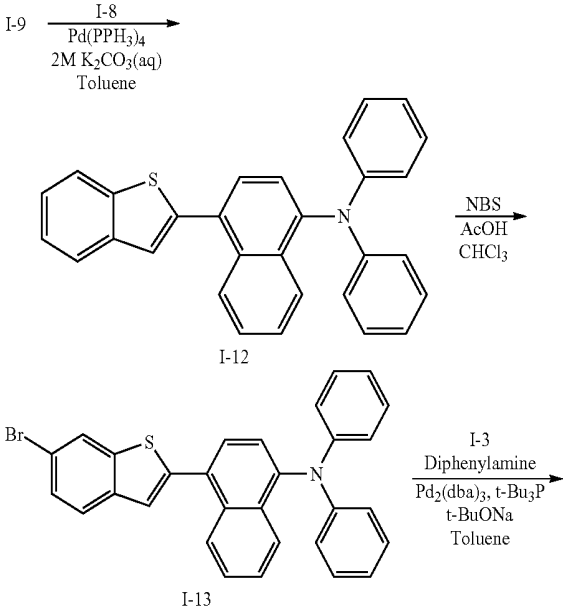
3) Synthesis of Compound 10

[0380] 3 g (8.21 mmol) of Intermediate I-5, 4.15 g (9.86 mmol) of Intermediate I-8, and 475 mg (0.41 mmol) of tetrakis(triphenylphosphine)palladium(0) were dissolved in 21 ml of 2 M K_2CO_3 (aqueous solution) and 30 ml of toluene, and then; the result was stirred at a temperature of 110° C. for 8 hours while refluxing. Once the reaction was complete, 24 ml of cold distilled water was added thereto, and then an extraction process was performed thereon by using ethyl acetate. The result was dried by using magnesium sulfate, filtered, and a solvent was removed therefrom by evaporation. Thereafter, column chromatography was performed thereon to obtain 3.96 g (yield of 83%) of Compound 10 (4-(2,3-diphenyl diphenylbenzo[b]thiophene-6-yl)-N,N-diphenylaniline).

Synthesis Example 3

Synthesis of Compound 20

[0381]



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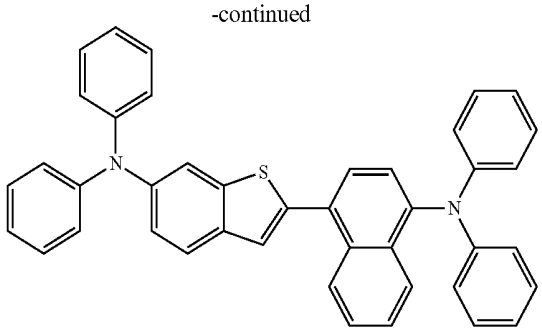


20

1) Synthesis of Intermediate I-12

[0382] 5 g (23.46 mmol) of Compound I-9, 11.86 g (28.16 mmol) of Intermediate I-8, and 1.36 mg (1.17 mmol) of tetrakis(triphenylphosphine)palladium(0) were dissolved in 59 ml of 2 M K_2CO_3 (aqueous solution) and 50 ml of toluene, and then, the result was stirred at a temperature of 110° C. for 8 hours while refluxing. Once the reaction was complete, 40 ml of cold distilled water was added thereto, and then an extraction process was performed thereon by using ethyl acetate. The result was dried by using magnesium sulfate, filtered, and a solvent was removed therefrom by evaporation. Thereafter, column chromatography was performed thereon to obtain 9.24 g (yield of 92%) of Intermediate I-12 (4-(benzo[b]thiophene-2-yl)-N,N-diphenylnaphthalene-1-amine).

2) Synthesis of Intermediate I-13

[0383] 5 g (11.69 mmol) of Intermediate I-12 was dissolved in 50 ml of an acetic acid and 50 ml of chloroform, and then, 2.19 g (12.28 mmol) of N-bromosuccinimide was added thereto, and the result was stirred at ambient temperature for 1 hour. Once the reaction was complete, 50 ml of distilled water was added thereto, and a saturated Na_2CO_3 aqueous solution was added thereto to perform a neutralization reaction, followed by an extraction process using ethyl acetate. The result was dried by using magnesium sulfate, and filtered, and a solvent was removed therefrom by evaporation. Thereafter, column chromatography was performed thereon to obtain 4.82 g (yield of 81%) of Intermediate I-13 (4-(6-bromobenzo[b]thiophene-2-yl)-N,N-diphenylnaphthalene-1-amine).

3) Synthesis of Compound 20

[0384] 90.4 mg (0.10 mmol) of $Pd_2(dba)_3$ and 39.9 mg (0.20 mmol) of t-Bu_3P were dissolved in 50 ml of o-xylene, and then, the result was stirred for 10 minutes at ambient temperature. 5 g (9.87 mmol) of Intermediate I-13, 1.84 g (10.86 mmol) of diphenylamine, and 569.2 mg (5.92 mmol) of t-BuONa were added thereto, and the result was stirred at a temperature of 160° C. for 48 hours while refluxing. Once the reaction was complete, 30 ml of cold distilled water was added thereto, and then an extraction process was performed thereon by using ethyl acetate. The result was dried by using magnesium sulfate, filtered, and a solvent was removed therefrom by evaporation. Thereafter, column chromatography was performed thereon to obtain 4.88 g (yield of 83%) of Compound 20 (2-(4-(diphenylan amino group)naphthalene-1-yl)-N,N-diphenylbenzo[b]thiophene-6-amine).

Example 1

[0385] An ITO glass substrate (a product of Corning Co., Ltd) having a sheet resistance of 15 Ω/cm^2 and a thickness of 500 Å was cut to a size of 50 mm×50 mm×0.7 mm, and then, sonicated by using isopropyl alcohol and pure water each for 5 minutes, and cleaned by the exposure to ultraviolet rays for 30 minutes, and then ozone, and the ITO glass substrate was mounted on a vacuum deposition apparatus.

[0386] 2-TNATA was deposited on the ITO glass substrate to form a hole injection layer having a thickness of 600 Å. Then, NPB was deposited on the hole injection layer to form a hole transport layer having a thickness of 300 Å. Then, Compound 2 was vacuum deposited on the hole transport layer to form an emission auxiliary layer having a thickness of 100 Å.

[0387] ADN and TBPe were co-deposited on the emission auxiliary layer at a weight ratio of 95:5 to form an emission layer having a thickness of 200 Å.

[0388] Thereafter, ET1 was deposited on the emission layer to form an electron transport layer having a thickness of 300 Å, and LiF was deposited on the electron transport layer to form an electron injection layer having a thickness of 10 Å. Al was deposited on the electron injection layer to form a cathode having a thickness of 1,000 Å, thereby completing the manufacture of an organic light-emitting device.

Example 2

[0389] An organic light-emitting device was manufactured in the same manner as in Example 1, except that in forming the emission auxiliary layer, Compound 11 was used instead of Compound 2.

Example 3

[0390] An organic light-emitting device was manufactured in the same manner as in Example 1, except that in forming the emission auxiliary layer, Compound 17 was used instead of Compound 2.

Example 4

[0391] An organic light-emitting device was manufactured in the same manner as in Example 1, except that in forming the emission auxiliary layer, Compound 27 was used instead of Compound 2.

Example 5

[0392] An organic light-emitting device was manufactured in the same manner as in Example 1, except that in forming the emission auxiliary layer, Compound 43 was used instead of Compound 2.

Example 6

[0393] An organic light-emitting device was manufactured in the same manner as in Example 1, except that in forming the emission auxiliary layer, Compound 46 was used instead of Compound 2.

Example 7

[0394] An organic light-emitting device was manufactured in the same manner as in Example 1, except that in forming the emission auxiliary layer, Compound 49 was used instead of Compound 2.

Example 8

[0395] An organic light-emitting device was manufactured in the same manner as in Example 1, except that in forming the emission auxiliary layer, Compound 50 was used instead of Compound 2.

Example 9

[0396] An organic light-emitting device was manufactured in the same manner as in Example 1, except that in forming the emission auxiliary layer, Compound 58 was used instead of Compound 2.

Example 10

[0397] An organic light-emitting device was manufactured in the same manner as in Example 1, except that in forming the emission auxiliary layer, Compound 61 was used instead of Compound 2.

Example 11

[0398] An organic light-emitting device was manufactured in the same manner as in Example 1, except that in forming the emission auxiliary layer, Compound 65 was used instead of Compound 2.

Example 12

[0399] An organic light-emitting device was manufactured in the same manner as in Example 1, except that in forming the hole transport layer, Compound 32 was used instead of NPB.

Example 13

[0400] An organic light-emitting device was manufactured in the same manner as in Example 1, except that in forming the hole transport layer, Compound 25 was used instead of NPB.

Example 14

[0401] An ITO glass substrate (a product of Corning Co., Ltd) having a sheet resistance of 15 Ω/cm^2 and a thickness of 500 Å was cut to a size of 50 mm×50 mm×0.7 mm, and then, sonicated by using isopropyl alcohol and pure water each for 5 minutes, and cleaned by the exposure to ultraviolet rays for 30 minutes, and then ozone, and the ITO glass substrate was mounted on a vacuum deposition apparatus.

[0402] 2-TNATA was deposited on the ITO glass substrate to form a hole injection layer having a thickness of 600 Å. Then, HT5 was deposited on the hole injection layer to form a hole transport layer having a thickness of 300 Å. Then, Compound 2 was vacuum deposited on the hole transport layer to form an emission auxiliary layer having a thickness of 100 Å.

[0403] CBP and PD1 ($Ir(ppy)_3$) were co-deposited at a weight ratio of 85:15 on the emission auxiliary layer to form an emission layer having a thickness of 300 Å.

[0404] Thereafter, ET1 was deposited on the emission layer to form an electron transport layer having a thickness of 300 Å, and LiF was deposited on the electron transport layer to form an electron injection layer having a thickness of 10 Å. Al was deposited on the electron injection layer to form a cathode having a thickness of 1,000 Å, thereby completing the manufacture of an organic light-emitting device.

Example 15

[0405] An organic light-emitting device was manufactured in the same manner as in Example 14, except that in forming the emission auxiliary layer, Compound 27 was used instead of Compound 2.

Example 16

[0406] An organic light-emitting device was manufactured in the same manner as in Example 14, except that in forming the emission auxiliary layer, Compound 17 was used instead of Compound 2.

Comparative Example 1

[0407] An organic light-emitting device was manufactured in the same manner as in Example 1, except that in forming the emission auxiliary layer, Compound HT3 was used instead of Compound 2.

Comparative Example 2

[0408] An organic light-emitting device was manufactured in the same manner as in Example 14, except that in forming the emission auxiliary layer, Compound HT3 was used instead of Compound 2.

Evaluation Example

[0409] The luminescent efficiency and lifespan of the organic light-emitting devices manufactured according to Examples 1 to 16, and Comparative Examples 1 and 2 were measured by using Kethley SMU 236 and a brightness photometer PR650, and results thereof are shown in Table 1. The lifespan is a period of time that lapses until the brightness of the organic light-emitting device was 95% of initial brightness. Herein, the efficiency and lifespan are shown as a ratio value with respect to those of Comparative Examples. Examples 1 to 13 were compared with Comparative Example 1, and Examples 14-16 were compared with Comparative Example 2.

TABLE 1

Example	Hole transport layer	Emission auxiliary layer	Emission layer	Emission Efficiency	Lifespan
Example 1	NPB	Compound 2	ADN:TBPe	1.2	1.15
Example 2	NPB	Compound 11	ADN:TBPe	1.15	1.2
Example 3	NPB	Compound 17	ADN:TBPe	1.2	1.2
Example 4	NPB	Compound 27	ADN:TBPe	1.3	1.2
Example 5	NPB	Compound 43	ADN:TBPe	1.2	1.2
Example 6	NPB	Compound 46	ADN:TBPe	1.3	1.2
Example 7	NPB	Compound 49	ADN:TBPe	1.3	1.2
Example 8	NPB	Compound 50	ADN:TBPe	1.3	1.3
Example 9	NPB	Compound 58	ADN:TBPe	1.3	1.2
Example 10	NPB	Compound 61	ADN:TBPe	1.3	1.1
Example 11	NPB	Compound 65	ADN:TBPe	1.25	1.1
Example 12	Compound 32	Compound 2	ADN:TBPe	1.2	1.2
Example 13	Compound 25	Compound 2	ADN:TBPe	1.2	1.1
Example 14	HT3	Compound 2	CBP:PD1	1.1	1.35
Example 15	HT3	Compound 27	CBP:PD1	1.05	1.2
Example 16	HT3	Compound 17	CBP:PD1	1.1	1.2
Comparative Example 1	NPB	HT3	ADN:TBPe	1	1
Comparative Example 2	NPB	HT3	CBP:PD1	1	1

[0410] From Table 1, it may be seen that the luminescent efficiency and lifespan of the organic light-emitting devices manufactured according to Examples 1 to 16 are higher than he luminescent efficiency and lifespan of the organic light-emitting devices manufactured according to Comparative Examples 1 and 2.

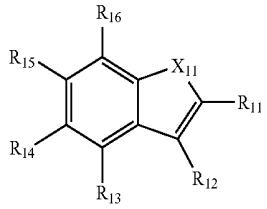
[0411] According to embodiments, an organic light-emitting device including the condensed cyclic compound may have a low driving voltage, high efficiency, high luminance, and long lifespan.

[0412] Example embodiments have been disclosed herein, and although specific terms are employed, they are used and are to be interpreted in a generic and descriptive sense only and not for purpose of limitation. In some instances, as would be apparent to one of ordinary skill in the art as of the filing of the present application, features, characteristics, and/or elements described in connection with a particular embodiment may be used singly or in combination with features, characteristics, and/or elements described in connection with other embodiments unless otherwise specifically indicated. Accordingly, it will be understood by those of skill in the art that various changes in form and details may be made without departing from the spirit and scope of the present invention as set forth in the following claims.

What is claimed is:

1. A condensed cyclic compound represented by one of the following Formulae 1 or 2:

<Formula 1>



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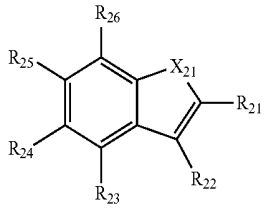
<Formula 2>



wherein, in Formulae 1 and 2,

X_{11} is selected from a sulfur (S) atom, an oxygen (O) atom, and $N(R_{17})$;

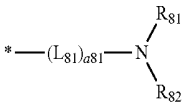
X_{21} is selected from a sulfur (S) atom, an oxygen (O) atom, and $N(R_{27})$;

R_{11}, R_{17}, and R_{27} are each independently selected from a hydrogen, a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a substituted or unsubstituted C_1-C_{60} alkyl group, a substituted or unsubstituted C_2-C_{60} alkenyl group, a substituted or unsubstituted C_2-C_{60} alkynyl group, a substituted or unsubstituted C_1-C_{60} alkoxy group, a substituted or unsubstituted C_3-C_{10} cycloalkyl group, a substituted or unsubstituted C_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, and a substituted or unsubstituted monovalent non-aromatic condensed heteropolycyclic group;

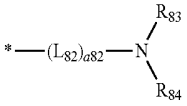
R_{12} to R_{16} and R_{22} to R_{26} are each independently selected from a group represented by the following Formula 8-1, a hydrogen, a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a substituted or unsubstituted C_1-C_{60} alkyl group, a substituted or unsubstituted C_2-C_{60} alkenyl group, a substituted or unsubstituted C_2-C_{60} alkynyl group, a substituted or unsubstituted C_1-C_{60} alkoxy group, a substituted or unsubstituted C_3-C_{10} cycloalkyl group, a substituted or unsubstituted 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, and a substituted or unsubstituted monovalent non-aromatic condensed heteropolycyclic group;

R_{21} is a group represented by the following Formula 8-2;

<Formula 8-1>



<Formula 8-2>



at least one selected from R_{12} to R_{16} is a group represented by Formula 8-1;

at least one selected from R_{22} to R_{26} is a group represented by Formula 8-1;

wherein, in Formulae 8-1 and 8-2,

L_{81} and L_{82} are each independently selected from 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_{30} arylene group, a substituted or unsubstituted C_1-C_{30} heteroarylene group, a substituted or unsubstituted divalent non-aromaticcondensed polycyclic group, and a substituted or unsubstituted divalent non-aromaticcondensed heteropolycyclic group;

a81 and a82 are each independently selected from 0, 1, 2, and 3;

R_{81} to R_{84} are each independently selected from a substituted or unsubstituted C_1-C_{60} alkyl group, a substituted or unsubstituted C_2-C_{60} alkenyl group, a substituted or unsubstituted C_2-C_{60} alkynyl group, a substituted or unsubstituted C_1-C_{60} alkoxy group, a substituted or unsubstituted C_3-C_{10} cycloalkyl group, a substituted or unsubstituted C_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, and a substituted or unsubstituted monovalent non-aromatic condensed heteropolycyclic group;

R_{81} and R_{82} are separate from one another or N, R_{81}, and R_{82} are bound to form a carbazole group;

R_{83} and R_{84} are separate from one another or N, R_{83} and R_{84} are bound to form a carbazole group; and

* indicates a binding site to a neighboring atom.

2. The condensed cyclic compound as claimed in claim **1**, wherein R_{11}, R_{17}, and R_{27} are each independently selected from:

a hydrogen, a deuterium, —F, —Cl, —Br, —I, a methyl group, an ethyl group, a propyl group, a butyl group, pentyl group, a hexyl group, a heptyl group, an octyl group, a nonyl group, a decyl group, a phenyl group, a pentalenyl group, an indenyl group, a naphthyl group, an azulenyl group, a heptalenyl group, an indacenyl group,

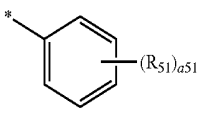
an acenaphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenalenyl group, a phenanthrenyl group, an anthracenyl group, a fluoranthenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a naphthacenyl group, a picenyl group, a perylenyl group, a pentaphenyl group, a hexacenyl group, a pentacenyl group, a rubicenyl group, a coronenyl group, an ovalenyl group, a pyrrolyl group, a thiophenyl group, a furanyl group, an imidazolyl group, a pyrazolyl group, a thiazolyl group, an isothiazolyl group, an oxazolyl group, an isoxazolyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, an indolyl group, an indazolyl group, a purinyl group, a quinolinyl group, an isoquinolinyl group, a carbazolyl group, a benzoquinolinyl group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, a benzoquinoxalinyl group, a quinazolinyl group, a benzoquinazolinyl 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, 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 benzocarbazolyl group, a dibenzocarbazolyl group, a thiadiazolyl group, an imidazopyridinyl group, and an imidazopyrimidinyl group; and

a phenyl group, a pentalenyl group, an indenyl group, a naphthyl group, an azulenyl group, a heptalenyl group, an indacenyl group, an acenaphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenalenyl group, a phenanthrenyl group, an anthracenyl group, a fluoranthenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a naphthacenyl group, a picenyl group, a perylenyl group, a pentaphenyl group, a hexacenyl group, a pentacenyl group, a rubicenyl group, a coronenyl group, an ovalenyl group, a pyrrolyl group, a thiophenyl group, a furanyl group, an imidazolyl group, a pyrazolyl group, a thiazolyl group, an isothiazolyl group, an oxazolyl group, an isoxazolyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, an indolyl group, an indazolyl group, a purinyl group, a quinolinyl group, an isoquinolinyl group, a carbazolyl group, a benzoquinolinyl group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, a benzoquinoxalinyl group, a quinazolinyl group, a benzoquinazolinyl 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, 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 benzocarbazolyl group, a dibenzocarbazolyl group, a thiadiazolyl group, an imidazopyridinyl group and an imidazopyrimidinyl group, a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a phenyl group, a biphenyl group, a pentalenyl group, an indenyl group, a naphthyl group, an azulenyl group, a heptalenyl group, an indacenyl group, an acenaphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenalenyl group, a phenanthrenyl group, an anthracenyl group, a fluoranthenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a naphthacenyl group, a picenyl group, a perylenyl group, a pentaphenyl group, a hexacenyl group, a pentacenyl group, a rubicenyl group, a coronenyl group, an ovalenyl group, a pyrrolyl group, a thiophenyl group, a furanyl group, an imidazolyl group, a pyrazolyl group, a thiazolyl group, an isothiazolyl group, an oxazolyl group, an isoxazolyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, an indolyl group, an indazolyl group, a purinyl group, a quinolinyl group, an isoquinolinyl group, a carbazolyl group, a benzoquinolinyl group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, a benzoquinoxalinyl group, a quinazolinyl group, a benzoquinazolinyl group, a cinnolinyl group, a carbazolyl group, a phenanthridinyl group, an acridinyl group, a phenanthrolinyl group, a phenazinyl group, a benzimidazolyl group, a benzofuranyl group, a benzothiophenyl group, an isobenzothiazolyl group, a benzoxazolyl group, an isobenzoxazolyl group, a triazolyl group, a tetrazolyl group, an oxadiazolyl group, a triazinyl group, a dibenzofuranyl group, a dibenzothiophenyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a thiadiazolyl group, an imidazopyridinyl group, an imidazopyrimidinyl group, and —$Si(Q_{33})(Q_{34})(Q_{35})$;

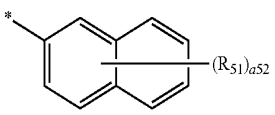
wherein Q_{33} to Q_{35} are each independently selected from a C_1-C_{60} alkyl group and a C_6-C_{60} aryl group.

3. The condensed cyclic compound as claimed in claim **1**, wherein R_{11}, R_{17}, and R_{27} are each independently a group represented by one of the following Formulae 5-1 to 5-10:

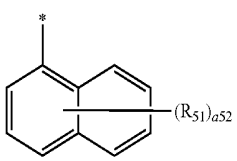
5-1



5-2

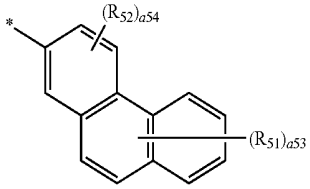


5-3

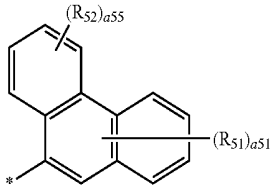


-continued

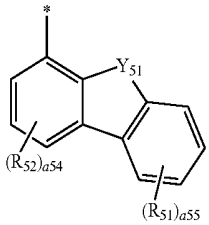
5-4



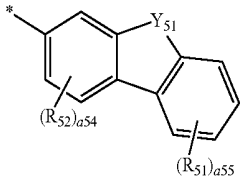
5-5



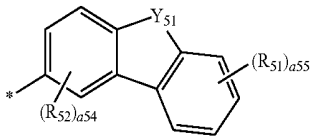
5-6



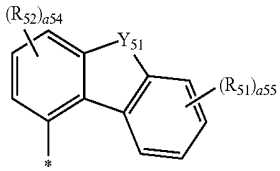
5-7



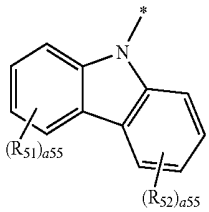
5-8



5-9



5-10



wherein, in Formulae 5-1 to 5-10,

Y_{51} is selected from $C(R_{53})(R_{54})$, $Si(R_{53})(R_{54})$, $N(R_{53})$, O, and S;

R_{51} to R_{54} are each independently selected from a hydrogen, a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, a triazinyl group, and —$Si(Q_{33})(Q_{34})(Q_{35})$;

Q_{33} to Q_{35} are each independently selected from a methyl group, an ethyl group, a tert-butyl group, a phenyl group, and a naphthyl group;

a51 is selected from 1, 2, 3, 4, and 5;

a52 is selected from 1, 2, 3, 4, 5, 6, and 7;

a53 is selected from 1, 2, 3, 4, 5, and 6;

a54 is selected from 1, 2, and 3;

a55 is selected from 1, 2, 3, and 4; and

* indicates a binding site to a neighboring atom.

4. The condensed cyclic compound as claimed in claim **1**, wherein R_{12} to R_{16} and R_{22} to R_{26} are each independently selected from:

a group represented by Formula 8-1, a hydrogen, a deuterium, —F, —Cl, —Br, —I, a methyl group, an ethyl group, a propyl group, a butyl group, pentyl group, a hexyl group, a heptyl group, an octyl group, a nonyl group, a decyl group, a phenyl group, a pentalenyl group, an indenyl group, a naphthyl group, an azulenyl group, a heptalenyl group, an indacenyl group, an acenaphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenalenyl group, a phenanthrenyl group, an anthracenyl group, a fluoranthenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a naphthacenyl group, a picenyl group, a perylenyl group, a pentaphenyl group, a hexacenyl group, a pentacenyl group, a rubicenyl group, a coronenyl group, an ovalenyl group, a pyrrolyl group, a thiophenyl group, a furanyl group, an imidazolyl group, a pyrazolyl group, a thiazolyl group, an isothiazolyl group, an oxazolyl group, an isoxazolyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, an indolyl group, an indazolyl group, a purinyl group, a quinolinyl group, an isoquinolinyl group, a carbazolyl group, a benzoquinolinyl group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, a benzoquinoxalinyl group, a quinazolinyl group, a benzoquinazolinyl 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, 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 benzocarbazolyl group, a dibenzocarbazolyl group, a thiadiazolyl group, an imidazopyridinyl group and an imidazopyrimidinyl group; and

a phenyl group, a pentalenyl group, an indenyl group, a naphthyl group, an azulenyl group, a heptalenyl group, an indacenyl group, an acenaphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenalenyl group, a phenanthrenyl group, an anthracenyl group, a fluoranthenyl group, a triphenylenyl group, a pyrenyl group, a chryse-

nyl group, a naphthacenyl group, a picenyl group, a perylenyl group, a pentaphenyl group, a hexacenyl group, a pentacenyl group, a rubicenyl group, a coronenyl group, an ovalenyl group, a pyrrolyl group, a thiophenyl group, a furanyl group, an imidazolyl group, a pyrazolyl group, a thiazolyl group, an isothiazolyl group, an oxazolyl group, an isoxazolyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, an indolyl group, an indazolyl group, a purinyl group, a quinolinyl group, an isoquinolinyl group, a carbazolyl group, a benzoquinolinyl group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, a benzoquinoxalinyl group, a quinazolinyl group, a benzoquinazolinyl 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, 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 benzocarbazolyl group, a dibenzocarbazolyl group, a thiadiazolyl group, an imidazopyridinyl group, and an imidazopyrimidinyl group, each substituted with at least one selected from a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a phenyl group, a biphenyl group, a pentalenyl group, an indenyl group, a naphthyl group, an azulenyl group, a heptalenyl group, an indacenyl group, an acenaphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenalenyl group, a phenanthrenyl group, an anthracenyl group, a fluoranthenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a naphthacenyl group, a picenyl group, a perylenyl group, a pentaphenyl group, a hexacenyl group, a pentacenyl group, a rubicenyl group, a coronenyl group, an ovalenyl group, a pyrrolyl group, a thiophenyl group, a furanyl group, an imidazolyl group, a pyrazolyl group, a thiazolyl group, an isothiazolyl group, an oxazolyl group, an isoxazolyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, an indolyl group, an indazolyl group, a purinyl group, a quinolinyl group, an isoquinolinyl group, a carbazolyl group, a benzoquinolinyl group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, a benzoquinoxalinyl group, a quinazolinyl group, a benzoquinazolinyl group, a cinnolinyl group, a carbazolyl group, a phenanthridinyl group, an acridinyl group, a phenanthrolinyl group, a phenazinyl group, a benzimidazolyl group, a benzofuranyl group, a benzothiophenyl group, an isobenzothiazolyl group, a benzoxazolyl group, an isobenzoxazolyl group, a triazolyl group, a tetrazolyl group, an oxadiazolyl group, a triazinyl group, a dibenzofuranyl group, a dibenzothiophenyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a thiadiazolyl group, an imidazopyridinyl group, an imidazopyrimidinyl group, and $—Si(Q_{33})(Q_{34})(Q_{35})$;

wherein Q_{33} to Q_{35} are each independently selected from a C_1-C_{60} alkyl group and a C_6-C_{60} aryl group.

5. The condensed cyclic compound as claimed in claim **1**, wherein R_{12} to R_{16} and R_{22} to R_{26} are each independently selected from a group represented by Formula 8-1, a hydrogen, a phenyl group, and a naphthyl group.

6. The condensed cyclic compound as claimed in claim **1**, wherein R_{12}, R_{13}, R_{14}, R_{15}, or R_{16} are each independently a group represented by Formula 8-1.

7. The condensed cyclic compound as claimed in claim **1**, wherein R_{22}, R_{23}, R_{24}, R_{25}, or R_{26} are each independently a group represented by Formula 8-1.

8. The condensed cyclic compound as claimed in claim **1**, wherein L_{81} and L_{82} are each independently selected from:

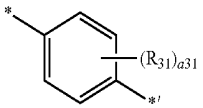
a phenylene group, a pentalenylene group, an indenylene group, a naphthylene group, an azulenylene group, a heptalenylene group, an indacenylene group, an acenaphthylene group, a fluorenylene group, a spiro-fluorenylene group, a benzofluorenylene group, a dibenzofluorenylene group, a phenalenylene group, a phenanthrenylene group, an anthracenylene group, a fluoranthenylene group, a triphenylenylene group, a pyrenylene group, a chrysenylene group, a naphthacenylene group, a picenylene group, a perylenylene group, a pentaphenylene group, a hexacenylene group, a pentacenylene group, a rubicenylene group, a coronenylene group, an ovalenylene group, a pyrrolylene group, a thiophenylene group, a furanylene 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 isoindolylene group, an indolylene 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 carbazolylene group, a phenanthridinylene group, an acridinylene group, a phenanthrolinylene group, a phenazinylene group, a benzoimidazolylene group, a benzofuranylene group, a benzothiophenylene 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 benzocarbazolylene group, and a dibenzocarbazolylene group; and

a phenylene group, a pentalenylene group, an indenylene group, a naphthylene group, an azulenylene group, a heptalenylene group, an indacenylene group, an acenaphthylene group, a fluorenylene group, a spiro-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 naphthacenylene group, a picenylene group, a perylenylene group, a pentaphenylene group, a hexacenylene group, a pentacenylene group, a rubicenylene group, a coronenylene group, an ovalenylene group, a pyrrolylene group, a thiophenylene group, a furanylene group, an imidazolylene group, a pyrazolylene group, a thiazolylene

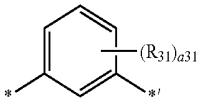
group, an isothiazolylene group, an oxazolylene group, an isoxazolylene group, a pyridinylene group, a pyrazinylene group, a pyrimidinylene group, a pyridazinylene group, an isoindolylene group, an indolylene group, an indazolylene group, a purinylene group, a quinolinylene group, an isoquinolinylene group, a benzoquinolinylene group, a phthalazinylene group, a naphthyridinylene group, a quinoxalinylene group, a quinazolinylene group, a cinnolinylene group, a carbazolylene group, a phenanthridinylene group, an acridinylene group, a phenanthrolinylene group, a phenazinylene group, a benzoimidazolylene group, a benzofuranylene group, a benzothiophenylene 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 benzocarbazolylene group, and a dibenzocarbazolylene group, each substituted with at least one selected from a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a cyclopentyl group, a cyclohexyl group, a cycloheptyl group, a cyclopentenyl group, a cyclohexenyl group, a phenyl group, a pentalenyl group, an indenyl group, a naphthyl group, an azulenyl group, a heptalenyl group, an indacenyl group, an acenaphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenalenyl group, a phenanthrenyl group, an anthracenyl group, a fluoranthenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a naphthacenyl group, a picenyl group, a perylenyl group, a pentaphenyl group, a hexacenyl group, a pentacenyl group, a rubicenyl group, a coronenyl group, an ovalenyl group, a pyrrolyl group, a thiophenyl group, a furanyl group, an imidazolyl group, a pyrazolyl group, a thiazolyl group, an isothiazolyl group, an oxazolyl group, an isoxazolyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, an indolyl group, an indazolyl group, a purinyl group, a quinolinyl group, an isoquinolinyl group, a benzoquinolinyl group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, a quinazolinyl group, a cinnolinyl group, a carbazolyl group, a phenanthridinyl group, an acridinyl group, a phenanthrolinyl group, a phenazinyl group, a benzoimidazolyl group, a benzofuranyl group, a benzothiophenyl group, an isobenzothiazolyl group, a benzoxazolyl group, an isobenzoxazolyl group, a triazolyl group, a tetrazolyl group, an oxadiazolyl group, a triazinyl group, a dibenzofuranyl group, a dibenzothiophenyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a thiadiazolyl group, and an imidazopyridinyl group.

9. The condensed cyclic compound as claimed in claim **1**, wherein L_{81} and L_{82} are each independently a group represented by one of the following Formulae 3-1 to 3-11:

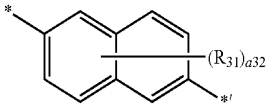
3-1



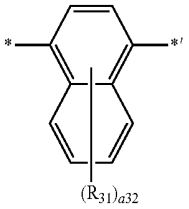
3-2



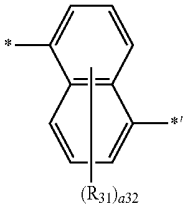
3-3



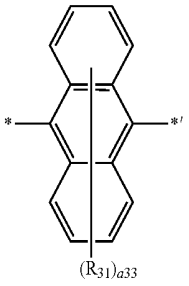
3-4



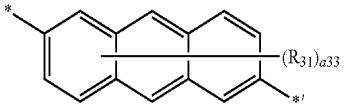
3-5



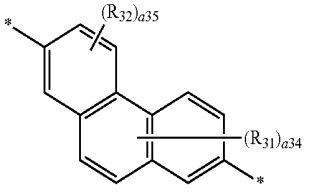
3-6



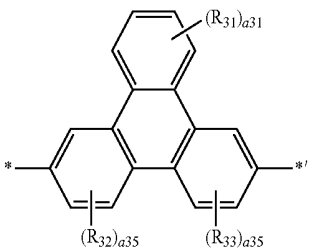
3-7



3-8

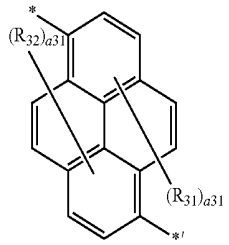


3-9

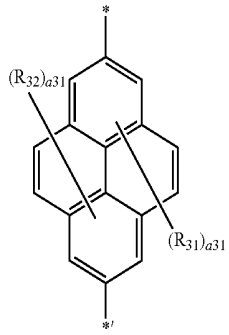


-continued

3-10



3-11



wherein, in Formulae 3-1 to 3-11,

R_{31} to R_{33} are each independently selected from a hydrogen, a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, and a triazinyl group;

a31 is selected from 1, 2, 3, and 4;

a32 is selected from 1, 2, 3, 4, 5, and 6;

a33 is selected from 1, 2, 3, 4, 5, 6, 7, and 8;

a34 is selected from 1, 2, 3, 4, and 5;

a35 is selected from 1, 2, and 3; and

each of * and *' indicates a binding site to a neighboring atom.

10. The condensed cyclic compound as claimed in claim **1**, wherein a81 and a82 are each independently 0 or 1.

11. The condensed cyclic compound as claimed in claim **1**, wherein R_{81} to R_{84} are each independently selected from:

a phenyl group, a pentalenyl group, an indenyl group, a naphthyl group, an azulenyl group, a heptalenyl group, an indacenyl group, an acenaphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenalenyl group, a phenanthrenyl group, an anthracenyl group, a fluoranthenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a naphthacenyl group, a picenyl group, a perylenyl group, a pentaphenyl group, a hexacenyl group, a pentacenyl group, a rubicenyl group, a coronenyl group, an ovalenyl group, a pyrrolyl group, a thiophenyl group, a furanyl group, an imidazolyl group, a pyrazolyl group, a thiazolyl group, an isothiazolyl group, an oxazolyl group, an isoxazolyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, an indolyl group, an indazolyl group, a purinyl group, a quinolinyl group, an isoquinolinyl group, a carbazolyl group, a benzoquinolinyl group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, a benzoquinoxalinyl group, a quinazolinyl group, a benzoquinazolinyl 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, 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 benzocarbazolyl group, a dibenzocarbazolyl group, a thiadiazolyl group, an imidazopyridinyl group and an imidazopyrimidinyl group; and

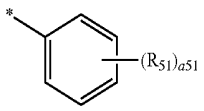
a phenyl group, a pentalenyl group, an indenyl group, a naphthyl group, an azulenyl group, a heptalenyl group, an indacenyl group, an acenaphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenalenyl group, a phenanthrenyl group, an anthracenyl group, a fluoranthenyl group, a triphenylenyl group, a pyrenyl group, a chrysenyl group, a naphthacenyl group, a picenyl group, a perylenyl group, a pentaphenyl group, a hexacenyl group, a pentacenyl group, a rubicenyl group, a coronenyl group, an ovalenyl group, a pyrrolyl group, a thiophenyl group, a furanyl group, an imidazolyl group, a pyrazolyl group, a thiazolyl group, an isothiazolyl group, an oxazolyl group, an isoxazolyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, an indolyl group, an indazolyl group, a purinyl group, a quinolinyl group, an isoquinolinyl group, a carbazolyl group, a benzoquinolinyl group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, a benzoquinoxalinyl group, a quinazolinyl group, a benzoquinazolinyl 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, 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 benzocarbazolyl group, a dibenzocarbazolyl group, a thiadiazolyl group, an imidazopyridinyl group and an imidazopyrimidinyl group, each substituted with at least one selected from a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a phenyl group, a biphenyl group, a pentalenyl group, an indenyl group, a naphthyl group, an azulenyl group, a heptalenyl group, an indacenyl group, an acenaphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenalenyl group, a phenanthrenyl group, an anthracenyl group, a fluoranthenyl group, a triphenyle-

nyl group, a pyrenyl group, a chrysenyl group, a naphthacenyl group, a picenyl group, a perylenyl group, a pentaphenyl group, a hexacenyl group, a pentacenyl group, a rubicenyl group, a coronenyl group, an ovalenyl group, a pyrrolyl group, a thiophenyl group, a furanyl group, an imidazolyl group, a pyrazolyl group, a thiazolyl group, an isothiazolyl group, an oxazolyl group, an isoxazolyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, an indolyl group, an indazolyl group, a purinyl group, a quinolinyl group, an isoquinolinyl group, a carbazolyl group, a benzoquinolinyl group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, a benzoquinoxalinyl group, a quinazolinyl group, a benzoquinazolinyl group, a cinnolinyl group, a carbazolyl group, a phenanthridinyl group, an acridinyl group, a phenanthrolinyl group, a phenazinyl group, a benzimidazolyl group, a benzofuranyl group, a benzothiophenyl group, an isobenzothiazolyl group, a benzoxazolyl group, an isobenzoxazolyl group, a triazolyl group, a tetrazolyl group, an oxadiazolyl group, a triazinyl group, a dibenzofuranyl group, a dibenzothiophenyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a thiadiazolyl group, an imidazopyridinyl group, an imidazopyrimidinyl group and —$Si(Q_{33})(Q_{34})(Q_{35})$,

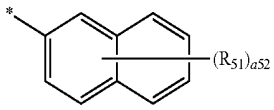
wherein Q_{33} to Q_{35} are each independently selected from a C_1-C_{60} alkyl group and a C_6-C_{60} aryl group.

12. The condensed cyclic compound as claimed in claim **1**, wherein R_{81} to R_{84} are each independently a group represented by one of the following Formulae 5-1 to 5-10:

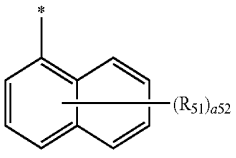
5-1



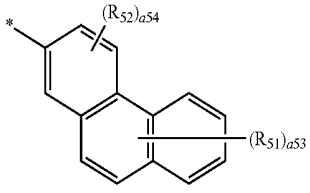
5-2



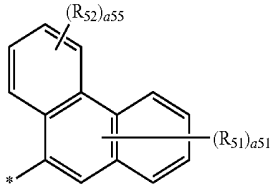
5-3



5-4



5-5



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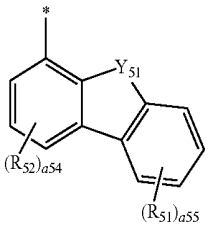
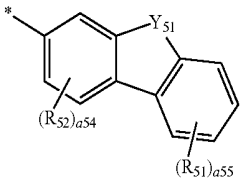
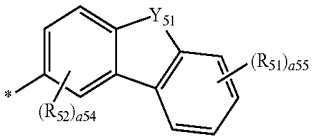
5-6



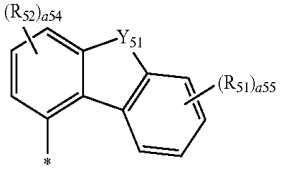
5-7



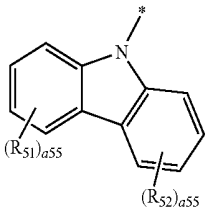
5-8



5-9



5-10



wherein, in Formulae 5-1 to 5-10,

Y_{51} is selected from $C(R_{53})(R_{54})$, $Si(R_{53})(R_{54})$, $N(R_{53})$, O, and S;

R_{51} to R_{54} are each independently selected from a hydrogen, a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a C_1-C_{20} alkyl group, a C_1-C_{20} alkoxy group, a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, a triazinyl group, and —$Si(Q_{33})(Q_{34})(Q_{35})$;

Q_{33} to Q_{35} are each independently selected from a methyl group, an ethyl group, a tert-butyl group, a phenyl group, and a naphthyl group;

a51 is selected from 1, 2, 3, 4, and 5;

a52 is selected from 1, 2, 3, 4, 5, 6, and 7;

a53 is selected from 1, 2, 3, 4, 5, and 6;

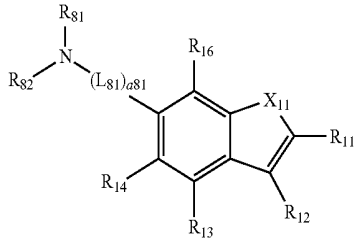
a54 is selected from 1, 2, and 3;

a55 is selected from 1, 2, 3, and 4; and

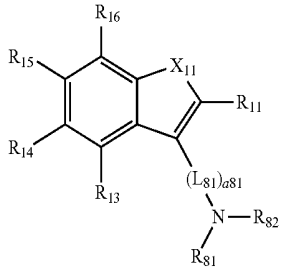
* indicates a binding site to a neighboring atom.

13. The condensed cyclic compound as claimed in claim **1**, wherein the condensed cyclic compound is represented by one of the following Formulae 1-1 to 1-4 and 2-1 to 2-4:

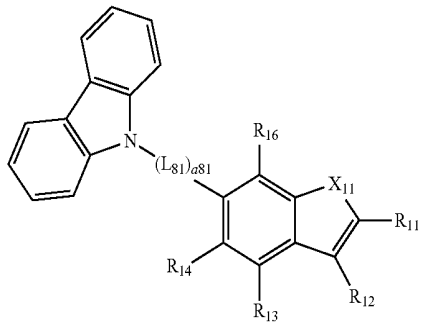
1-1



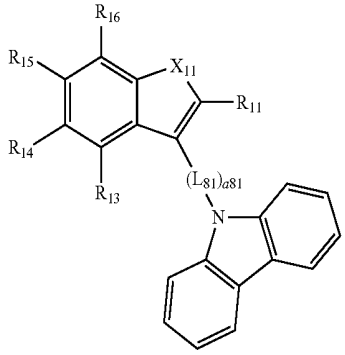
1-2



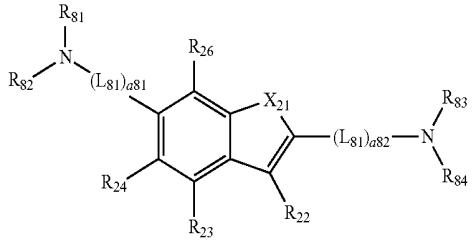
1-3



1-4



2-1



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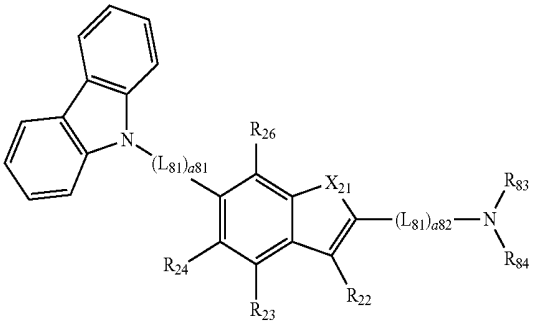
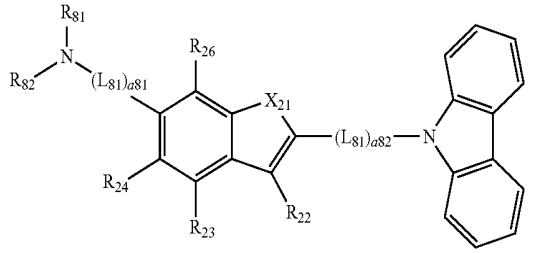
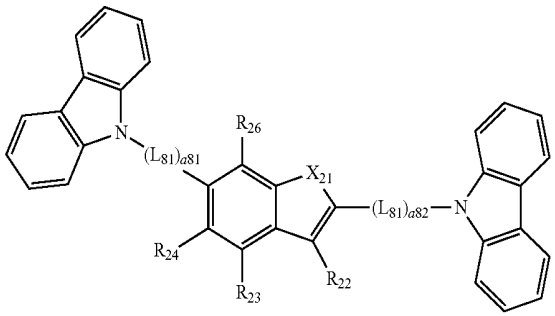
2-2



2-3



2-4



wherein, in Formulae 1-1 to 1-4 and 2-1 to 2-4,

X_{11} is selected from a sulfur (S) atom, an oxygen (O) atom, and $N(R_{17})$;

X_{21} is selected from a sulfur (S) atom, an oxygen (O) atom, and $N(R_{27})$;

R_{11} to R_{17}, R_{22} to R_{24}, R_{26}, and R_{27} are each independently selected from a hydrogen, a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid group or a salt thereof, a sulfonic acid group or a salt thereof, a phosphoric acid group or a salt thereof, a substituted or unsubstituted C_1-C_{60} alkyl group, a substituted or unsubstituted C_2-C_{60} alkenyl group, a substituted or unsubstituted C_2-C_{60} alkynyl group, a substituted or unsubstituted C_1-C_{60} alkoxy group, a substituted or unsubstituted C_3-C_{10} cycloalkyl group, a substituted or unsubstituted C_1-C_{10} heterocycloalkyl group, a substituted or unsubstituted C_3-C_{10} cycloalkenyl group, a substituted or unsubstituted 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, and a substituted or unsubstituted monovalent non-aromatic condensed heteropolycyclic group;

L_{81} and L_{82} are each independently selected from 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_{30} arylene group, a substituted or unsubstituted C_1-C_{30} heteroarylene group, a substituted or unsubstituted divalent non-aromaticcondensed polycyclic group, and a substituted or unsubstituted divalent non-aromaticcondensed heteropolycyclic group;

a81 and a82 are each independently selected from 0, 1, 2, and 3;

R_{81} to R_{84} are each independently selected from a substituted or unsubstituted C_1-C_{60} alkyl group, a substituted or unsubstituted C_2-C_{60} alkenyl group, a substituted or unsubstituted C_2-C_{60} alkynyl group, a substituted or unsubstituted C_1-C_{60} alkoxy group, a substituted or unsubstituted C_3-C_{10} cycloalkyl group, a substituted or unsubstituted C_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 and a substituted or unsubstituted monovalent non-aromatic condensed heteropolycyclic group;

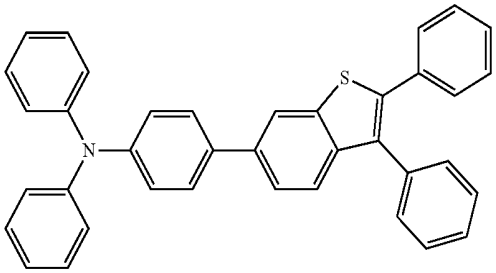
R_{81} and R_{82} are separate or N, R_{81}, and R_{82} are bound to form a carbazole group;

R_{83} and R_{84} are separate or N, R_{83}, and R_{84} are bound to form a carbazole group; and

* indicates a binding site to a neighboring atom.

14. The condensed cyclic compound as claimed in claim **1**, wherein the condensed cyclic compound is one of the following Compounds 1 to 67:

1



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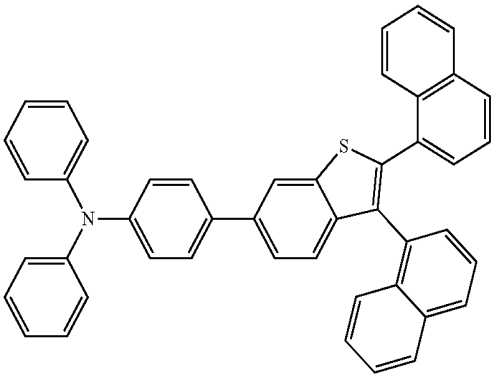
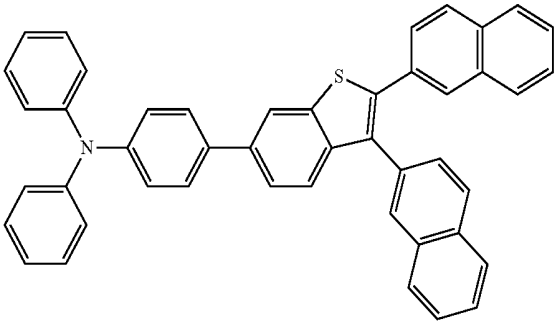
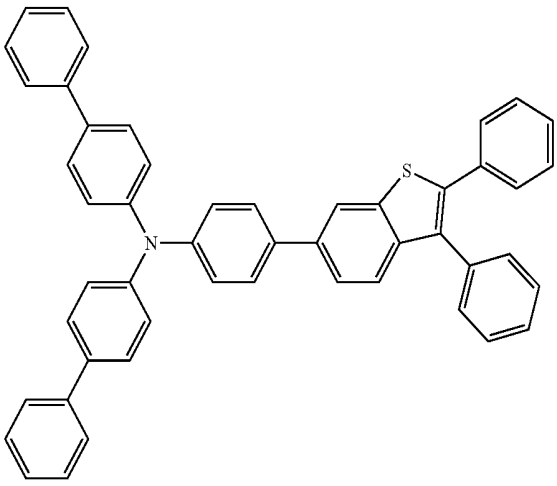
2



3



4



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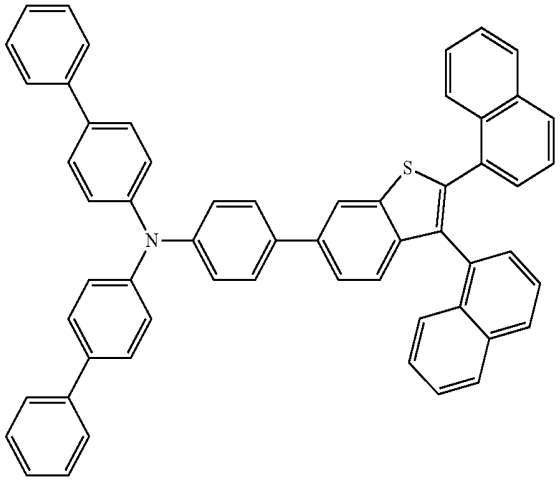
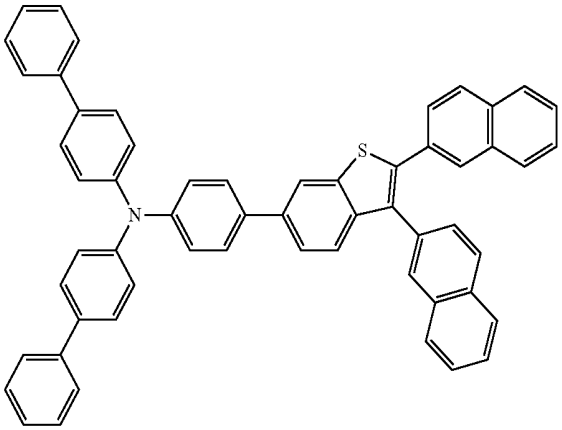
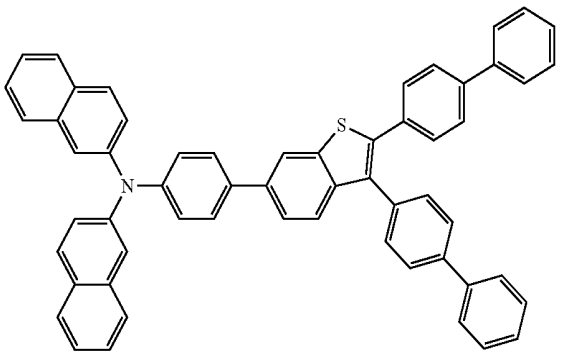
5



6



7



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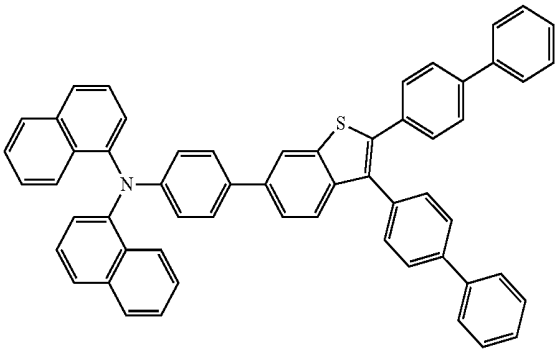

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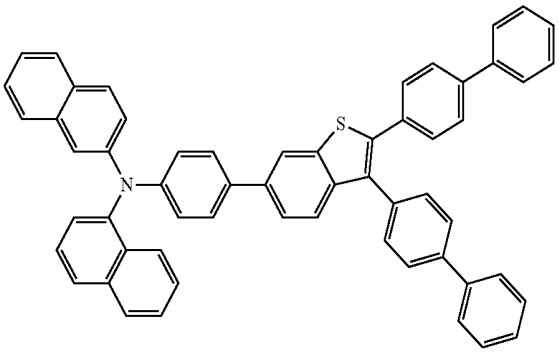

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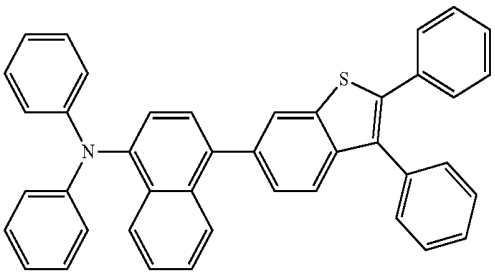

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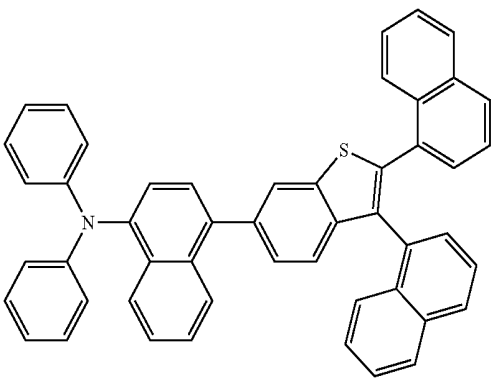

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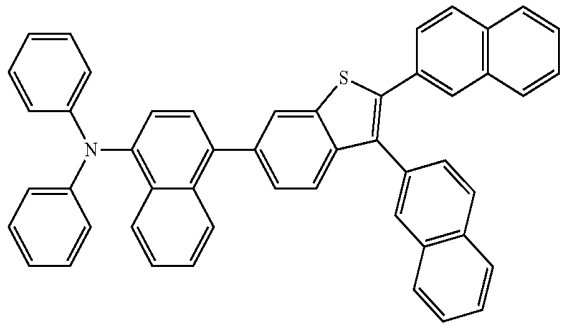

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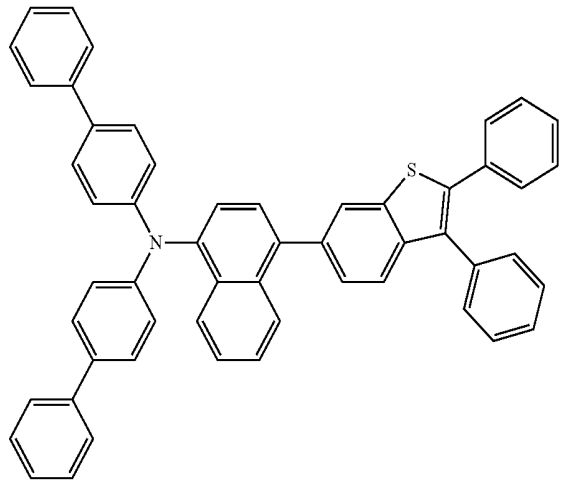

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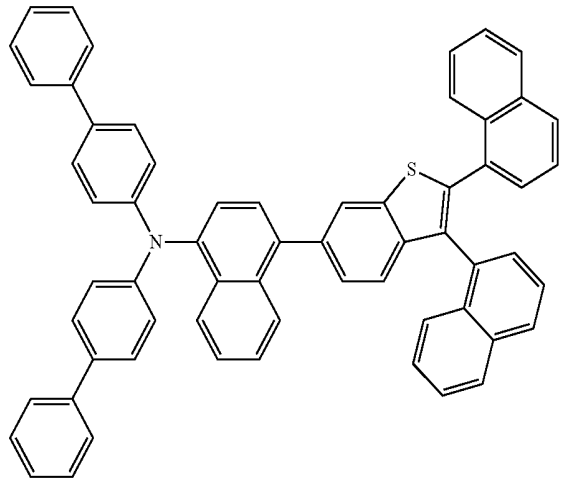

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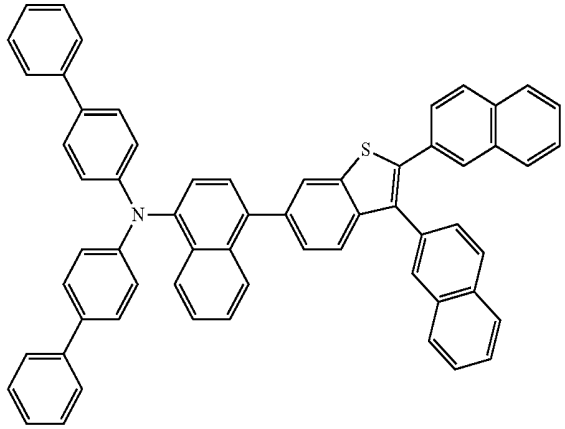

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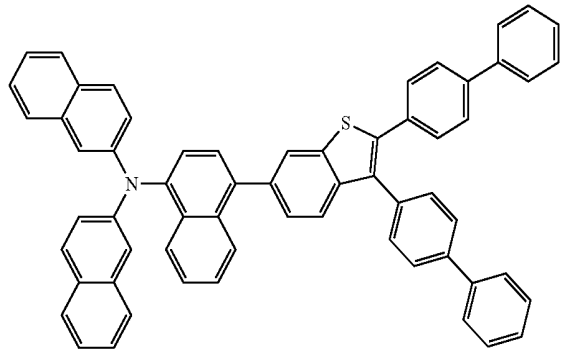

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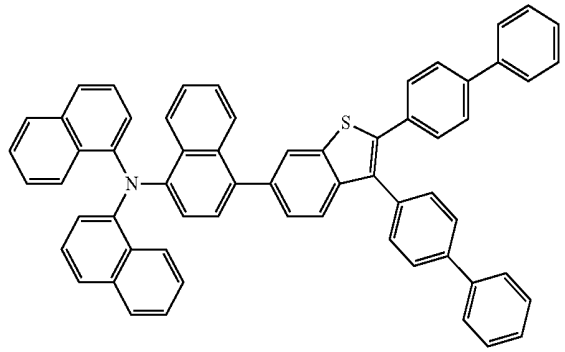

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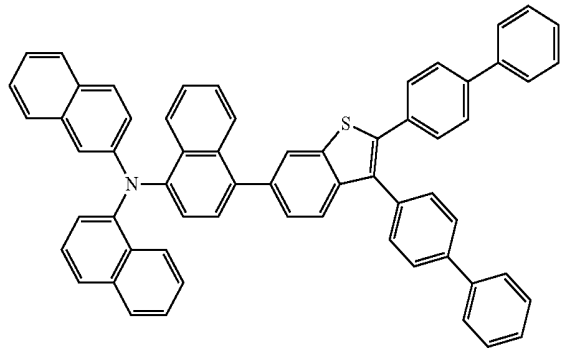

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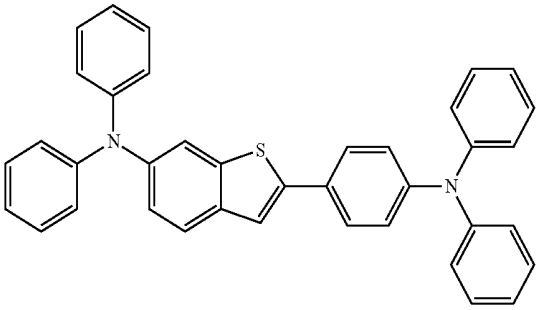

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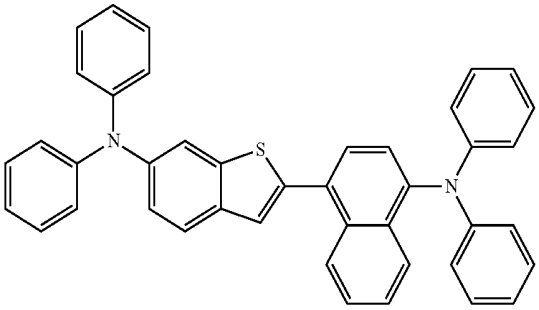

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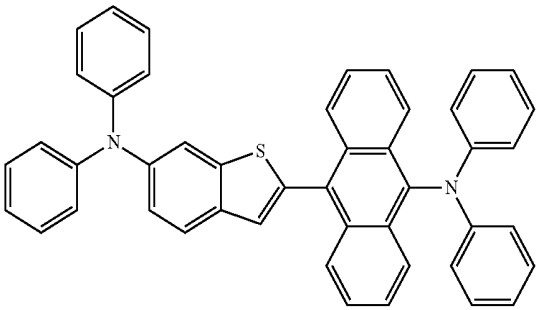

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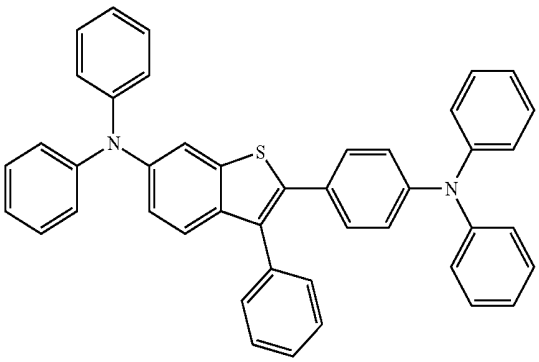

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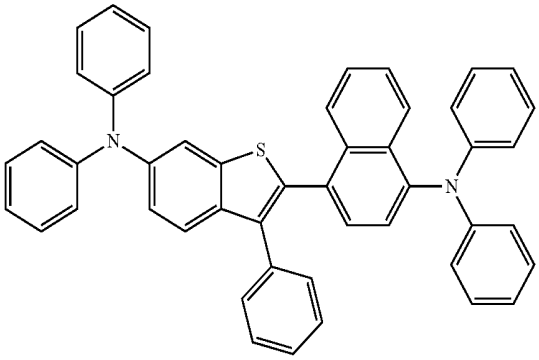

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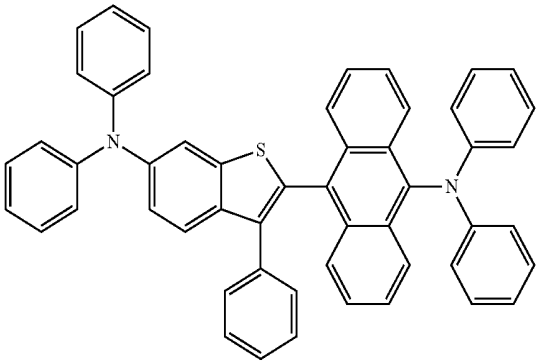

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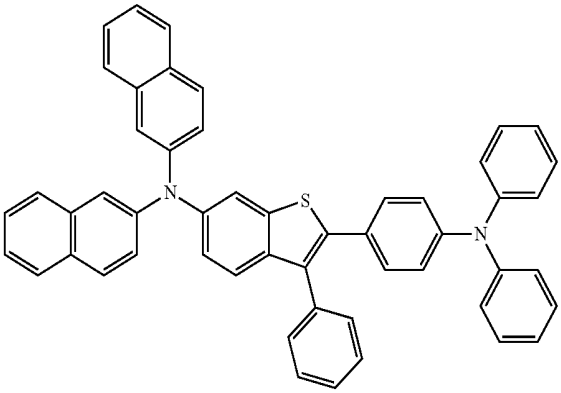

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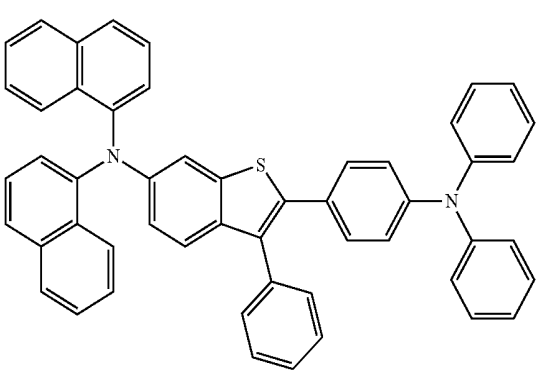

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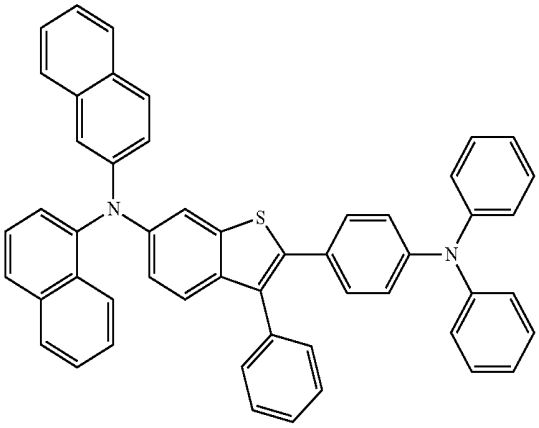

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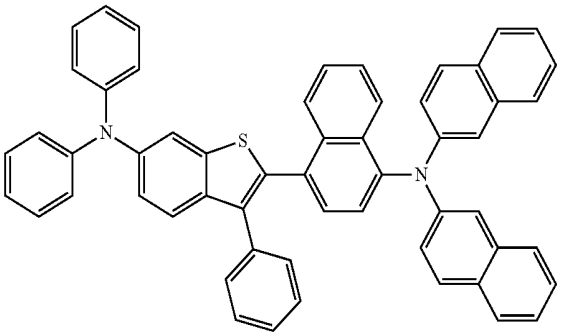

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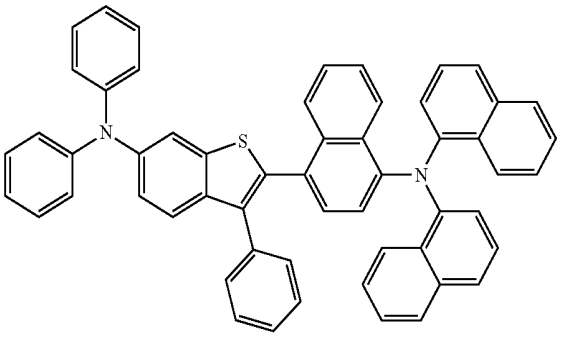

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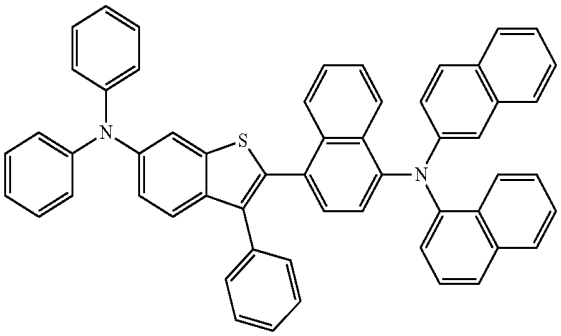

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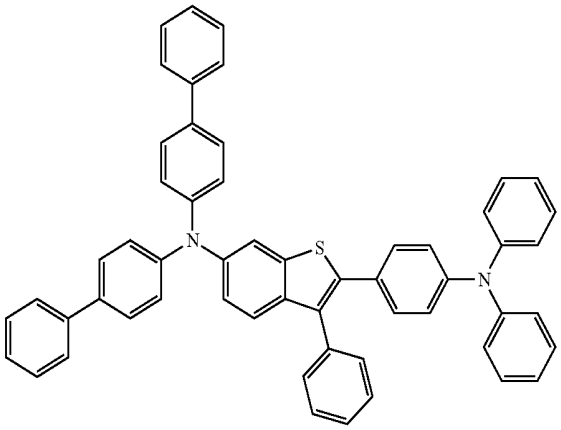

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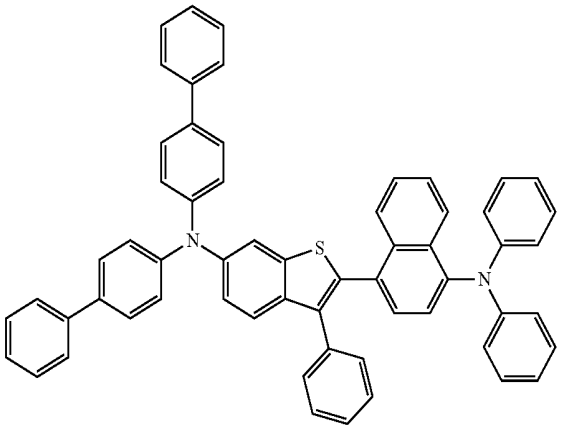

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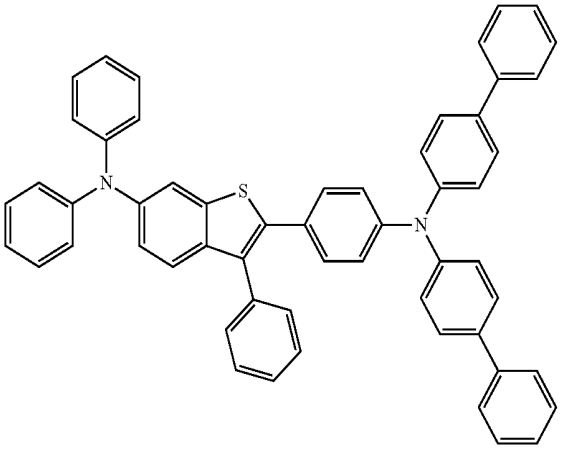

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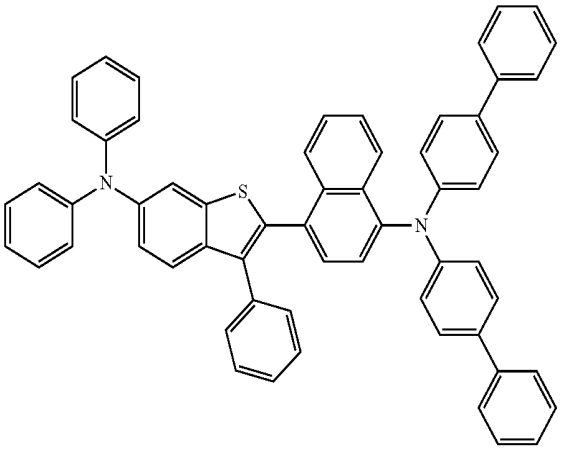

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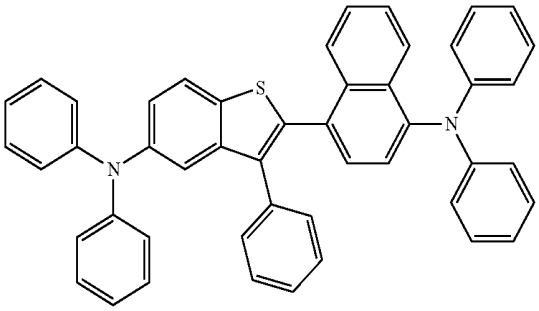

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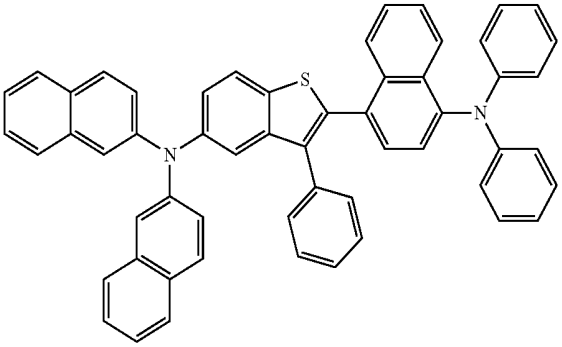

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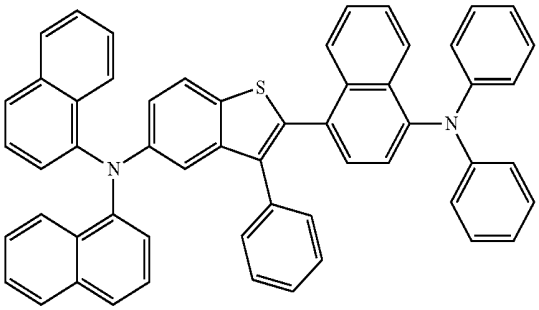

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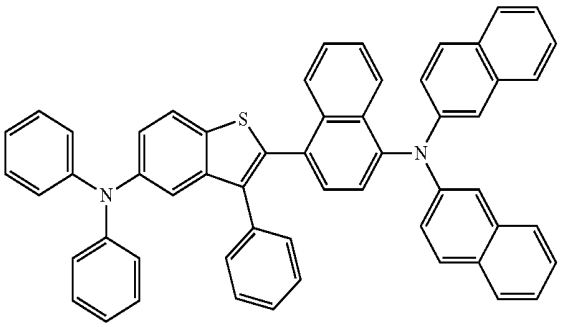

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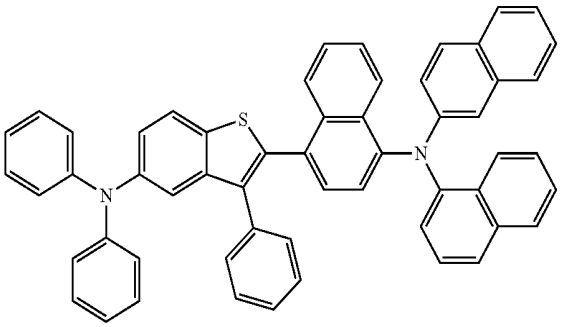

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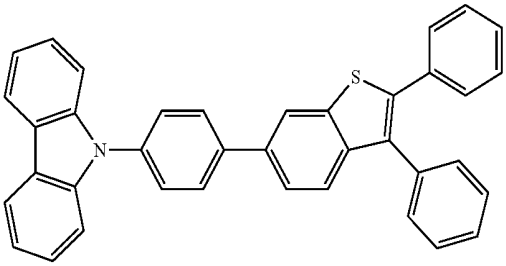

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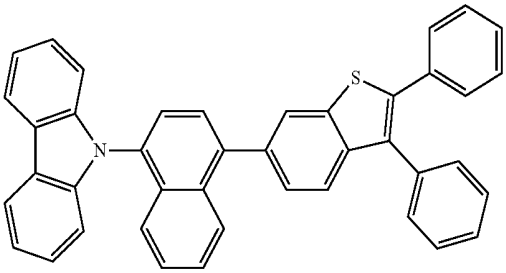

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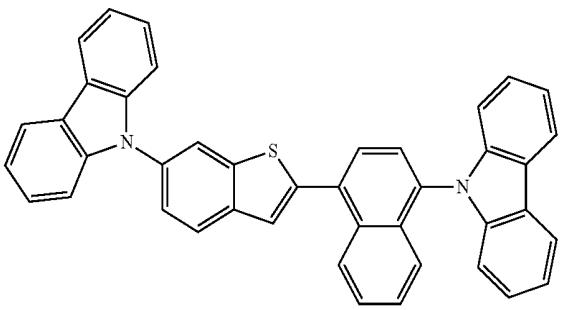

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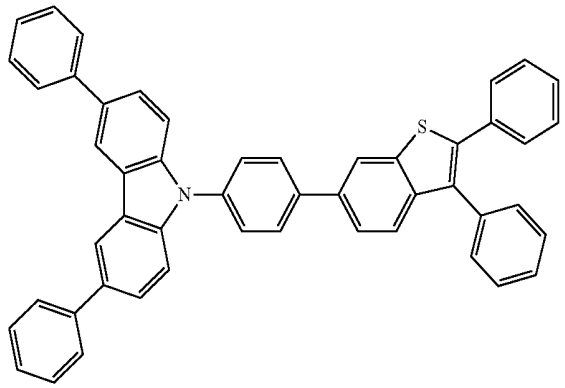

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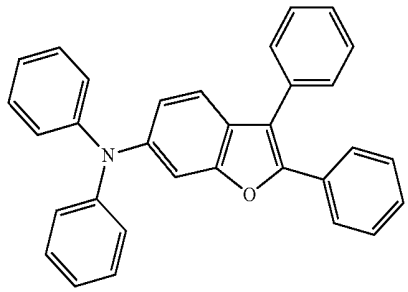

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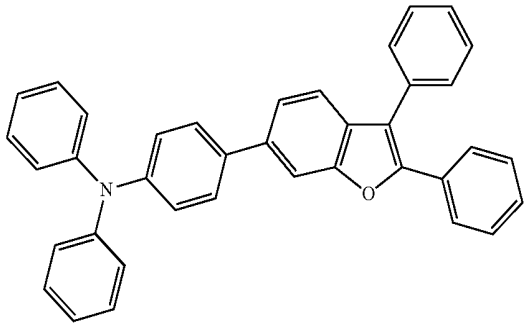

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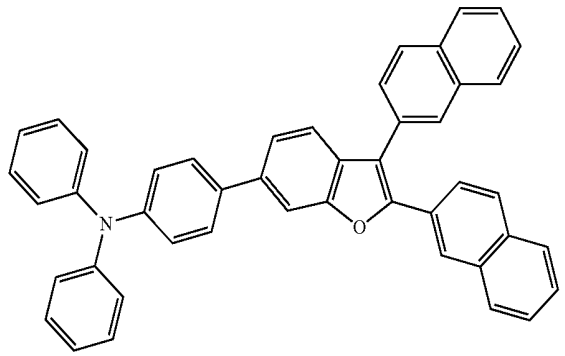

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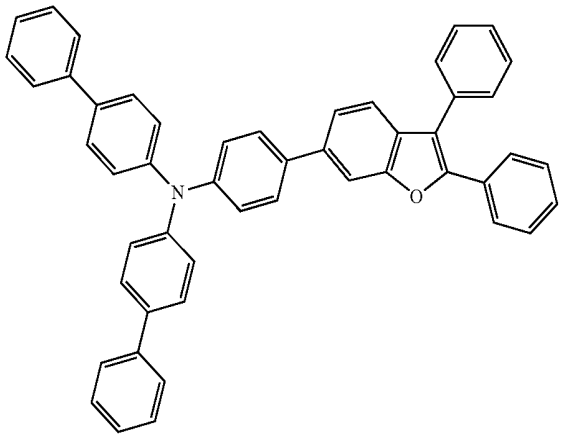

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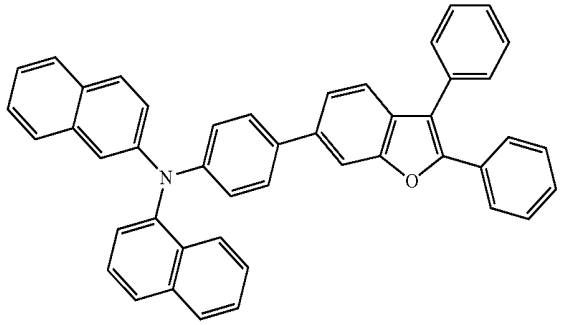

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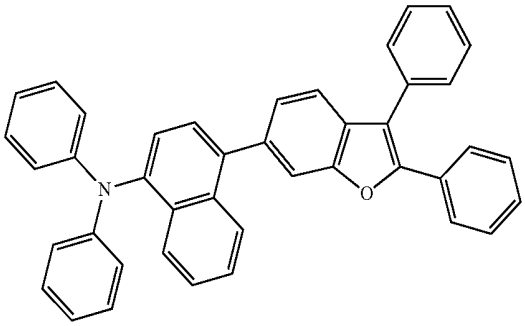

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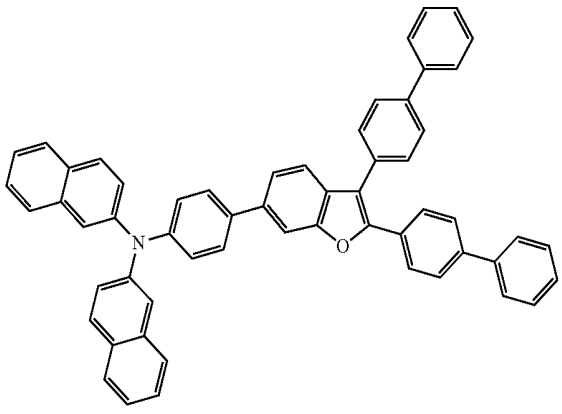

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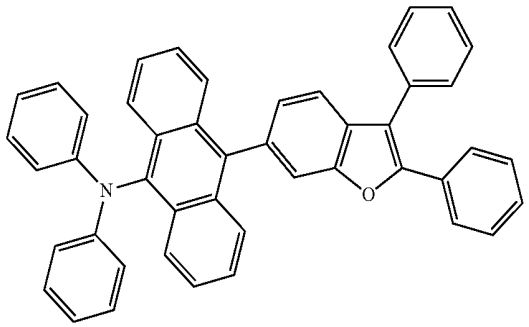

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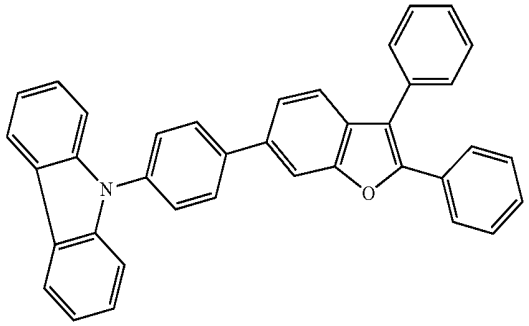

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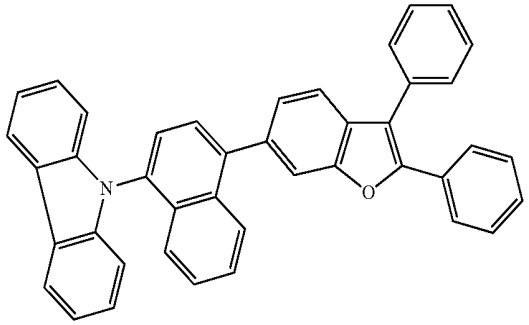

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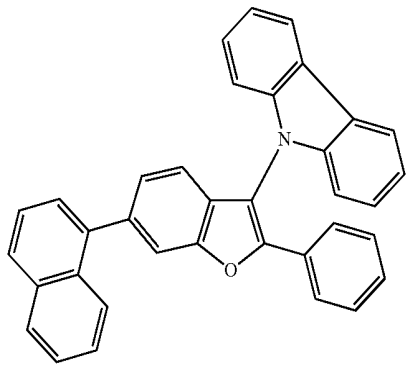

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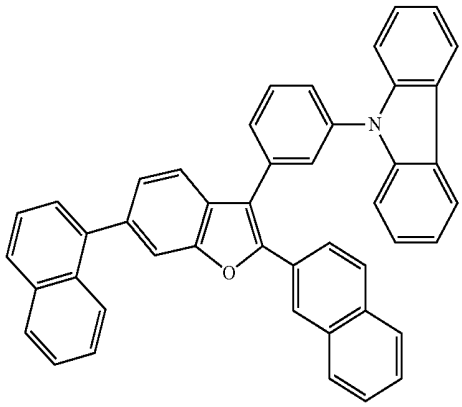

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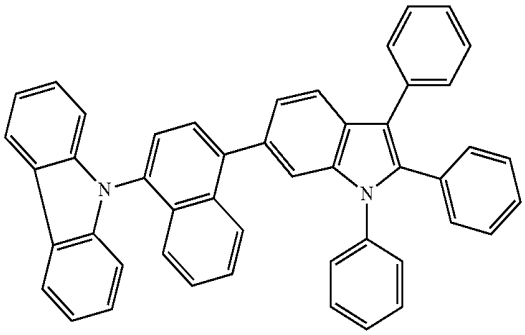

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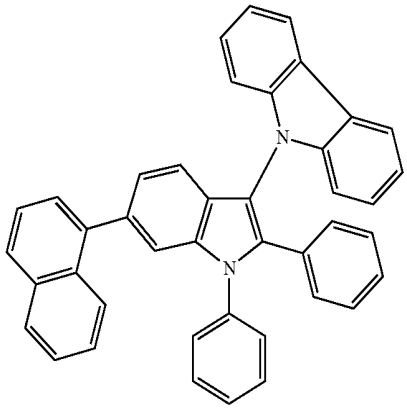

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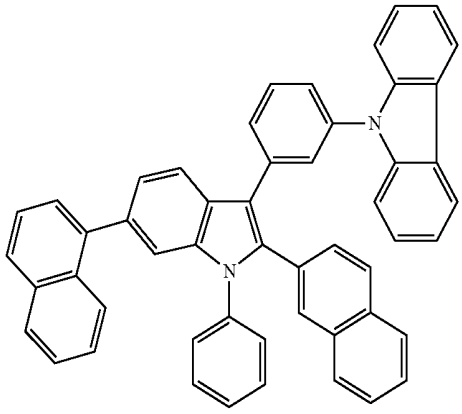

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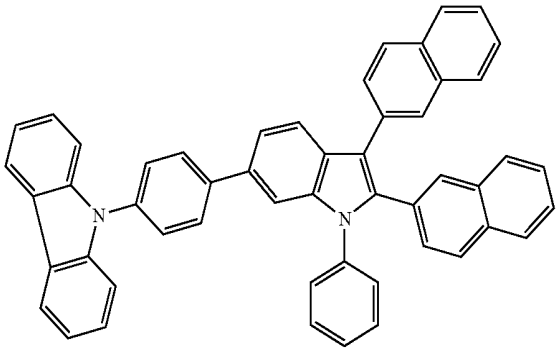

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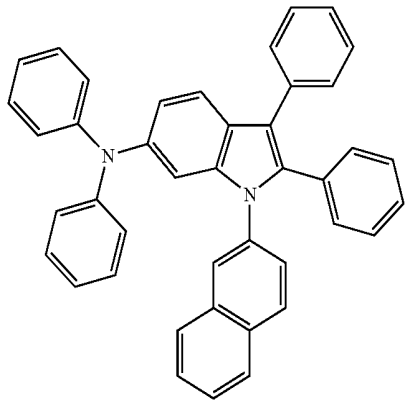

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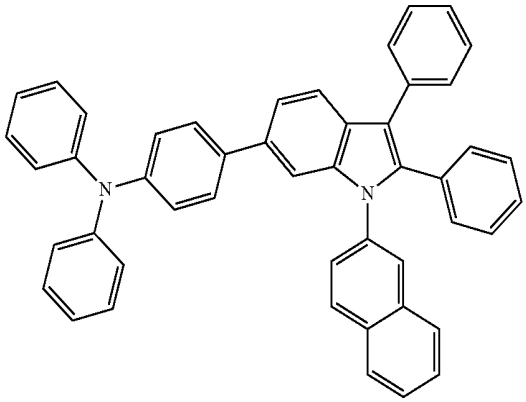

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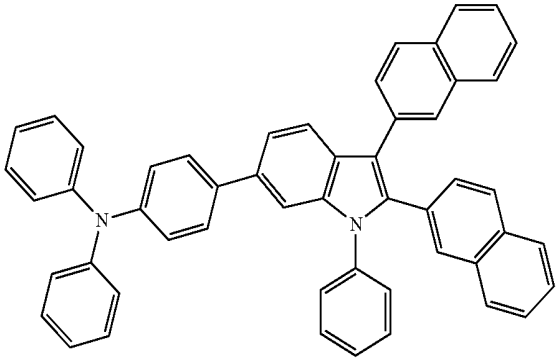

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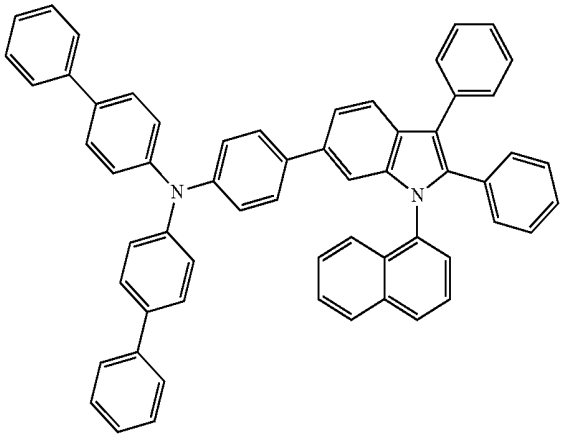

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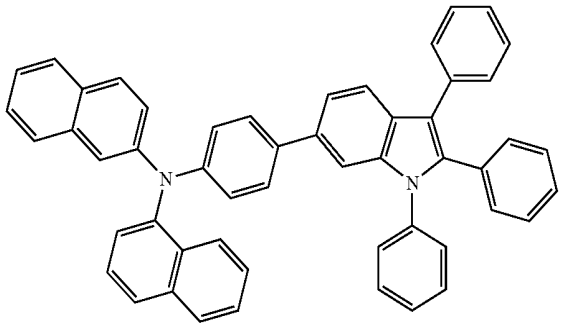

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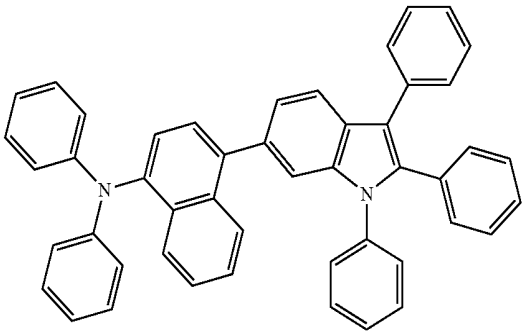

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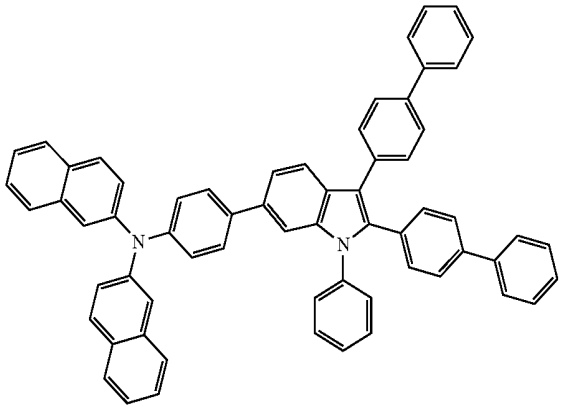

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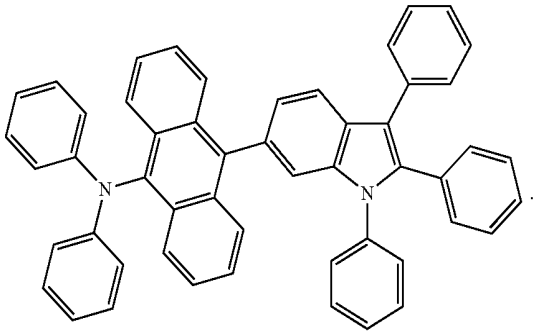

15. An organic light-emitting device, comprising:

a first electrode;

a second electrode; and

an organic layer between the first electrode and the second electrode, the organic layer including an emission layer,

wherein the organic layer includes the condensed cyclic compound as claimed in claim **1**.

16. The organic light-emitting device as claimed in claim **15**, wherein:

the organic layer further includes a hole transport region between the first electrode and the emission layer; and

the hole transport region includes the condensed cyclic compound.

17. The organic light-emitting device as claimed in claim **16**, wherein:

the hole transport region includes a hole transport layer, and

the hole transport layer includes the condensed cyclic compound.

18. The organic light-emitting device as claimed in claim **16**, wherein:

the hole transport region includes a hole transport layer and an emission auxiliary layer, the emission auxiliary layer being between the hole transport layer and the emission layer, and

at least one of the hole transport layer or the emission auxiliary layer includes the condensed cyclic compound.

19. An organic light-emitting device, comprising:

a substrate including a first sub-pixel region, a second sub-pixel region, and a third sub-pixel region;

a first electrode on each of the first sub-pixel region, the second sub-pixel region, and the third sub-pixel region of the substrate;

a second electrode facing the first electrode;

an emission layer between the first electrode and the second electrode; and

a hole transport region between the emission layer and the first electrode;

wherein the hole transport region includes the condensed cyclic compound as claimed in claim **1**.

20. The organic light-emitting device as claimed in claim **19**, wherein:

the hole transport region includes a hole transport layer and an emission auxiliary layer, the emission auxiliary layer being between the hole transport layer and the emission layer, and

at least one of the hole transport layer or the emission auxiliary layer includes the condensed cyclic compound.

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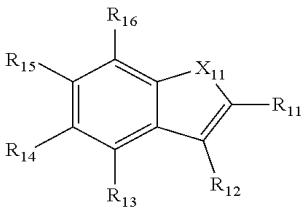
摘要(译)

缩合环状化合物和有机发光器件，缩合环状化合物由下式1或2之一表示：

<Formula 1>



<Formula 2>