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wherein substituents of Formula 1 are understood by referring to the description provided in the detailed description.

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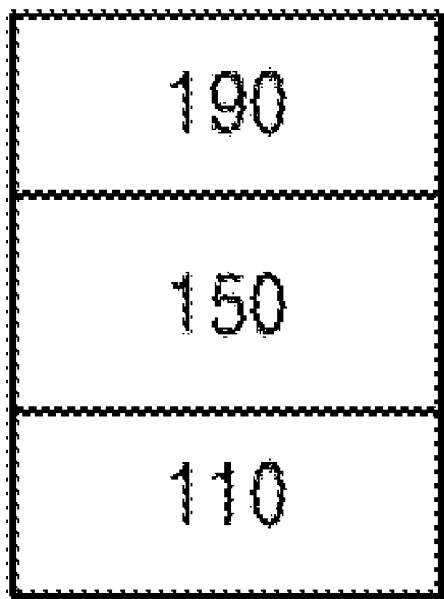
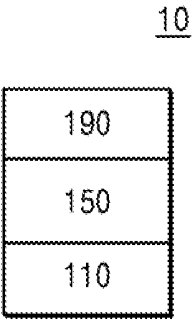


FIG. 1



COMPOUND AND ORGANIC LIGHT-EMITTING DEVICE INCLUDING THE SAME

CROSS-REFERENCE TO RELATED APPLICATION

[0001] Korean Patent Application No. 10-2014-0132492, filed on Oct. 1, 2014, in the Korean Intellectual Property Office, and entitled: "Compound and Organic Light-Emitting Device Including the Same," is incorporated by reference herein in its entirety.

BACKGROUND

[0002] 1. Field

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

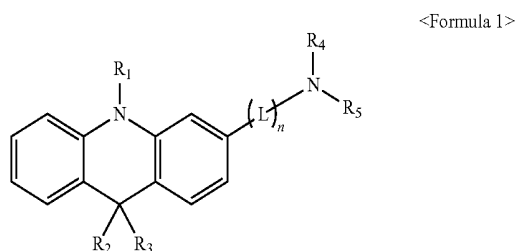
[0004] 2. Description of the Related Art

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

[0006] The organic light-emitting device may include a first electrode 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 compound represented by Formula 1 below:



[0008] wherein in Formula 1,

[0009] R_1 to R_5 may be 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 or a salt thereof, a sulfonic acid or a salt thereof, a phosphoric acid 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_2 - C_{10} heterocycloalkyl group, a substituted or unsubstituted C_3 - C_{10}

cycloalkenyl group, a substituted or unsubstituted C_2 - C_{10} heterocycloalkenyl group, a substituted or unsubstituted C_6 - C_{60} aryl group, a substituted or unsubstituted C_6 - C_{60} aryloxy group, a substituted or unsubstituted C_6 - C_{60} arylthio group, a substituted or unsubstituted C_1 - C_{60} heteroaryl group, a substituted or unsubstituted monovalent non-aromatic condensed polycyclic group, a substituted or unsubstituted monovalent non-aromatic condensed heteropolycyclic group, —N(Q_1)(Q_2), —Si(Q_3)(Q_4)(Q_5), and —B(Q_6)(Q_7);

[0010] L may be selected from a bond, a substituted or unsubstituted C_3 - C_{10} cycloalkylene group, a substituted or unsubstituted C_2 - C_{10} heterocycloalkylene group, a substituted or unsubstituted C_3 - C_{10} cycloalkenylene group, a substituted or unsubstituted C_2 - C_{10} heterocycloalkenylene group, a substituted or unsubstituted C_6 - C_{60} arylene group, a substituted or unsubstituted C_1 - C_{60} heteroarylene group, a substituted or unsubstituted divalent non-aromatic condensed polycyclic group, and a substituted or unsubstituted divalent non-aromatic condensed heteropolycyclic group;

[0011] n may be an integer selected from 1, 2, and 3, and when n is 2 or more, a plurality of L may be identical or different;

[0012] at least one substituent of the substituted C_1 - C_{60} alkyl group, substituted C_2 - C_{60} alkenyl group, substituted C_2 - C_{60} alkynyl group, substituted C_1 - C_{60} alkoxy group, substituted C_3 - C_{10} cycloalkyl group, substituted C_3 - C_{10} cycloalkylene group, substituted C_2 - C_{10} heterocycloalkyl group, substituted C_2 - C_{10} heterocycloalkylene group, substituted C_3 - C_{10} cycloalkenyl group, substituted C_3 - C_{10} cycloalkenylene group, substituted C_2 - C_{10} heterocycloalkenyl group, substituted C_2 - C_{10} heterocycloalkenylene group, substituted C_6 - C_{60} aryl group, substituted C_6 - C_{60} arylene group, substituted C_6 - C_{60} aryloxy group, substituted C_6 - C_{60} arylthio group, substituted C_1 - C_{60} heteroaryl group, substituted C_1 - C_{60} heteroarylene group, substituted monovalent non-aromatic condensed polycyclic group, substituted monovalent non-aromatic condensed heteropolycyclic group, substituted divalent non-aromatic condensed polycyclic group, and substituted divalent non-aromatic condensed heteropolycyclic group may be selected from

[0013] 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, and a C_1 - C_{60} alkoxy group;

[0014] 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 or a salt thereof, a sulfonic acid or a salt thereof, a phosphoric acid or a salt thereof, a C_3 - C_{10} cycloalkyl group, a C_2 - C_{10} heterocycloalkyl group, a C_3 - C_{10} cycloalkenyl group, a C_2 - C_{10} heterocycloalkenyl group, a C_6 - C_{60} aryl group, a C_6 - C_{60} aryloxy group, a C_6 - C_{60} arylthio group, a C_1 - C_{60} heteroaryl group, a monovalent non-aromatic condensed polycyclic group, a monovalent non-aromatic condensed heteropolycyclic group, —N(Q_{11})(Q_{12}), —Si(Q_{13})(Q_{14})(Q_{15}), and —B(Q_{16})(Q_{17});

[0015] a C_3 - C_{10} cycloalkyl group, a C_2 - C_{10} heterocycloalkyl group, a C_3 - C_{10} cycloalkenyl group, a C_2 - C_{10} heterocycloalkenyl group, a C_6 - C_{60} aryl group, a C_6 - C_{60} aryloxy

group, a C₆-C₆₀ arylthio group, a C₁-C₆₀ heteroaryl group, a monovalent non-aromatic condensed polycyclic group, and a monovalent non-aromatic condensed heteropolycyclic group;

[0016] a C₃-C₁₀ cycloalkyl group, a C₂-C₁₀ heterocycloalkyl group, a C₃-C₁₀ cycloalkenyl group, a C₂-C₁₀ heterocycloalkenyl group, a C₆-C₆₀ aryl group, a C₆-C₆₀ aryloxy group, a C₆-C₆₀ arylthio group, a C₂-C₆₀ heteroaryl group, a monovalent non-aromatic condensed polycyclic group, and a monovalent non-aromatic condensed heteropolycyclic group, each substituted with at least one selected from 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 C₁-C₆₀ alkyl group, a C₂-C₆₀ alkenyl group, a C₂-C₆₀ alkynyl group, a C₁-C₆₀ alkoxy group, a C₃-C₁₀ cycloalkyl group, a C₂-C₁₀ heterocycloalkyl group, a C₃-C₁₀ cycloalkenyl group, a C₂-C₁₀ heterocycloalkenyl group, a C₆-C₆₀ aryl group, a C₆-C₆₀ aryloxy group, a C₆-C₆₀ arylthio group, a C₁-C₆₀ heteroaryl group, a monovalent non-aromatic condensed polycyclic group, a monovalent non-aromatic condensed heteropolycyclic group, —N(Q₂₁)(Q₂₂), —Si(Q₂₃)(Q₂₄)(Q₂₅) and —B(Q₂₆)(Q₂₇); and

[0017] —N(Q₃₁)(Q₃₂), —Si(Q₃₃)(Q₃₄)(Q₃₅), and —B(Q₃₆)(Q₃₇),

[0018] wherein Q₁ to Q₇, Q₁₁ to Q₁₇, Q₂₁ to Q₂₇, and Q₃₁ to Q₃₇ may be 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 hydrazine group, a carboxylic acid or a salt thereof, a sulfonic acid or a salt thereof, a phosphoric acid or a salt thereof, a C₁-C₆₀ alkyl group, a C₂-C₆₀ alkenyl group, a C₂-C₆₀ alkynyl group, a C₁-C₆₀ alkoxy group, a C₃-C₁₀ cycloalkyl group, a C₂-C₁₀ heterocycloalkyl group, a C₃-C₁₀ cycloalkenyl group, a C₂-C₁₀ heterocycloalkenyl group, a C₆-C₆₀ aryl group, a C₁-C₆₀ heteroaryl group, a monovalent non-aromatic condensed polycyclic group, and a monovalent non-aromatic condensed heteropolycyclic group.

[0019] Embodiments are also directed to an organic light-emitting device, including a first electrode, a second electrode facing the first electrode, and an organic layer that is disposed between the first electrode and the second electrode and includes an emission layer. The organic layer may include at least one compound according to an embodiment.

[0020] Embodiments are also directed to a flat panel display apparatus including the organic light-emitting device. The first electrode of the organic light-emitting device may be electrically connected to a source electrode or drain electrode of a thin film transistor.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] Features will become apparent to those of skill in the art by describing in detail example embodiments with reference to the attached drawing in which:

[0022] FIG. 1 illustrates a schematic view of an organic light-emitting device according to an embodiment.

DETAILED DESCRIPTION

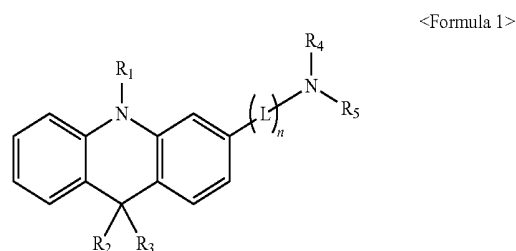
[0023] Example embodiments will now be described more fully hereinafter with reference to the accompanying drawing; however, they may be embodied in different forms and should not be construed as limited to the embodiments set

forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey example implementations to those skilled in the art.

[0024] In the drawing figure, the dimensions of layers and regions may be exaggerated for clarity of illustration. Like reference numerals refer to like elements throughout.

[0025] As used herein, the term “and/or” includes any and all combinations of one or more of the associated listed items. Expressions such as “at least one of,” when preceding a list of elements, modify the entire list of elements and do not modify the individual elements of the list.

[0026] A compound according to an embodiment is represented by Formula 1 below:



[0027] In Formula 1,

[0028] R₁ to R₅ may be 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 hydrazine group, a hydrazine group, a carboxylic acid or a salt thereof, a sulfonic acid or a salt thereof, a phosphoric acid or a salt thereof, a substituted or unsubstituted C₁-C₆₀ alkyl group, a substituted or unsubstituted C₂-C₆₀ alkenyl group, a substituted or unsubstituted C₂-C₆₀ alkynyl group, a substituted or unsubstituted C₁-C₆₀ alkoxy group, a substituted or unsubstituted C₃-C₁₀ cycloalkyl group, a substituted or unsubstituted C₂-C₁₀ heterocycloalkyl group, a substituted or unsubstituted C₃-C₁₀ cycloalkenyl group, a substituted or unsubstituted C₂-C₁₀ heterocycloalkenyl group, a substituted or unsubstituted C₆-C₆₀ aryl group, a substituted or unsubstituted C₆-C₆₀ aryloxy group, a substituted or unsubstituted C₆-C₆₀ arylthio group, a substituted or unsubstituted C₁-C₆₀ heteroaryl group, a substituted or unsubstituted monovalent non-aromatic condensed polycyclic group, a substituted or unsubstituted monovalent non-aromatic condensed heteropolycyclic group, —N(Q₁)(Q₂), —Si(Q₃)(Q₄)(Q₅), and —B(Q₆)(Q₇);

[0029] L may be selected from a bond, a substituted or unsubstituted C₃-C₁₀ cycloalkylene group, a substituted or unsubstituted C₂-C₁₀ heterocycloalkylene group, a substituted or unsubstituted C₃-C₁₀ cycloalkenylene group, a substituted or unsubstituted C₂-C₁₀ heterocycloalkenylene group, a substituted or unsubstituted C₆-C₆₀ arylene group, a substituted or unsubstituted C₁-C₆₀ heteroarylene group, a substituted or unsubstituted divalent non-aromatic condensed polycyclic group, and a substituted or unsubstituted divalent non-aromatic condensed heteropolycyclic group;

[0030] n is an integer selected from 1, 2, and 3, and when n is 2 or more, a plurality of L may be identical or different;

[0031] at least one substituent of the substituted C₁-C₆₀ alkyl group, substituted C₂-C₆₀ alkenyl group, substituted C₂-C₆₀ alkynyl group, substituted C₁-C₆₀ alkoxy group, substituted C₃-C₁₀ cycloalkyl group, substituted C₃-C₁₀ cycloalkylene group, substituted C₂-C₁₀ heterocycloalkyl

group, substituted C_2 - C_{10} heterocycloalkylene group, substituted C_3 - C_{10} cycloalkenyl group, substituted C_3 - C_{10} cycloalkenylene group, substituted C_2 - C_{10} heterocycloalkenyl group, substituted C_2 - C_{10} heterocycloalkenylene group, substituted C_6 - C_{60} aryl group, substituted C_6 - C_{60} arylene group, substituted C_6 - C_{60} aryloxy group, substituted C_6 - C_{60} arylthio group, substituted C_1 - C_{60} heteroaryl group, substituted C_1 - C_{60} heteroarylene group, substituted monovalent non-aromatic condensed polycyclic group, substituted monovalent non-aromatic condensed heteropolycyclic group, substituted divalent non-aromatic condensed polycyclic group, and substituted divalent non-aromatic condensed heteropolycyclic group may be selected from

[0032] 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, and a C_1 - C_{60} alkoxy group;

[0033] 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 or a salt thereof, a sulfonic acid or a salt thereof, a phosphoric acid or a salt thereof, a C_3 - C_{10} cycloalkyl group, a C_2 - C_{10} heterocycloalkyl group, a C_3 - C_{10} cycloalkenyl group, a C_2 - C_{10} heterocycloalkenyl group, a C_6 - C_{60} aryl group, a C_6 - C_{60} aryloxy group, a C_6 - C_{60} arylthio group, a C_1 - C_{60} heteroaryl group, a monovalent non-aromatic condensed polycyclic group, a monovalent non-aromatic condensed heteropolycyclic group, —N(Q_{11})(Q_{12}), —Si(Q_{13})(Q_{14})(Q_{15}), and —B(Q_{16})(Q_{17});

[0034] a C_3 - C_{10} cycloalkyl group, a C_2 - C_{10} heterocycloalkyl group, a C_3 - C_{10} cycloalkenyl group, a C_2 - C_{10} heterocycloalkenyl group, a C_6 - C_{60} aryl group, a C_6 - C_{60} aryloxy group, a C_6 - C_{60} arylthio group, a C_1 - C_{60} heteroaryl group, a monovalent non-aromatic condensed polycyclic group, and a monovalent non-aromatic condensed heteropolycyclic group;

[0035] a C_3 - C_{10} cycloalkyl group, a C_2 - C_{10} heterocycloalkyl group, a C_3 - C_{10} cycloalkenyl group, a C_2 - C_{10} heterocycloalkenyl group, a C_6 - C_{60} aryl group, a C_6 - C_{60} aryloxy group, a C_6 - C_{60} arylthio group, a C_2 - 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_2 - C_{10} heterocycloalkyl group, a C_3 - C_{10} cycloalkenyl group, a C_2 - C_{10} heterocycloalkenyl group, a C_6 - C_{60} aryl group, a C_6 - C_{60} aryloxy group, a C_6 - C_{60} arylthio group, a C_1 - C_{60} heteroaryl group, a monovalent non-aromatic condensed polycyclic group, a monovalent non-aromatic condensed heteropolycyclic group, —N(Q_{21})(Q_{22}), —Si(Q_{23})(Q_{24})(Q_{25}) and —B(Q_{26})(Q_{27}); and

[0036] —N(Q_{31})(Q_{32}), —Si(Q_{33})(Q_{34})(Q_{35}), and —B(Q_{36})(Q_{37}),

[0037] wherein Q_1 to Q_7 , Q_{11} to Q_{17} , Q_{21} to Q_{27} , and Q_{31} to Q_{37} may be 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 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_2 - C_{10} heterocycloalkyl group, a C_3 - C_{10} cycloalkenyl group, a C_2 - C_{10} heterocycloalkenyl group, a C_6 - C_{60} aryl group, a C_1 - C_{60} heteroaryl group, a monovalent non-aromatic condensed polycyclic group, and a monovalent non-aromatic condensed heteropolycyclic group.

[0038] The compound represented by Formula 1 may be an asymmetric compound, e.g., the 9,10-dihydroacridine or acridane-based core moiety may be asymmetrically substituted.

[0039] As a material for the hole transport layer, for example, a fluorene derivative or an anthracene derivative have been considered. However, an organic light-emitting device including a hole transport layer formed of a general material for a transport layer may exhibit unsatisfactory lifespan, efficiency, and consumption power characteristics. A hole transport layer formed of an acridine has also been considered but acridine may not provide satisfactory characteristics for use in a hole transport layer.

[0040] Embodiments described herein may provide stability, high charge transport capabilities, a high glass transition temperature, and crystallization-preventing properties.

[0041] Substituents of Formula 1 will now be described in detail.

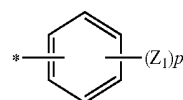
[0042] In some embodiments, two or more substituents selected from R_1 to R_5 in Formula 1 may be linked to each other to form a ring. For example, R_2 and R_3 , or R_4 and R_5 may be linked to each other to form a C_{10} - C_{60} non-aromatic ring or aromatic ring. The non-aromatic ring or aromatic ring may include a hetero atom.

[0043] In some embodiments, R_1 to R_5 in Formula 1 may be each independently selected from a substituted or unsubstituted C_1 - C_{60} alkyl group, a substituted or unsubstituted C_6 - C_{60} aryl group, and a substituted or unsubstituted C_1 - C_{60} heteroaryl group.

[0044] In some embodiments, L in Formula 1 may be a bond, a substituted or unsubstituted C_6 - C_{60} arylene group, or a substituted or unsubstituted C_1 - C_{60} heteroarylene group.

[0045] In some embodiments, n in Formula 1 may be 1.

[0046] In some embodiments, R_1 in Formula 1 may be Formula 2a below:



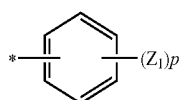
2a

[0047] Z_1 in Formula 2a may 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 or a salt thereof, a sulfonic acid or a salt thereof, a phosphoric acid or a salt thereof, a substituted or unsubstituted C_1 to C_{20} alkyl group, a substituted or unsubstituted C_6 to C_{20} aryl group, a substituted or unsubstituted C_1 to C_{20} heteroaryl group, a

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

[0048] p may be an integer selected from 1, 2, 3, 4, and 5; and when p is 2 or more, a plurality of Z_1 may be identical or different; and * indicates a binding site to a neighboring atom.

[0049] In some embodiments, R_2 and R_3 in Formula 1 may be each independently Formulae 3A or 3B:



3a

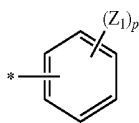


3b

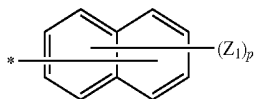
[0050] Z_1 in Formula 3a may be selected from a hydrogen, a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid or a salt thereof, a sulfonic acid or a salt thereof, a phosphoric acid or a salt thereof, a substituted or unsubstituted C_1 to C_{20} alkyl group, a substituted or unsubstituted C_6 to C_{20} aryl group, a substituted or unsubstituted C_1 to C_{20} heteroaryl group, a substituted or unsubstituted monovalent non-aromatic condensed polycyclic group, and a substituted or unsubstituted monovalent non-aromatic condensed heteropolycyclic group;

[0051] p may be an integer selected from 1, 2, 3, 4, and 5; and when p is 2 or more, a plurality of Z_1 may be identical or different; and * indicates a binding site to a neighboring atom.

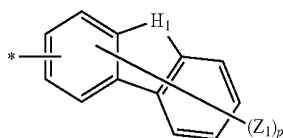
[0052] In some embodiments, R_4 and R_5 in Formula 1 may be each independently any one of Formulae 4a to 4c below:



4a



4b



4c

[0053] wherein in Formulae 4a to 4c,

[0054] H_1 may be $CR_{21}R_{22}$ or NR_{23} ;

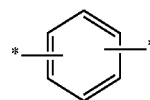
[0055] R_{21} , R_{22} , R_{23} , and Z_1 may be each independently selected from a hydrogen, a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid or a salt thereof, a sulfonic acid or a salt thereof, a phosphoric acid or a salt thereof, a substituted or unsubstituted C_1 - C_{20} alkyl group, a substituted or unsubstituted C_6 - C_{20} aryl group, a substituted or unsubstituted

C_1 - C_{20} heteroaryl group, a substituted or unsubstituted monovalent non-aromatic condensed polycyclic group, a substituted or unsubstituted monovalent non-aromatic condensed heteropolycyclic group, and —Si(Q_3)(Q_4)(Q_5);

[0056] Q_3 to Q_5 may be 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 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_2 - C_{10} heterocycloalkyl group, a C_3 - C_{10} cycloalkenyl group, a C_2 - C_{10} heterocycloalkenyl group, a C_6 - C_{60} aryl group, a C_1 - C_{60} heteroaryl group, a monovalent non-aromatic condensed polycyclic group, and a monovalent non-aromatic condensed heteropolycyclic group;

[0057] p may be an integer selected from 1, 2, 3, 4, 5, 6, and 7; and when p is 2 or more, a plurality of Z_1 may be identical or different; and * indicates a binding site to a neighboring atom.

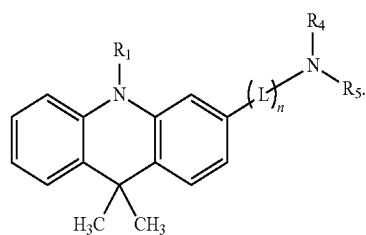
[0058] In some embodiments, L in Formula 1 may be a bond or Formula 5a below:



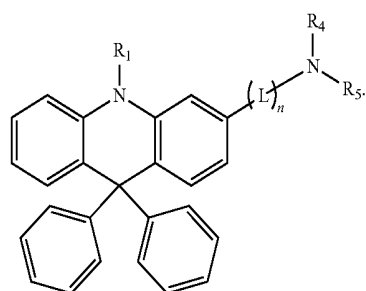
5a

[0059] * in Formula 5a indicates a binding site to a neighboring atom.

[0060] In some embodiments, Formula 1 may be Formulae 2, 3, or 4 below.



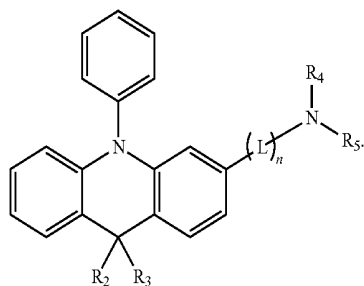
<Formula 2>



<Formula 3>

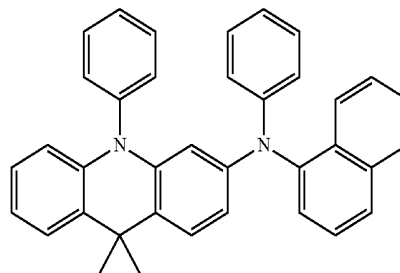
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<Formula 4>



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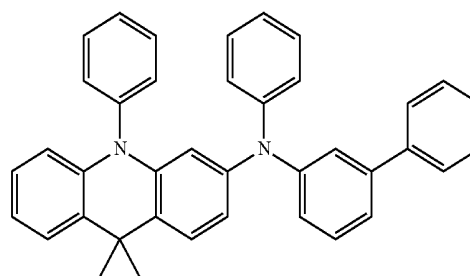
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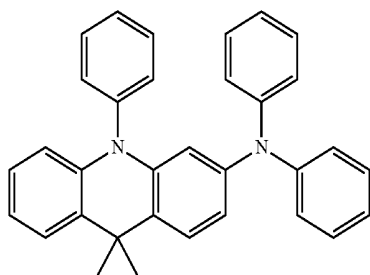
[0061] Definitions of substituents used in Formulae 2, 3, and 4 are presented above.

[0062] According to another embodiment, the compound of Formula 1 may be any one of compounds illustrated below:

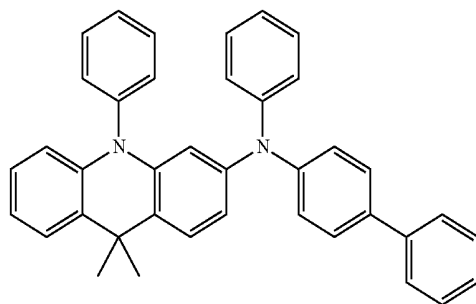
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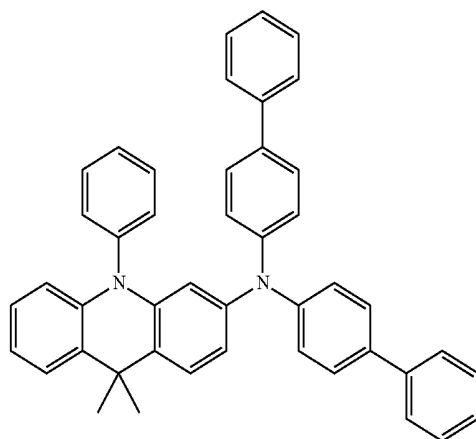
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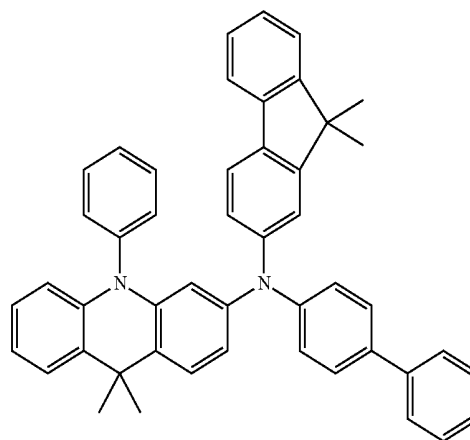
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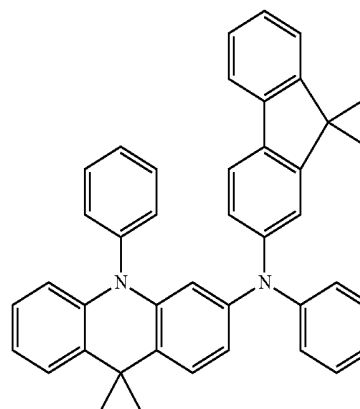
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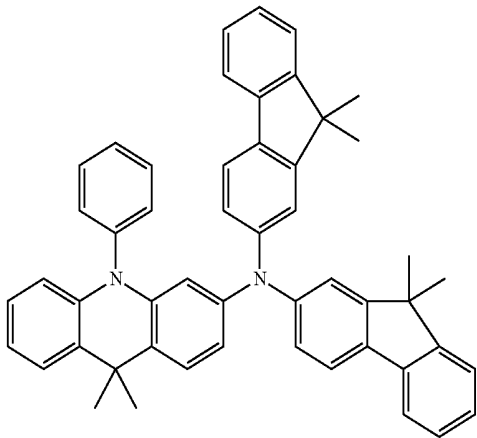
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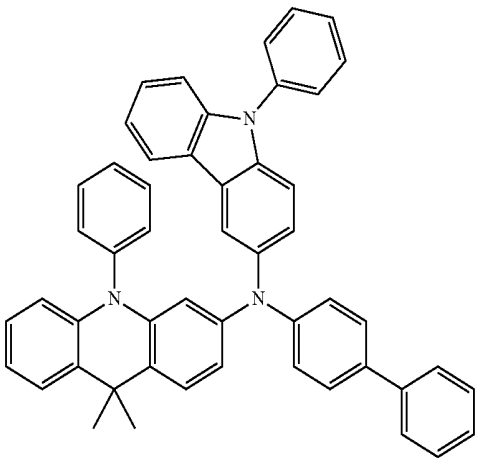


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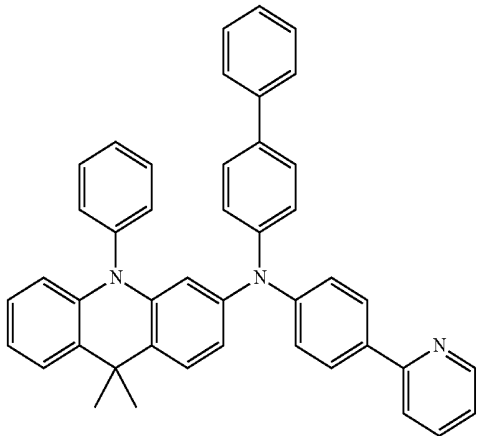
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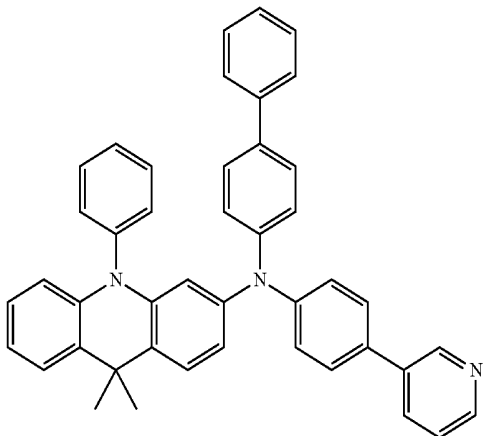


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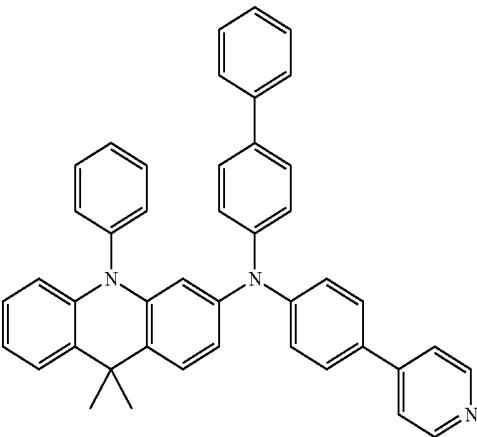
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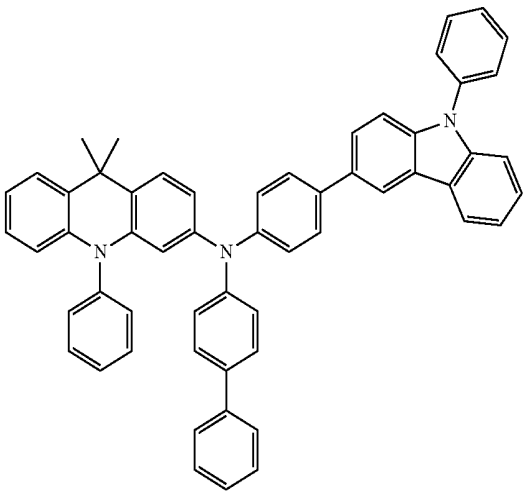
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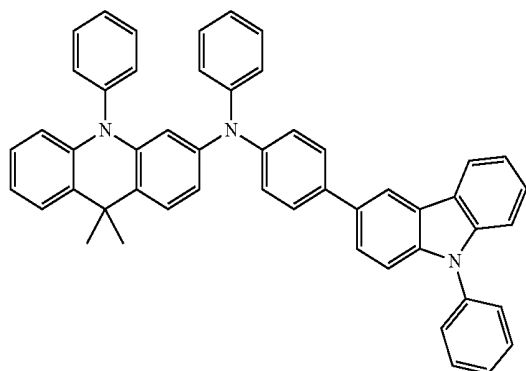


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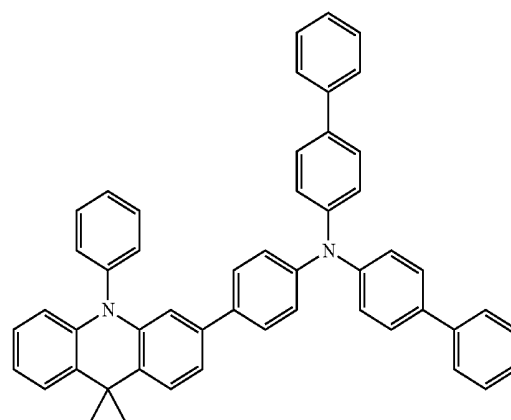
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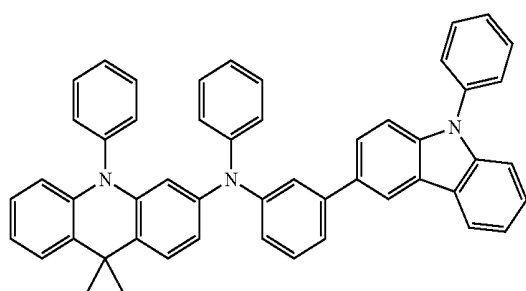
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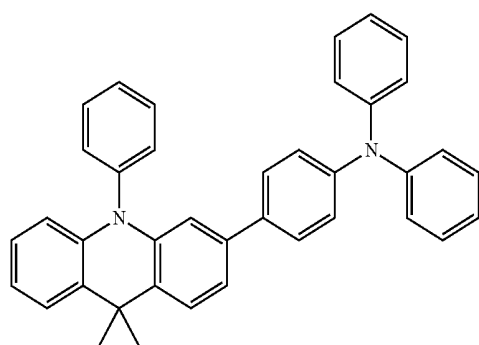
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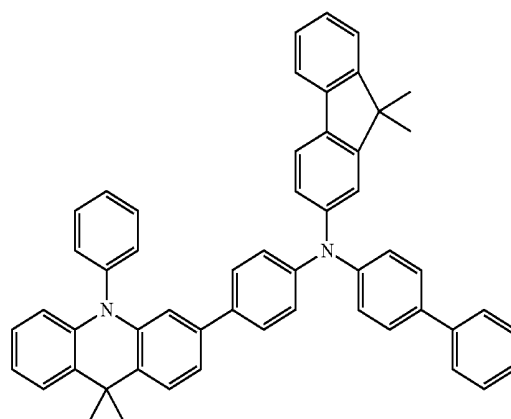
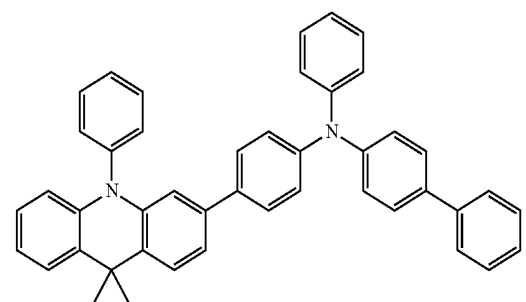
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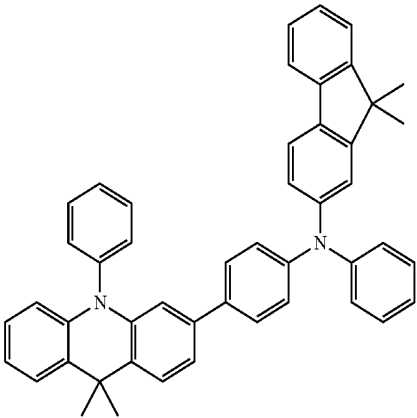
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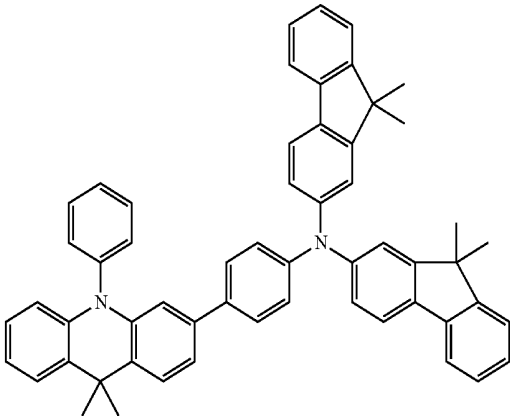


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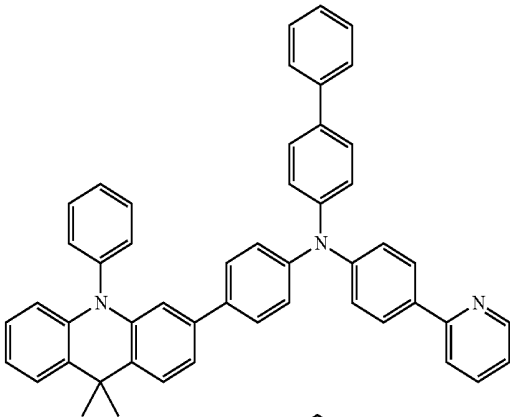
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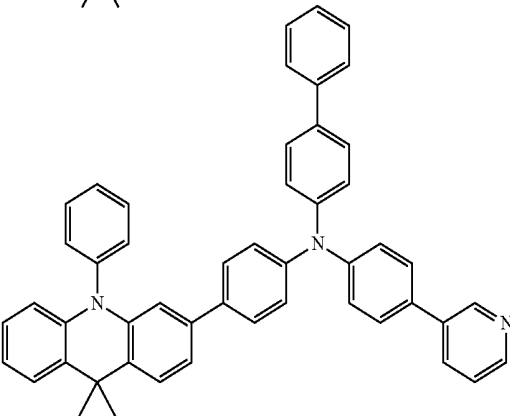
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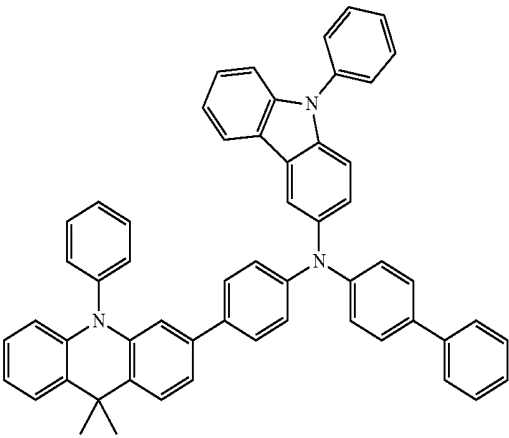


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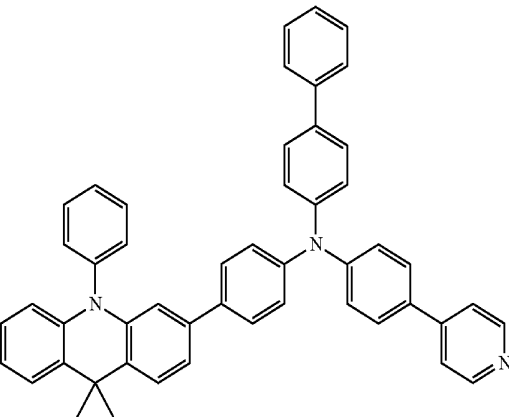


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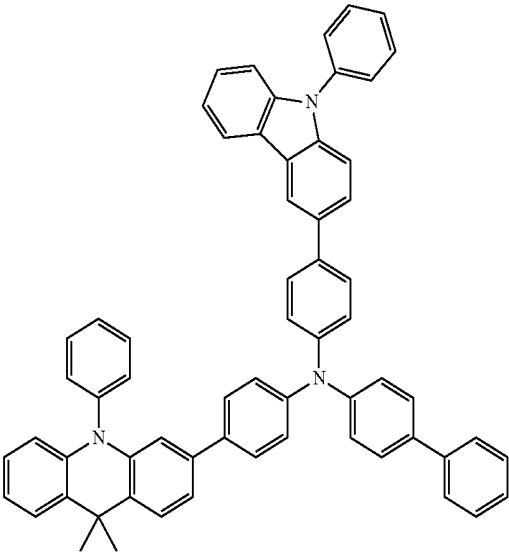
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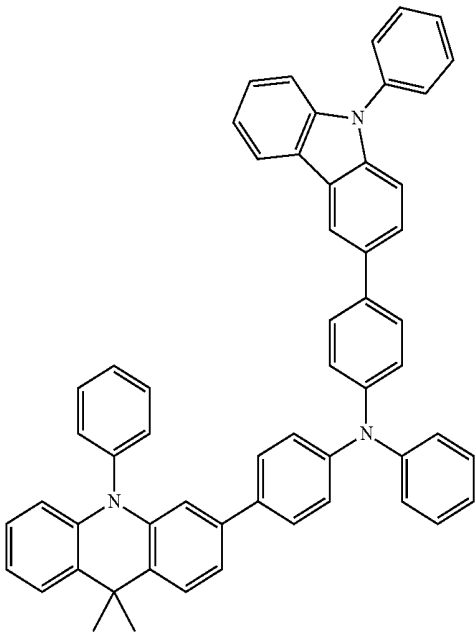


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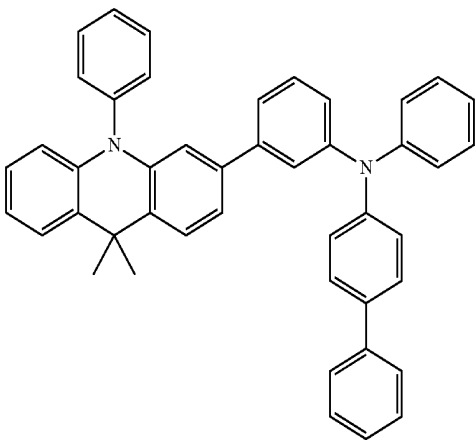
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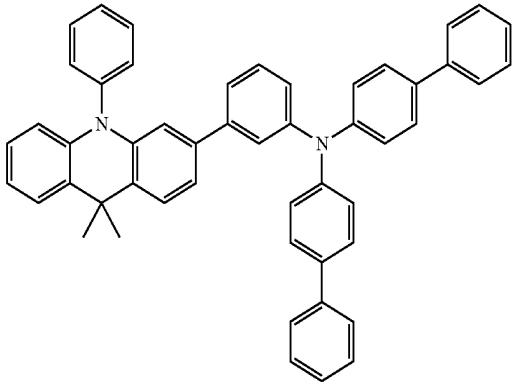


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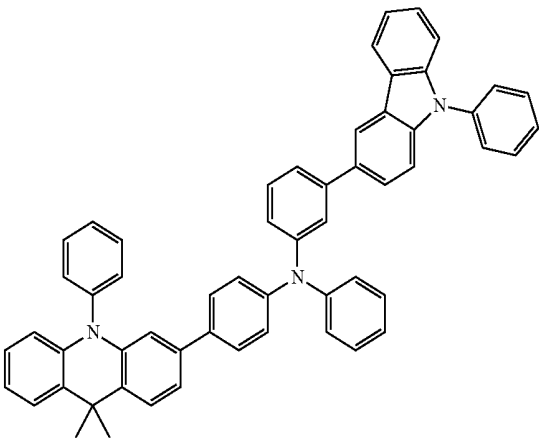
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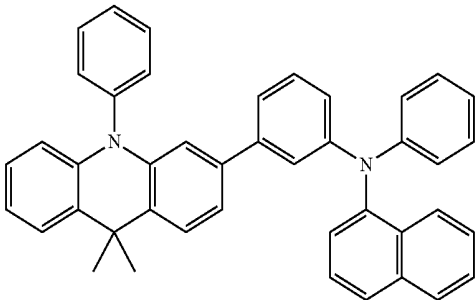
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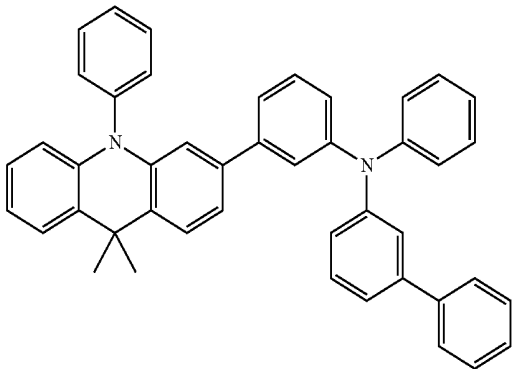
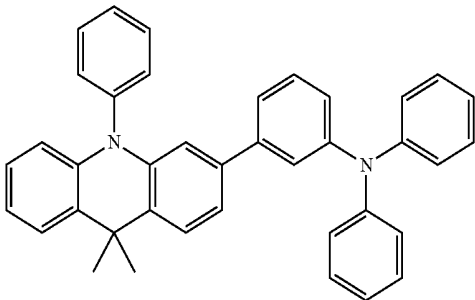


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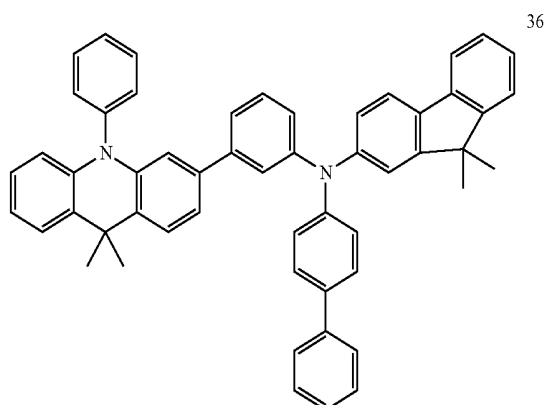


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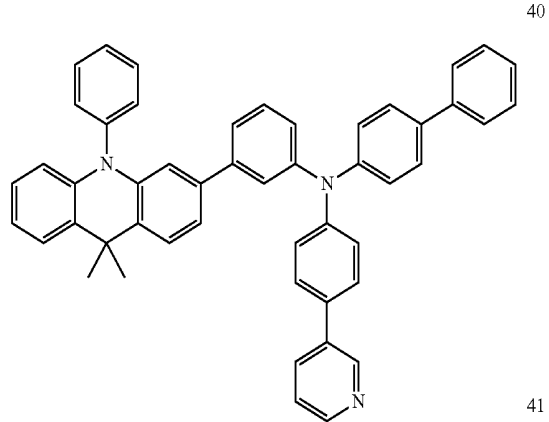


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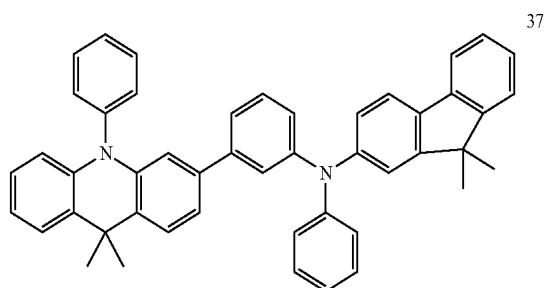


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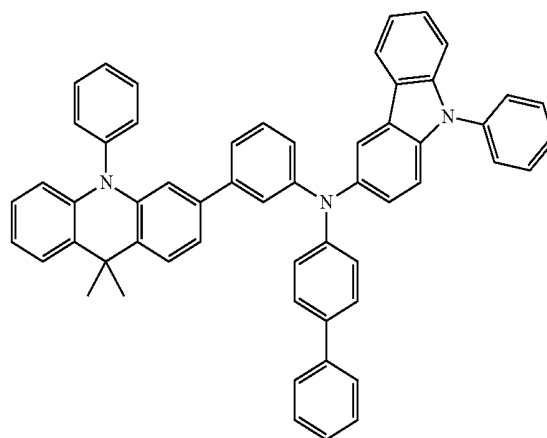
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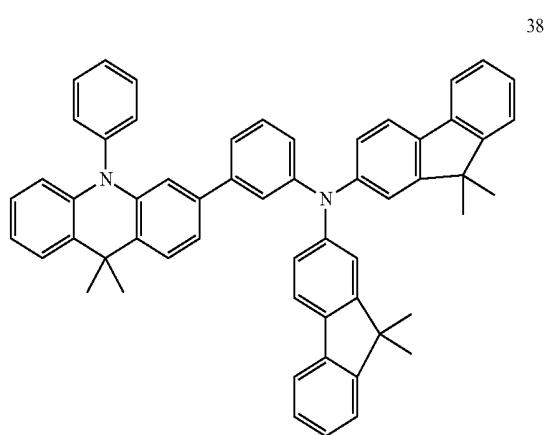
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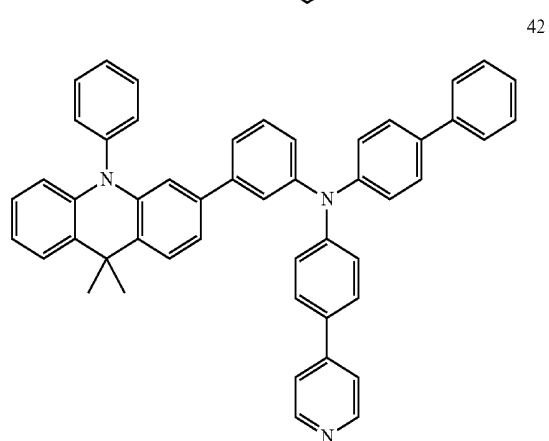
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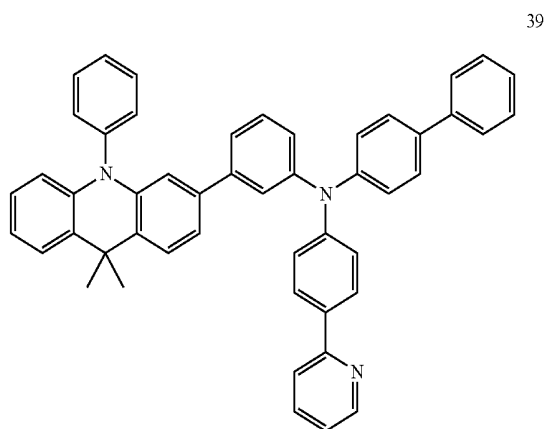
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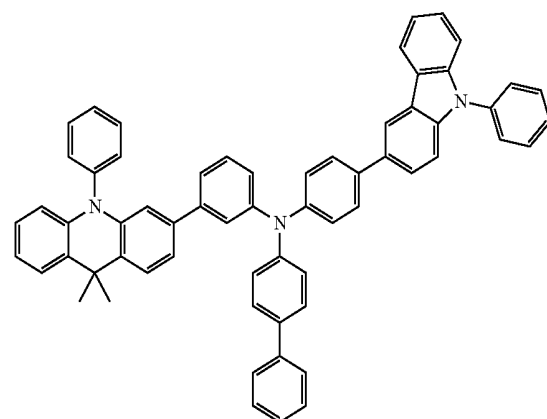
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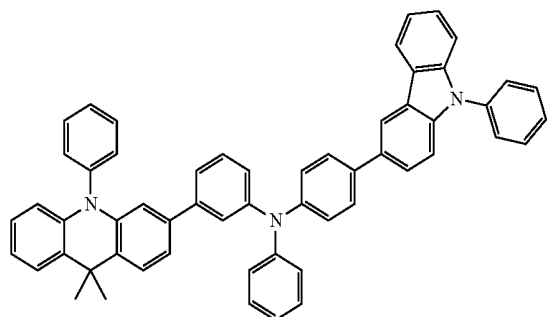


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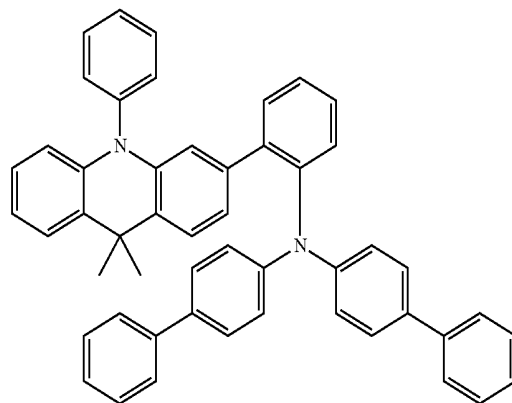
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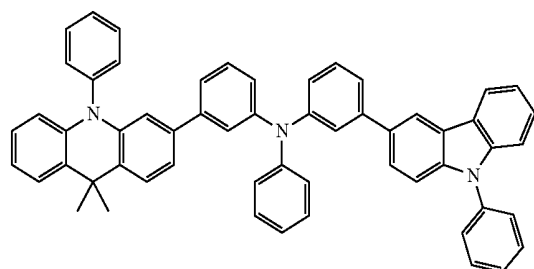


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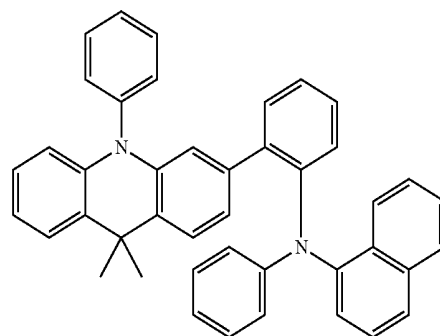
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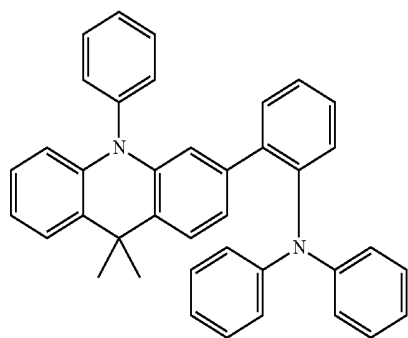
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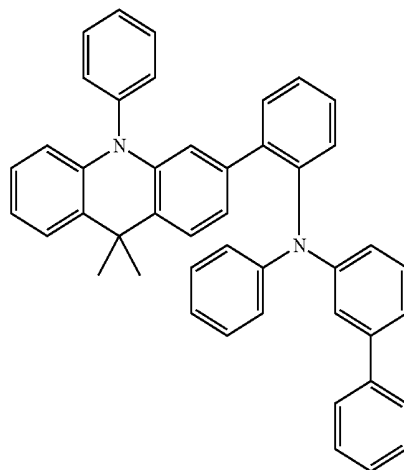
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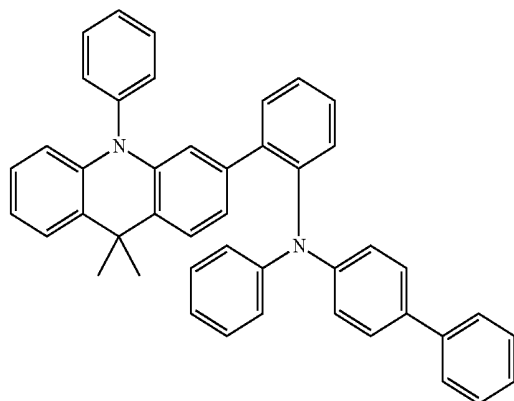
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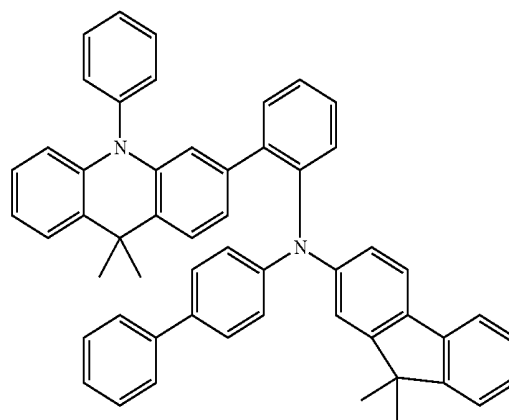
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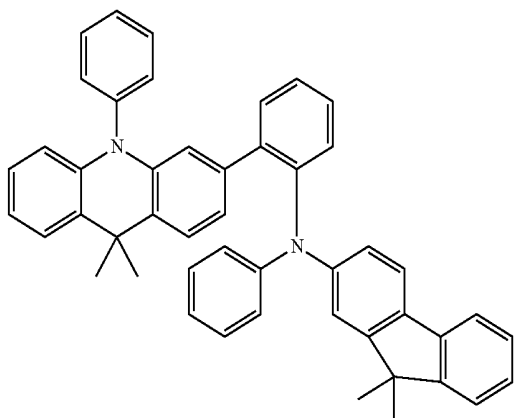
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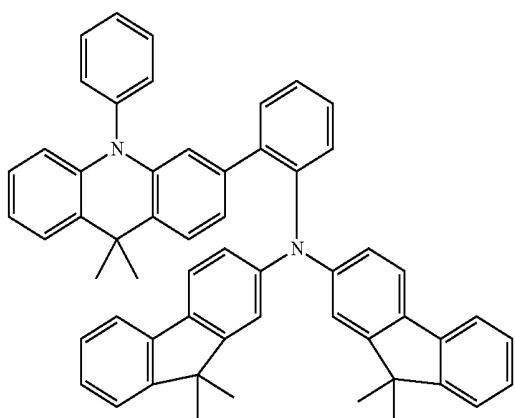
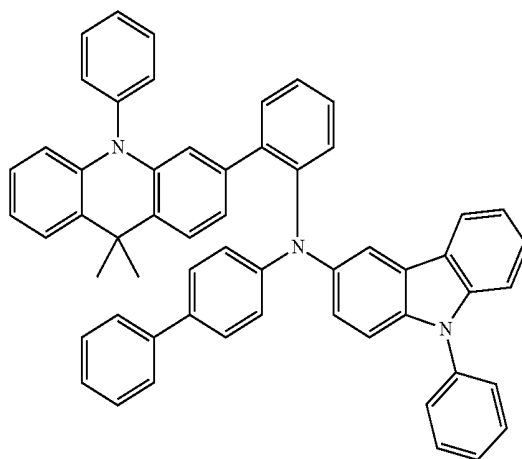
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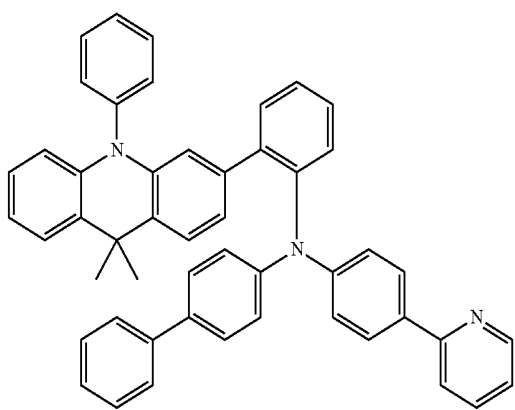
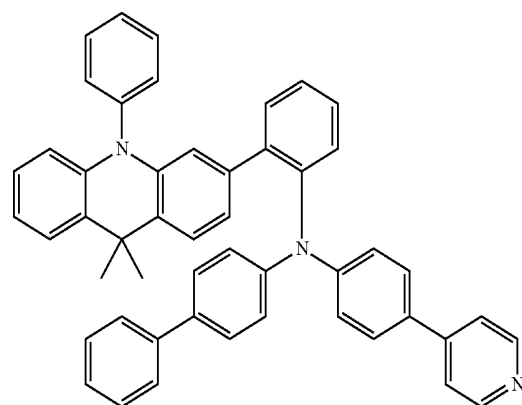
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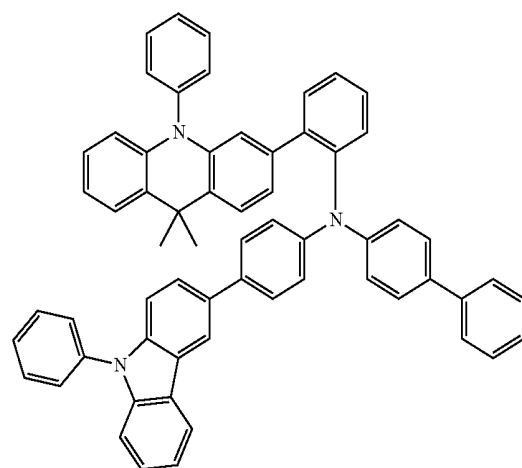
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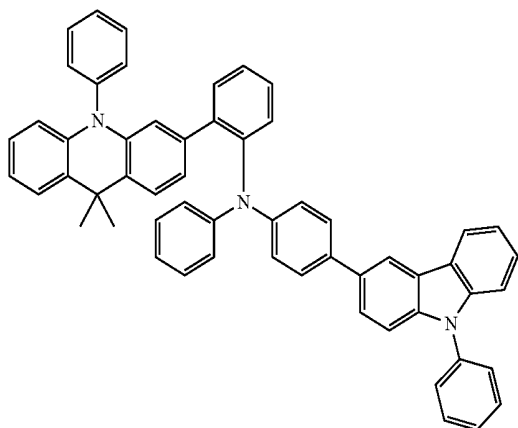
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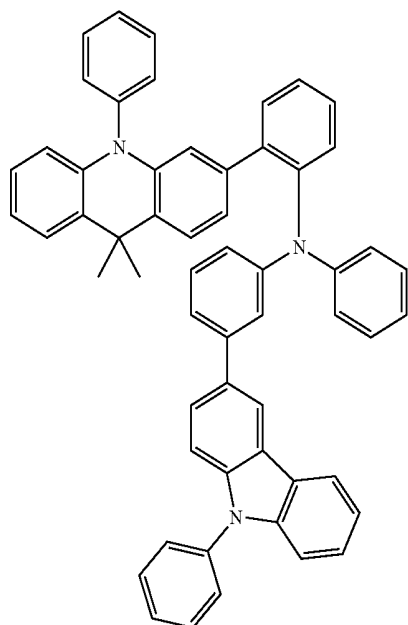


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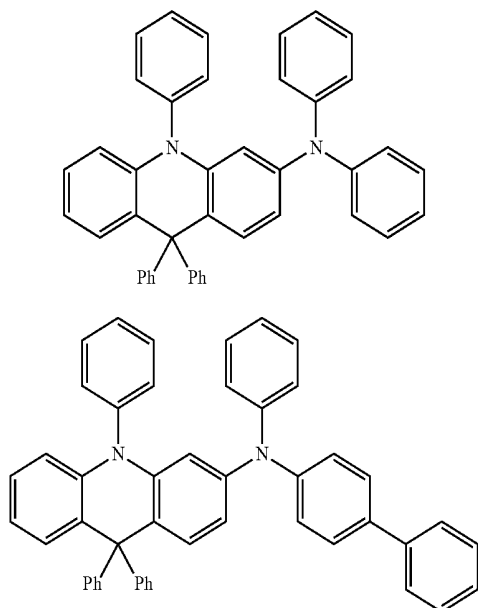
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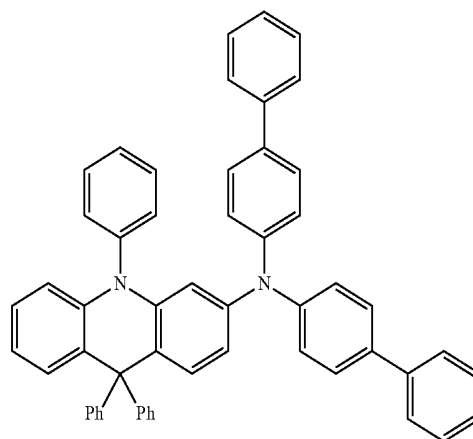
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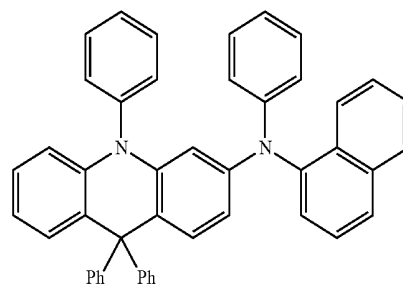
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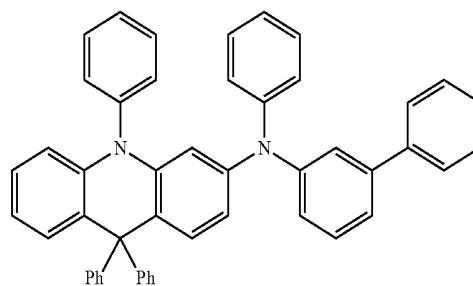
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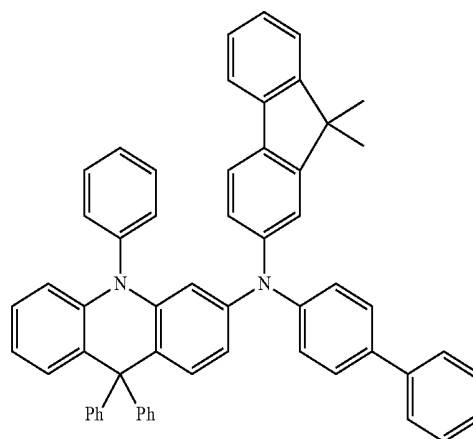
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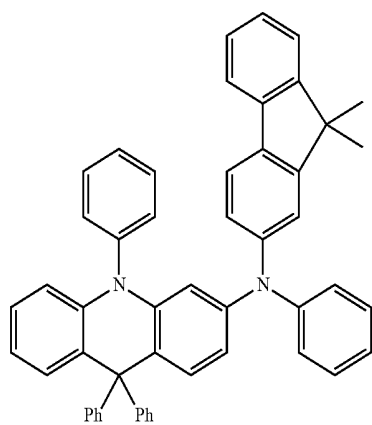
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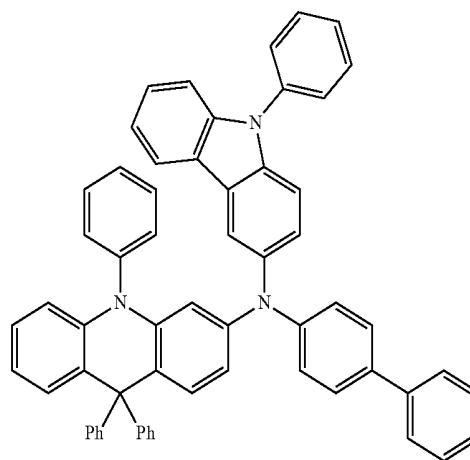


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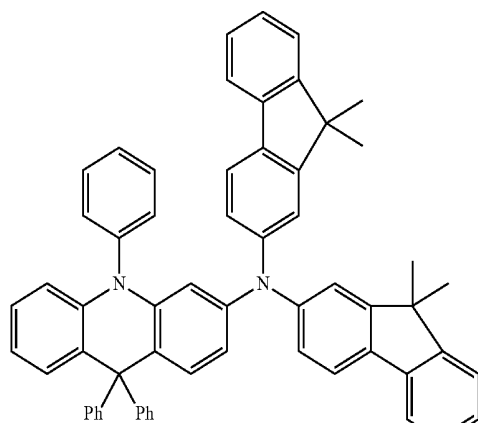
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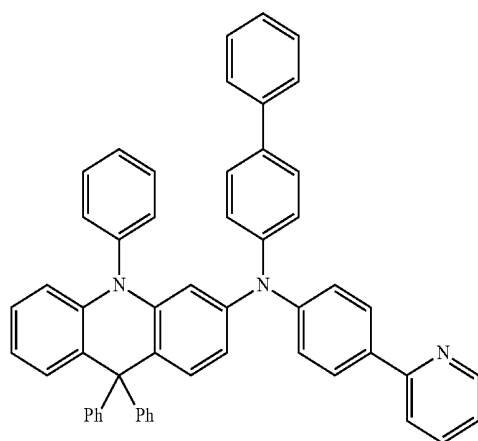
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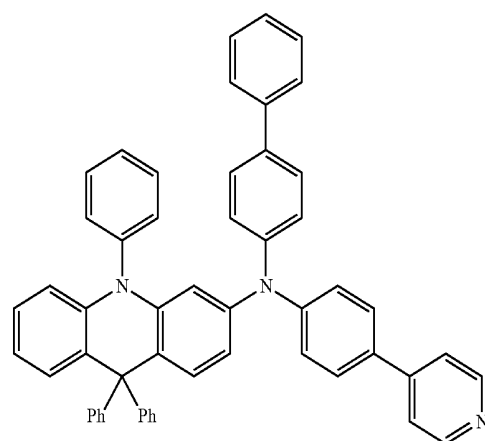


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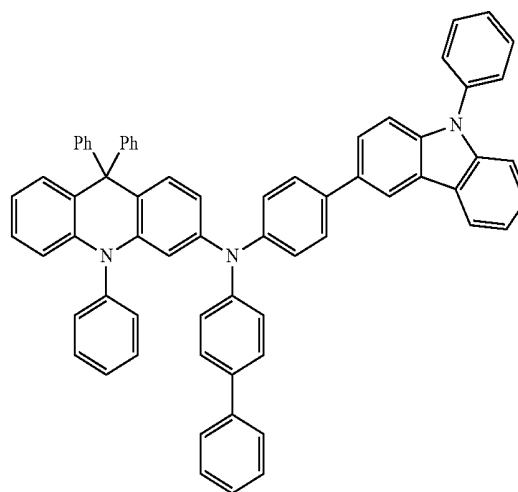
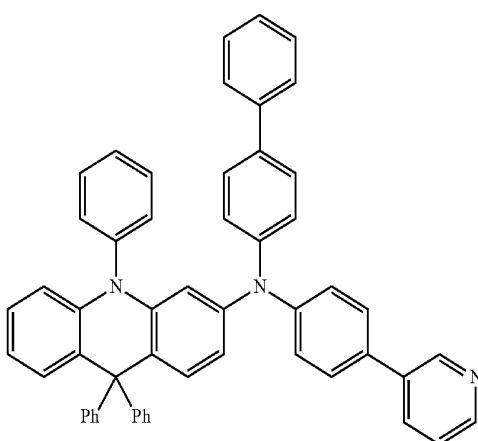
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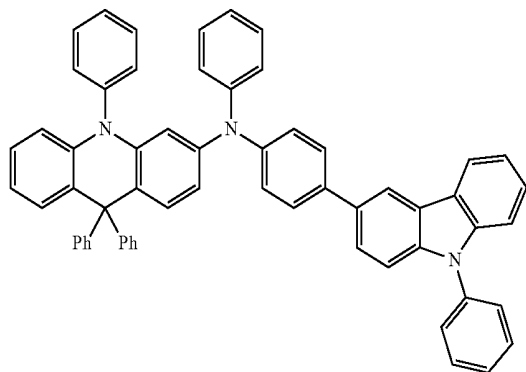


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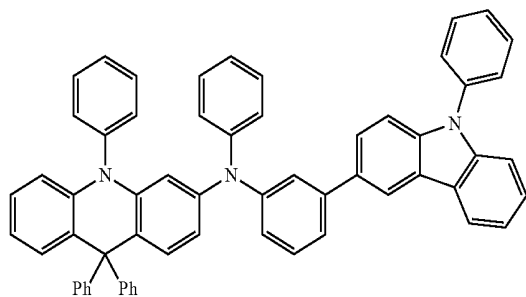


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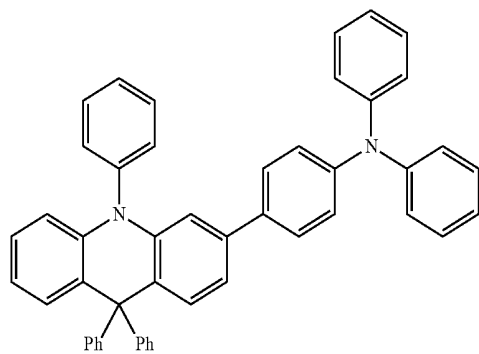
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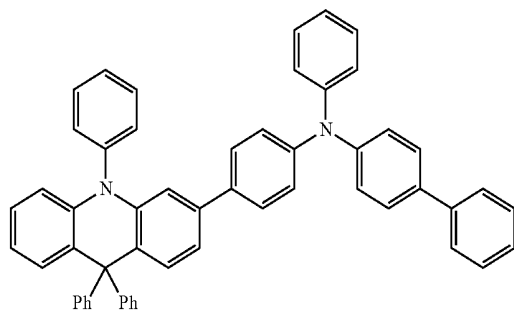
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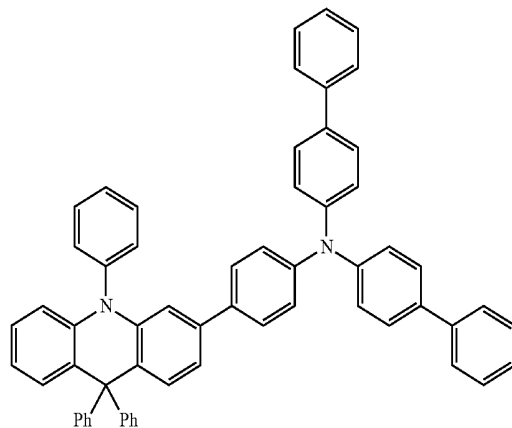


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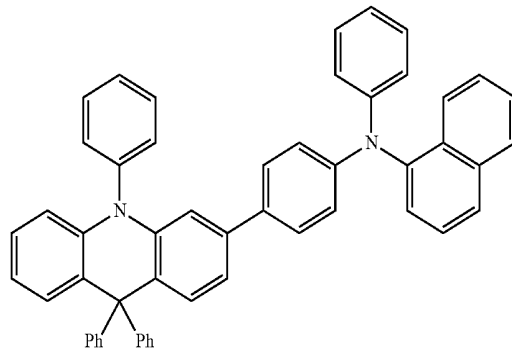


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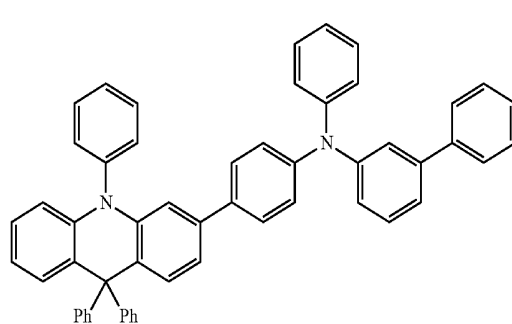
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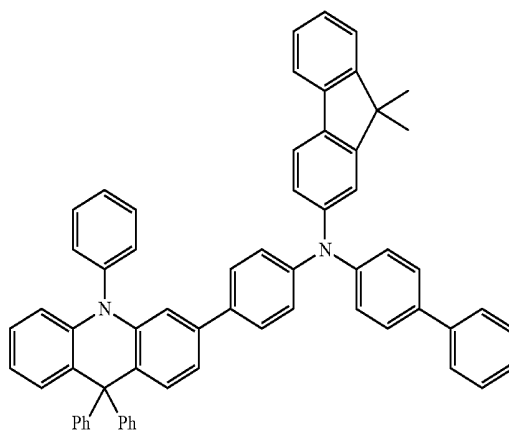
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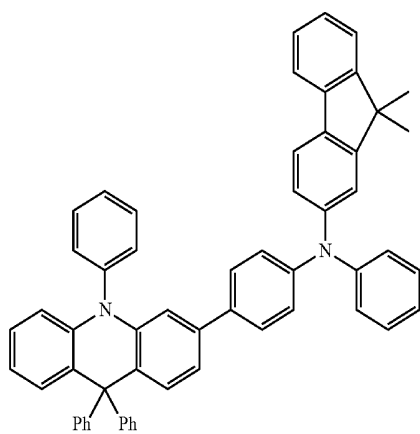


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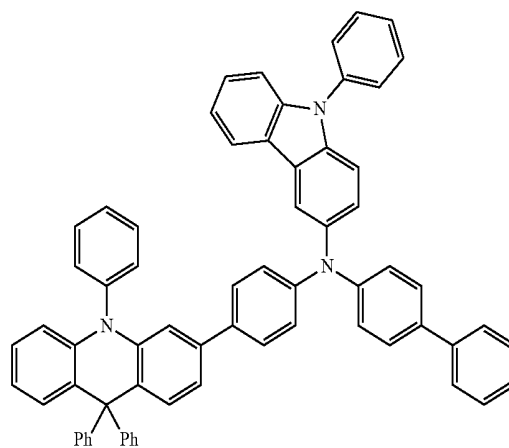
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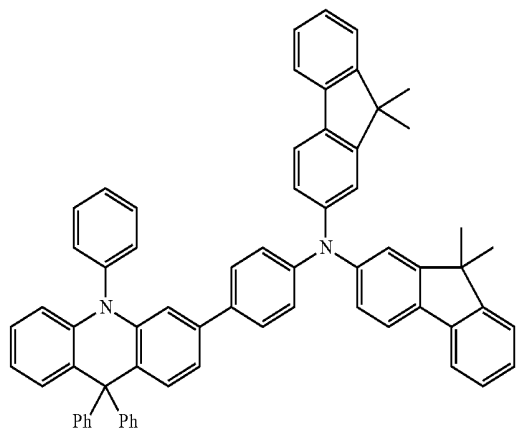
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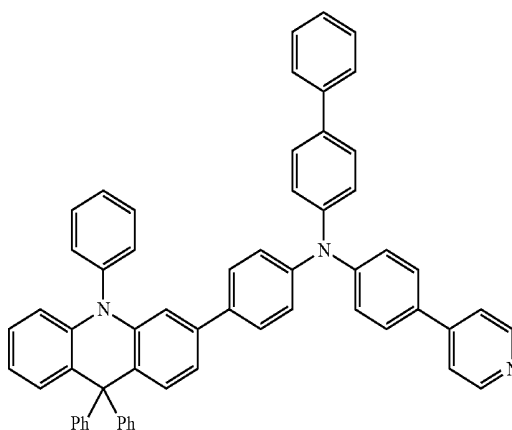
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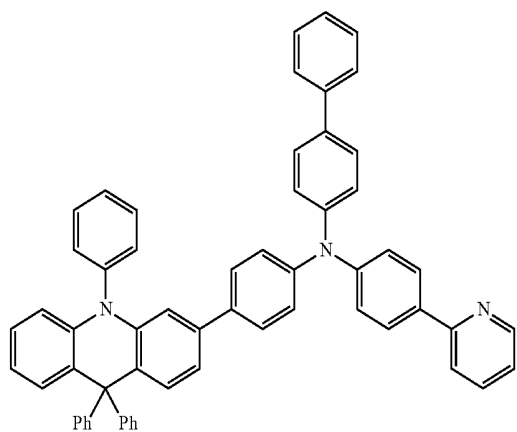
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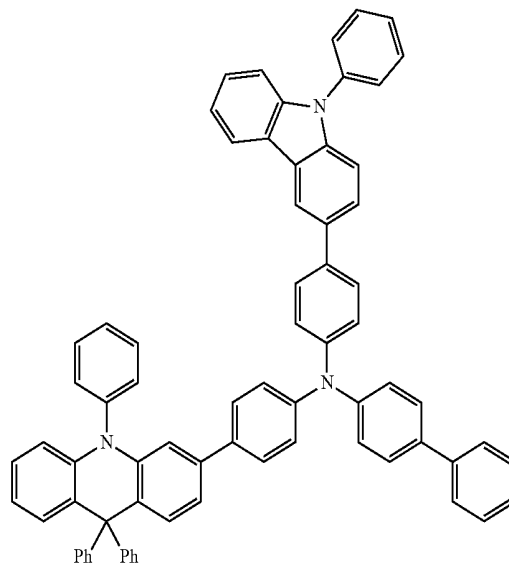
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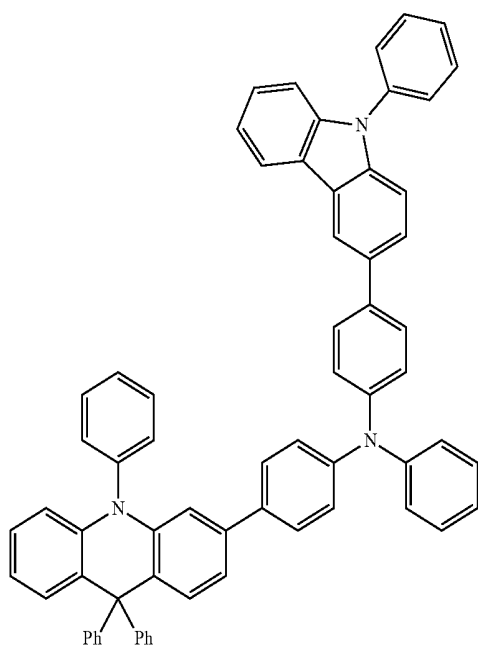
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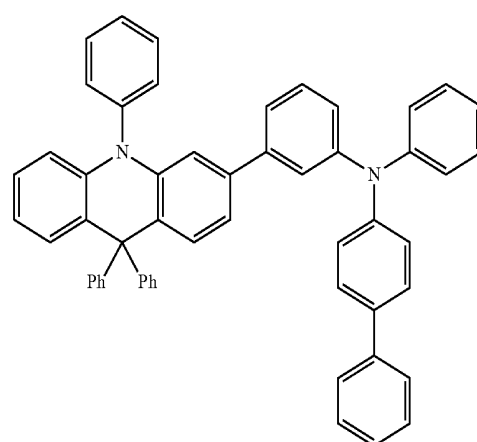


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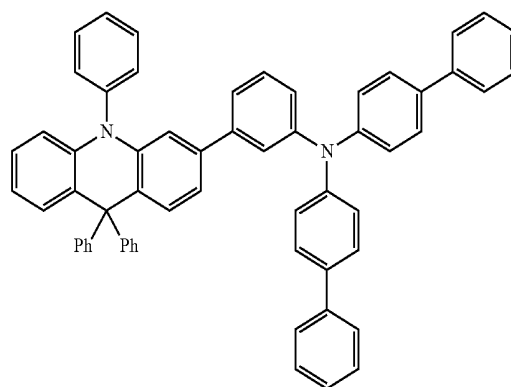


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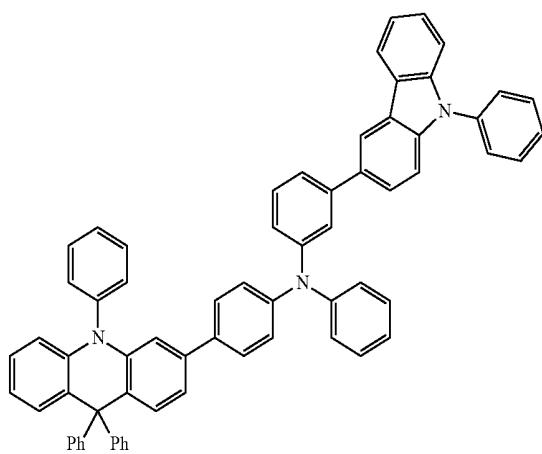
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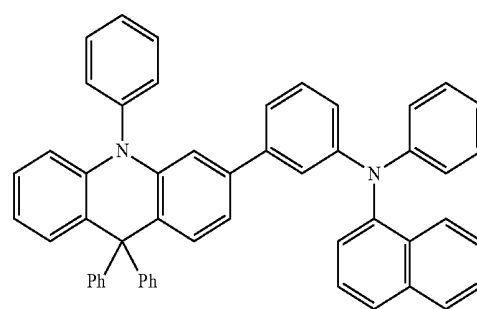
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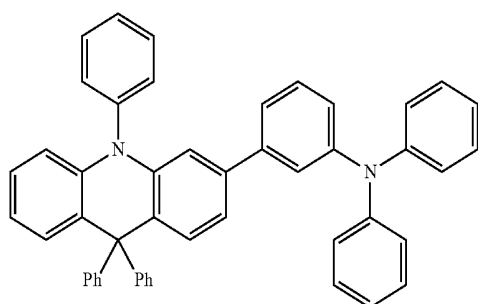
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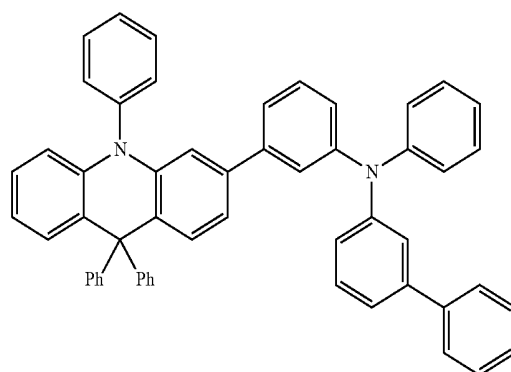
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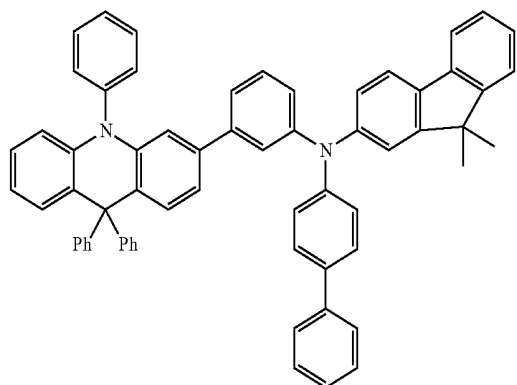


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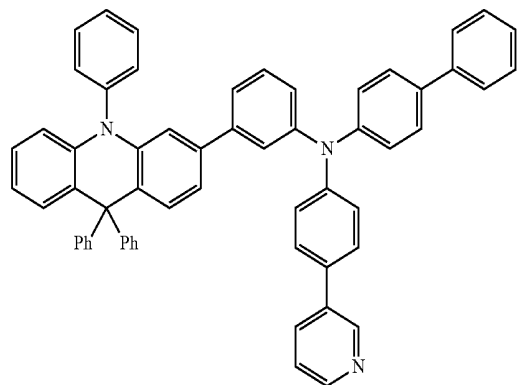
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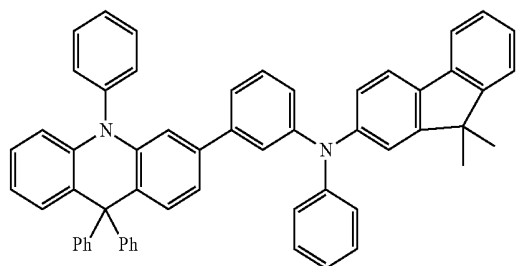


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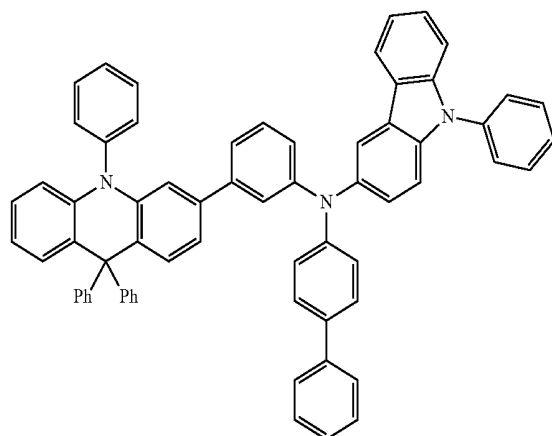
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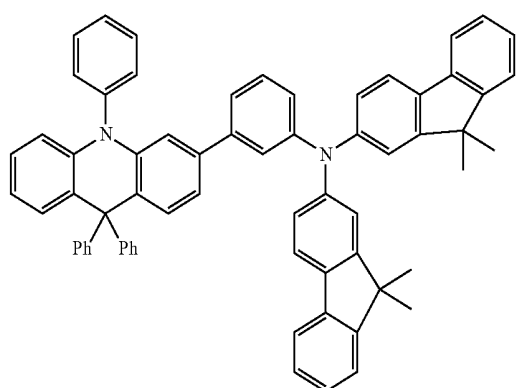
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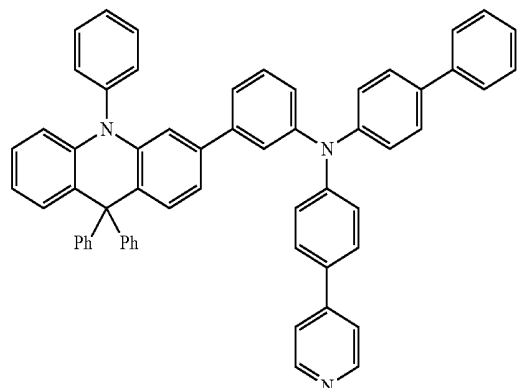
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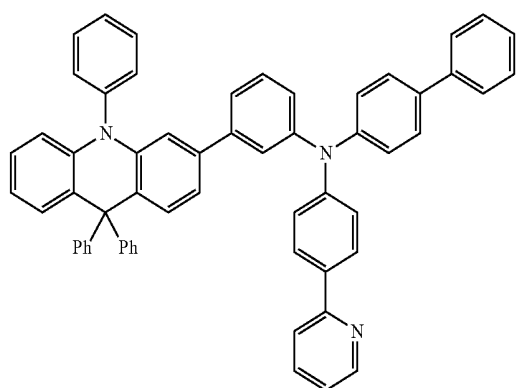
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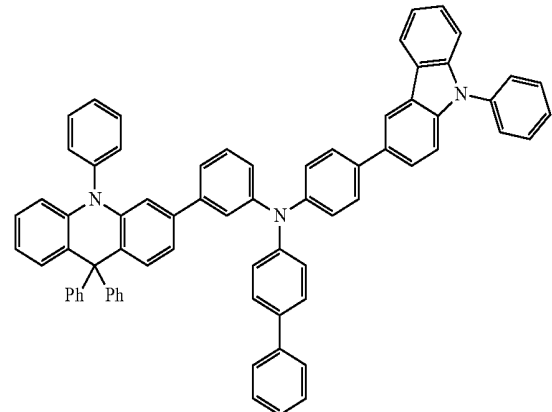
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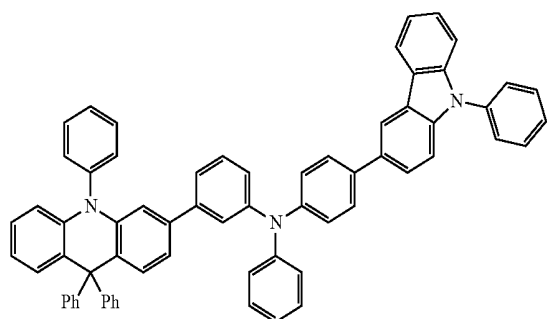


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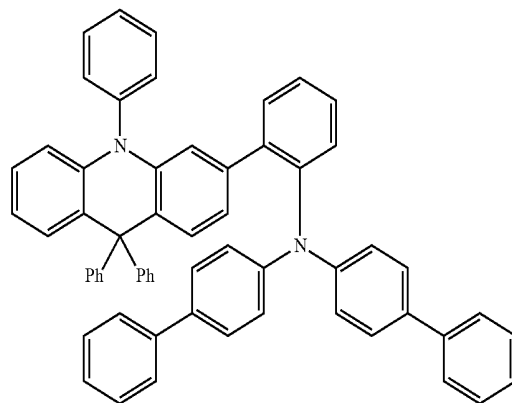
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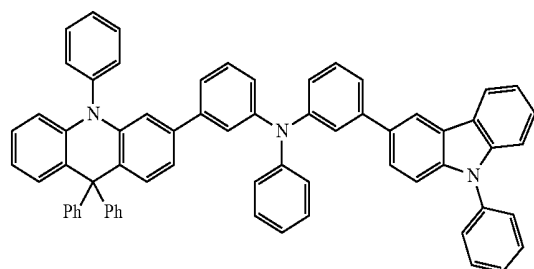


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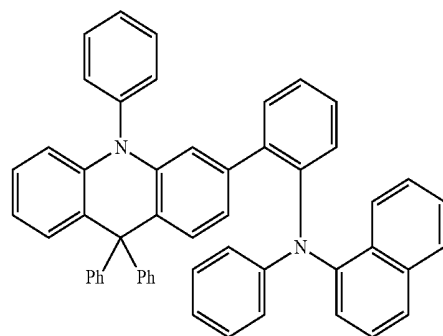
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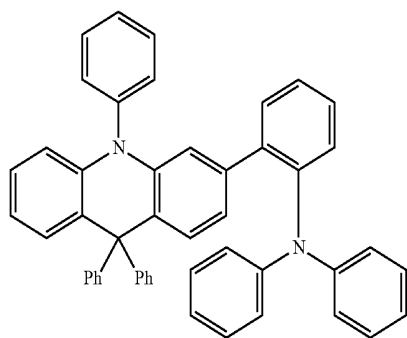
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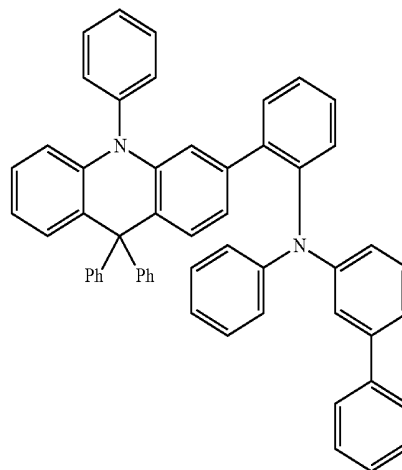
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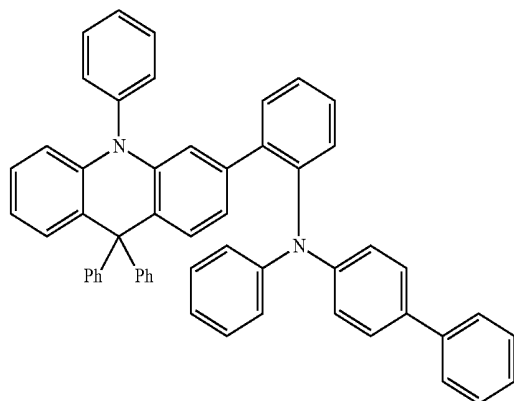
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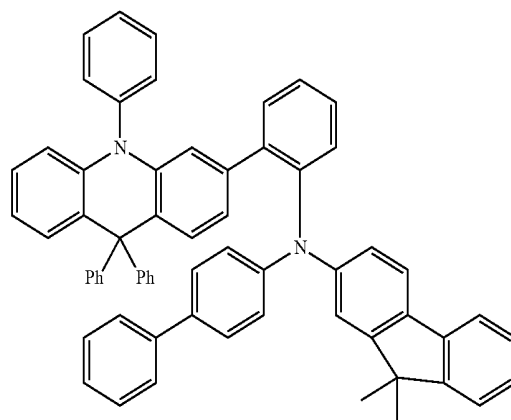
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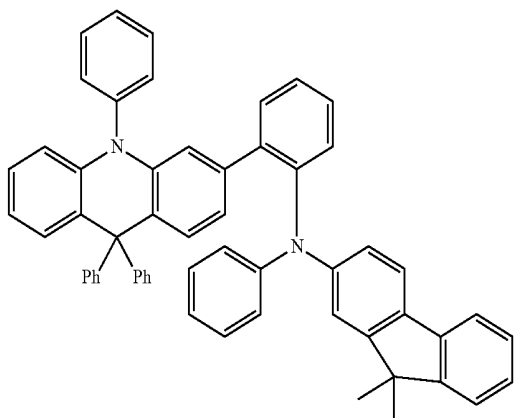
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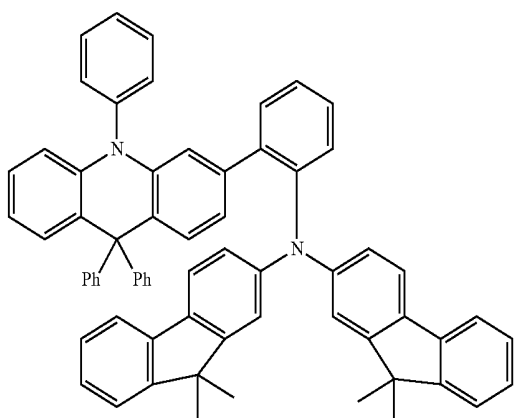
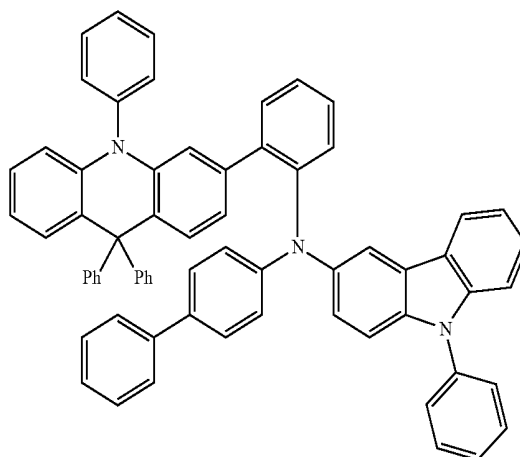
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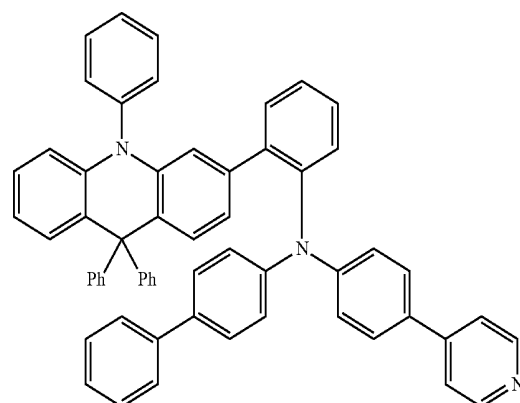
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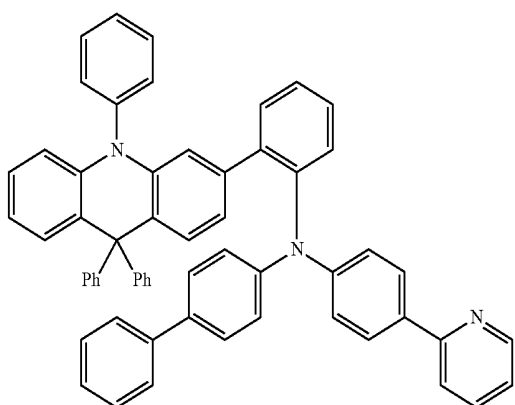
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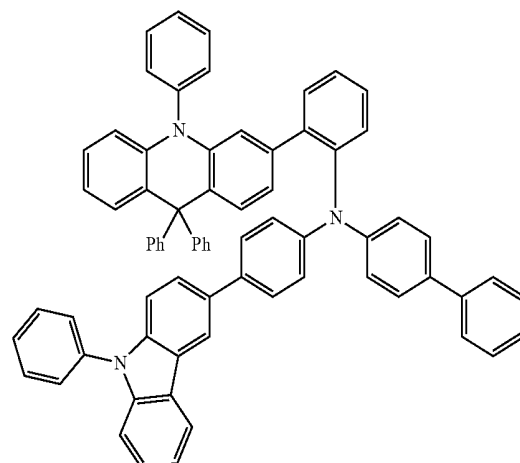
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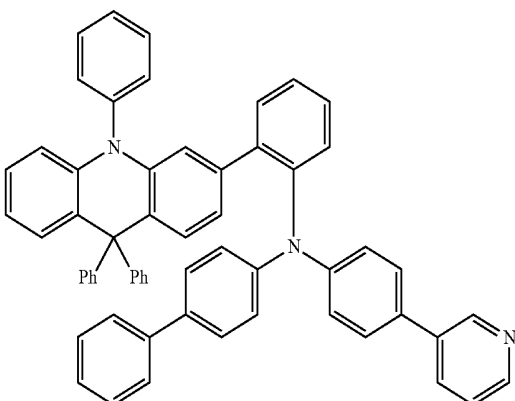
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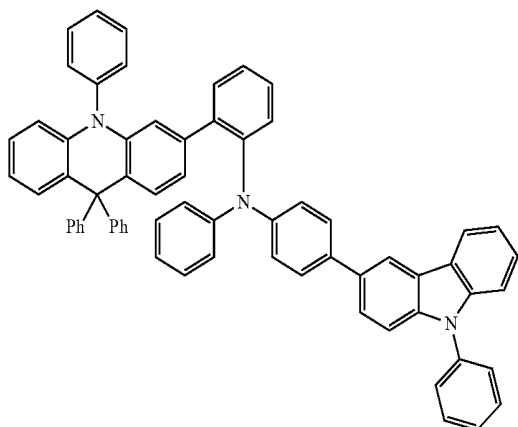


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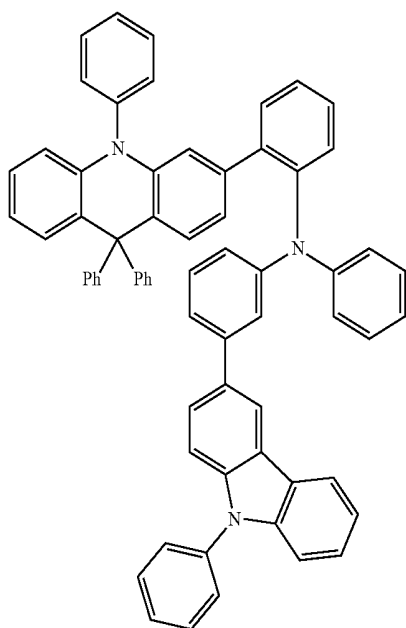


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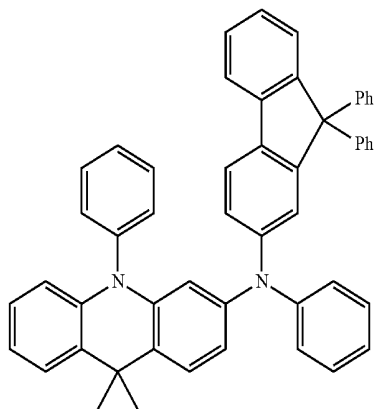
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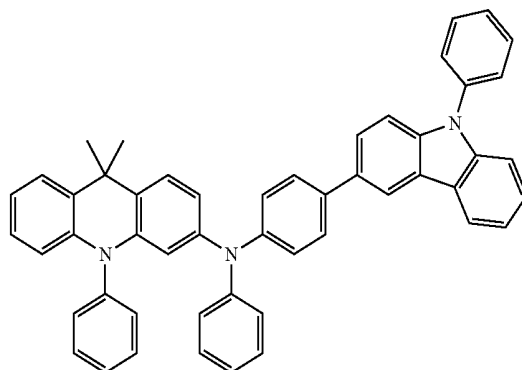


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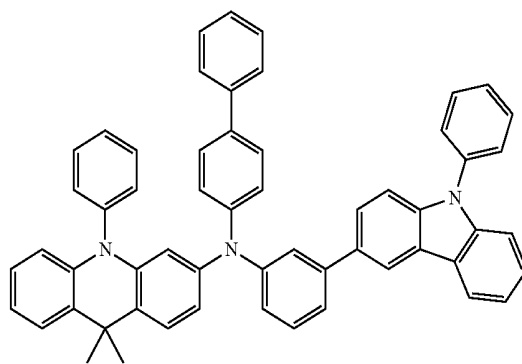


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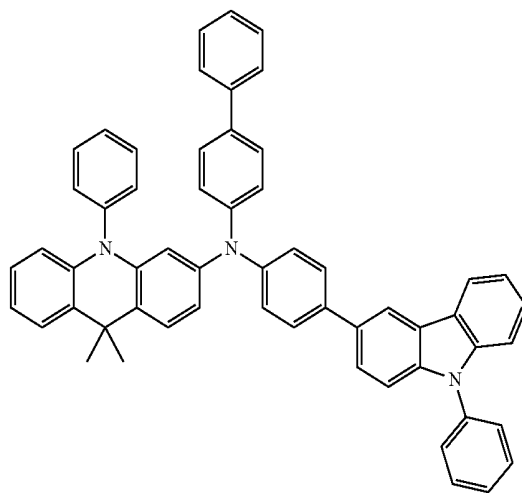
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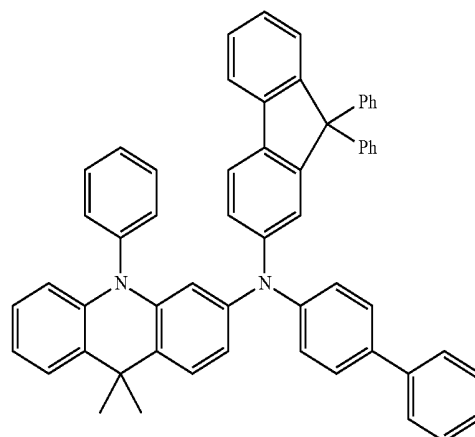
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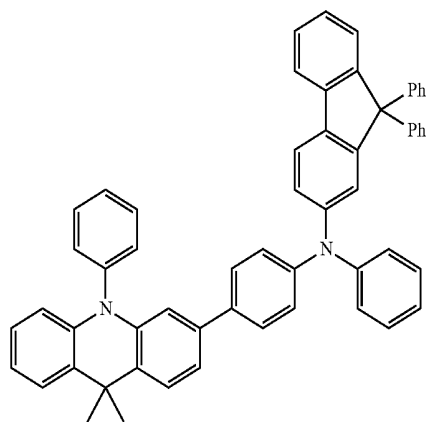
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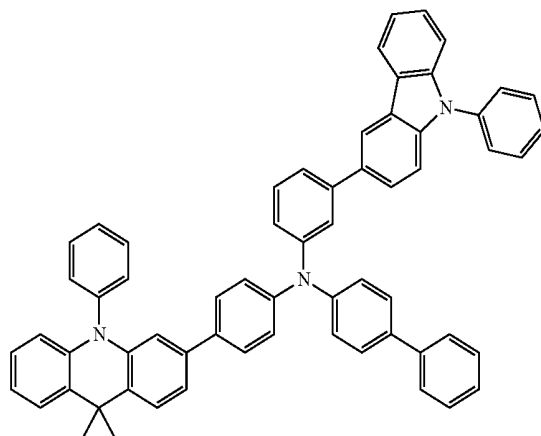


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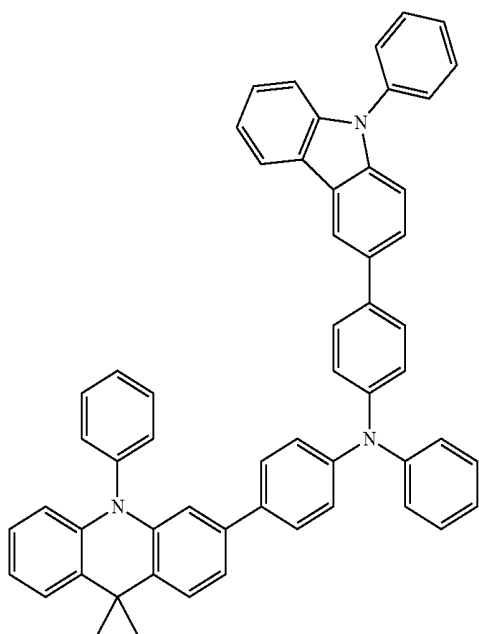
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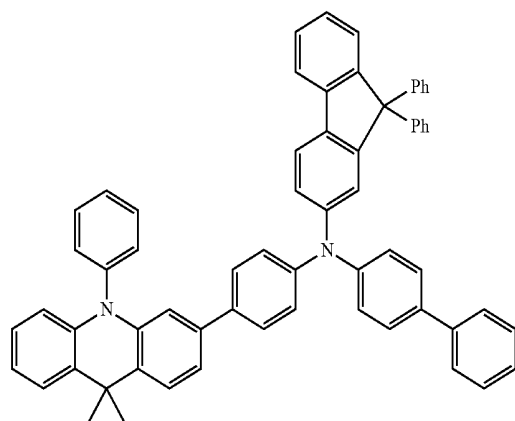


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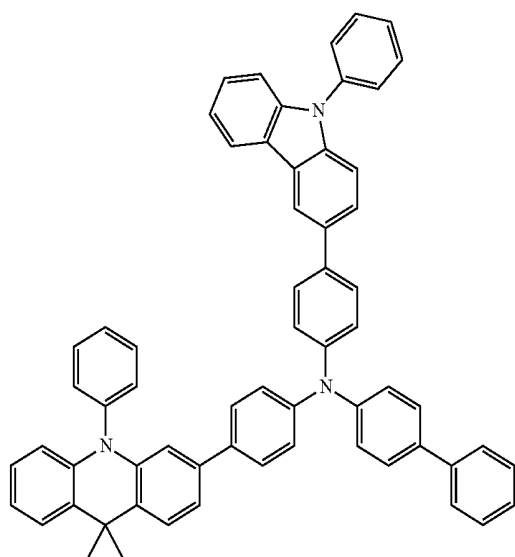
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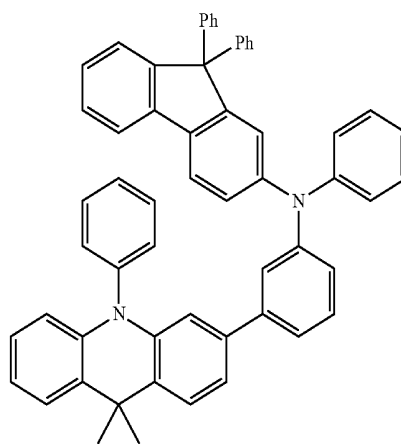
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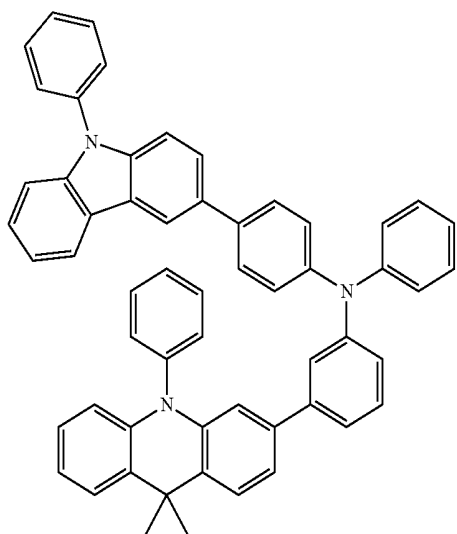


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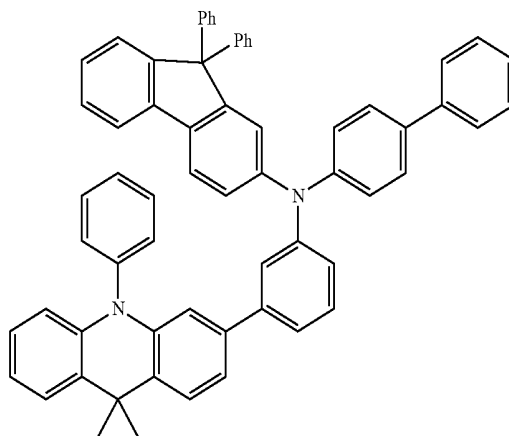
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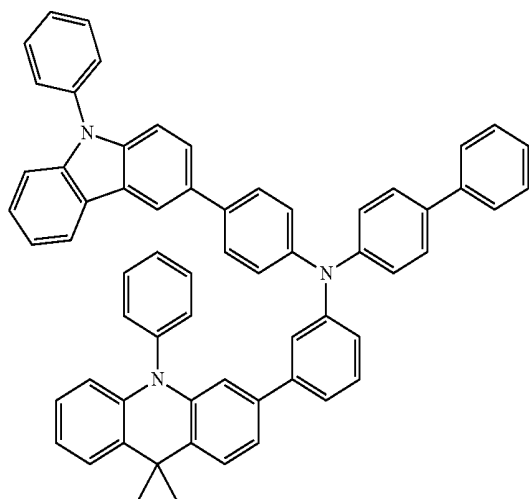


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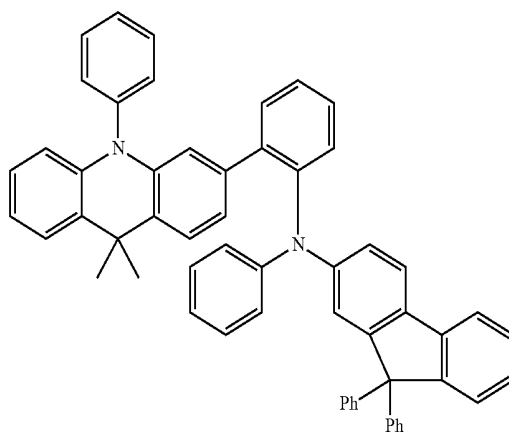
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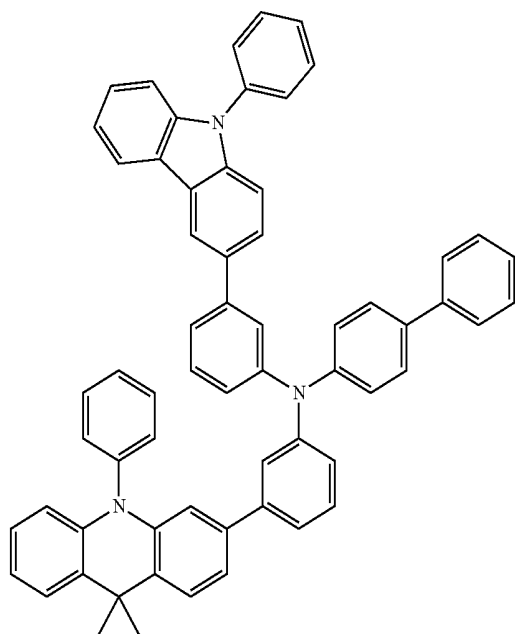
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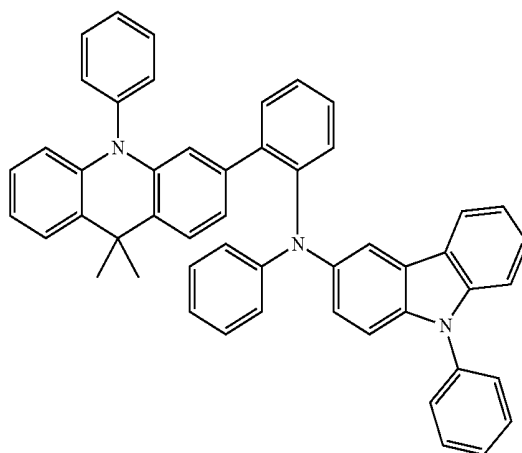
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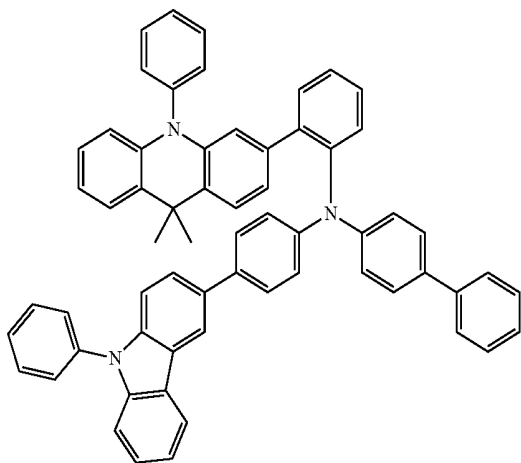


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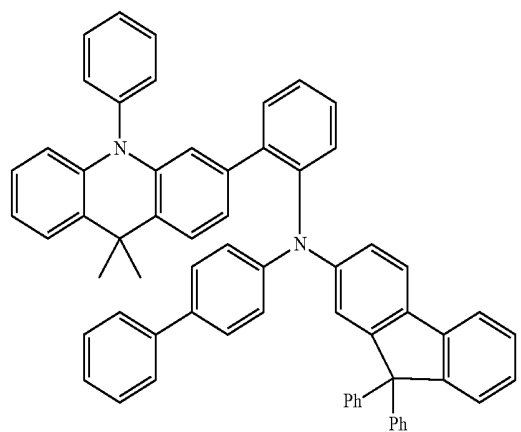


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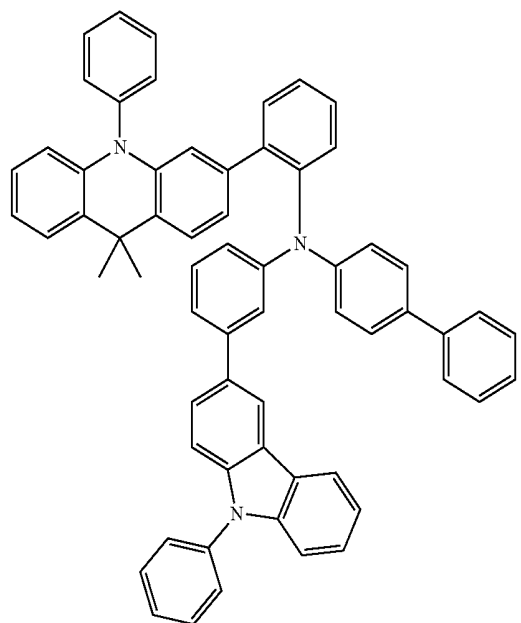
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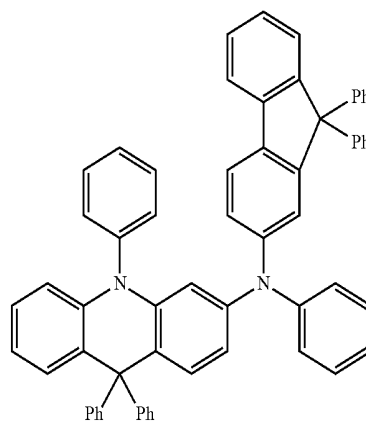


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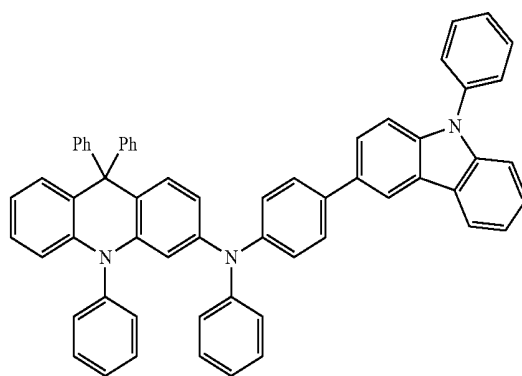


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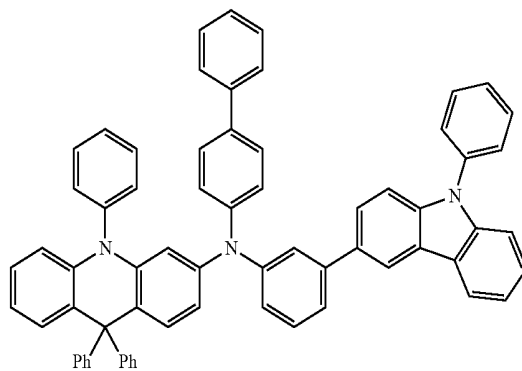
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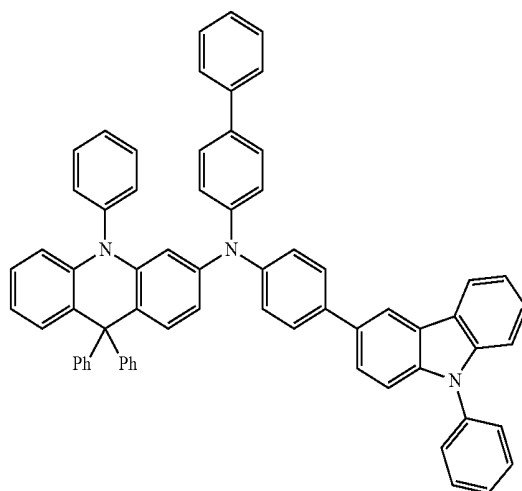
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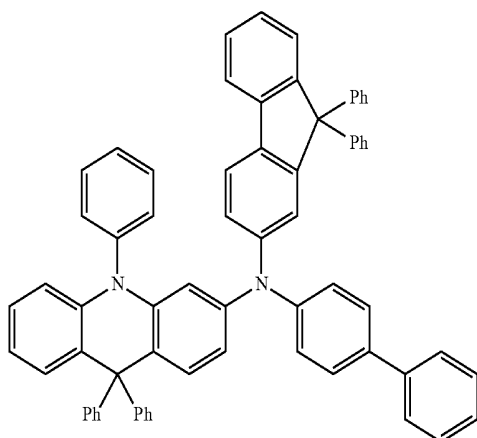
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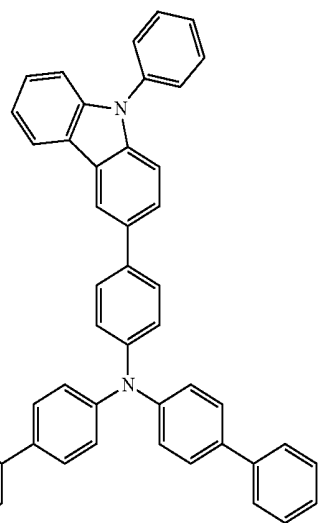


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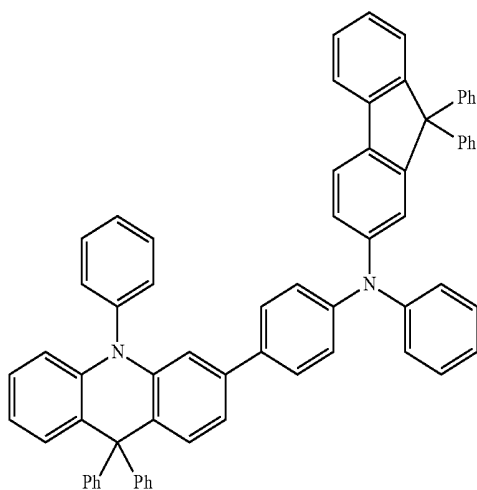
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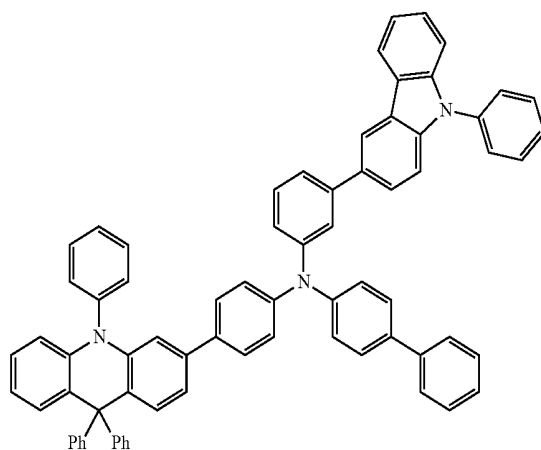


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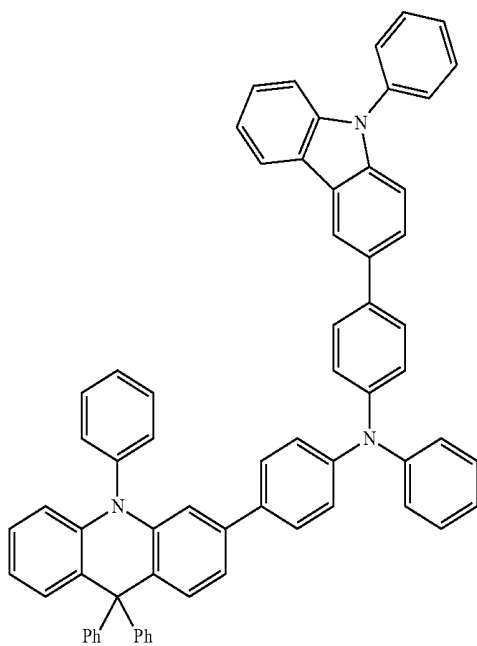
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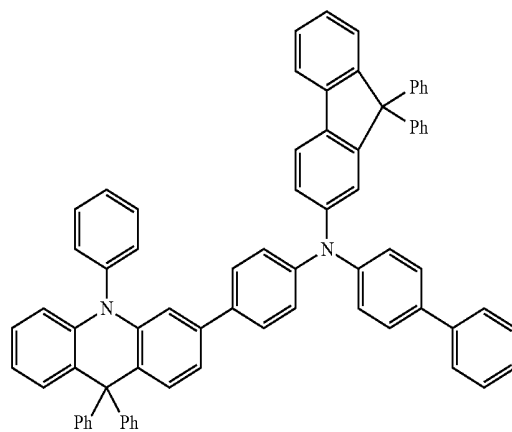
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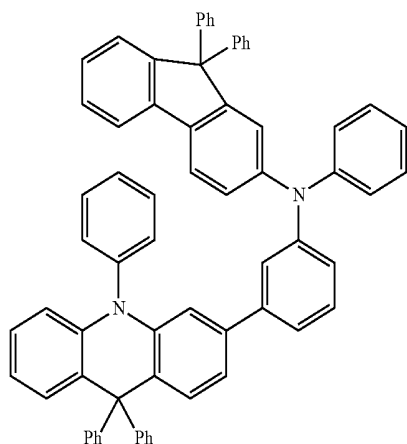
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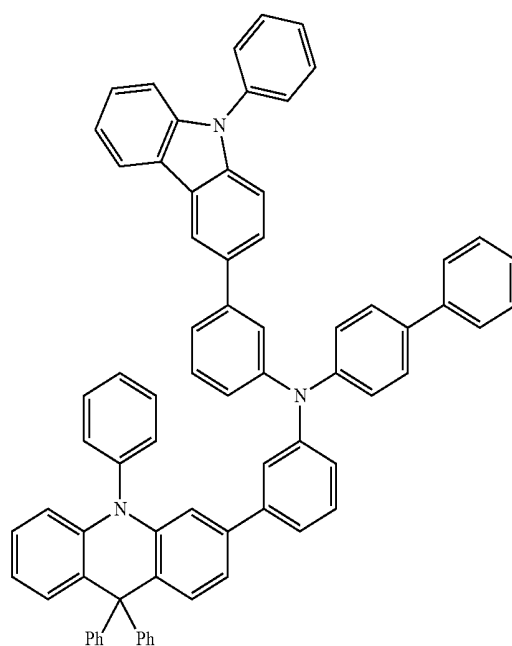


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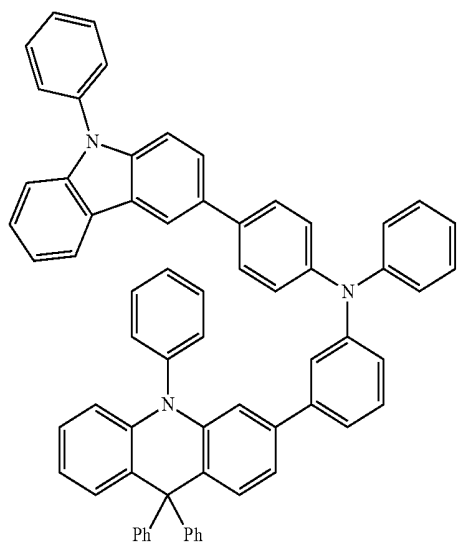
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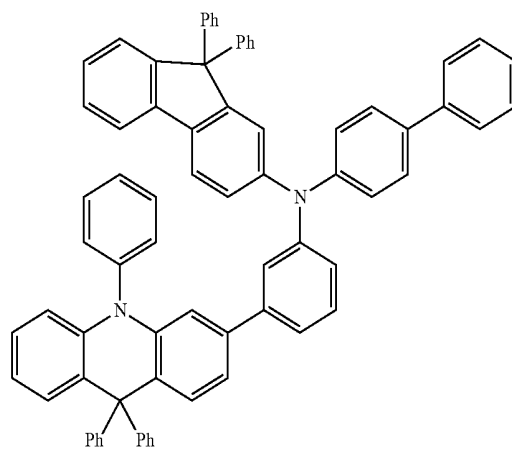


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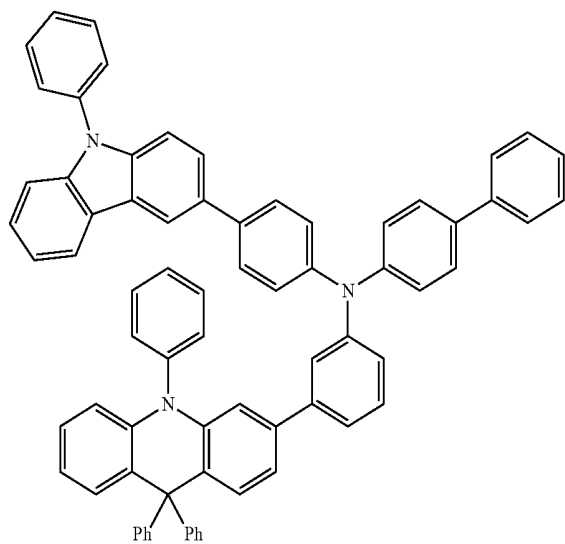
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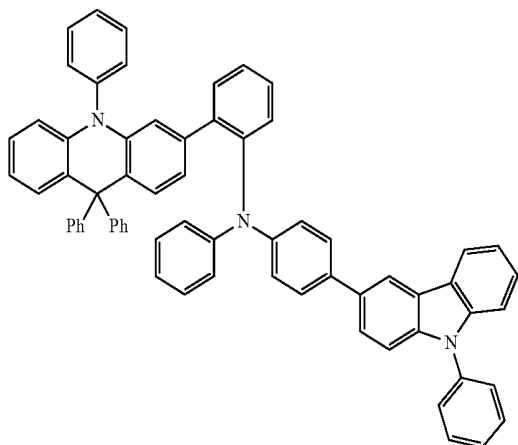
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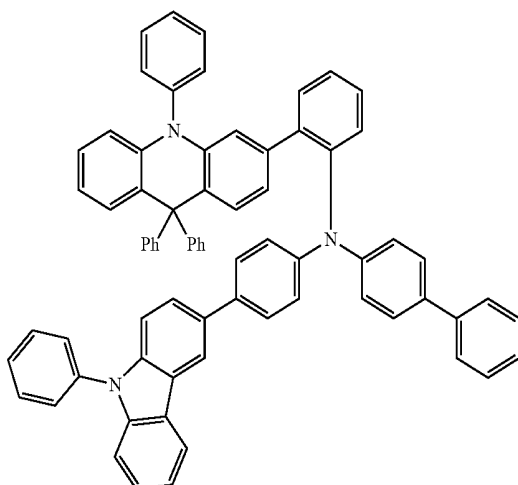
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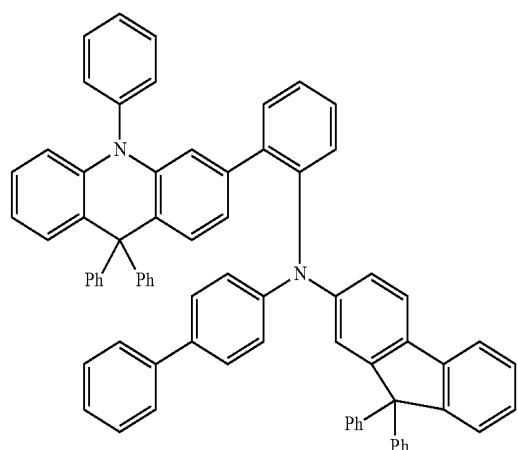
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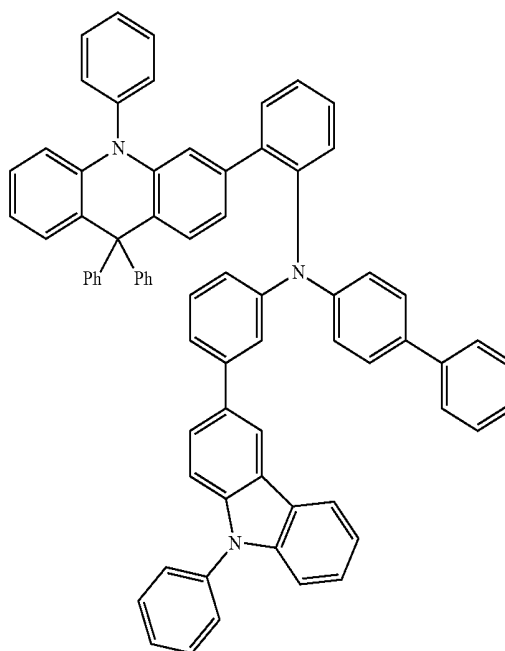


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[0063] The compound represented by Formula 1 may be synthesized by using a general organic synthetic method.

[0064] The compound of Formula 1 may be used between a pair of electrodes of an organic light-emitting device. For example, the compound may be included in a hole transport region or an emission layer. Accordingly, an organic light-emitting device according to an embodiment includes: a first electrode; a second electrode facing the first electrode; and an organic layer that is disposed between the first electrode and the second electrode and includes an emission layer, wherein the organic layer includes at least one of the compounds described above.

[0065] The expression that “(an organic layer) includes at least one compound” used herein may include a case in which “(an organic layer) includes identical compounds represented by Formula 1 and a case in which (an organic layer) includes two or more different compounds represented by Formula 1.

[0066] The organic layer includes i) a hole transport region that is disposed between the first electrode (anode) and the emission layer and includes at least one of a hole injection layer, a hole transport layer, and an electron blocking layer, and ii) an electron transport region that is disposed between the emission layer and the second electrode (cathode) and includes at least one selected from a hole blocking layer, an electron transport layer, and an electron injection layer. For example, the hole transport layer may include the compound represented by Formula 1.

[0067] The term “organic layer” used herein refers to a single layer and/or a plurality of layers disposed between the first electrode and the second electrode of an organic light-emitting device. A material included in the “organic layer” is not limited to an organic material.

[0068] FIG. 1 illustrates a schematic view of an organic light-emitting device 10 according to an embodiment. The organic light-emitting device 10 includes a first electrode 110, an organic layer 150, and a second electrode 190.

[0069] 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.

[0070] In FIG. 1, a substrate may be additionally disposed under the first electrode **110** or above the second electrode **190**. The substrate may be, for example, a glass substrate or transparent plastic substrate, each with excellent mechanical strength, thermal stability, transparency, surface smoothness, ease of handling, and water resistance.

[0071] 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 make holes be easily injected. 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 are 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.

[0072] 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.

[0073] The organic layer **150** is disposed on the first electrode **110**. The organic layer **150** may include an emission layer.

[0074] The organic layer **150** may further include a hole transport region disposed between the first electrode and the emission layer, and an electron transport region disposed between the emission layer and the second electrode.

[0075] The hole transport region may include, for example, at least one selected from a hole injection layer (HIL), a hole transport layer (HTL), a buffer layer, and an electron blocking layer (EBL), and the electron transport region may include at least one selected from a hole blocking layer (HBL), an electron transport layer (ETL), and an electron injection layer (EIL).

[0076] 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.

[0077] 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/buffer layer, a structure of hole injection layer/buffer layer, a structure of hole transport layer/buffer layer, or a structure of hole injection layer/hole transport layer/electron blocking layer, wherein layers of each structure are sequentially stacked from the first electrode **110** in this stated order.

[0078] 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, such as vacuum deposition, spin coating casting, a Langmuir-Blodgett (LB) method, ink-jet printing, laser-printing, or laser-induced thermal imaging.

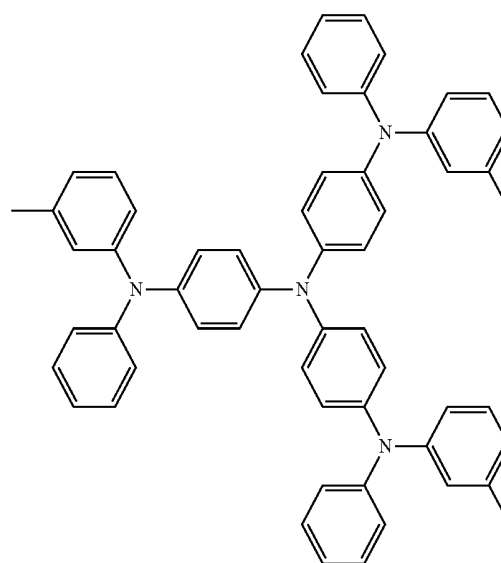
[0079] When a hole injection layer is formed by vacuum deposition, for example, the vacuum deposition may be per-

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

[0080] When a hole injection layer is formed by spin coating, the spin coating may be performed at a coating rate of about 2000 rpm to about 5000 rpm, and at a temperature of about 80° C. to 200° C. in consideration of a compound for a hole injection layer to be deposited, and the structure of a hole injection layer to be formed.

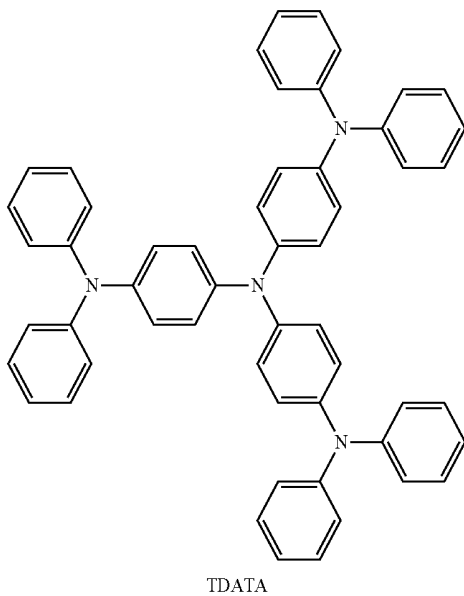
[0081] When the hole transport region includes a hole transport layer, the hole transport layer may be formed on the first electrode **110** or the hole injection layer by using various methods, such as vacuum deposition, spin coating, casting, a LB method, ink-jet printing, laser-printing, or laser-induced 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.

[0082] The hole transport region may further include, in addition to the compound of Formula 1, 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 sulfonic acid (Pani/CSA), (polyaniline)/poly(4-styrenesulfonate) (PANI/PSS), a compound represented by Formula 201 below, and a compound represented by Formula 202 below:

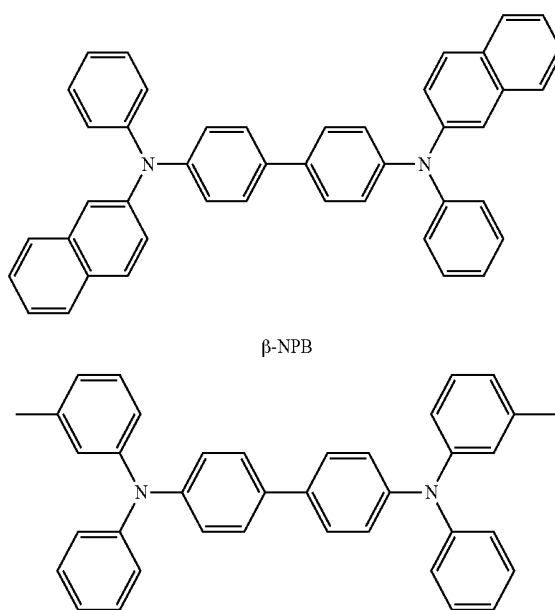


m-MTDATA

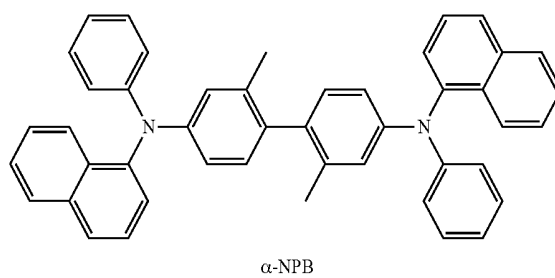
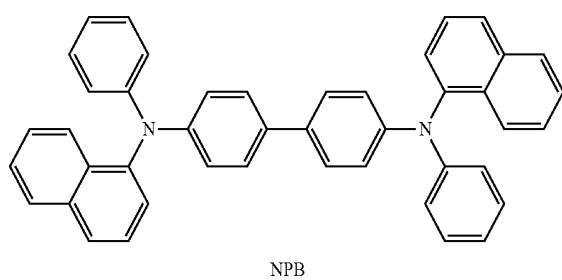
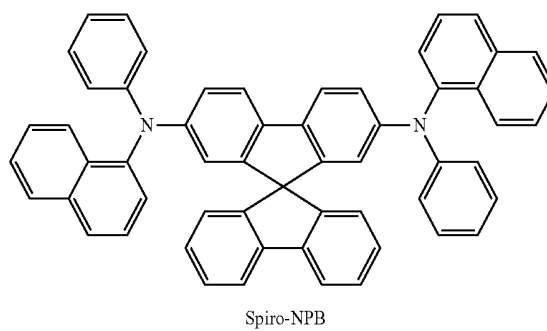
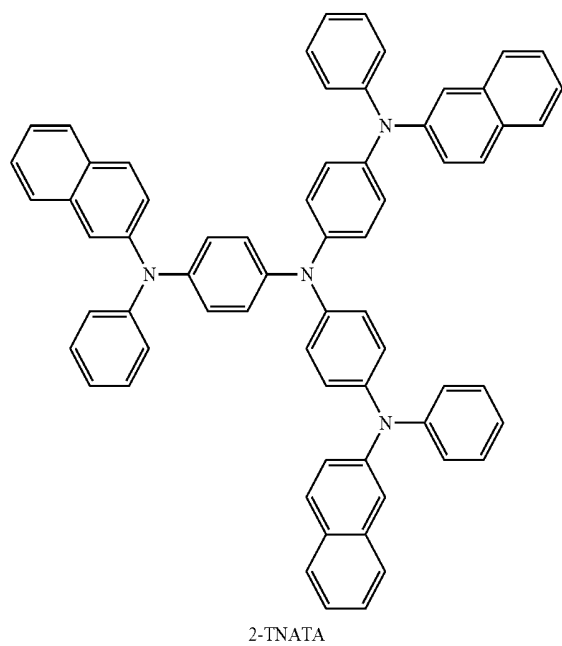
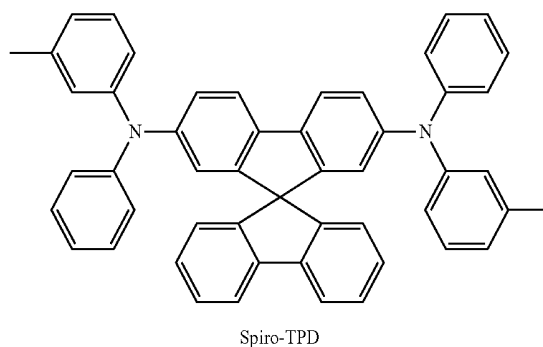
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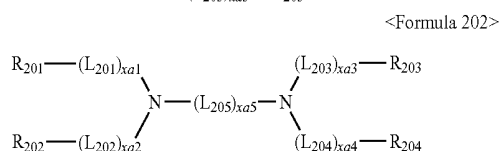
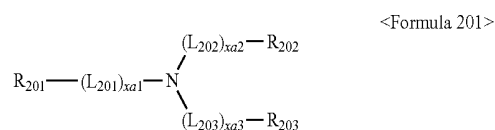
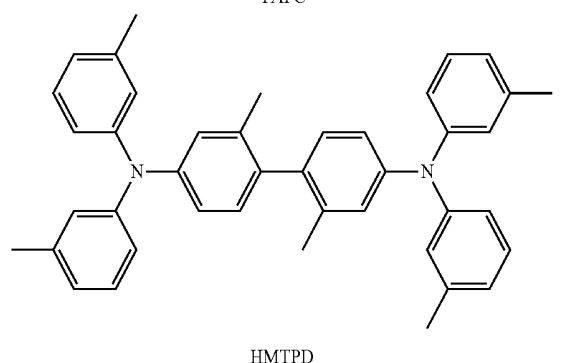
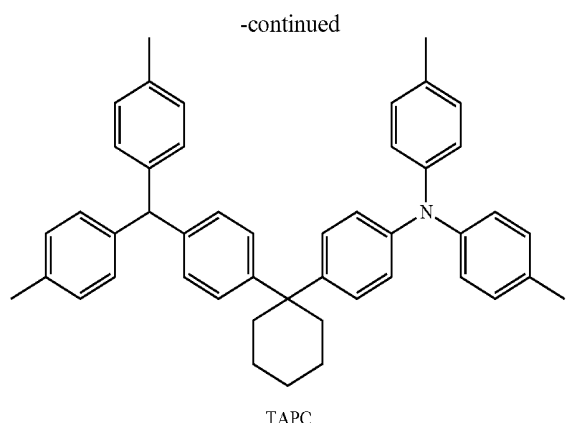


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TPD





[0083] wherein in Formulae 201 and 202,

[0084] descriptions of L_{201} to L_{205} are the same as the description provided herein in connection with L ;

[0085] xa1 to xa4 may be each independently selected from 0, 1, 2, and 3;

[0086] xa5 may be selected from 1, 2, 3, 4, and 5; and

[0087] R_{201} to R_{204} may be each independently selected from a substituted or unsubstituted C_3 - C_{10} cycloalkyl group, a substituted or unsubstituted C_2 - C_{10} heterocycloalkyl group, a substituted or unsubstituted C_3 - C_{10} cycloalkenyl group, a substituted or unsubstituted C_2 - C_{10} heterocycloalkenyl group, a substituted or unsubstituted C_6 - C_{60} aryl group, a substituted or unsubstituted C_6 - C_{60} aryloxy group, a substituted or unsubstituted C_6 - C_{60} arylthio group, 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.

[0088] wherein in Formulae 201 and 202,

[0089] L_{201} to L_{205} may be each independently selected from

[0090] 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 carbazolylenylene group, and a triazinylene group; and

[0091] 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 carbazolylenylene group, and a triazinylene group, each substituted with at least one of a deuterium, $-\text{F}$, $-\text{Cl}$, $-\text{Br}$, $-\text{I}$, 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_{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;

[0092] xa1 to xa4 may be each independently 0, 1, or 2;

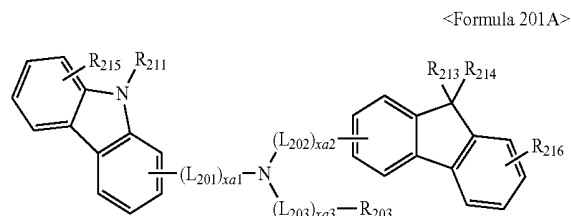
[0093] xa5 may be 1, 2, or 3;

[0094] R_{201} to R_{204} may be each independently selected from

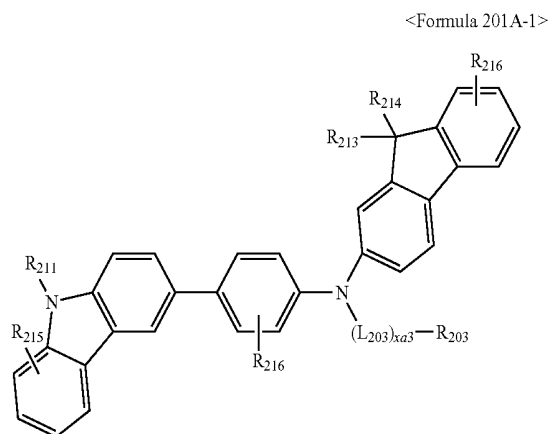
[0095] a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, and a triazinyl group; and

[0096] 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 of a deuterium, $-\text{F}$, $-\text{Cl}$, $-\text{Br}$, $-\text{I}$, 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_{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, but they are not limited thereto.

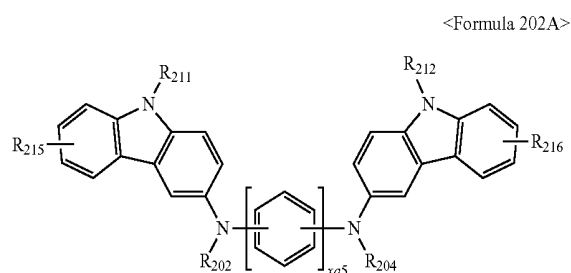
[0097] The compound represented by Formula 201 may be represented by Formula 201A:



[0098] For example, the compound represented by Formula 201 may be represented by Formula 201A-1 below:



[0099] For example, the compound represented by Formula 202 may be represented by Formula 202A below:



[0100] 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} may be understood by referring to the description provided herein in connection with R_{203} , and R_{213} to R_{216} may be 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 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_2 - C_{10} heterocycloalkyl group, a C_3 - C_{10} cycloalkenyl group, a C_2 - C_{10} heterocycloalkenyl group, a C_6 - C_{60} aryl group, a C_6 - C_{60} aryloxy group, a C_6 - C_{60} arylthio group, a C_1 - C_{60} heteroaryl group, a monovalent non-aromatic

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

[0101] For example, in Formulae 201A, 201A-1, and 202A,

[0102] L_{201} to L_{203} may be each independently selected from

[0103] a phenylene group, a naphthylene group, a fluorenylene group, a spiro-fluorenylene group, a benzofluorenylene group, a dibenzofluorenylene group, a phenanthrenylene group, an anthracenylenylene group, a pyrenylene group, a chrysénylene group, a pyridinylenylene group, a pyrazinylenylene group, a pyrimidinylenylene group, a pyridazinylenylene group, a quinolinylenylene group, an isoquinolinylenylene group, a quinoxalinylenylene group, a quinazolinylenylene group, a carbazolinylenylene group, and a triazinylenylene group; and

[0104] a phenylene group, a naphthylene group, a fluorenylene group, a spiro-fluorenylene group, a benzofluorenylene group, a dibenzofluorenylene group, a phenanthrenylene group, an anthracenylenylene group, a pyrenylene group, a chrysénylene group, a pyridinylenylene group, a pyrazinylenylene group, a pyrimidinylenylene group, a pyridazinylenylene group, a quinolinylenylene group, an isoquinolinylenylene group, a quinoxalinylenylene group, a quinazolinylenylene group, a carbazolinylenylene group, and a triazinylenylene group, each substituted with at least one of 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_{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 chrysényl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinoliny group, an isoquinoliny group, a quinoxaliny group, a quinazoliny group, a carbazolyl group, and a triazinyl group;

[0105] $xa1$ to $xa3$ may be each independently 0 or 1;

[0106] R_{203} , R_{211} , and R_{212} may be each independently selected from

[0107] 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 chrysényl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinoliny group, an isoquinoliny group, a quinoxaliny group, a quinazoliny group, a carbazolyl group, and a triazinyl group; and

[0108] 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 chrysényl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinoliny group, an isoquinoliny group, a quinoxaliny group, a quinazoliny group, a carbazolyl group, and a triazinyl group, each substituted with at least one of 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_{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 chrysényl group, a pyridinyl group, a pyrazinyl

group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxaliny group, a quinazolinyl group, a carbazolyl group, and a triazinyl group; [0109] R_{213} and R_{214} may be each independently selected from

[0110] a C_1 - C_{20} alkyl group and a C_1 - C_{20} alkoxy group;

[0111] a C_1 - C_{20} alkyl group and a C_1 - C_{20} alkoxy group, each substituted with at least one of 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 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 quinoxaliny group, a quinazolinyl group, a carbazolyl group, and a triazinyl group;

[0112] 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 quinoxaliny group, a quinazolinyl group, a carbazolyl group, and a triazinyl group; and

[0113] 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 quinoxaliny group, a quinazolinyl group, a carbazolyl group, and a triazinyl group, each substituted with at least one of 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_{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 quinoxaliny group, a quinazolinyl group, a carbazolyl group, and a triazinyl group; and

[0114] R_{215} and R_{216} may be each independently selected from

[0115] 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 or a salt thereof, a sulfonic acid or a salt thereof, a phosphoric acid or a salt thereof, a C_1 - C_{20} alkyl group, and a C_1 - C_{20} alkoxy group;

[0116] a C_1 - C_{20} alkyl group and a C_1 - C_{20} alkoxy group, each substituted with at least one of 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 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 quinoxaliny group, a quinazolinyl group, a carbazolyl group, and a triazinyl group;

[0117] 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 quinoxaliny group, a quinazolinyl group, and a triazinyl group; and

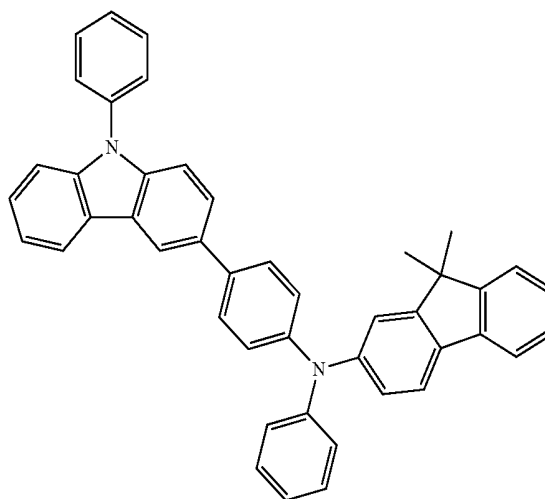
[0118] a phenyl group, a naphthyl group, a fluorenyl group, a spiro-fluorenyl group, a benzofluorenyl group, a dibenzofluorenyl group, a phenanthrenyl group, an anthracenyl group, a pyrenyl group, a chrysenyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, a quinolinyl group, an isoquinolinyl group, a quinoxaliny group, a quinazolinyl group, a carbazolyl group, and a triazinyl group, each substituted with at least one of 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_{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 quinoxaliny group, a quinazolinyl group, a carbazolyl group, and a triazinyl group; and

[0119] $xa5$ is 1 or 2.

[0120] R_{213} and R_{214} in Formulae 201A, and 201A-1 may bind to each other to form a saturated or unsaturated ring.

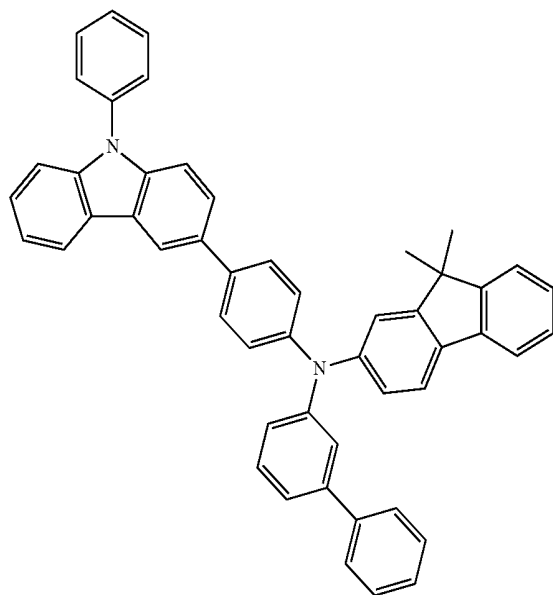
[0121] The compound represented by Formula 201, and the compound represented by Formula 202 may each include compounds HT1 to HT20 illustrated below:

HT1



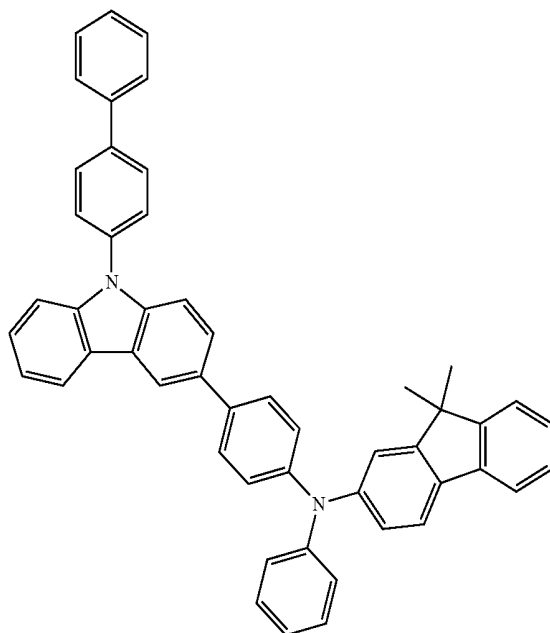
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HT2

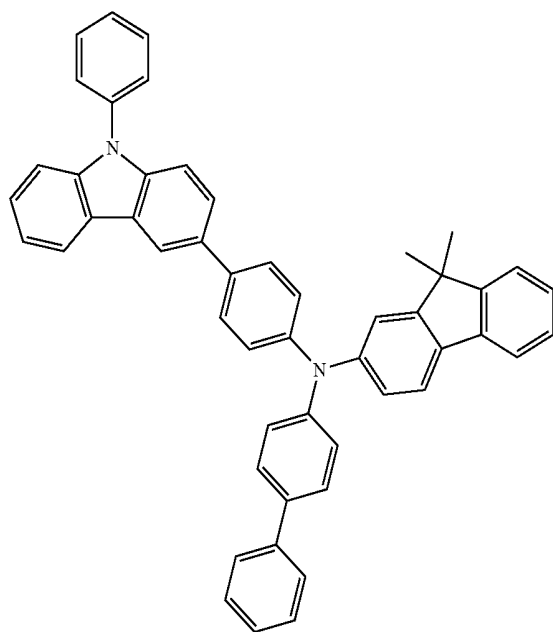


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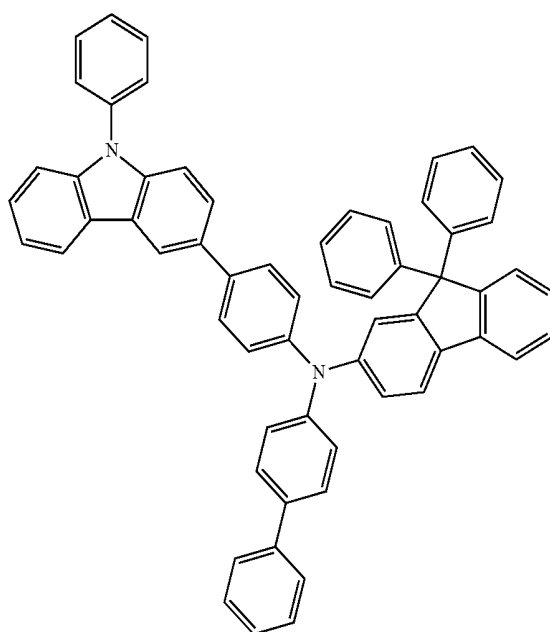
HT4



HT3

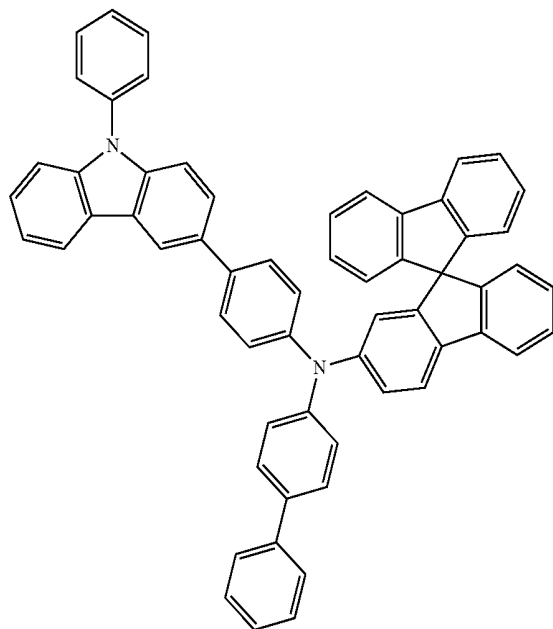


HT5



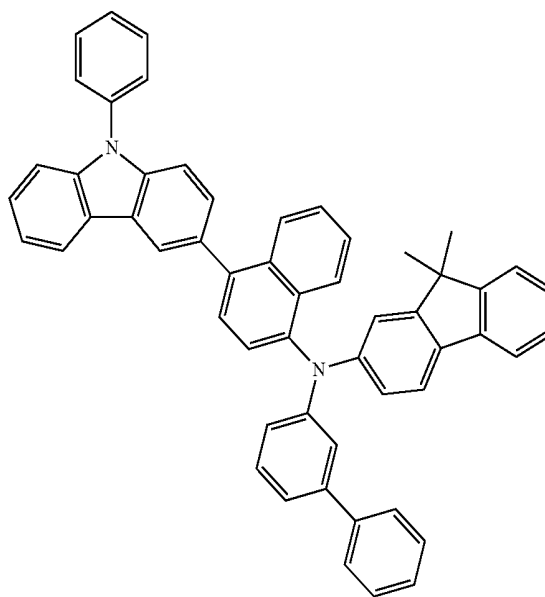
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HT6

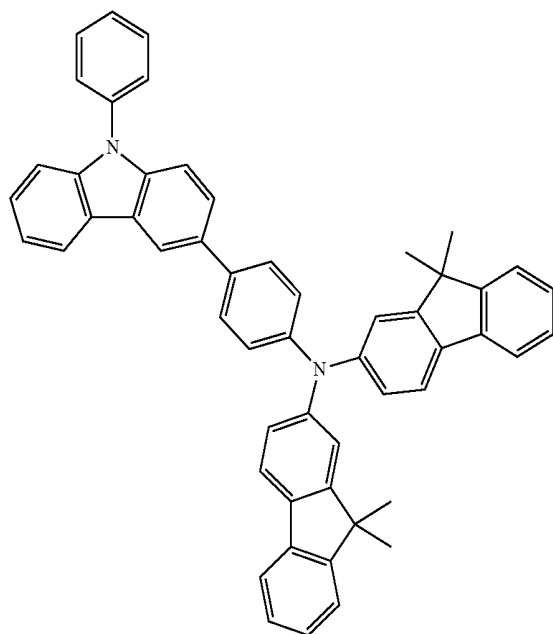


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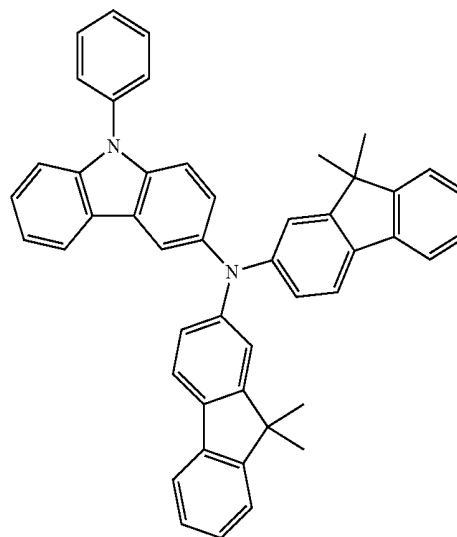
HT8



HT7

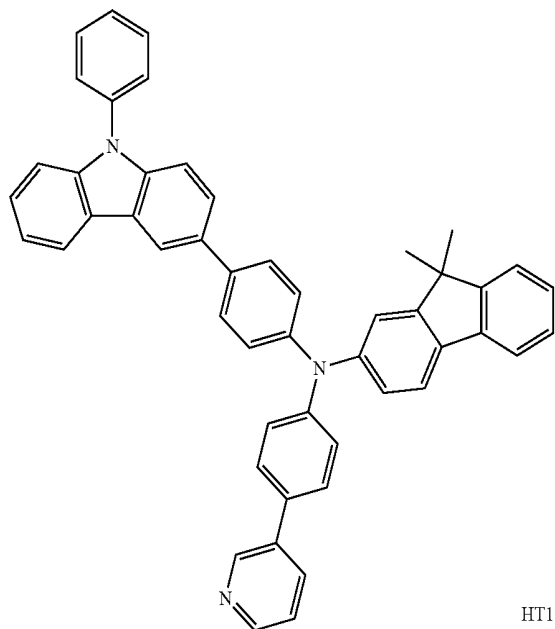


HT9

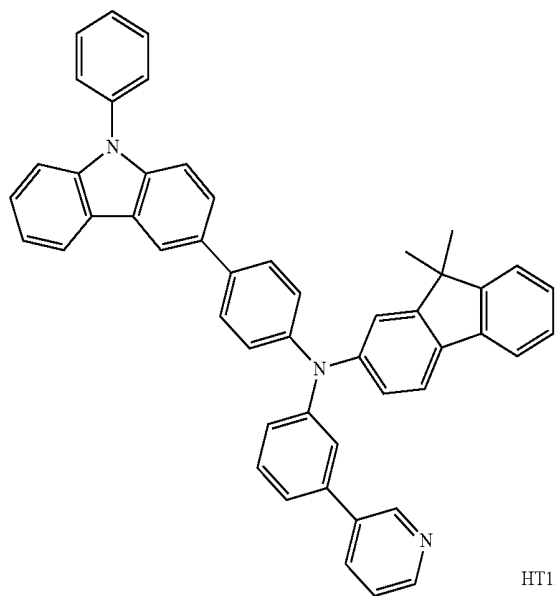


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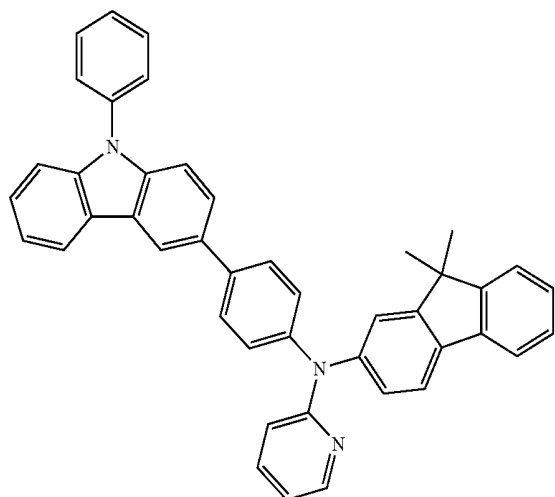
HT10



HT11

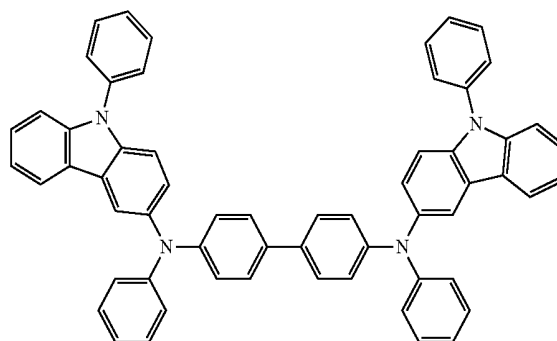


HT12

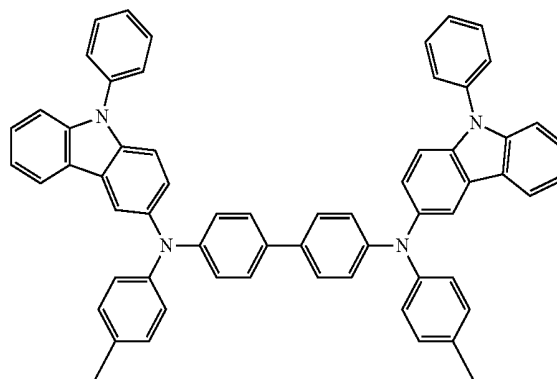


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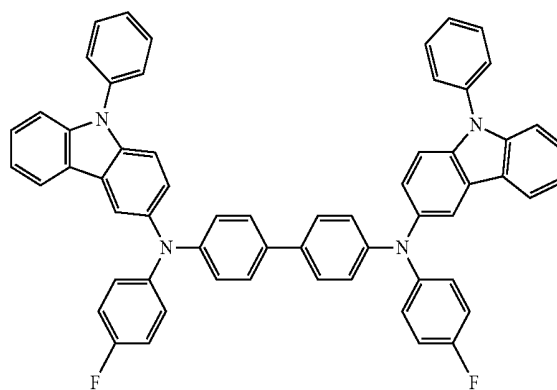
HT13



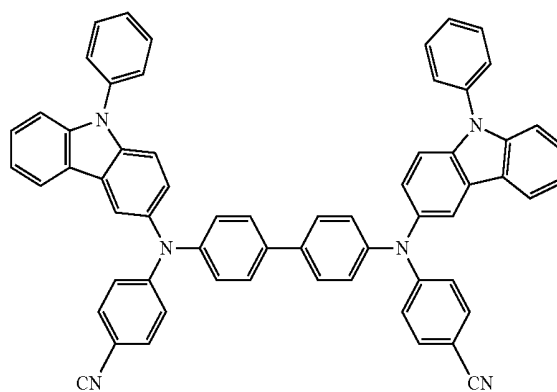
HT14



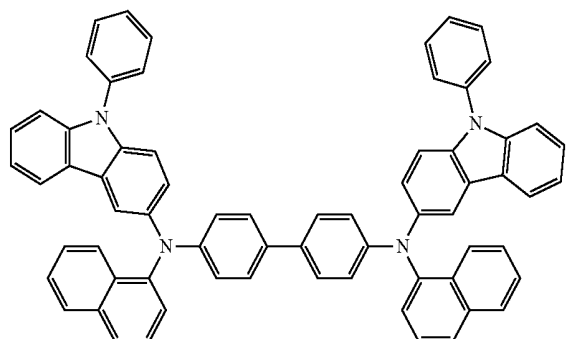
HT15



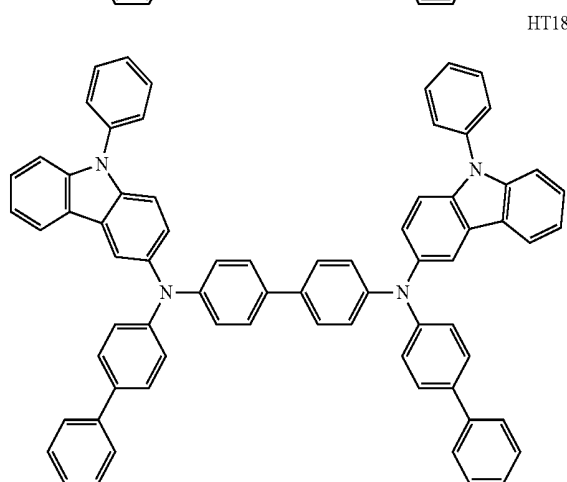
HT16



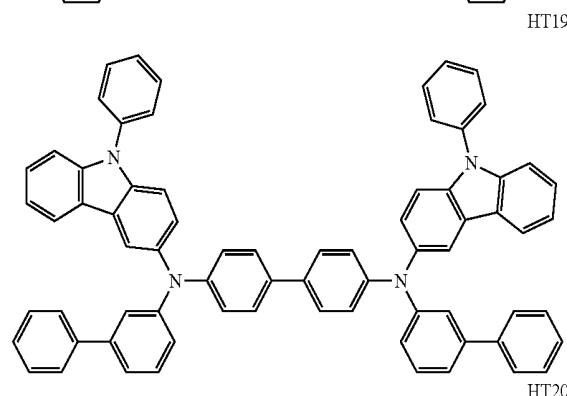
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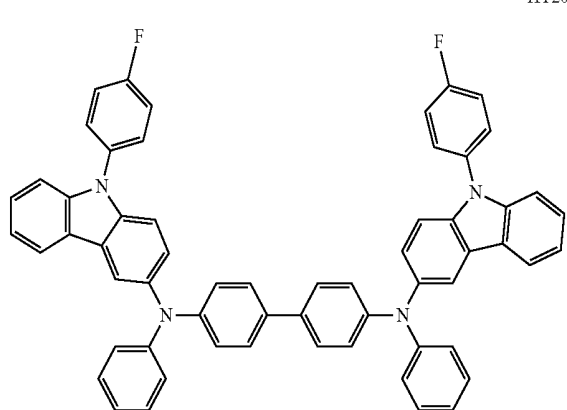
HT17



HT18



HT19



HT20

[0122] A thickness of the hole transport region may be in a range of about 100 Å to about 10,000 Å, for example, about 100 Å to about 1000 Å. When the hole transport region

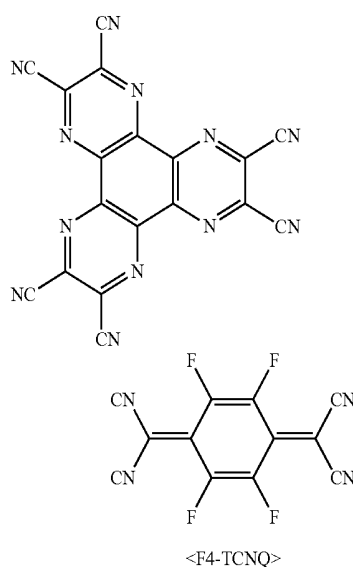
includes both a hole injection layer and a hole transport layer, a thickness of the hole injection layer may be in a range of about 100 Å to about 10000 Å, for example, about 100 Å to about 1000 Å, and a thickness of the hole transport layer may be in a range of about 50 Å to about 2000 Å, for example about 100 Å to about 1500 Å. When the thicknesses of the hole transport region, the hole injection layer, and the hole transport layer are within these ranges, satisfactory hole transporting characteristics may be obtained without a substantial increase in driving voltage.

[0123] According to an embodiment, the organic layer 150 of the organic light-emitting device includes a hole transport region disposed between the emission layer and the second electrode 190, wherein the hole transport region includes the compound represented by Formula 1. For example, the compound represented by Formula 1 may be included in a hole transport layer.

[0124] 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 inhomogeneously dispersed in the hole transport region.

[0125] The charge-generation material may be, for example, a p-dopant. The p-dopant may be one of a quinone derivative, a metal oxide, and a cyano group-containing compound, but is not limited thereto. Examples of the p-dopant are a quinone derivative, such as tetracyanoquinodimethane (TCNQ) or 2,3,5,6-tetrafluoro-tetracyano-1,4-benzoquinodimethane (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>

[0126] The hole transport region may further include, in addition to the hole injection layer and the hole transport layer, at least one of a buffer layer and an electron blocking layer. The buffer layer may compensate for an optical resonance distance according to a wavelength of light emitted from the emission layer. Thus, light-emission efficiency of a formed organic light-emitting device may be improved. For use as a material included in the buffer layer, materials that are

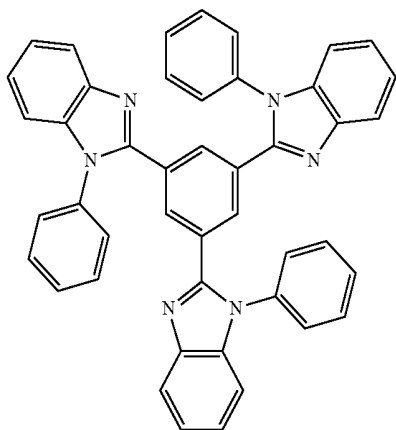
included in the hole transport region may be used. The electron blocking layer may prevent injection of electrons from the electron transport region.

[0127] An emission layer is formed on the first electrode **110** or the hole transport region by using various methods, such as 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.

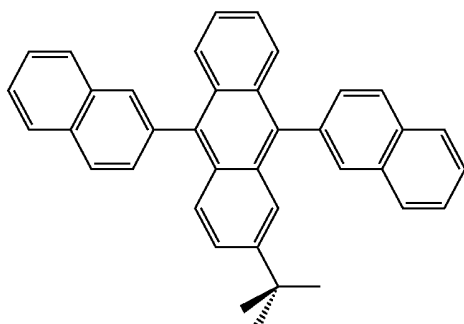
[0128] When the organic light-emitting device **10** is a full color organic light-emitting device, the emission layer may be patterned into a red emission layer, a green emission layer, or a blue emission layer, according to a sub pixel. In some embodiments, the emission layer may have a stacked structure 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.

[0129] The emission layer may include a host and a dopant.

[0130] The host may include at least one selected from TPBi, TBADN, ADN (also referred to as "DNA"), CBP, CDBP, and TCP:

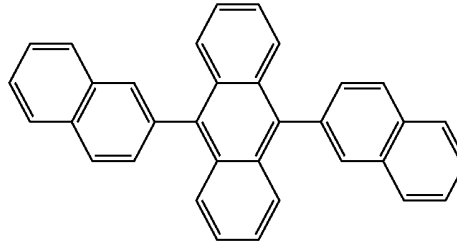


TPBi

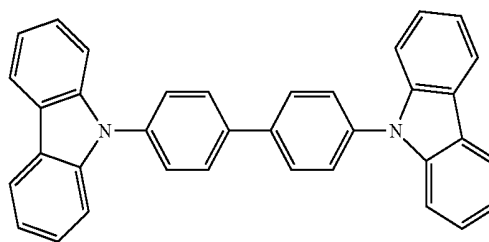


TBADN

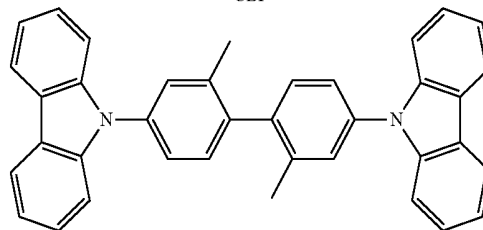
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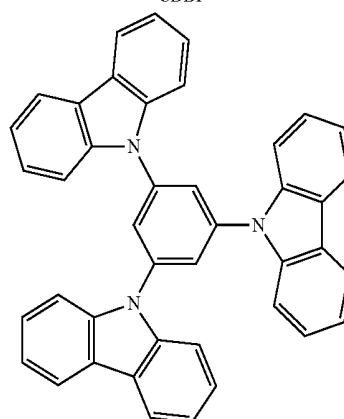
ADN



CBP

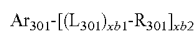


CDBP



TCP

[0131] According to another embodiment, the host may include a compound represented by Formula 301 below.



<Formula 301>

[0132] wherein in Formula 301,

[0133] Ar_{301} may be selected from

[0134] a naphthalene, a heptalene, a fluorene, a spirofluorene, a benzofluorene, a dibenzofluorene, a phenalene, a phenanthrene, an anthracene, a fluoranthene, a triphenylene, a pyrene, a chrysene, a naphthacene, a picene, a perylene, a pentaphene, and an indenoanthracene; and

[0135] a naphthalene, a heptalene, a fluorene, a spirofluorene, a benzofluorene, a dibenzofluorene, a phenalene, a phenanthrene, an anthracene, a fluoranthene, a triphenylene, a pyrene, a chrysene, a naphthacene, a picene, a perylene, a pentaphene, and an indenoanthracene, each substituted with

at least one of 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 C₁-C₆₀ alkyl group, a C₂-C₆₀ alkenyl group, a C₂-C₆₀ alkynyl group, a C₁-C₆₀ alkoxy group, a C₃-C₁₀ cycloalkyl group, a C₂-C₁₀ heterocycloalkyl group, a C₃-C₁₀ cycloalkenyl group, a C₂-C₁₀ heterocycloalkenyl group, a C₆-C₆₀ aryl group, a C₆-C₆₀ aryloxy group, a C₆-C₆₀ arylthio group, a C₁-C₆₀ heteroaryl group, a monovalent non-aromatic condensed polycyclic group, monovalent non-aromatic condensed heteropolycyclic group, and —Si(Q₃₀₁)(Q₃₀₂)(Q₃₀₃) (Q₃₀₁ to Q₃₀₃ may be each independently selected from a hydrogen, a C₁-C₆₀ alkyl group, a C₂-C₆₀ alkenyl group, a C₆-C₆₀ aryl group, and a C₁-C₆₀ heteroaryl group);

[0136] L₃₀₁ may be understood by referring to the description provided in connection with L₂₀₁;

[0137] R₃₀₁ may be selected from

[0138] a C₁-C₂₀ alkyl group and a C₁-C₂₀ alkoxy group;

[0139] a C₁-C₂₀ alkyl group and a C₁-C₂₀ alkoxy group, each substituted with at least one of 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 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;

[0140] 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

[0141] 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 of 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 C₁-C₂₀ alkyl group, a C₁-C₂₀ 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

[0142] xb1 may be selected from 0, 1, 2, and 3;

[0143] xb2 may be selected from 1, 2, 3, and 4.

[0144] wherein in Formula 301,

[0145] L₃₀₁ may be selected from

[0146] a phenylene group, a naphthylene group, a fluorenylene group, a spiro-fluorenylene group, a benzofluorenylene group, a dibenzofluorenylene group, a phenanthrenylene group, an anthracenylenylene group, a pyrenylene group, and a chrysenylene group; and

[0147] a phenylene group, a naphthylene group, a fluorenylene group, a spiro-fluorenylene group, a benzofluorenylene group, a dibenzofluorenylene group, a phenanthrenylene group, an anthracenylenylene group, a pyrenylene group, and a chrysenylene group, each substituted with at least one of 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 C₁-C₂₀ alkyl group, a C₁-C₂₀ 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;

[0148] R₃₀₁ may be selected from

[0149] a C₁-C₂₀ alkyl group and a C₁-C₂₀ alkoxy group;

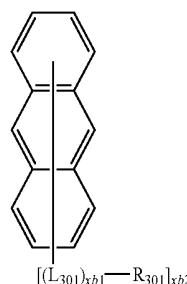
[0150] a C₁-C₂₀ alkyl group and a C₁-C₂₀ alkoxy group, each substituted with at least one of a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino group, an amidino group, a hydrazine group, a hydrazone group, a carboxylic acid or a salt thereof, a sulfonic acid or a salt thereof, a phosphoric acid or a salt thereof, a 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;

[0151] 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

[0152] 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 of 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 C₁-C₂₀ alkyl group, a C₁-C₂₀ 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, but is not limited thereto.

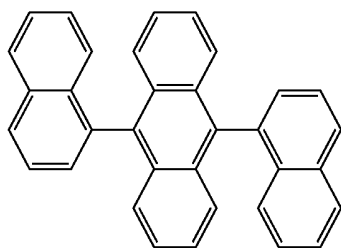
[0153] For example, the host may include a compound represented by Formula 301A below:

<Formula 301A>

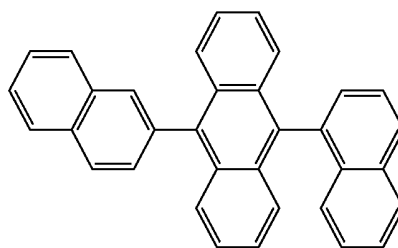


[0154] Substituents of Formula 301A may be understood by corresponding descriptions provided herein.

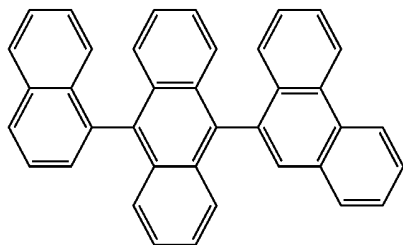
[0155] The compound represented by Formula 301 may include at least one of Compounds H1 to H42, but is not limited thereto:



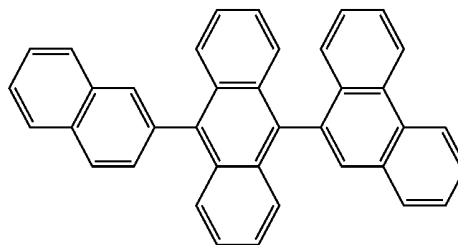
H1



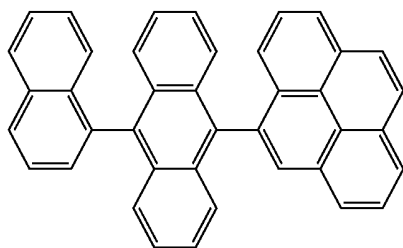
H2



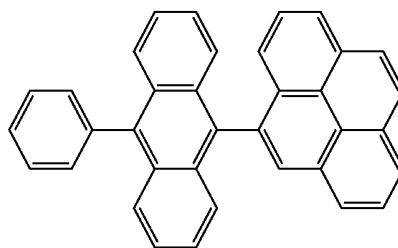
H3



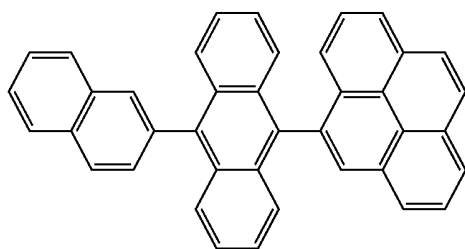
H4



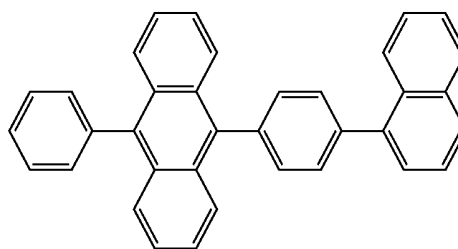
H5



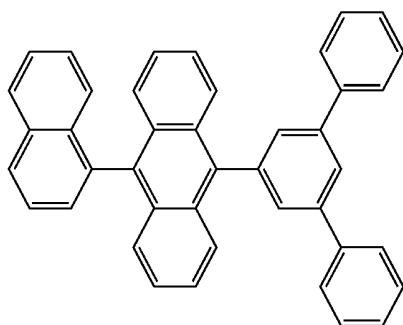
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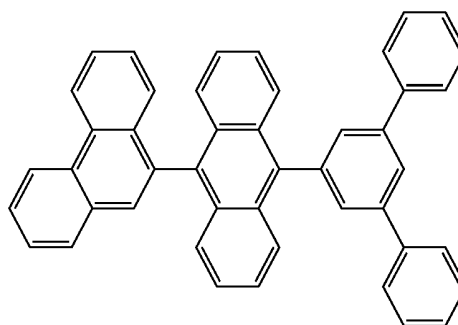
H7



H8



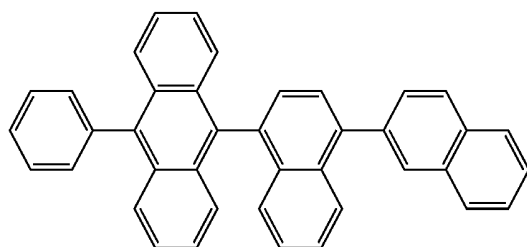
H9



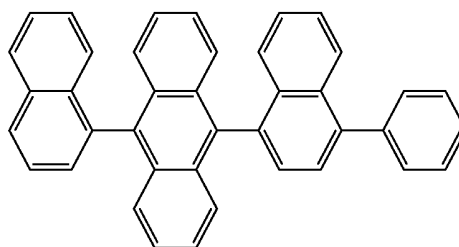
H10

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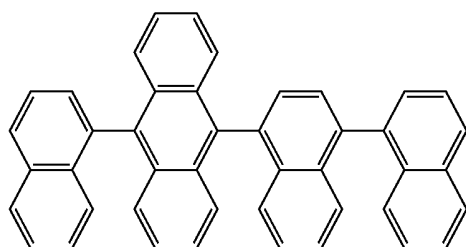
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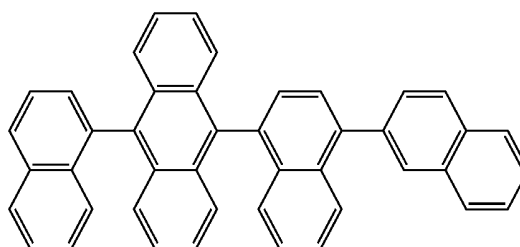
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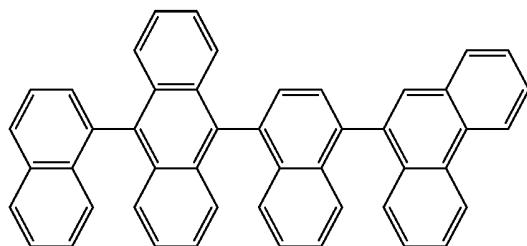
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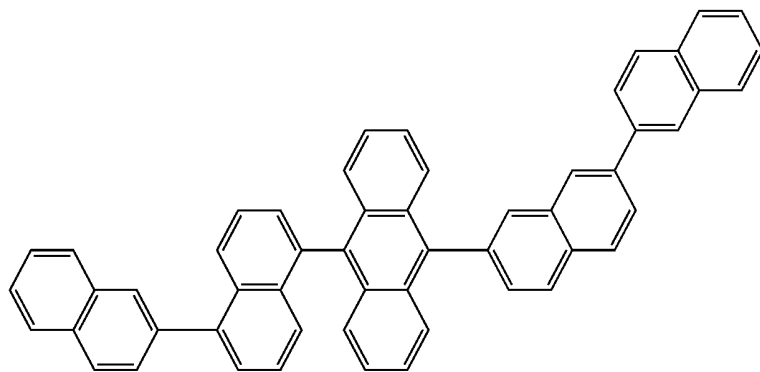
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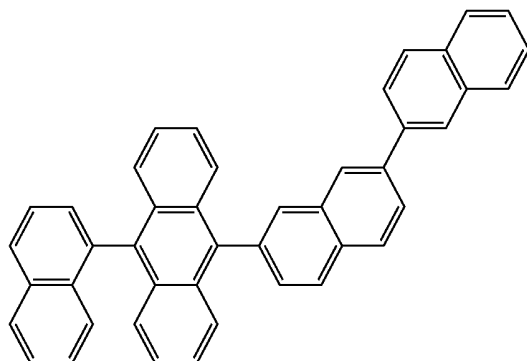
H15



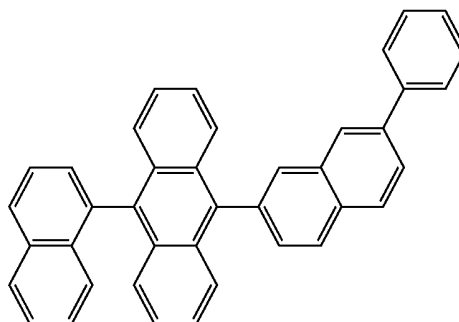
H16



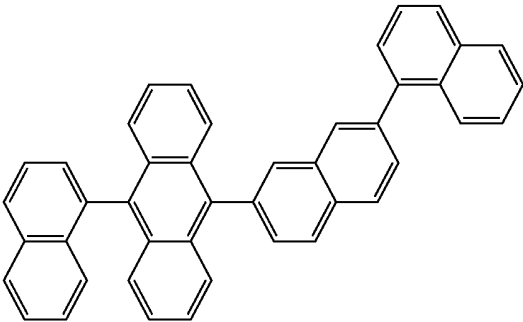
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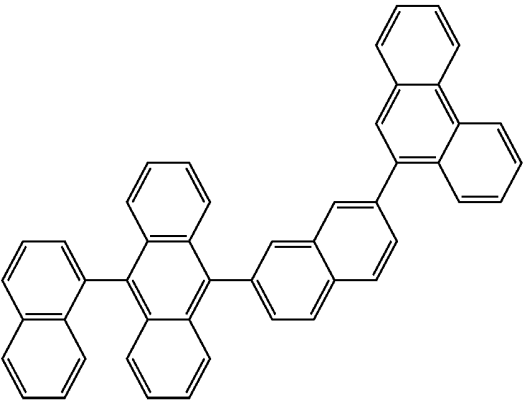
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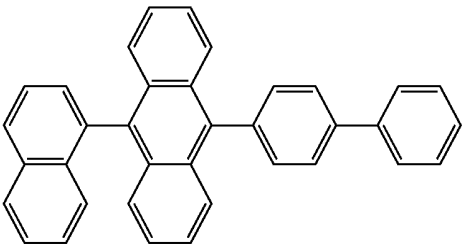
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H19



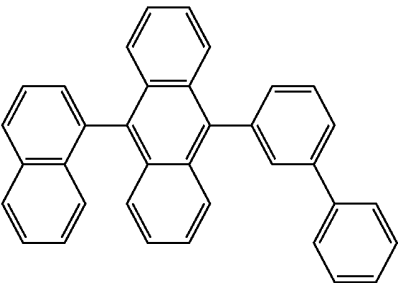
H20



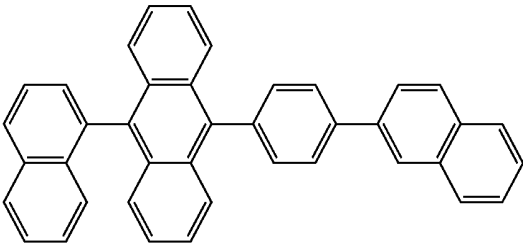
H21



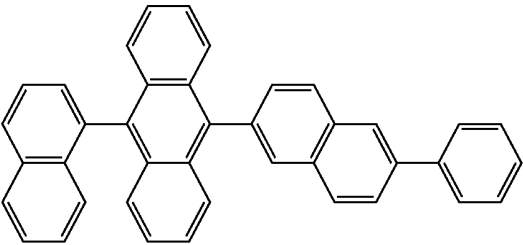
H22



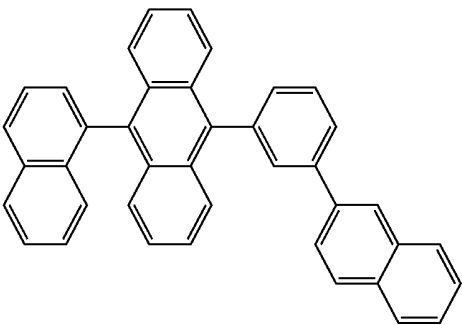
H23



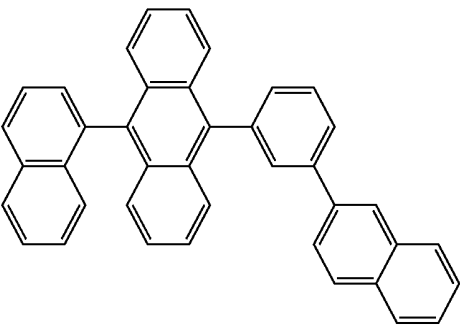
H24



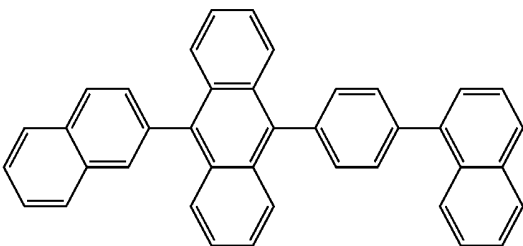
H25



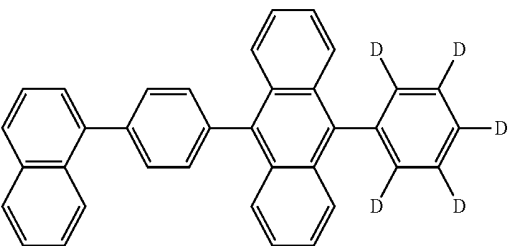
H26



H27



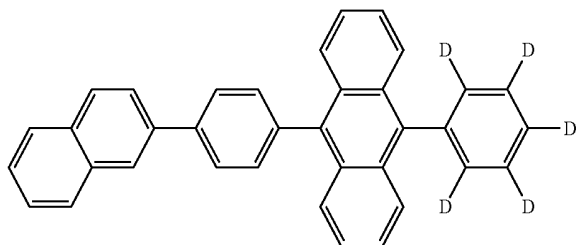
H28



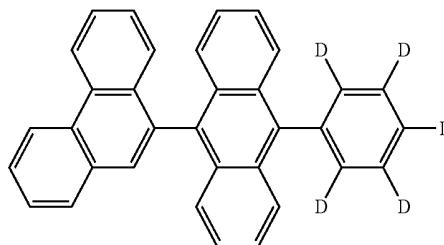
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H29

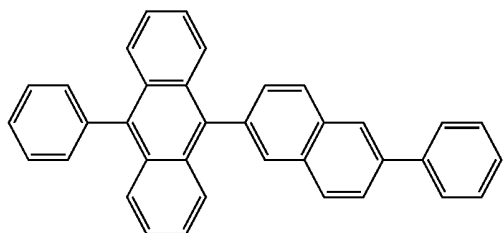
H30



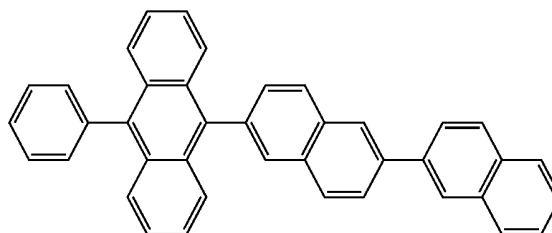
H31



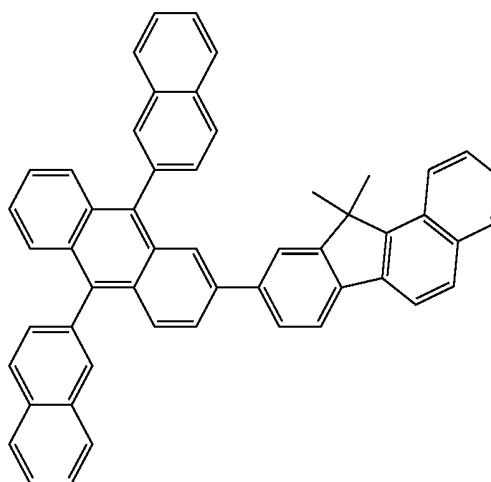
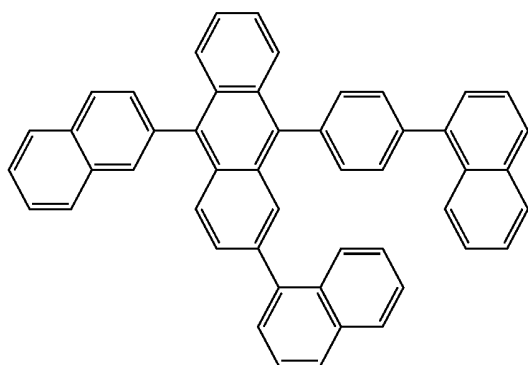
H32



H33

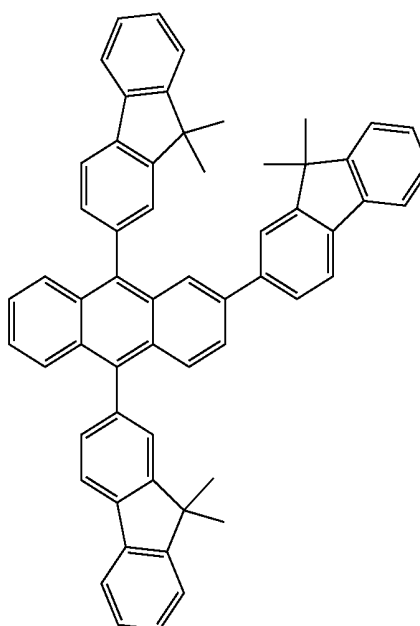
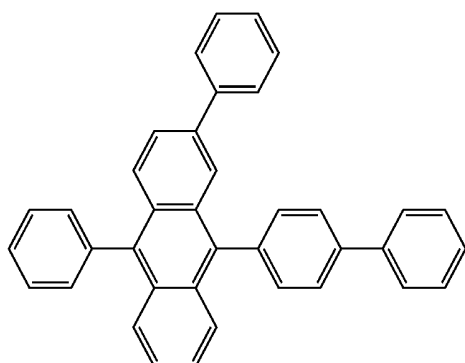


H34

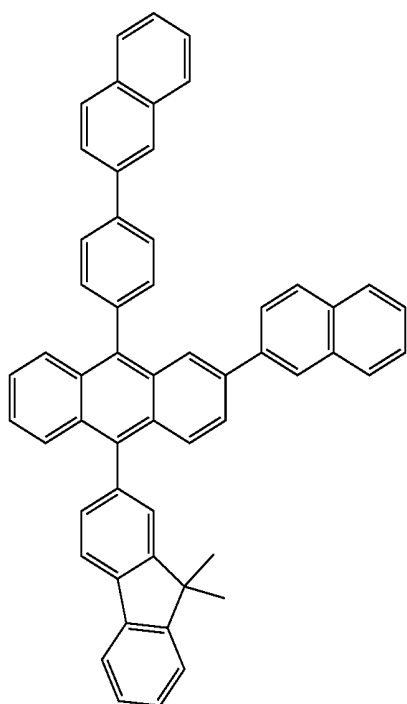


H35

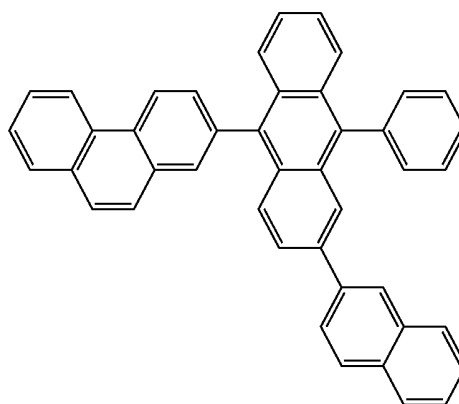
H36



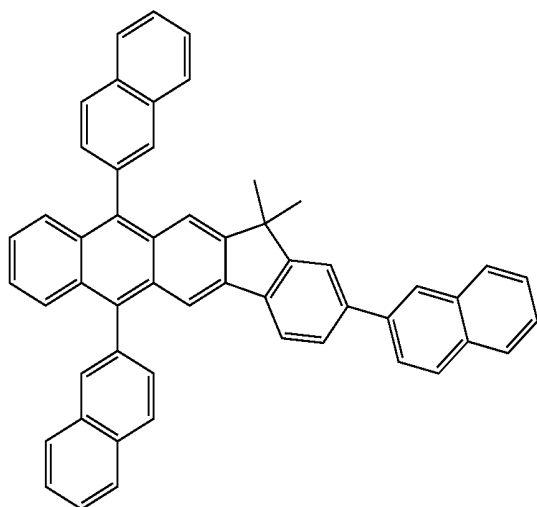
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H37



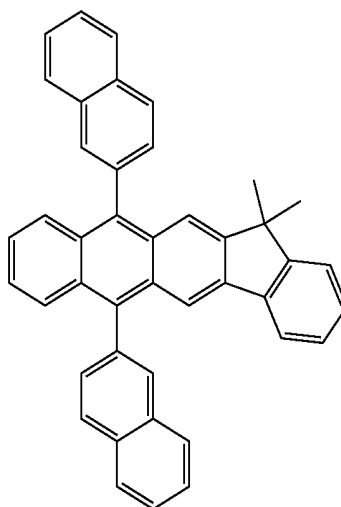
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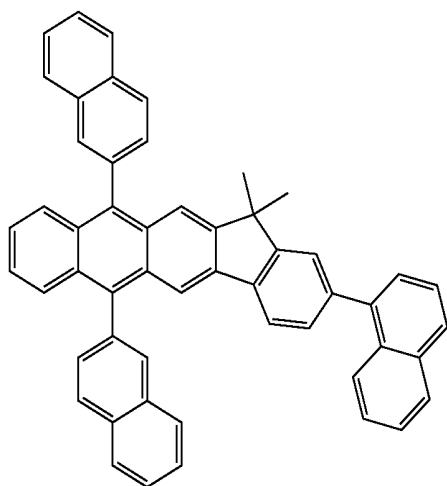
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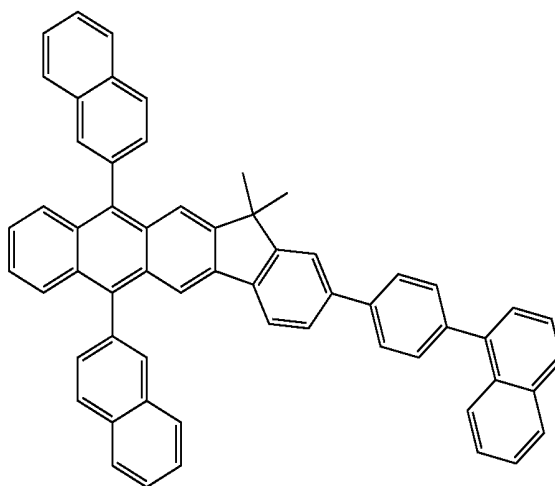
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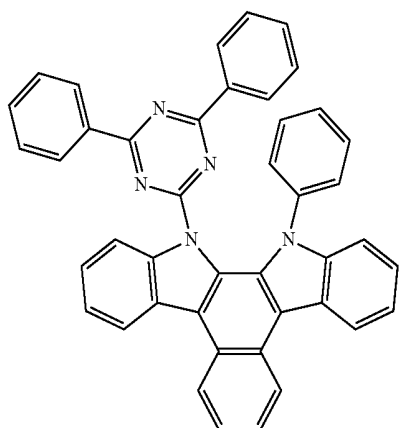
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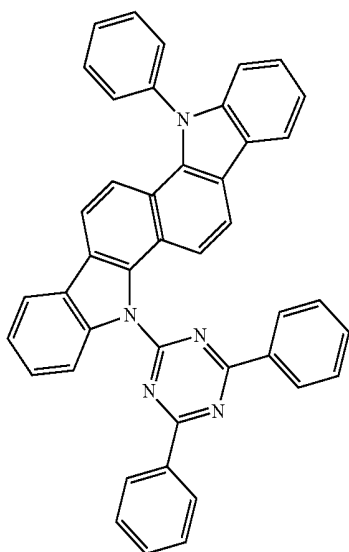
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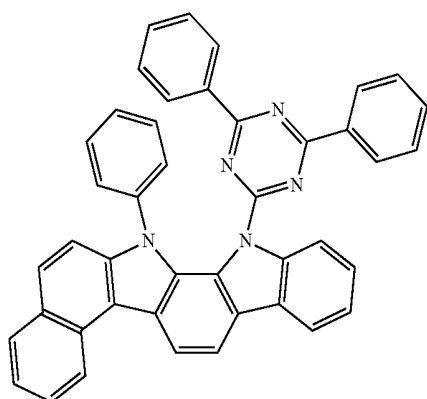
[0156] According to another embodiment, the host may include at least one of Compounds H43 to H49 below, but are not limited thereto:



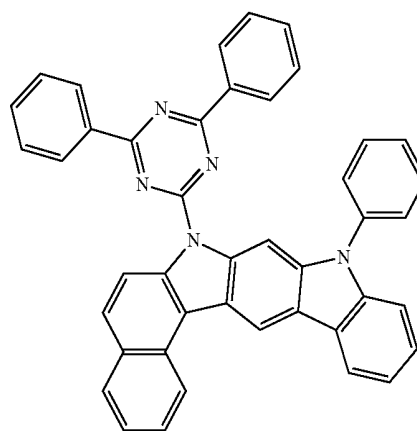
H43



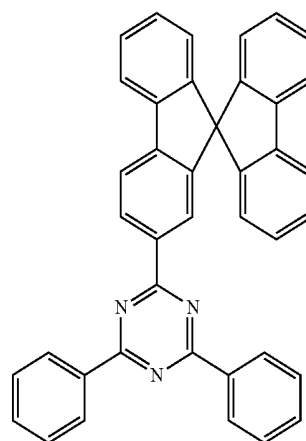
H44



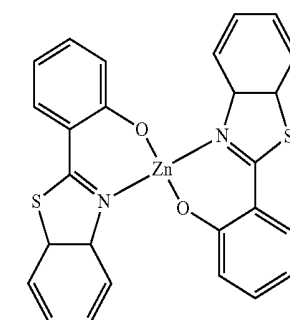
H45



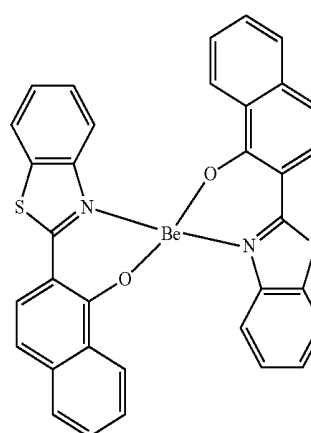
H46



H47



H48

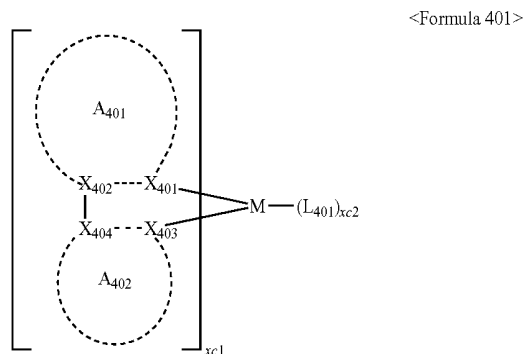


H49

-continued

[0157] The dopant may be at least one selected from a suitable fluorescent dopant and a known phosphorescent dopant.

[0158] The phosphorescent dopant may include an organo-metallic complex represented by Formula 401 below:



[0159] wherein in Formula 401,

[0160] M may be selected from iridium (Ir), platinum (Pt), osmium (Os), titanium (Ti), zirconium (Zr), hafnium (Hf), euroform (Eu), terbium (Tb), and thulium (TM);

[0161] X₄₀₁ to X₄₀₄ may be each independently nitrogen or carbon;

[0162] A₄₀₁ and A₄₀₂ rings may be each independently selected from a substituted or unsubstituted benzene group, a substituted or unsubstituted naphthalene group, a substituted or unsubstituted fluorene group, a substituted or unsubstituted spiro-fluorene group, a substituted or unsubstituted indene group, a substituted or unsubstituted pyrrol group, a substituted or unsubstituted thiophene group, a substituted or unsubstituted furan group, a substituted or unsubstituted imidazole group, a substituted or unsubstituted pyrazole group, a substituted or unsubstituted thiazole group, a substituted or unsubstituted isothiazole group, a substituted or unsubstituted oxazole group, a substituted or unsubstituted isoxazole group, a substituted or unsubstituted pyridine group, a substituted or unsubstituted pyrazine group, a substituted or unsubstituted pyrimidine group, a substituted or unsubstituted pyridazine group, a substituted or unsubstituted quinoline group, a substituted or unsubstituted isoquinoline group, a substituted or unsubstituted benzoquinoline group, a substituted or unsubstituted quinoxaline group, a substituted or unsubstituted quinazoline group, a substituted or unsubstituted carbazole group, a substituted or unsubstituted benzimidazole group, a substituted or unsubstituted benzofuran group, a substituted or unsubstituted benzothiophene group, a substituted or unsubstituted isobenzothiophene group, a substituted or unsubstituted benzooxazole group, a substituted or unsubstituted isobenzooxazole group, a substituted or unsubstituted triazole group, a substituted or unsubstituted oxadiazole group, a substituted or unsubstituted triazine group, a substituted or unsubstituted dibenzofuran group, and a substituted or unsubstituted dibenzothiophene group; and

[0163] at least one substituent of the substituted benzene group, substituted naphthalene group, substituted fluorene group, substituted spiro-fluorene group, substituted indene group, substituted pyrrol group, substituted thiophene group, substituted furan group, substituted imidazole group, substituted pyrazole group, substituted thiazole group, substituted isothiazole group, substituted oxazole group, substituted

isoxazole group, substituted pyridine group, substituted pyrazine group, substituted pyrimidine group, substituted pyridazine group, substituted quinoline group, substituted isoquinoline group, substituted benzoquinoline group, substituted quinoxaline group, substituted quinazoline group, substituted carbazole group, substituted benzimidazole group, substituted benzofuran group, substituted benzothiophene group, substituted isobenzothiophene group, substituted benzooxazole group, substituted isobenzooxazole group, substituted triazole group, substituted oxadiazole group, substituted triazine group, substituted dibenzofuran group, and substituted dibenzothiophene group may be selected from

[0164] 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 C₁-C₆₀ alkyl group, a C₂-C₆₀ alkenyl group, a C₂-C₆₀ alkynyl group, and a C₁-C₆₀ alkoxy group;

[0165] a C₁-C₆₀ alkyl group, a C₂-C₆₀ alkenyl group, a C₂-C₆₀ alkynyl group, and a C₁-C₆₀ alkoxy group, each substituted with at least one selected from 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 C₃-C₁₀ cycloalkyl group, a C₂-C₁₀ heterocycloalkyl group, a C₃-C₁₀ cycloalkenyl group, a C₂-C₁₀ heterocycloalkenyl group, a C₆-C₆₀ aryl group, a C₆-C₆₀ aryloxy group, a C₆-C₆₀ arylthio group, a C₁-C₆₀ heteroaryl group, a monovalent non-aromatic condensed polycyclic group, a monovalent non-aromatic condensed heteropolycyclic group, —N(Q₄₀₁)(Q₄₀₂), —Si(Q₄₀₃)(Q₄₀₄)(Q₄₀₅), and —B(Q₄₀₆)(Q₄₀₇);

[0166] a C₃-C₁₀ cycloalkyl group, a C₂-C₁₀ heterocycloalkyl group, a C₃-C₁₀ cycloalkenyl group, a C₂-C₁₀ heterocycloalkenyl group, a C₆-C₆₀ aryl group, a C₆-C₆₀ aryloxy group, a C₆-C₆₀ arylthio group, a C₁-C₆₀ heteroaryl group, and a non-aromatic condensed polycyclic group;

[0167] a C₃-C₁₀ cycloalkyl group, a C₂-C₁₀ heterocycloalkyl group, a C₃-C₁₀ cycloalkenyl group, a C₂-C₁₀ heterocycloalkenyl group, a C₆-C₆₀ aryl group, a C₆-C₆₀ aryloxy group, a C₆-C₆₀ arylthio group, a C₁-C₆₀ heteroaryl group, a monovalent non-aromatic condensed polycyclic group, and a monovalent non-aromatic condensed heteropolycyclic group, each substituted with at least one selected from 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 C₁-C₆₀ alkyl group, a C₂-C₆₀ alkenyl group, a C₁-C₆₀ alkynyl group, a C₁-C₆₀ alkoxy group, a C₃-C₁₀ cycloalkyl group, a C₂-C₁₀ heterocycloalkyl group, a C₃-C₁₀ cycloalkenyl group, a C₂-C₁₀ heterocycloalkenyl group, a C₆-C₆₀ aryl group, a C₆-C₆₀ aryloxy group, a C₆-C₆₀ arylthio group, a C₁-C₆₀ heteroaryl group, a monovalent non-aromatic condensed polycyclic group, a monovalent non-aromatic condensed heteropolycyclic group, —N(Q₄₁₁)(Q₄₁₂), —Si(Q₄₁₃)(Q₄₁₄)(Q₄₁₅) and —B(Q₄₁₆)(Q₄₁₇); and

[0168] —N(Q₄₂₁)(Q₄₂₂), —Si(Q₄₂₃)(Q₄₂₄)(Q₄₂₅), and —B(Q₄₂₆)(Q₄₂₇);

[0169] L₄₀₁ is an organic ligand;

[0170] xc1 is 1, 2, or 3; and

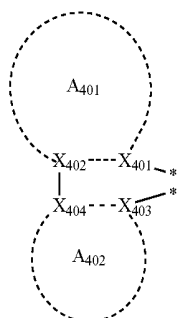
[0171] xc2 is 0, 1, 2, or 3.

[0172] 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-propanedionate, 2,2,6,6-tetramethyl-3,5-heptanedionate, or hexafluoroacetonate), a carboxylic acid ligand (for example, picolinate, dimethyl-3-pyrazolecarboxylate, or benzoate), a carbon monoxide ligand, an isonitrile ligand, a cyano ligand, and a phosphorous ligand (for example, phosphine, and phosphite), but is not limited thereto.

[0173] 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.

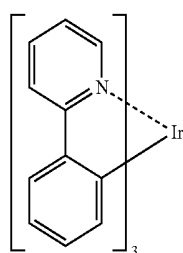
[0174] When A_{401} in Formula 402 has two or more substituents, the substituents of A_{402} may bind to each other to form a saturated or unsaturated ring.

[0175] When xc1 in Formula 401 is two or more, a plurality of ligands



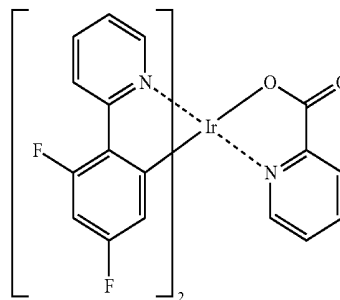
in Formula 401 may be identical or different. When xc1 in Formula 401 is two or more, A_{401} and A_{402} may be respectively directly connected to A_{401} and A_{402} of other neighboring ligands with or without a linker (for example, a C_1 - C_5 alkylene, or $-N(R')$ (wherein R' may be a C_1 - C_{10}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

[0176] The phosphorescent dopant may include at least one of Compounds PD1 to PD74 below:

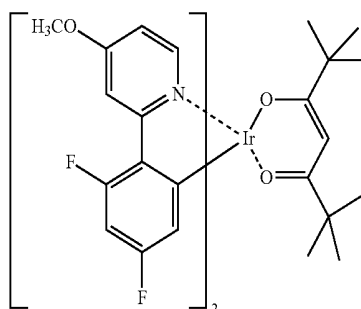


PD1

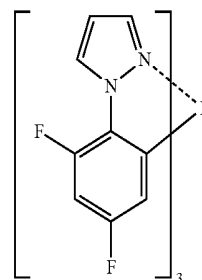
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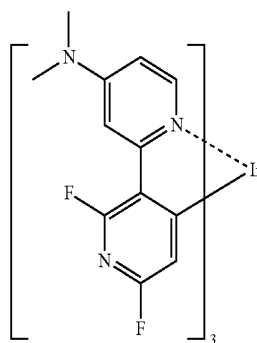
PD2



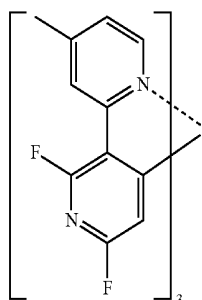
PD3



PD4

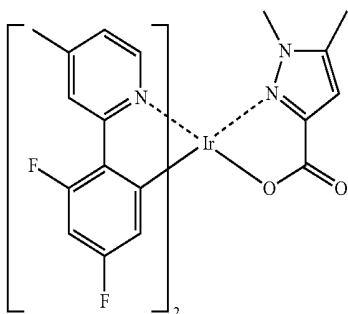
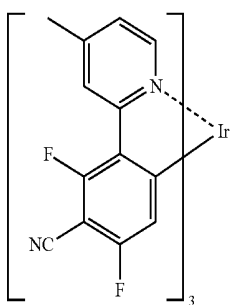
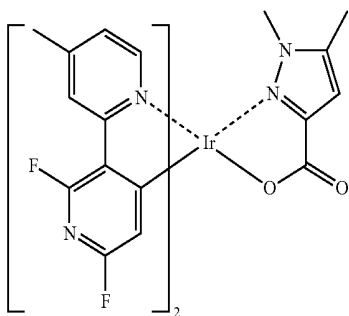
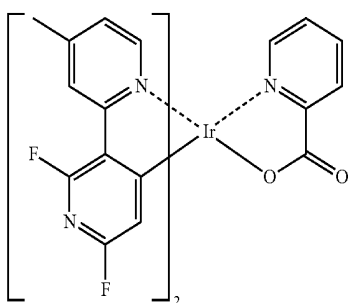
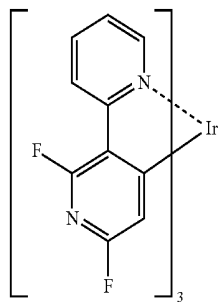


PD5



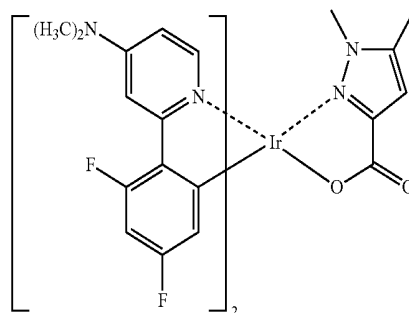
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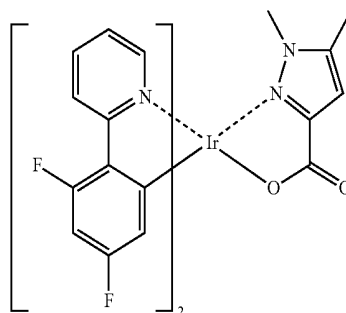
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PD7



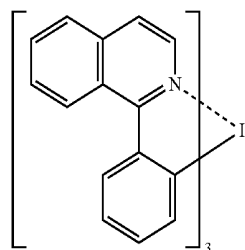
PD12

PD8



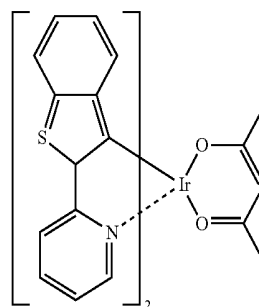
PD13

PD9



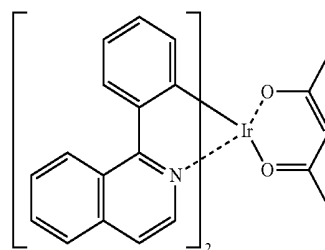
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PD10



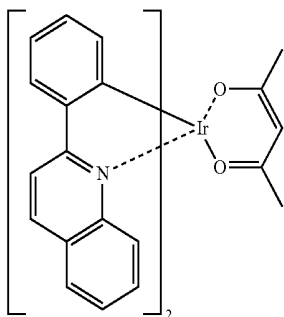
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PD11



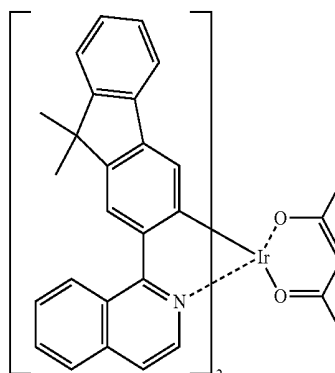
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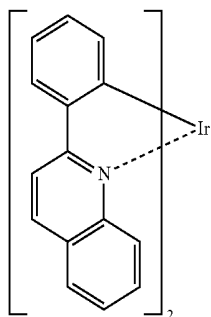


PD17

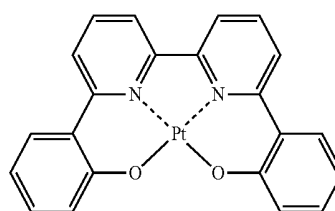
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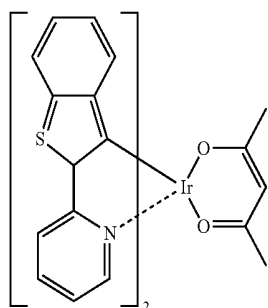
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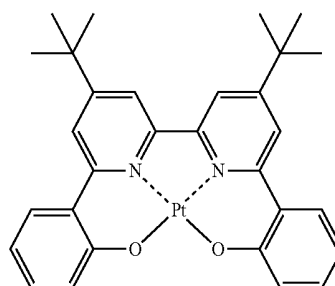
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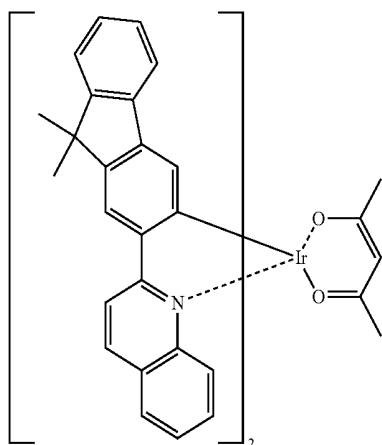
PD22



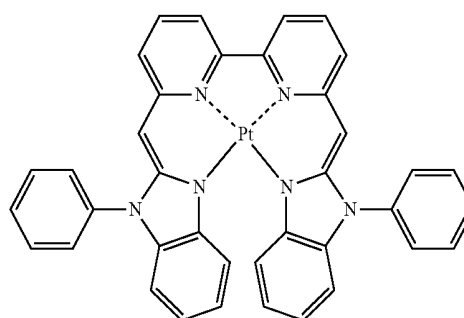
PD19



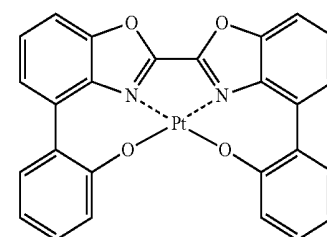
PD23



PD20

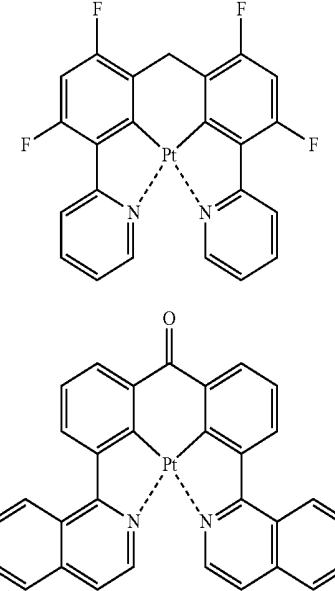
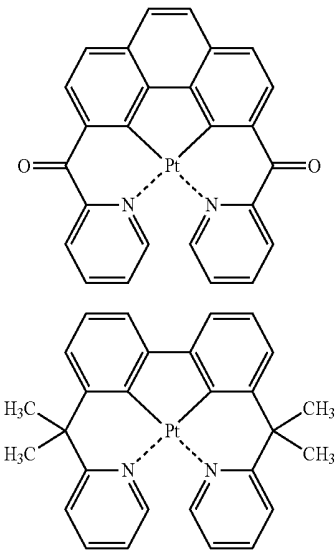
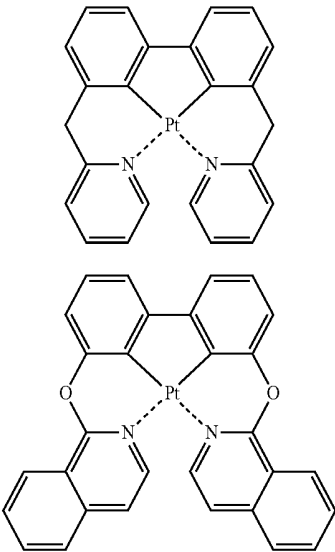


PD24

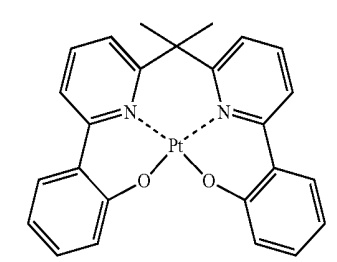
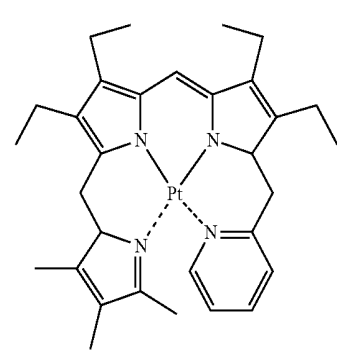
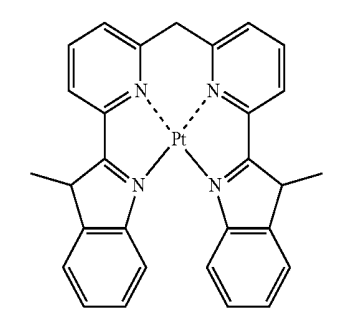
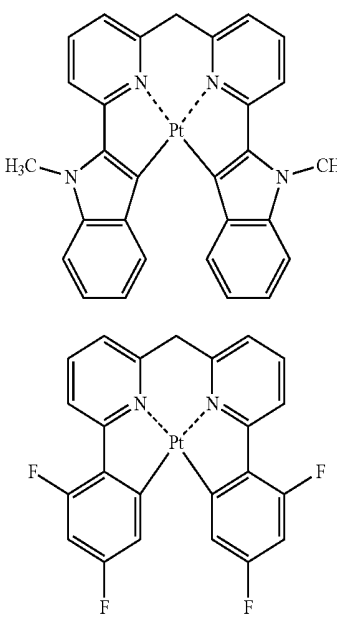


PD25

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PD26

PD27

PD28

PD29

PD30

PD31

PD32

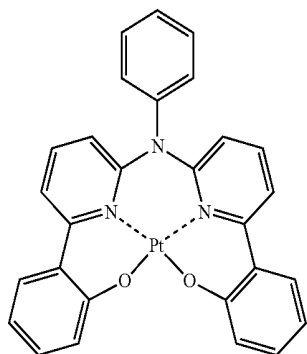
PD33

PD34

PD35

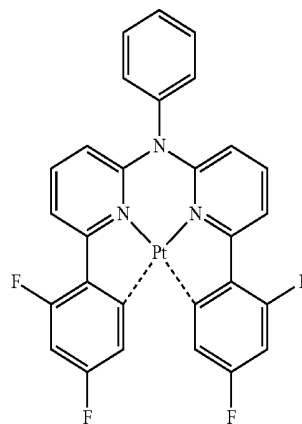
PD36

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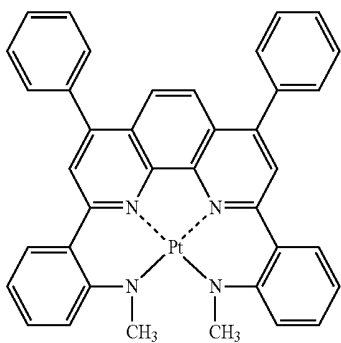


PD37

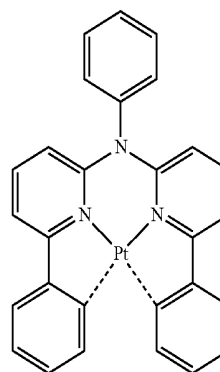
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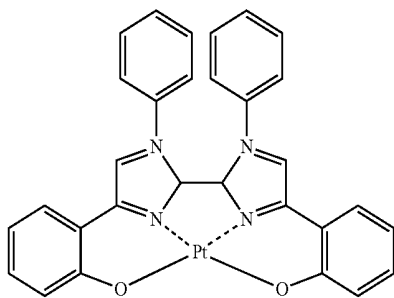
PD42



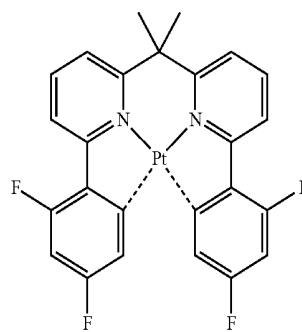
PD38



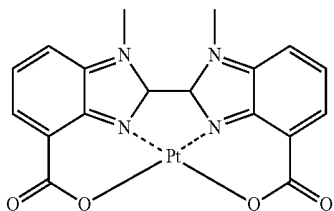
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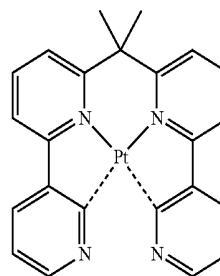
PD39



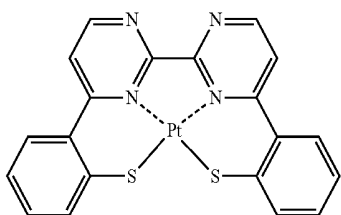
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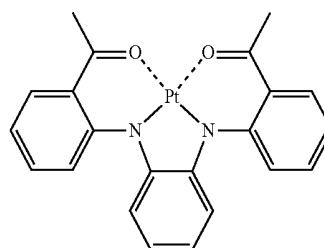
PD40



PD45

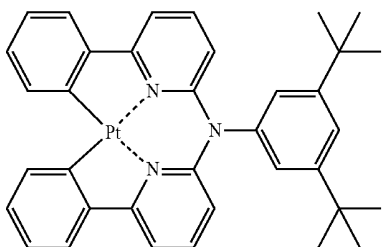


PD41

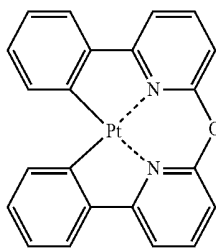


PD46

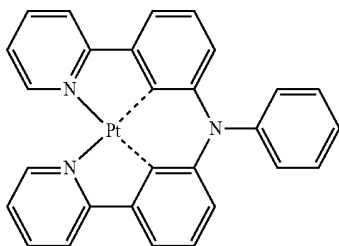
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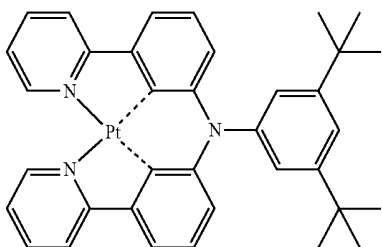
PD47



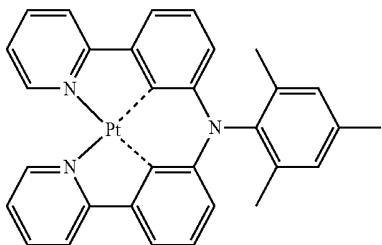
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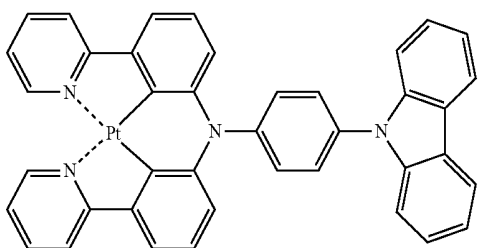
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PD50

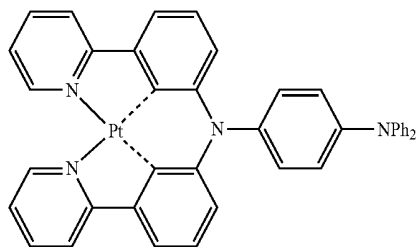


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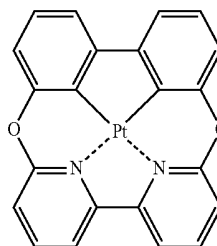


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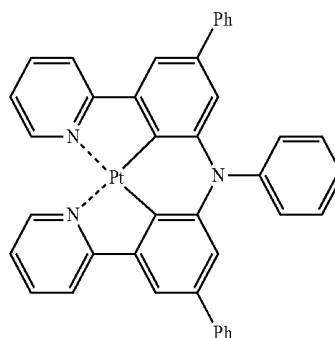
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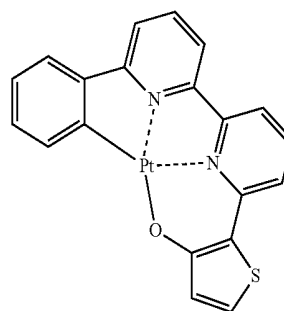
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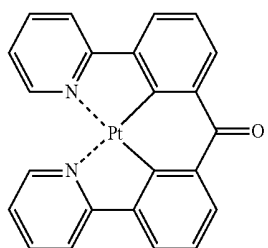
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PD55



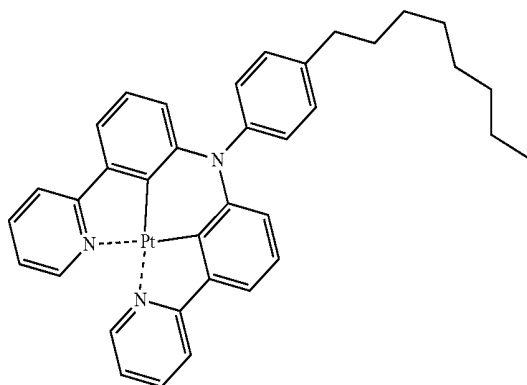
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PD57

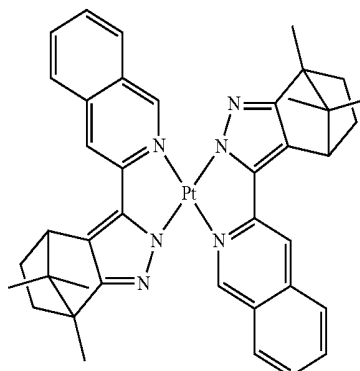
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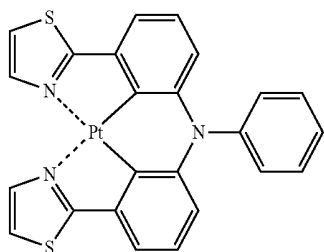


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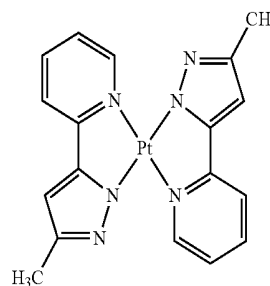
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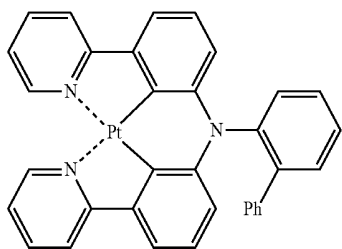
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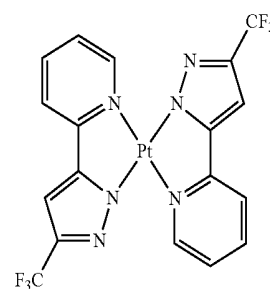
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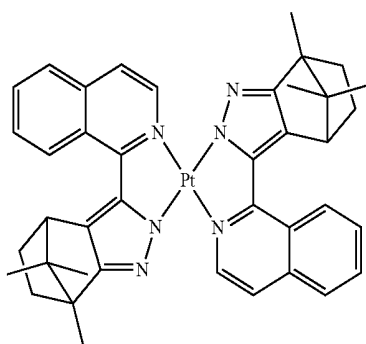
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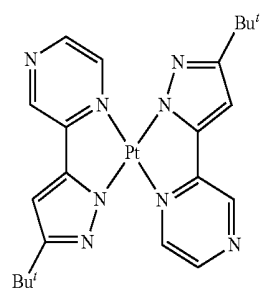
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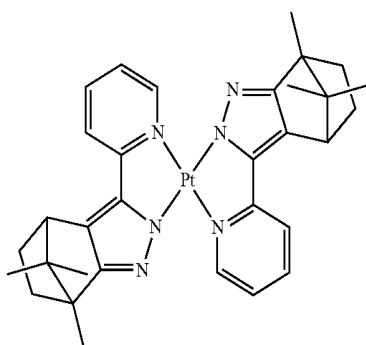
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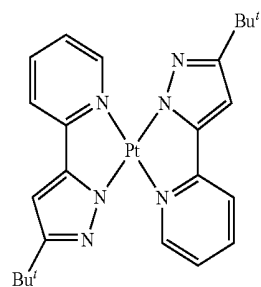
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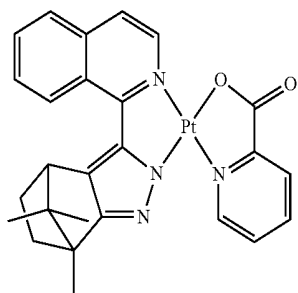
PD62



PD67

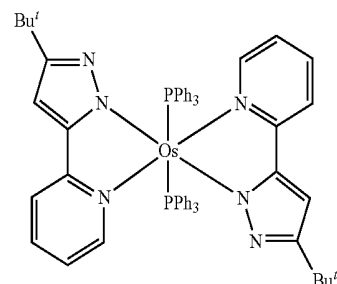


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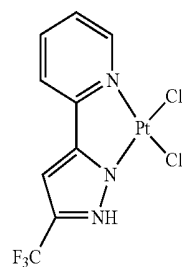


PD68

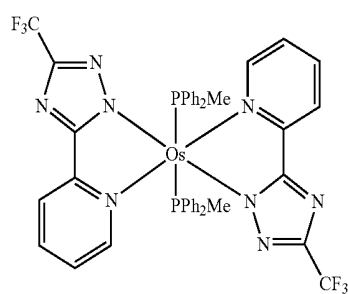
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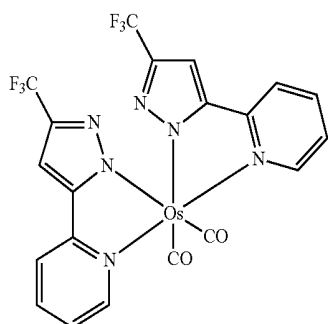
PD72



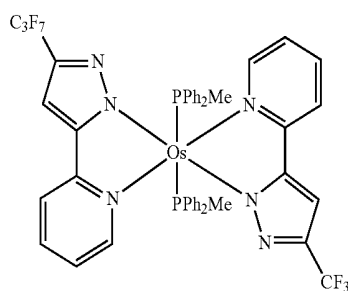
PD69



PD73

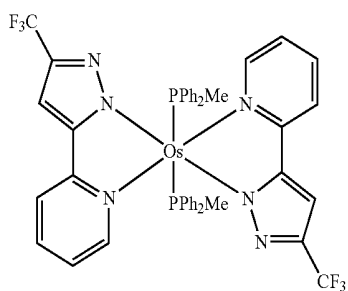


PD70

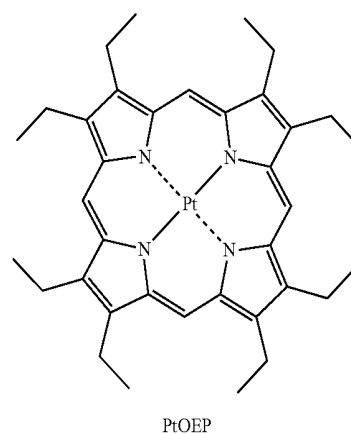


PD74

[0177] According to another embodiment, the phosphorescent dopant may include PtOEP:

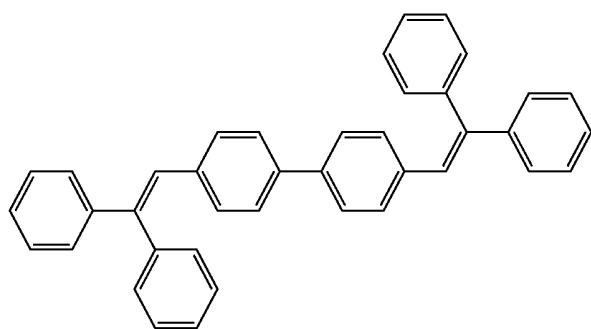


PD71

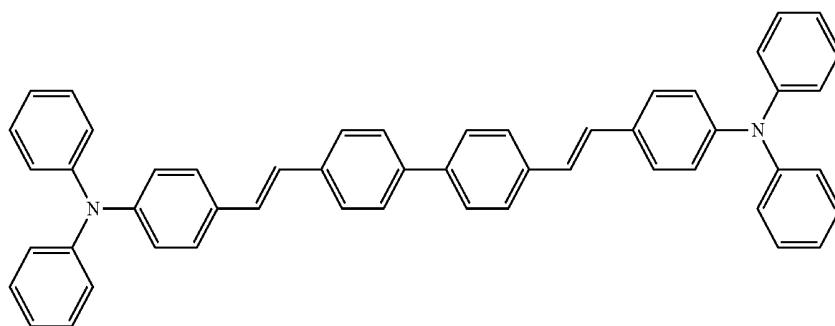


PtOEP

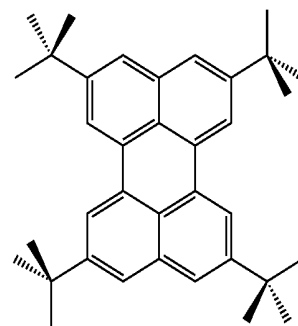
[0178] The fluorescent dopant may include at least one selected from DPAVBi, BDAVBi, TBPe, DCM, DCJTb, Coumarin 6, and C545T:



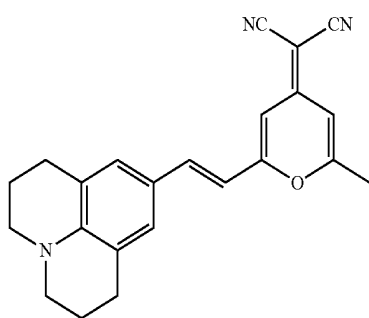
DPVBi



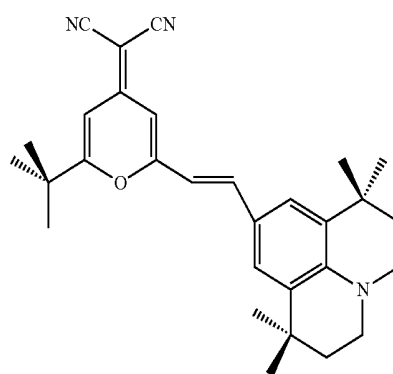
DPAVB



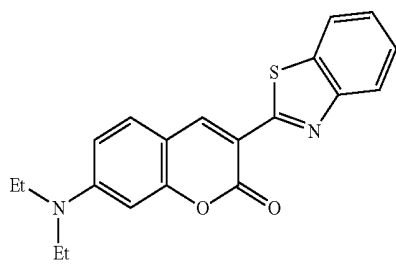
TBP



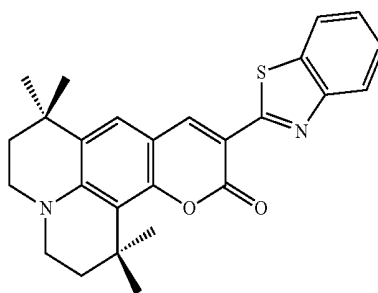
DCM



DCJT

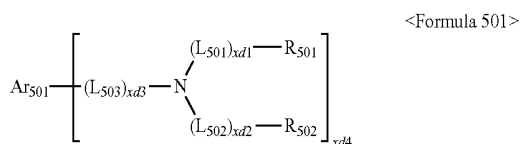


Coumarin 6



C545T

[0179] According to another embodiment, the fluorescent dopant may include a compound represented by Formula 501 below:



[0180] wherein in Formula 501,

[0181] Ar_{501} may be selected from

[0182] a naphthalene, a heptalene, a fluorene, a spiro-fluorene, a benzofluorene, a dibenzofluorene, a phenalene, a phenanthrene, an anthracene, a fluoranthene, a triphenylene, a pyrene, a chrysene, a naphthacene, a picene, a perylene, a pentaphene, and an indenoanthracene; and

[0183] a naphthalene, a heptalene, a fluorene, a spiro-fluorene, a benzofluorene, a dibenzofluorene, a phenalene, a phenanthrene, an anthracene, a fluoranthene, a triphenylene, a pyrene, a chrysene, a naphthacene, a picene, a perylene, a pentaphene, and an indenoanthracene, each substituted with at least one of 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_2 - C_{10} heterocycloalkyl group, a C_3 - C_{10} cycloalkenyl group, a C_2 - C_{10} heterocycloalkenyl group, a C_6 - C_{60} aryl group, a C_6 - C_{60} aryloxy group, a C_6 - C_{60} arylthio group, a C_1 - C_{60} heteroaryl group, a monovalent non-aromatic condensed polycyclic group, monovalent non-aromatic condensed heteropolycyclic group, and —Si(Q_{501})(Q_{502})(Q_{503}) (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);

[0184] L_{501} to L_{503} may be understood by referring to the description provided herein in connection with L_{201} ;

[0185] R_{501} and R_{502} may be each independently selected from

[0186] 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

[0187] 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

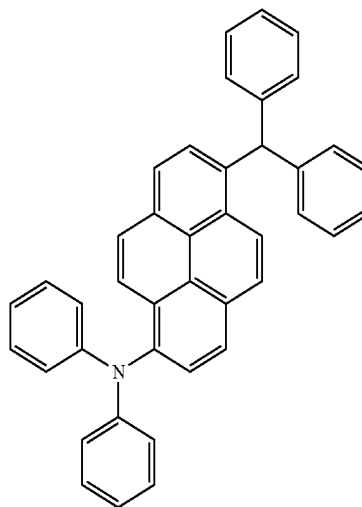
quinolinyl group, an isoquinolinyl group, a quinoxalinyl group, a quinazolinyl group, a carbazolyl group, a triazinyl group, a dibenzofuranyl group, and a dibenzothiophenyl group, each substituted with at least one of a deuterium, —F, —Cl, —Br, —I, a hydroxyl group, a cyano group, a nitro group, an amino 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_{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;

[0188] xd1 to xd3 may be each independently selected from 0, 1, 2, and 3; and

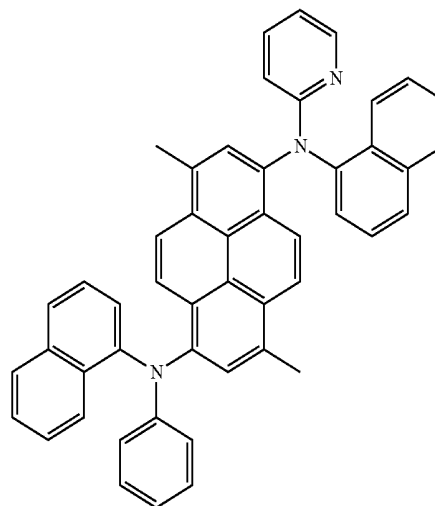
[0189] xb4 may be selected from 1, 2, 3, and 4.

[0190] The fluorescent host may include at least one of Compounds FD1 to FD8:

FD1

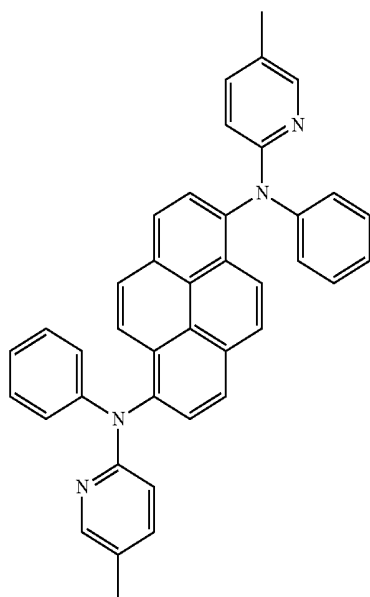


FD2



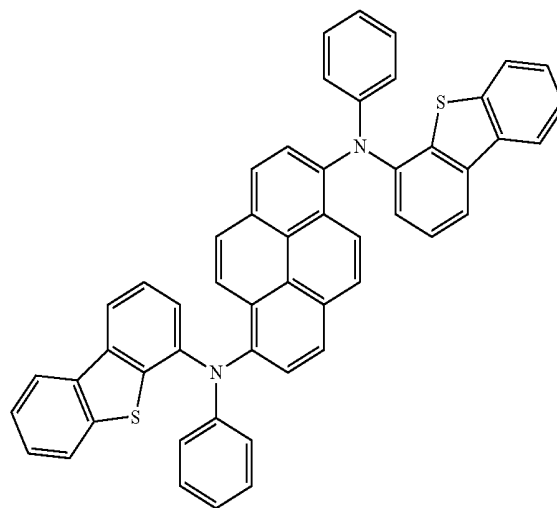
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FD3

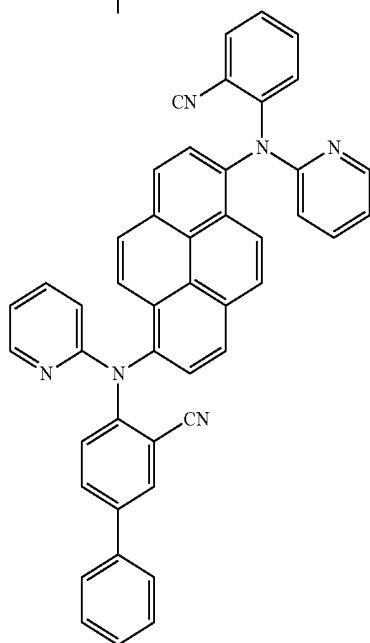


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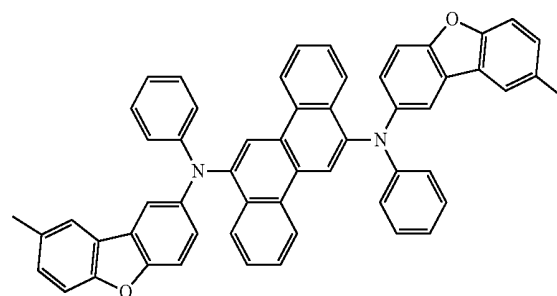
FD6



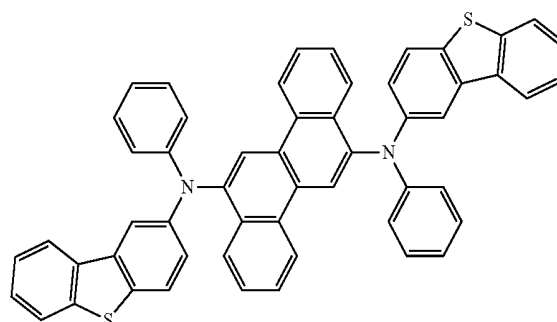
FD4



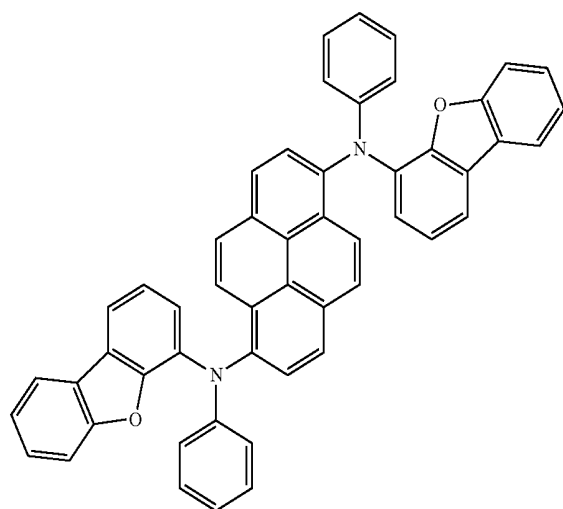
FD7



FD8



FD5



[0191] An amount of the dopant in the emission layer may be, for example, in a range of about 0.01 to about 15 parts by weight based on 100 parts by weight of the host.

[0192] A thickness of the emission layer may be in a range of about 100 Å to about 1,000 Å, for example, 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.

[0193] An electron transport region may be disposed on the emission layer.

[0194] The electron transport region may include, for example, at least one selected from a hole blocking layer, an electron transport layer (ETL), and an electron injection layer.

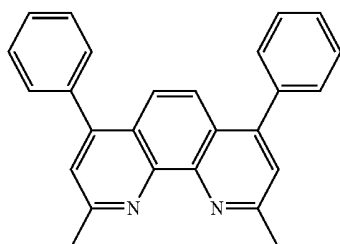
[0195] For example, the electron transport region may have a structure of electron transport layer/electron injection layer

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.

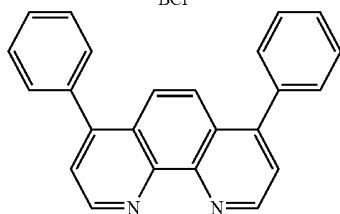
[0196] The electron transport region may include a hole blocking layer. The hole blocking layer may be formed, when the emission layer includes a phosphorescent dopant, to prevent diffusion of excitons or holes into an electron transport layer.

[0197] 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, such as 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.

[0198] The hole blocking layer may include, for example, at least one of BCP and Bphen:



BCP



Bphen

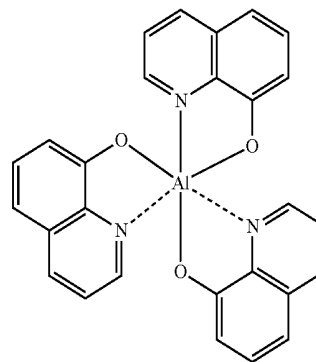
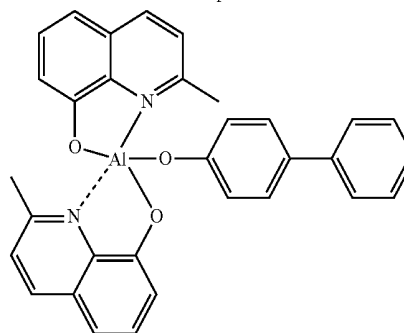
[0199] A thickness of the hole blocking layer may be in a range of about 20 Å to about 1,000 Å, for example, about 30 Å to about 300 Å. When the thickness of the hole blocking layer is within these ranges, the hole blocking layer may have excellent hole blocking characteristics without a substantial increase in driving voltage.

[0200] 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, such as 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.

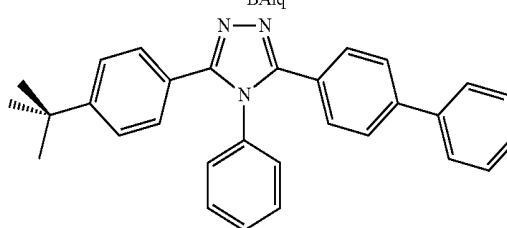
[0201] According to an embodiment, the organic layer 150 of the organic light-emitting device includes an electron transport region disposed between the emission layer and the second electrode 190, wherein the electron transport region

includes an electron transport layer, and the electron transport layer includes the compound represented by Formula 1.

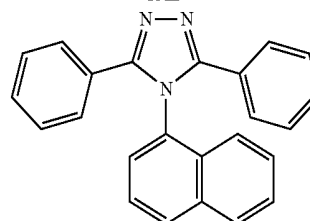
[0202] The electron transport layer may include at least one selected from BCP, Bphen, and Alq₃, Balq, TAZ, and NTAZ, which are illustrated below:

Alq₃

Balq



TAZ

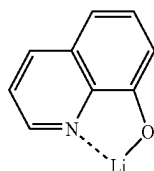


NTAZ

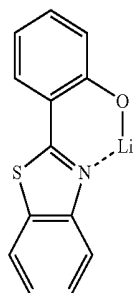
[0203] A thickness of the electron transport layer may be in a range of about 100 Å to about 1,000 Å, for example, about 150 Å to about 500 Å. When the thickness of the electron transport layer is within the range described above, the electron transport layer may have satisfactory electron transport characteristics without a substantial increase in driving voltage.

[0204] Also, the electron transport layer may further include, in addition to the materials described above, a metal-containing material.

[0205] The metal-containing material may include a Li complex. The Li complex may include, for example, Compound ET-D1 (lithium quinolate, LiQ) or ET-D2:



ET-D1



ET-D2

[0206] The electron transport region may include an electron injection layer that allows electrons to be easily provided from the second electrode **190**.

[0207] The electron injection layer may be formed on the electron transport layer by using various methods, such as 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.

[0208] The electron injection layer may include at least one selected from, LiF, NaCl, CsF, Li₂O, BaO, and LiQ.

[0209] A thickness of the electron injection layer may be in a range of about 1 Å to about 100 Å, for example, about 3 Å to about 90 Å. When the thickness of the electron injection layer is within the range described above, the electron injection layer may have satisfactory electron injection characteristics without a substantial increase in driving voltage.

[0210] The second electrode **190** is 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 metal, an alloy, an electrically conductive compound, or a mixture thereof, which have a relatively low work function.

[0211] Examples of the second electrode **190** are lithium (Li), magnesium (Mg), aluminum (Al), aluminum-lithium (Al—Li), calcium (Ca), magnesium-indium (Mg—In), or magnesium-silver (Mg—Ag). According to another embodiment, the material for forming the second electrode **190** may be ITO or IZO. The second electrode **190** may be, for example, a reflective electrode, a semi-transmissive electrode, or a transmissive electrode.

[0212] Also, an organic layer according to an embodiment may be formed by depositing the compound according to an embodiment, or may be formed by using a wet method in which the compound according to an embodiment is prepared in the form of solution and then the solution of the compound is used for coating.

[0213] An organic light-emitting device according to an embodiment may be used in various flat panel display apparatuses, such as a passive matrix organic light-emitting display apparatus or an active matrix organic light-emitting display apparatus. In particular, when the organic light-emitting device is included in an active matrix organic light-emitting display apparatus, a first electrode disposed on a substrate acts as a pixel and may be electrically connected to a source electrode or a drain electrode of a thin film transistor. In addition, the organic light-emitting device may be included in a flat panel display apparatus that emits light in opposite directions.

[0214] Hereinbefore, the organic light-emitting device has been described with reference to FIG. 1, but the device may have various structures.

[0215] Hereinafter, definitions of substituents used herein will be presented (the number of carbon numbers used to restrict a substituent is not limited, and does not limit properties of the substituent, and unless defined otherwise, the definition of the substituent is consistent with a general definition thereof).

[0216] A C₁-C₆₀ alkyl group used herein refers to a linear or branched aliphatic hydrocarbon monovalent group having 1 to 60 carbon atoms, and examples thereof are a methyl group, an ethyl group, a propyl group, an isobutyl group, a sec-butyl group, a tert-butyl group, a pentyl group, an iso-amyl group, and a hexyl group. A C₁-C₆₀ alkylene group used herein refers to a divalent group having the same structure as the C₁-C₆₀ alkyl group.

[0217] A C₁-C₆₀ alkoxy group used herein refers to a monovalent group represented by —OA₁₀₁ (wherein A₁₀₁ is the C₁-C₆₀ alkyl group), and examples thereof are a methoxy group, an ethoxy group, and an isopropoxy group.

[0218] A C₂-C₆₀ alkenyl group used herein refers to a hydrocarbon group having at least one carbon double bond in the middle or terminal of the C₂-C₆₀ alkyl group, and examples thereof are an ethenyl group, a propenyl group, and a butenyl group. A C₂-C₆₀ alkenylene group used herein refers to a divalent group having the same structure as the C₂-C₆₀ alkenyl group.

[0219] A C₂-C₆₀ alkynyl group used herein refers to a hydrocarbon group having one carbon triple bond in the middle or terminal of the C₂-C₆₀ alkyl group, and examples thereof are an ethynyl group, and a propynyl group. A C₂-C₆₀ alkynylene group used herein refers to a divalent group having the same structure as the C₂-C₆₀ alkynyl group.

[0220] A C₃-C₁₀ cycloalkyl group used herein refers to a monovalent hydrocarbon monocyclic group having 3 to 10 carbon atoms, and examples thereof are a cyclopropyl group, a cyclobutyl group, a cyclopentyl group, a cyclohexyl group, and a cycloheptyl group. A C₃-C₁₀ cycloalkylene group used herein refers to a divalent group having the same structure as the C₃-C₁₀ cycloalkyl group.

[0221] A C₂-C₁₀ 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 2 to 10 carbon atoms, and examples thereof are a tetrahydrofuran group, and a tetrahydrothiophene group. A C₂-C₁₀ heterocycloalkylene group used herein refers to a divalent group having the same structure as the C₂-C₁₀ heterocycloalkyl group.

[0222] A C₃-C₁₀ 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 examples thereof are a cyclopentenyl group, a cyclohexenyl group, and a cycloheptenyl group. A C₃-C₁₀ cycloalkenylene group used herein refers to a divalent group having the same structure as the C₃-C₁₀ cycloalkenyl group.

[0223] A C₂-C₁₀ 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, 2 to 10 carbon atoms, and at least one double bond in its ring. Examples of the C₂-C₁₀ heterocycloalkenyl group are a 2,3-hydrofuranyl group and a 2,3-hydrothiophenyl group. A C₂-C₁₀ heterocycloalkenylene group used herein refers to a divalent group having the same structure as the C₂-C₁₀ heterocycloalkenyl group.

[0224] A C₆-C₆₀ aryl group used herein refers to a monovalent group having a carbocyclic aromatic system having 6 to 60 carbon atoms, and a C₆-C₆₀ arylene group used herein refers to a divalent group having a carbocyclic aromatic system having 6 to 60 carbon atoms. Examples of the C₆-C₆₀ aryl group are a phenyl group, a naphthyl group, an anthracenyl group, a phenanthrenyl group, a pyrenyl group, and a chrysenyl group. When the C₆-C₆₀ aryl group and the C₆-C₆₀ arylene group each include two or more rings, the rings may be fused to each other.

[0225] A C₁-C₆₀ 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 C₁-C₆₀ 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 C₁-C₆₀ 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 C₁-C₆₀ heteroaryl group and the C₁-C₆₀ heteroarylene group each include two or more rings, the rings may be fused to each other.

[0226] A C₆-C₆₀ aryloxy group used herein indicates —OA₁₀₂ (wherein A₁₀₂ is the C₆-C₆₀ aryl group), and a C₆-C₆₀ arylthio group indicates —SA₁₀₃ (wherein A₁₀₃ is the C₆-C₆₀ aryl group).

[0227] A monovalent non-aromatic condensed polycyclic group used herein refers to a monovalent group (for example, having 8 to 60 carbon atoms) that has two or more rings condensed to each other, only carbon atoms as a ring forming atom, and non-aromaticity in the entire molecular structure. A detailed 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.

[0228] A monovalent non-aromatic condensed heteropolycyclic group used herein refers to a monovalent group (for example, having 2 to 60 carbon atoms) that has two or more rings condensed to each other, has a heteroatom selected from N, O, P, and S, other than carbon atoms, as a ring forming atom, and has non-aromaticity 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.

[0229] In the present specification, at least one substituent of the substituted C₃-C₁₀ cycloalkylene group, the substituted C₂-C₁₀ heterocycloalkylene group, the substituted C₃-C₁₀ cycloalkenylene group, the substituted C₂-C₁₀ heterocycloalkenylene group, the substituted C₆-C₆₀ arylene group, the substituted C₁-C₆₀ heteroarylene group, the substituted divalent non-aromatic condensed polycyclic group, the substituted divalent non-aromatic condensed heteropolycyclic group, the substituted C₁-C₆₀ alkyl group, the substituted C₂-C₆₀ alkenyl group, the substituted C₂-C₆₀ alkynyl group, the substituted C₁-C₆₀ alkoxy group, the substituted C₃-C₁₀ cycloalkyl group, the substituted C₂-C₁₀ heterocycloalkyl group, the substituted C₃-C₁₀ cycloalkenyl group, the substituted C₂-C₁₀ heterocycloalkenyl group, the substituted C₆-C₆₀ aryl group, the substituted C₆-C₆₀ aryloxy group, the substituted C₆-C₆₀ arylthio group, the substituted C₁-C₆₀ heteroaryl group, the substituted monovalent non-aromatic condensed polycyclic group, and the substituted monovalent non-aromatic condensed heteropolycyclic group may be 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 C₁-C₆₀ alkyl group, a C₂-C₆₀ alkenyl group, a C₂-C₆₀ alkynyl group, and a C₁-C₆₀ alkoxy group;

[0230] a C₁-C₆₀ alkyl group, a C₂-C₆₀ alkenyl group, a C₂-C₆₀ alkynyl group, and a C₁-C₆₀ alkoxy group, each substituted with at least one selected from 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 C₃-C₁₀ cycloalkyl group, a C₂-C₁₀ heterocycloalkyl group, a C₃-C₁₀ cycloalkenyl group, a C₂-C₁₀ heterocycloalkenyl group, a C₆-C₆₀ aryl group, a C₆-C₆₀ aryloxy group, a C₆-C₆₀ arylthio group, a C₁-C₆₀ heteroaryl group, a monovalent non-aromatic condensed polycyclic group, a monovalent non-aromatic condensed heteropolycyclic group, —N(Q₁₁)(Q₁₂), —Si(Q₁₃)(Q₁₄)(Q₁₅), and —B(Q₁₆)(Q₁₇);

[0231] a C₃-C₁₀ cycloalkyl group, a C₂-C₁₀ heterocycloalkyl group, a C₃-C₁₀ cycloalkenyl group, a C₂-C₁₀ heterocycloalkenyl group, a C₆-C₆₀ aryl group, a C₆-C₆₀ aryloxy group, a C₆-C₆₀ arylthio group, a C₁-C₆₀ heteroaryl group, a monovalent non-aromatic condensed polycyclic group, and a monovalent non-aromatic condensed heteropolycyclic group;

[0232] a C₃-C₁₀ cycloalkyl group, a C₂-C₁₀ heterocycloalkyl group, a C₃-C₁₀ cycloalkenyl group, a C₂-C₁₀ heterocycloalkenyl group, a C₆-C₆₀ aryl group, a C₆-C₆₀ aryloxy group, a C₆-C₆₀ arylthio group, a C₂-C₆₀ heteroaryl group, a monovalent non-aromatic condensed polycyclic group, and a monovalent non-aromatic condensed heteropolycyclic group, each substituted with at least one selected from 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 C₁-C₆₀ alkyl group, a C₂-C₆₀ alkenyl group, a C₁-C₆₀ alkynyl group, a C₁-C₆₀ alkoxy group, a C₃-C₁₀ cycloalkyl group, a C₂-C₁₀ heterocycloalkyl group, a C₃-C₁₀ cycloalkenyl group, a C₂-C₁₀ heterocycloalkenyl group, a C₆-C₆₀ aryl group, a C₆-C₆₀ aryloxy group, a C₆-C₆₀ arylthio group, a C₁-C₆₀ heteroaryl group, a monovalent non-aromatic

condensed polycyclic group, a monovalent non-aromatic condensed heteropolycyclic group, $-\text{N}(\text{Q}_{21})(\text{Q}_{22})$, $-\text{Si}(\text{Q}_{23})(\text{Q}_{24})(\text{Q}_{25})$ and $-\text{B}(\text{Q}_{26})(\text{Q}_{27})$; and

[0233] $-\text{N}(\text{Q}_{31})(\text{Q}_{32})$, $-\text{Si}(\text{Q}_{33})(\text{Q}_{34})(\text{Q}_{35})$, and $-\text{B}(\text{Q}_{36})(\text{Q}_{37})$.

[0234] Q_{11} to Q_{17} , Q_{21} to Q_{27} , and Q_{31} to Q_{37} may be each independently selected from a hydrogen, a deuterium, $-\text{F}$, $-\text{Cl}$, $-\text{Br}$, $-\text{I}$, 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 $\text{C}_1\text{-C}_{60}$ alkyl group, a $\text{C}_2\text{-C}_{60}$ alkenyl group, a $\text{C}_2\text{-C}_{60}$ alkynyl group, a $\text{C}_1\text{-C}_{60}$ alkoxy group, a $\text{C}_3\text{-C}_{10}$ cycloalkyl group, a $\text{C}_2\text{-C}_{10}$ heterocycloalkyl group, a $\text{C}_3\text{-C}_{10}$ cycloalkenyl group, a $\text{C}_2\text{-C}_{10}$ heterocycloalkenyl group, a $\text{C}_6\text{-C}_{60}$ aryl group, a $\text{C}_1\text{-C}_{60}$ heteroaryl group, a monovalent non-aromatic condensed polycyclic group, and a monovalent non-aromatic condensed heteropolycyclic group.

[0235] For example, at least one substituent of the substituted $\text{C}_3\text{-C}_{10}$ cycloalkylene group, the substituted $\text{C}_2\text{-C}_{10}$ heterocycloalkylene group, the substituted $\text{C}_3\text{-C}_{10}$ cycloalkenylene group, the substituted $\text{C}_2\text{-C}_{10}$ heterocycloalkenylene group, the substituted $\text{C}_6\text{-C}_{60}$ arylene group, the substituted $\text{C}_1\text{-C}_{60}$ heteroarylene group, the substituted divalent non-aromatic condensed polycyclic group, the substituted divalent non-aromatic condensed heteropolycyclic group, the substituted $\text{C}_1\text{-C}_{60}$ alkyl group, the substituted $\text{C}_2\text{-C}_{60}$ alkenyl group, the substituted $\text{C}_2\text{-C}_{60}$ alkynyl group, the substituted $\text{C}_1\text{-C}_{60}$ alkoxy group, the substituted $\text{C}_3\text{-C}_{10}$ cycloalkyl group, the substituted $\text{C}_2\text{-C}_{10}$ heterocycloalkyl group, the substituted $\text{C}_3\text{-C}_{10}$ cycloalkenyl group, the substituted $\text{C}_2\text{-C}_{10}$ heterocycloalkenyl group, the substituted $\text{C}_6\text{-C}_{60}$ aryl group, the substituted $\text{C}_6\text{-C}_{60}$ aryloxy group, the substituted $\text{C}_6\text{-C}_{60}$ arylthio group, the substituted $\text{C}_1\text{-C}_{60}$ heteroaryl group, the substituted monovalent non-aromatic condensed polycyclic group, and the substituted monovalent non-aromatic condensed heteropolycyclic group may be selected from

[0236] a deuterium, $-\text{F}$, $-\text{Cl}$, $-\text{Br}$, $-\text{I}$, 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 $\text{C}_1\text{-C}_{60}$ alkyl group, a $\text{C}_2\text{-C}_{60}$ alkenyl group, a $\text{C}_2\text{-C}_{60}$ alkynyl group, and a $\text{C}_1\text{-C}_{60}$ alkoxy group;

[0237] a $\text{C}_1\text{-C}_{60}$ alkyl group, a $\text{C}_2\text{-C}_{60}$ alkenyl group, a $\text{C}_2\text{-C}_{60}$ alkynyl group, and a $\text{C}_1\text{-C}_{60}$ alkoxy group, each substituted with at least one of a deuterium, $-\text{F}$, $-\text{Cl}$, $-\text{Br}$, $-\text{I}$, 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 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 benzo-fluorenyl 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 fura-

nyl group, an imidazolyl group, a pyrazolyl group, a thiazolyl group, an isothiazolyl group, an oxazolyl group, an isooxazolyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, an indolyl group, an indazolyl group, a furinyl group, a quinolinyl group, an isoquinolinyl group, a benzoquinolinyl group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, a quinazolinyl group, a cinnolinyl group, a carbazolyl group, a phenanthridinyl group, an acridinyl group, a phenanthrolinyl group, a phenazinyl group, a benzoimidazolyl group, a benzofuranyl group, a benzothiophenyl group, an isobenzothiazolyl group, a benzooxazolyl group, an isobenzooxazolyl 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, $-\text{N}(\text{Q}_{11})(\text{Q}_{12})$, $-\text{Si}(\text{Q}_{13})(\text{Q}_{14})(\text{Q}_{15})$, and $-\text{B}(\text{Q}_{16})(\text{Q}_{17})$;

[0238] 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 benzo-fluorenyl 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 isooxazolyl group, a pyridinyl group, a pyrazinyl group, a pyrimidinyl group, a pyridazinyl group, an isoindolyl group, an indolyl group, an indazolyl group, a furinyl group, a quinolinyl group, an isoquinolinyl group, a benzoquinolinyl group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, a quinazolinyl group, a cinnolinyl group, a carbazolyl group, a phenanthridinyl group, an acridinyl group, a phenanthrolinyl group, a phenazinyl group, a benzoimidazolyl group, a benzofuranyl group, a benzothiophenyl group, an isobenzothiazolyl group, a benzooxazolyl group, an isobenzooxazolyl 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;

[0239] 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 benzo-fluorenyl 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 isooxazolyl 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 quinolyl group, an isoquinolyl group, a benzoquinolyl group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, a quinazolinyl group, a cinnolyl group, a carbazolyl group, a phenanthridinyl group, an acridinyl group, a phenanthrolinyl group, a phenazinyl group, a benzoimidazolyl group, a benzofuranlyl group, a benzothiophenyl group, an isobenzothiazolyl group, a benzooxazolyl group, an isobenzooxazolyl group, a triazolyl group, a tetrazolyl group, an oxadiazolyl group, a triazinyl group, a dibenzofuranlyl group, a dibenzothiophenyl group, a benzocarbazolyl group, a thiadiazolyl group, an imidazopyridinyl group, and an imidazopyrimidinyl group, each substituted with at least one of 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 C₁-C₆₀ alkyl group, a C₂-C₆₀ alkenyl group, a C₂-C₆₀ alkynyl group, a C₁-C₆₀ 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 isooxazolyl 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 quinolyl group, an isoquinolyl group, a benzoquinolyl group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, a quinazolinyl group, a cinnolyl group, a carbazolyl group, a phenanthridinyl group, an acridinyl group, a phenanthrolinyl group, a phenazinyl group, a benzoimidazolyl group, a benzofuranlyl group, a benzothiophenyl group, an isobenzothiazolyl group, a benzooxazolyl group, an isobenzooxazolyl group, a triazolyl group, a tetrazolyl group, an oxadiazolyl group, a triazinyl group, a dibenzofuranlyl group, a dibenzothiophenyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a thiadiazolyl group, an imidazopyridinyl group, and an imidazopyrimidinyl group.

[0240] —N(Q₃₁)(Q₃₂), —Si(Q₃₃)(Q₃₄)(Q₃₅), and —B(Q₃₆)(Q₃₇).

[0241] Q₁ to Q₇, Q₁₁ to Q₁₇, Q₂₁ to Q₂₇, and Q₃₁ to Q₃₇ may be 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 or a salt thereof, a sulfonic acid or a salt thereof, a phosphoric acid or a salt thereof, a C₁-C₆₀ alkyl group, a C₂-C₆₀ alkenyl group, a C₂-C₆₀ alkynyl group, a C₁-C₆₀ alkoxy group, a 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 acenaph-

thyl 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 isooxazolyl 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 quinolyl group, an isoquinolyl group, a benzoquinolyl group, a phthalazinyl group, a naphthyridinyl group, a quinoxalinyl group, a quinazolinyl group, a cinnolyl group, a carbazolyl group, a phenanthridinyl group, an acridinyl group, a phenanthrolinyl group, a phenazinyl group, a benzoimidazolyl group, a benzofuranlyl group, a benzothiophenyl group, an isobenzothiazolyl group, a benzooxazolyl group, an isobenzooxazolyl group, a triazolyl group, a tetrazolyl group, an oxadiazolyl group, a triazinyl group, a dibenzofuranlyl group, a dibenzothiophenyl group, a benzocarbazolyl group, a dibenzocarbazolyl group, a thiadiazolyl group, an imidazopyridinyl group, and an imidazopyrimidinyl group.

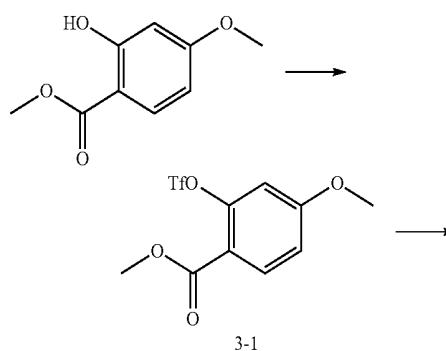
[0242] The term “Ph” used herein refers to a phenyl group, the term “Me” used herein refers to a methyl group, the term “Et” used herein refers to an ethyl group, and the term “ter-Bu” or “Bu” used herein refers to a tert-butyl group.

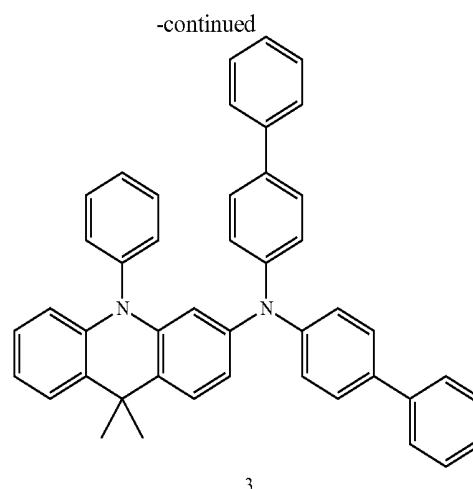
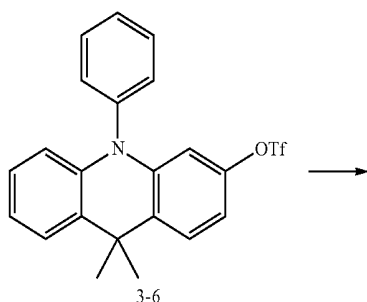
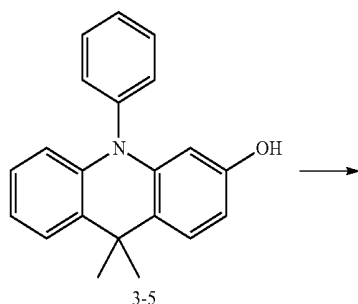
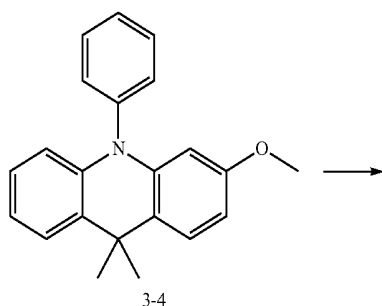
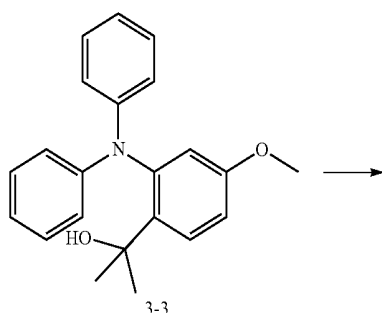
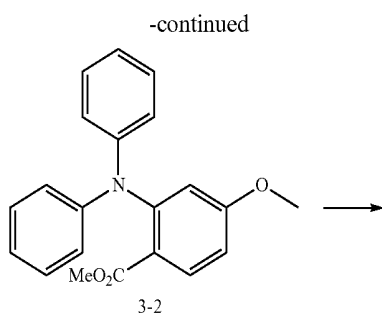
[0243] The following Examples and Comparative Examples are provided in order to highlight characteristics of one or more embodiments, but it will be understood that the Examples and Comparative Examples are not to be construed as limiting the scope of the embodiments, nor are the Comparative Examples 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.

[0244] 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.

Synthesis Example

[0245] Synthesis of Compound 3





[0246] Synthesis of Intermediate 3-1

[0247] 6.5 g of methyl-4-methoxysalicylate was diluted with 300 ml of dichloromethane, and then 6.4 ml of triethylamine was dropped thereto. Then, 9.9 g of anhydrous trifluoroacetic acid was slowly added dropwise thereto. After 3 hours, water was used to stop the reaction, and an organic layer was isolated and dried using anhydrous magnesium sulfate and concentrated under reduced pressure, and the result was purified by silica gel column chromatography to obtain Intermediate 3-1 (10.2 g, 91%) LC/MS cal'd: 314.23 found: 314.25

[0248] (2) Synthesis of Intermediate 3-2

[0249] 10 g of Intermediate 3-1, diphenylamine (12.5 g), Pd₂(dba)₃ (0.85 g), PtBu₃ (0.25 ml), and KOtBu (9 g) were dissolved in toluene (250 mL), and then the result was stirred at a temperature of 85° C. for 2 hours. The reaction product was quenched using water at room temperature, and then an extraction process was performed thereon three times using ethyl acetate. A separated organic layer was dried using anhydrous magnesium sulfate and concentrated under reduced pressure, and the result was purified by silica gel column chromatography to obtain Intermediate 3-2 (10 g, 98%). LC/MS cal'd: 333.39 found: 333.40

[0250] (3) Synthesis of Intermediate 3-3

[0251] 10 g of Intermediate 3-2 was diluted in 300 mL of tetrahydrofuran, and then at a temperature of 0° C., 25 ml of methylmagnesiumchloride (3M) was slowly added dropwise thereto. After 6 hours of mixing, the reaction was quenched using ammonium chloride, and then an extraction process was performed thereon three times using ethyl acetate. A separated organic layer was dried using anhydrous magnesium sulfate and concentrated under reduced pressure, and the result was purified by silica gel column chromatography to obtain 3-3 (82%). LC/MS cal'd: 333.43 found: 333.44

[0252] (4) Synthesis of Intermediate 3-4

[0253] 8.2 g of Intermediate 3-3 was diluted in 400 mL of dichloromethane, and then 0.82 ml of methansulfonyl acid was slowly added dropwise thereto. 5 minutes after the addition, a reaction was quenched using triethylamine, and the residual obtained by reduced-pressure distillation was separation-purified by silica gel column chromatography to obtain 3-4 (87%). LC/MS cal'd: 315.42 found: 315.42

[0254] (5) Synthesis of Intermediate 3-5

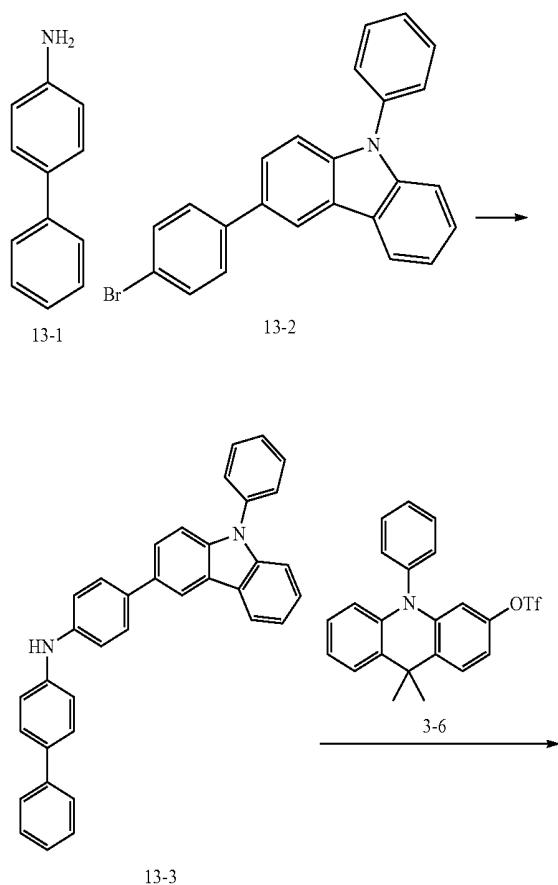
[0255] 6.7 g of Intermediate 3-4 was diluted in 100 mL of dichloromethane, and then 2.4 mL of tribromoborane was slowly added dropwise thereto. After 3 hours, a saturated sodium bicarbonate solvent was used to stop the reaction and the reaction solution was divided into layers. A separated organic layer was dried using anhydrous magnesium sulfate and concentrated under reduced pressure, and the residual was purified by silica gel column chromatography to obtain 5.3 g of Intermediate 3-5 (91%). LC/MS cal'd: 301.39 found: 301.42

[0256] (6) Synthesis of Intermediate 3-6

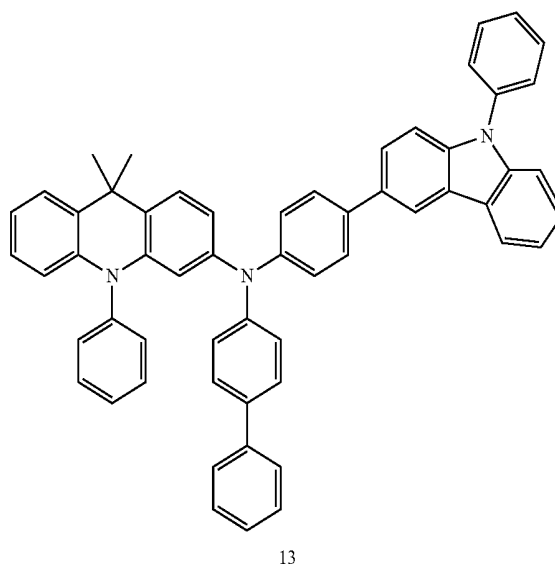
[0257] 6.5 g of Intermediate 3-6 (94%) was obtained in the same manner as used to synthesize Intermediate 3-1, except that 5.3 g of Intermediate 3-5 was used. LC/MS cal'd: 433.45 found: 433.47

[0258] (7) Synthesis of Intermediate 3

[0259] 3.6 g of Compound 3 (86%) was obtained in the same manner as used to synthesize Intermediate 3-2, except that 3 g of Intermediate 3-6 and 2.7 g of di([1,1'-biphenyl]-4-yl)amine were used.

[0260] Synthesis of Compound 13

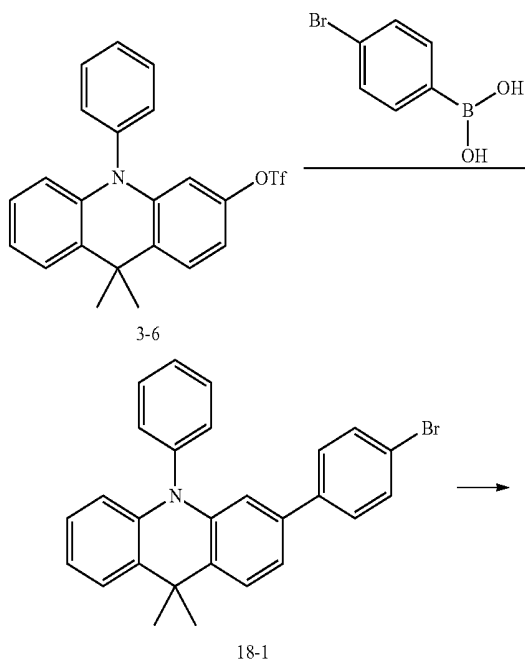
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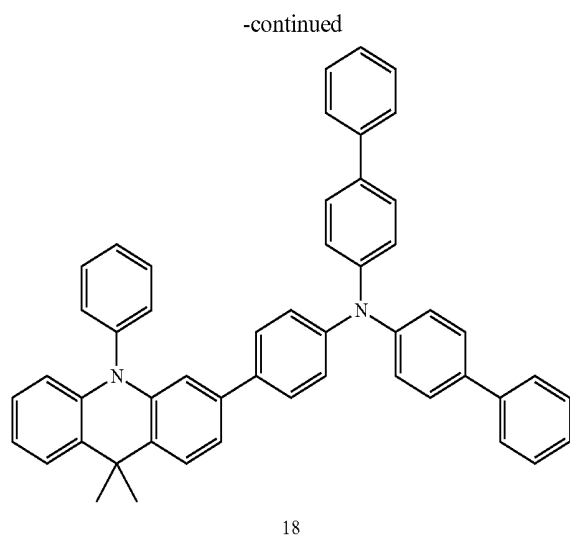
**[0261]** Synthesis of Intermediate 13-3

[0262] 14.9 g of Intermediate 13-3 (yield of 78%) was obtained in the same manner as used to synthesize Intermediate 3-2, except that 10 g of [1,1'-biphenyl]-4-amine (13-1) and 15.6 g of 3-(4-bromophenyl)-9-phenyl-9H-carbazole (13-2) were used. LC/MS cal'd: 486.21 found: 486.23

[0263] Synthesis of Compound 13

[0264] 4.4 g of Compound 13 (82%) was obtained in the same manner as used to synthesize Intermediate 3-2, except that 3 g of Intermediate 3-6 and 3.6 g of Intermediate 13-3 were used.

[0265] Synthesis of Compound 18



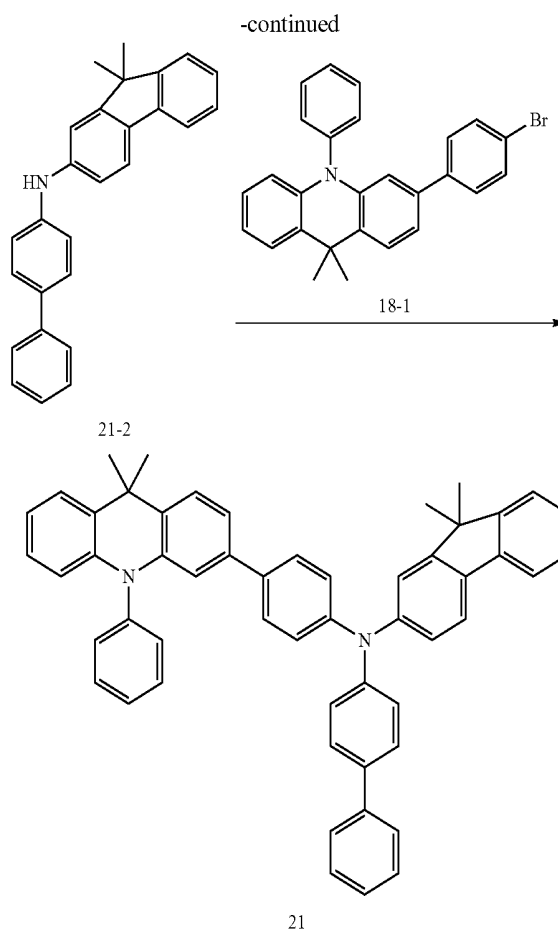
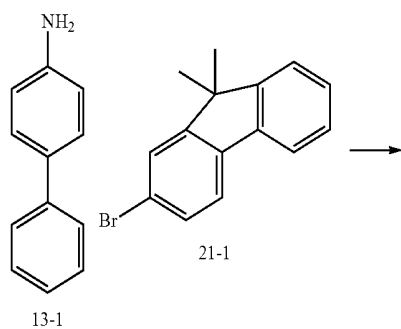
[0266] Synthesis of Intermediate 18-1

[0267] 5 g of Intermediate 3-6 and 2.3 g of 4-bromophenylboronic acid were diluted in 50 ml of tetrahydrofuran and 15 ml of water, and then 0.58 g of $\text{Pd}(\text{PPh}_3)_4$ and 4.8 g of K_2CO_3 were added thereto, and then the result was stirred at a temperature of 65° C. for 8 hours. The reaction product was quenched using water at room temperature, and then an extraction process was performed thereon three times using ethyl acetate. A separated organic layer was dried using anhydrous magnesium sulfate and concentrated under reduced pressure, and the result was purified by silica gel column chromatography to obtain Intermediate 18-1 (2.8 g, 56%). LC/MS cal'd: 439.09 found: 439.09

[0268] Synthesis of Compound 18

[0269] 3.2 g of Compound 18 (76%) was obtained in the same manner as used to synthesize Intermediate 3-2, except that 2.8 g of Intermediate 18-1 and 1.6 g of di([1,1'-biphenyl]-4-yl)amine were used.

[0270] Synthesis of Compound 21



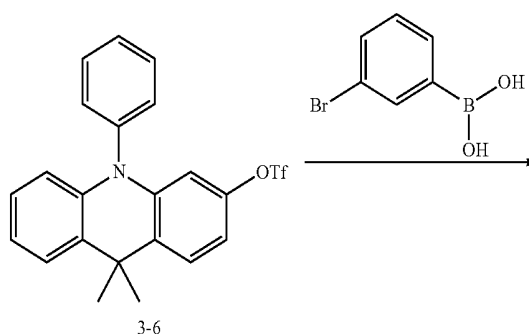
[0271] Synthesis of Intermediate 21-2

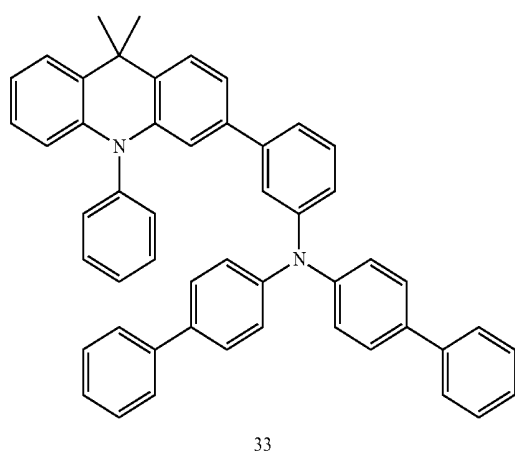
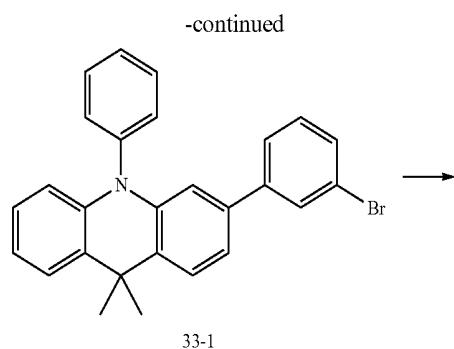
[0272] 9.4 g of Compound 21-2 (yield of 89%) was obtained in the same manner as used to synthesize Intermediate 3-2, except that 8 g of [1,1'-biphenyl]-4-amine (13-1) and 8 g of 2-bromo-9,9-dimethyl-9H-fluorene (21-1) were used. LC/MS cal'd: 361.49 found: 361.48

[0273] Synthesis of Compound 21

[0274] 3.9 g of Compound 21 (81%) was obtained in the same manner as used to synthesize Intermediate 3-2, except that 4 g of Intermediate 21-2 and 1.6 g of Intermediate 18-1 were used.

[0275] Synthesis of Compound 33





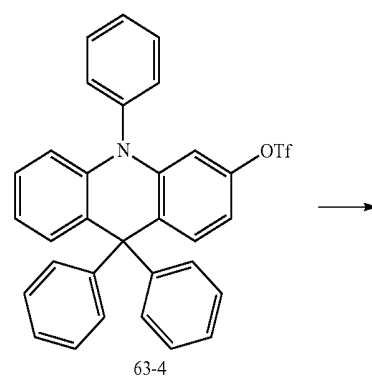
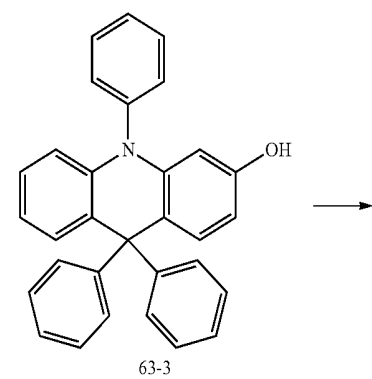
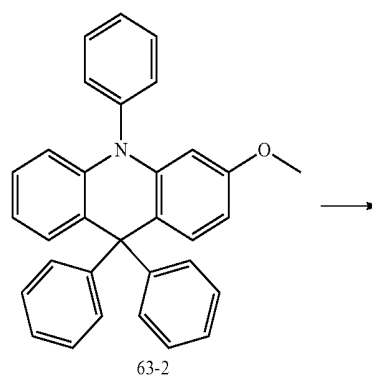
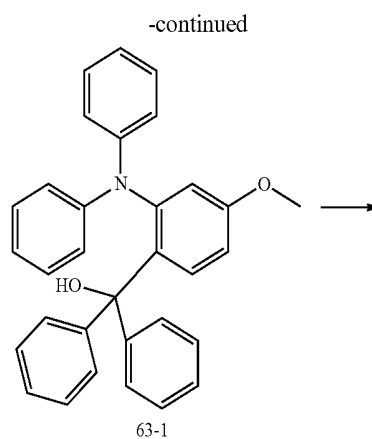
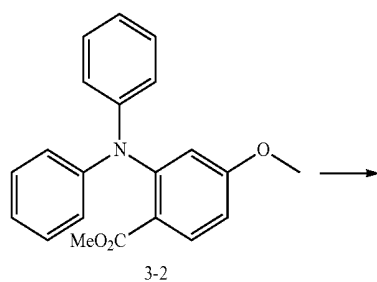
[0276] Synthesis of Intermediate 33-1

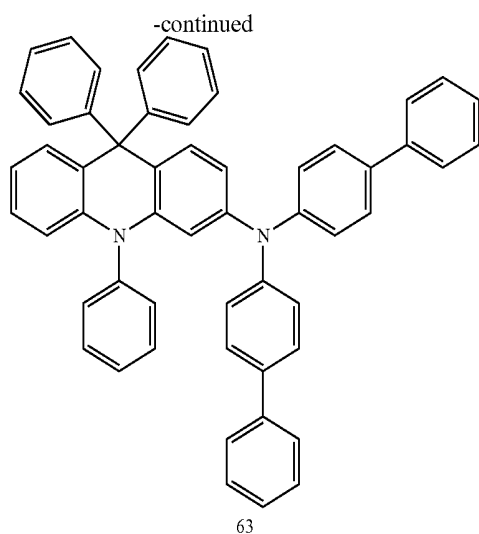
[0277] 2.5 g of Compound 33-1 (51%) was obtained in the same manner as used to synthesize Intermediate 18-1, except that 4.8 g of Intermediate 3-6 and 2.4 g of 3-bromophenylboronic acid were used. LC/MS cal'd: 439.09 found: 439.09

[0278] Synthesis of Compound 33

[0279] 3.0 g of Compound 33 (79%) was obtained in the same manner as used to synthesize Intermediate 3-2, except that 2.5 g of Intermediate 33-1 and 1.6 g of di([1,1'-biphenyl]-4-yl)amine were used.

[0280] Synthesis of Compound 63



**[0281]** Synthesis of Intermediate 63-1

[0282] 10 g of Intermediate 3-2 was diluted in 300 mL of tetrahydrofuran, and then at a temperature of 0° C., 62 mL of phenylmagnesiumbromide (1 M) was slowly added dropwise thereto. After 6 hours of mixing, the reaction was quenched using ammonium chloride, and then an extraction process was performed thereon three times using ethyl acetate. A separated organic layer was dried using anhydrous magnesium sulfate and concentrated under reduced pressure, and the result was purified by silica gel column chromatography to obtain 13 g of Intermediate 63-1 (96%). LC/MS cal'd: 457.20 found: 457.23

[0283] (2) Synthesis of Intermediate 63-2

[0284] 13 g of Intermediate 63-1 was diluted in 400 mL of dichloromethane, and then 0.82 mL of methanesulfonyl acid was slowly added dropwise thereto. 5 minutes after the addition, a reaction was quenched using triethylamine, and the residual obtained by reduced-pressure distillation was separation-purified by silica gel column chromatography to obtain 11 g of Intermediate 63-2 (89%). LC/MS cal'd: 439.19 found: 439.21

[0285] (3) Synthesis of Intermediate 63-3

[0286] 11 g of Intermediate 63-2 was diluted in 100 mL of dichloromethane, and then 2.4 mL of tribromoborane was slowly added dropwise thereto. After 3 hours, a saturated sodium bicarbonate solvent was used to stop the reaction and the reaction solution was divided into layers. An organic layer was dried using anhydrous magnesium sulfate and concentrated under reduced pressure, and the result was purified by silica gel column chromatography to obtain 9.1 g of Intermediate 63-3 (86%). LC/MS cal'd: 425.18 found: 425.19

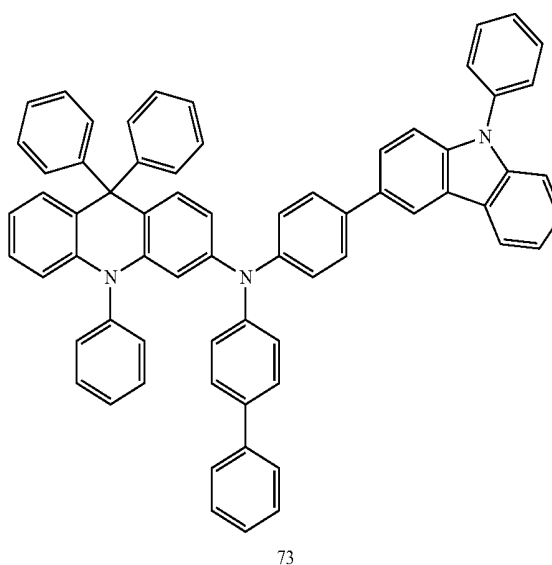
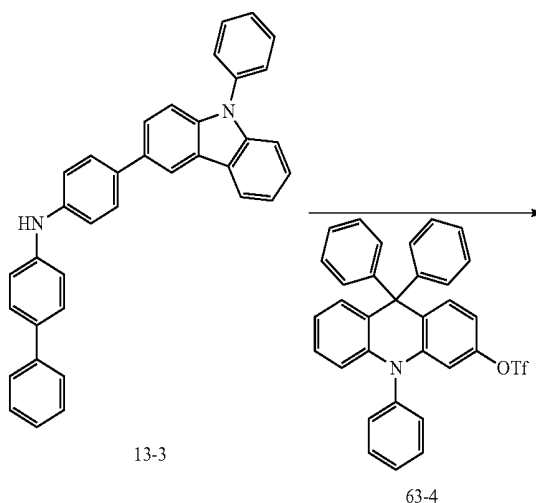
[0287] (4) Synthesis of Intermediate 63-4

[0288] 11.2 g of Intermediate 63-4 (94%) was obtained in the same manner as used to synthesize Intermediate 3-1, except that 9.1 g of Intermediate 63-3 was used. LC/MS cal'd: 557.13 found: 557.14

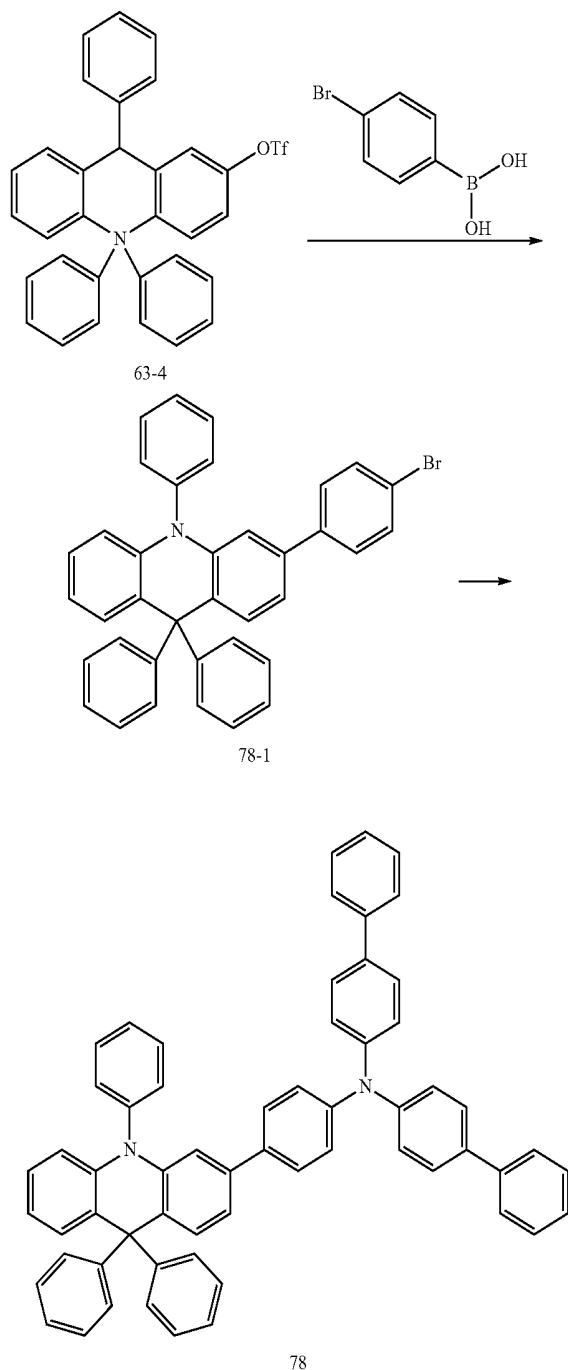
[0289] (5) Synthesis of Compound 63

[0290] 2.9 g of Compound 63 (75%) was obtained in the same manner as used to synthesize

[0291] Intermediate 3-2, except that 3 g of Intermediate 63-4 and 2 g of di([1,1'-biphenyl]-4-yl)amine were used.

[0292] Synthesis of Compound 73**[0293]** Synthesis of Compound 73

[0294] 4 g of Compound 73 (84%) was obtained in the same manner as used to synthesize Intermediate 3-2, except that 2.6 g of Intermediate 13-3 and 3 g of Intermediate 63-4 were used.

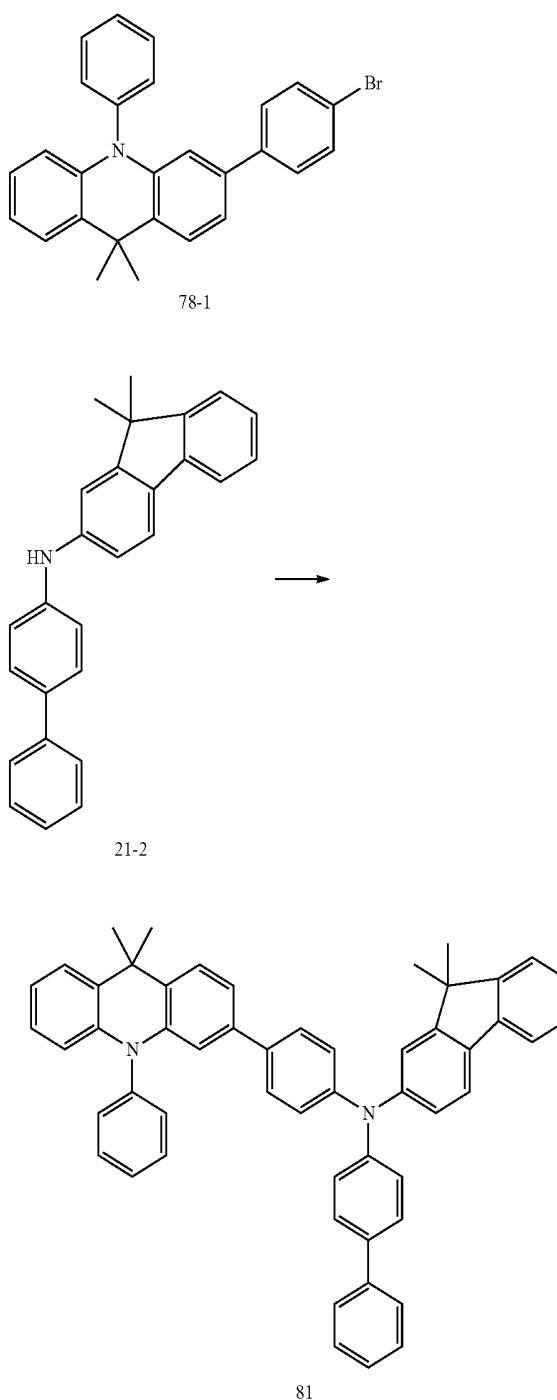
[0295] Synthesis of Compound 78**[0296]** Synthesis of Intermediate 78-1

[0297] 5.4 g of Intermediate 78-1 (54%) was obtained in the same manner as used to synthesize Intermediate 18-1, except that 10 g of Intermediate 63-4 was used. LC/MS cal'd: 563.12 found: 563.13

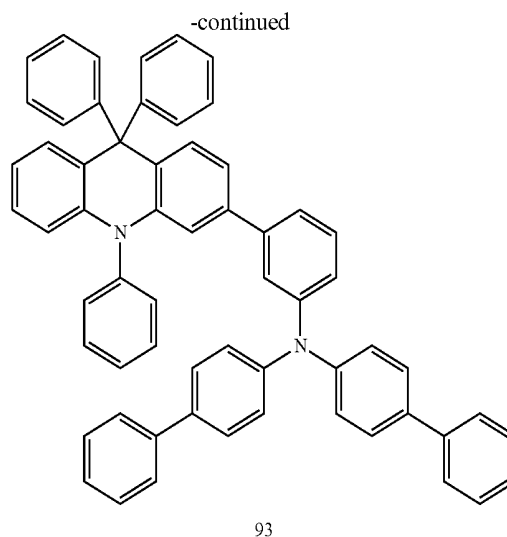
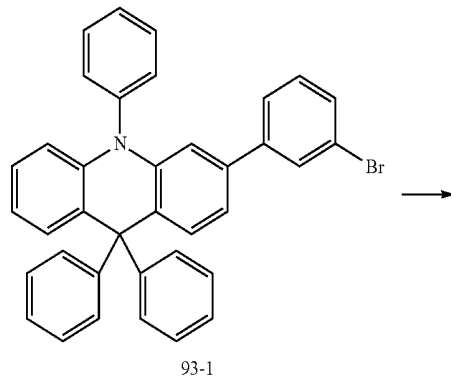
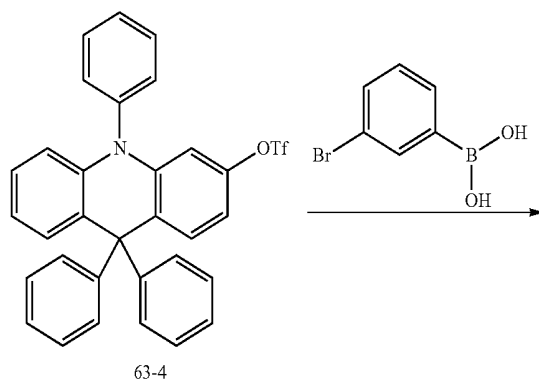
[0298] Synthesis of Compound 78

[0299] 2.9 g of Compound 3 (76%) was obtained in the same manner as used to synthesize

[0300] Intermediate 3-2, except that 2.7 g of Intermediate 78-1 and 2 g of di([1,1'-biphenyl]-4-yl)amine were used.

[0301] Synthesis of Compound 81**[0302]** Synthesis of Compound 81

[0303] 2.2 g of Compound 81 (88%) was obtained in the same manner as used to synthesize Intermediate 3-2, except that 2 g of Intermediate 21-2 and 3.1 g of Intermediate 78-1 were used.

[0304] Synthesis of Compound 93**[0305]** Synthesis of Intermediate 93-1

[0306] 5.1 g of Compound 93-1 (51%) was obtained in the same manner as used to synthesize Intermediate 78-1, except that 8 g of Intermediate 63-4 and 2.8 g of 3-bromophenylboronic acid were used. LC/MS cal'd: 563.12 found: 563.13

[0307] Synthesis of Compound 93

[0308] 3.8 g of Compound 93 (88%) was obtained in the same manner as used to synthesize Intermediate 3-2, except that 3 g of Intermediate 93-1 and 2 g of di([1,1'-biphenyl]-4-yl)amine were used.

[0309] NMR data of the synthesized compounds are shown in Table 1 below.

TABLE 1

Compound	¹ H NMR (CDCl ₃ , 400 MHz)	LC/MS	
		found	calc.
3	7.57-7.54(m, 4H), 7.48-7.42(m, 9H), 7.37(m, 2H), 7.22(m, 1H), 7.08-7.05(m, 2H), 6.99(d, 1H), 6.87-6.84(m, 2H), 6.64-6.59(m, 5H), 6.54(d, 1H), 6.37 (m, 2H), 6.27(dd, 1H), 1.77(m, 3H), 1.64(m, 3H)	433.47	433.45
13	8.23(d, 1H), 8.05(d, 1H), 7.74(d, 1H), 7.66(dd, 1H), 7.57-7.54(m, 4H), 7.50-7.19 (m, 15H), 7.11-7.07(m, 2H), 6.99-6.83(m, 3H), 6.65-6.54(m, 6H), 6.37(td, 2H), 6.27(dd, 1H), 1.77(m, 3H), 1.64(m, 3H)	769.36	769.35
18	7.60-7.55(m, 4H), 7.48-7.33(m, 13H), 7.15(dd, 1H), 7.08-6.99(m, 4H), 6.88-6.81(m, 6H), 6.62-6.58(m, 3H), 6.34-6.31(m, 2H), 1.77(m, 3H), 1.64(m, 3H)	680.33	680.32
21	7.76(td, 1H), 7.58-7.56(m, 2H), 7.47-7.30(m, 12H), 7.14-6.97(m, 6H), 6.87-6.83(m, 2H), 6.72-6.50(m, 6H), 6.42(dd, 1H), 6.33-6.31(m, 2H), 1.77(m, 3H), 1.64(m, 3H), 1.61(s, 6H)	720.38	720.35
33	7.58-7.56(m, 4H), 7.48-7.33(m, 12H), 7.23(qd, 1H), 7.13-6.94(m, 7H), 6.88-6.83(m, 2H), 6.64-6.57(m, 5H), 6.34-6.32(m, 2H), 6.24(qd, 1H), 1.77(m, 3H), 1.64(m, 3H)	680.88	680.89
63	7.59-7.56(m, 4H), 7.50-7.43(m, 8H), 7.40-7.34(m, 2H), 7.26-7.14(m, 6H), 7.11-7.05(m, 6H), 6.99(m, 1H), 6.84(m, 1H), 6.64-6.59(m, 5H), 6.46(m, 1H), 6.40-6.37(m, 3H), 6.24-6.22(m, 2H), 6.15(td, 1H)	723.33	728.32
73	8.24(d, 1H), 8.05(m, 1H), 7.75-7.65(m, 2H), 7.59-6.95(m, 31H), 6.84(dd, 1H), 6.67-6.59(m, 5H), 6.48-6.37(m, 3H), 6.24-6.12(m, 3H)	898.39	898.38
78	7.58-7.55(m, 4H), 7.49-7.33(m, 12H), 7.26-7.04(m, 12H), 6.97(dt, 1H), 6.90(dd, 1H), 6.85-6.81(m, 5H), 6.64-6.58(m, 4H), 6.46(dd, 1H), 6.33-6.30(m, 2H), 6.15-6.12(td, 1H), 6.03(dd, 1H)	804.36	804.35
81	7.77(dd, 1H), 7.58-7.56(m, 2H), 7.48-7.30(m, 10H), 7.26-7.06(m, 14H), 6.99(td, 1H), 6.90(dd, 1H), 6.83-6.72(m, 2H), 6.62-6.30(m, 9H), 6.15-6.01(m, 2H), 1.62(s, 6H)	844.40	844.38
93	7.58-7.55(m, 4H), 7.48-7.34(m, 12H), 7.21-6.95(m, 15H), 6.85(dd, 1H), 6.64-6.55(m, 5H), 6.45-6.30(m, 4H), 6.25-6.10(m, 3H)	804.34	804.35

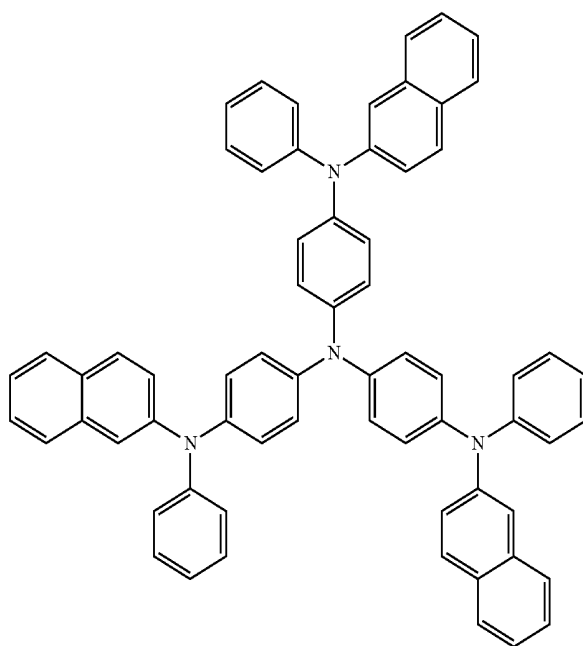
EXAMPLE

Comparative Example 1

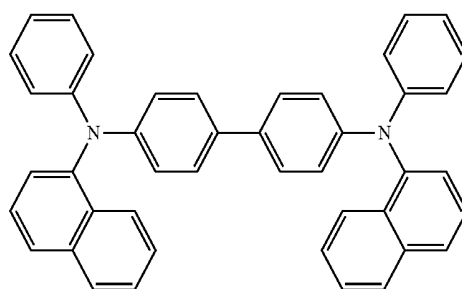
[0310] An anode was prepared by cutting a Corning 15 Ωcm^2 (1200 Å) ITO glass substrate to a size of 50 mm×50 mm×0.7 mm, ultrasonically cleaning the glass substrate by using isopropyl alcohol and pure water for 5 minutes each, and then irradiating UV light for 30 minutes thereto and exposing to ozone to clean. Then, the anode was loaded into a vacuum deposition apparatus.

[0311] Then, 2-TNATA was vacuum deposited on thereon to form a hole injection layer having a thickness of 600 Å, and then 4,4'-bis[N-(1-naphthyl)-N-phenylamino]biphenyl (NPB), which is a known hole transport compound, was deposited on the hole injection layer to form a hole transport layer having a thickness of 300 Å.

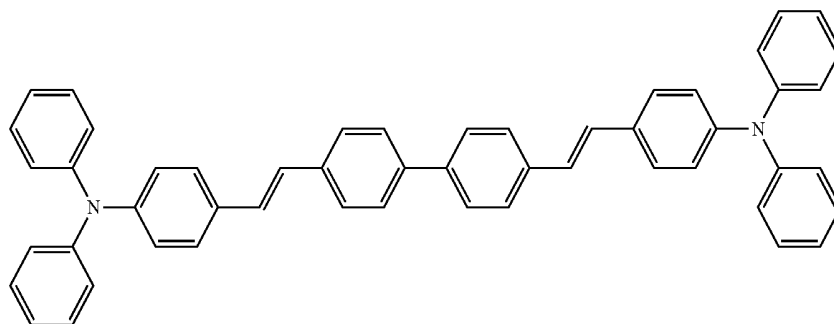
[0312] 9,10-di(naphthalen-2-yl)anthracene (DNA), which is a known blue fluorescent host, and 4,4'-bis[2-(4-(N,N-diphenylamino)phenyl)vinyl]biphenyl (BDAVB), which is a known blue fluorescent dopant, were co-deposited on the hole transport layer at a weight ratio of 98:2 to form an emission layer having a thickness of 300 Å to form an emission layer.



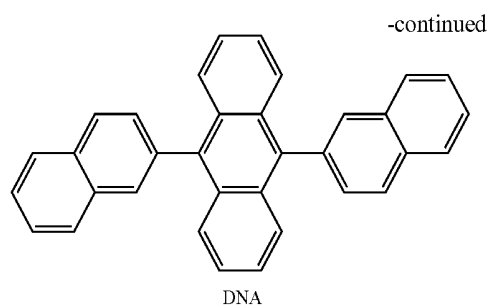
2-TNATA



NPB



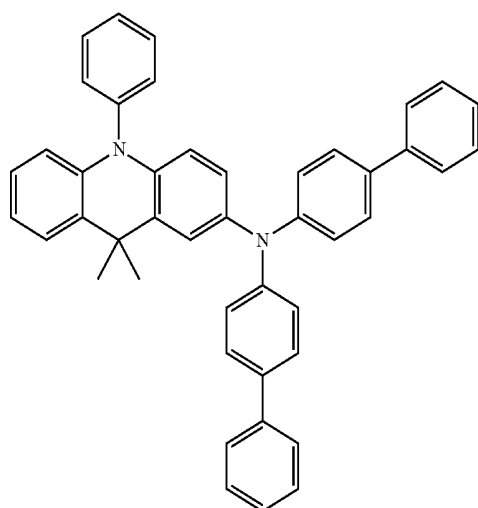
BDAVB



[0313] Then, Alg_3 was deposited on the emission layer to form an electron transport layer having a thickness of 300 Å, and then LiF, which is a halogenated alkali metal, was deposited on the electron transport layer to form an electron injection layer having a thickness of 10 Å, and Al was vacuum deposited thereon to a thickness of 3000 Å (cathode), thereby forming an LiF/Al electrode, thereby completing the manufacturing of an organic light-emitting device.

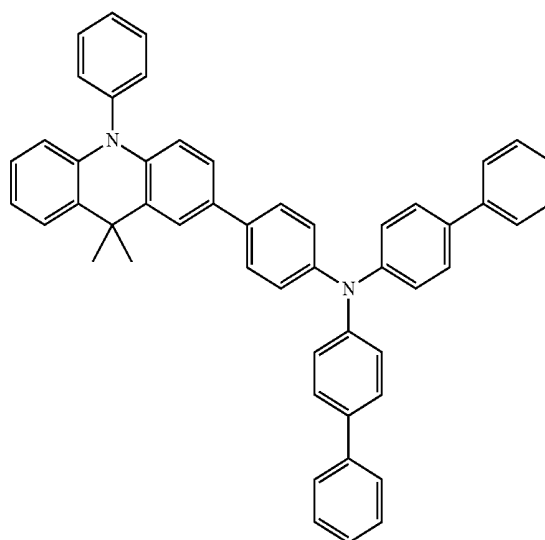
Comparative Example 2

[0314] An organic light-emitting device was manufactured in the same manner as in Example 1, except that in forming the hole transport layer, Compound A was used instead of NPB.



Comparative Example 3

[0315] An organic light-emitting device was manufactured in the same manner as in Example 1, except that in forming the hole transport layer, Compound B was used instead of NPB.



Example 1

[0316] An organic light-emitting device was manufactured in the same manner as in Comparative Example 1, except that in forming the hole transport layer, Compound 3 was used instead of NPB.

Example 2

[0317] An organic light-emitting device was manufactured in the same manner as in Comparative Example 1, except that in forming the hole transport layer, Compound 13 was used instead of NPB.

Example 3

[0318] An organic light-emitting device was manufactured in the same manner as in Comparative Example 1, except that in forming the hole transport layer, Compound 18 was used instead of NPB.

Examples 4 to 10

[0319] Organic light-emitting devices were manufactured in the same manner as in Comparative Example 1, except that in forming the hole transport layer, compounds shown in Table 2 below were used instead of NPB.

[0320] Compounds represented by Formula 1 according to embodiments were used as a material for a hole transport

layer. Compared with the compounds used in Comparative Examples, the compounds according to embodiments provided excellent I-V-L characteristics, such as low driving voltage and high efficiency, and in particular, high lifespan improvement effects, leading to substantially prolonged lifespan. Representative characteristics and lifespan results were summarized and results thereof are shown in Table 2 below.

TABLE 2

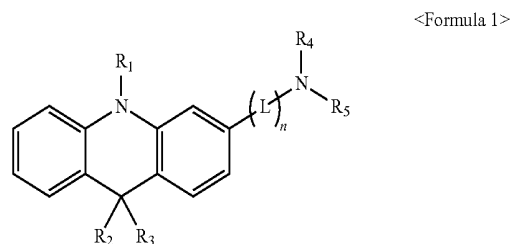
	Hole transport material	Driving voltage (V)	Current density (mA/cm ²)	Brightness (cd/m ²)	Efficiency (cd/A)	Emission color	Half lifespan (hr @ 100 mA/cm ²)
Comparative Example 1	NPB	7.01	50	2645	5.29	Blue	258
Comparative Example 2	A	6.75	50	2700	5.40	Blue	274
Comparative Example 3	B	6.43	50	2760	5.52	Blue	286
Example 1	Compound 3	5.34	50	3320	6.64	Blue	348
Example 2	Compound 13	5.20	50	3410	6.82	Blue	362
Example 3	Compound 18	5.40	50	3485	6.97	Blue	378
Example 4	Compound 21	5.28	50	3470	6.94	Blue	376
Example 5	Compound 33	5.43	50	3490	6.98	Blue	364
Example 6	Compound 63	5.67	50	3335	6.67	Blue	391
Example 7	Compound 73	5.72	50	3325	6.65	Blue	389
Example 8	Compound 78	5.68	50	3235	6.47	Blue	390
Example 9	Compound 81	5.70	50	3290	6.58	Blue	392
Example 10	Compound 93	5.72	50	3215	6.43	Blue	393

[0321] An organic light-emitting device including the compound according to an embodiment may have a low driving voltage, high efficiency, high brightness, and long lifespan.

[0322] 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 compound represented by Formula 1 below:



wherein in Formula 1,

R₁ to R₅ 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 or a salt thereof, a sulfonic acid or a salt thereof, a phosphoric acid or a salt thereof, a substituted or unsubstituted C₁-C₆₀ alkyl group, a substituted or unsubstituted C₂-C₆₀ alkenyl group, a substituted or unsubstituted C₂-C₆₀ alkynyl group, a substituted or unsubstituted C₁-C₆₀ alkoxy group, a substituted or unsubstituted C₃-C₁₀ cycloalkyl group, a substituted or

unsubstituted C₂-C₁₀ heterocycloalkyl group, a substituted or unsubstituted C₃-C₁₀ cycloalkenyl group, a substituted or unsubstituted C₂-C₁₀ heterocycloalkenyl group, a substituted or unsubstituted C₆-C₆₀ aryl group, a substituted or unsubstituted C₆-C₆₀ aryloxy group, a substituted or unsubstituted C₆-C₆₀ arylthio group, a substituted or unsubstituted C₁-C₆₀ heteroaryl group, a substituted or unsubstituted monovalent non-aromatic condensed polycyclic group, a substituted or unsubstituted monovalent non-aromatic condensed heteropolycyclic group, —N(Q₁)(Q₂), —Si(Q₃)(Q₄)(Q₅), and —B(Q₆)(Q₇);

L is selected from a bond, a substituted or unsubstituted C₃-C₁₀ cycloalkylene group, a substituted or unsubstituted C₂-C₁₀ heterocycloalkylene group, a substituted or unsubstituted C₃-C₁₀ cycloalkenylene group, a substituted or unsubstituted C₂-C₁₀ heterocycloalkenylene group, a substituted or unsubstituted C₆-C₆₀ arylene group, a substituted or unsubstituted C₁-C₆₀ heteroarylene group, a substituted or unsubstituted divalent non-aromatic condensed polycyclic group, and a substituted or unsubstituted divalent non-aromatic condensed heteropolycyclic group;

n is an integer selected from 1, 2, and 3, and when n is 2 or more, a plurality of L are identical or different;

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

substituted C₆-C₆₀ arylene group, substituted C₆-C₆₀ aryloxy group, substituted C₆-C₆₀ arylthio group, substituted C₁-C₆₀ heteroaryl group, substituted C₁-C₆₀ heteroarylene group, substituted monovalent non-aromatic condensed polycyclic group, substituted monovalent non-aromatic condensed heteropolycyclic group, substituted divalent non-aromatic condensed polycyclic group, and substituted divalent non-aromatic condensed heteropolycyclic group is 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 C₁-C₆₀ alkyl group, a C₂-C₆₀ alkenyl group, a C₂-C₆₀ alkynyl group, and a C₁-C₆₀ alkoxy group;

a C₁-C₆₀ alkyl group, a C₂-C₆₀ alkenyl group, a C₂-C₆₀ alkynyl group, and a C₁-C₆₀ alkoxy group, each substituted with at least one selected from 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 C₃-C₁₀ cycloalkyl group, a C₂-C₁₀ heterocycloalkyl group, a C₃-C₁₀ cycloalkenyl group, a C₂-C₁₀ heterocycloalkenyl group, a C₆-C₆₀ aryl group, a C₆-C₆₀ aryloxy group, a C₆-C₆₀ arylthio group, a C₁-C₆₀ heteroaryl group, a monovalent non-aromatic condensed polycyclic group, a monovalent non-aromatic condensed heteropolycyclic group, —N(Q₁₁)(Q₁₂), —Si(Q₁₃)(Q₁₄)(Q₁₅), and —B(Q₁₆)(Q₁₇);

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

a C₃-C₁₀ cycloalkyl group, a C₂-C₁₀ heterocycloalkyl group, a C₃-C₁₀ cycloalkenyl group, a C₂-C₁₀ heterocycloalkenyl group, a C₆-C₆₀ aryl group, a C₆-C₆₀ aryloxy group, a C₆-C₆₀ arylthio group, a C₂-C₆₀ heteroaryl group, a monovalent non-aromatic condensed polycyclic group, and a monovalent non-aromatic condensed heteropolycyclic group, each substituted with at least one selected from 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 C₁-C₆₀ alkyl group, a C₂-C₆₀ alkenyl group, a C₁-C₆₀ alkynyl group, a C₁-C₆₀ alkoxy group, a C₃-C₁₀ cycloalkyl group, a C₂-C₁₀ heterocycloalkyl group, a C₃-C₁₀ cycloalkenyl group, a C₂-C₁₀ heterocycloalkenyl group, a C₆-C₆₀ aryl group, a C₆-C₆₀ aryloxy group, a C₆-C₆₀ arylthio group, a C₁-C₆₀ heteroaryl group, a monovalent non-aromatic condensed polycyclic group, a monovalent non-aromatic condensed heteropolycyclic group, —N(Q₂₁)(Q₂₂), —Si(Q₂₃)(Q₂₄)(Q₂₅) and —B(Q₂₆)(Q₂₇); and

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

wherein Q₁ to Q₇, Q₁₁ to Q₁₇, Q₂₁ to Q₂₇, and Q₃₁ to Q₃₇ are each independently selected from a hydrogen, a deute-

rium, —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 C₁-C₆₀ alkyl group, a C₂-C₆₀ alkenyl group, a C₂-C₆₀ alkynyl group, a C₁-C₆₀ alkoxy group, a C₃-C₁₀ cycloalkyl group, a C₂-C₁₀ heterocycloalkyl group, a C₃-C₁₀ cycloalkenyl group, a C₂-C₁₀ heterocycloalkenyl group, a C₆-C₆₀ aryl group, a C₁-C₆₀ heteroaryl group, a monovalent non-aromatic condensed polycyclic group, and a monovalent non-aromatic condensed heteropolycyclic group.

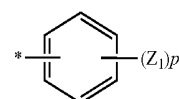
2. The compound as claimed in claim 1, wherein two or more adjacent substituents selected from R₁ to R₅ in Formula 1 are linked to each other to form a ring.

3. The compound as claimed in claim 1, wherein R₁ to R₅ in Formula 1 are each independently selected from a substituted or unsubstituted C₁-C₆₀ alkyl group, a substituted or unsubstituted C₆-C₆₀ aryl group, and a substituted or unsubstituted C₁-C₆₀ heteroaryl group.

4. The compound as claimed in claim 1, wherein L in Formula 1 is a bond, a substituted or unsubstituted C₆-C₆₀ arylene group, or a substituted or unsubstituted C₁-C₆₀ heteroarylene group.

5. The compound as claimed in claim 1, wherein n in Formula 1 is 1

6. The compound as claimed in claim 1, wherein R₁ in Formula 1 is Formula 2a:



2a

Z₁ in Formula 2a is 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 or a salt thereof, a sulfonic acid or a salt thereof, a phosphoric acid or a salt thereof, a substituted or unsubstituted C₁ to C₂₀ alkyl group, a substituted or unsubstituted C₆ to C₂₀ aryl group, a substituted or unsubstituted C₁ to C₂₀ heteroaryl group, a substituted or unsubstituted monovalent non-aromatic condensed polycyclic group, and a substituted or unsubstituted monovalent non-aromatic condensed heteropolycyclic group;

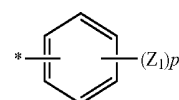
p is an integer of 1 to 5; and

when p is 2 or more, a plurality of Z₁ are identical or different; and

* indicates a binding site.

7. The compound as claimed in claim 1, wherein

R₂ and R₃ in Formula 1 are each independently Formulae 3a or 3b below:



3a

-continued

*—CH₃

3b

wherein in Formula 3a, Z₁ is 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 or a salt thereof, a sulfonic acid or a salt thereof, a phosphoric acid or a salt thereof, a substituted or unsubstituted C₁ to C₂₀ alkyl group, a substituted or unsubstituted C₆ to C₂₀ aryl group, a substituted or unsubstituted C₁ to C₂₀ heteroaryl group, a substituted or unsubstituted monovalent non-aromatic condensed polycyclic group, and a substituted or unsubstituted monovalent non-aromatic condensed heteropolycyclic group;

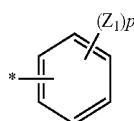
p is an integer of 1 to 5; and

when p is 2 or more, a plurality of Z₁ are identical or different; and

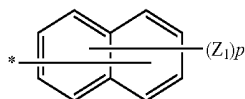
* indicates a binding site.

8. The compound as claimed in claim 1, wherein

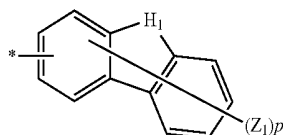
R₄ and R₅ in Formula 1 are each independently one of Formulae 4a to 4c below:



4a



4b



4c

wherein in Formulae 4a to 4c,

H₁ is CR₂₁R₂₂ or NR₂₃;

R₂₁, R₂₂, R₂₃, and Z₁ 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 or a salt thereof, a sulfonic acid or a salt thereof, a phosphoric acid or a salt thereof, a substituted or unsubstituted C₁-C₂₀ alkyl group, a substituted or unsubstituted C₆-C₂₀ aryl group, a substituted or unsubstituted C₁-C₂₀ heteroaryl group, a substituted or unsubstituted monovalent non-aromatic condensed polycyclic group, a substituted or unsubstituted monovalent non-aromatic condensed heteropolycyclic group, and —Si(Q₃)(Q₄)(Q₅);

Q₃ to Q₅ 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 or a salt thereof, a sulfonic acid or a salt thereof, a phosphoric acid or a salt thereof, a C₁-C₆₀ alkyl group,

a C₂-C₆₀ alkenyl group, a C₂-C₆₀ alkynyl group, a C₁-C₆₀ alkoxy group, a C₃-C₁₀ cycloalkyl group, a C₂-C₁₀ heterocycloalkyl group, a C₃-C₁₀ cycloalkenyl group, a C₂-C₁₀ heterocycloalkenyl group, a C₆-C₆₀ aryl group, a C₁-C₆₀ heteroaryl group, a monovalent non-aromatic condensed polycyclic group, and a monovalent non-aromatic condensed heteropolycyclic group;

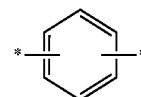
p is an integer of 1 to 7,

when p is 2 or more, a plurality of Z₁ are identical or different; and

* indicates a binding site to a neighboring atom.

9. The compound as claimed in claim 1, wherein

L in Formula 1 is a bond or Formula 5a:

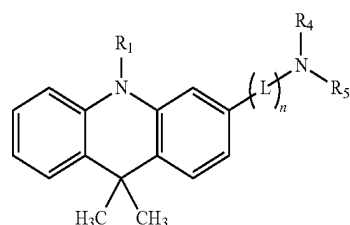


5a

* in Formula 5a indicates a binding site to a neighboring atom.

10. The compound as claimed in claim 1, wherein

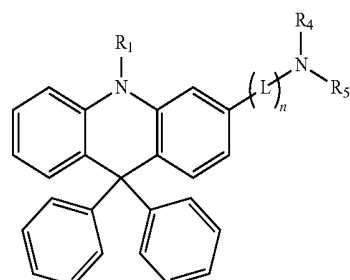
the compound represented by Formula 1 is a compound represented by Formula 2:



<Formula 2>

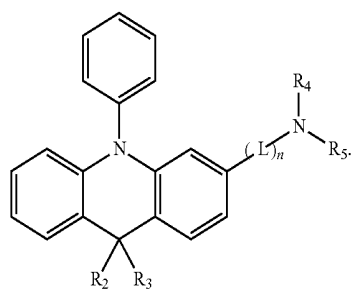
11. The compound as claimed in claim 1, wherein

the compound represented by Formula 1 is a compound represented by Formula 3 below:

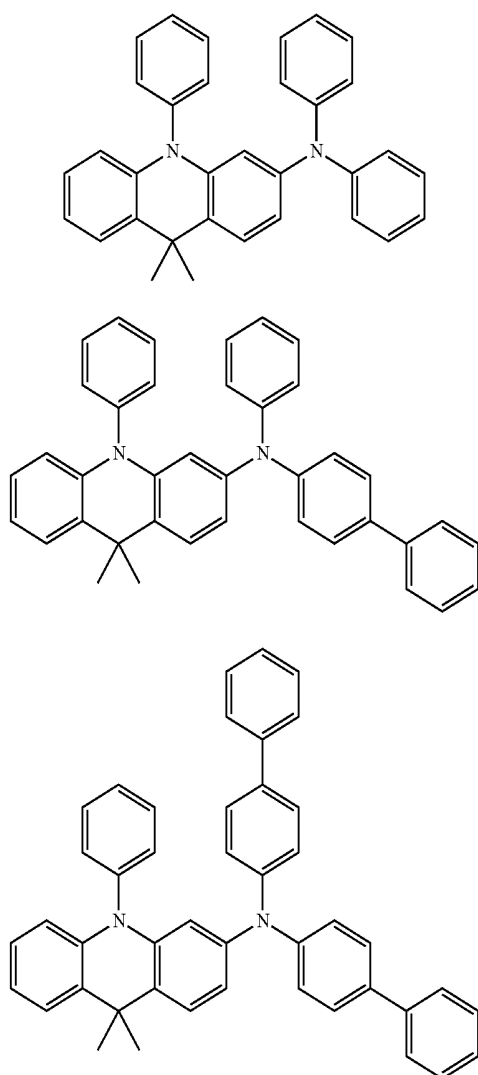


<Formula 3>

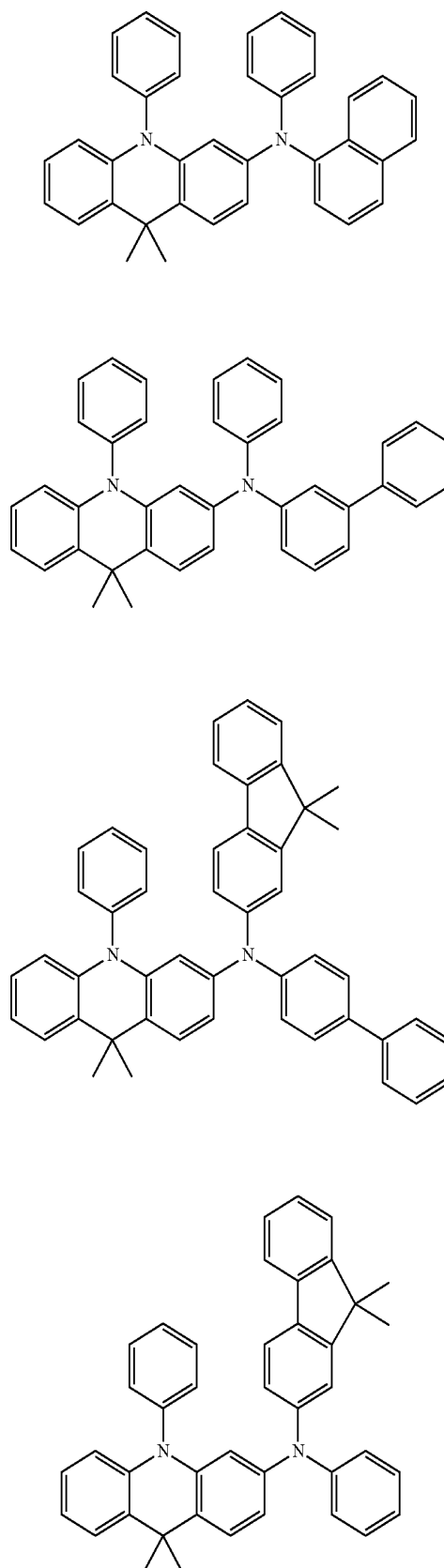
12. The compound as claimed in claim 1, wherein the compound represented by Formula 1 is a compound represented by Formula 4 below:



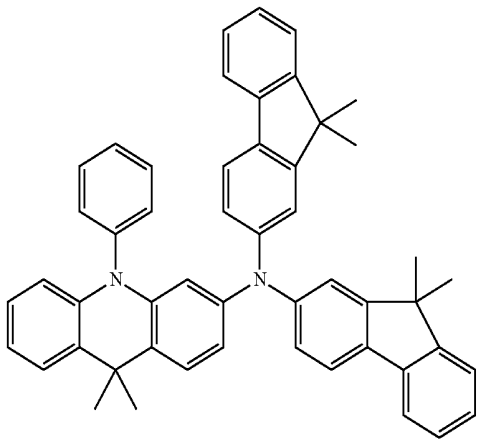
13. The compound as claimed in claim 1, wherein the compound of Formula 1 is any one of compounds below:



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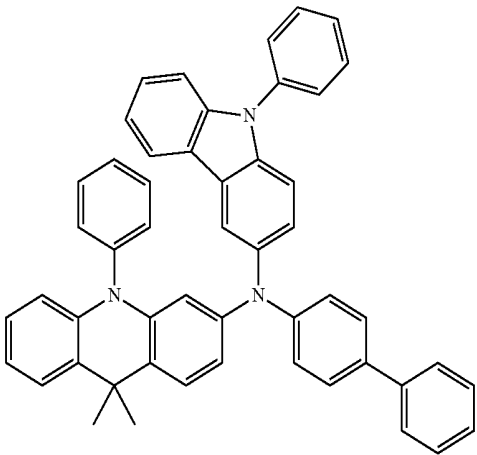


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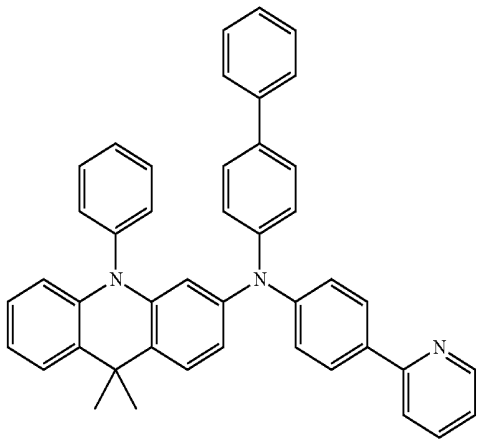
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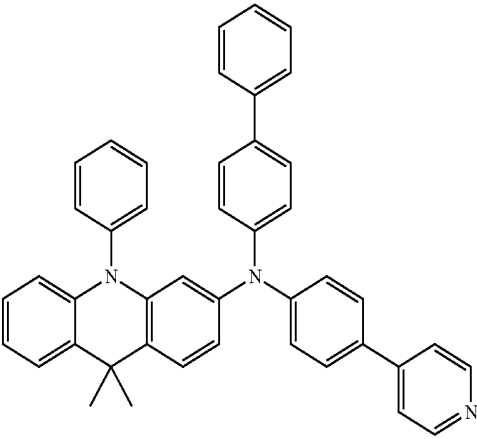


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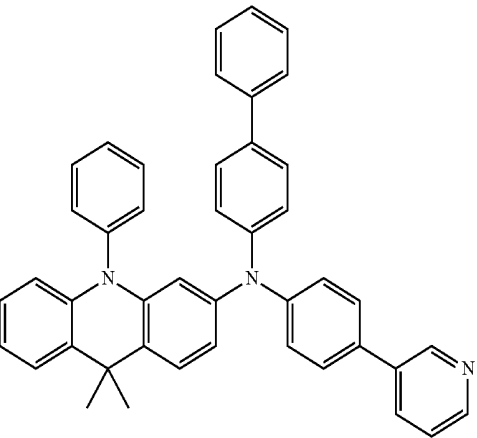
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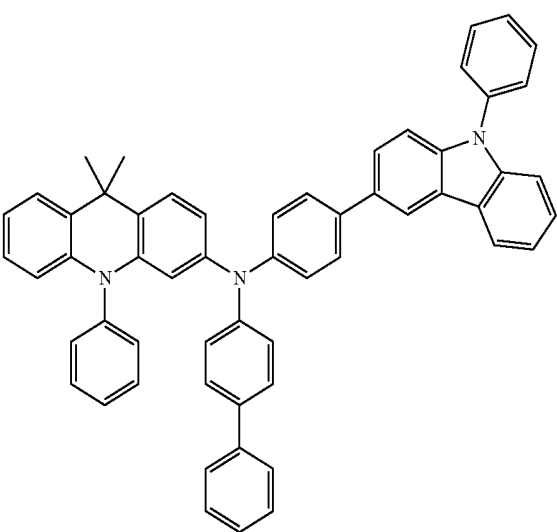
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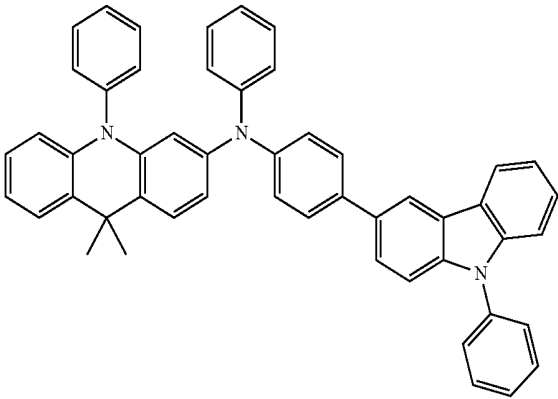


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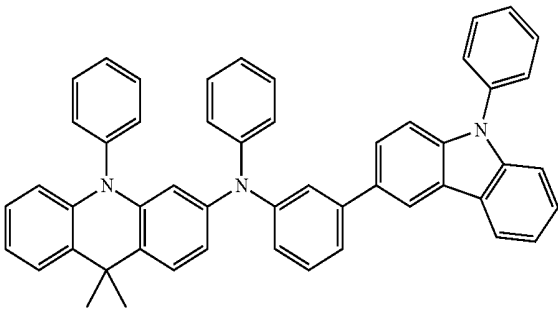


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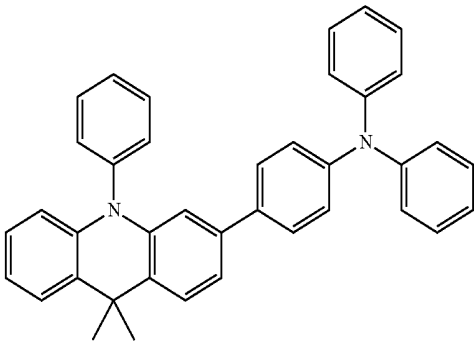
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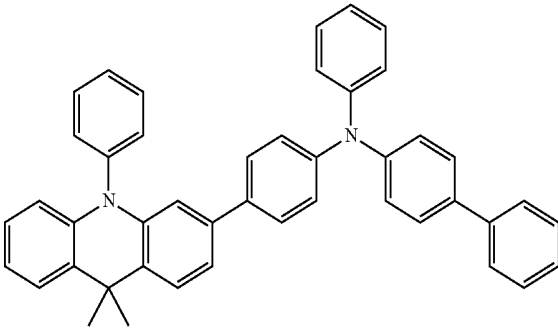
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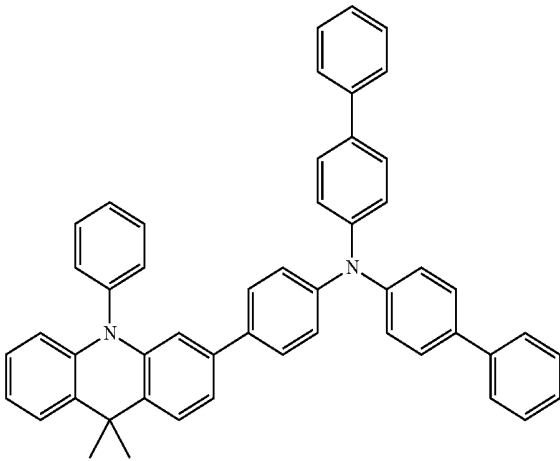


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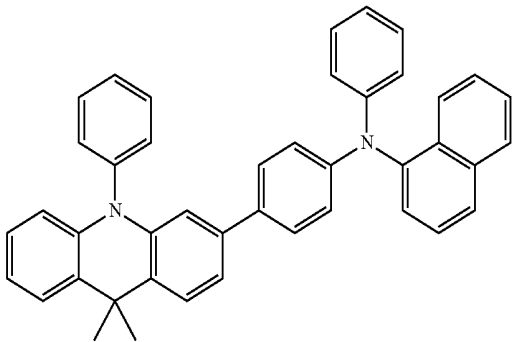


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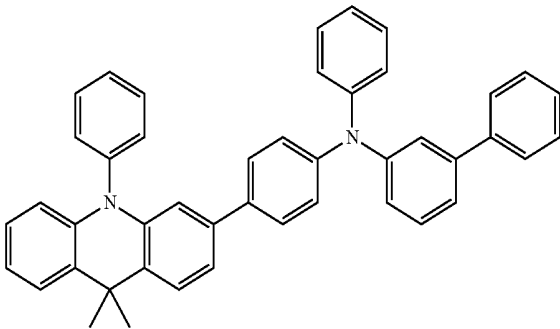
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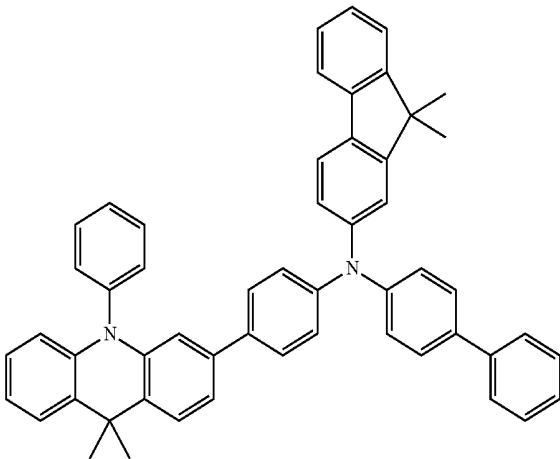
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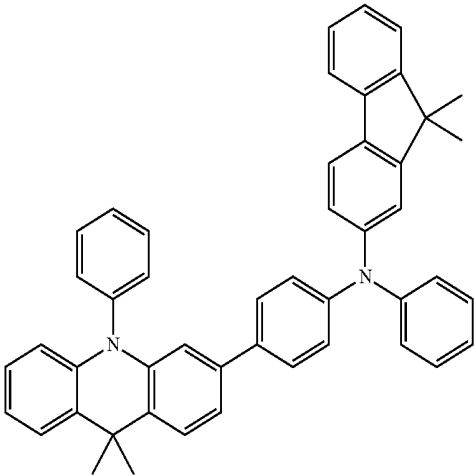


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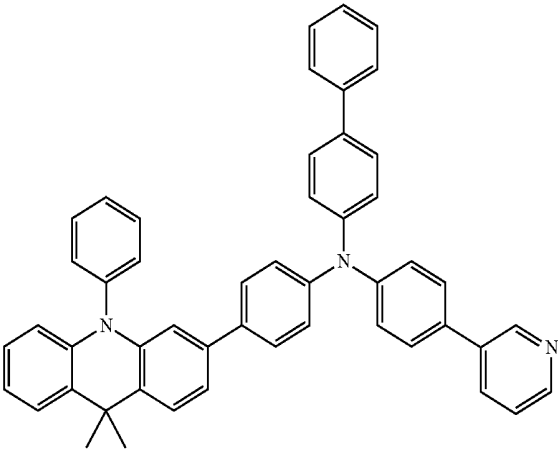
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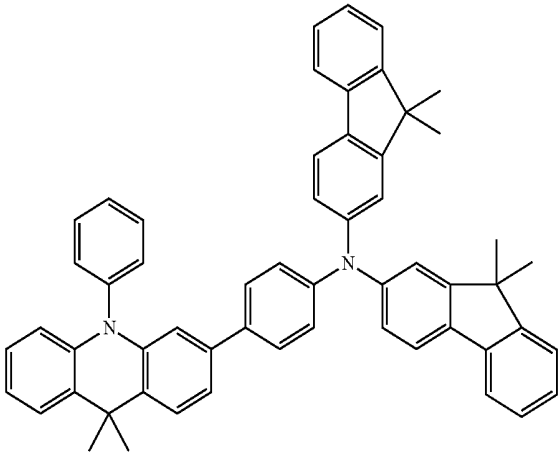


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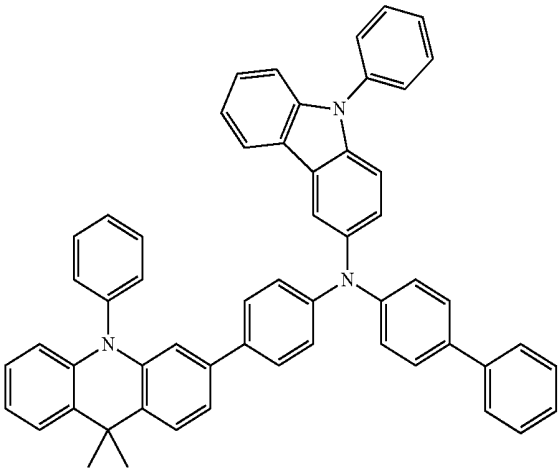
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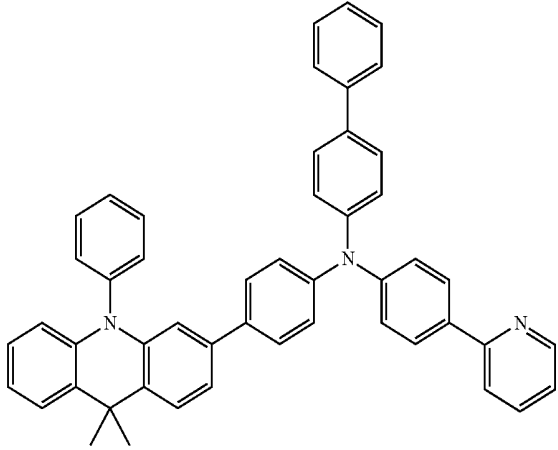
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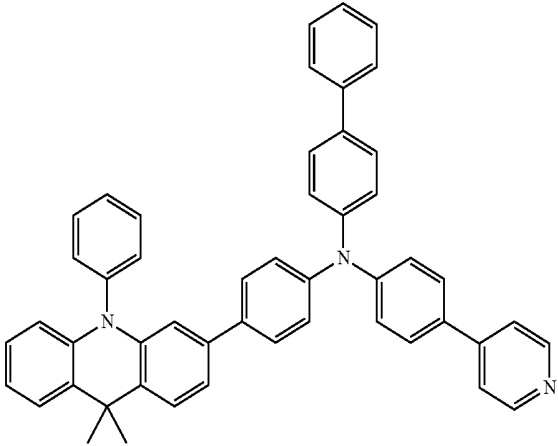
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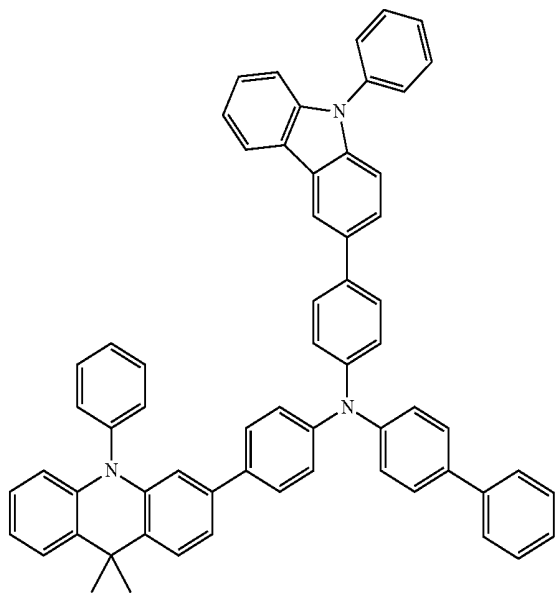


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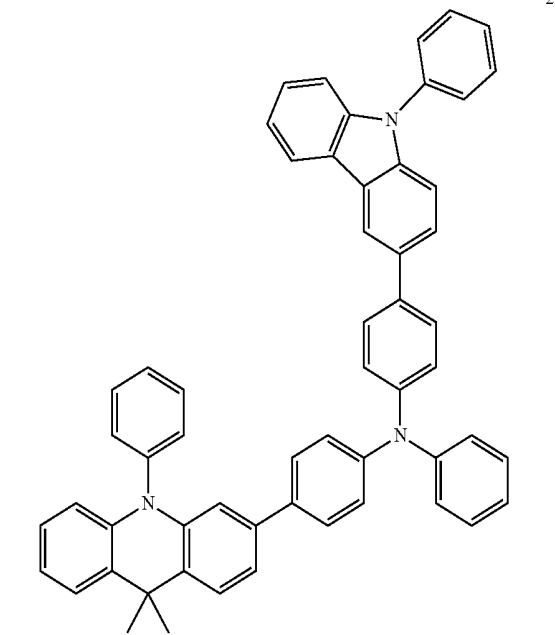


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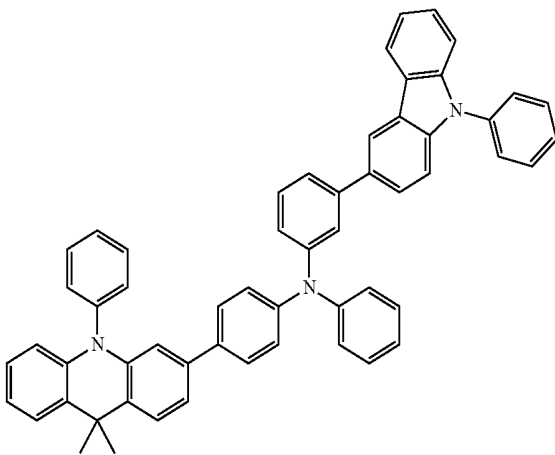
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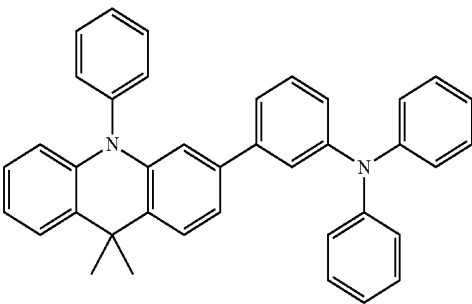


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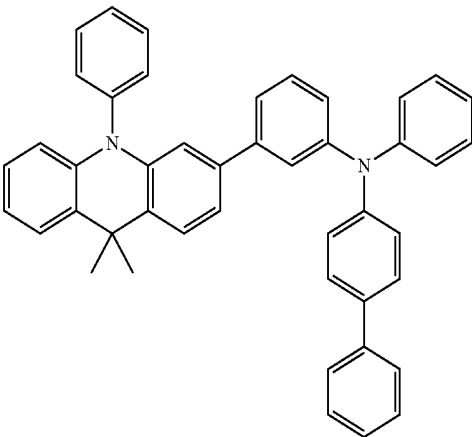


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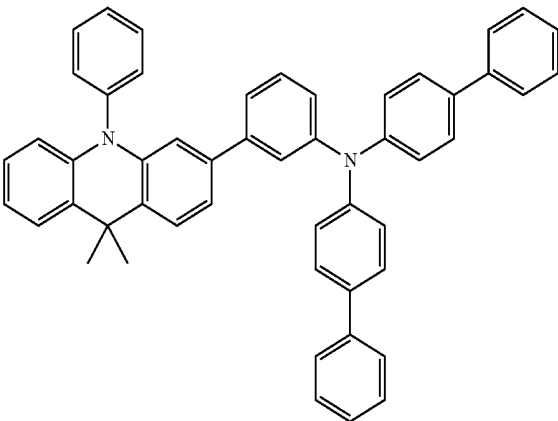
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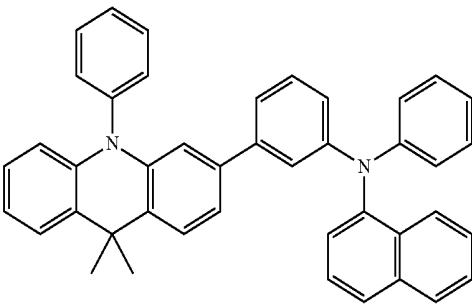
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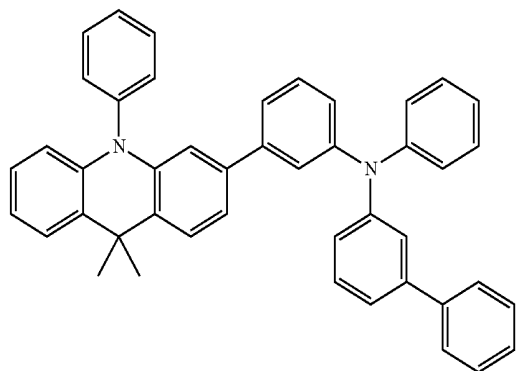


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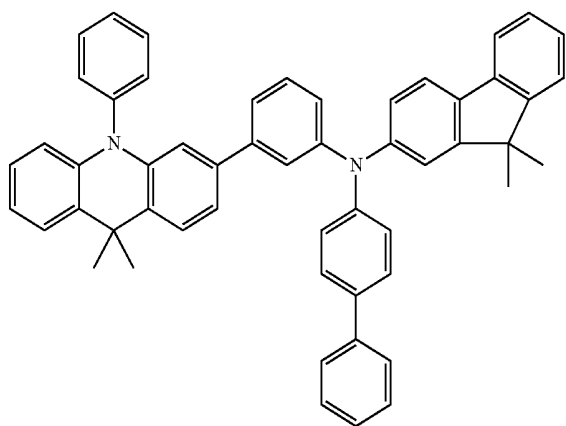


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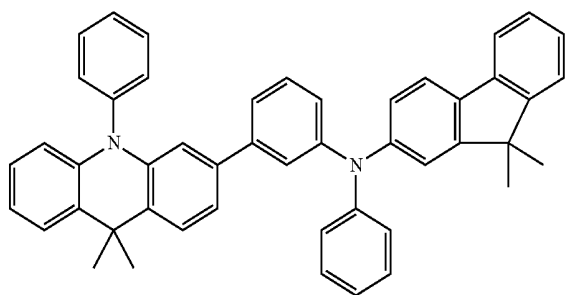
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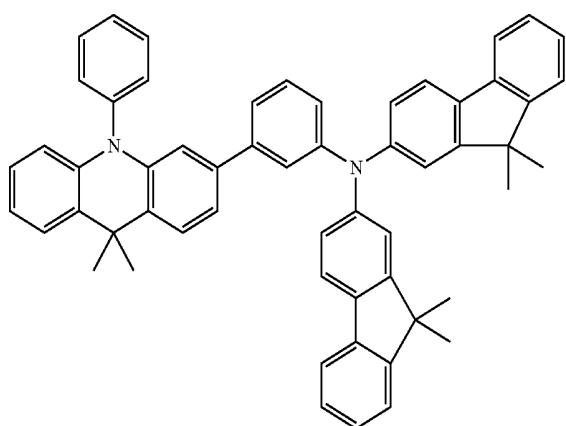
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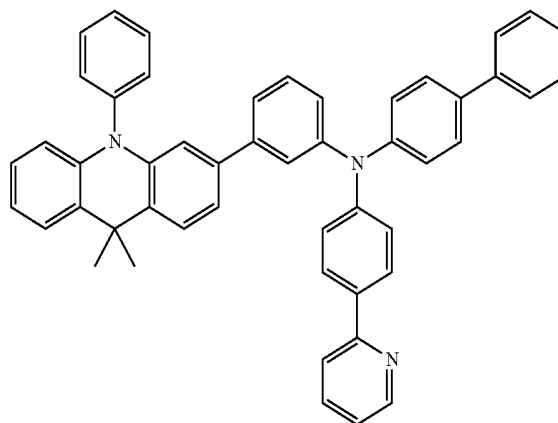


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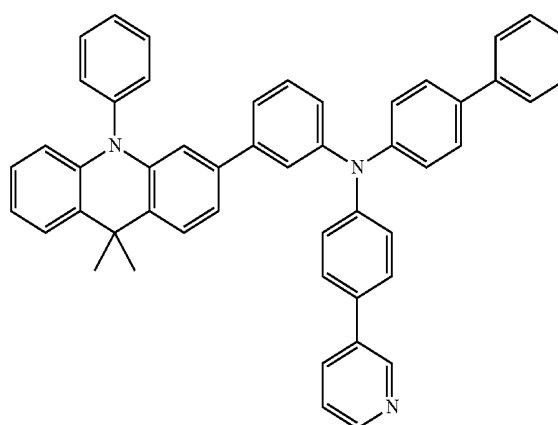


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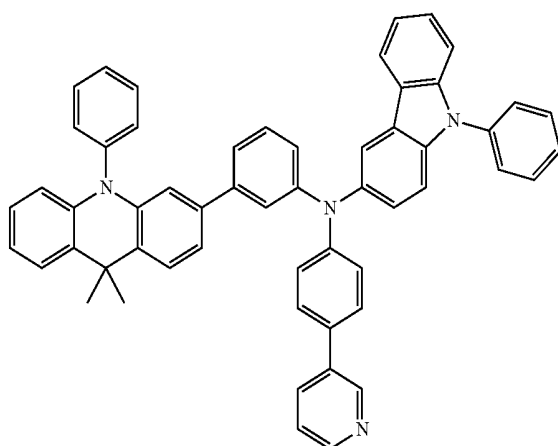
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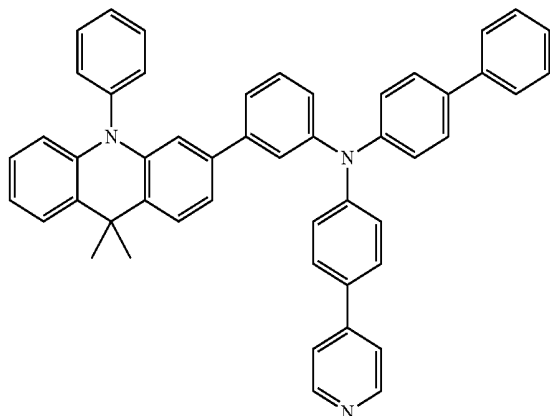


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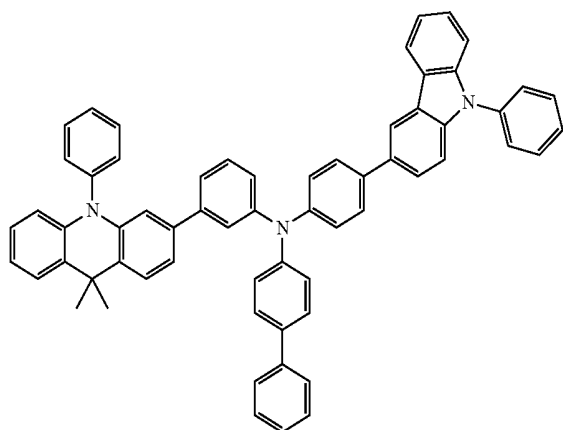


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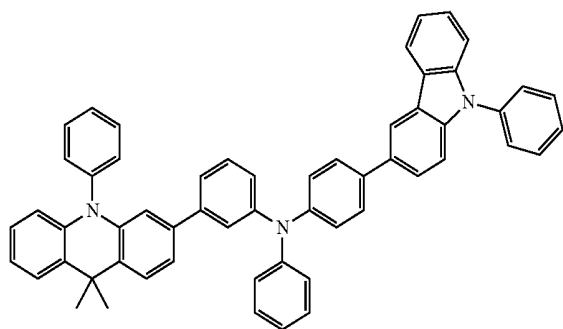
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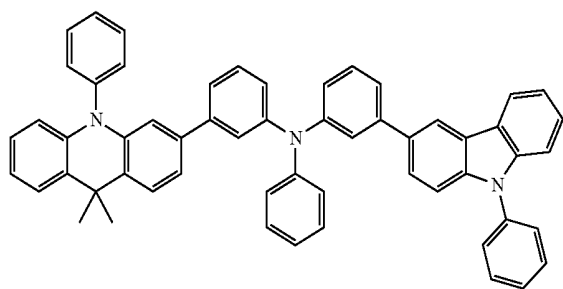
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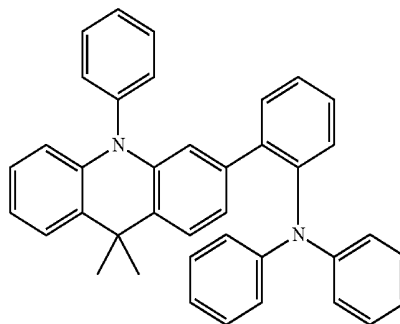


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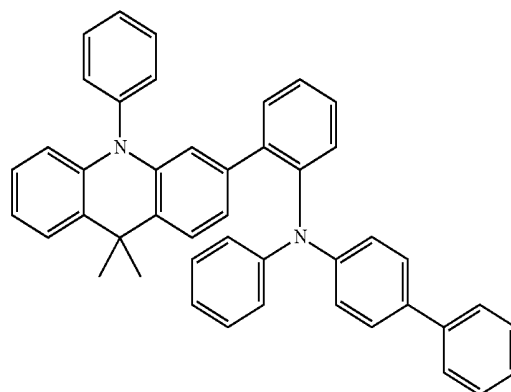


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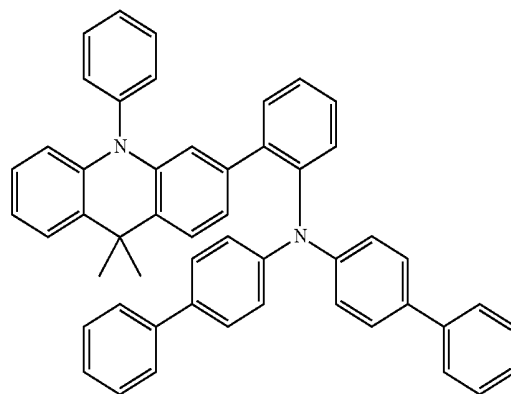
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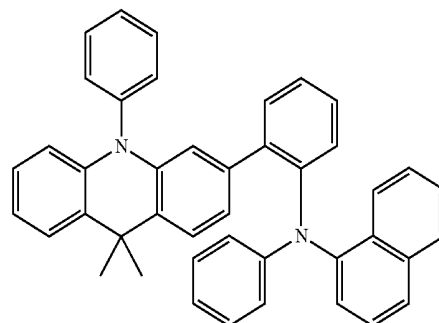
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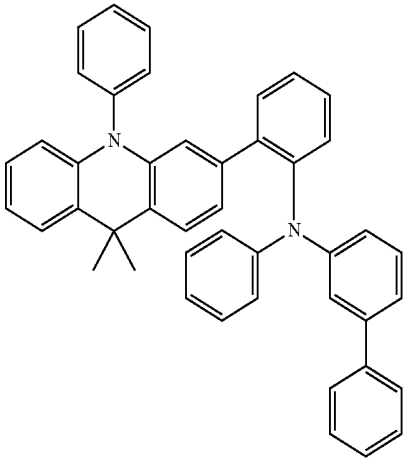


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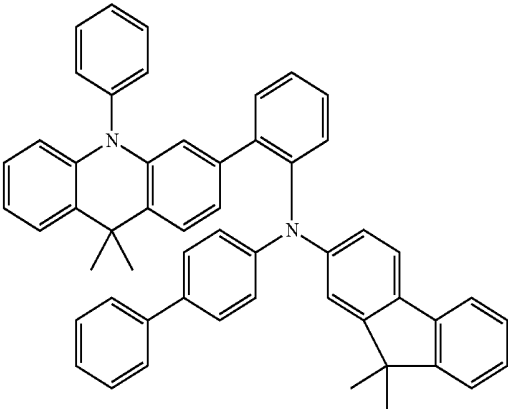


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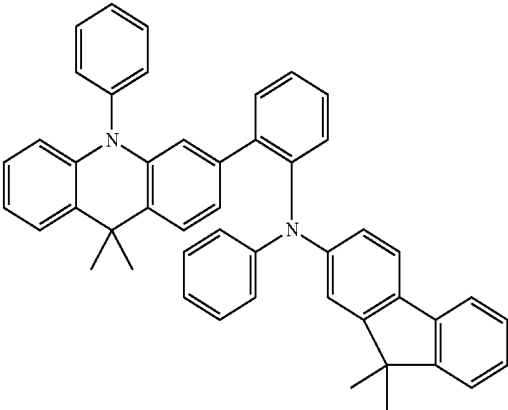
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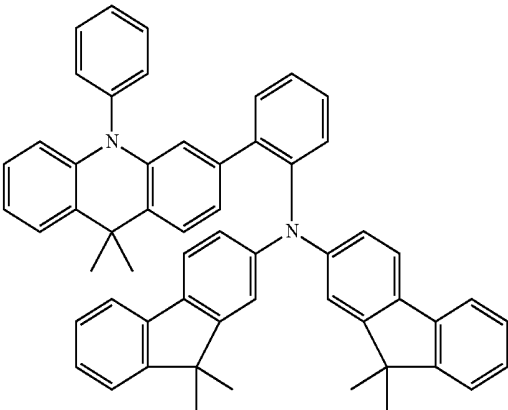
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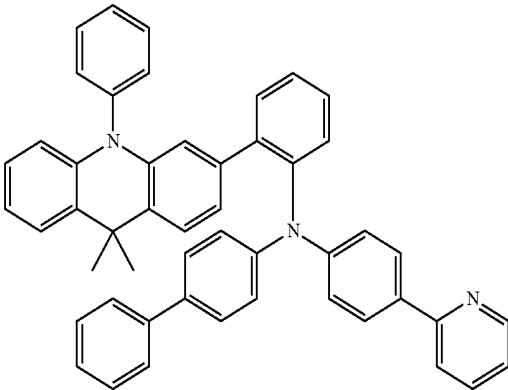


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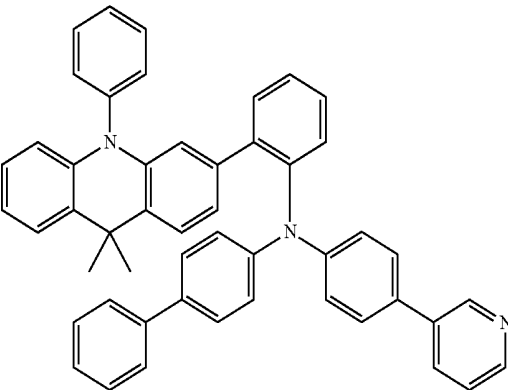


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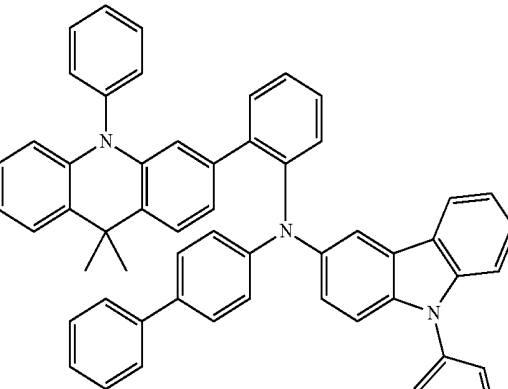
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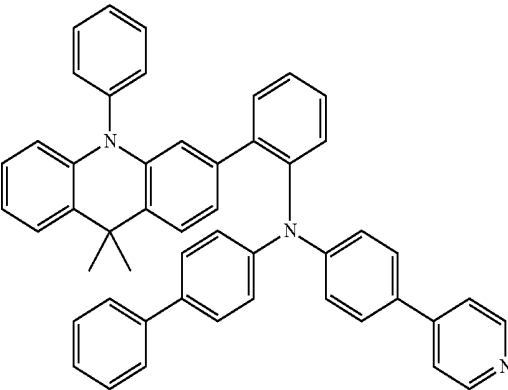
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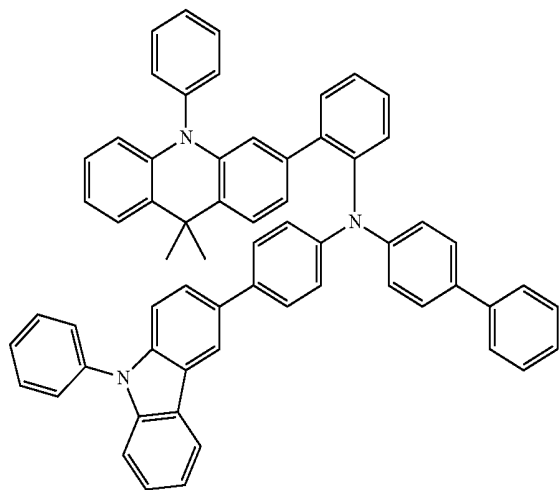


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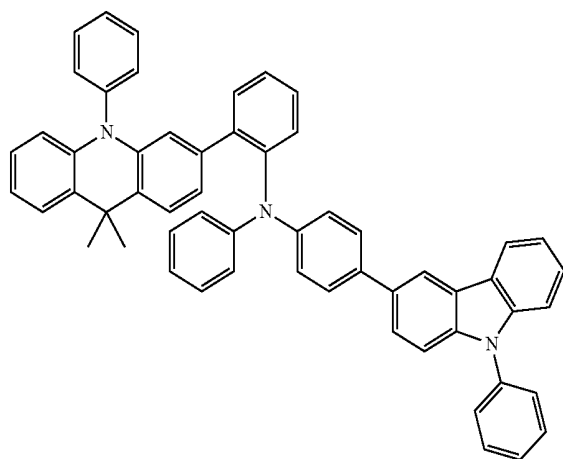


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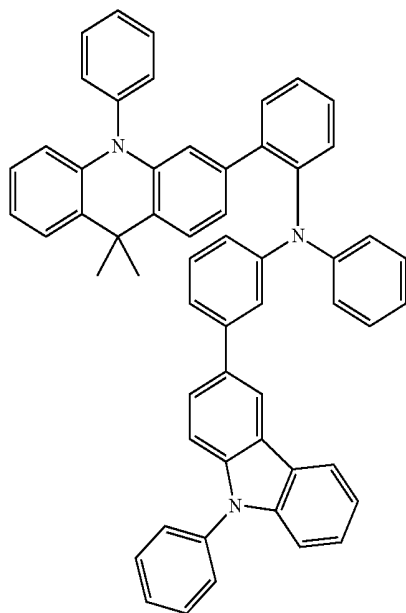
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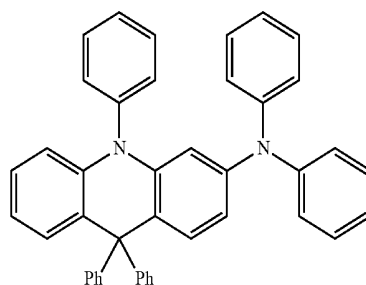


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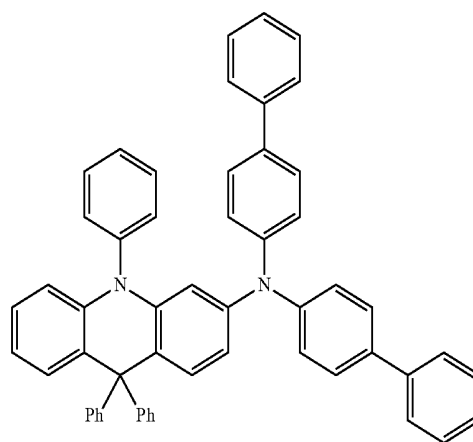


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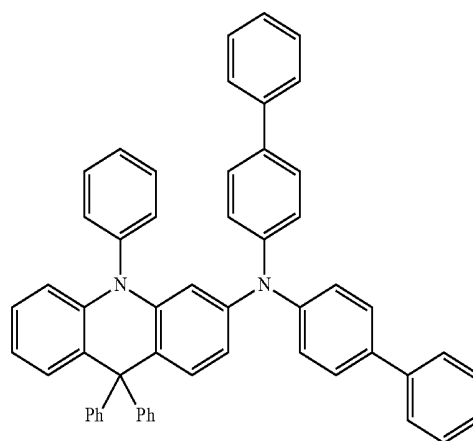
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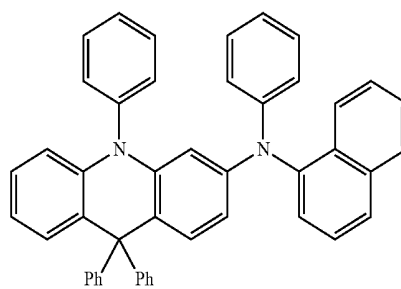
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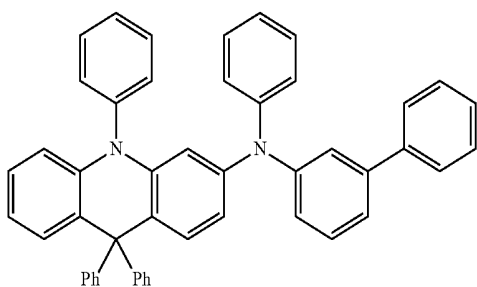
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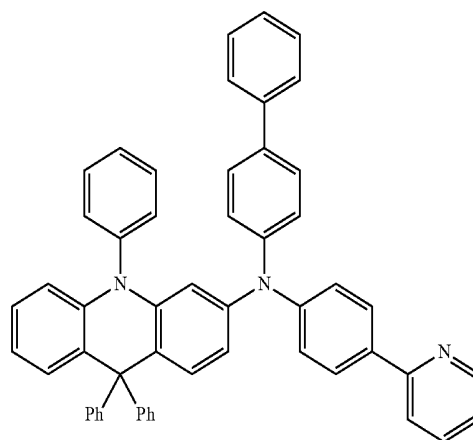


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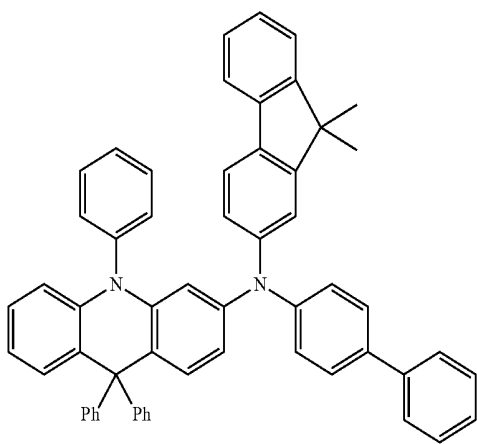
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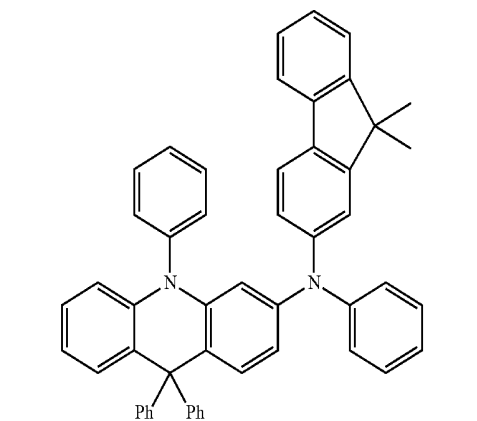
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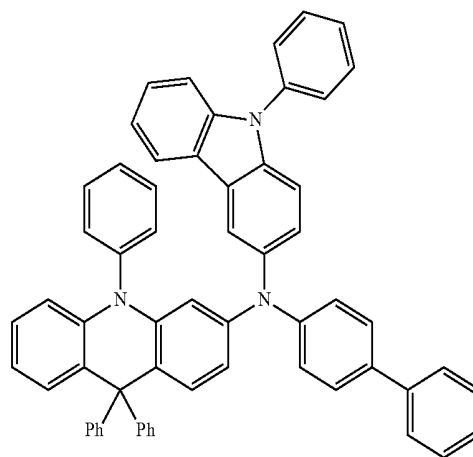
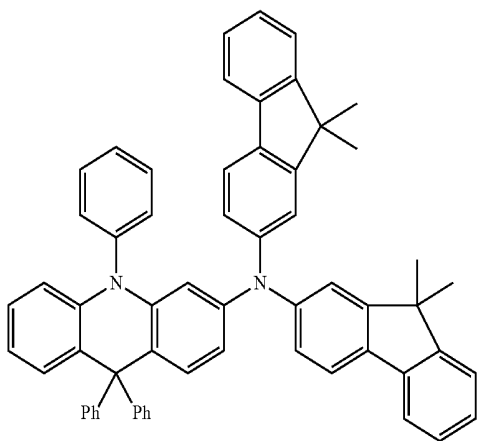
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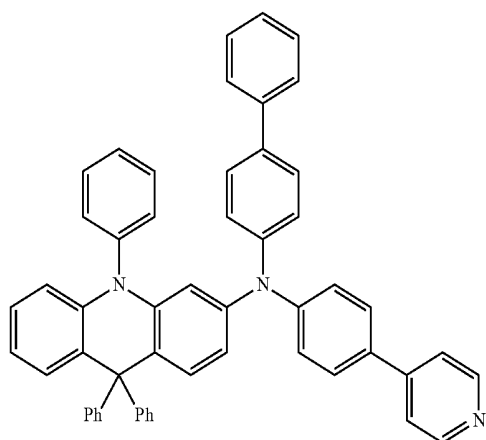


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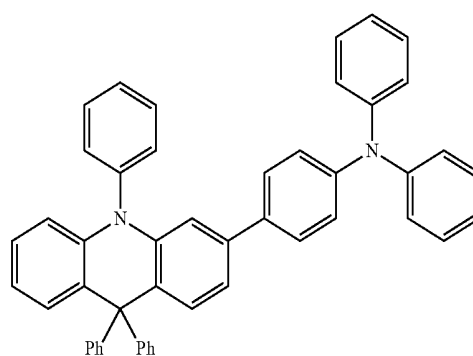


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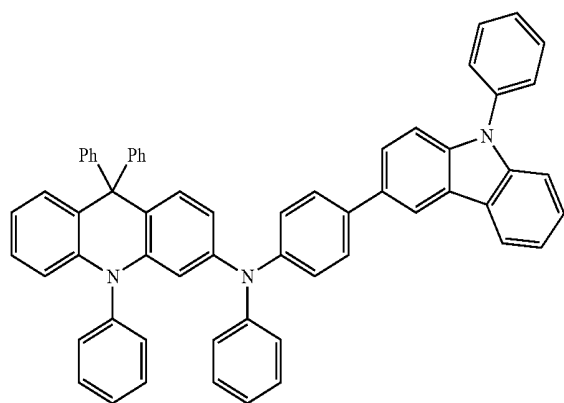


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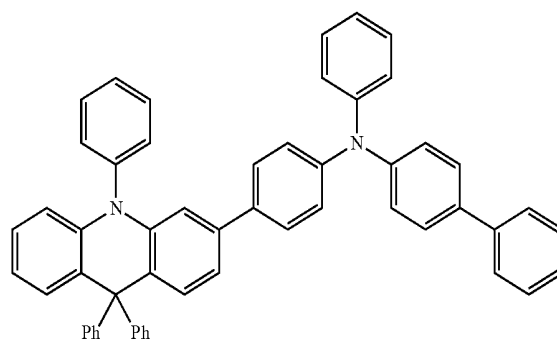
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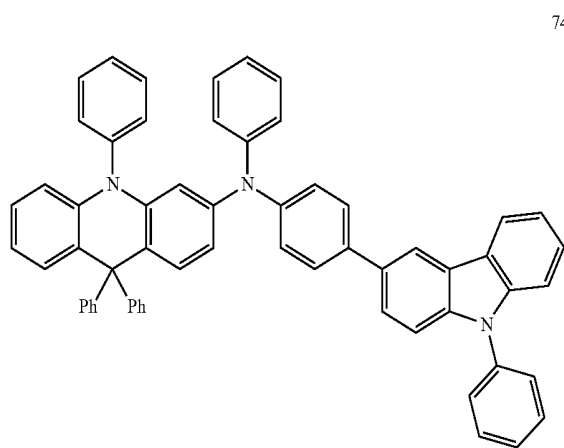
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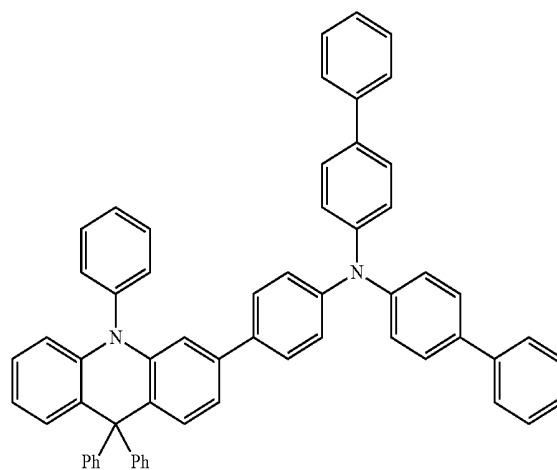
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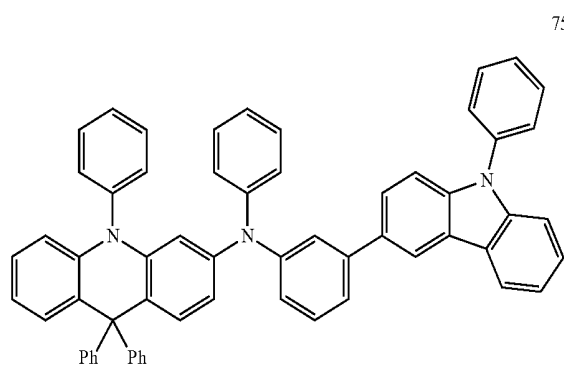
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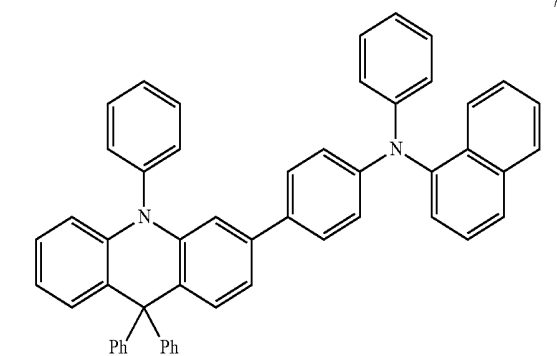
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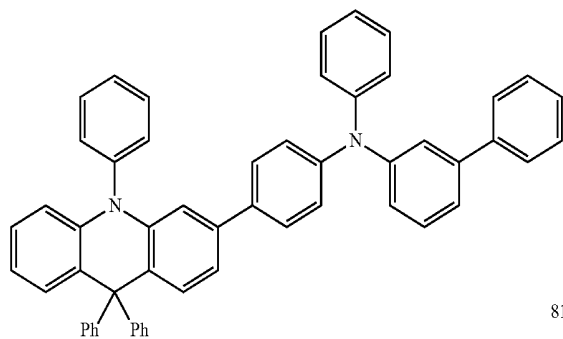
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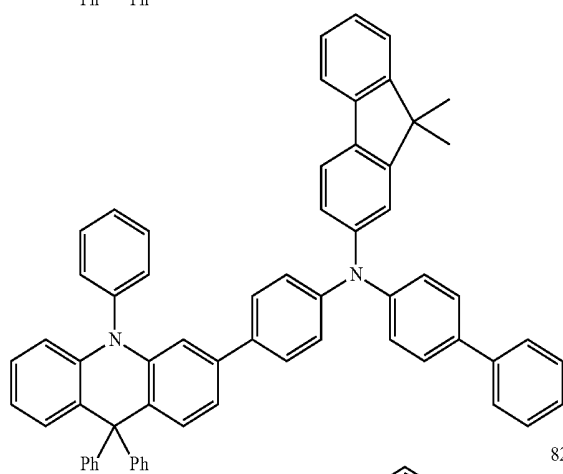
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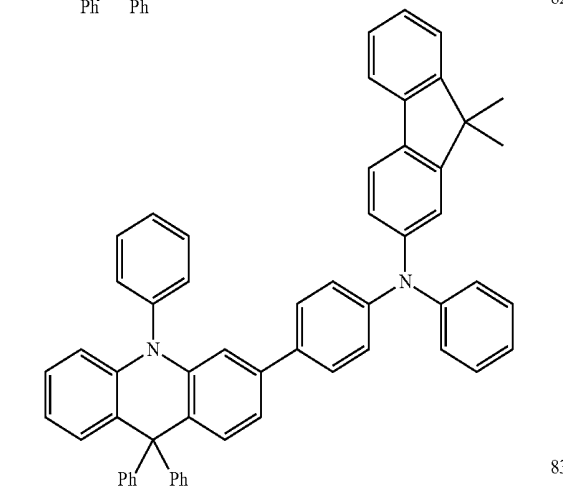
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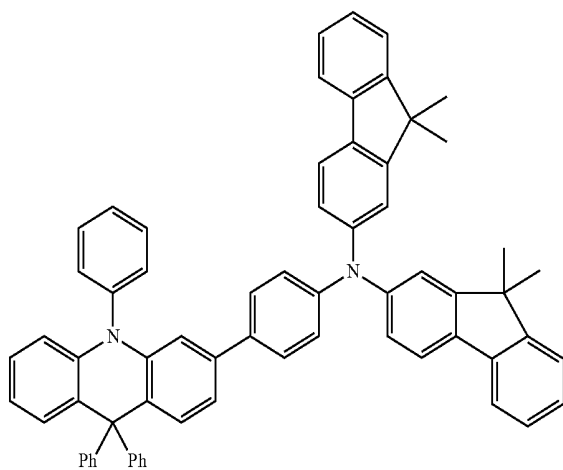
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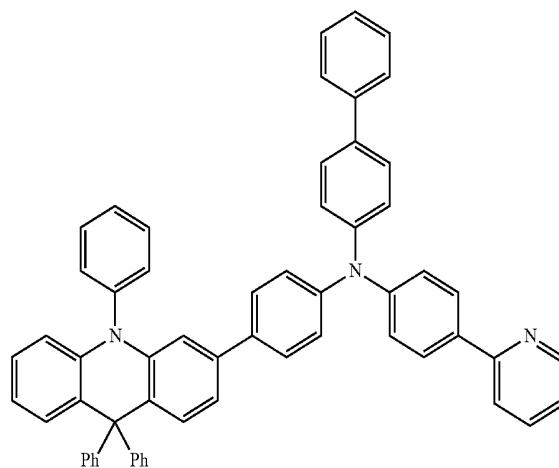


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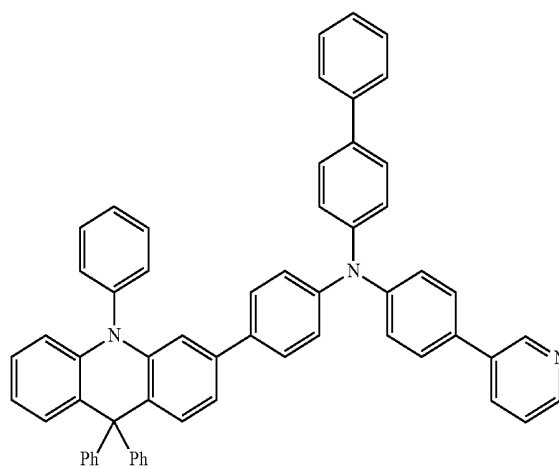


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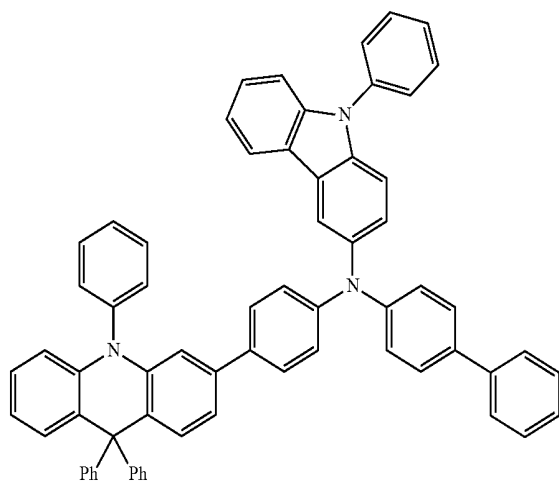
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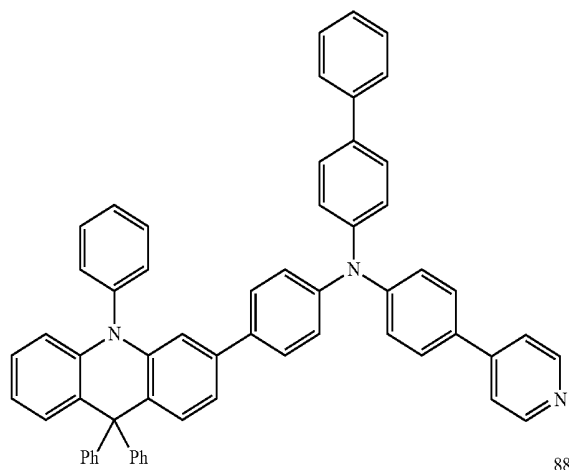


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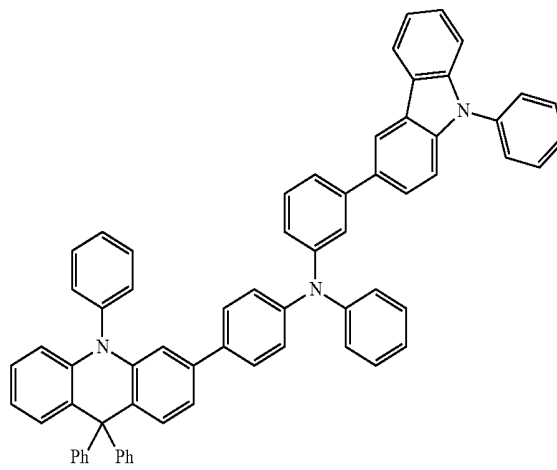
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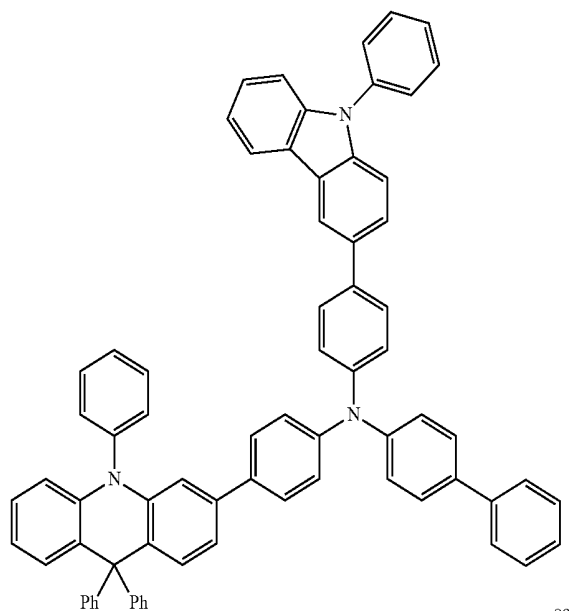
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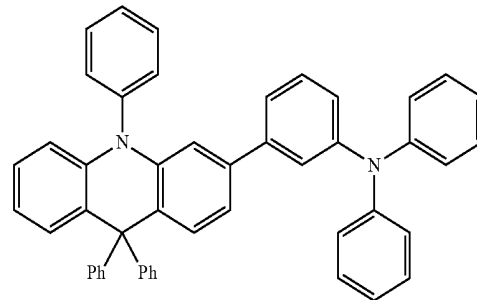
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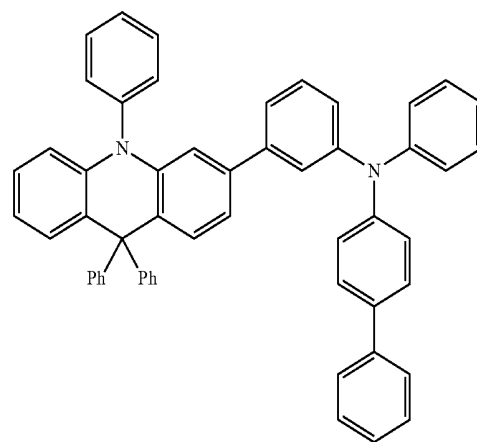
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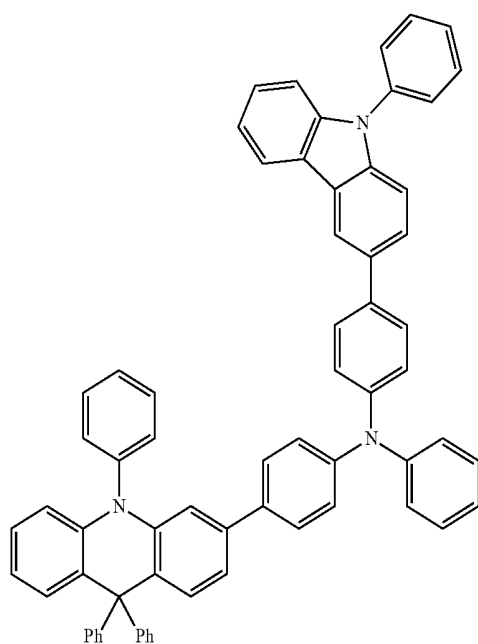
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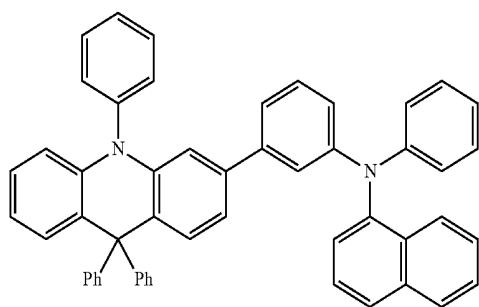
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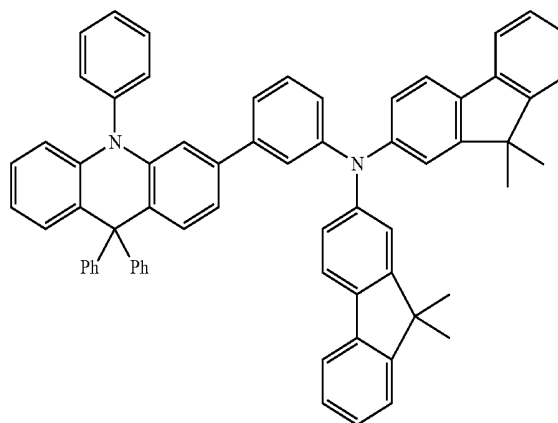


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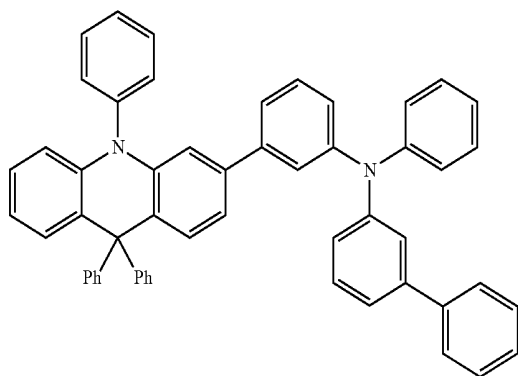


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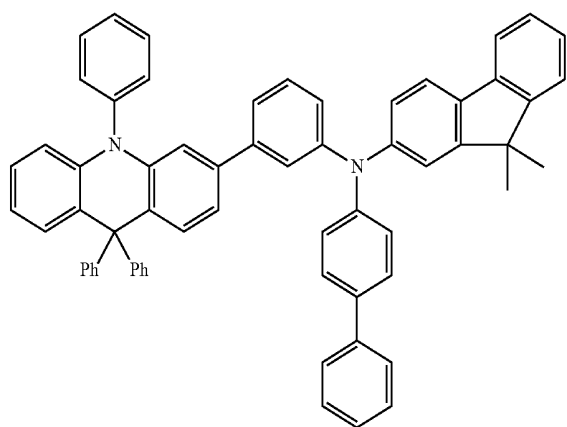
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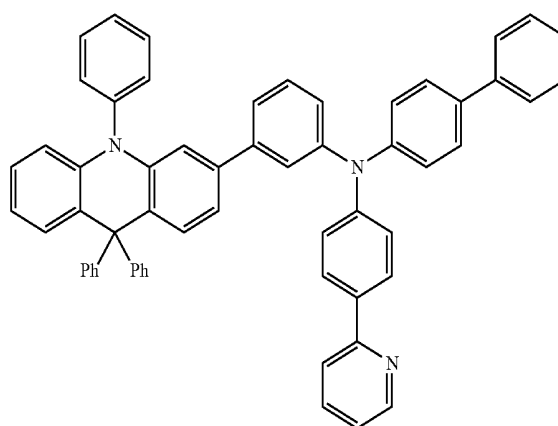
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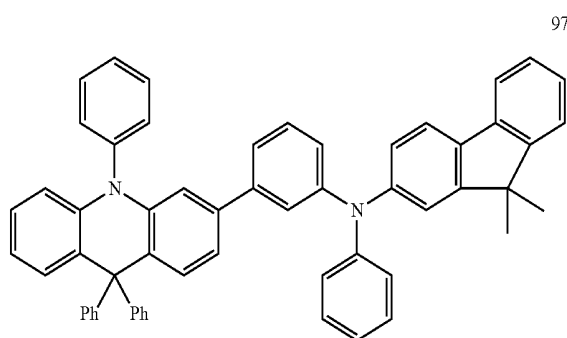
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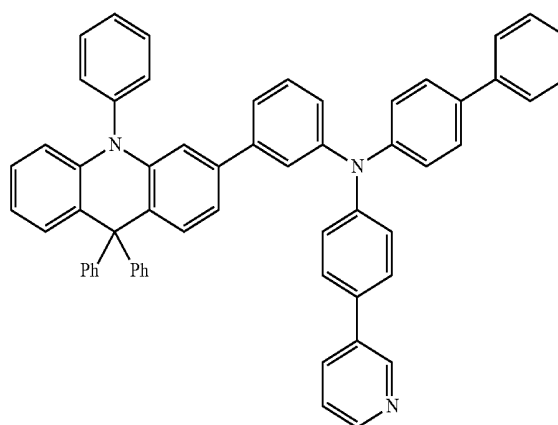
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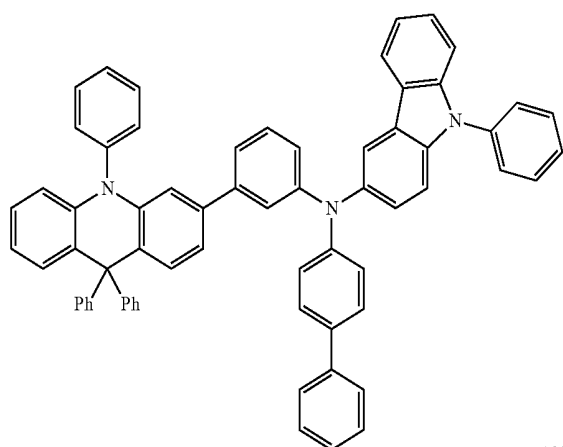
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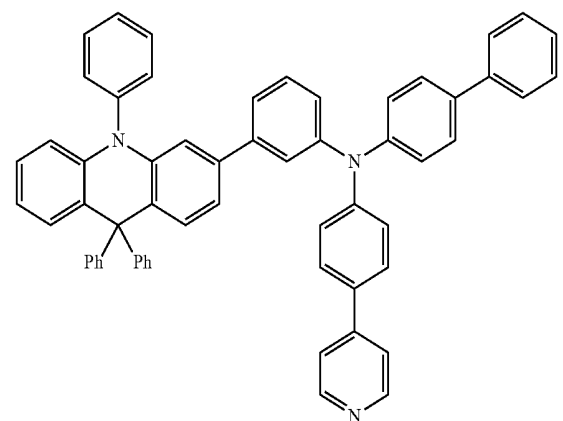
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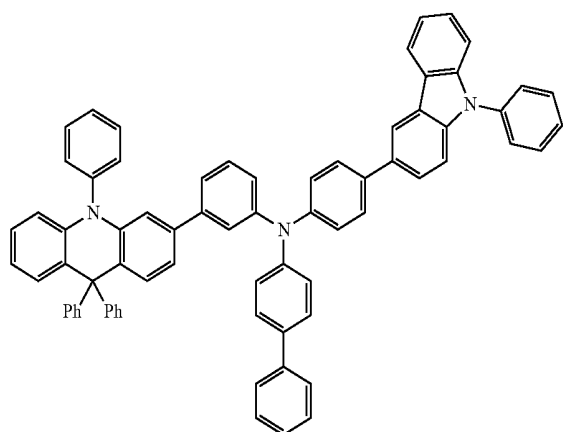
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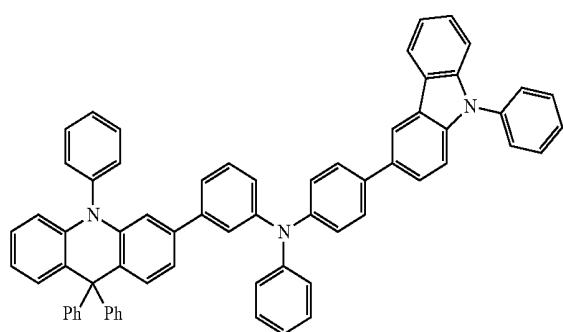
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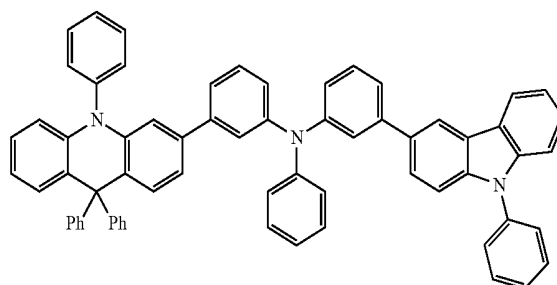


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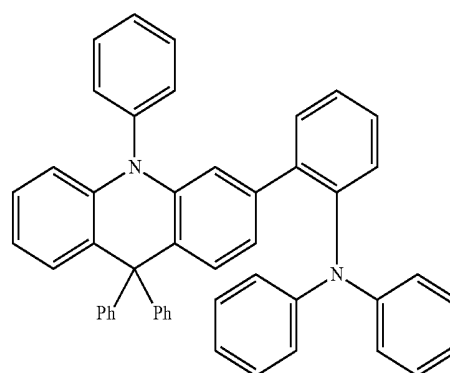


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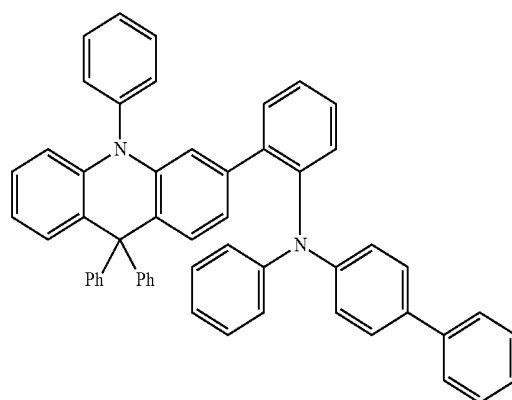
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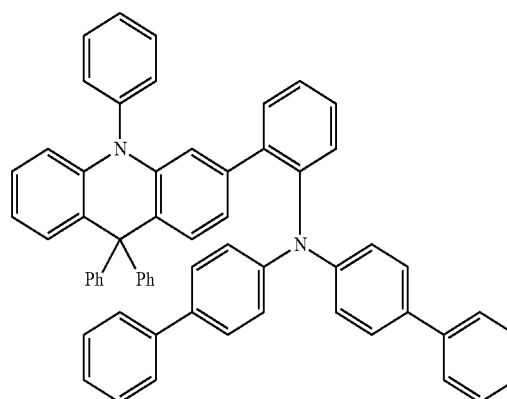
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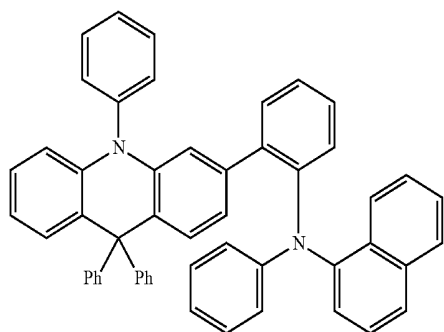
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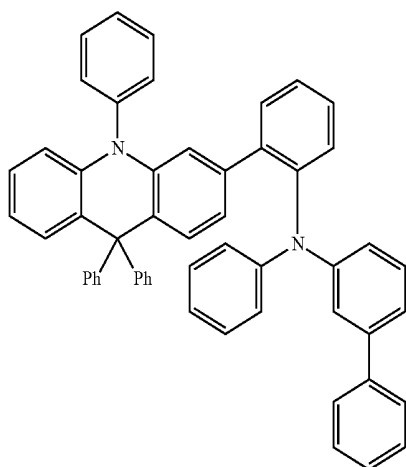
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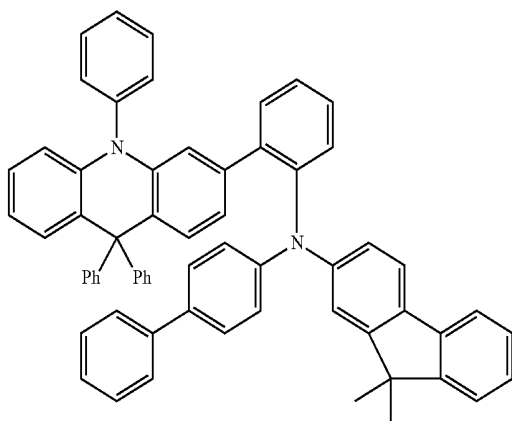
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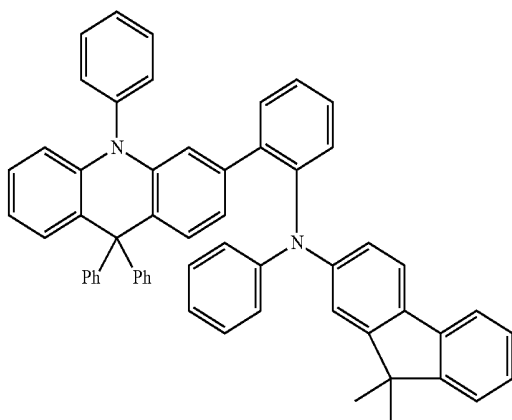
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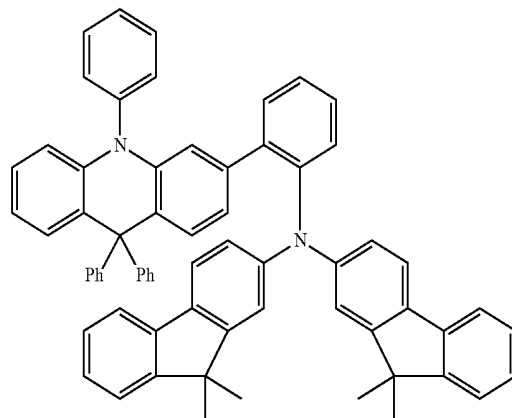


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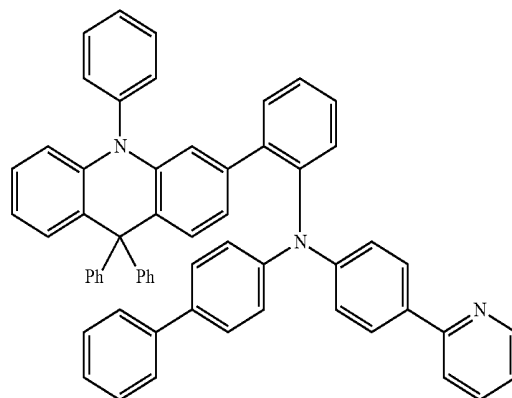


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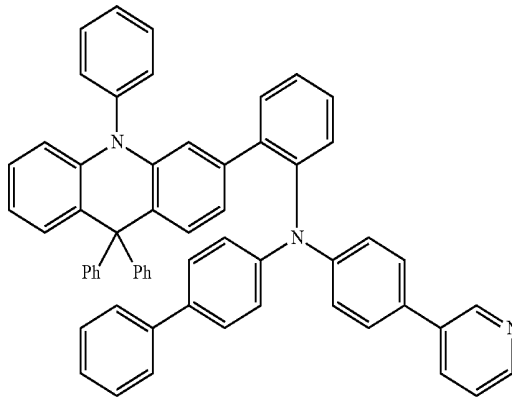
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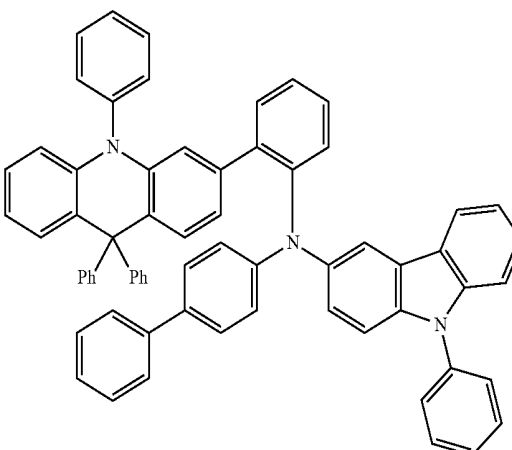
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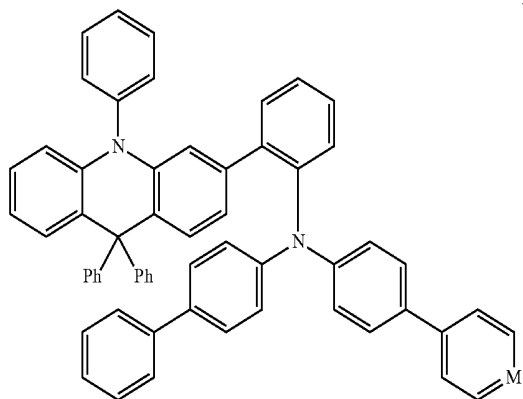
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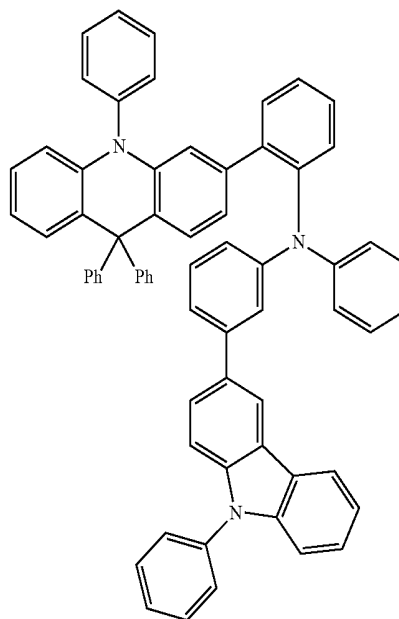
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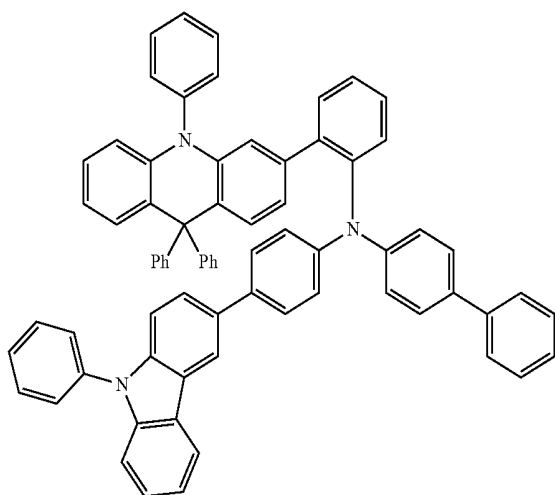


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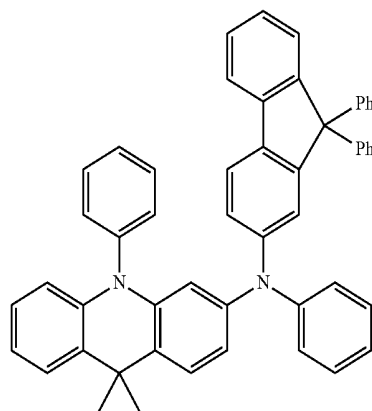
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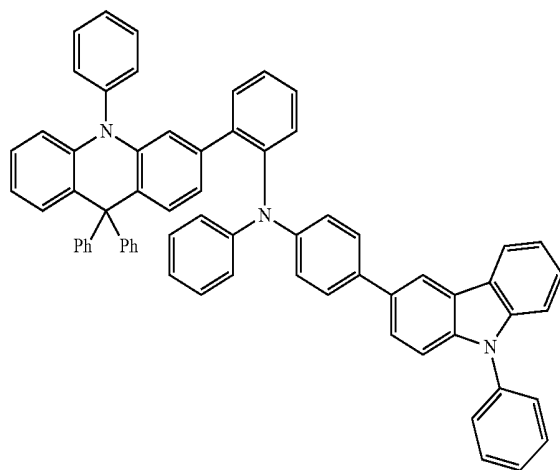
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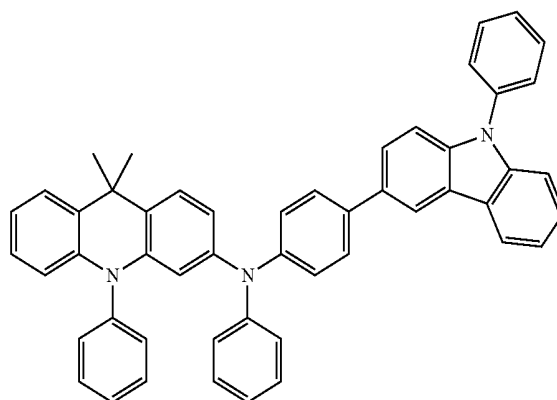
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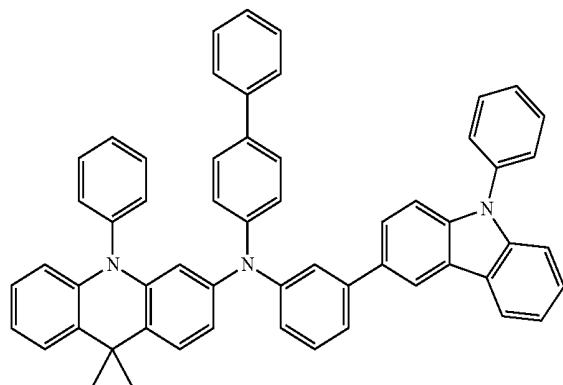


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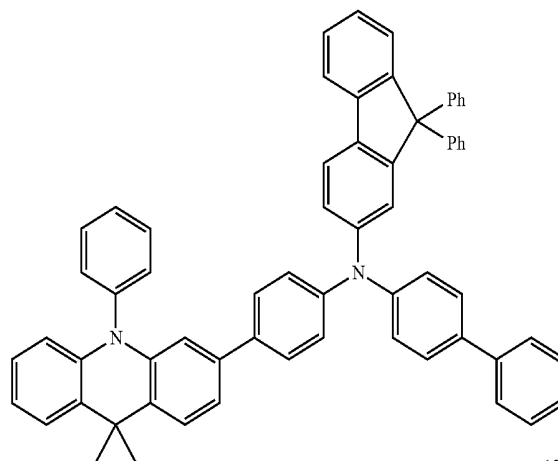
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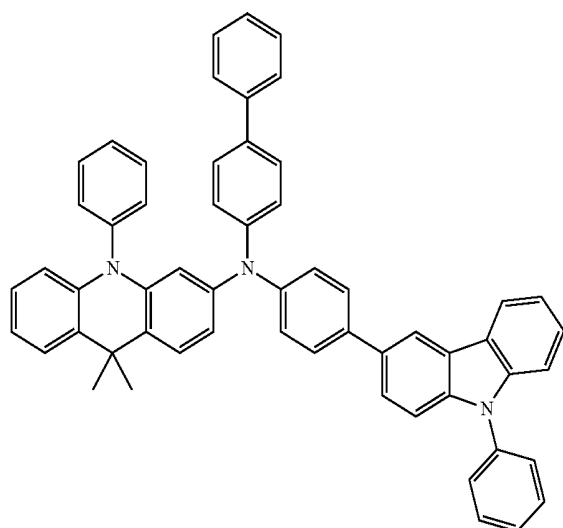


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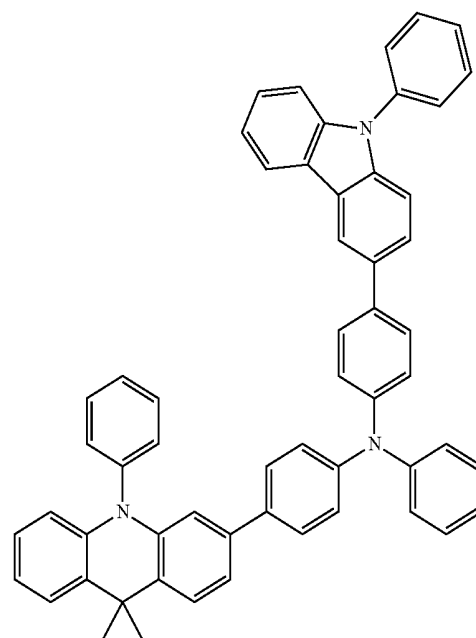
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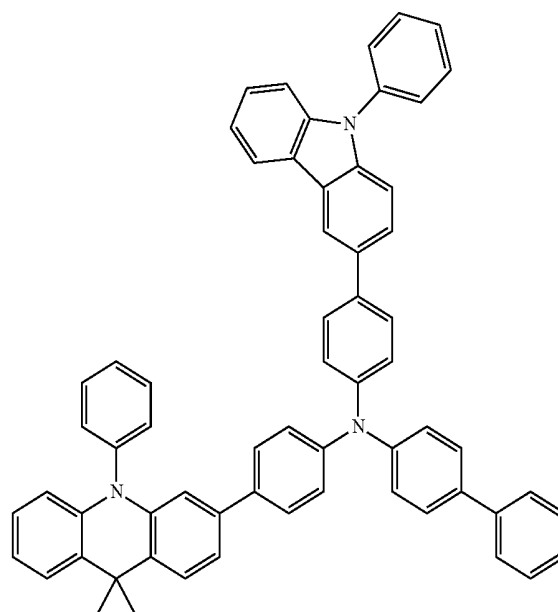
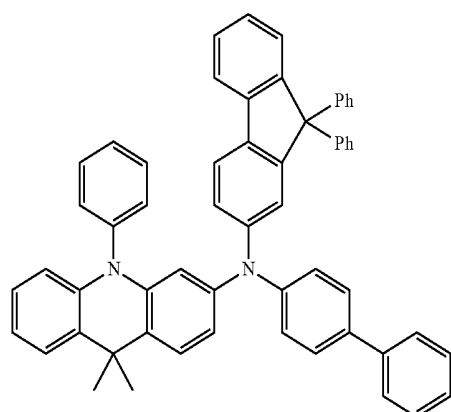


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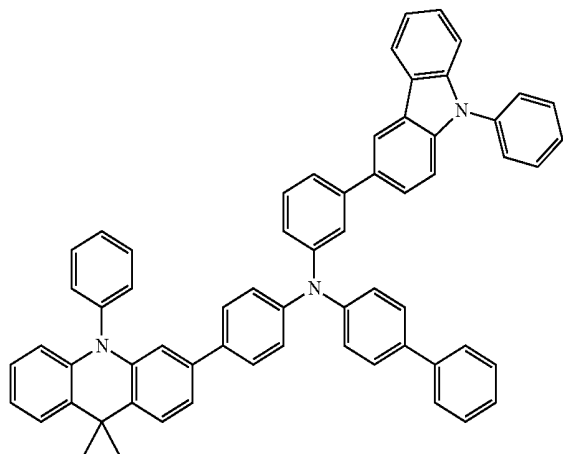
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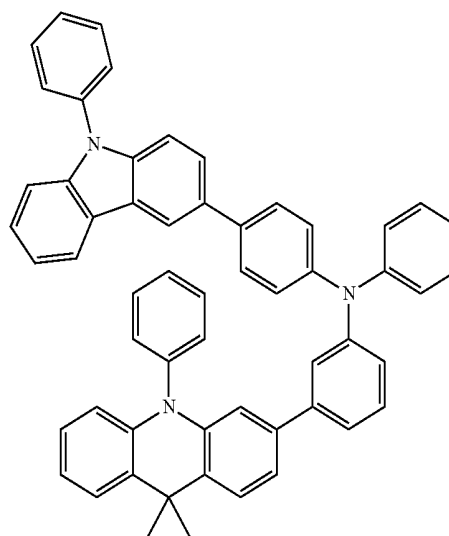
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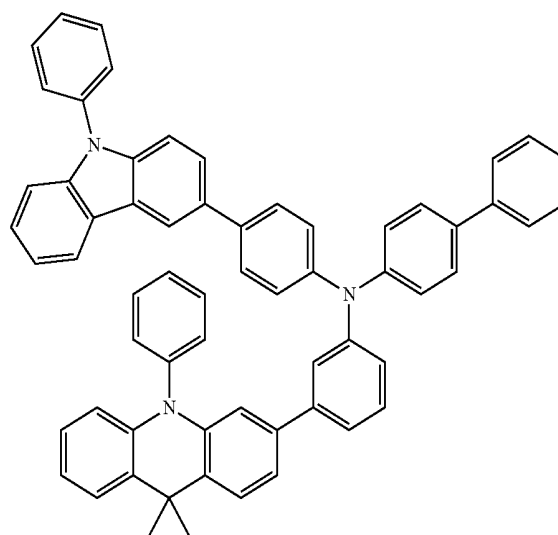
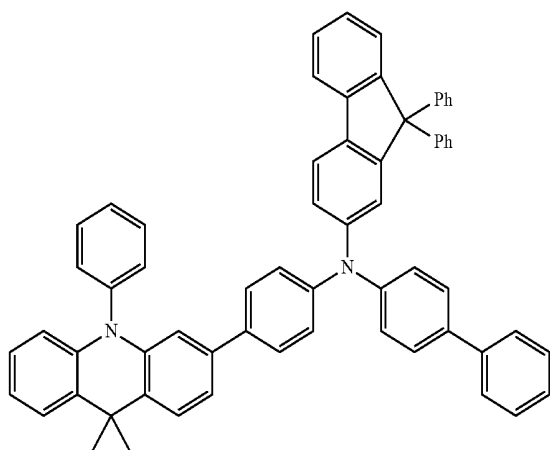
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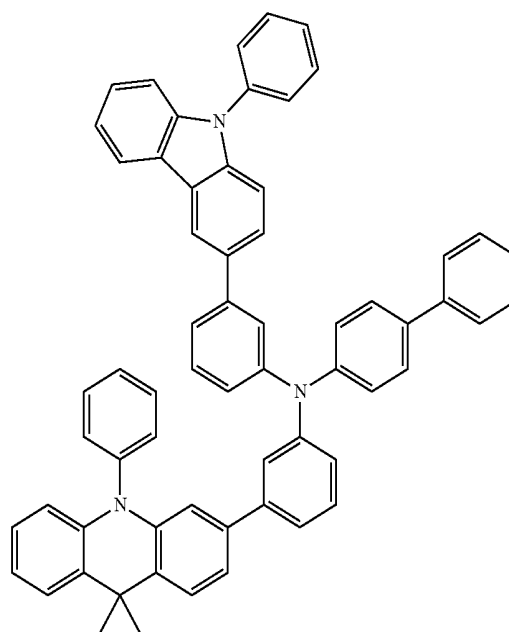
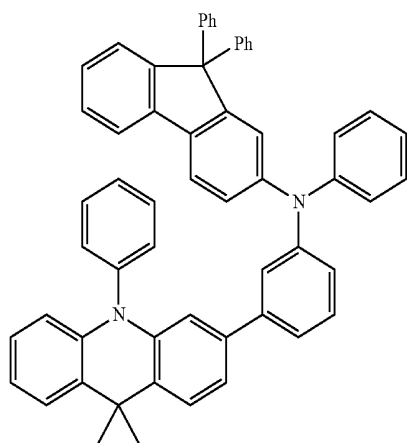
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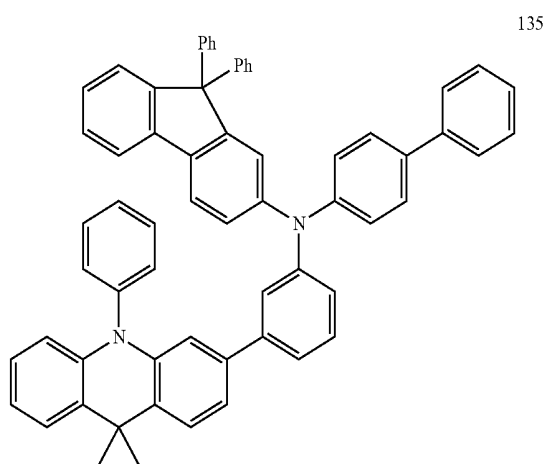


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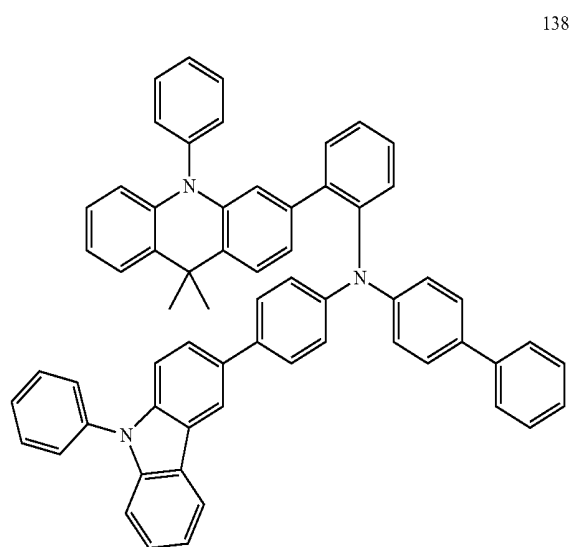
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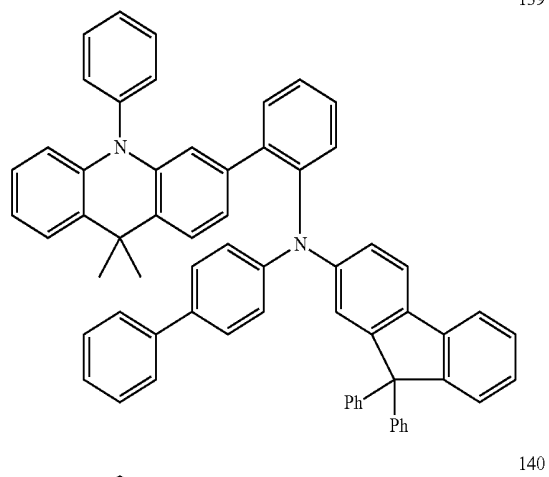
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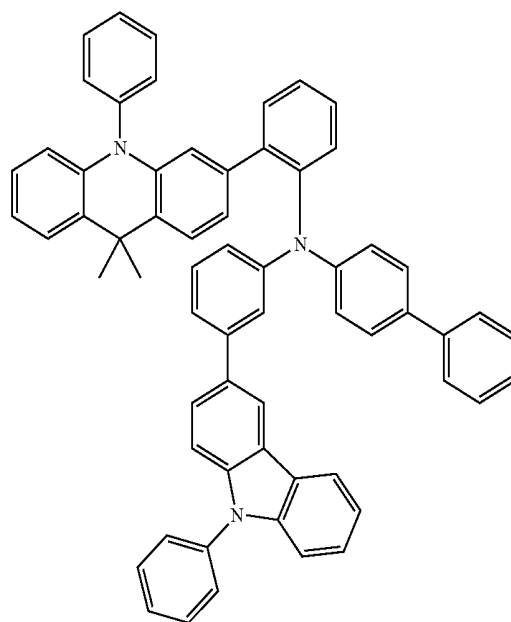


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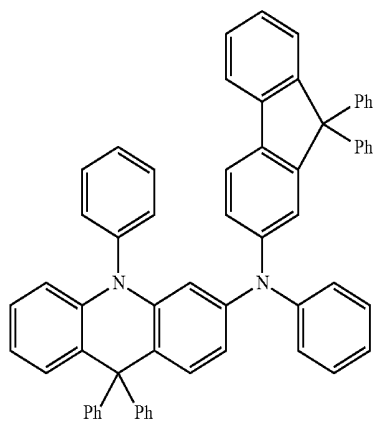


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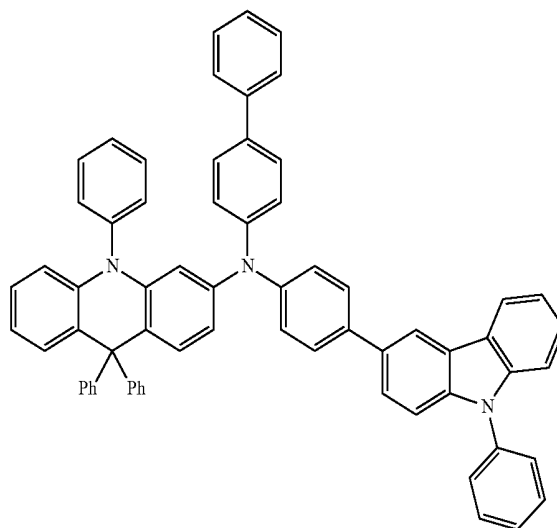


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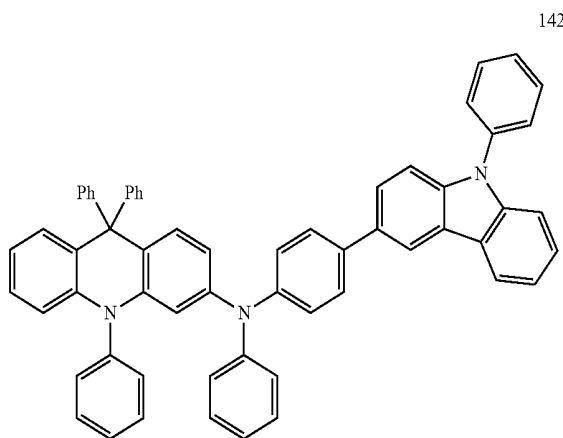


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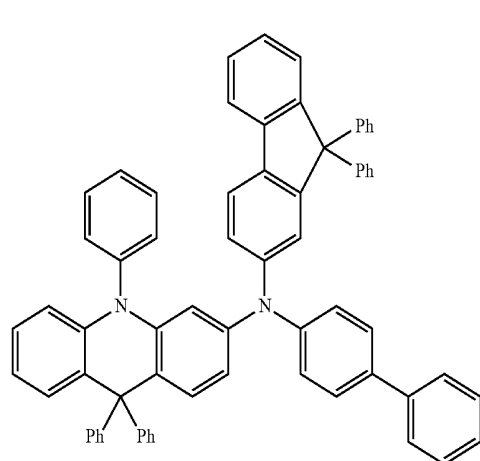
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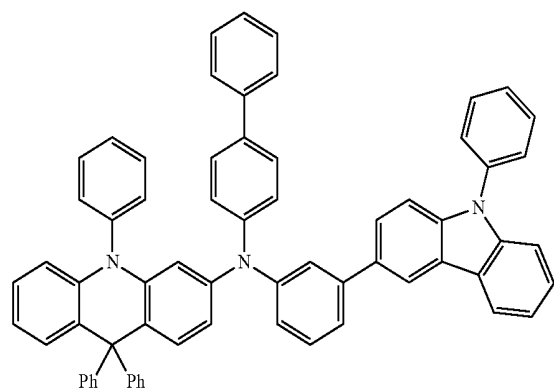
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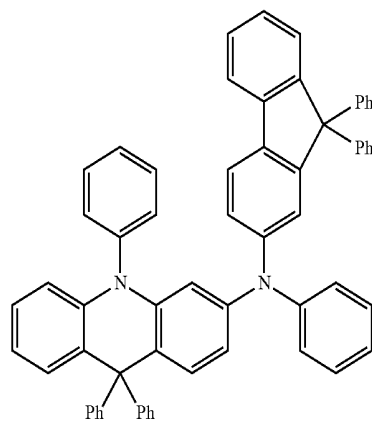
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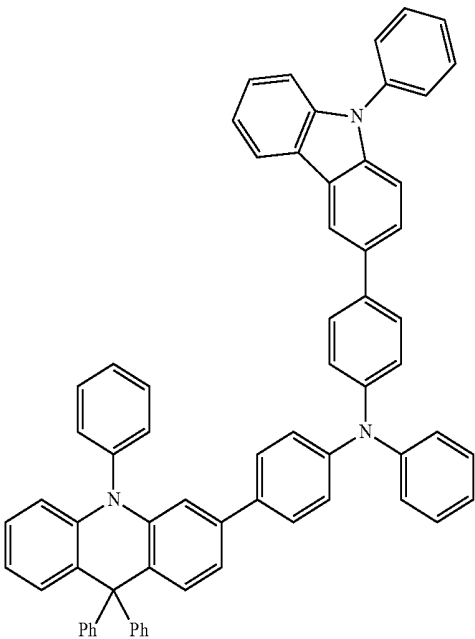


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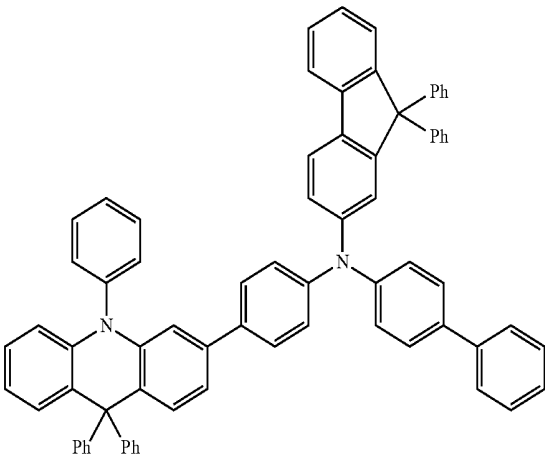
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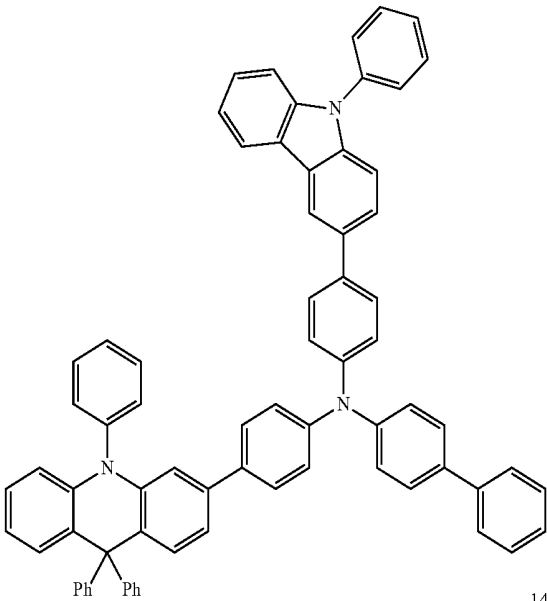


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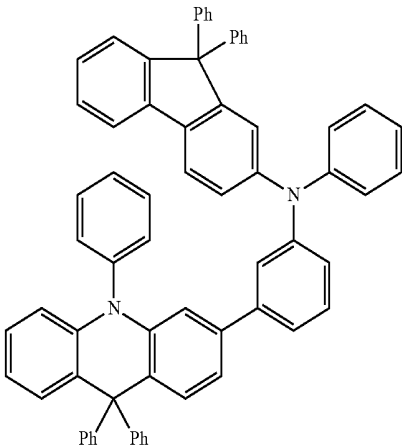
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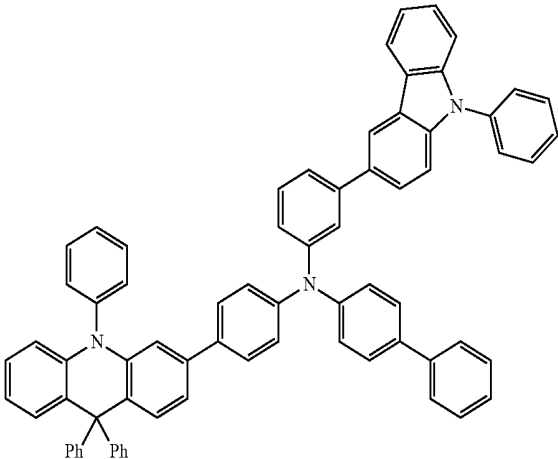
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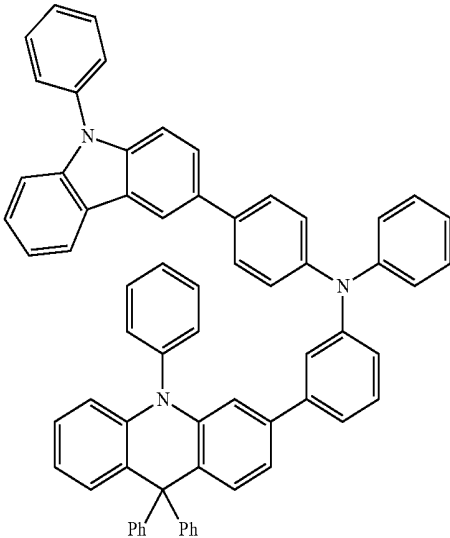
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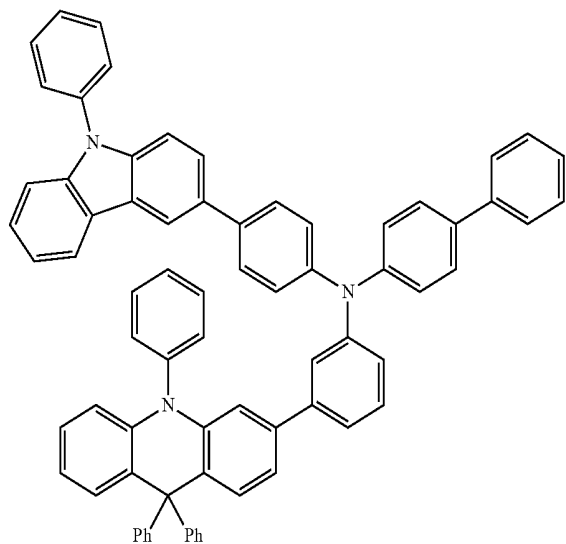
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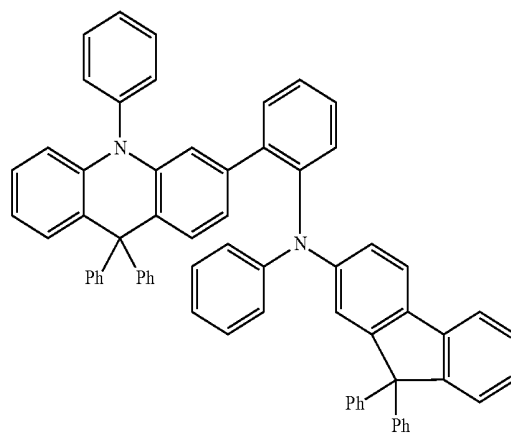
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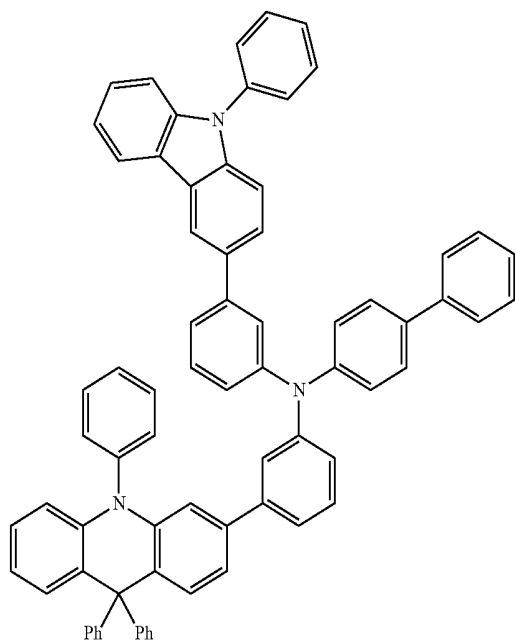


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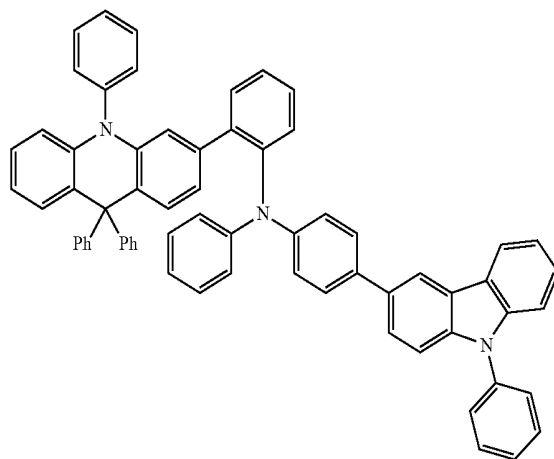
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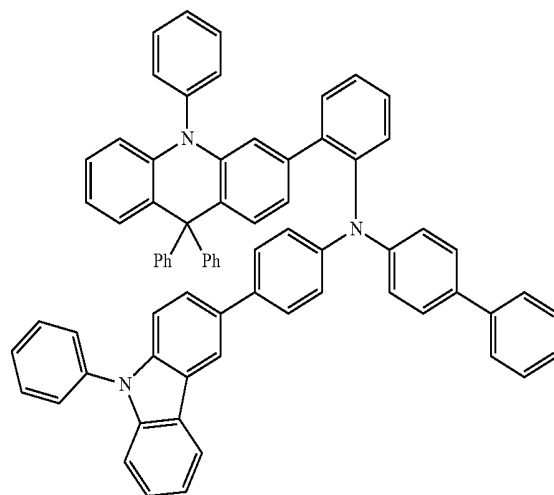
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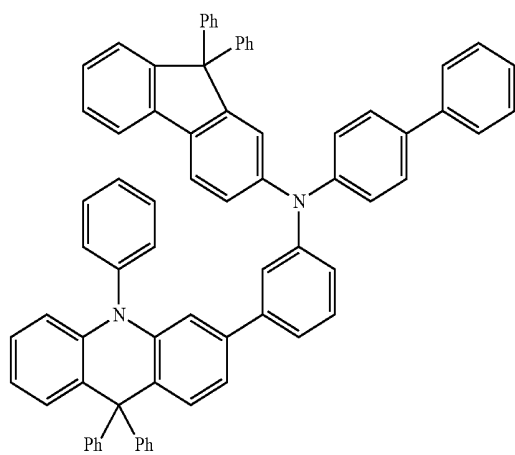
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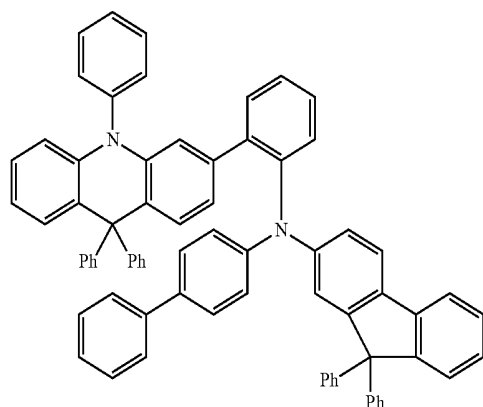
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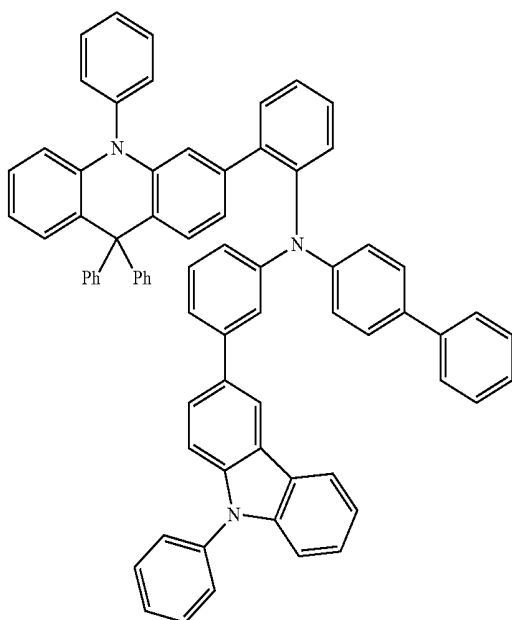
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14. An organic light-emitting device, comprising:

a first electrode;

a second electrode facing the first electrode; and

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

the organic layer includes at least one of the compound as claimed in claim 1.

15. The organic light-emitting device as claimed in claim 14, wherein

the organic layer is formed by using a wet process.

16. The organic light-emitting device as claimed in claim 14, wherein

the first electrode is an anode,

the second electrode is a cathode, and

the organic layer includes:

a hole transport region that is disposed between the first electrode and the emission layer and includes at least one of a hole injection layer, a hole transport layer, and an electron blocking layer, and

an electron transport region that is disposed between the emission layer and the second electrode and includes at least one selected from a hole blocking layer, an electron transport layer, and an electron injection layer.

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

the hole transport region includes the compound.

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

the hole transport layer of the hole transport region includes the compound.

19. The organic light-emitting device as claimed in claim 16, wherein

the electron transport region comprises a metal complex.

20. A flat display apparatus comprising the organic light-emitting device as claimed in claim 14, wherein the first electrode of the organic light-emitting device is electrically connected to a source electrode or a drain electrode of a thin film transistor.

* * * * *

专利名称(译)	包括其的化合物和有机发光装置		
公开(公告)号	US20160099421A1	公开(公告)日	2016-04-07
申请号	US14/645746	申请日	2015-03-12
[标]申请(专利权)人(译)	三星显示有限公司		
申请(专利权)人(译)	三星DISPLAY CO. , LTD.		
当前申请(专利权)人(译)	三星DISPLAY CO. , LTD.		
[标]发明人	KIM JONGWOO KIM YOUNGKOOK LIM JINO JANG HYUNGSEOK HWANG SEOKHWAN		
发明人	KIM, JONGWOO KIM, YOUNGKOOK LIM, JINO JANG, HYUNGSEOK HWANG, SEOKHWAN		
IPC分类号	H01L51/00 H01L27/32 C07D219/02 C07D219/08 C07D401/12		
CPC分类号	H01L51/0067 C07D219/08 C07D401/12 C07D219/02 H01L51/0061 H01L51/006 H01L51/5092 H01L51/0072 H01L51/0052 H01L51/0058 H01L51/5056 H01L51/5072 H01L51/5096 H01L27/3248 H01L51/0003		
优先权	1020140132492 2014-10-01 KR		
其他公开文献	US9893295		
外部链接	Espacenet USPTO		

摘要(译)

提供由式1表示的化合物和包含其的有机发光装置：其中式1的取代基是通过参考详细描述中提供的描述来理解。

