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Eum et al.

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(45) **Date of Patent:** **Apr. 10, 2012**

(54) **ORGANIC ELECTROLUMINESCENT COMPOUNDS AND ORGANIC ELECTROLUMINESCENT DEVICE USING THE SAME**

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(57) **ABSTRACT**

Provided are novel organic electroluminescent compounds, and organic electroluminescent devices and organic solar cells employing the same. Specifically, the organic electroluminescent compounds according to the invention are characterized in that they are represented by Chemical Formula (1):

(73) Assignee: **Gracel Display Inc.**, Seoul (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 514 days.

(21) Appl. No.: **12/456,844**

(22) Filed: **Jun. 23, 2009**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

Jun. 24, 2008 (KR) 10-2008-0059496

(51) **Int. Cl.**
H01L 51/54 (2006.01)

(52) **U.S. Cl.** 428/690; 428/917; 544/234; 564/234; 313/504; 313/505; 313/506; 136/263; 257/40

(58) **Field of Classification Search** 428/690, 428/917; 544/234; 564/234; 313/504, 505, 313/506; 136/263; 257/40

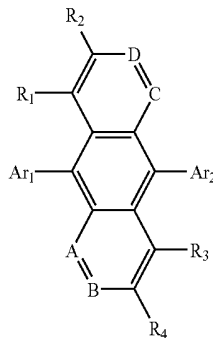
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,888,863 B2* 2/2011 Shin et al. 313/504
2006/0192482 A1* 8/2006 Igarashi et al. 313/504
* cited by examiner

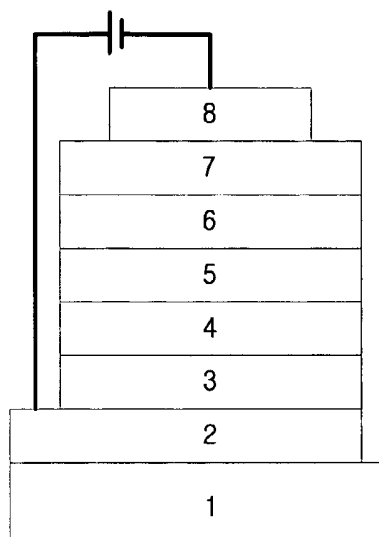
Chemical Formula 1

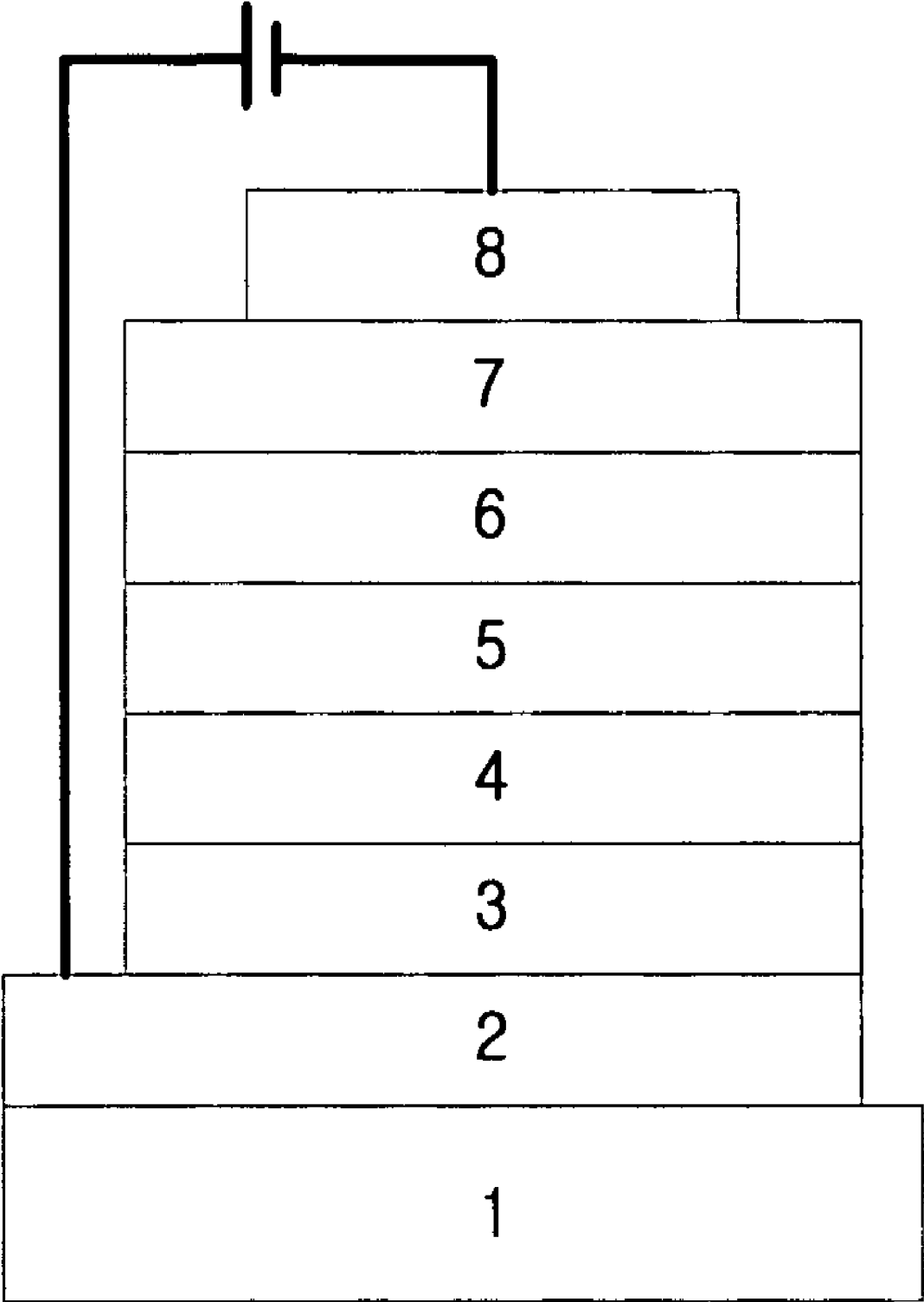


wherein, A, B, C and D independently represent CR₅ or N, provided that A, B, C and D cannot represent CR₅ all at the same time.

Since the organic electroluminescent compounds according to the invention have good luminous efficiency and excellent color purity and life property of material, OLED's having very good operation life can be manufactured therefrom.

9 Claims, 1 Drawing Sheet





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**ORGANIC ELECTROLUMINESCENT
 COMPOUNDS AND ORGANIC
 ELECTROLUMINESCENT DEVICE USING
 THE SAME**

FIELD OF THE INVENTION

The present invention relates to novel organic electroluminescent compounds, and organic electroluminescent devices employing the same in an electroluminescent layer. More specifically, the invention relates to novel organic electroluminescent compounds to be employed as green or blue electroluminescent material, and organic electroluminescent devices employing the same as host.

BACKGROUND OF THE INVENTION

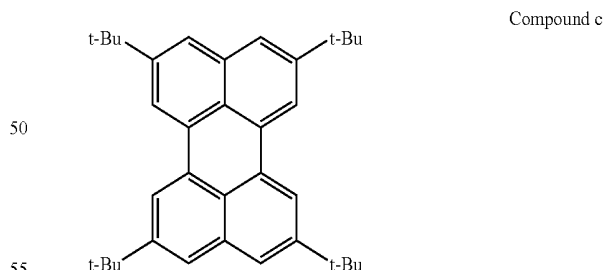
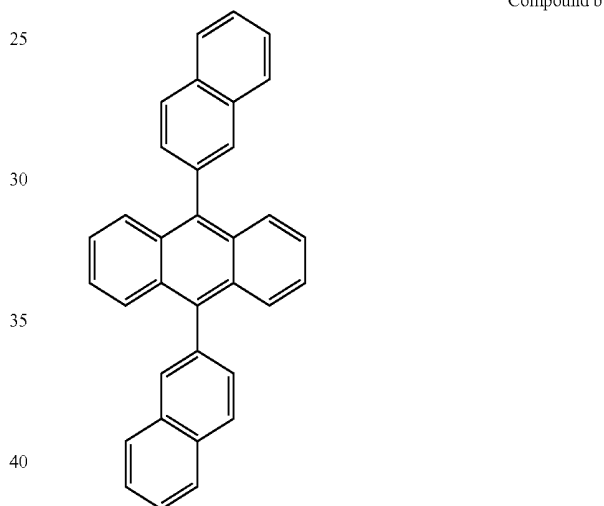
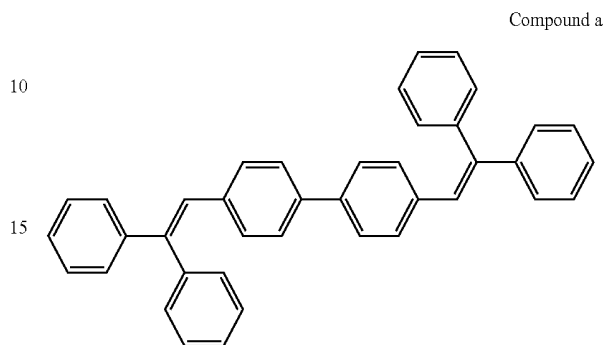
Three electroluminescent materials (for red, green and blue) are employed to realize a full-colored OLED display. The important issue is to develop red, green and blue electroluminescent materials with high efficiency and long life, in order to enhance the overall feature of the organic electroluminescent (EL) devices. The EL materials are classified into host materials and dopant materials from the aspect of their functions. It is generally known that a device structure having the most excellent EL properties can be fabricated with an EL layer prepared by doping a dopant to a host. Recently, development of organic EL devices with high efficiency and long life comes to the fore as an urgent subject, and particularly urgent is development of a material with far better EL properties as compared to conventional EL materials as considering EL properties required for a medium to large sized OLED panel. From this point of view, development of host material is one of the most important issues to be settled. The desired properties for the host material (serving as a solvent and energy conveyer in solid state) are high purity and appropriate molecular weight to enable vapor-deposition in vacuo. In addition, glass transition temperature and thermal decomposition temperature should be high enough to ensure thermal stability. Further, the host material should have high electrochemical stability for providing long life. It is to be easy to form an amorphous thin film, with high adhesiveness to other materials of adjacent layers but without interlayer migration.

In the meanwhile, for conventional blue materials, a number of materials have been developed and commercialized since the development of diphenylvinyl-biphenyl (DPVBi) (Compound a) by Idemitsu-Kosan. In addition to the blue material system from Idemitsu-Kosan, dinaphthylanthracene (DNA) (Compound b) of Kodac, tetra(t-butyl)perylene (Compound c) system or the like have been known. However, extensive research and development should be performed with respect to these materials. The distryl compound system of Idemitsu-Kosan, which is known to have highest efficiency up to now, has 6 lm/W power efficiency and beneficial device lifetime of more than 30,000 hr. However, when it is applied to a full-colored display, the lifetime is merely several thousand hours, owing to decrease of color purity over operation time. In case of blue electroluminescence, it becomes advantageous from the aspect of the luminous efficiency, if the electroluminescent wavelength is shifted a little toward longer wavelength. However, it is not easy to apply the material to a display of high quality because of unsatisfactory color

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purity in blue. Furthermore, the research and development of such materials are urgent because of the problems in color purity, efficiency and thermal stability.

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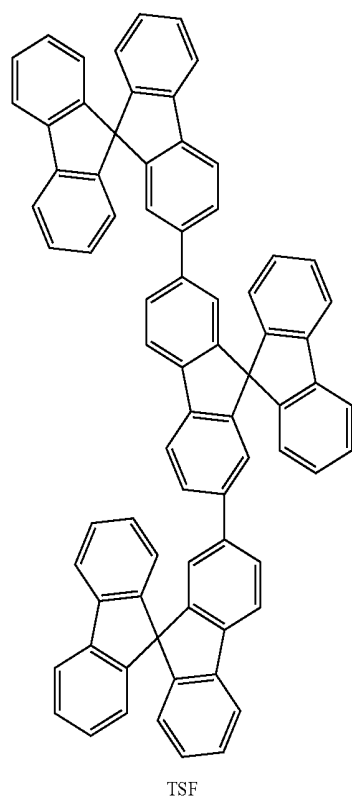
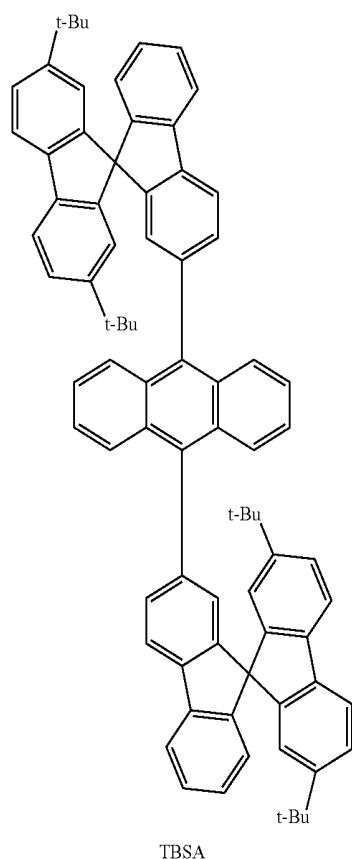


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In order to develop a host material with high efficiency and long life, compounds based on different backbones have been disclosed, such as dispiro-fluorene-anthracene (TBSA), ter-spirofluorene (TSF) and bitriphenylene (BTP). These compounds, however, did not result in color purity and luminous efficiency at a sufficient level.

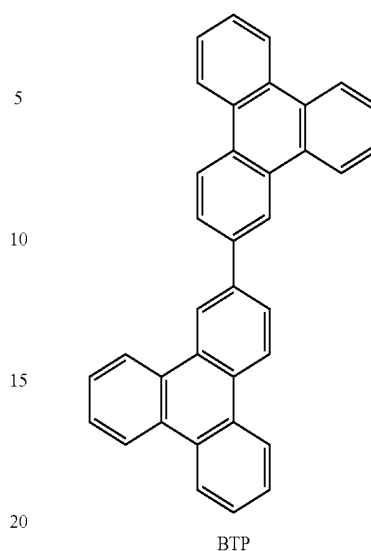
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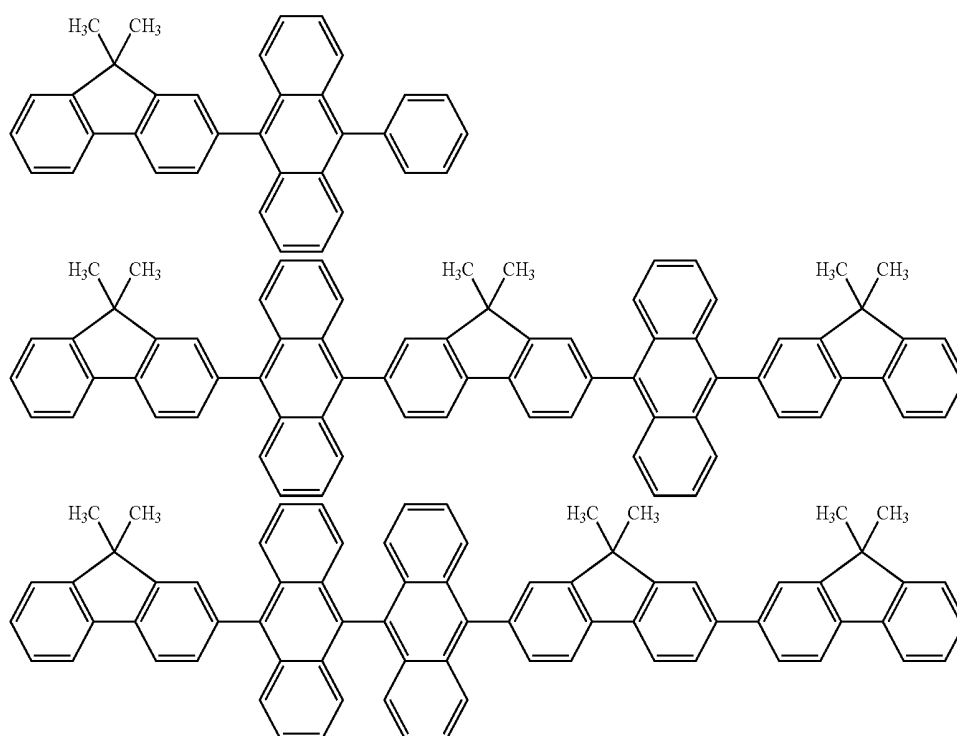


30 The compound TBSA as reported by Gyeongsang National University and Samsung SDI (Kwon, S. K. et al., *Advanced Materials*, 2001, 13, 1690; Japanese Patent Laid-Open No. 2002121547), showed luminous efficiency of 3 cd/A at 7.7 V, and relatively good color coordinate of (0.15, 0.11), but it was applied as a material for a single layer, being inappropriate for practical use. The compound TSF reported by Taiwan National University (Wu, C.-C. et al., *Advanced Materials*, 2004, 16, 61; US Patent Publication No. 2005040392) showed relatively good external quantum efficiency of 5.3%, but it was still inappropriate for practical use. The compound BTP reported by Chingwha National University of Taiwan (Cheng, C.-H. et al., *Advanced Materials*, 2002, 14, 1409; US Patent Publication No. 2004076852) showed luminous efficiency of 2.76 cd/A and relatively good color coordinate of (0.16, 0.14), but this was still insufficient for practical use.

As described above, conventional materials are constituted of a single layer, not forming a host-dopant thin layer, and is difficult to be used practically from the aspect of color purity and efficiency. There are not enough data reliable, with respect to its long life.

In the meanwhile, according to a patent application of Mitsui Chemicals (Japan) (U.S. Pat. No. 7,166,240), the compounds shown below have the absorption spectra at 390 to 430 nm, with luminous efficiency of 4.6 cd/A. However, on the basis of these data, the compounds with above absorption wavelength range, electroluminescence of greenish blue color is anticipated, and the Patent Publication also indicates the color as bluish green color.

Particularly, embodiment of pure blue color is impossible with the symmetrical structure of the Patent Publication, and the material, which cannot provide pure blue luminescence, is inadequate to be practically applied to a full-colored display.



SUMMARY OF THE INVENTION

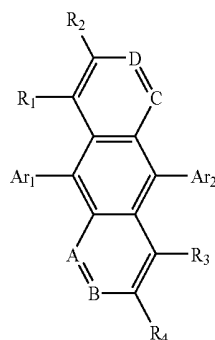
With intensive efforts to overcome the problems of conventional techniques as described above, the present inventors have invented novel electroluminescent compounds to realize an organic electroluminescent device having excellent luminous efficiency and noticeably improved lifetime.

The object of the present invention is to provide organic electroluminescent compounds having the backbone to give more excellent electroluminescent properties, longer device life and appropriate color coordinate, as compared to those of conventional host materials, with overcoming disadvantages of them.

Another object of the invention is to provide organic electroluminescent devices of high efficiency and long life, which employ said organic electroluminescent compounds as electroluminescent material.

Thus, the present invention relates to organic electroluminescent compounds represented by Chemical Formula (1), and organic electroluminescent devices comprising the same. Since the organic electroluminescent compounds according to the invention have good luminous efficiency and excellent color purity and life property of material, OLED's having very good operation life can be manufactured therefrom.

Chemical Formula 1

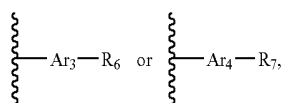


30 In Chemical Formula (1), A, B, C and D independently represent CR₅ or N, provided that A, B, C and D cannot represent CR₅ all at the same time;

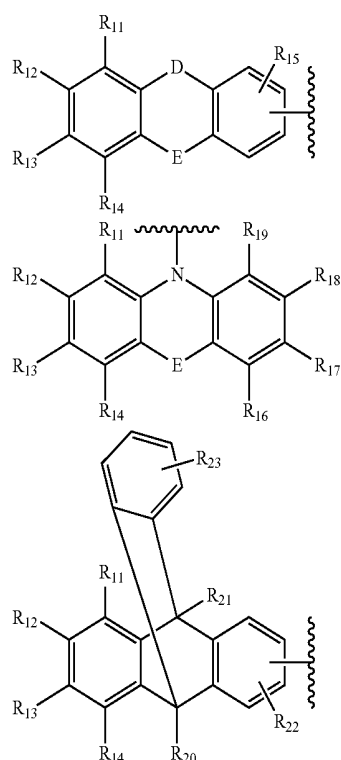
R₁ through R₅ independently represent hydrogen, halogen, (C1-C60)alkyl, (C6-C60)aryl, (C3-C60)heteroaryl, 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O, S and Si, (C3-C60)cycloalkyl, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl, tri(C6-C60)arylsilyl, adamantyl, (C7-C60)bicycloalkyl, (C2-C60)alkenyl, (C2-C60)alkynyl, (C1-C60)alkoxy, cyano, (C1-C60)alkylamino, (C6-C60)arylamino, (C6-C60)ar(C1-C60)alkyl, (C6-C60)aryloxy, (C6-C60)arylthio, (C1-C60)alkylthio, (C1-C60)alkoxycarbonyl, (C1-C60)alkylcarbonyl, (C6-C60)arylcarbonyl, carboxyl, nitro or hydroxyl, or R₁ and R₂ or R₃ and R₄ may be independently linked via (C3-C60)alkylene or (C3-C60)alkenylene with or without a fused ring to form an alicyclic ring, a mono- or a poly-cyclic aromatic ring; the alkylene or alkenylene may be further substituted by one or more substituent(s) selected from halogen, (C1-C60)alkyl, (C6-C60)aryl, (C3-C60)heteroaryl, 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O, S and Si, (C3-C60)cycloalkyl, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl, tri(C6-C60)arylsilyl, adamantyl, (C7-C60)bicycloalkyl, (C2-C60)alkenyl, (C2-C60)alkynyl, (C1-C60)alkoxy, cyano, (C1-C60)alkylamino, (C6-C60)arylamino, (C6-C60)ar(C1-C60)alkyl, (C6-C60)aryloxy, (C1-C60)alkylthio, (C6-C60)arylthio, (C1-C60)alkoxycarbonyl, (C1-C60)alkylcarbonyl, (C6-C60)arylcarbonyl, carboxyl, nitro and hydroxyl;

60 Ar₁ and Ar₂ independently represent (C1-C60)alkyl, (C6-C60)aryl, (C3-C60)heteroaryl, 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O, S and Si, (C3-C60)cycloalkyl, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl, tri(C6-C60)arylsilyl, adamantyl, (C7-C60)bicycloalkyl, (C2-C60)alkenyl, (C2-C60)alkynyl, (C1-C60)alkoxy, cyano, (C1-C60)alkylamino, (C6-C60)arylamino, (C6-C60)ar(C1-C60)alkyl, (C6-C60)

aryloxy, (C6-C60)arylthio, (C1-C60)alkylthio, (C1-C60)alkoxycarbonyl, (C1-C60)alkylcarbonyl, (C6-C60)arylcarbonyl, carboxyl, nitro, hydroxyl,



or a substituent represented by one of the following structural formulas:



Ar₃ and Ar₄ independently represent (C1-C60)alkylenoxy, (C1-C60)alkylenethio, (C6-C60)arylenoxy, (C6-C60)arylenethio, (C6-C60)arylene or (C3-C60)heteroarylene;

R₆ and R₇ independently represent (C1-C60)alkyl, (C6-C60)aryl, (C3-C60)heteroaryl, 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O, S and Si, (C3-C60)cycloalkyl, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl, tri(C6-C60)arylsilyl, adamantyl, (C7-C60)bicycloalkyl, (C2-C60)alkenyl, (C2-C60)alkynyl, (C1-C60)alkoxy, cyano, (C1-C60)alkylamino, (C6-C60)arylamino, (C6-C60)ar(C1-C60)alkyl, (C6-C60)aryloxy, (C6-C60)arylthio, (C1-C60)alkylthio, (C1-C60)alkoxycarbonyl, (C1-C60)alkylcarbonyl, (C6-C60)arylcarbonyl, carboxyl, nitro or hydroxyl;

R₃₁ through R₂₃ independently represent hydrogen, halogen, (C1-C60)alkyl, (C6-C60)aryl, (C3-C60)heteroaryl, 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O, S and Si, (C3-C60)cycloalkyl, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl, tri(C6-C60)arylsilyl, adamantyl, (C7-C60)bicycloalkyl, (C2-C60)alkenyl, (C2-C60)alkynyl, (C1-C60)alkoxy, cyano, (C1-C60)alkylamino, (C6-C60)arylamino, (C6-C60)ar(C1-C60)alkyl, (C6-C60)aryloxy, (C6-C60)arylthio, (C1-C60)alkylthio, (C1-C60)alkoxycarbonyl, (C1-C60)alkylcarbonyl, (C6-C60)arylcarbonyl, carboxyl, nitro or hydroxyl; or each of R₁₁ through R₂₃ may be linked to an adjacent substituent via (C3-C60)alkylene or (C3-C60)alkenylene with or without a fused ring to form an alicyclic ring, a monocyclic or polycyclic aromatic ring;

D and E independently represent a chemical bond, —(CR₃₁R₃₂)_a—, —N(R₃₃)—, —S—, —O—, —Si(R₃₄)(R₃₅)—, —P(R₃₆)—, —C(=O)—, —B(R₃₇)—, —In(R₃₈)—, —Se—, —Ge(R₃₉)(R₄₀)—, —Sn(R₄₁)(R₄₂)—, Ga(R₄₃)— or —(R₄₄)C=C(R₄₅)—;

R₃₁ through R₄₅ independently represent hydrogen, halogen, (C1-C60)alkyl, (C6-C60)aryl, (C3-C60)heteroaryl, 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O, S and Si, (C3-C60)cycloalkyl, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl, tri(C6-C60)arylsilyl, adamantyl, (C7-C60)bicycloalkyl, (C2-C60)alkenyl, (C2-C60)alkynyl, (C1-C60)alkoxy, cyano, (C1-C60)alkylamino, (C6-C60)arylamino, (C6-C60)ar(C1-C60)alkyl, (C6-C60)aryloxy, (C6-C60)arylthio, (C1-C60)alkylthio, (C1-C60)alkoxycarbonyl, (C1-C60)alkylcarbonyl, (C6-C60)arylcarbonyl, carboxyl, nitro or hydroxyl; or R₃₁, and R₃₂, R₃₄ and R₃₅, R₃₉ and R₄₀, R₄₁ and R₄₂, or R₄₄ and R₄₅ may be linked via (C3-C60)alkylene or (C3-C60)alkenylene with or without a fused ring to form an alicyclic ring, or a monocyclic or polycyclic aromatic ring;

the alkyl, aryl, heteroaryl, heterocycloalkyl, cycloalkyl, trialkylsilyl, dialkylarylsilyl, triarylsilyl, adamantyl, bicycloalkyl, alkenyl, alkynyl, alkylamino, arylamino, alkylthio, aryloxy, arylthio of R₁, through R₉, Ar₁, Ar₂, R₁₁ through R₂₃ and R₃₁ through R₄₅; and alkylenoxy, alkylenethio, arylenoxy, arylenethio, arylene or heteroarylene of Ar₃ and Ar₄ may be further substituted by one or more substituent(s) selected from halogen, (C1-C60)alkyl with or without halogen substituent(s), (C6-C60)aryl, (C3-C60)heteroaryl with or without (C6-C60)aryl substituent(s), 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O, S and Si, (C3-C60)cycloalkyl, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl, tri(C6-C60)arylsilyl, adamantyl, (C7-C60)bicycloalkyl, (C2-C60)alkenyl, (C2-C60)alkynyl, (C1-C60)alkoxy, cyano, (C1-C60)alkylamino, (C6-C60)arylamino, (C6-C60)ar(C1-C60)alkyl, (C6-C60)aryloxy, (C6-C60)arylthio, (C1-C60)alkylthio, (C1-C60)alkoxycarbonyl, (C1-C60)alkylcarbonyl, (C6-C60)arylcarbonyl, carboxyl, nitro and hydroxyl; and a is an integer from 0 to 4.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-sectional view of an OLED.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the Drawings, FIG. 1 illustrates a cross-sectional view of an OLED of the present invention comprising a Glass 1, Transparent electrode 2, Hole injecting layer 3, Hole transport layer 4, Electroluminescent layer 5, Electron transport layer 6, Electron injecting layer 7 and Al cathode 8.

The “alkyl”, “alkoxy” or other substituents containing “alkyl” moiety described in the present invention may be linear or branched species.

The term “aryl” described herein means an organic radical derived from aromatic hydrocarbon via elimination of one hydrogen atom. Each ring suitably comprises a monocyclic or fused ring system containing from 4 to 7, preferably from 5 to 6 cyclic atoms. Specific examples include phenyl, naphthyl, biphenyl, anthryl, tetrahydronaphthyl, indanyl, fluorenyl, phenanthryl, triphenylenyl, pyrenyl, perylenyl, chrysenyl, naphthaceny and fluorantheny, but they are not restricted thereto.

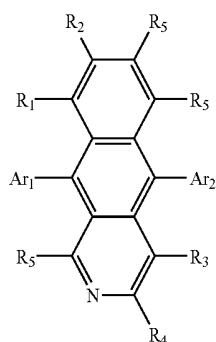
The term “heteroaryl” described herein means an aryl group containing from 1 to 4 heteroatom(s) selected from N, O, S and Si for the aromatic cyclic backbone atoms, and carbon atom(s) for remaining aromatic cyclic backbone atoms. The heteroaryl may be 5- or 6-membered monocyclic heteroaryl or a polycyclic heteroaryl which is fused with one or more benzene ring(s), and may be partially saturated. The heteroaryl groups may include divalent aryl groups of which

the heteroatoms are oxidized or quaternized to form N-oxides, quaternary salts, or the like. Specific examples include monocyclic heteroaryl groups such as furyl, thiophenyl, pyrrolyl, pyranlyl, imidazolyl, pyrazolyl, thiazolyl, thiadiazolyl, isothiazolyl, isoxazolyl, oxazolyl, oxadiazolyl, triazinyl, tetrazinyl, triazolyl, tetrazolyl, furazanyl, pyridyl, pyrazinyl, pyrimidinyl, pyridazinyl; polycyclic heteroaryl groups such as benzofuranyl, benzothiophenyl, isobenzofuranyl, benzimidazolyl, benzothiazolyl, benzisothiazolyl, benzisoxazolyl, benzoxazolyl, isoindolyl, indolyl, indazolyl, benzothiadiazolyl, quinolyl, isoquinolyl, cinnolyl, quinazolyl, quinolizyl, quinoxalyl, carbazolyl, phenanthridinyl and benzodioxolyl; and corresponding N-oxides (for example, pyridyl N-oxide, quinolyl N-oxide) and quaternary salts thereof; but they are not restricted thereto.

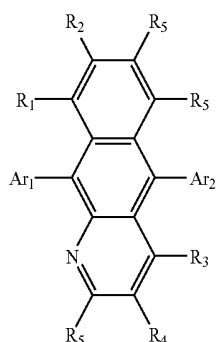
The naphthyl of Chemical Formula (1) may be 1-naphthyl or 2-naphthyl; the anthryl may be 1-anthryl, 2-anthryl or 9-anthryl; and the fluorenyl may be 1-fluorenyl, 2-fluorenyl, 3-fluorenyl, 4-fluorenyl or 9-fluorenyl.

The substituents comprising "(C1-C60)alkyl" moiety described herein may contain 1 to 60 carbon atoms, 1 to 20 carbon atoms, or 1 to 10 carbon atoms. The substituents comprising "(C6-C60)aryl" moiety may contain 6 to 60 carbon atoms, 6 to 20 carbon atoms, or 6 to 12 carbon atoms. The substituents comprising "(C3-C60)heteroaryl" moiety may contain 3 to 60 carbon atoms, 4 to 20 carbon atoms, or 4 to 12 carbon atoms. The substituents comprising "(C3-C60)cycloalkyl" moiety may contain 3 to 60 carbon atoms, 3 to 20 carbon atoms, or 3 to 7 carbon atoms. The substituents comprising "(C2-C60)alkenyl or alkynyl" moiety may contain 2 to 60 carbon atoms, 2 to 20 carbon atoms, or 2 to 10 carbon atoms.

The organic electroluminescent compounds according to the present invention may be selected from the compounds represented by one of Chemical Formulas (2) to (7):



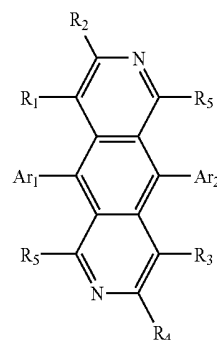
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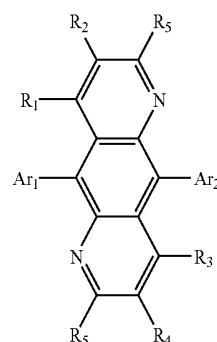
Chemical Formula 3

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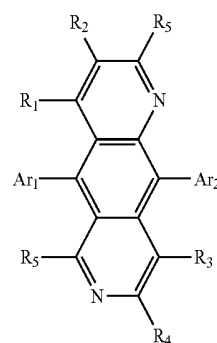
Chemical Formula 4



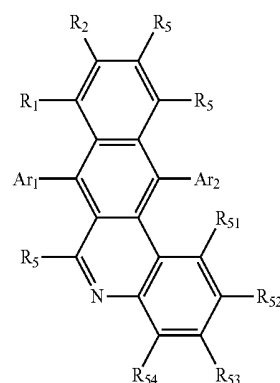
Chemical Formula 5



Chemical Formula 6



Chemical Formula 7



wherein, Ar₁, Ar₂ and R₁ through R₅ are defined as in Chemical Formula (1);

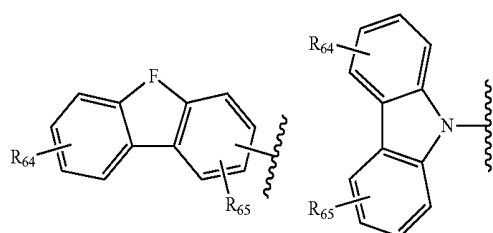
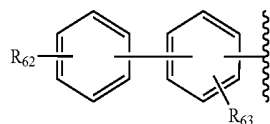
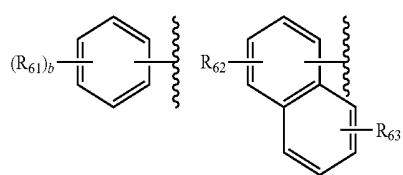
R₅₁ through R₅₄ independently represent hydrogen, halogen, (C1-C60)alkyl, (C6-C60)aryl, (C3-C60)heteroaryl, 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O, S and Si, (C3-C60)cycloalkyl, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl, tri(C6-C60)arylsilyl, adamantyl, (C7-C60)bicycloalkyl, (C2-C60)alkenyl, (C2-C60)alkynyl, (C1-C60)alkoxy, cyano, (C1-C60)alkylamino, (C6-C60)arylamino, (C6-C60)ar(C1-C60)alkyl, (C6-C60)aryloxy, (C1-C60)alkylthio, (C6-C60)arylthio, (C1-C60)alkoxycarbonyl, (C1-C60)alkylcarbonyl,

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(C6-C60)arylcarbonyl, carboxyl, nitro or hydroxyl, or R_{52} and R_{53} may be linked via (C3-C60)alkylene or (C3-C60)alkenylene with or without a fused ring to form an alicyclic ring, or a monocyclic or polycyclic aromatic ring;

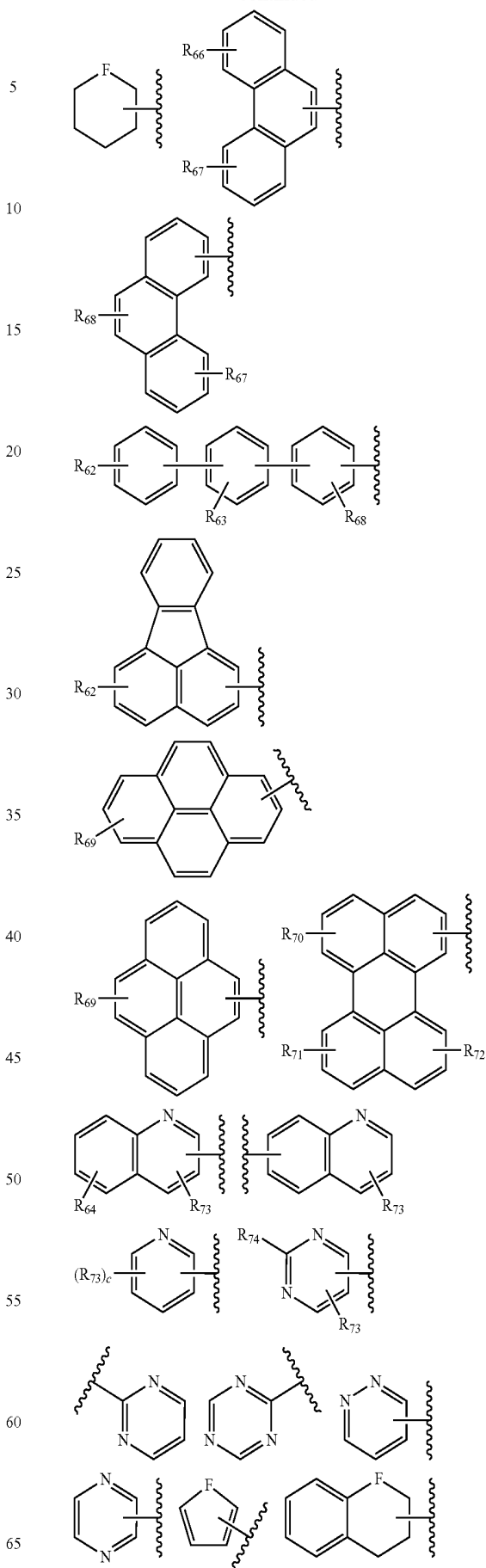
R_1 through R_5 independently represent hydrogen, chloro, fluoro, methyl, ethyl, n-propyl, i-propyl, n-butyl, i-butyl, t-butyl, n-pentyl, i-pentyl, n-hexyl, n-heptyl, n-octyl, 2-ethylhexyl, n-nonyl, decyl, dodecyl, hexadecyl, benzyl, trifluoromethyl, perfluoroethyl, trifluoroethyl, perfluoropropyl, perfluorobutyl, methoxy, ethoxy, n-propoxy, i-propoxy, n-butoxy, i-butoxy, t-butoxy, n-pentoxy, i-pentoxy, n-hexyloxy, n-heptoxy, cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, cycloheptyl, cyclooctyl, cyclononyl, cyclodecyl, morpholino, thiomorpholino, phenyl, naphthyl, biphenyl, 9,9-dimethylfluorenyl, 9,9-diphenylfluorenyl, phenanthryl, anthryl, fluoranthenyl, triphenylenyl, pyrenyl, chrysenyl, naphthacenyl, perylenyl, spirobifluorenyl, pyridyl, pyrrolyl, furanyl, thiophenyl, imidazolyl, benzimidazolyl, pyrazinyl, pyrimidinyl, pyridazinyl, quinolyl, triazinyl, benzofuranyl, benzothiofenyl, pyrazolyl, indolyl, carbazolyl, thiazolyl, oxazolyl, benzothiazolyl, benzoxazolyl, phenathrolinyl, trimethylsilyl, triethylsilyl, tripropylsilyl, tri(t-butyl)silyl, t-butyl dimethylsilyl, dimethylphenylsilyl, triphenylsilyl, adamantyl, bicyclo[2.2.1]heptyl, bicyclo[2.2.2]octyl, bicyclo[3.2.1]octyl, bicyclo[5.2.0]nonyl, bicyclo[4.2.2]decyl, bicyclo[2.2.2]octyl, 4-pentylbicyclo[2.2.2]octyl, ethenyl, phenylethenyl, ethynyl, phenylethynyl, cyano, dimethylamino, diphenylamino, monomethylamino, monophenylamino, phenyloxy, phenylthio, methoxycarbonyl, ethoxycarbonyl, t-butoxycarbonyl, methylcarbonyl, ethylcarbonyl, benzylcarbonyl, phenylcarbonyl, carboxyl, nitro or hydroxyl;

Ar_1 and Ar_2 are independently selected from methyl, ethyl, n-propyl, i-propyl, n-butyl, i-butyl, t-butyl, n-pentyl, i-pentyl, n-hexyl, n-heptyl, n-octyl, 2-ethylhexyl, n-nonyl, decyl, dodecyl, hexadecyl, benzyl, trifluoromethyl, perfluoroethyl, trifluoroethyl, perfluoropropyl, perfluorobutyl, trimethylsilyl, triethylsilyl, tripropylsilyl, tri(t-butyl)silyl, t-butyl dimethylsilyl, dimethylphenylsilyl, triphenylsilyl and the following structures, without restriction:



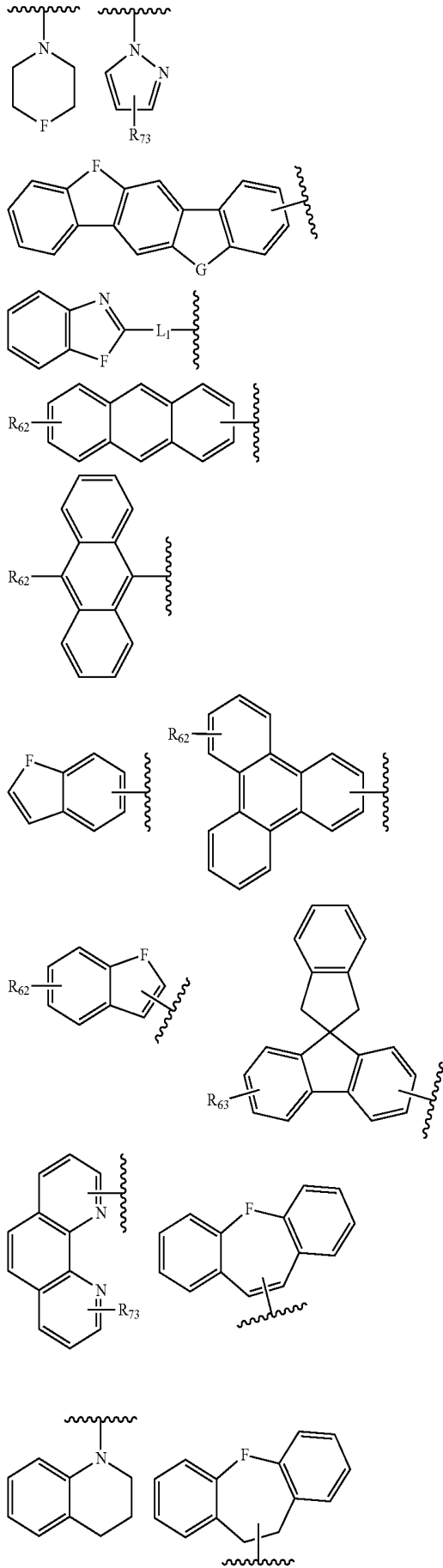
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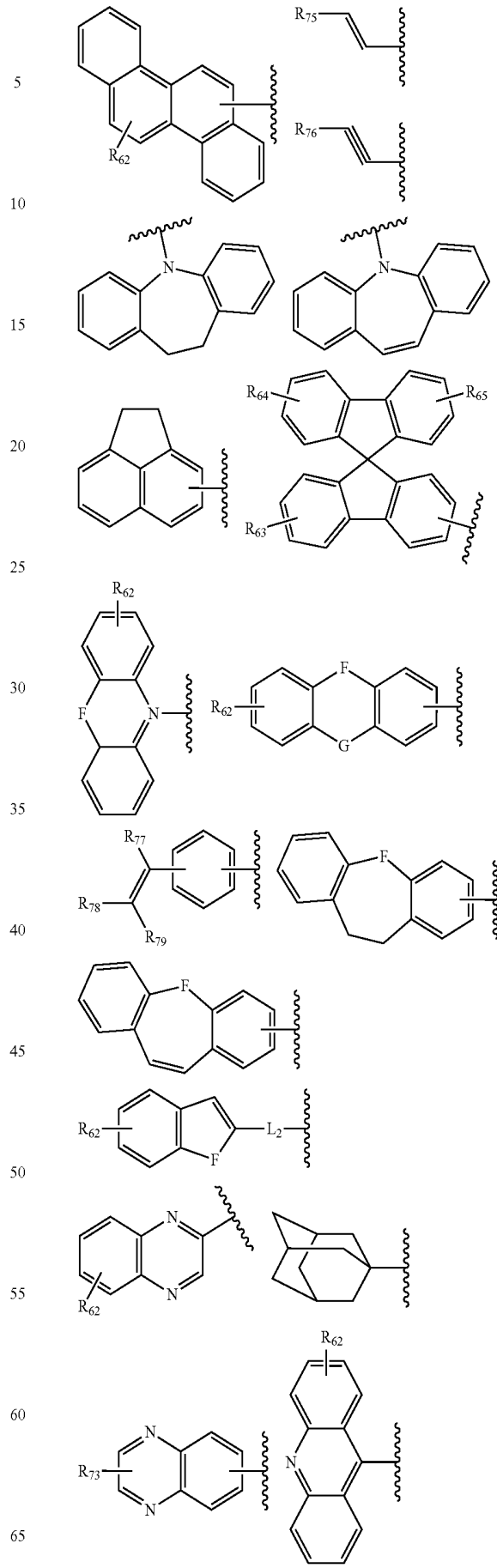
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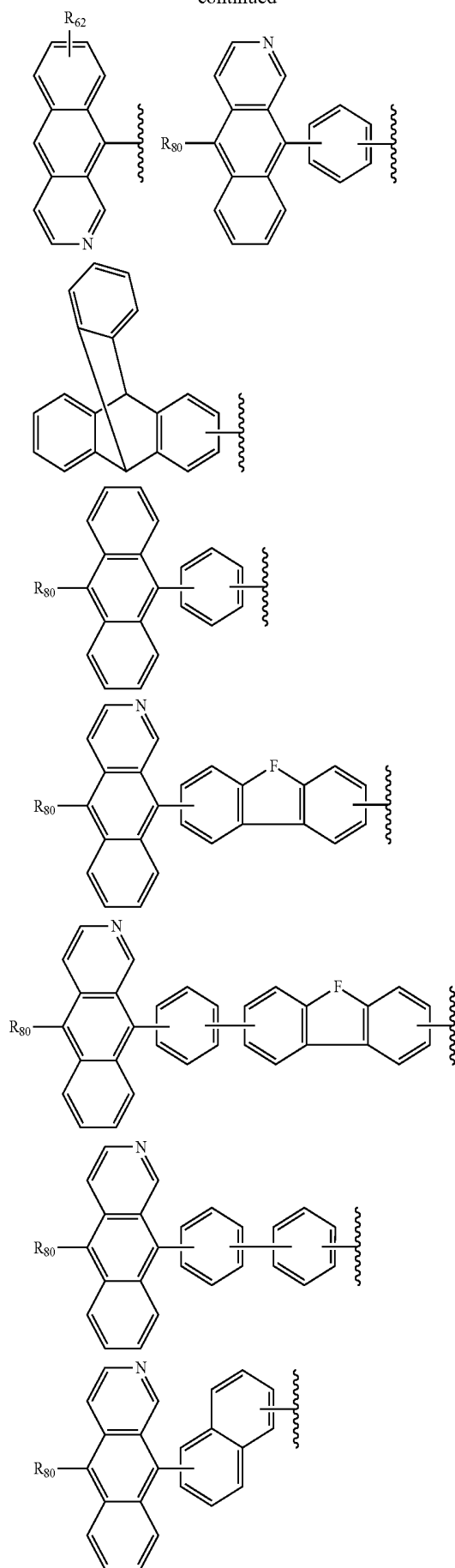
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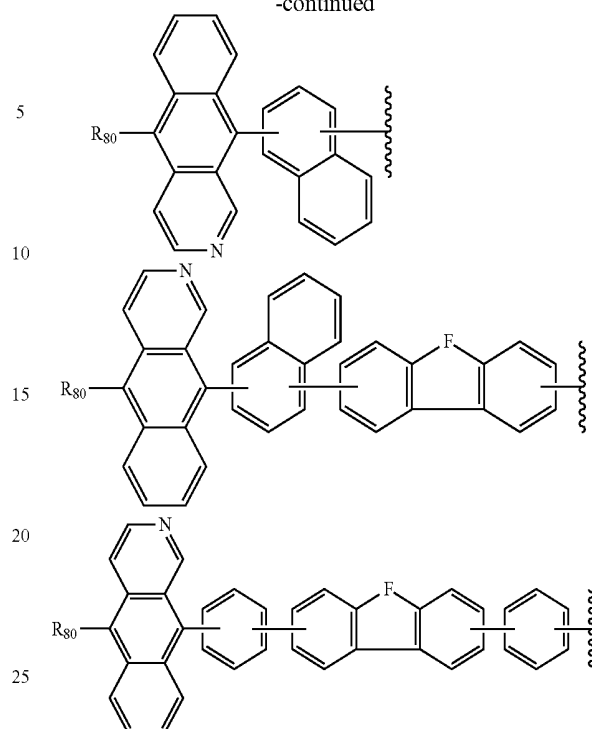
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wherein, R_{61} through R_{76} independently represent hydrogen, halogen, (C1-C60)alkyl, (C6-C60)aryl, (C3-C60)heteroaryl, 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O, S and Si, (C3-C60)cycloalkyl, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl, tri(C6-C60)arylsilyl, adamantyl, (C7-C60)bicycloalkyl, (C2-C60)alkenyl, (C1-C60)alkoxy, cyano, (C1-C60)alkylamino, (C6-C60)arylamino, (C6-C60)ar(C1-C60)alkyl, (C6-C60)aryloxy, (C6-C60)arylthio, (C1-C60)alkylthio, (C1-C60)alkoxycarbonyl, (C1-C60)alkylcarbonyl, (C6-C60)arylcarbonyl, carboxyl, nitro or hydroxyl; and the alkyl, aryl, heteroaryl, heterocycloalkyl, cycloalkyl, trialkylsilyl, dialkylarylsilyl, triarylsilyl, adamantyl, bicycloalkyl, alkenyl, alkynyl, alkylamino, arylamino, alkylthio, alkoxy, aryloxy or arylthio of R_{61} through R_{76} may be further substituted by halogen, (C1-C60)alkyl, (C6-C60)aryl, (C3-C60)heteroaryl, 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O, S and Si, (C3-C60)cycloalkyl, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl, tri(C6-C60)arylsilyl, adamantyl, (C7-C60)bicycloalkyl, (C2-C60)alkenyl, (C2-C60)alkynyl, (C1-C60)alkoxy, cyano, (C1-C60)alkylamino, (C6-C60)arylamino, (C6-C60)ar(C1-C60)alkyl, (C6-C60)aryloxy, (C6-C60)arylthio, (C1-C60)alkylthio, (C1-C60)alkoxycarbonyl, (C1-C60)alkylcarbonyl, (C6-C60)arylcarbonyl, carboxyl, nitro or hydroxyl;

R_{77} through R_{80} independently represent hydrogen, halogen, (C1-C60)alkyl with or without halogen substituent(s), (C6-C60)aryl, (C3-C60)heteroaryl with or without (C6-C60)aryl substituent(s), 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O, S and Si, (C3-C60)cycloalkyl, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl, tri(C6-C60)arylsilyl, adamantyl, (C7-C60)bicycloalkyl, (C2-C60)alkenyl, (C2-C60)alkynyl, (C1-C60)alkoxy, cyano, (C1-C60)alkylamino, (C6-C60)arylamino, (C6-C60)ar(C1-C60)alkyl, (C6-C60)aryloxy, (C6-C60)arylthio, (C1-C60)alkylthio, (C1-C60)alkoxycarbonyl, (C1-C60)alkylcarbonyl, (C6-C60)arylcarbonyl, carboxyl, nitro or hydroxyl;

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L_1 and L_2 independently represent a chemical bond, (C6-C60)arylene or (C3-C60)heteroarylene, wherein the arylene or heteroarylene of L_1 or L_2 may be further substituted by one or more substituent(s) selected from (C1-C60)alkyl, halogen, cyano, (C1-C60)alkoxy, (C3-C60)cycloalkyl, (C6-C60)aryl, (C3-C60)heteroaryl, adamantyl, (C7-C60)bicycloalkyl, cyano, (C1-C60)alkylamino, (C6-C60)arylamino, (C6-C60)ar(C1-C60)alkyl, (C6-C60)aryloxy, (C6-C60)arylthio, (C1-C60)alkylthio, (C1-C60)alkoxycarbonyl, (C1-C60)alkylcarbonyl, (C6-C60)arylcarbonyl, carboxyl, nitro, hydroxy, tri(C1-C30)alkylsilyl, di(C1-C30)alkyl(C6-C30)arylsilyl and tri(C6-C30)arylsilyl;

F and G independently represent a chemical bond, $-C(R_{81})(R_{82})-$, $-N(R_{83})-$, $-S-$, $-O-$, $-Si(R_{84})(R_{85})-$, $-P(R_{86})-$, $-C(=O)-$, $-B(R_{87})-$, $-In(R_{88})-$, $-Se-$, $-Ge(R_{89})(R_{90})-$, $-Sn(R_{91})(R_{92})-$ or $-Ga(R_{93})-$;

wherein R_{81} through R_{93} independently represent hydrogen, halogen, (C1-C60)alkyl, (C6-C60)aryl, (C3-C60)het-

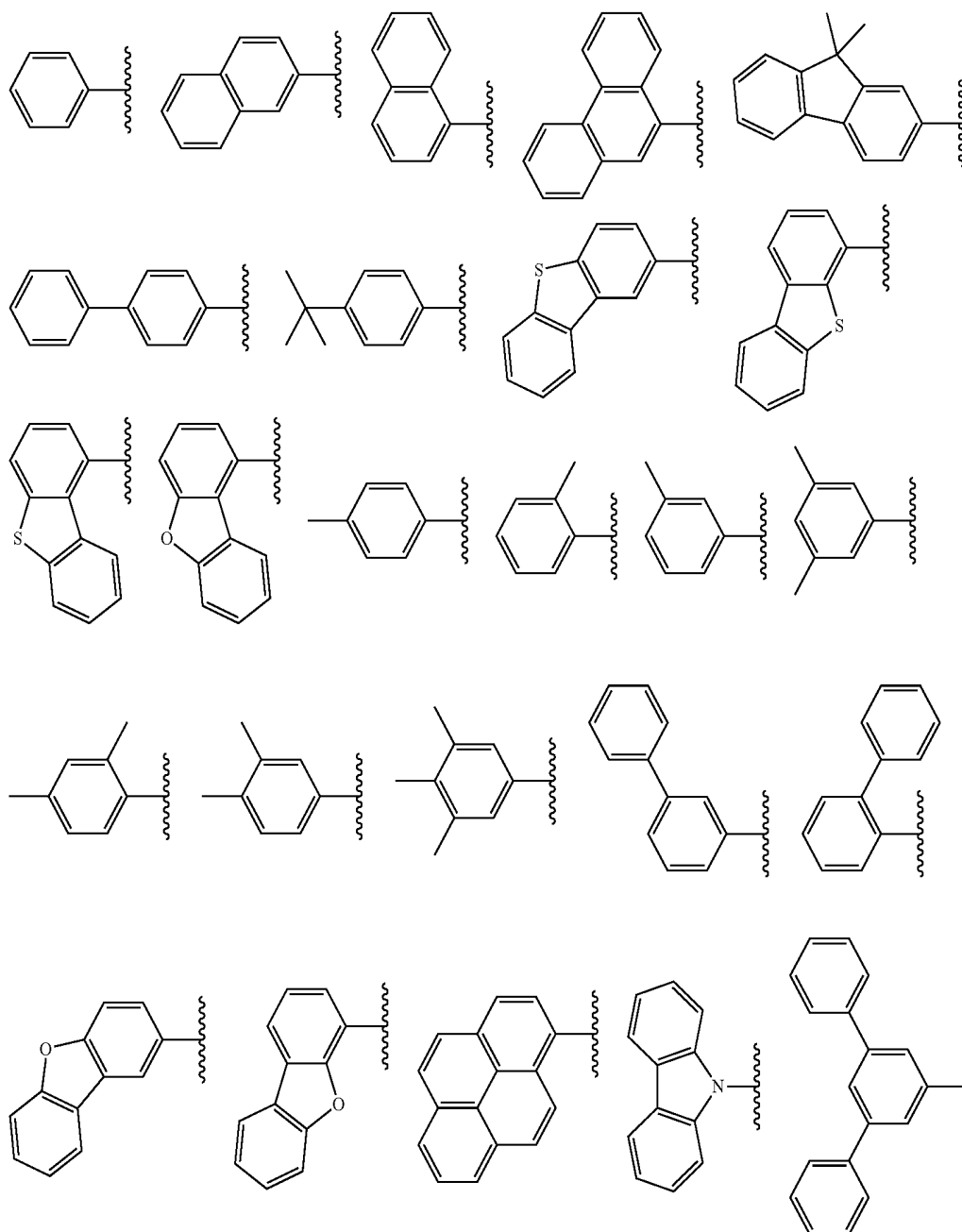
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eroaryl, 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O, S and Si, (C3-C60)cycloalkyl, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl, tri(C6-C60)arylsilyl, adamantyl, (C7-C60)bicycloalkyl, (C2-C60)alkenyl, (C2-C60)alkynyl, (C1-C60)alkoxy, cyano, (C1-C60)alkylamino, (C6-C60)arylamino, (C6-C60)ar(C1-C60)alkyl, (C6-C60)aryloxy, (C6-C60)arylthio, (C1-C60)alkylthio, (C1-C60)alkoxycarbonyl, (C1-C60)alkylcarbonyl, (C6-C60)arylcarbonyl, carboxyl, nitro or hydroxyl, or R_{81} and R_{82} , R_{84} and R_{85} , R_{89} and R_{90} , or R_{91} and R_{92} may be linked via (C3-C60)alkylene or (C3-C60)alkenylene with or without a fused ring to form an alicyclic ring, or a monocyclic or polycyclic aromatic ring;

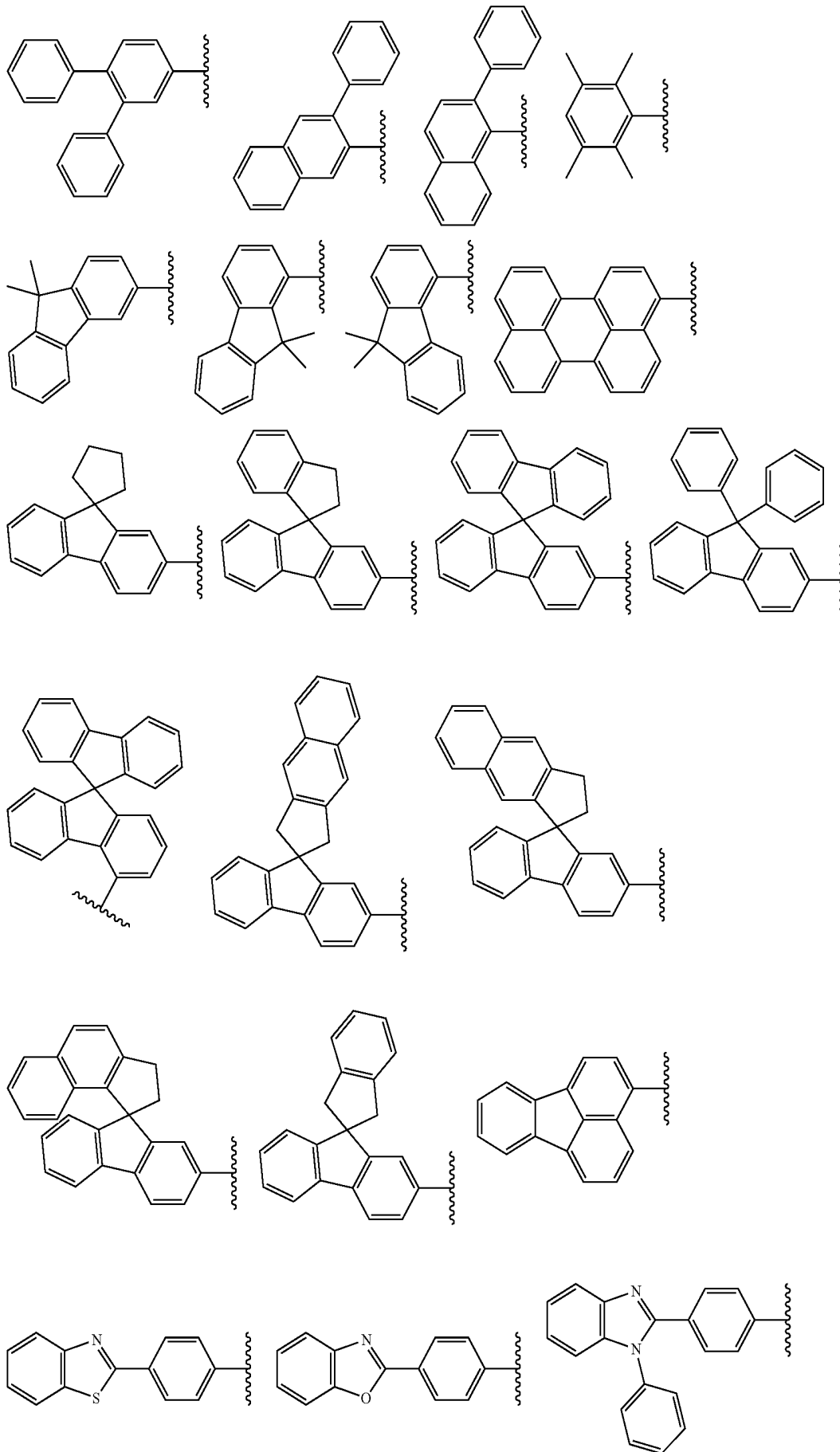
b is an integer from 1 to 5; and

c is an integer from 0 to 4.

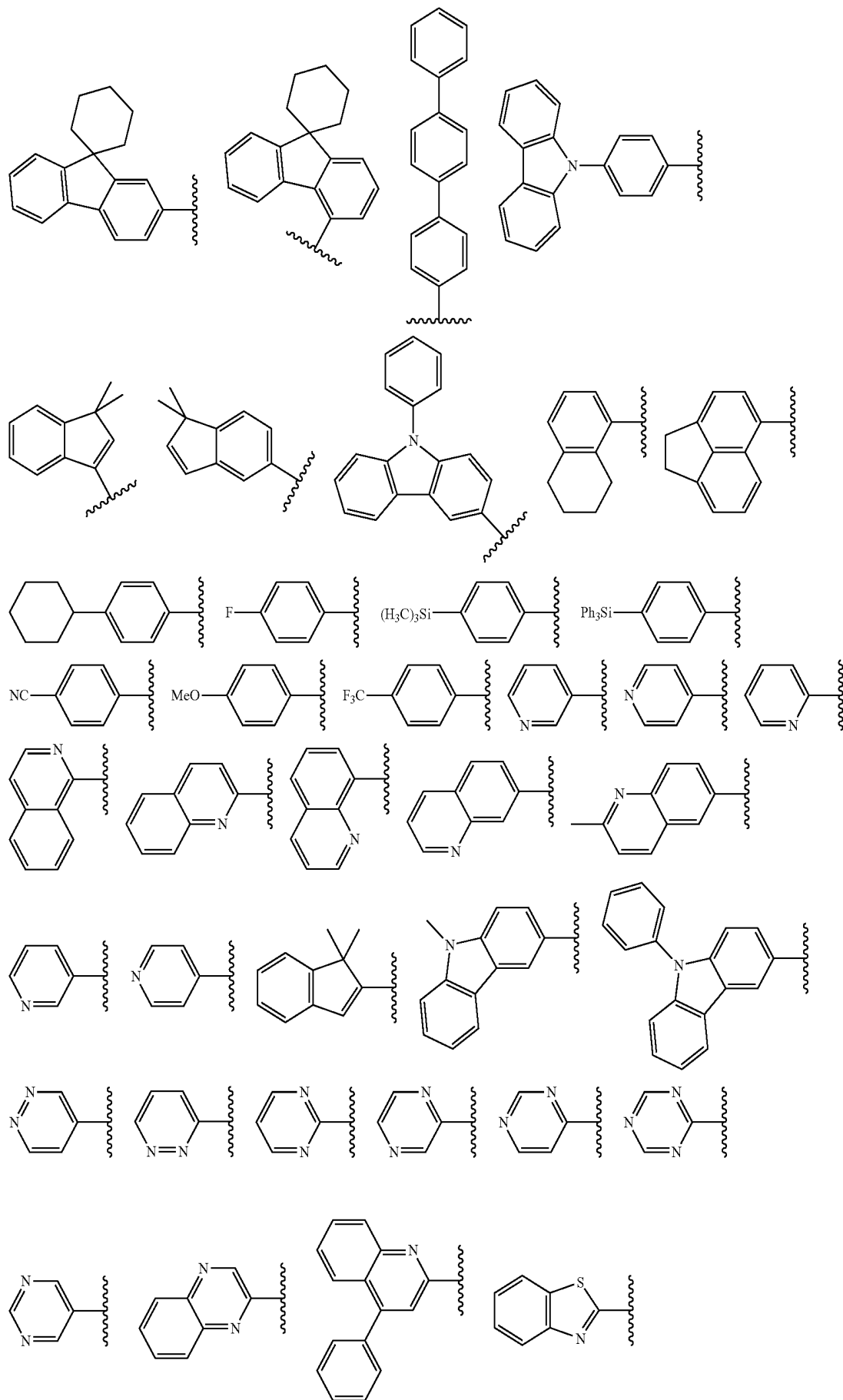
More specifically, Ar_1 and Ar_2 are independently selected from the following structures, without restriction:



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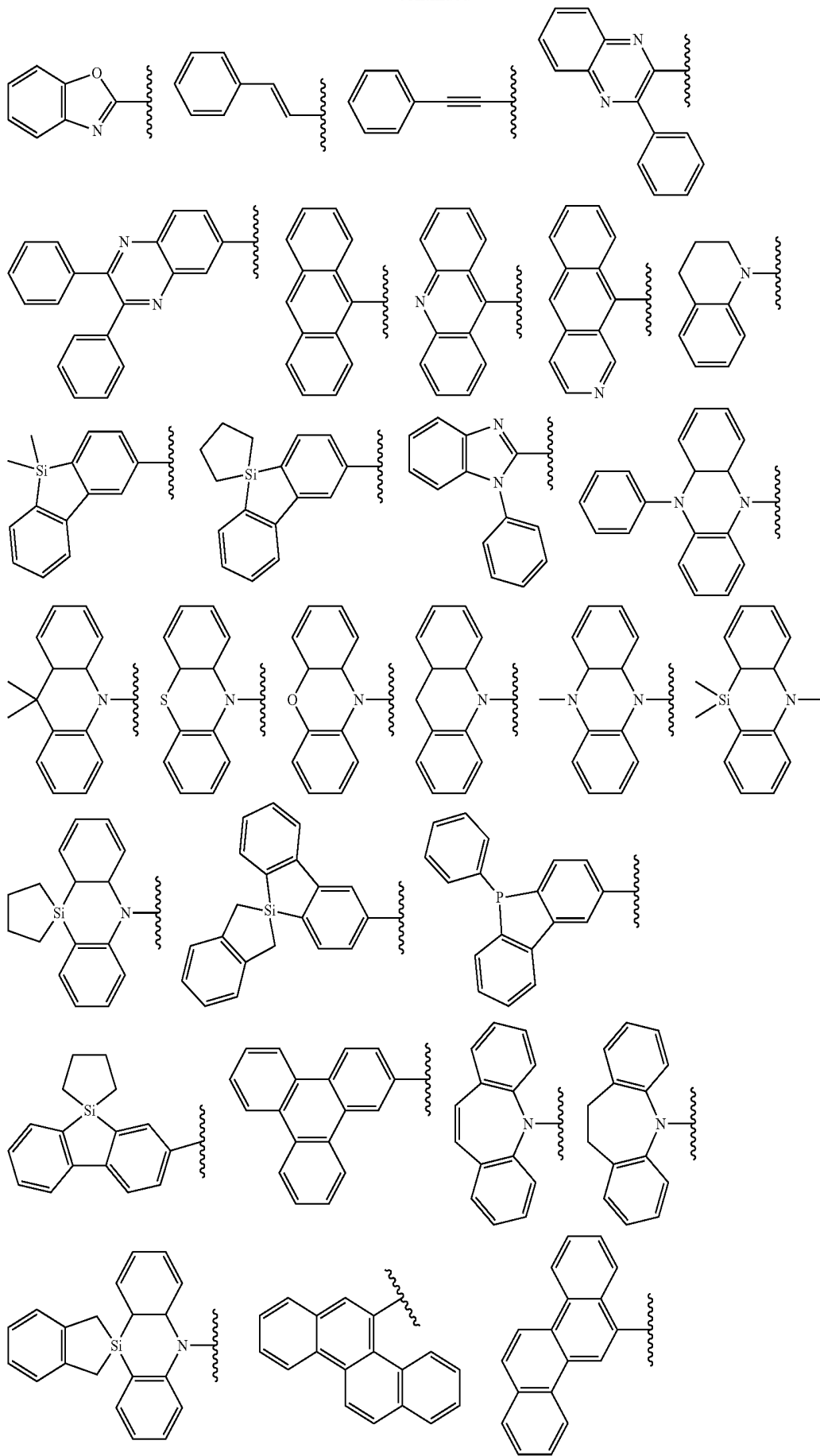
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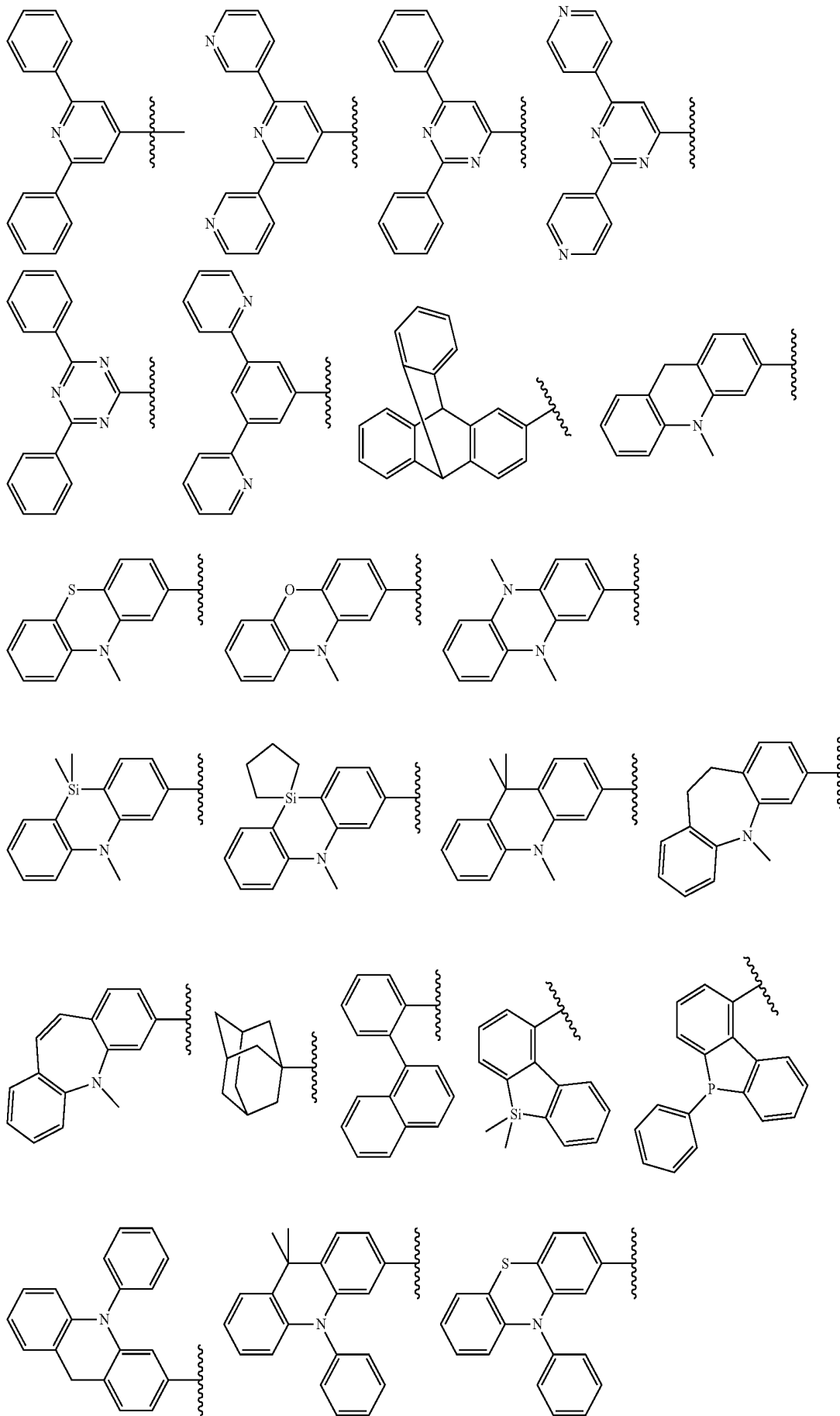
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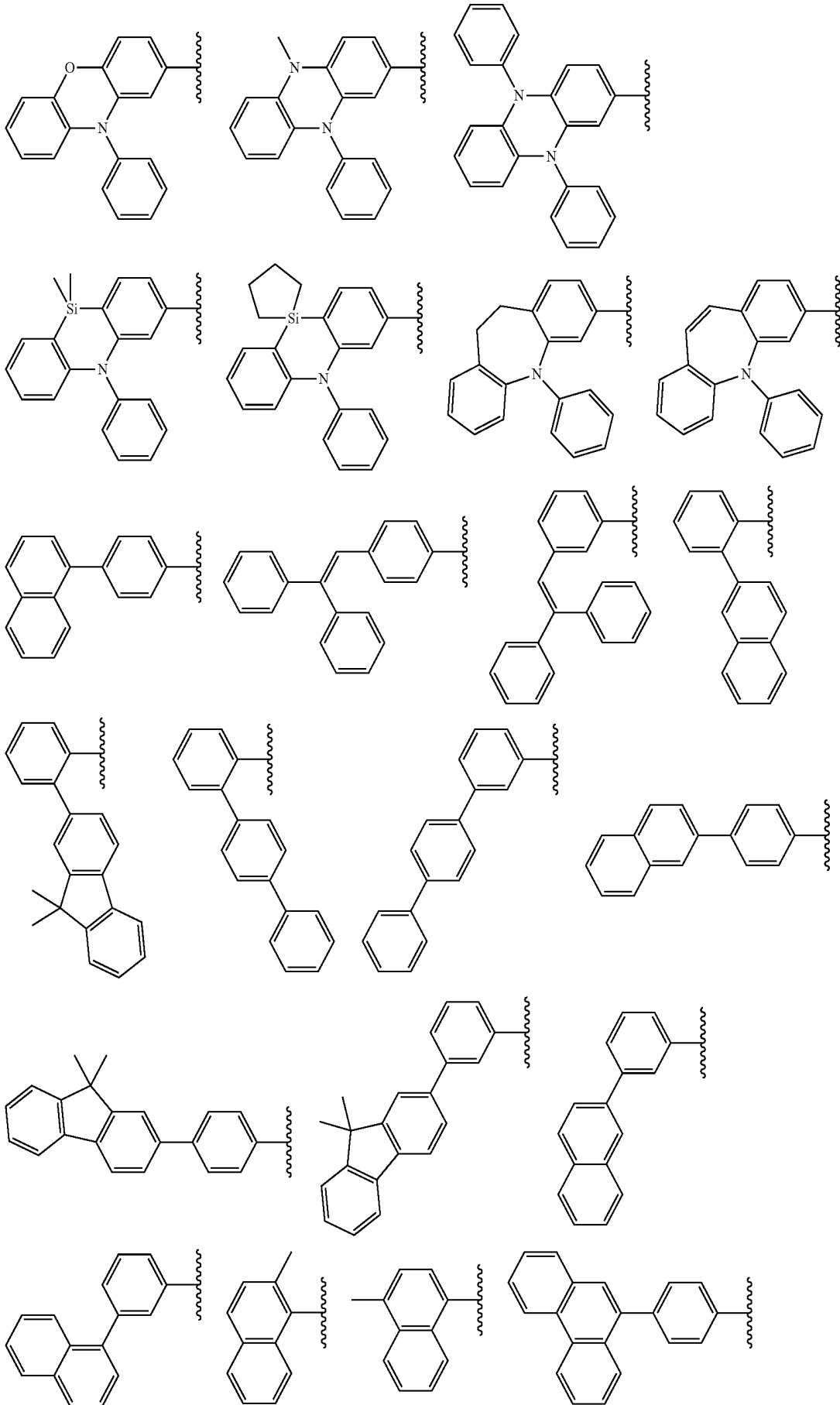
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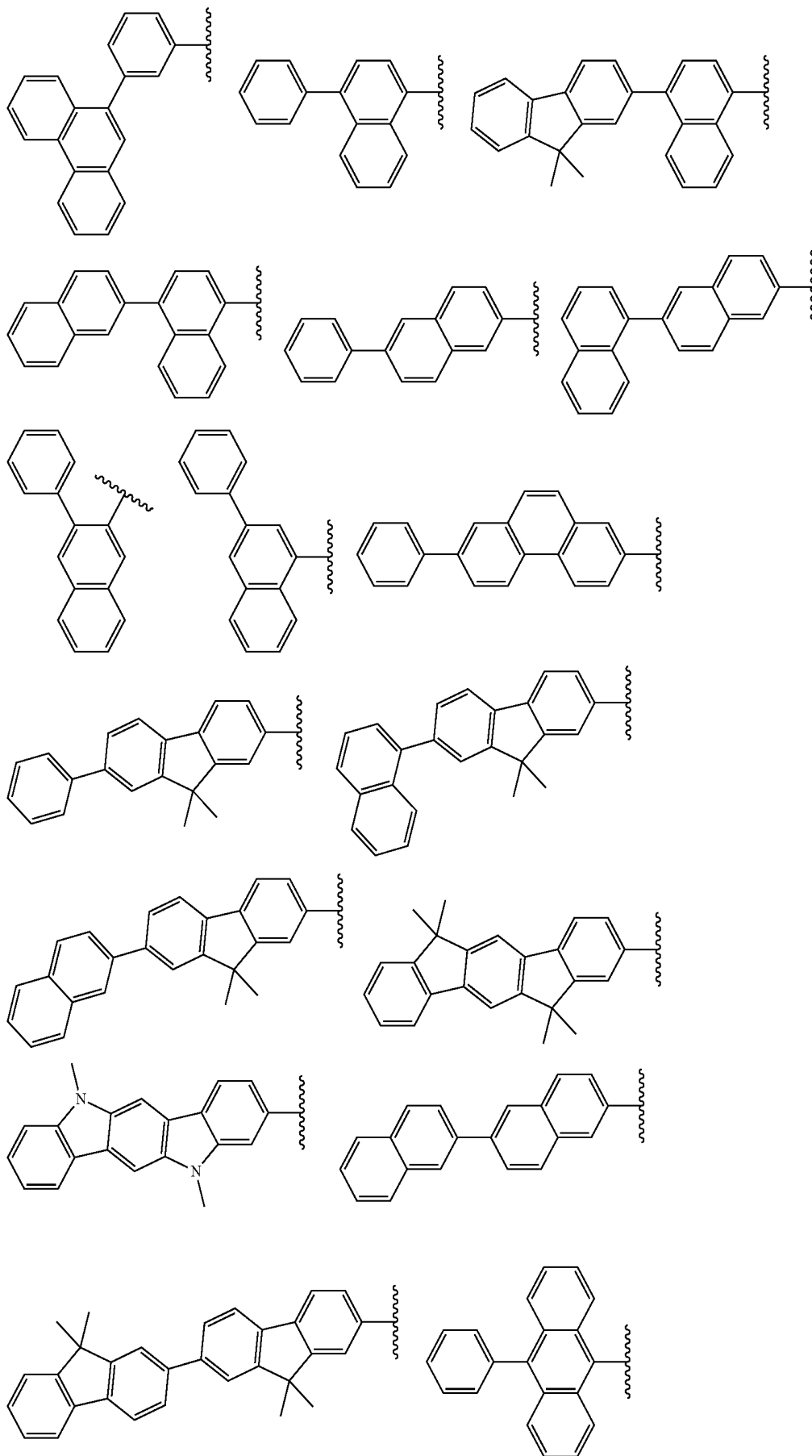
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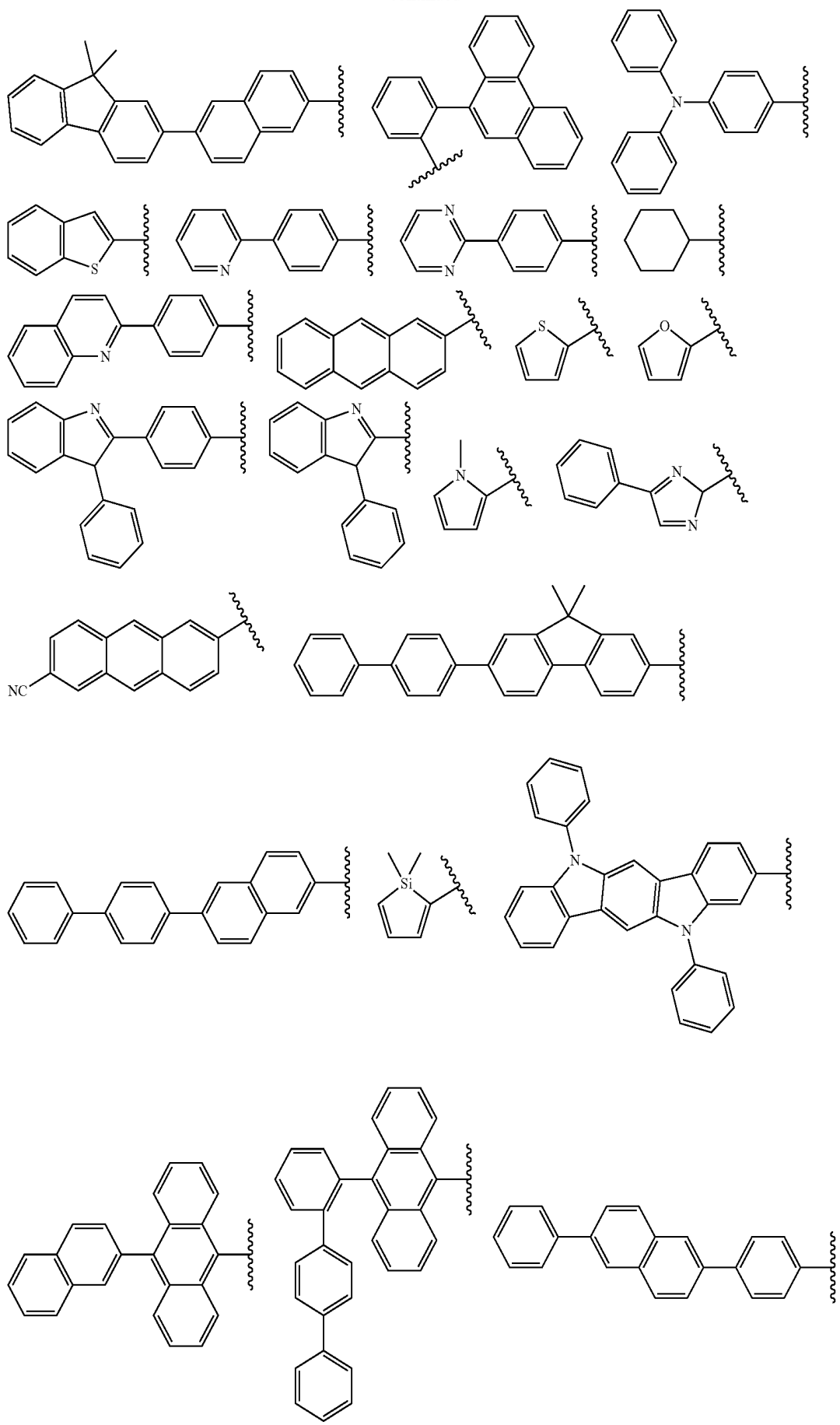
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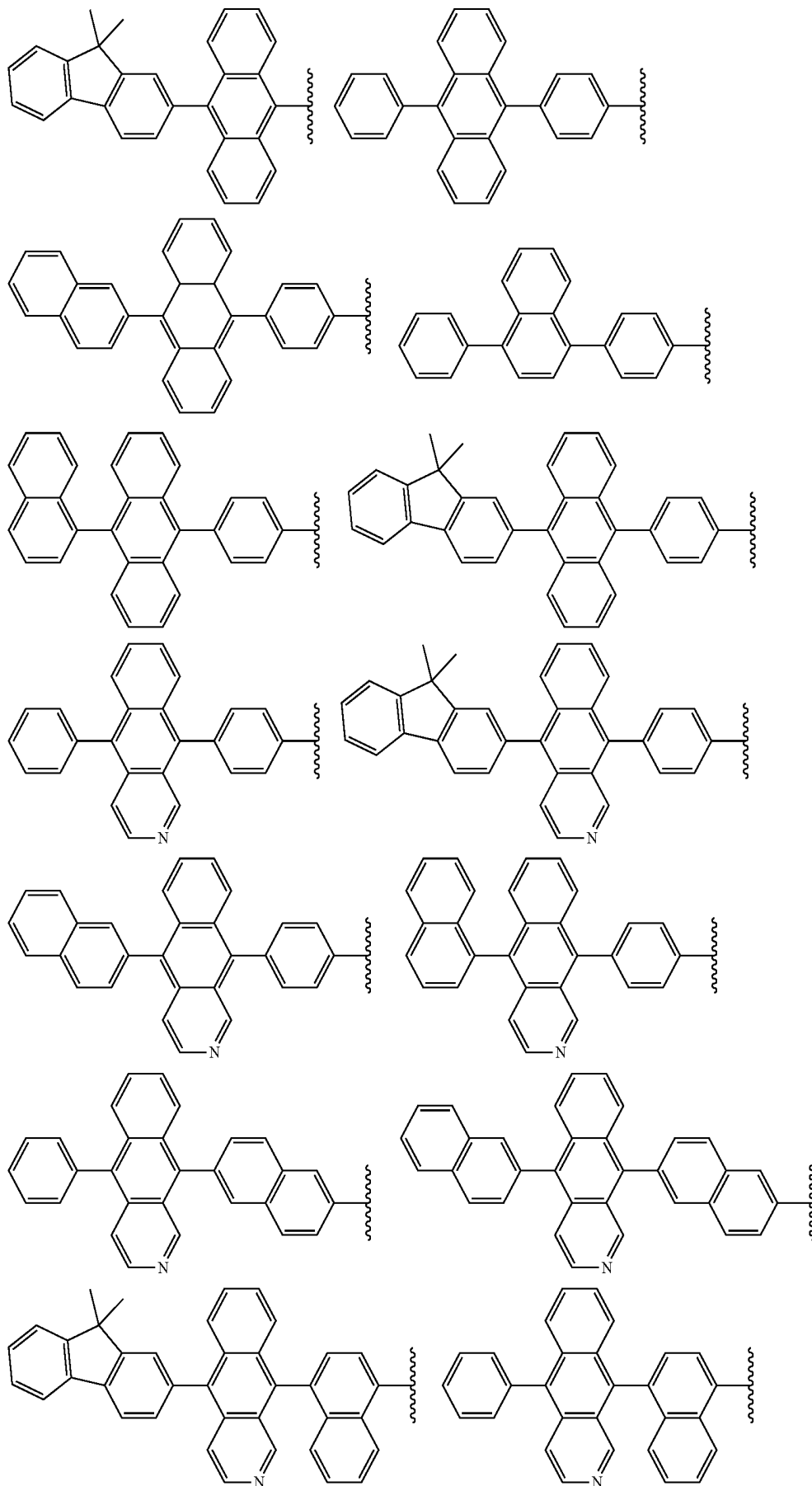
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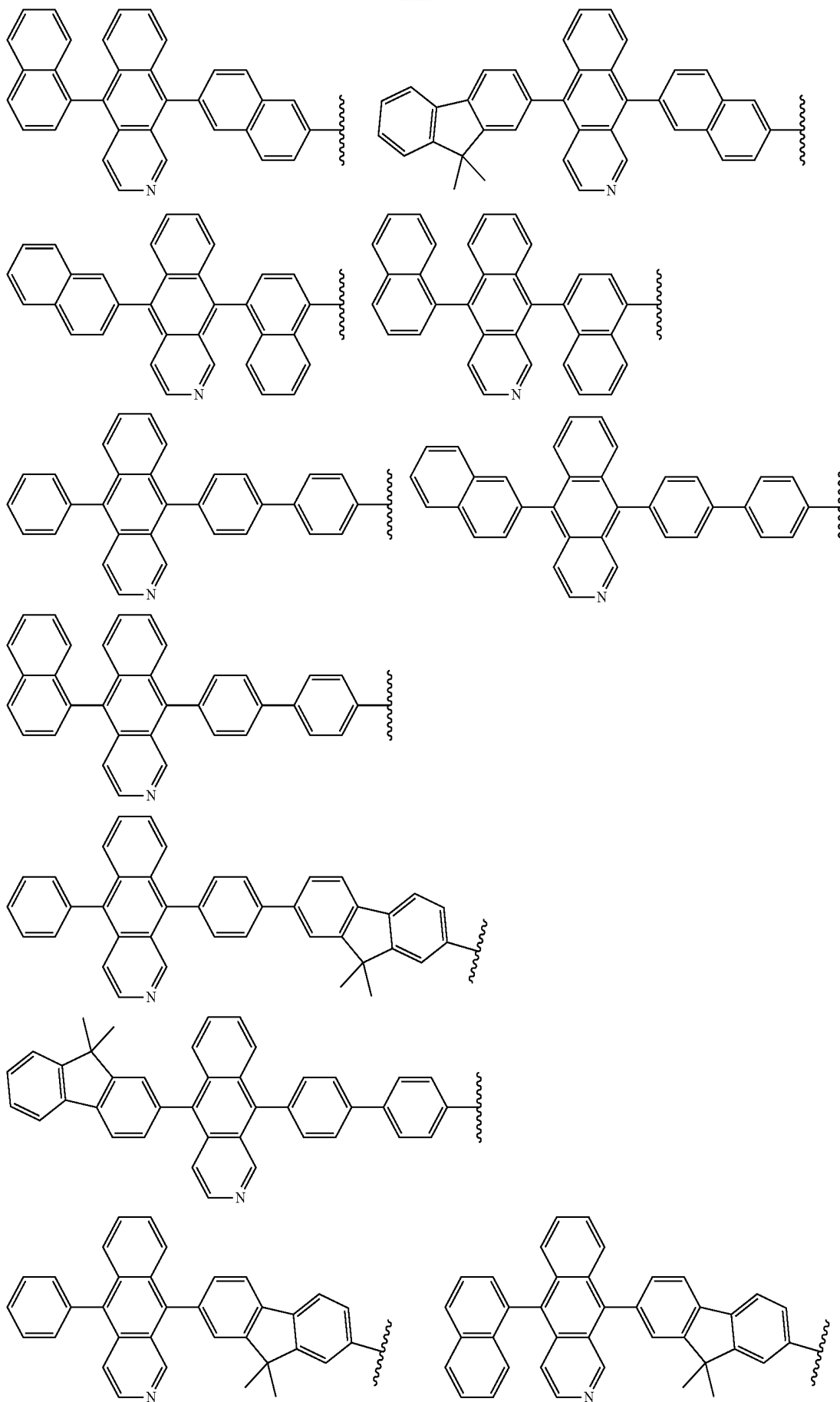
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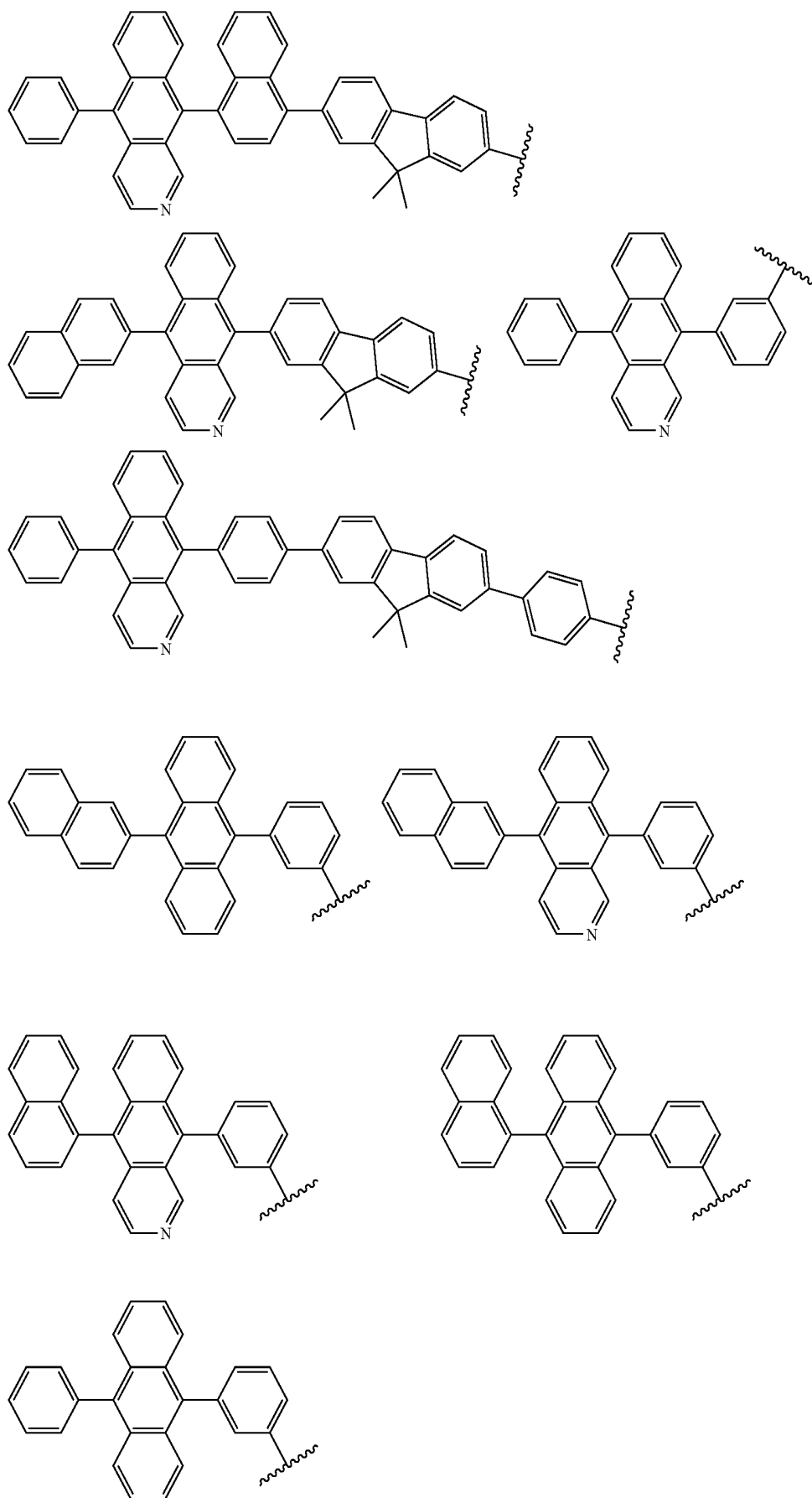
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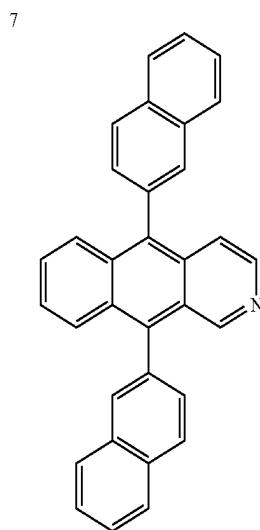
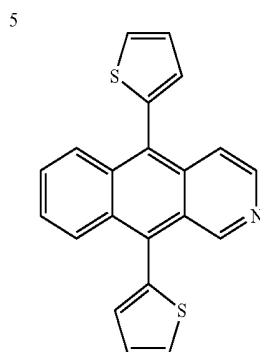
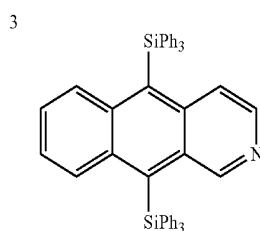
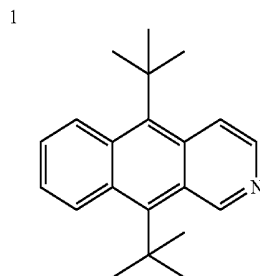
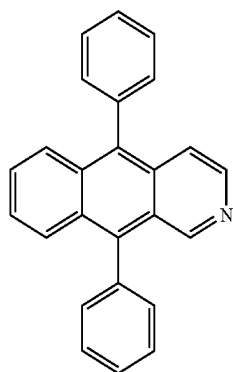
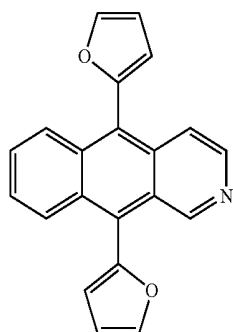
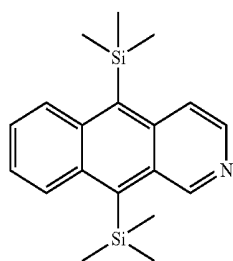
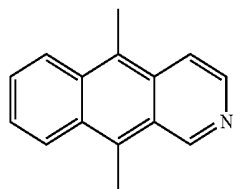
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The organic electroluminescent compounds according to the present invention can be more specifically exemplified by the following compounds, without restriction:



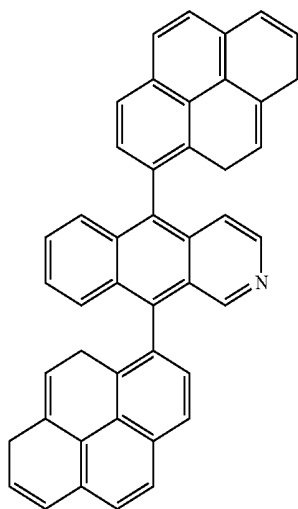
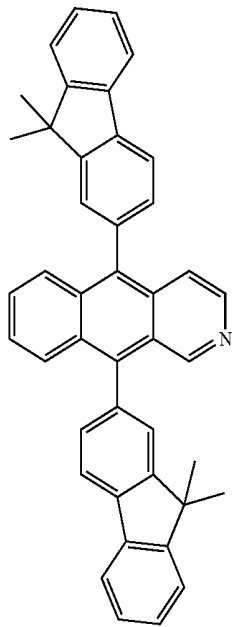
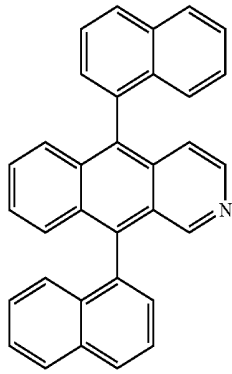
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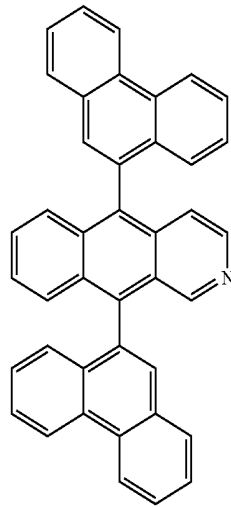
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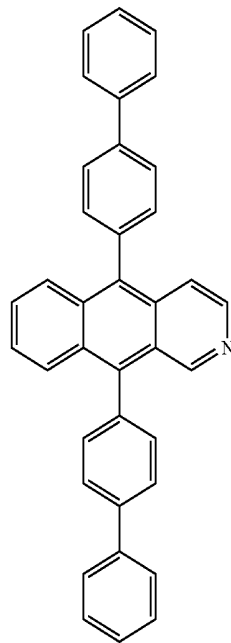


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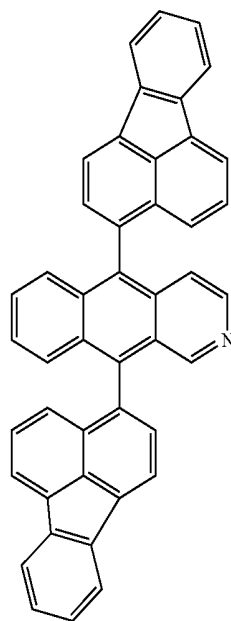
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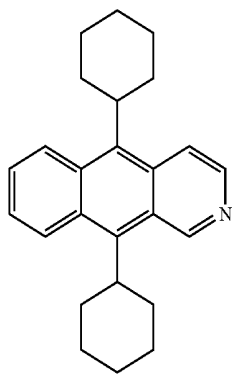
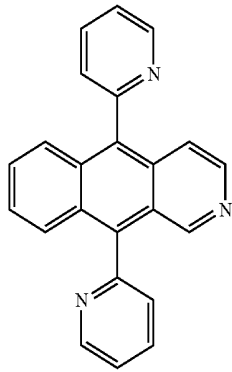
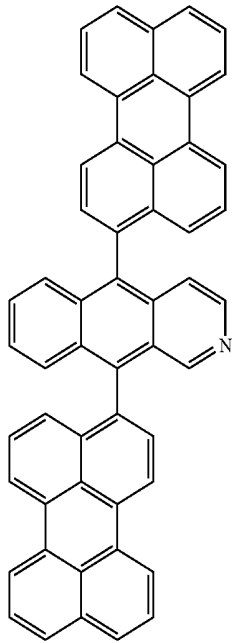


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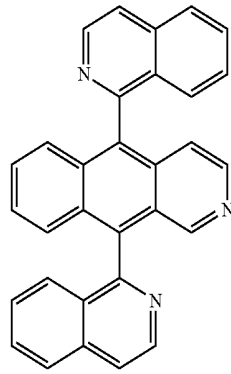
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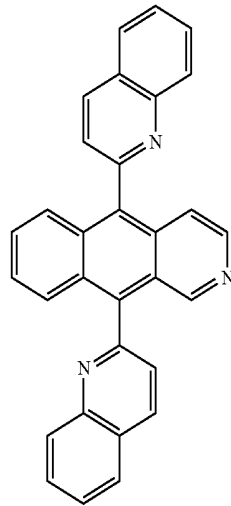
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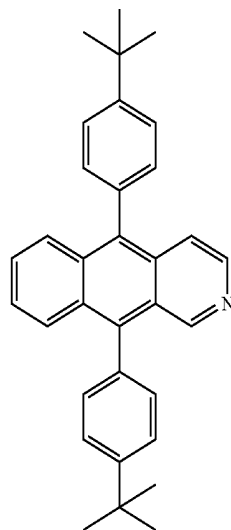
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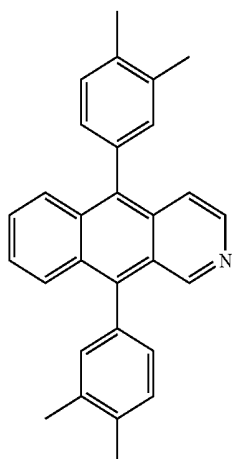
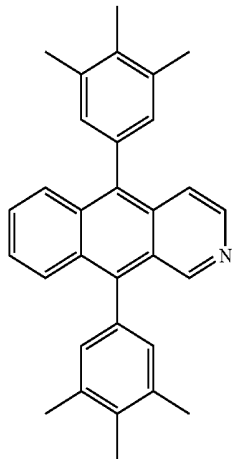
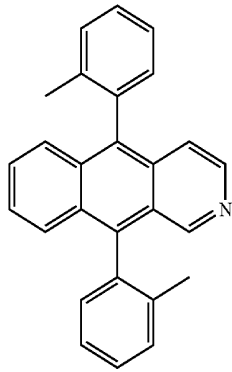
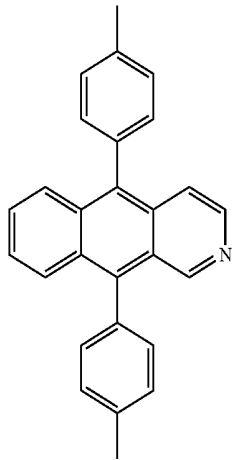
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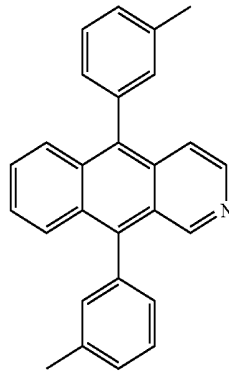
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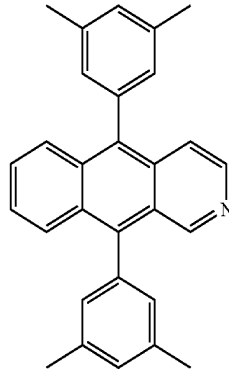
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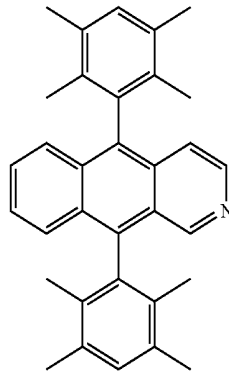
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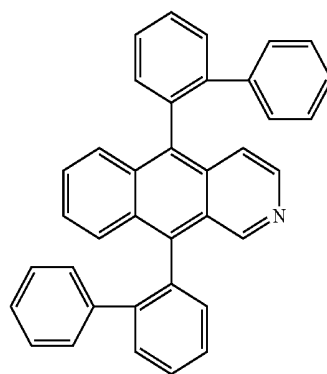
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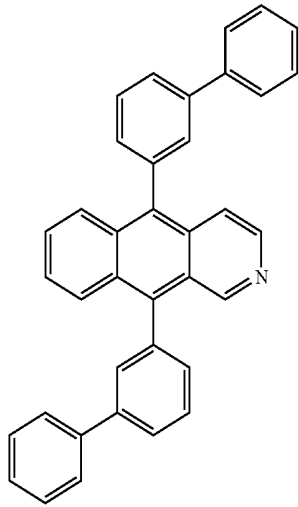
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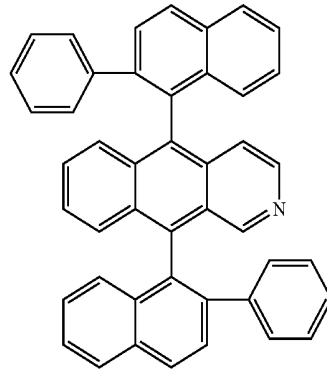


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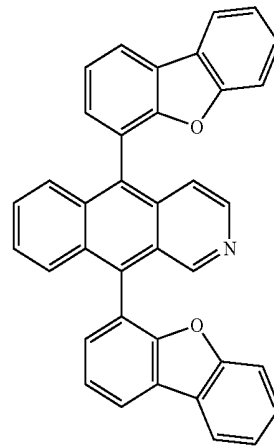
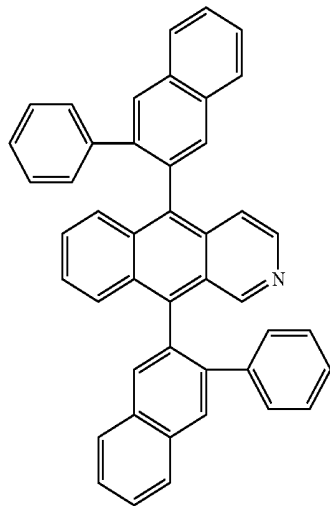
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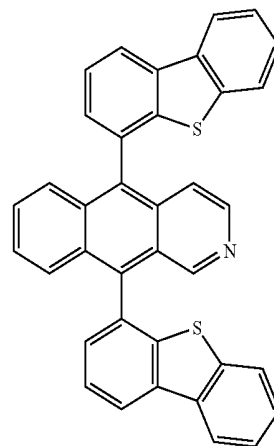
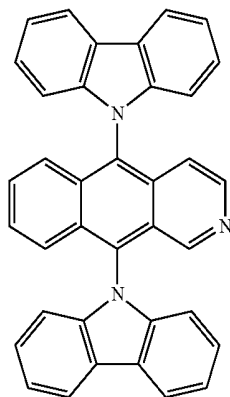
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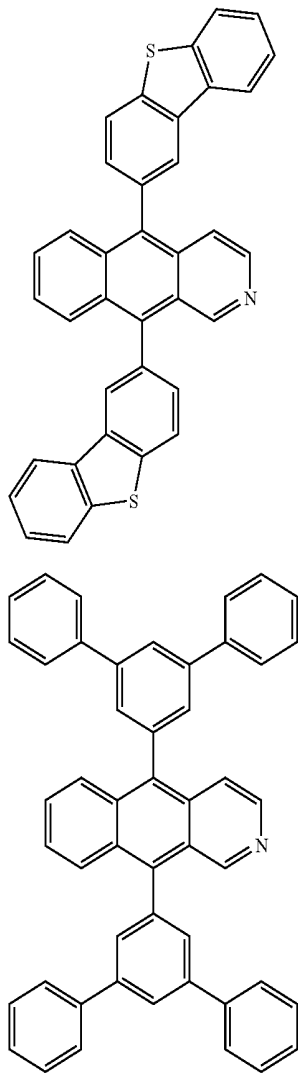


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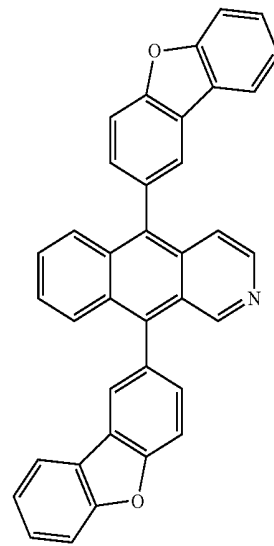
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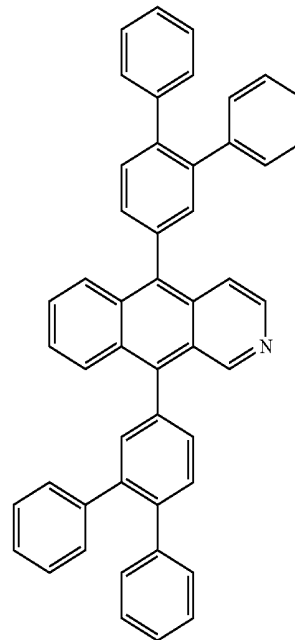
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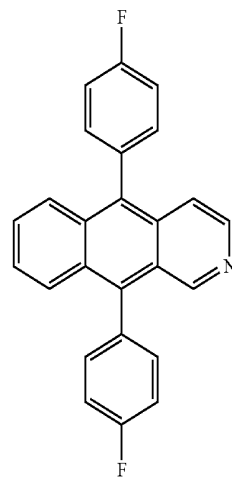
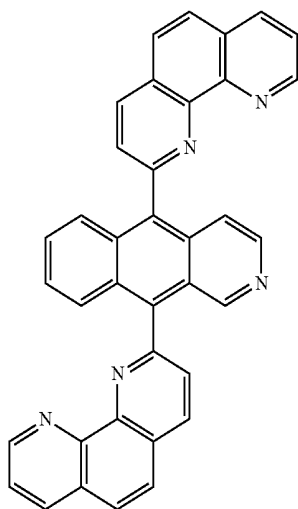
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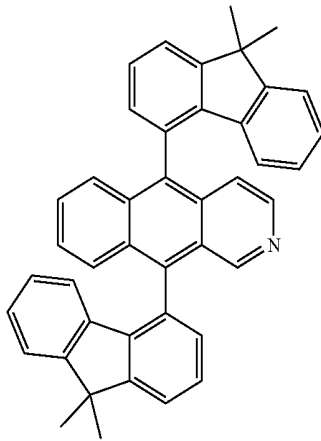


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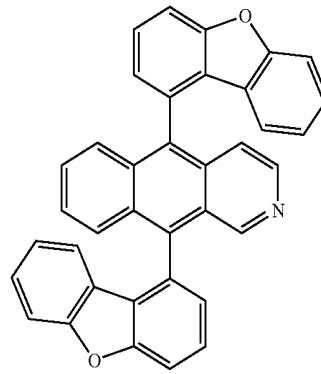


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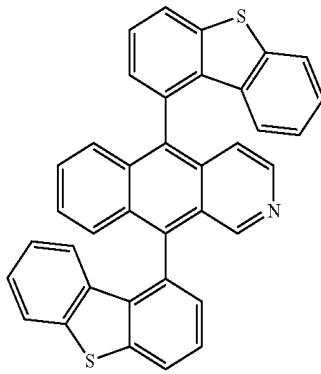


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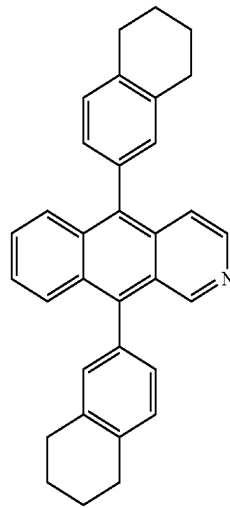
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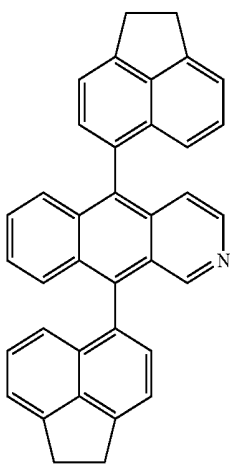
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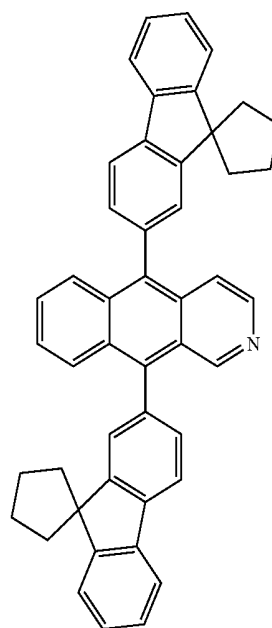
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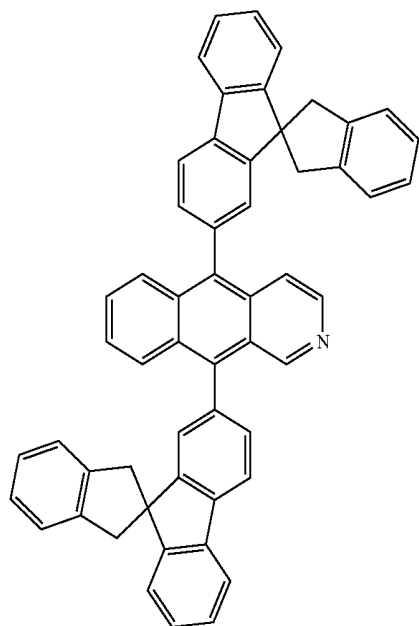


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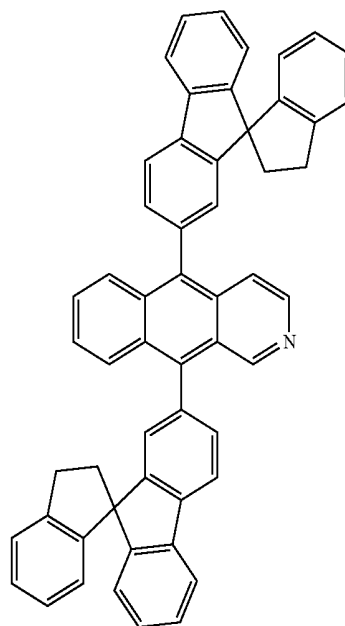
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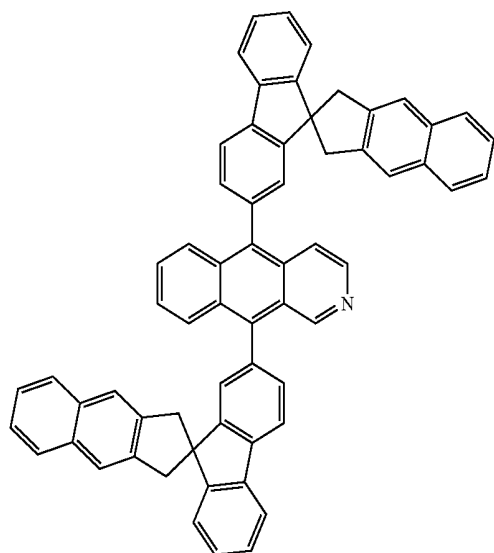
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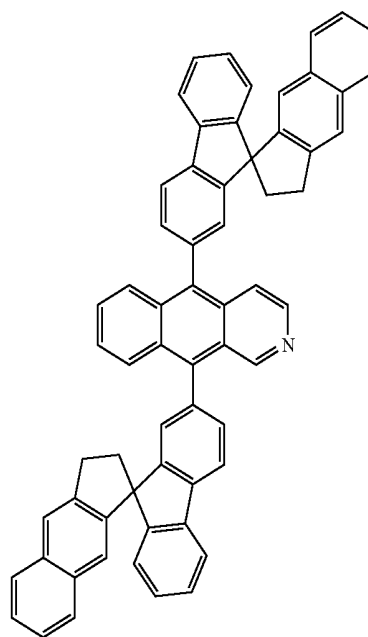
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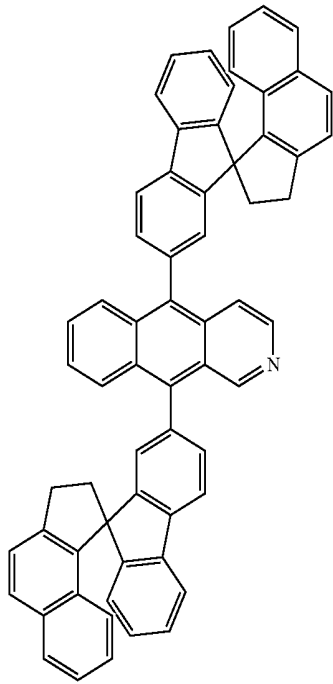


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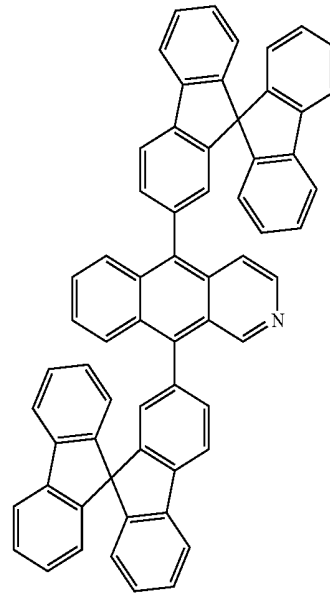
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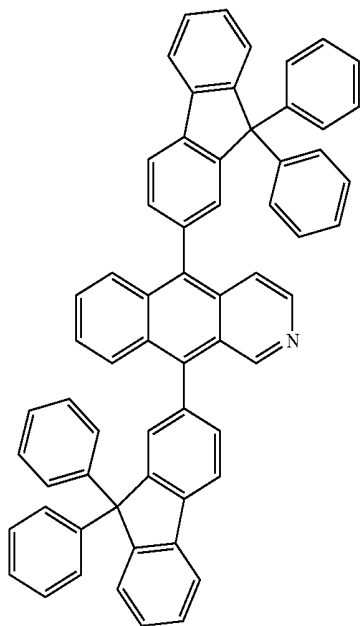
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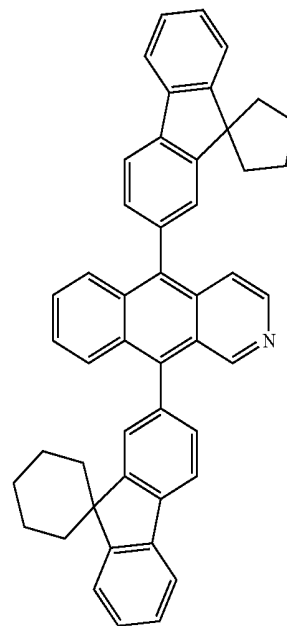


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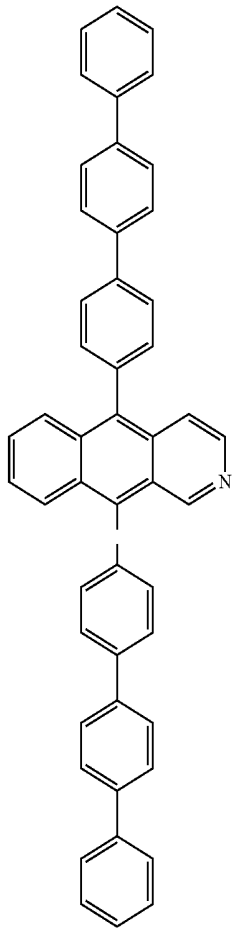
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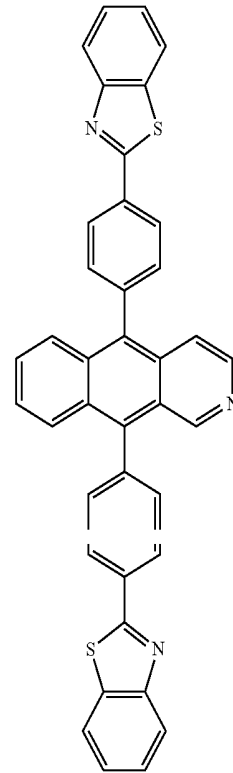
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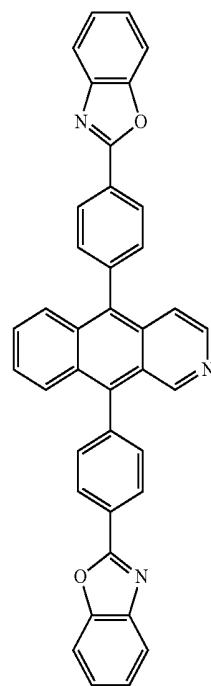
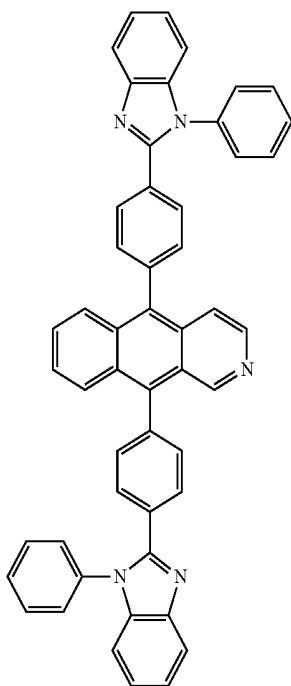
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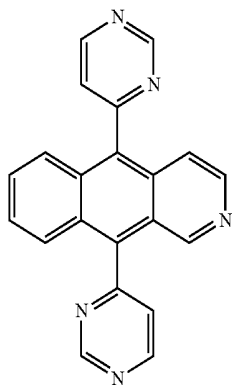
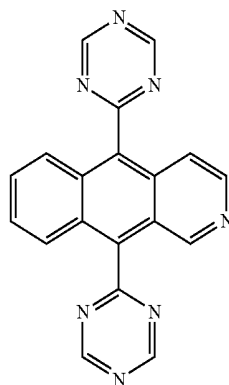
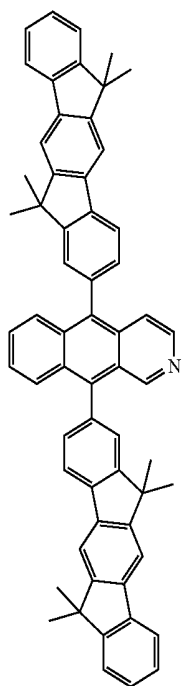
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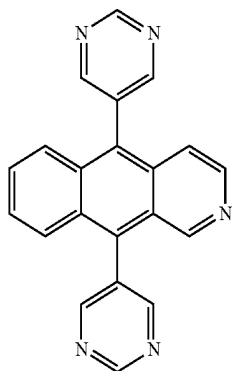
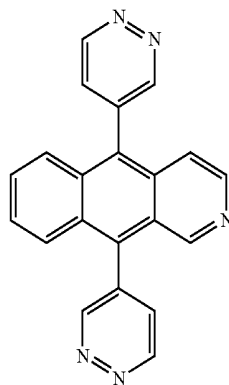
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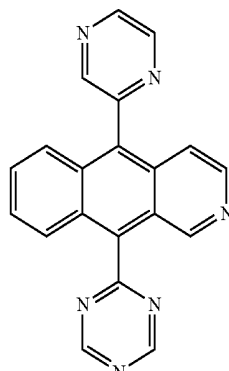
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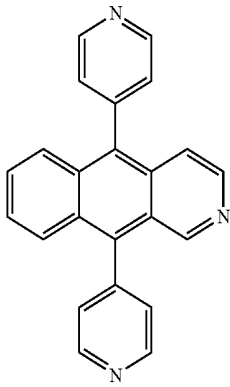


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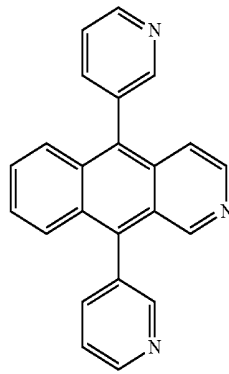


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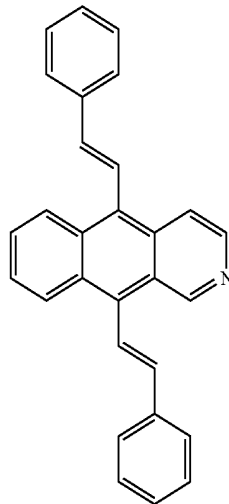
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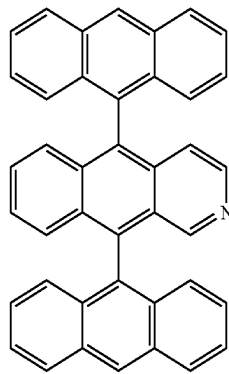
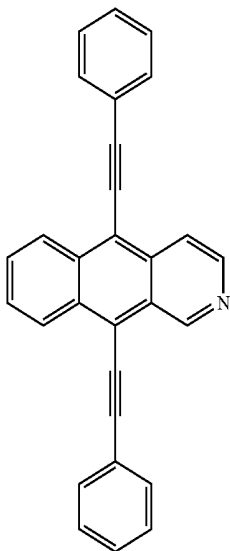
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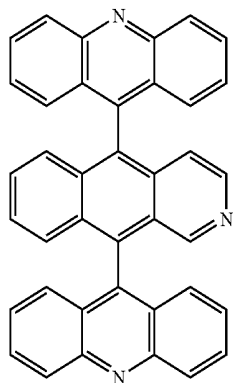


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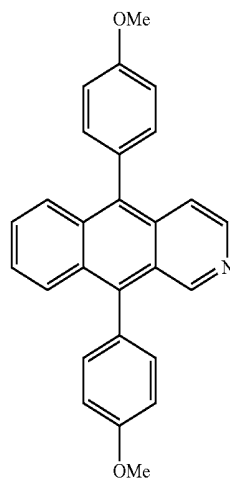
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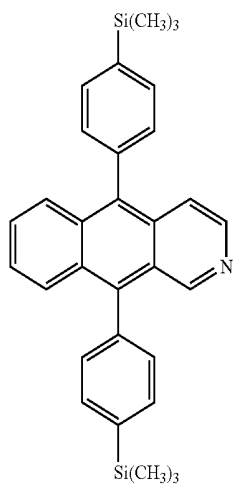
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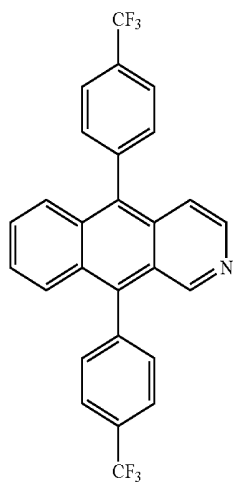
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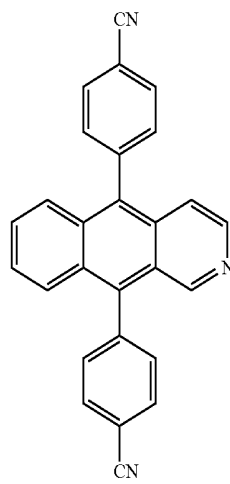


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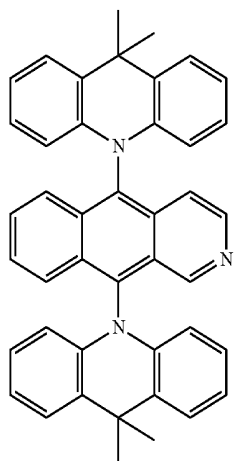
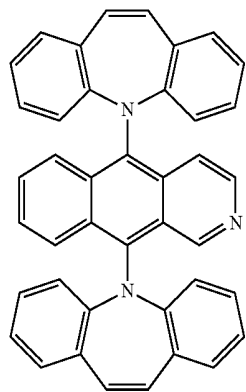
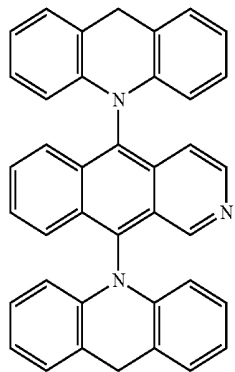
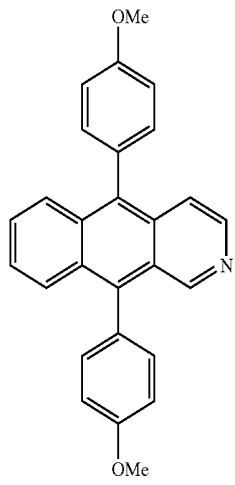
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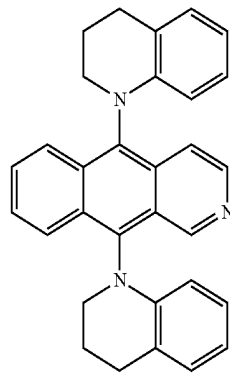
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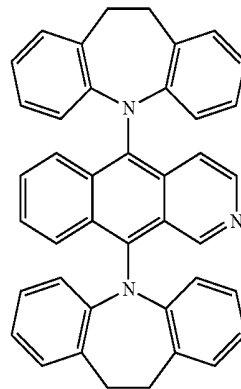
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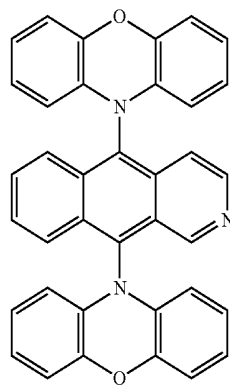
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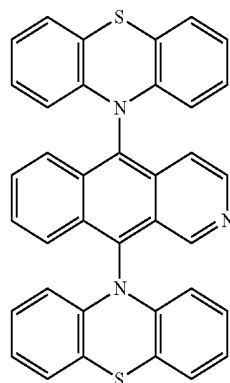
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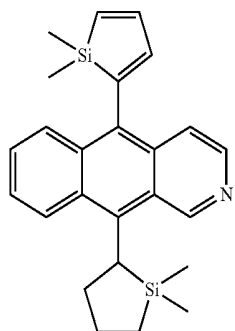
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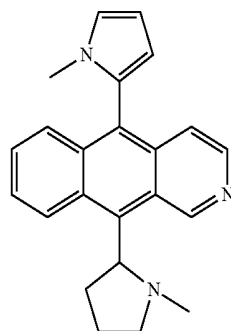
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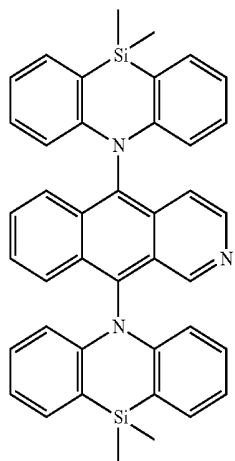
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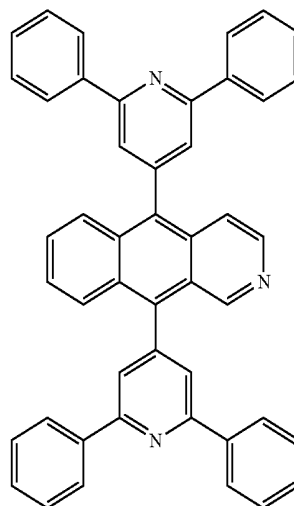
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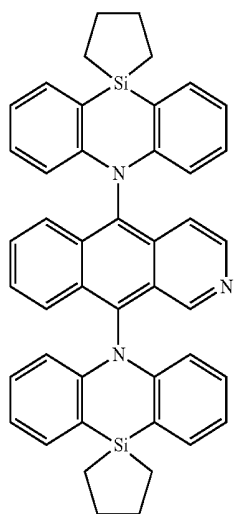
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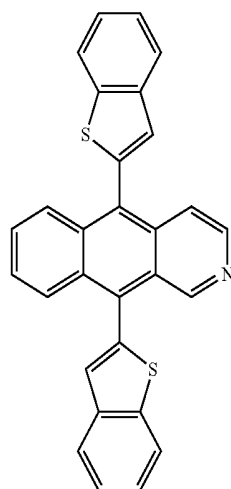
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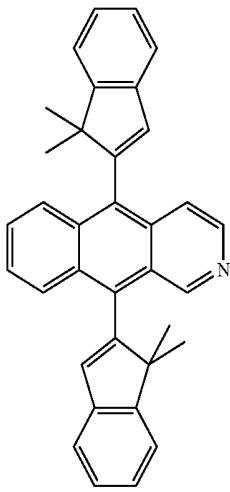


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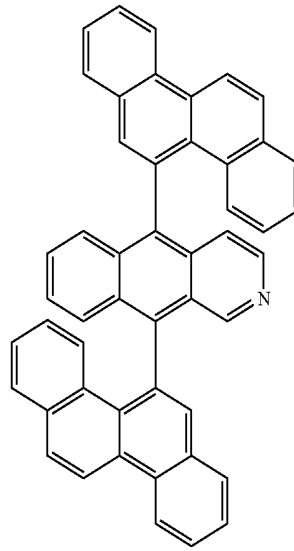
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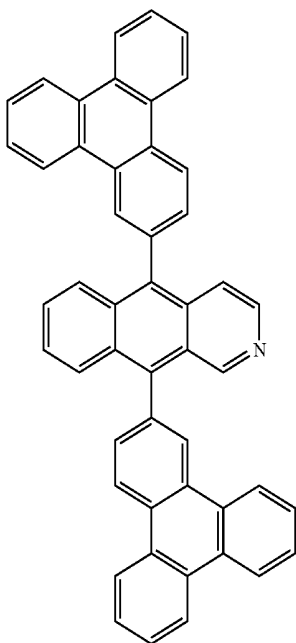
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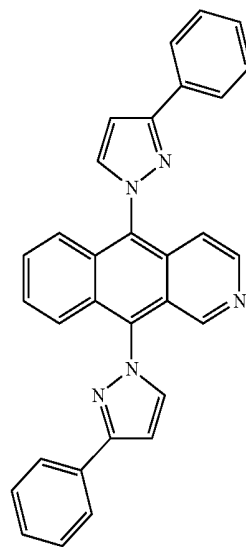


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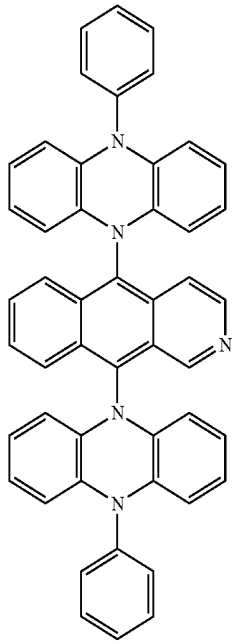
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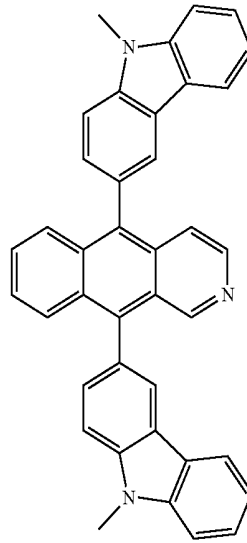


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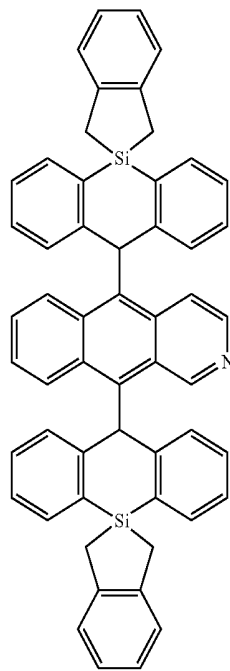
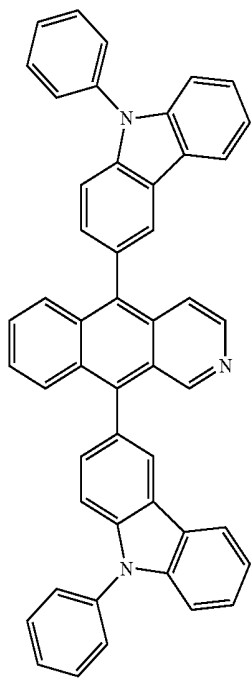
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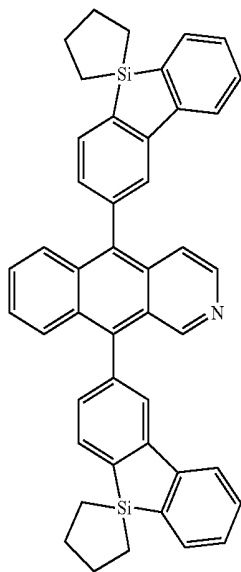
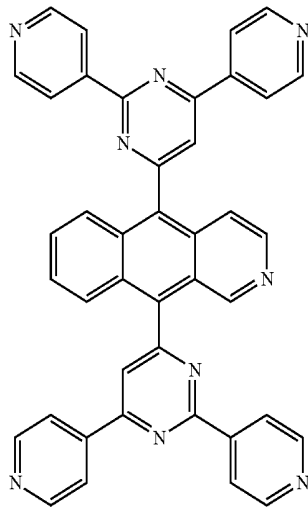
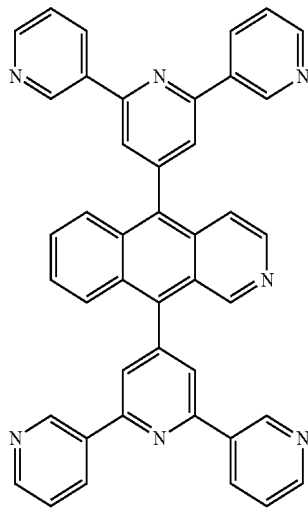


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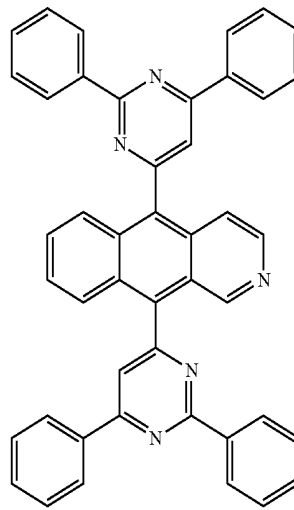
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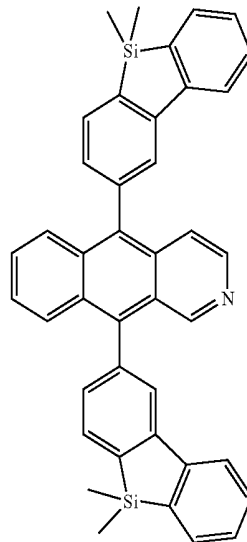
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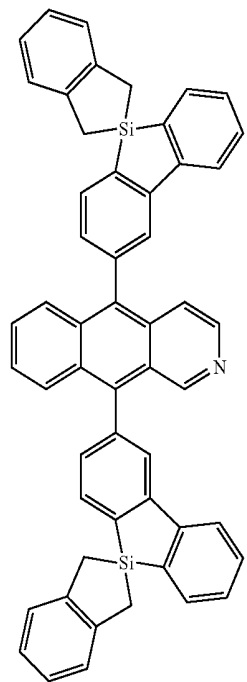
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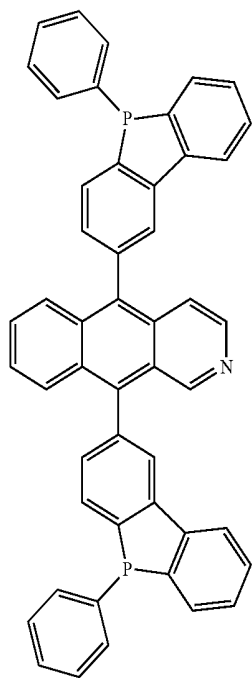


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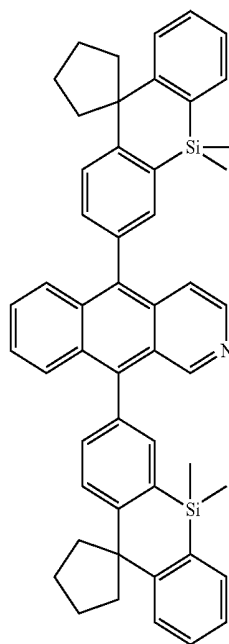
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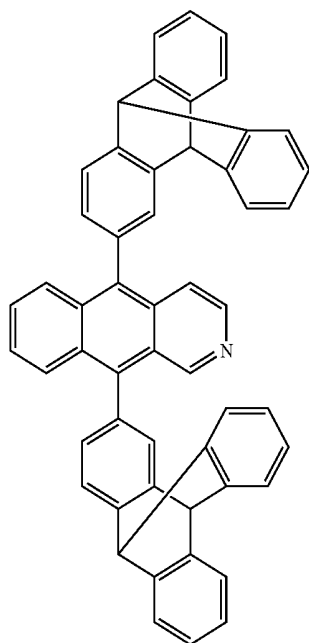
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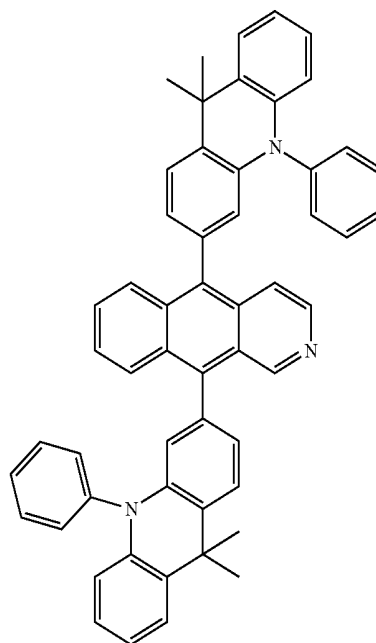


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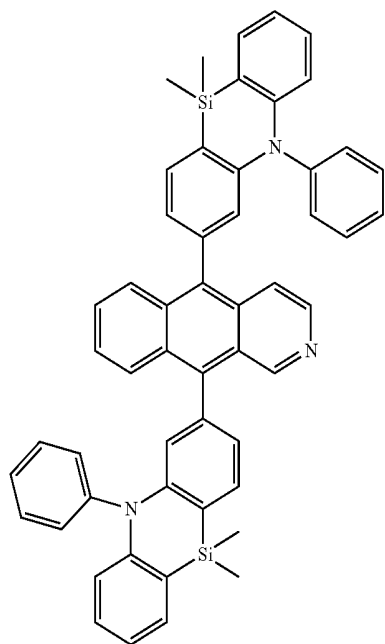
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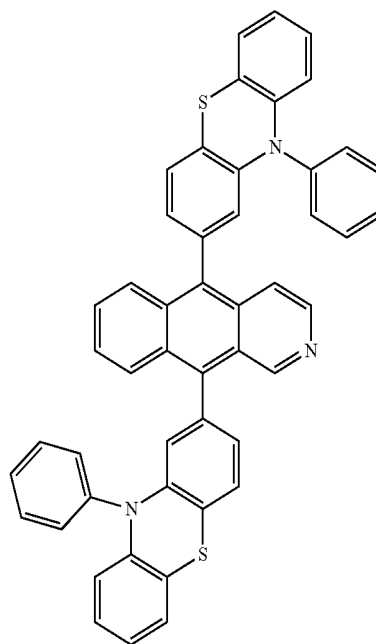
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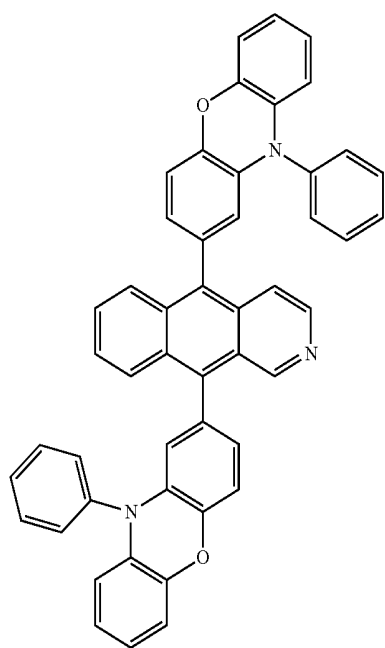
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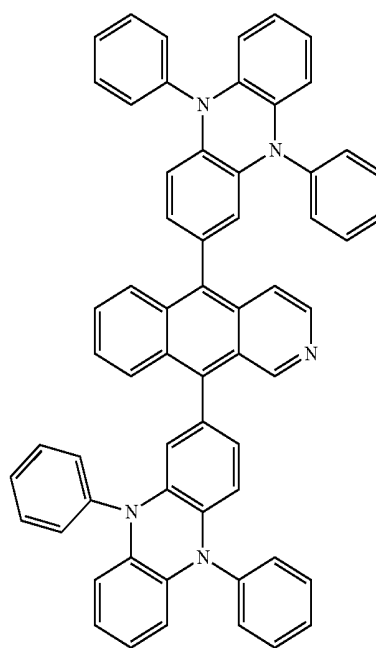


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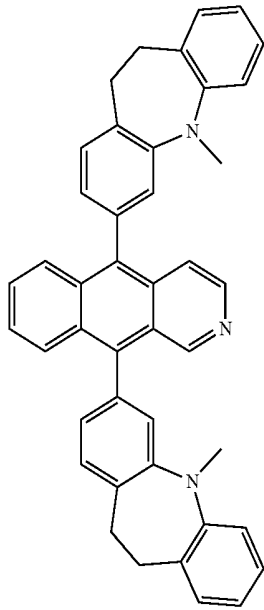
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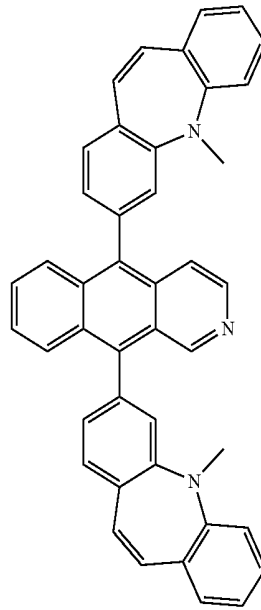
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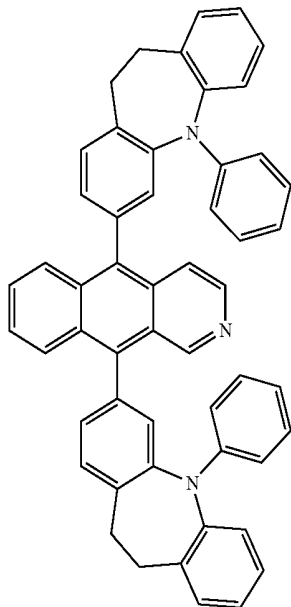
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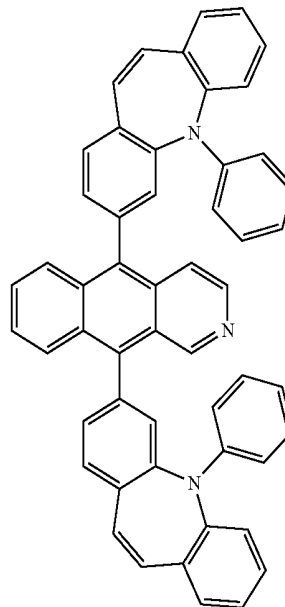


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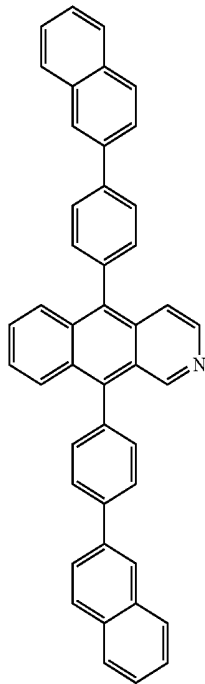
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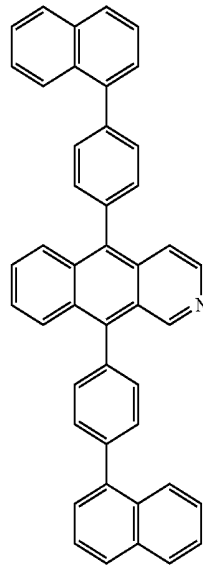


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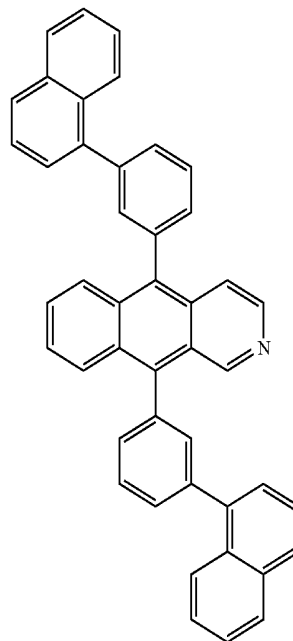
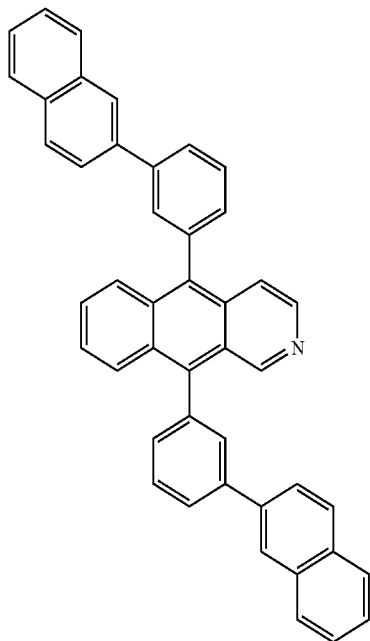
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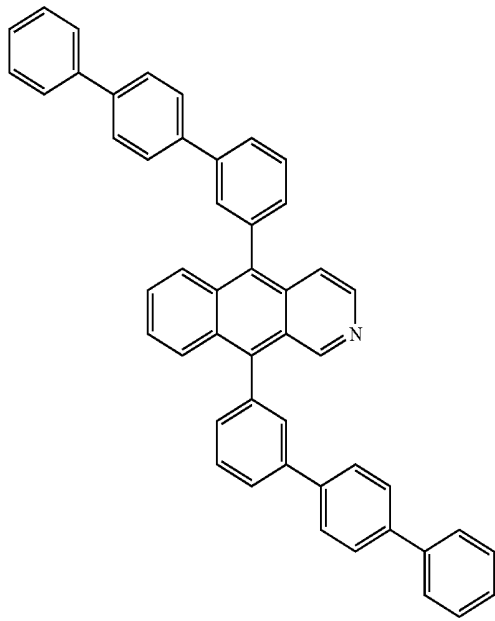


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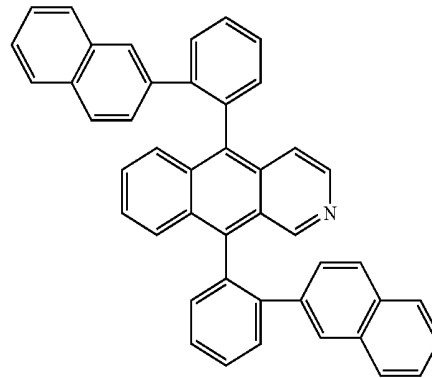


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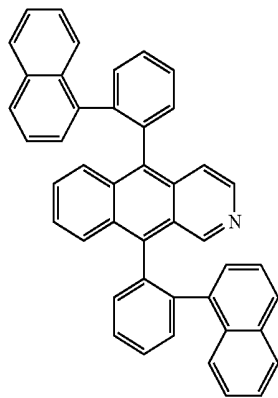


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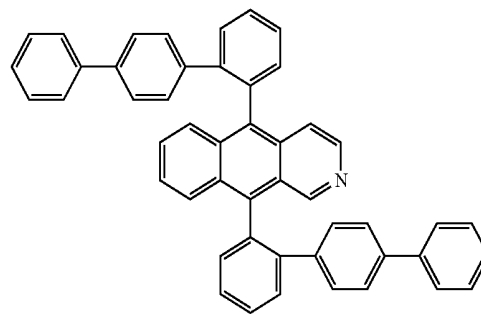
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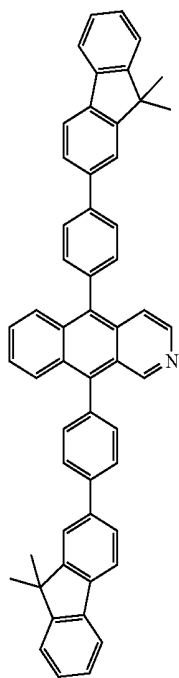
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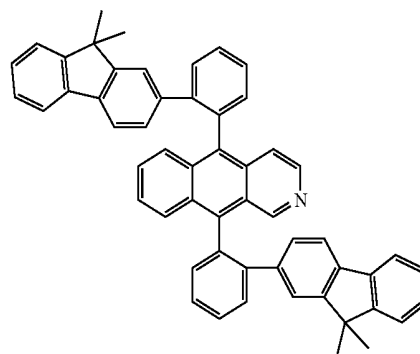
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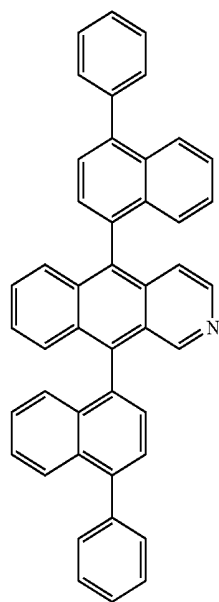
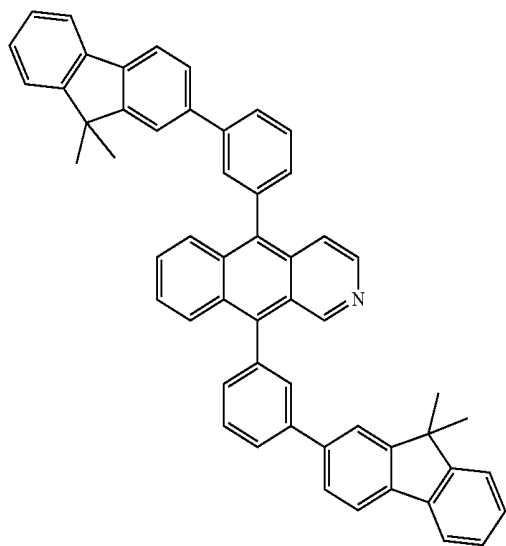
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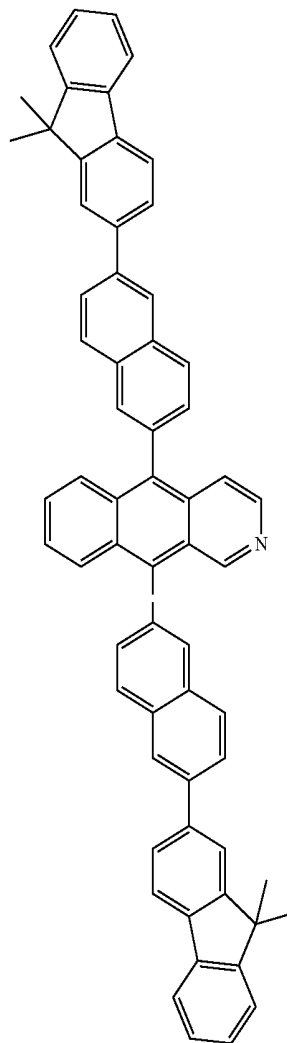
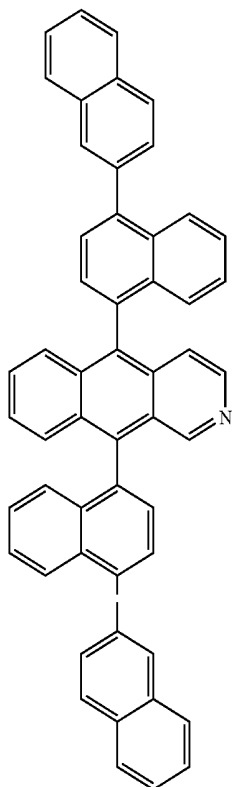
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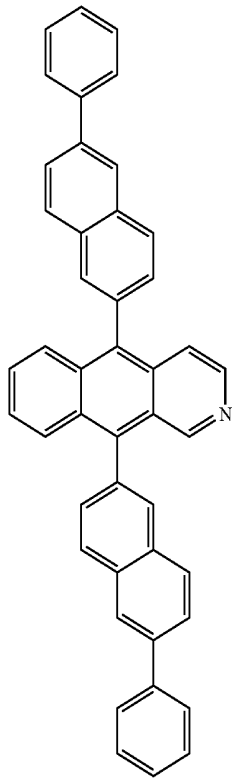


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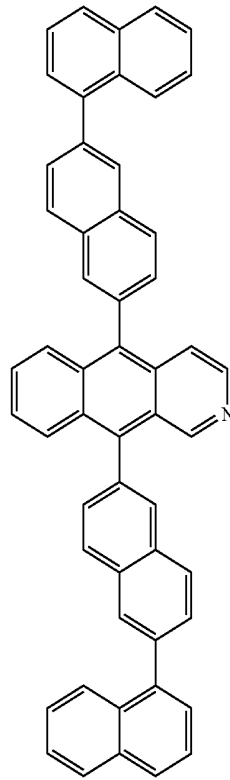


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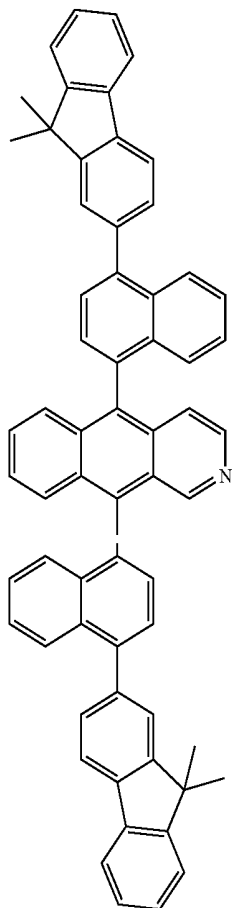
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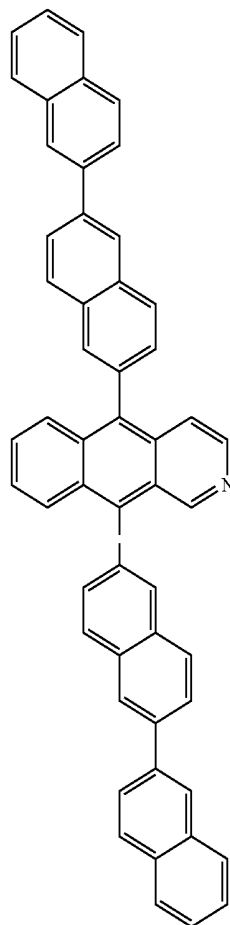


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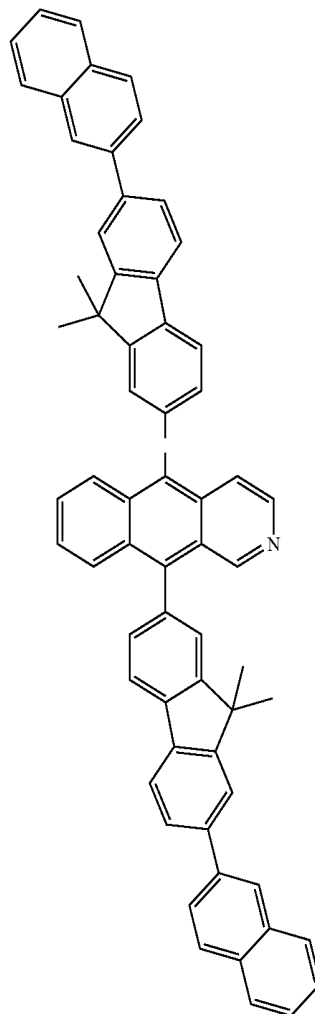
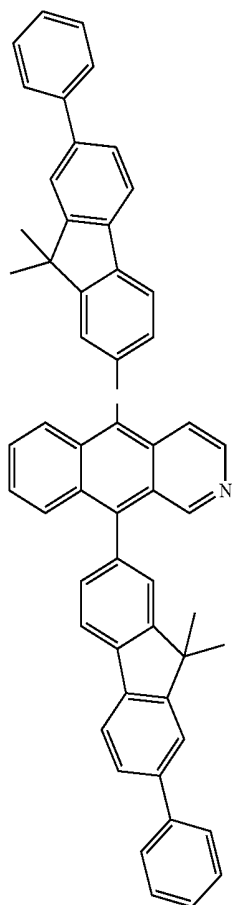


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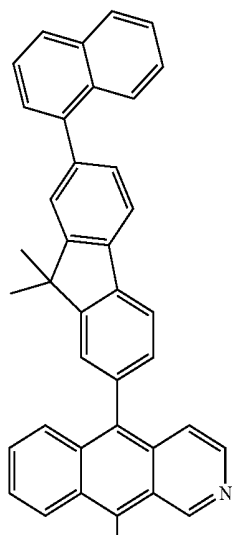


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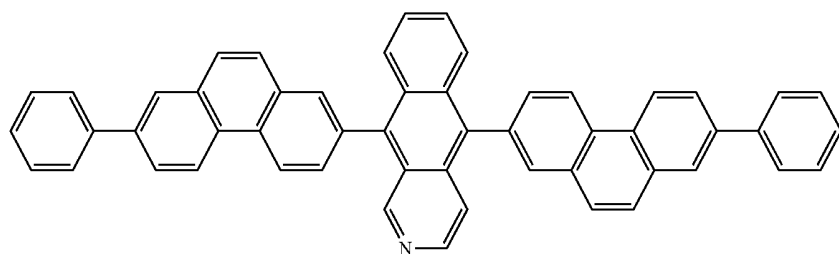
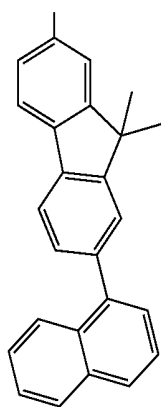
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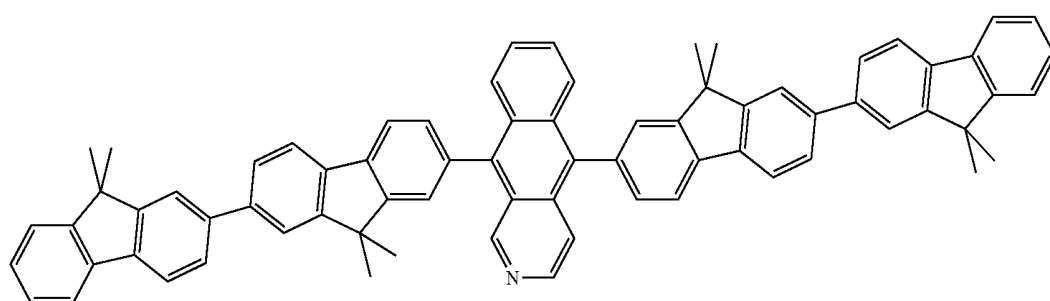
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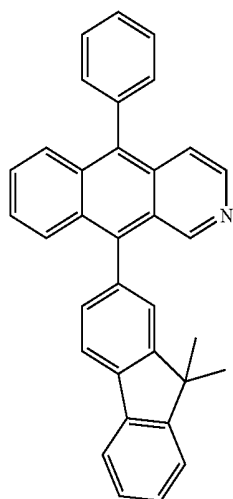
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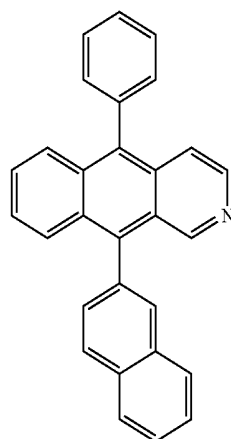
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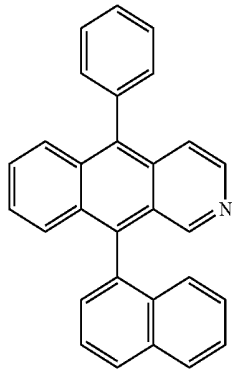


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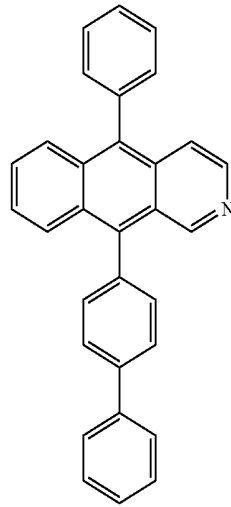


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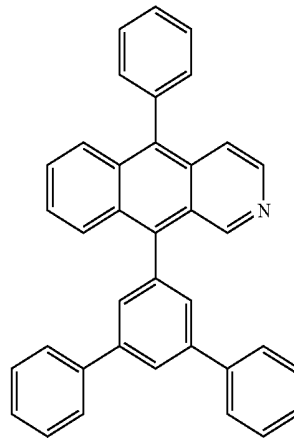
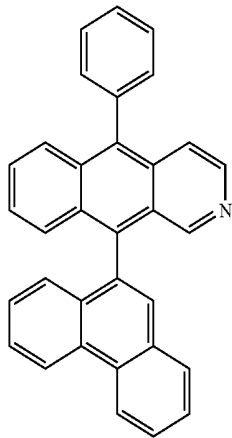
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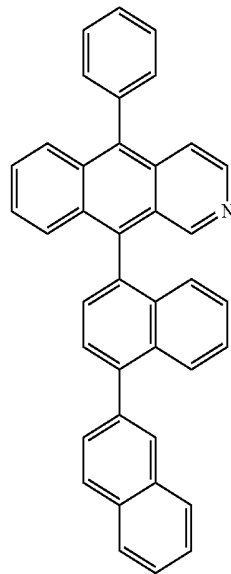
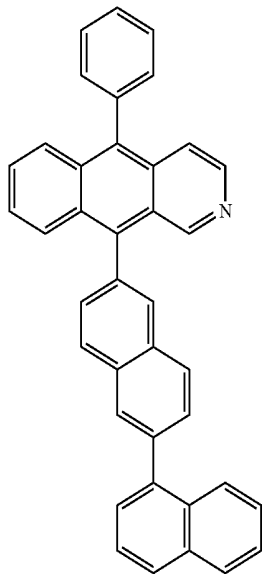
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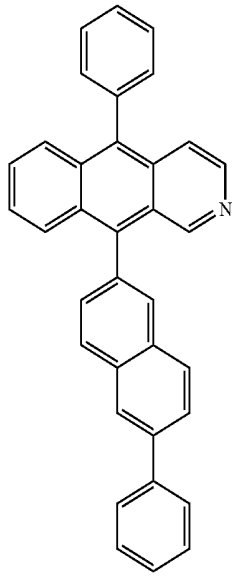


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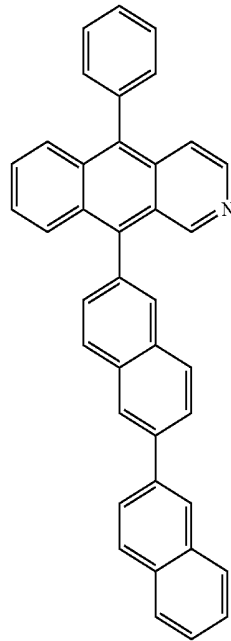


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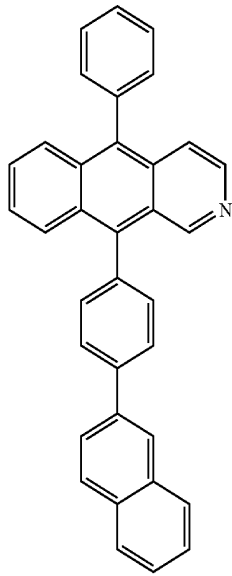
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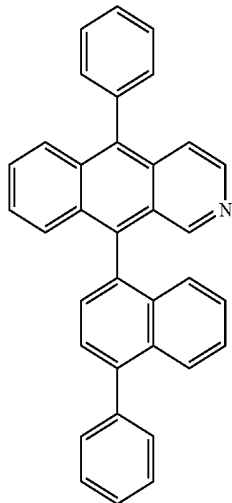
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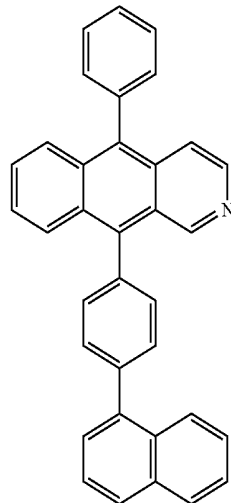
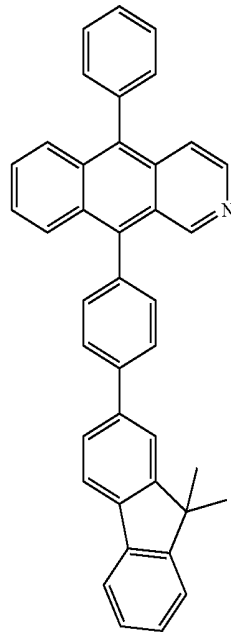


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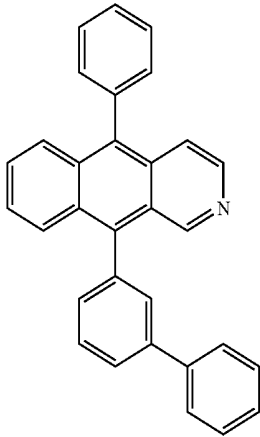
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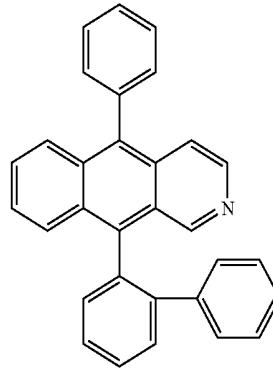


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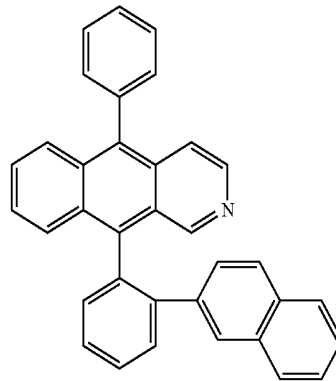
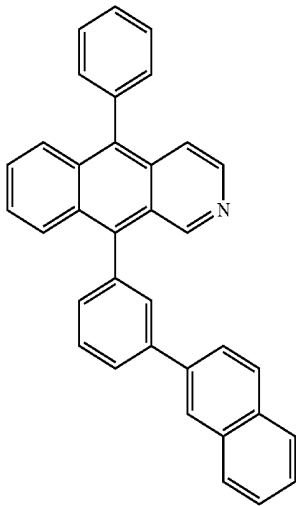
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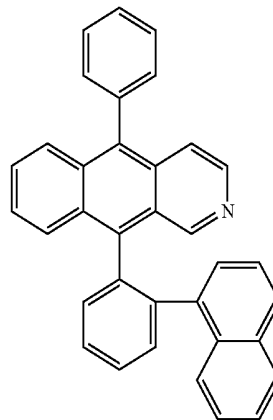
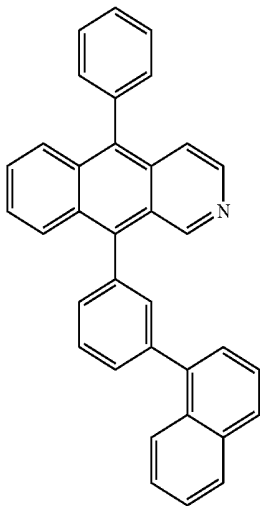
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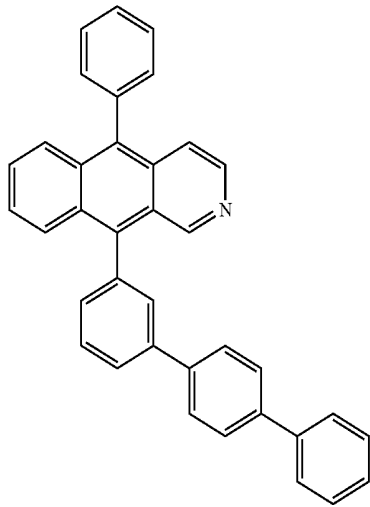


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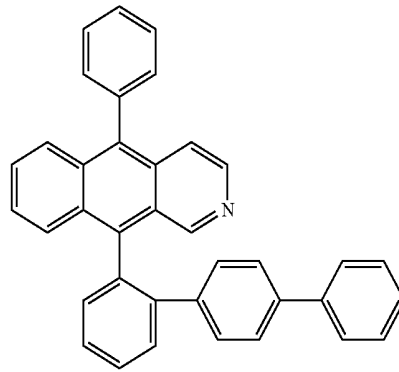
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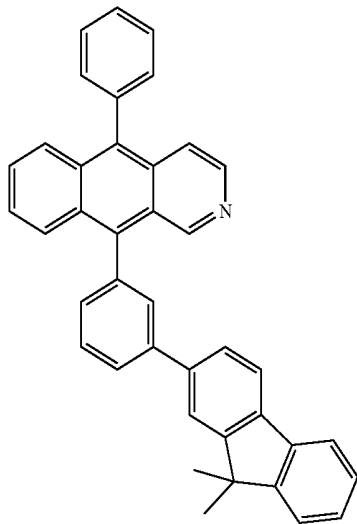
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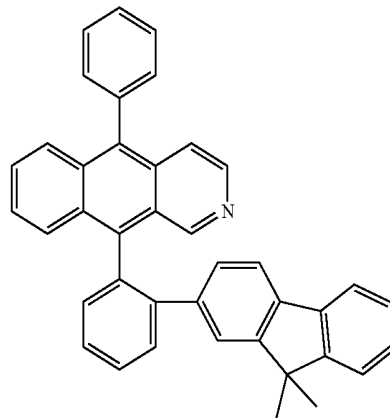


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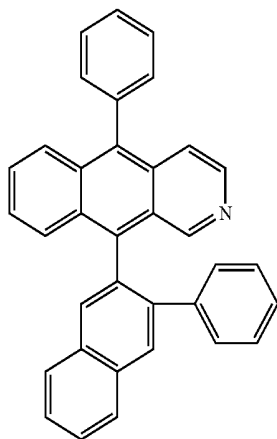
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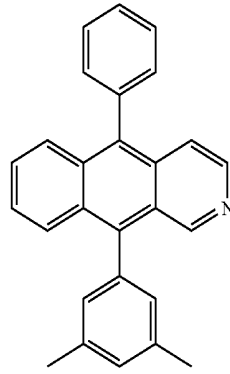
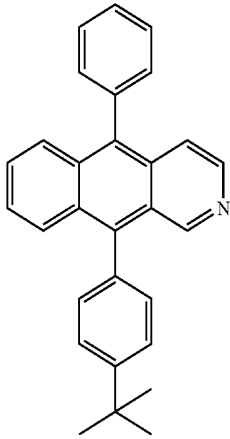
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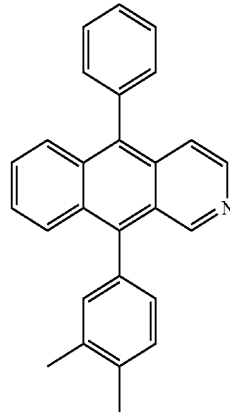
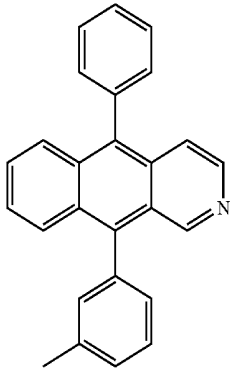
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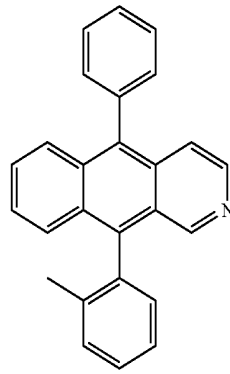
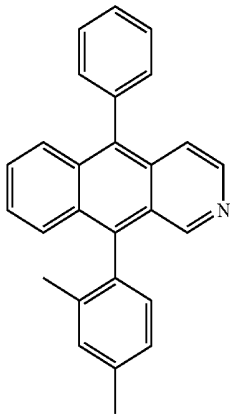
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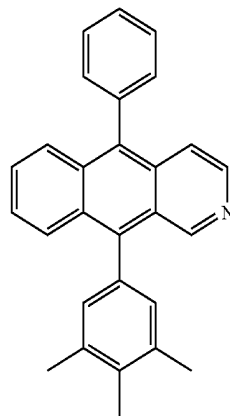
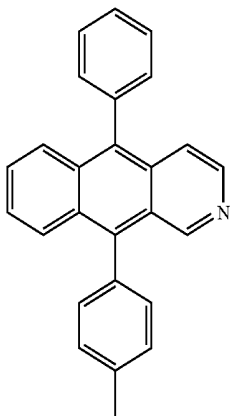
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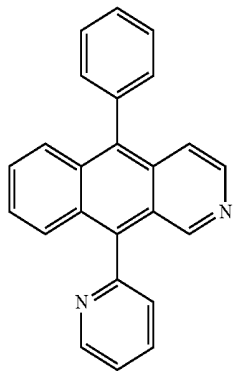


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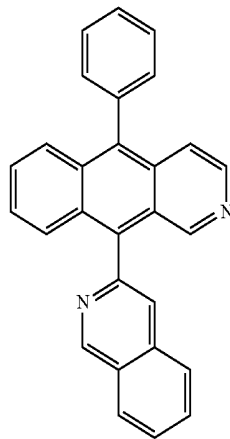
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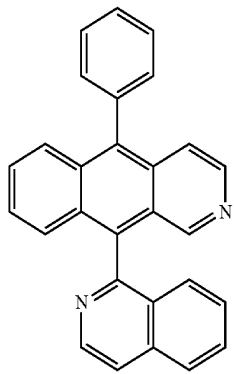
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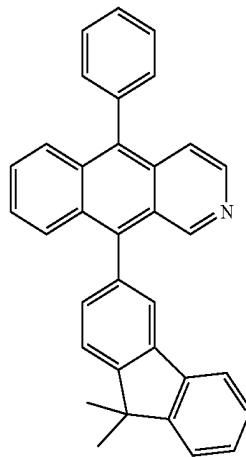
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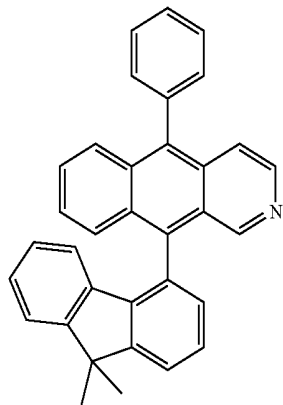
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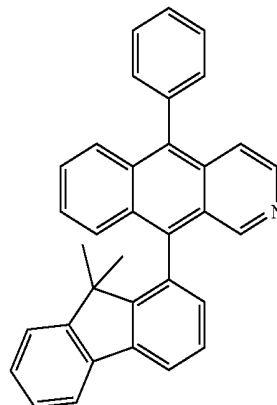
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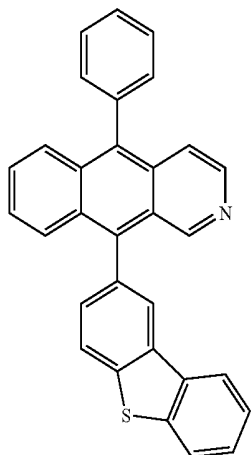
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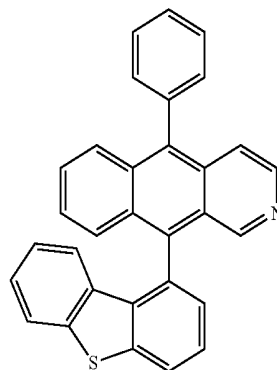
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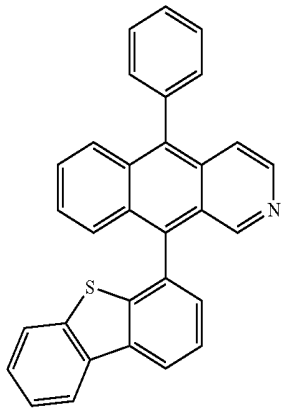
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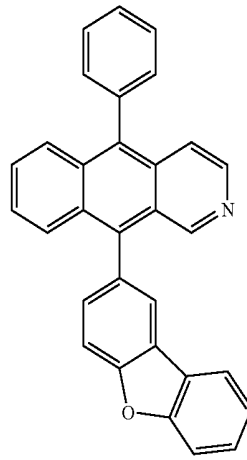


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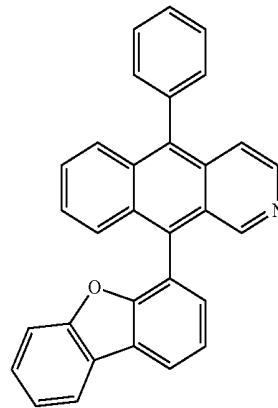
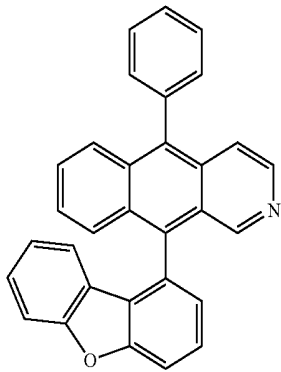
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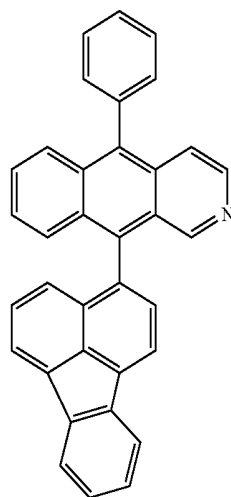
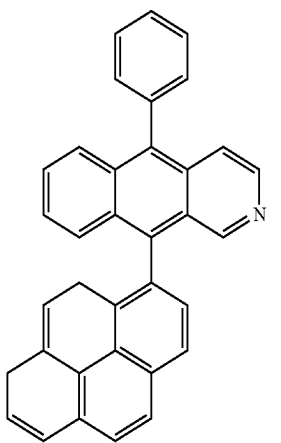
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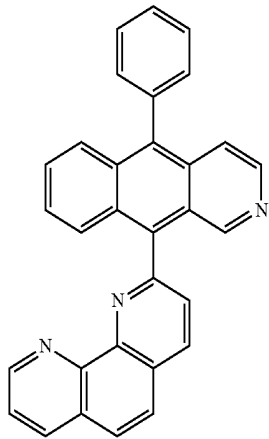


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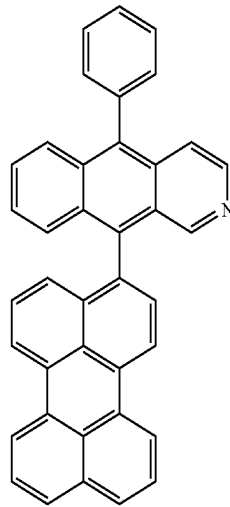


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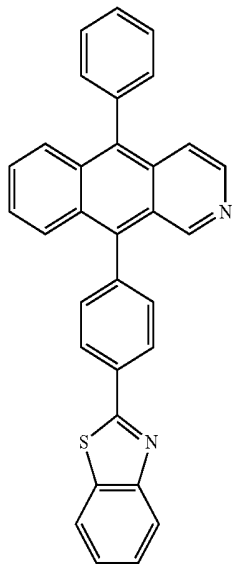
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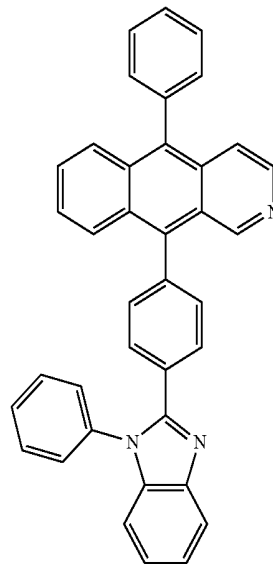


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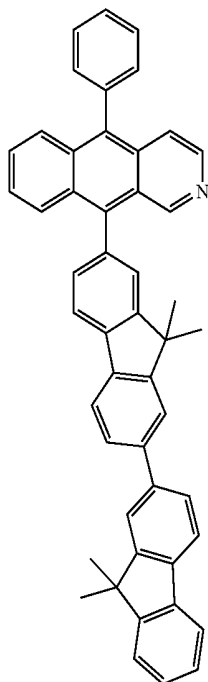
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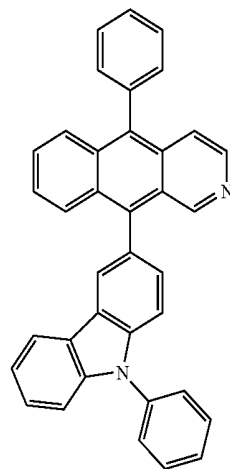
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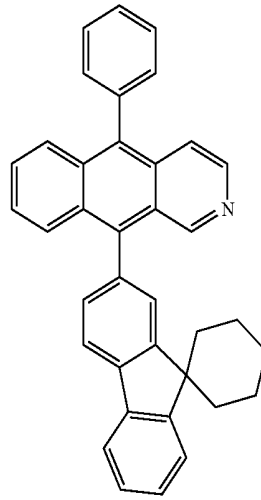
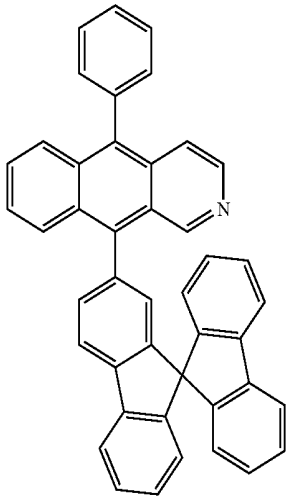


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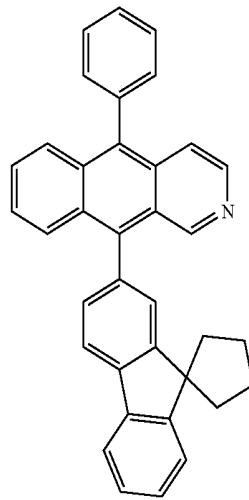
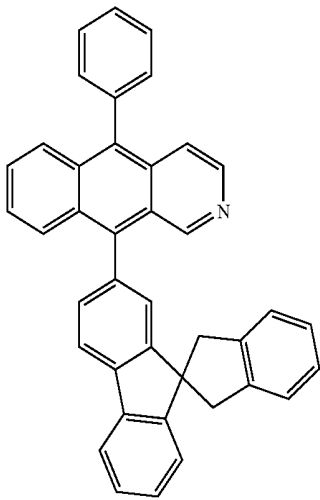
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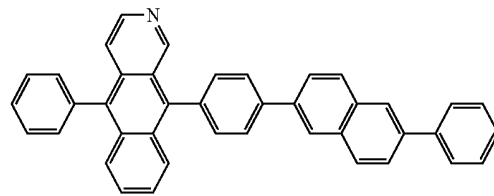
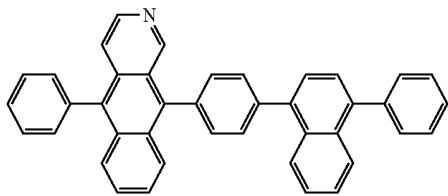
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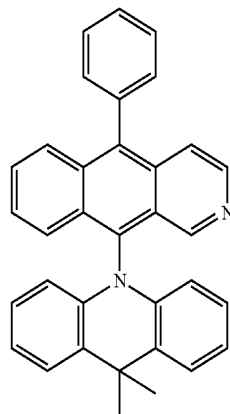
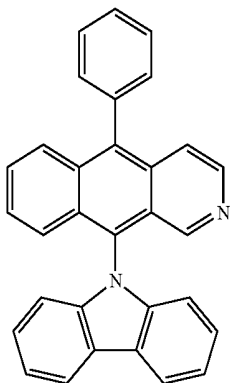
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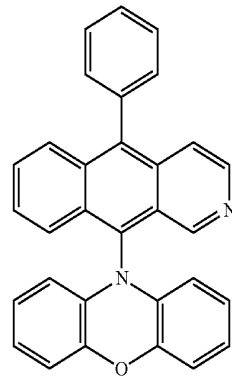
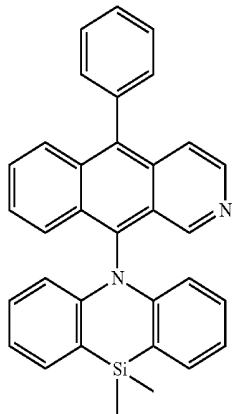


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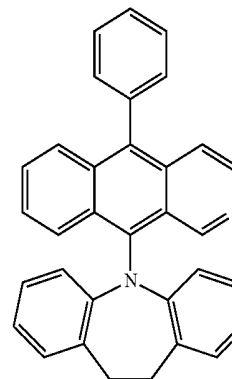
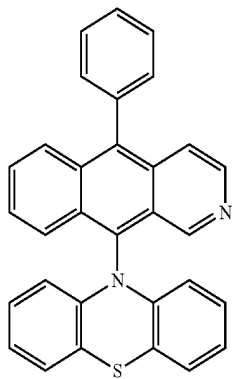
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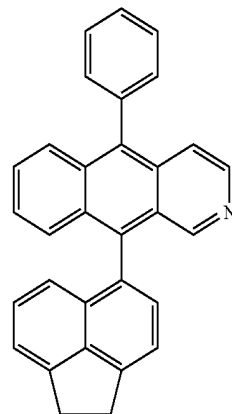
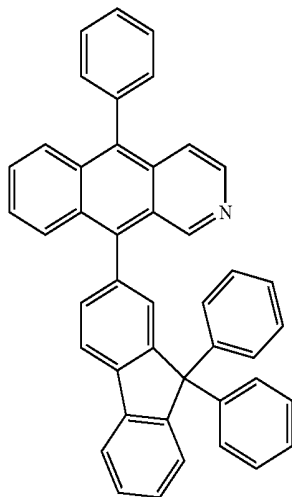
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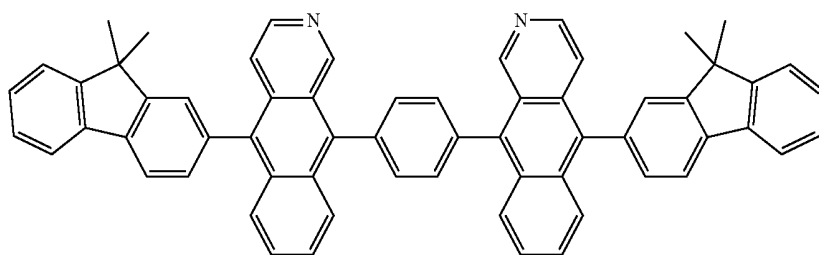


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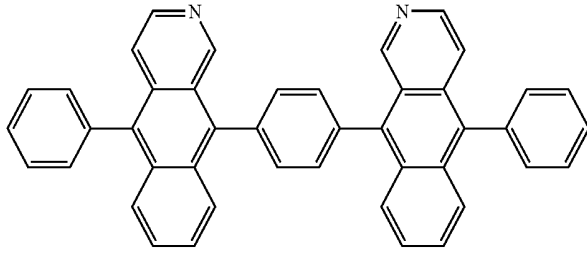
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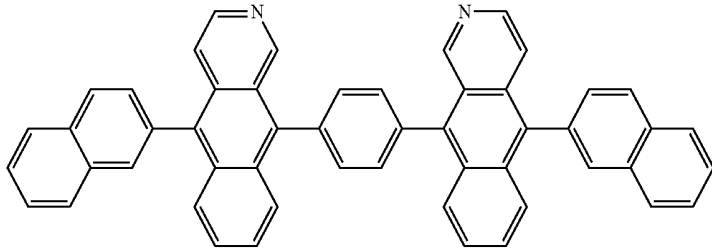
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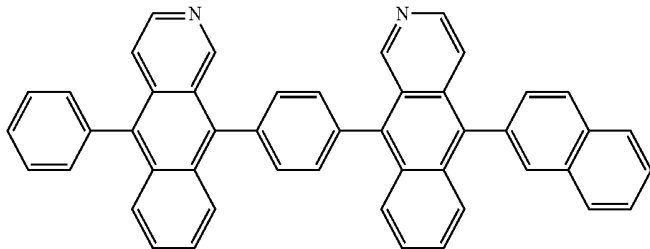
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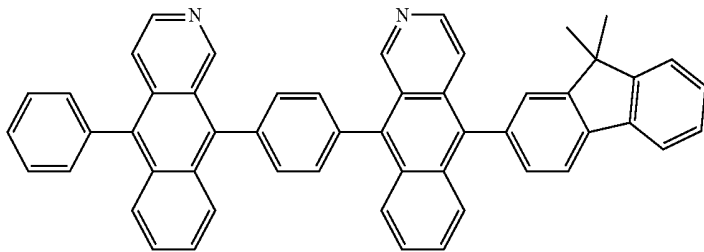
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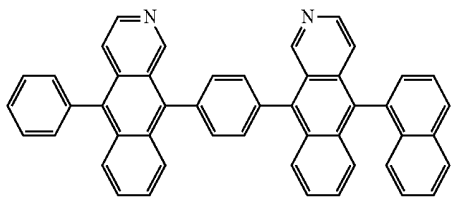
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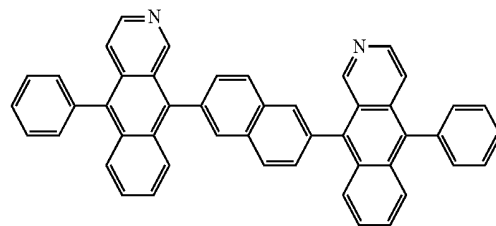
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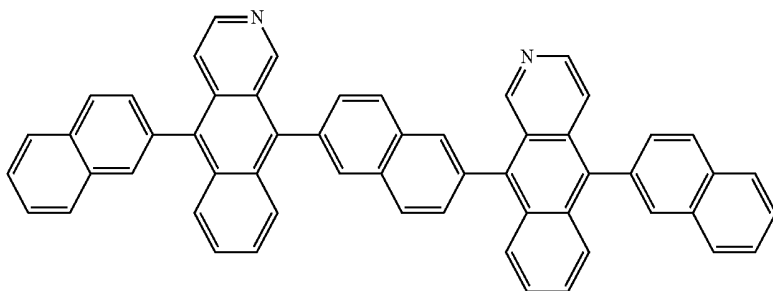
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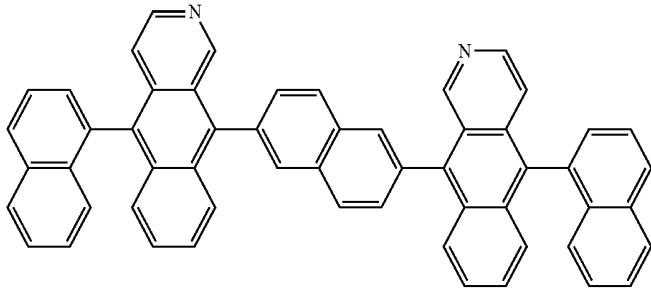
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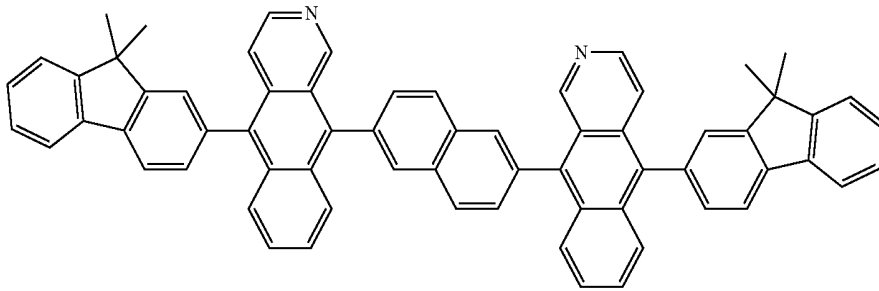
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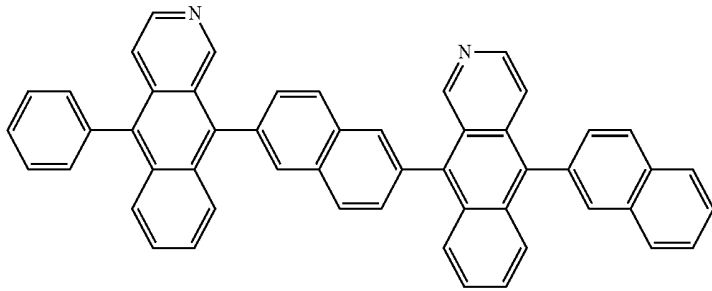
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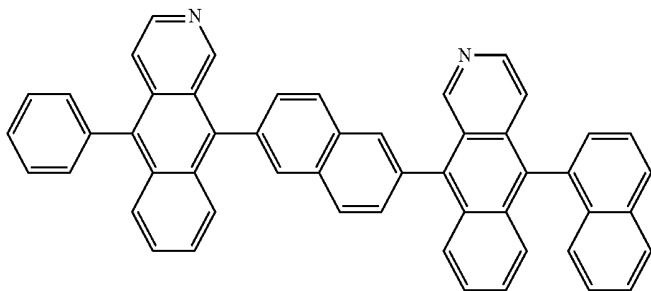
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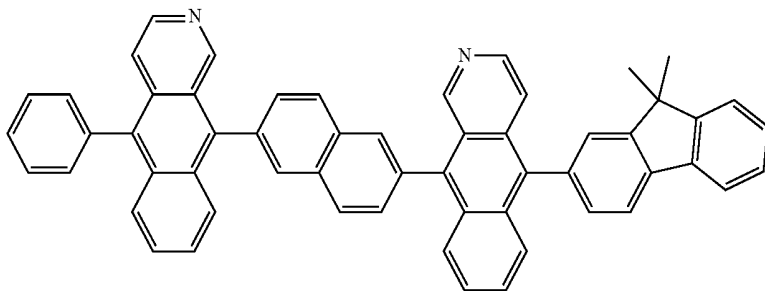
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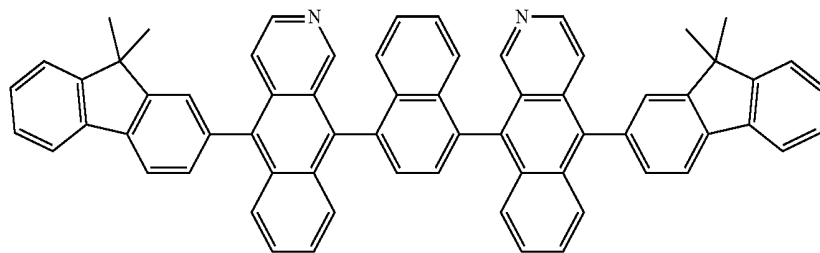
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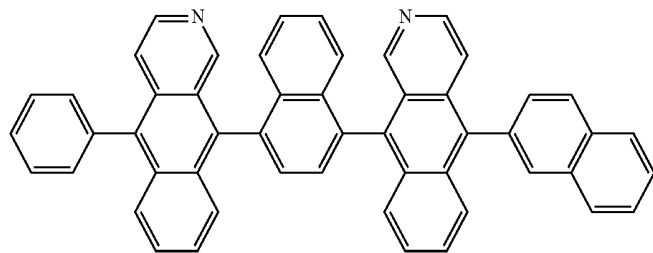
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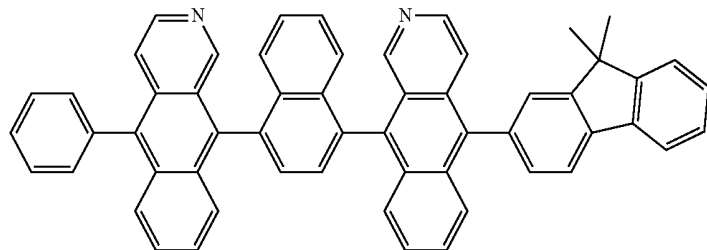
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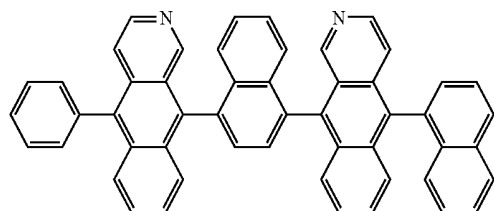
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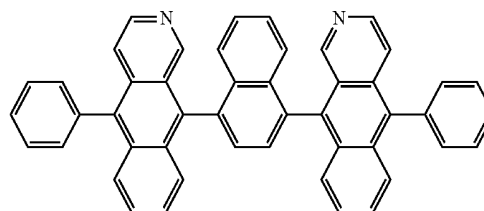
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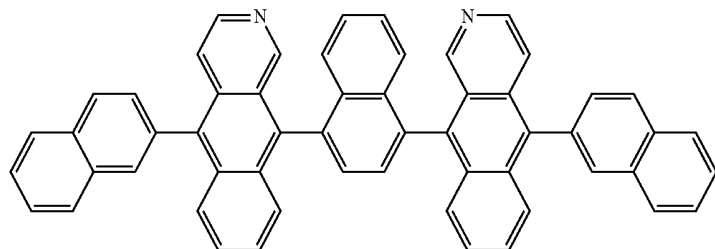
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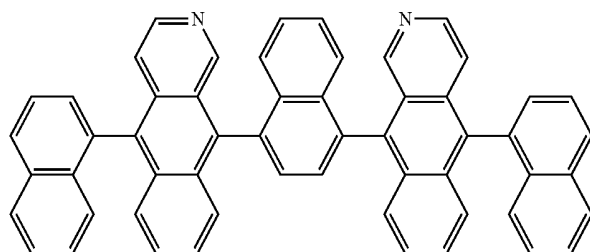
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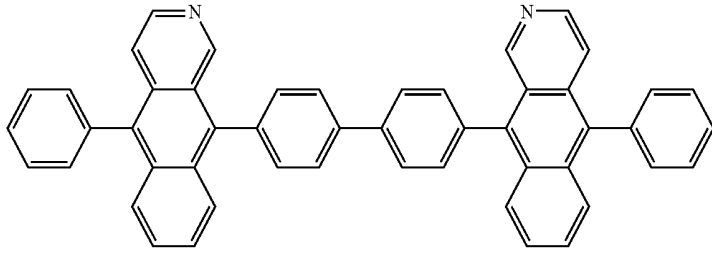


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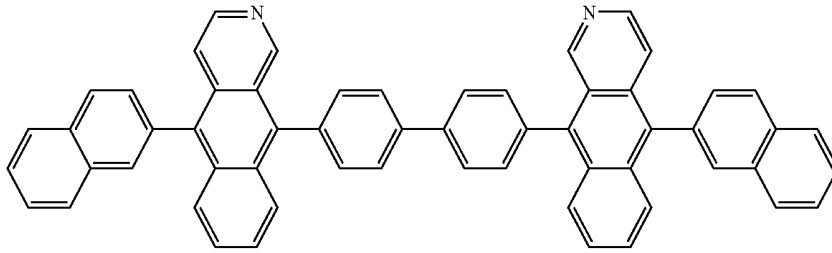
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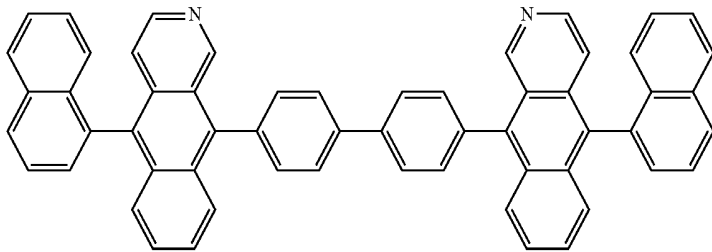
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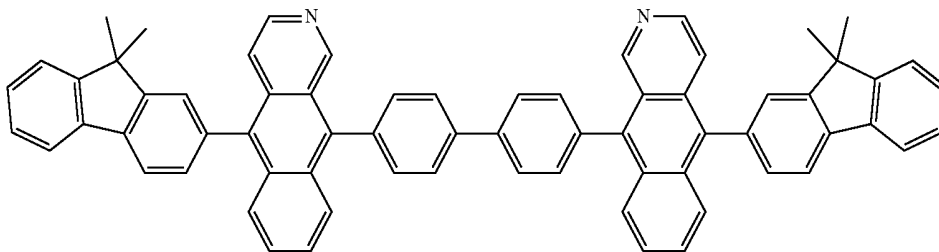
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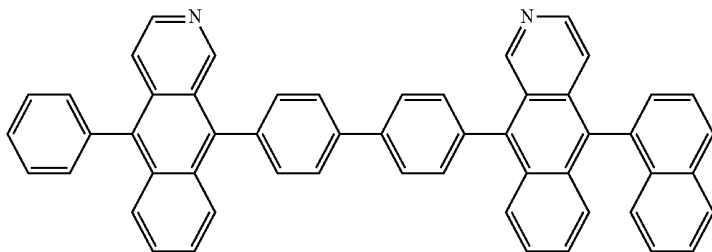
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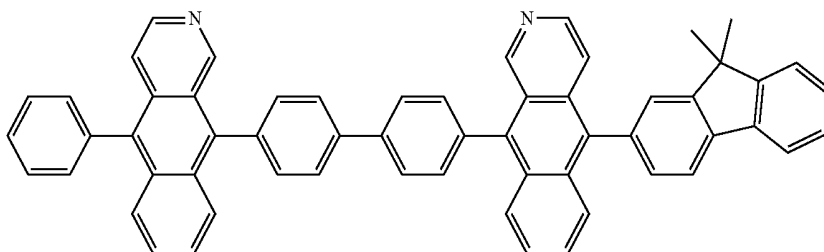
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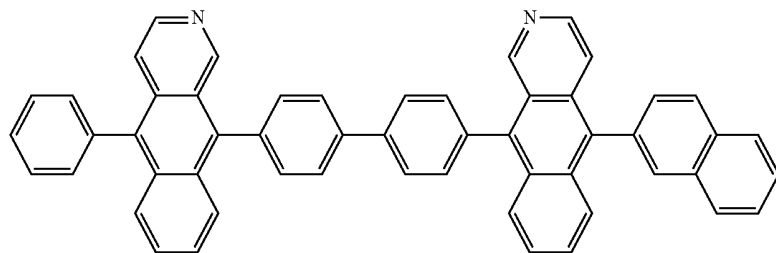


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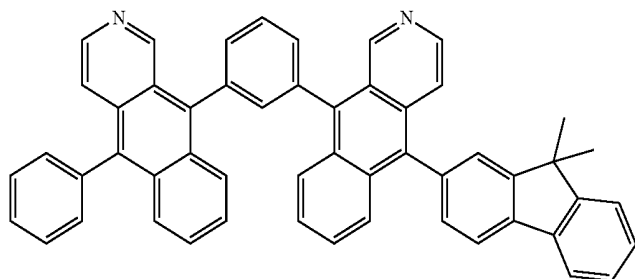
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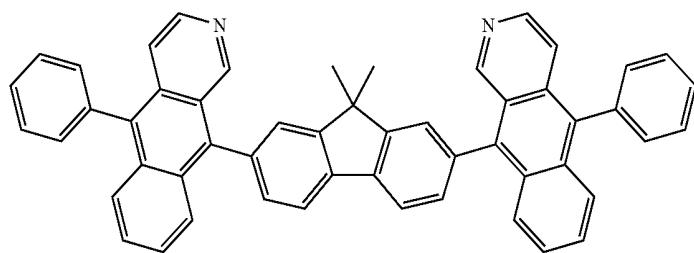
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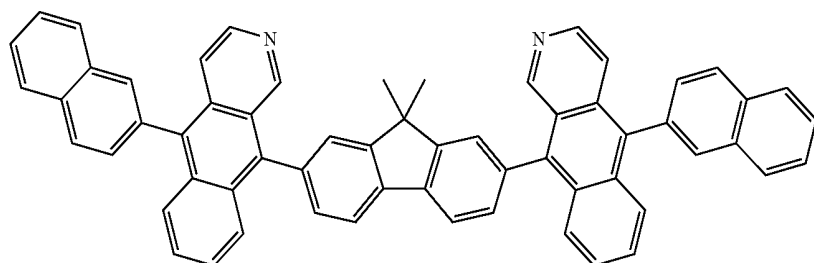
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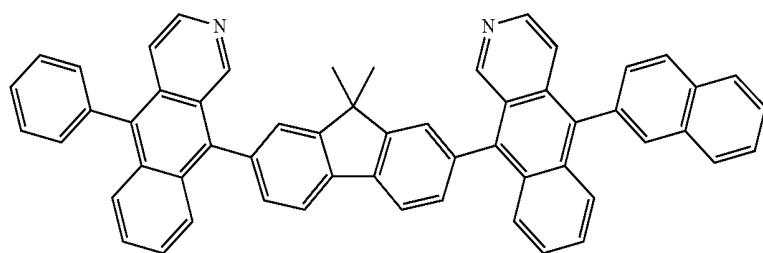
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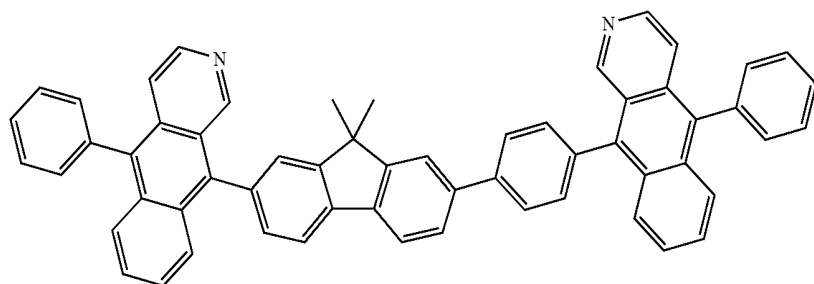
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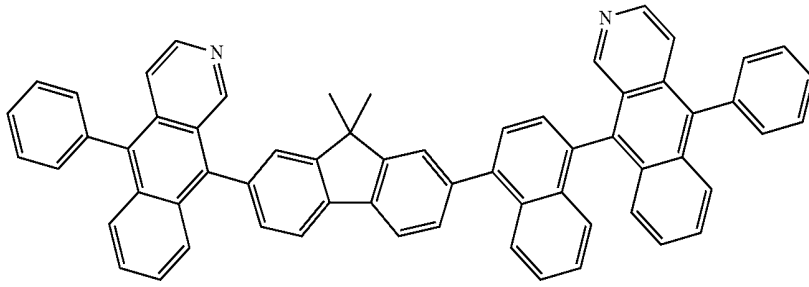
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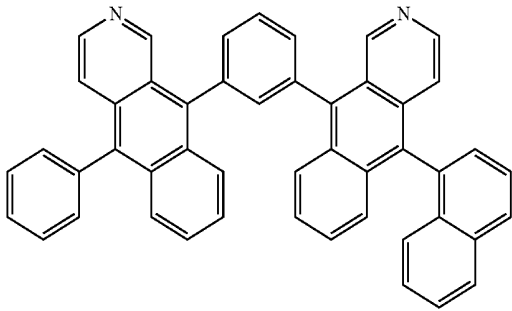
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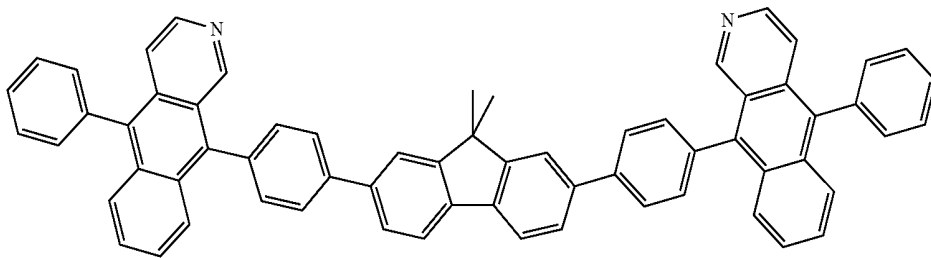
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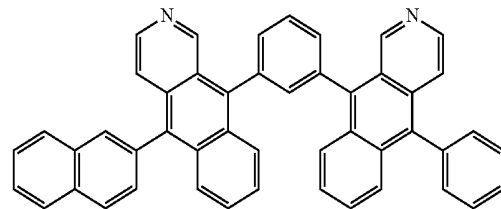
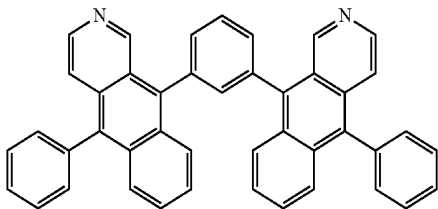


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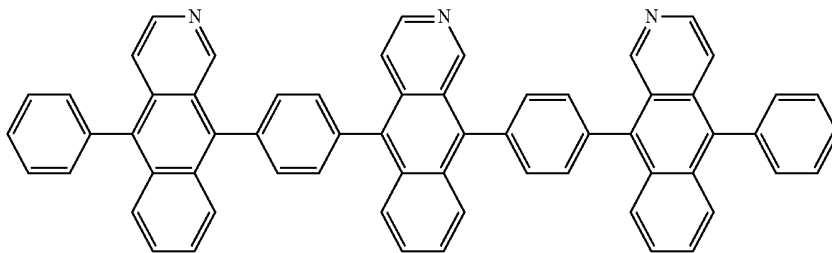


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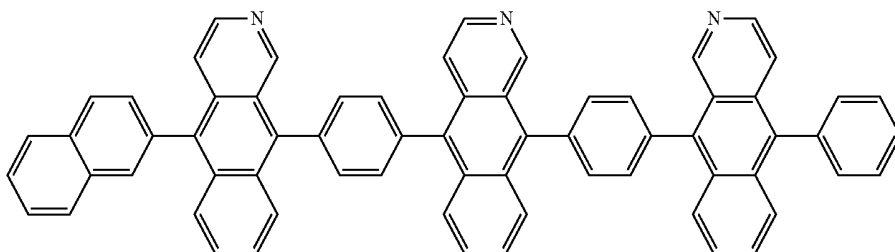
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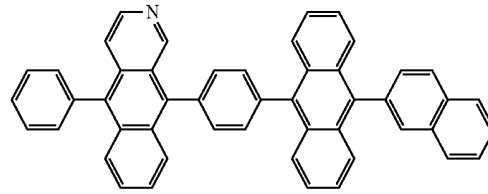
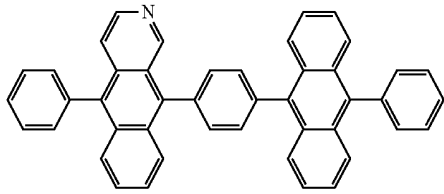


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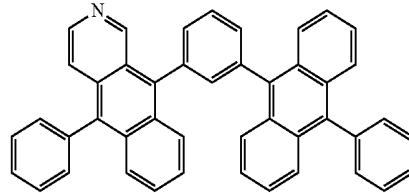
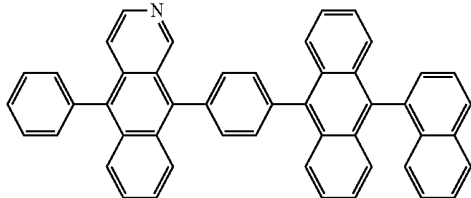
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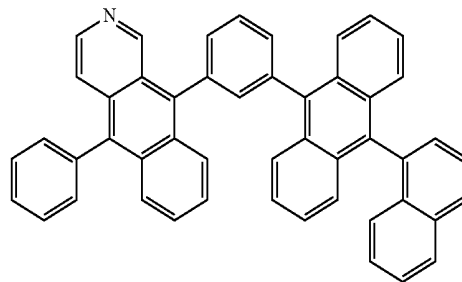
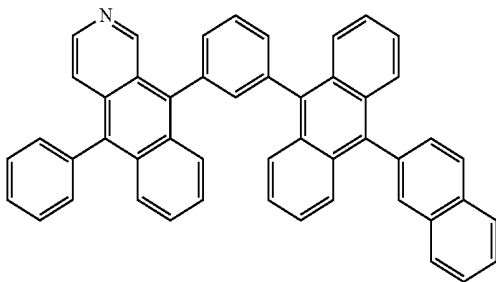
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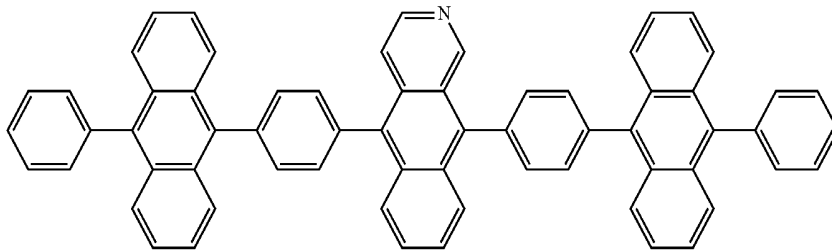


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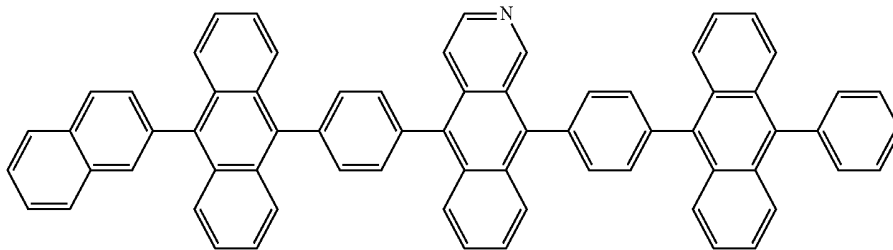
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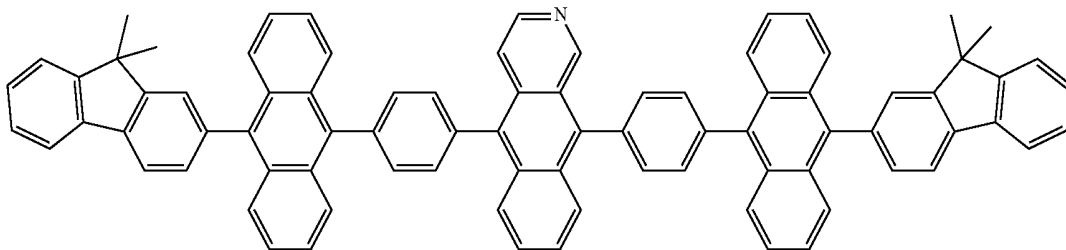
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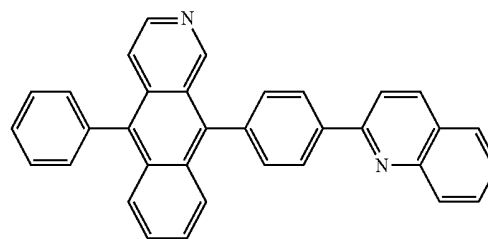
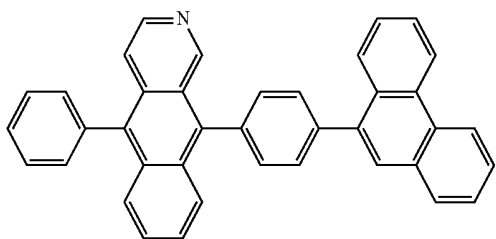


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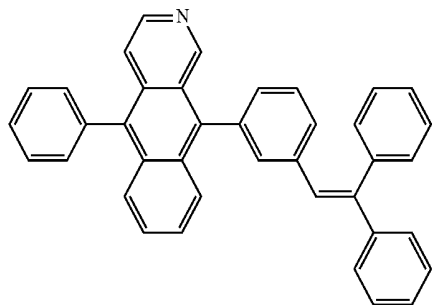


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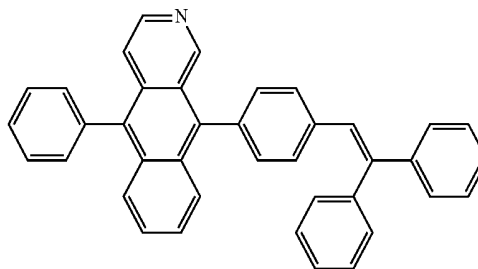


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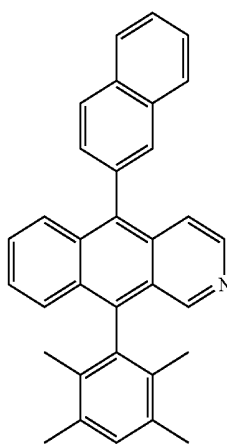
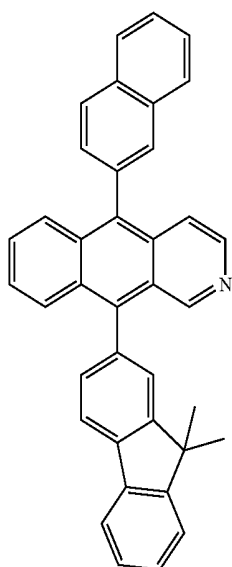
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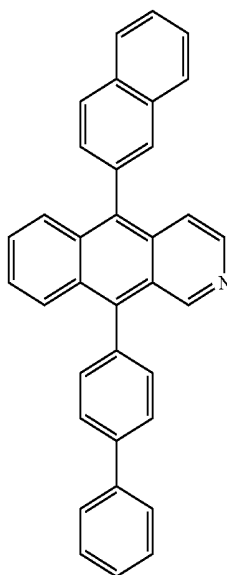
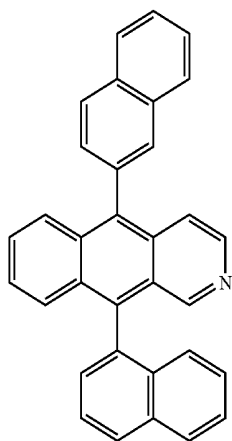
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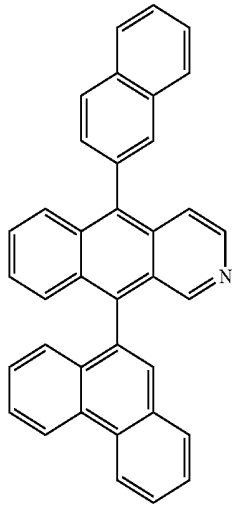


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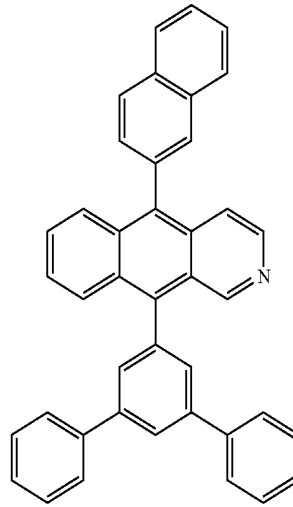
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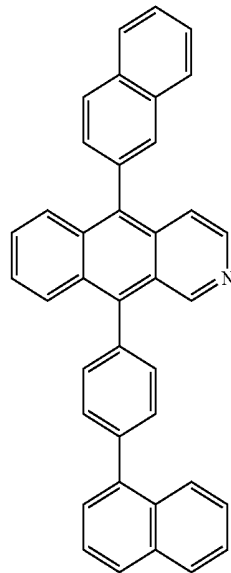
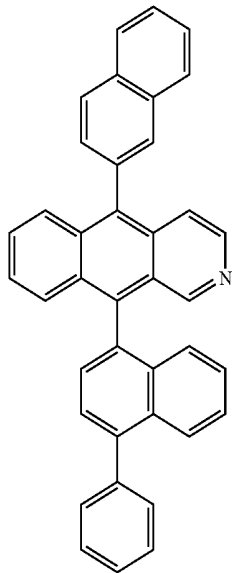
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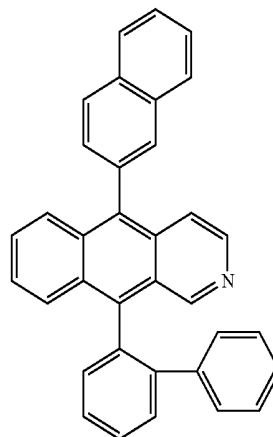
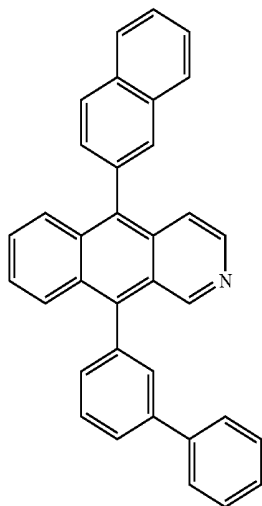
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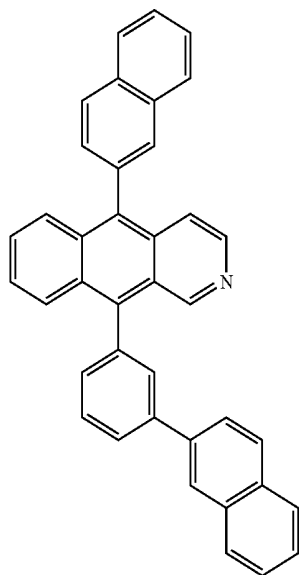


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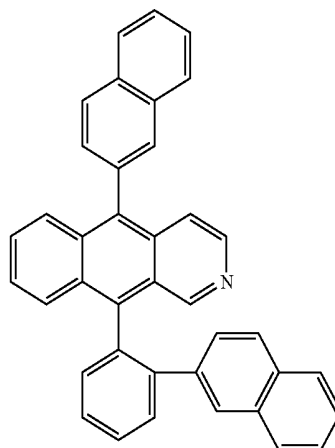
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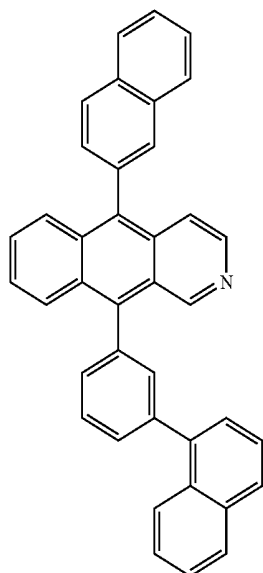
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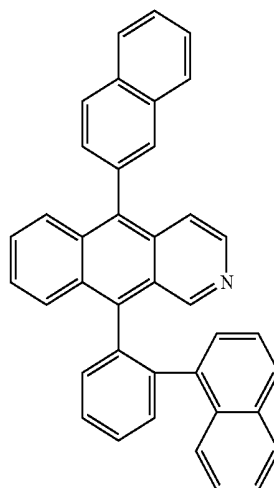


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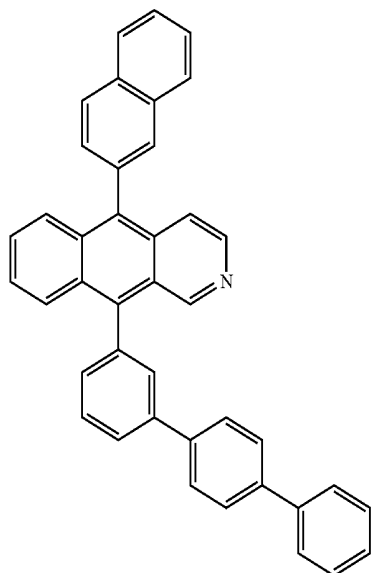
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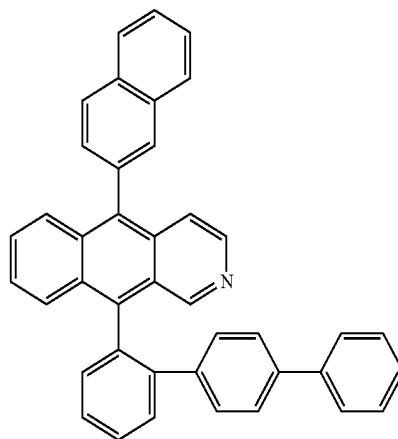
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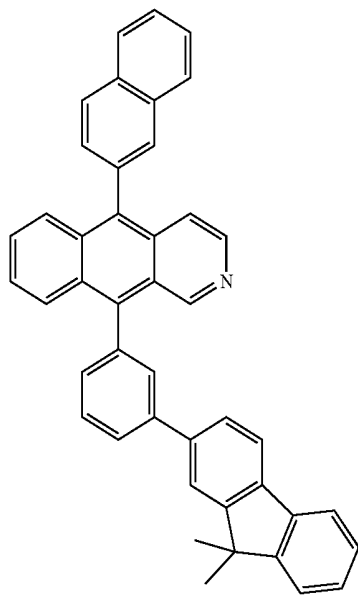
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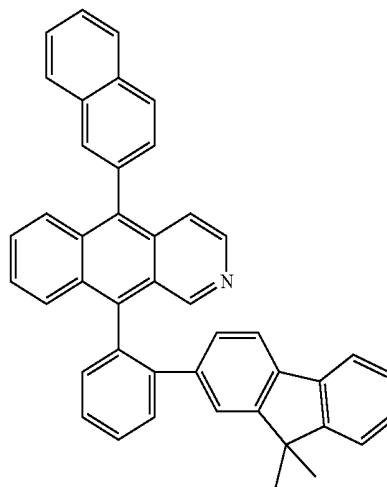


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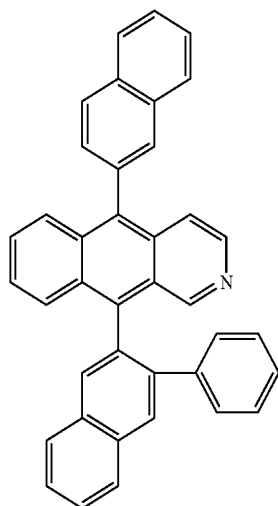
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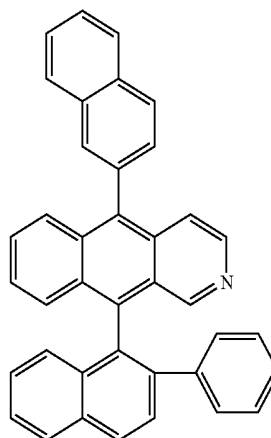


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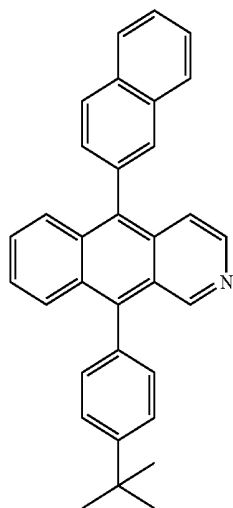
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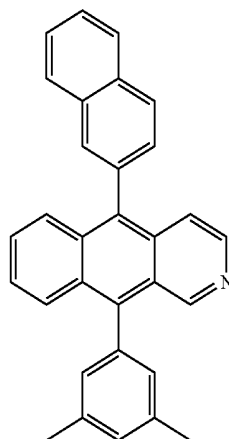
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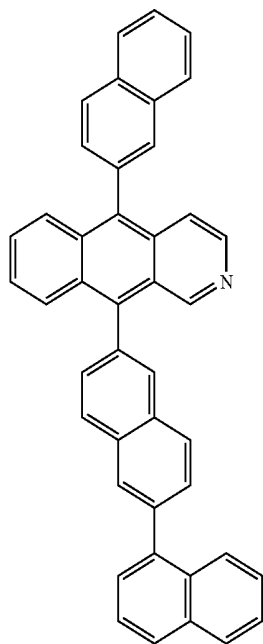
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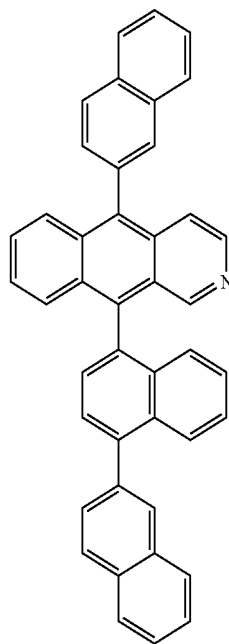
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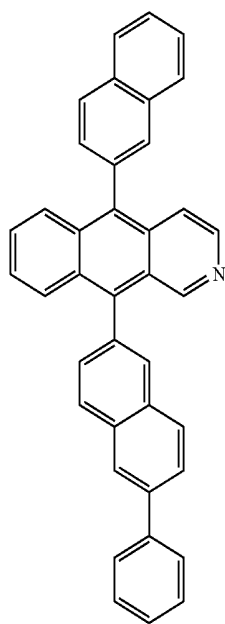
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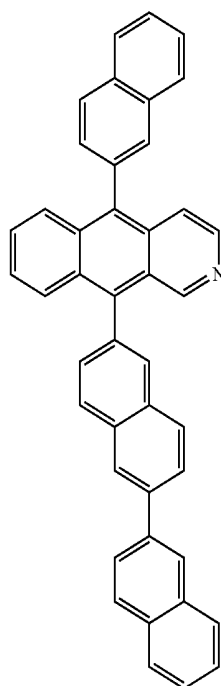


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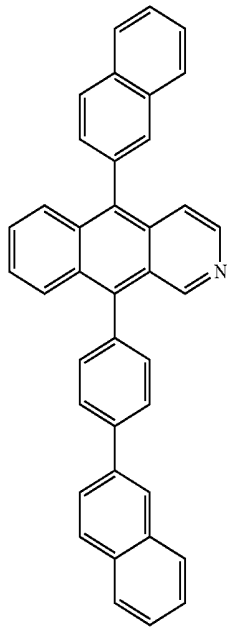
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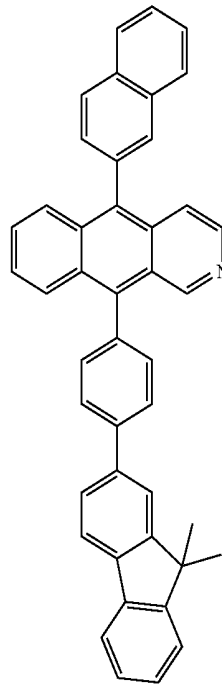


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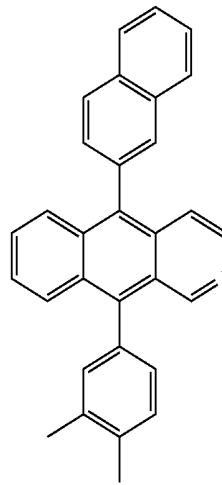
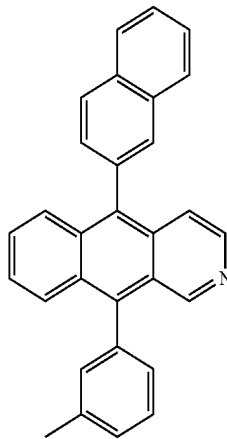
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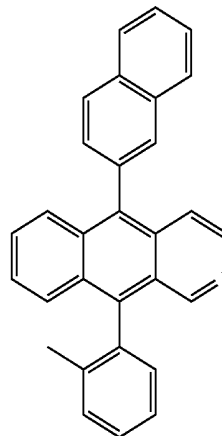
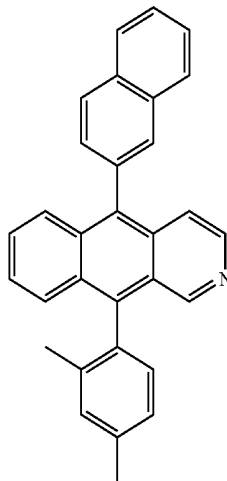
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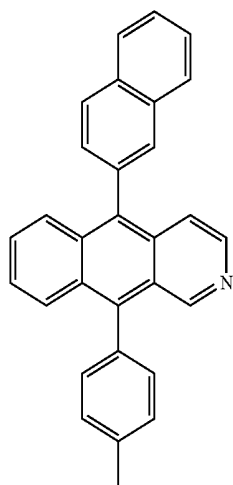


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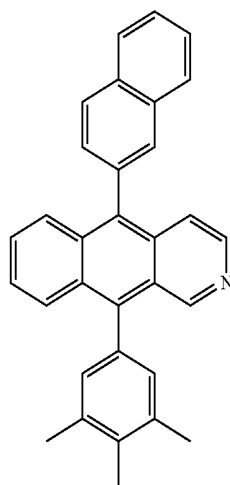
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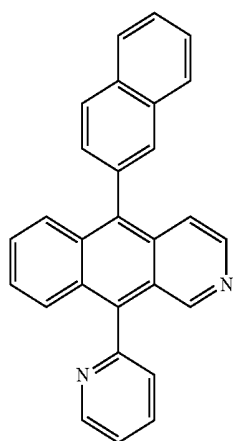
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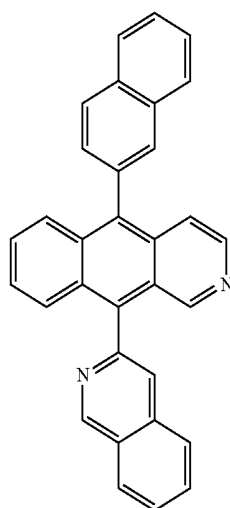


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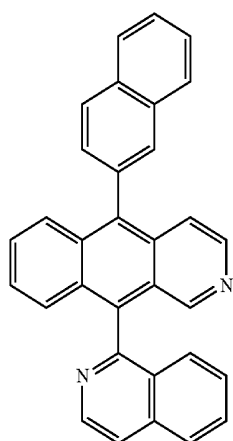
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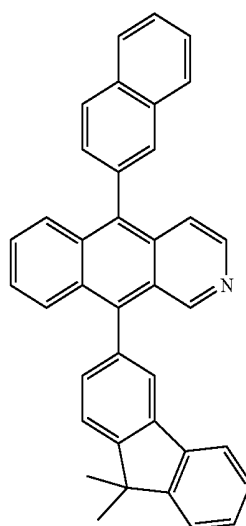
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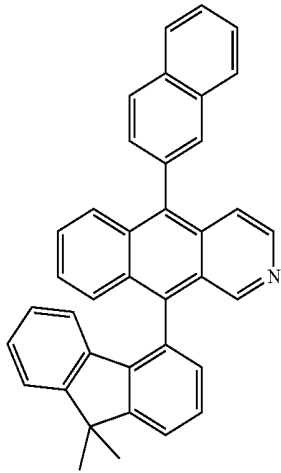
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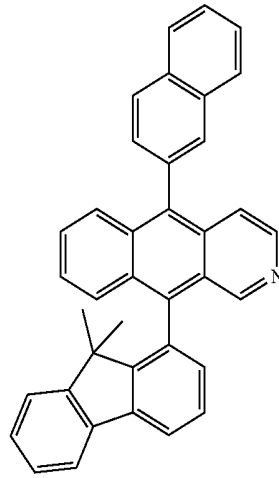


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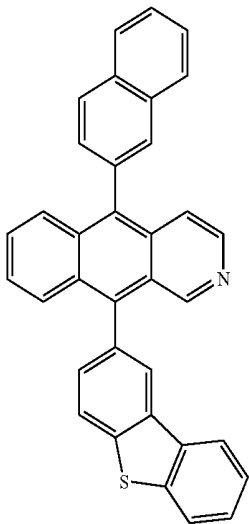
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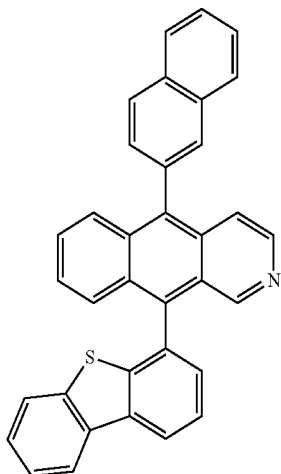
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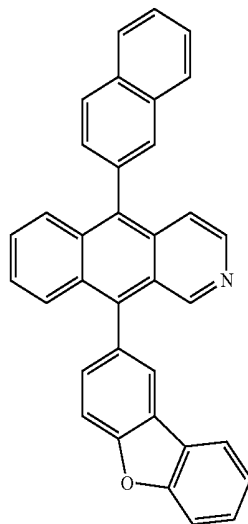
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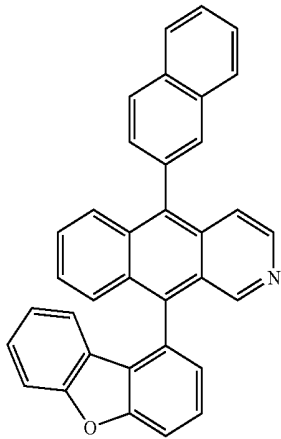


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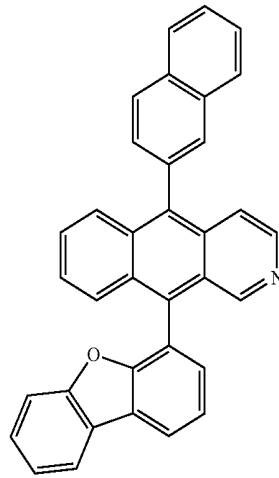


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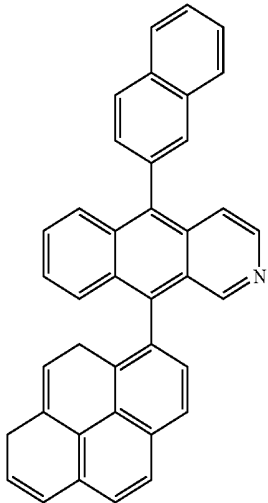
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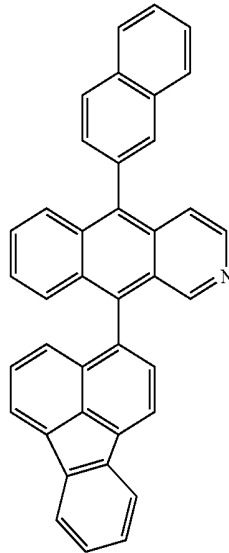


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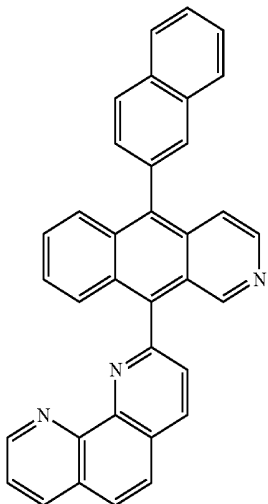
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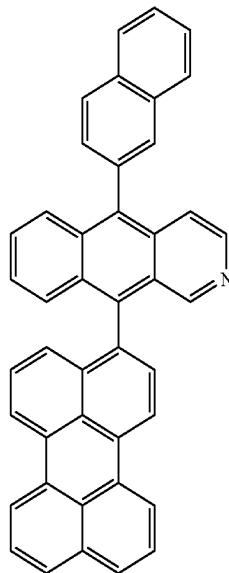
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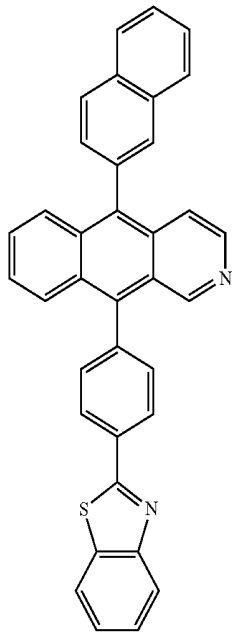
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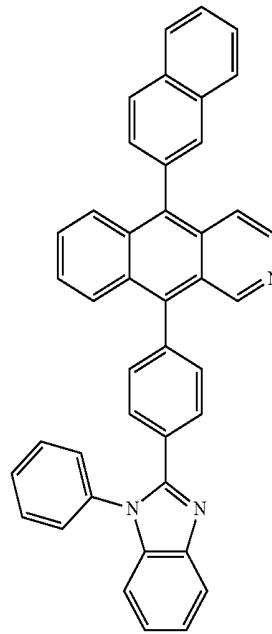


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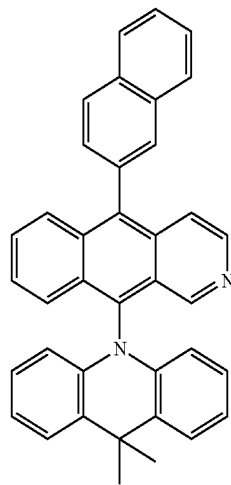
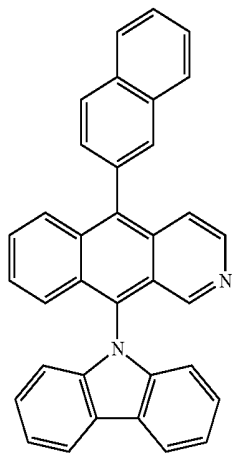
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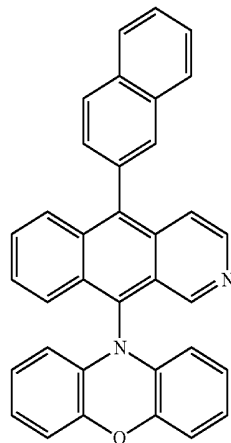
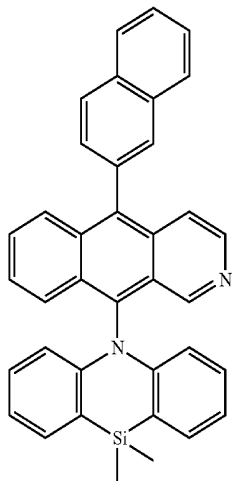
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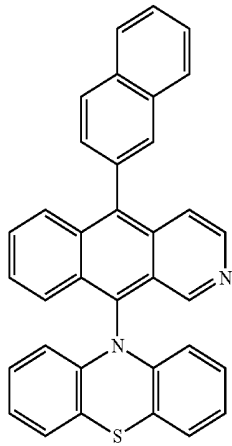


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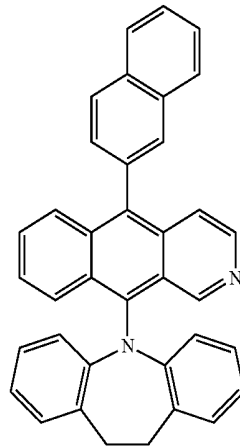


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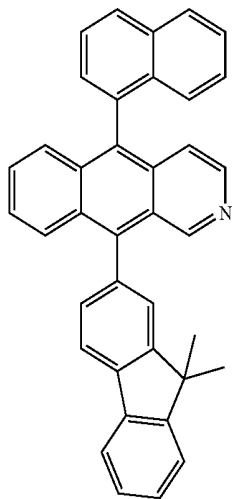
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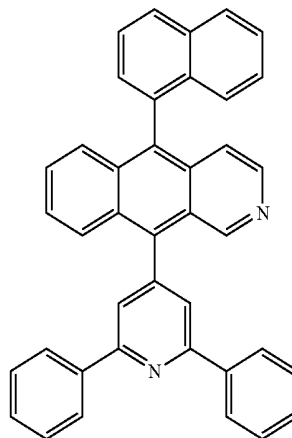


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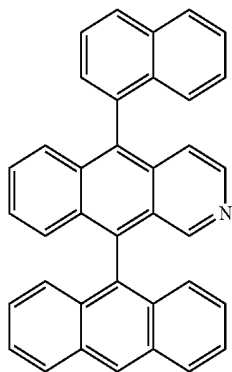
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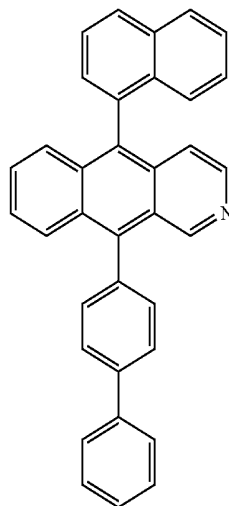
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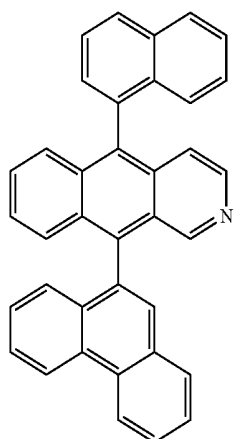
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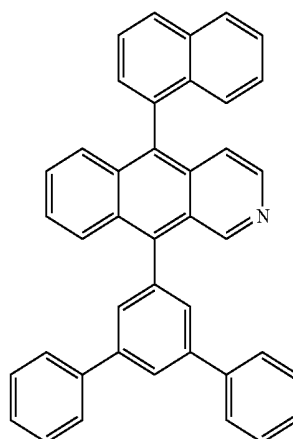
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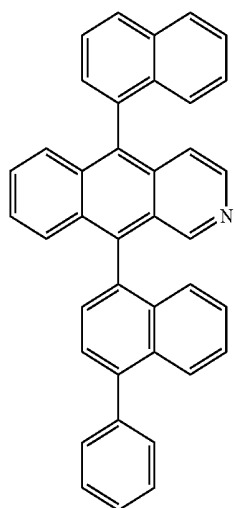
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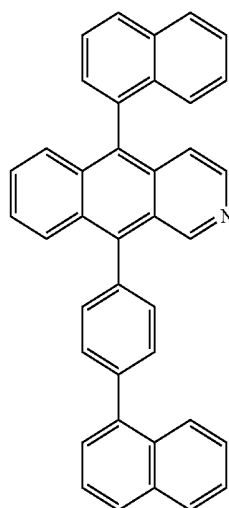
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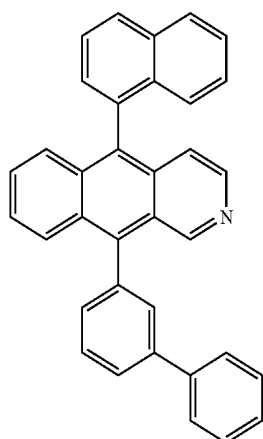
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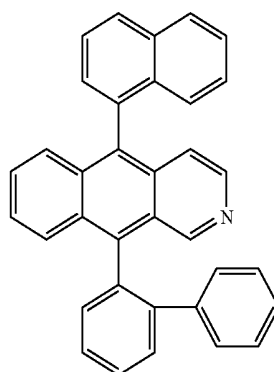
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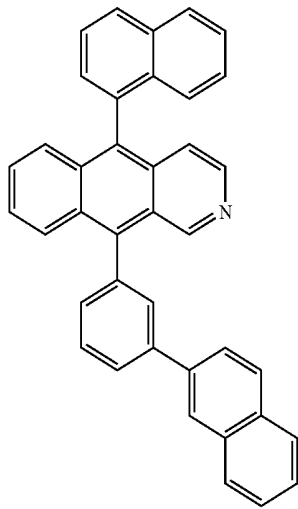


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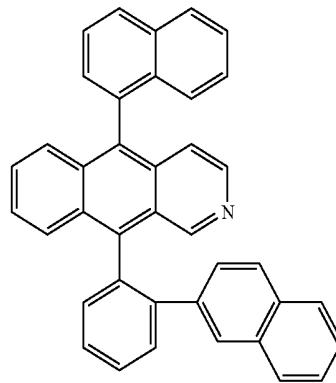
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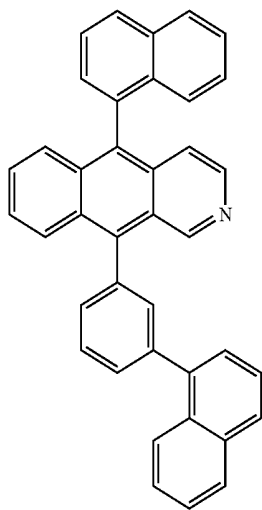


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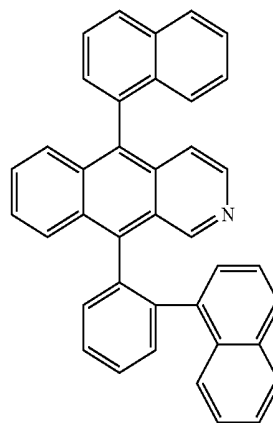
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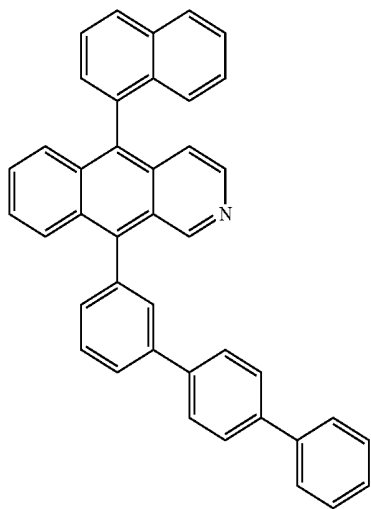
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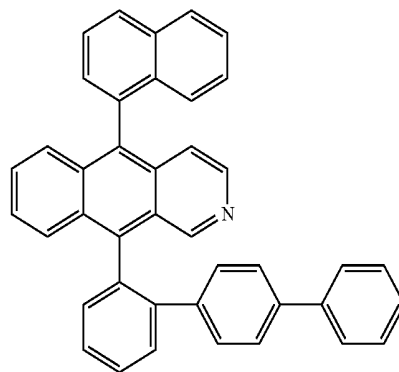
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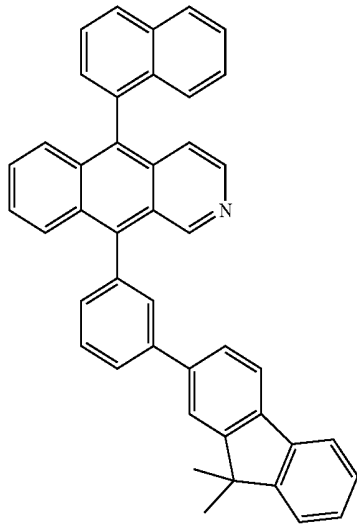


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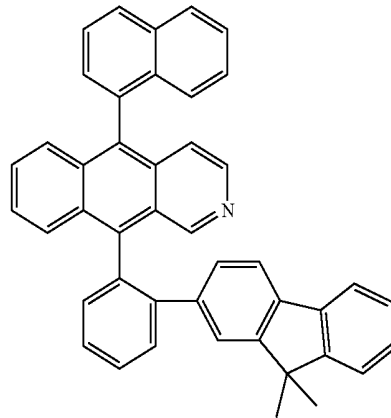
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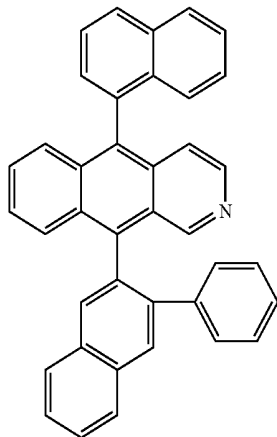
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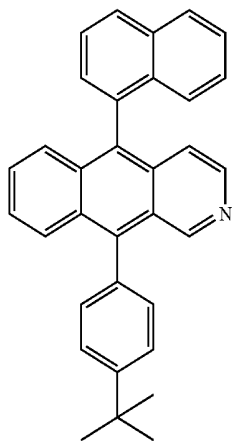
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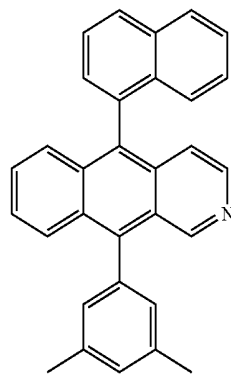


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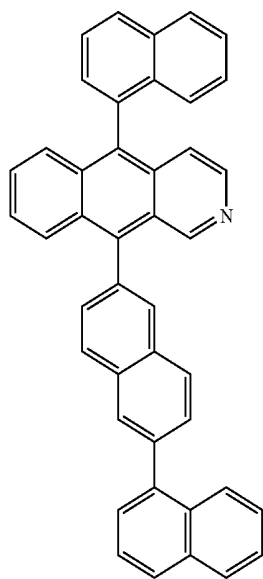
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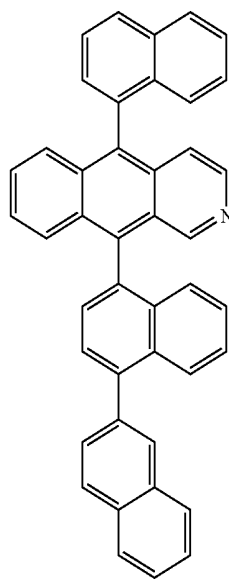
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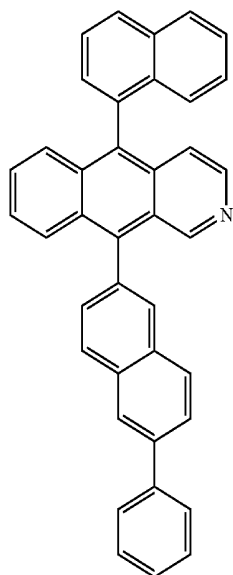
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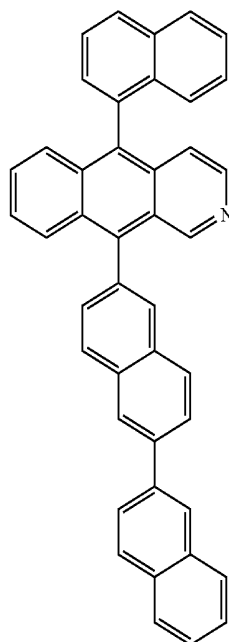


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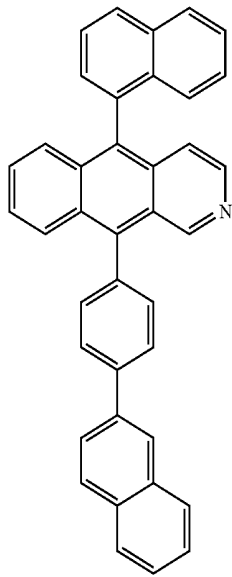
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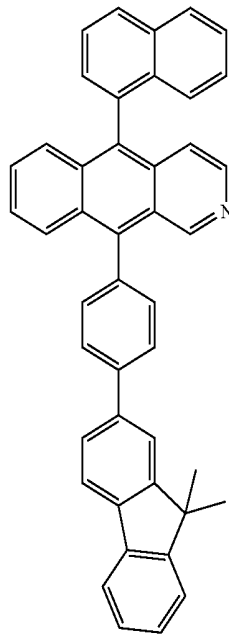


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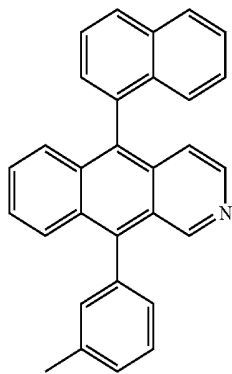


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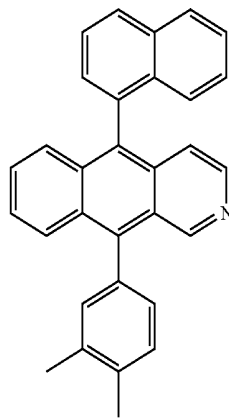
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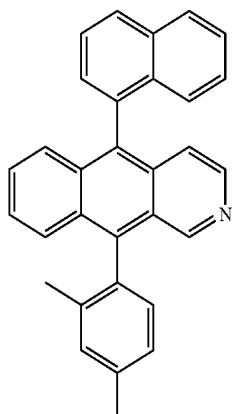
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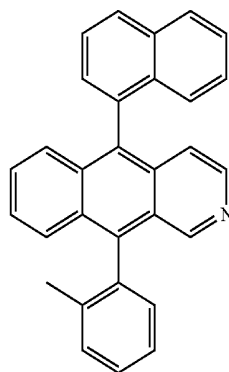
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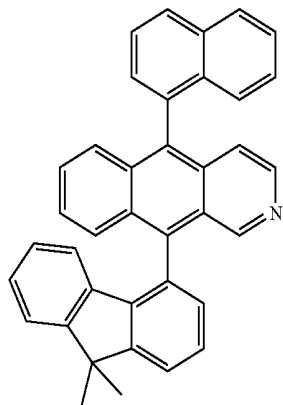
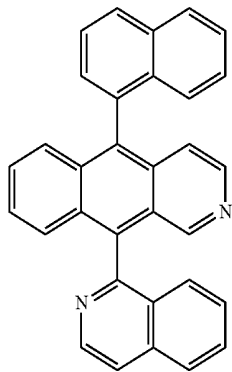
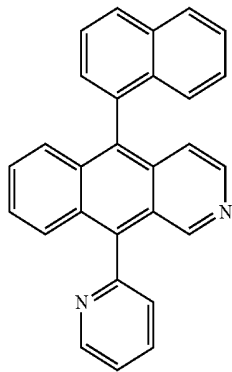
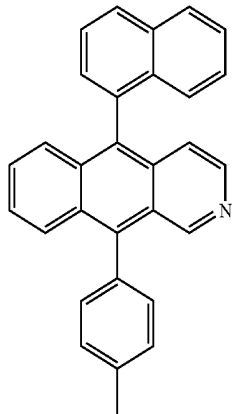


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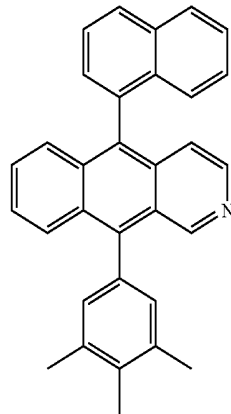
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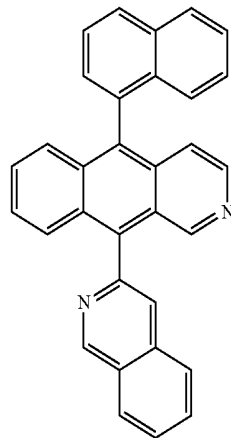


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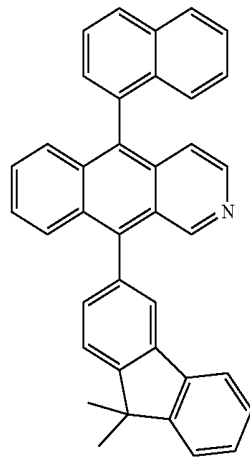
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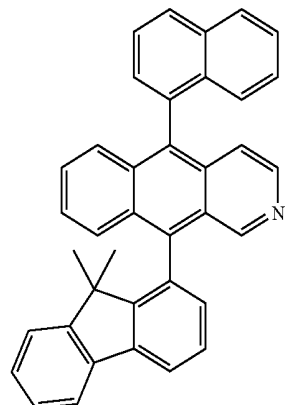
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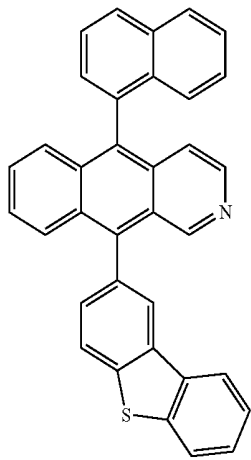
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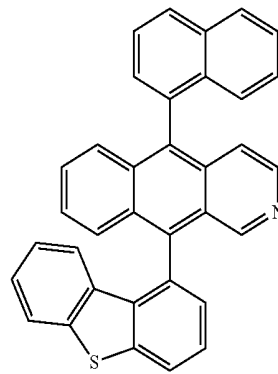
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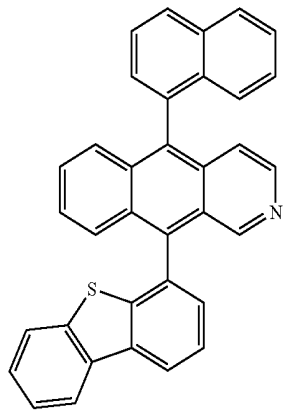
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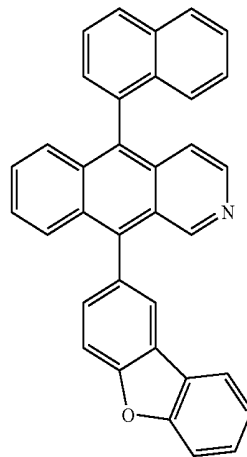


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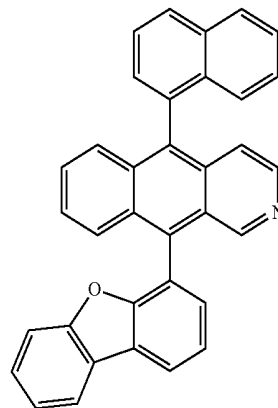
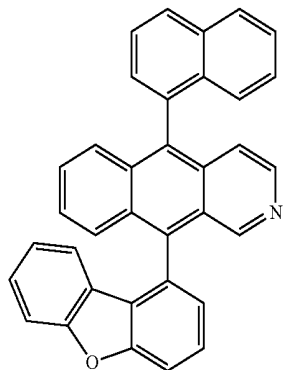
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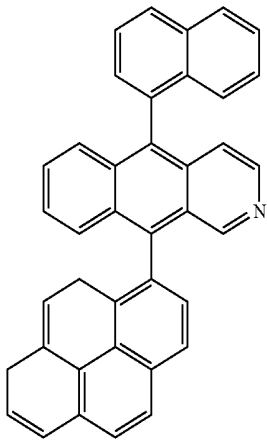


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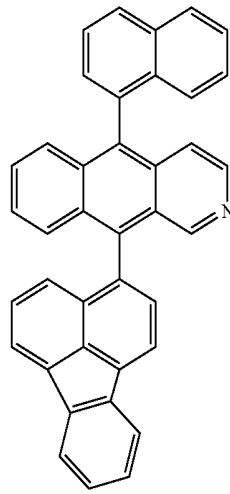


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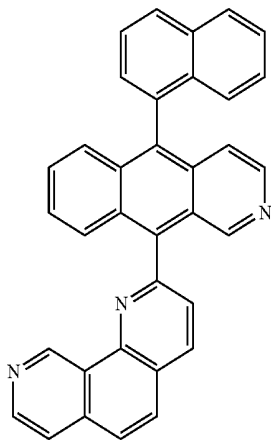


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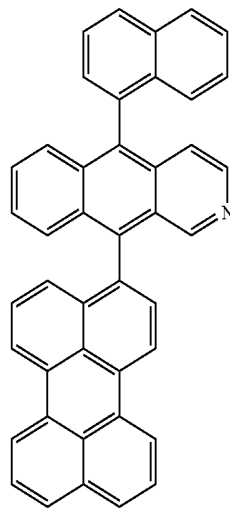
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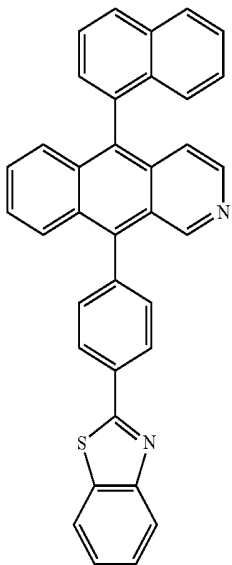
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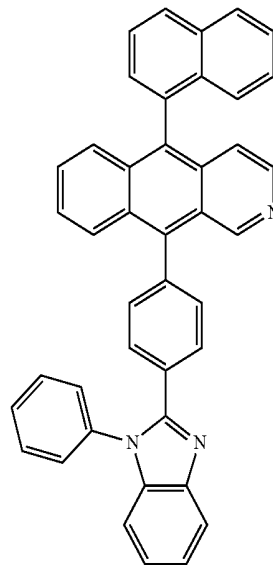
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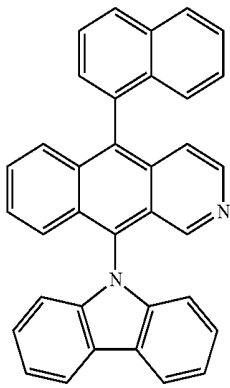


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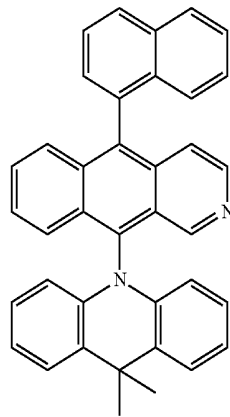
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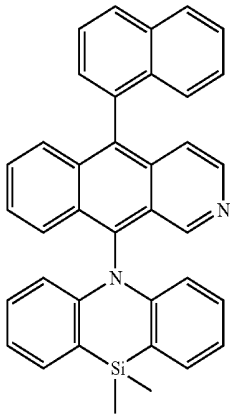


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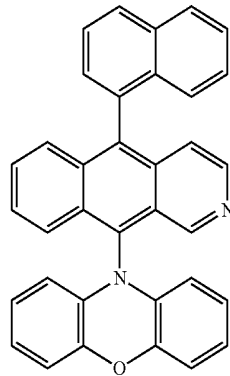
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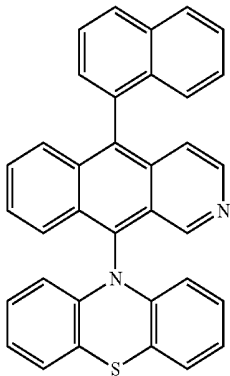
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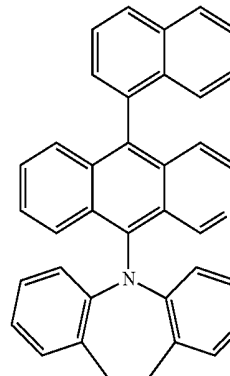
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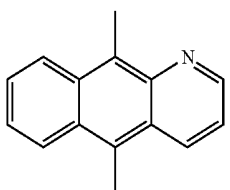
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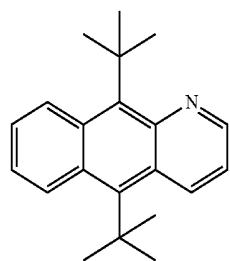
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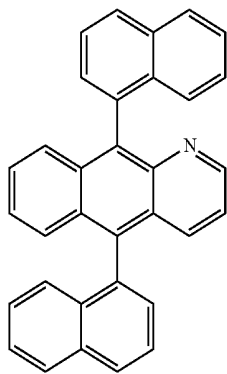
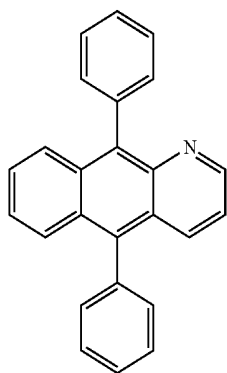
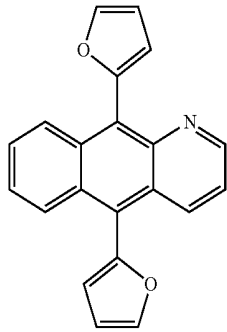
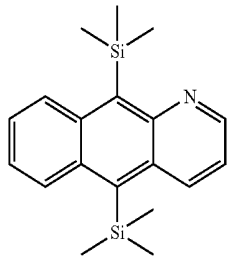


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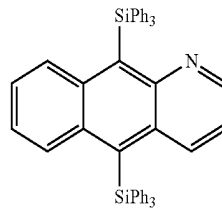
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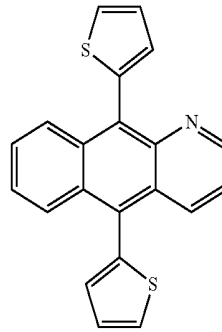


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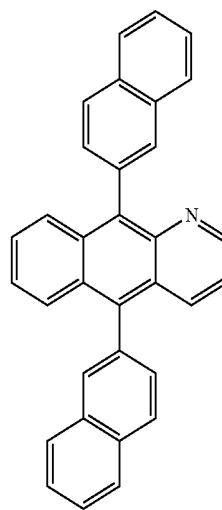
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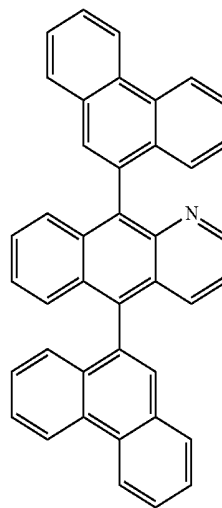
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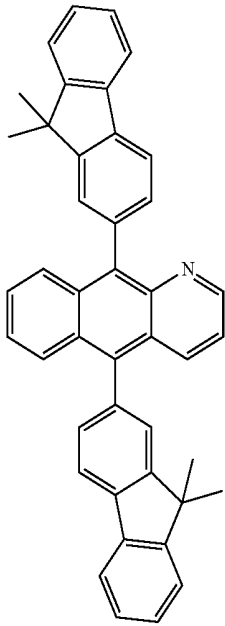
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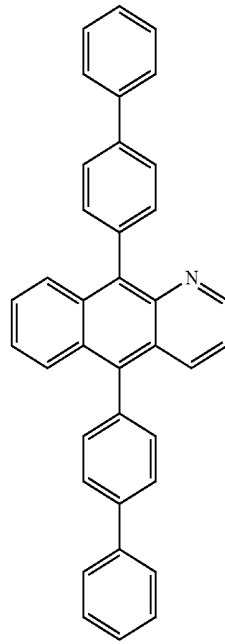
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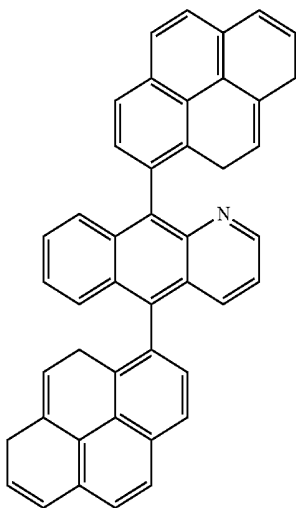
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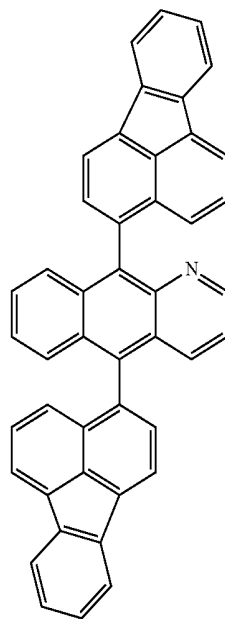
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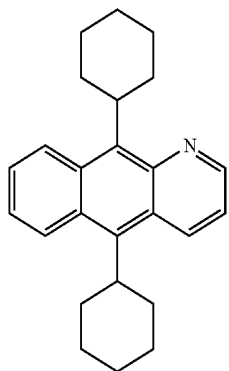
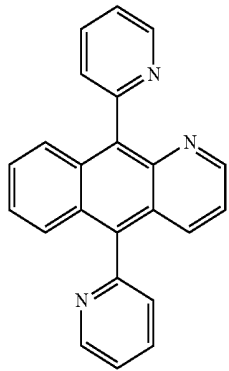
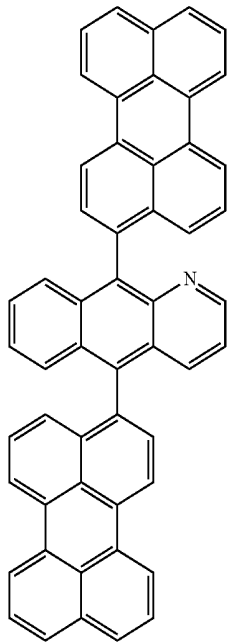


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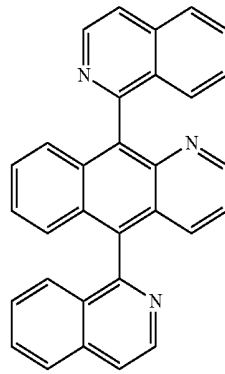
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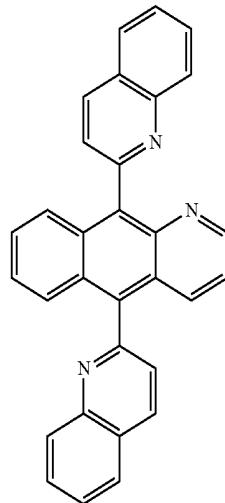
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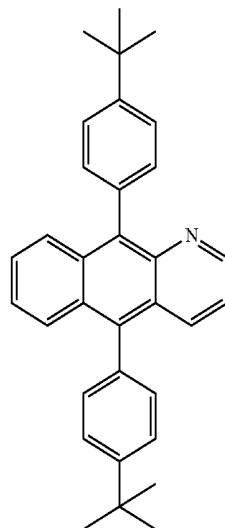
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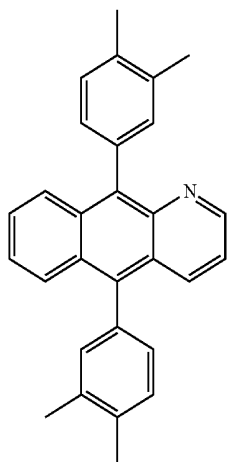
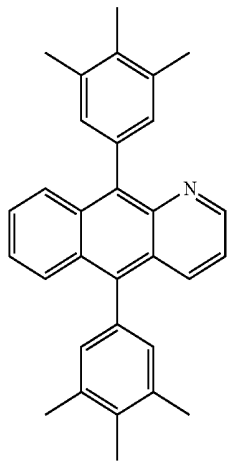
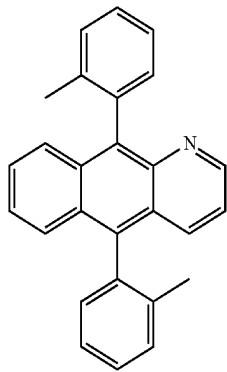
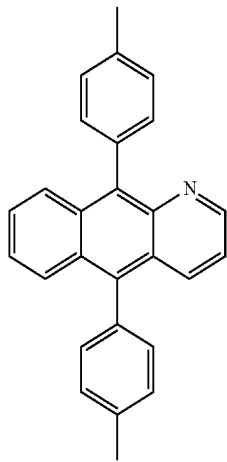
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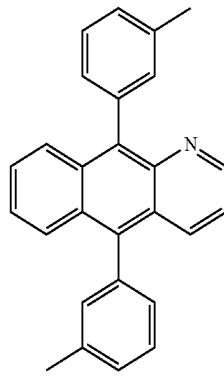
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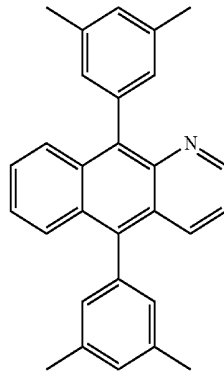
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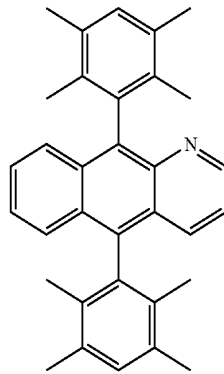
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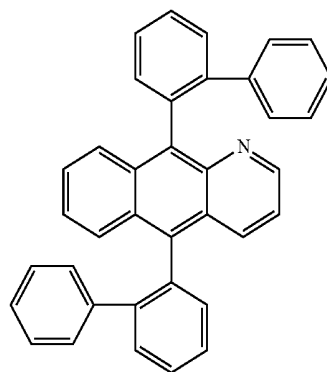
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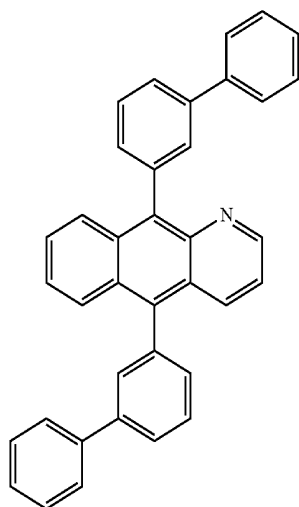
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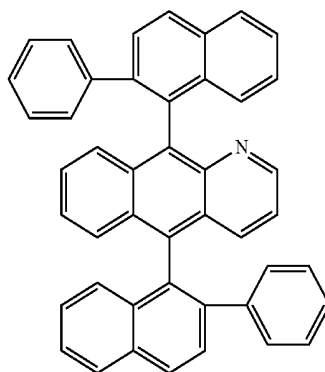
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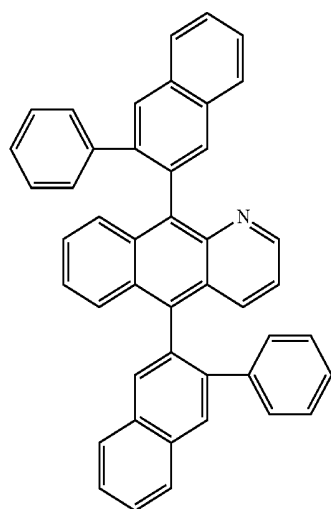
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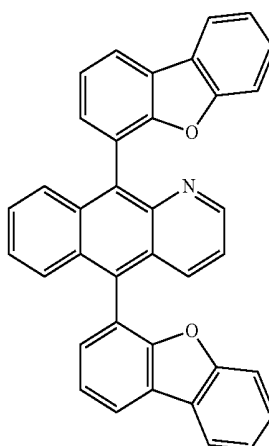


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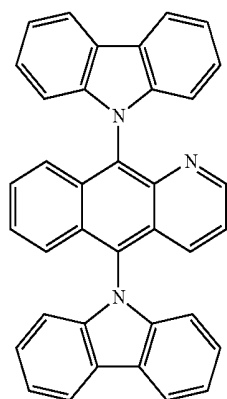
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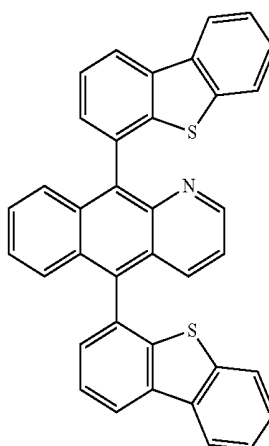
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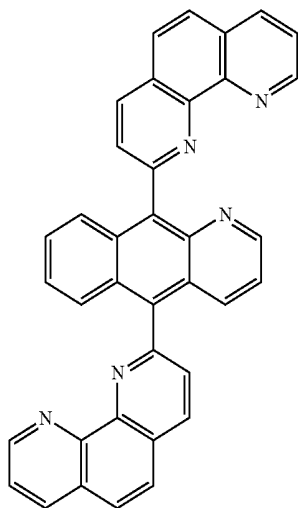
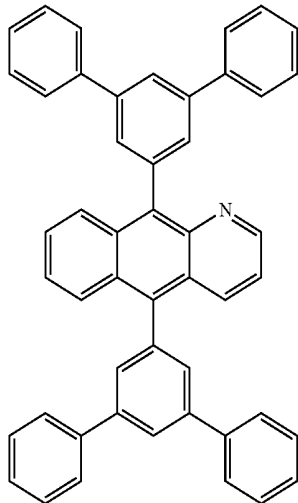
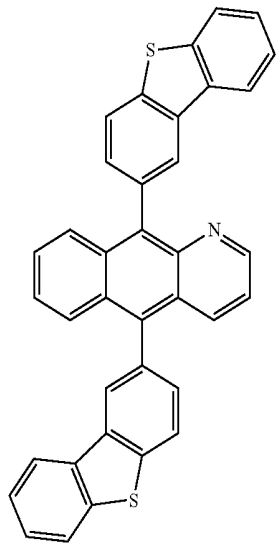
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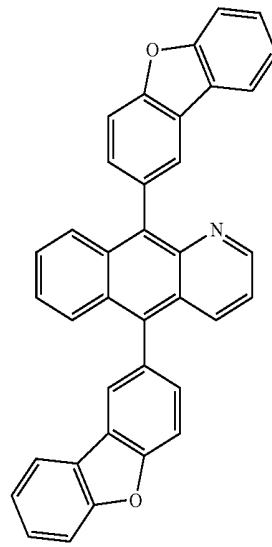


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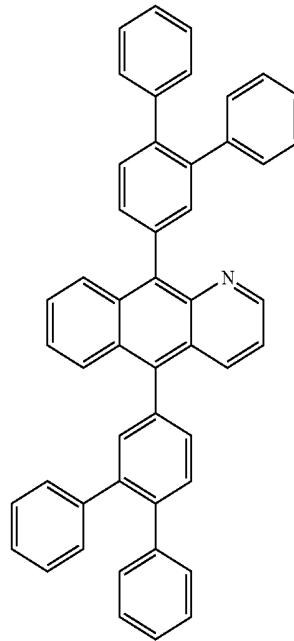


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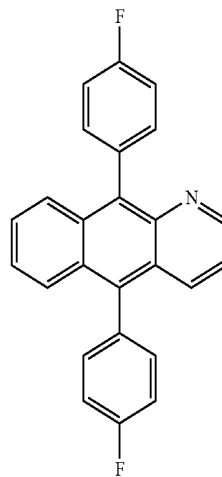
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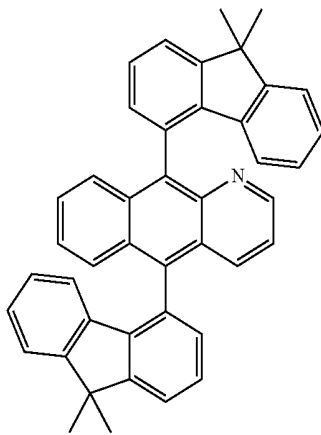


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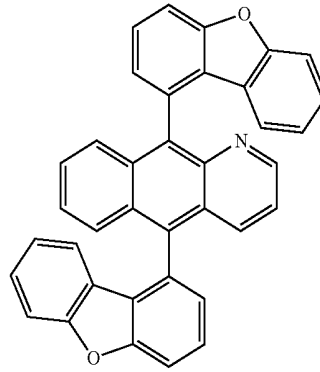
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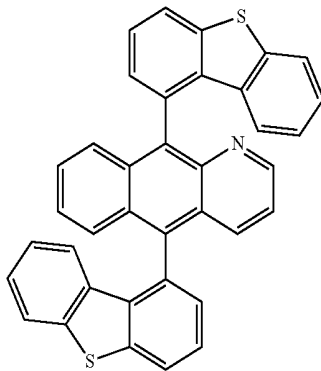
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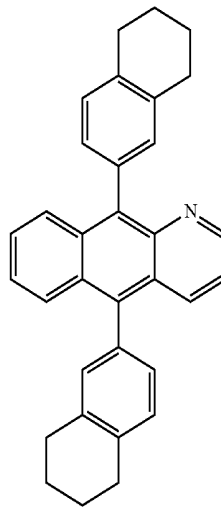


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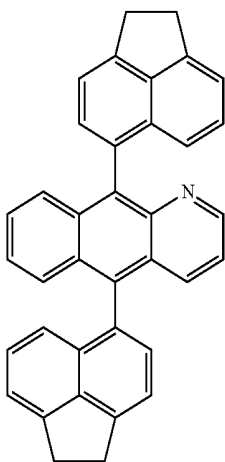
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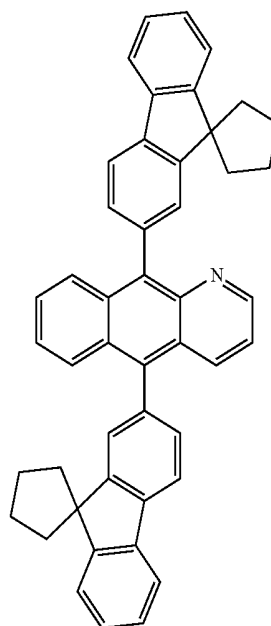
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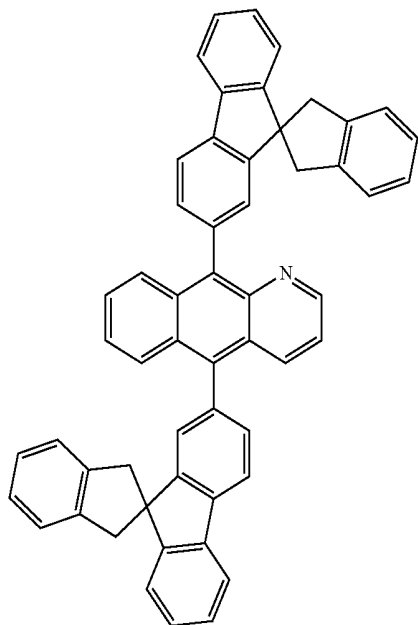
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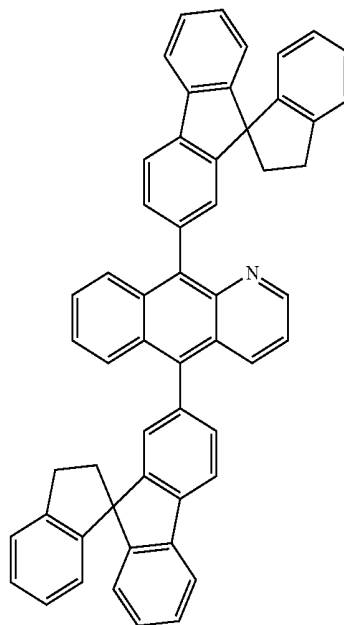
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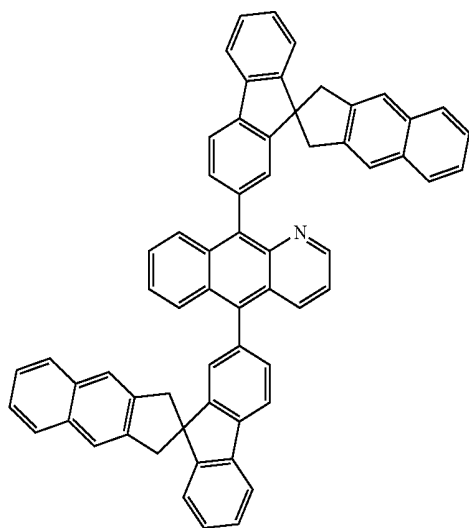
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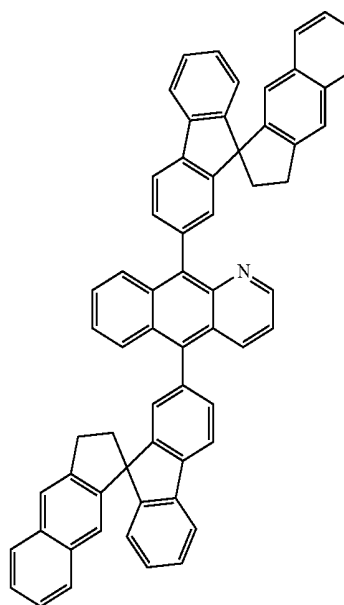


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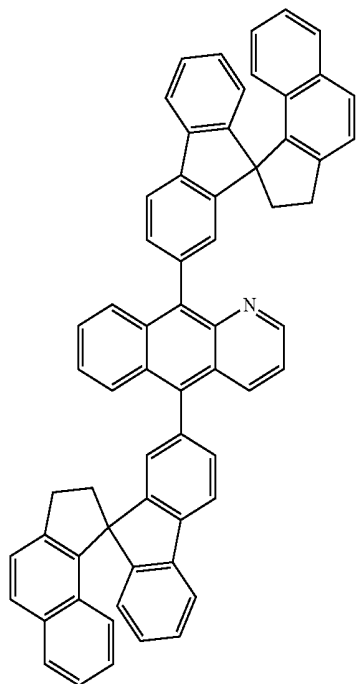
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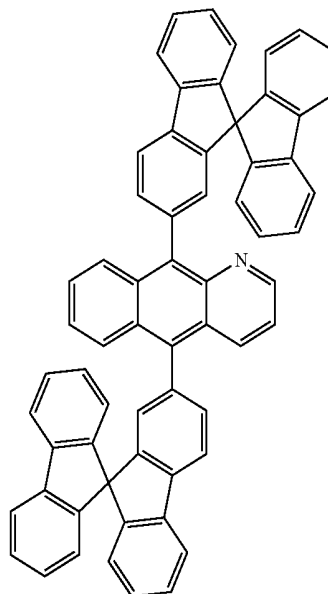
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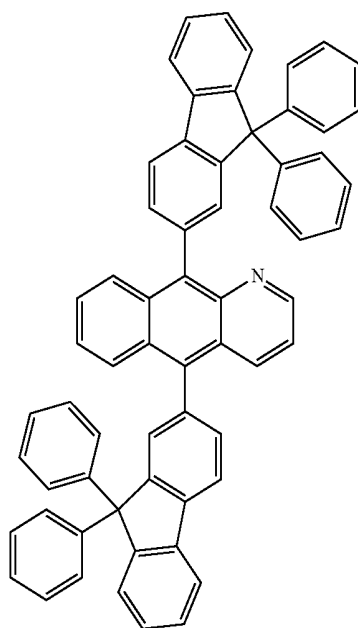
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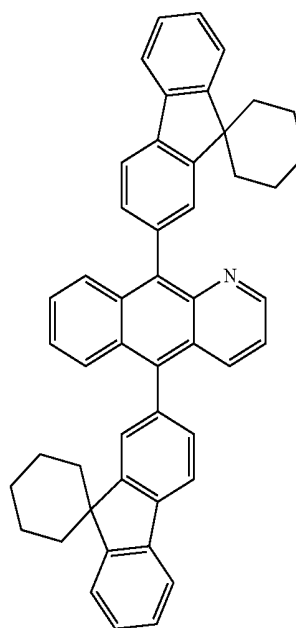


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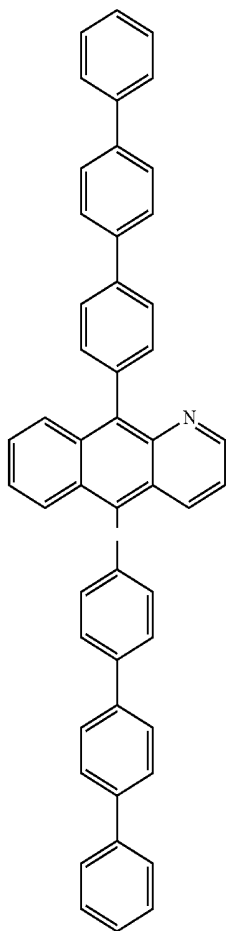
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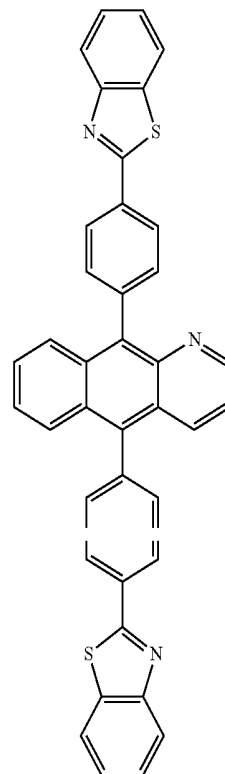
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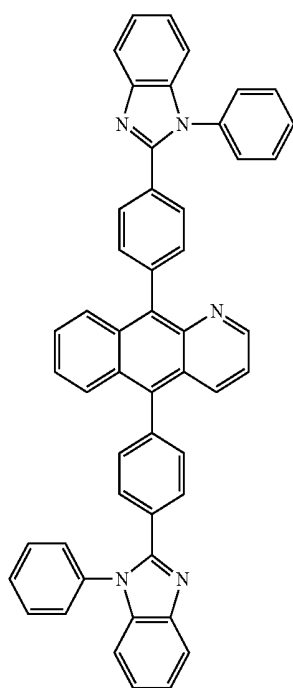
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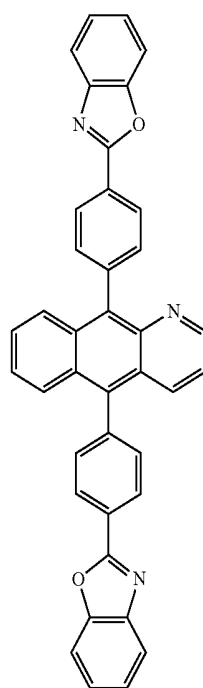
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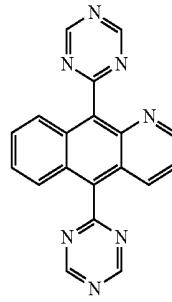
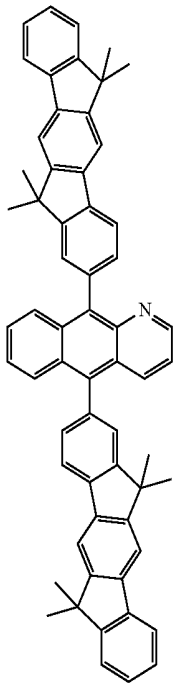
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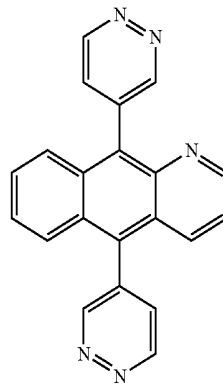
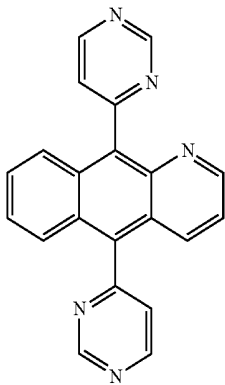
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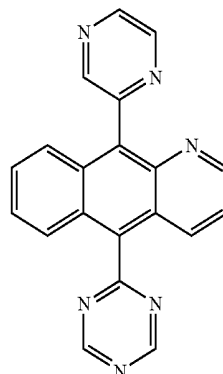
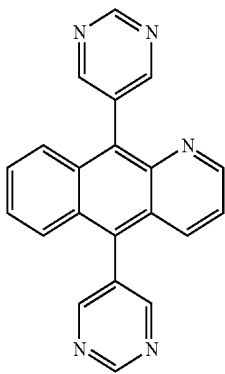
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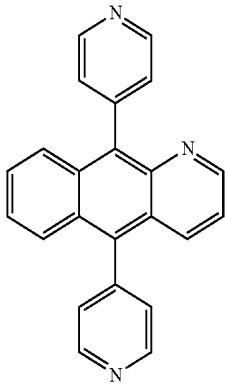


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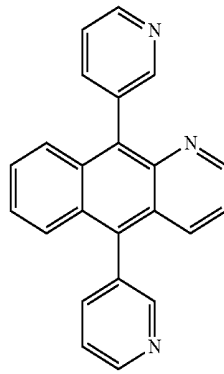


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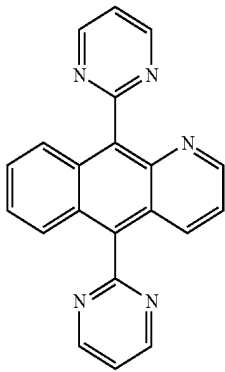


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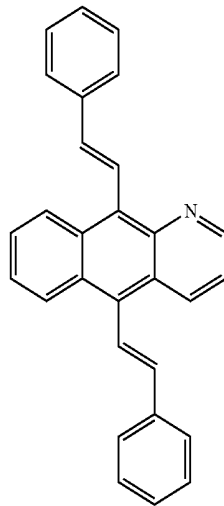
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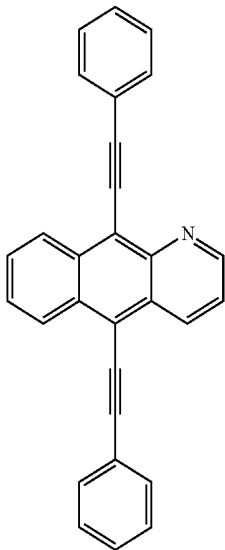
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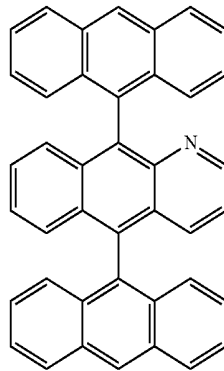
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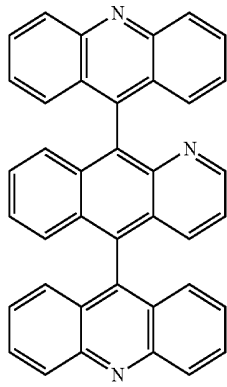


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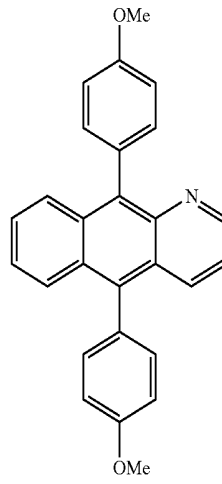


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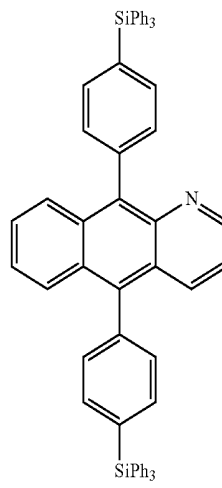
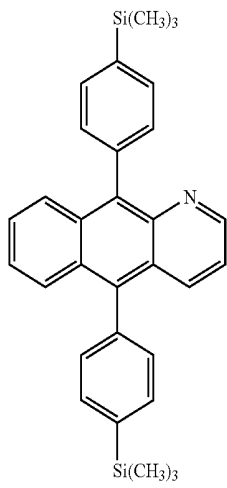
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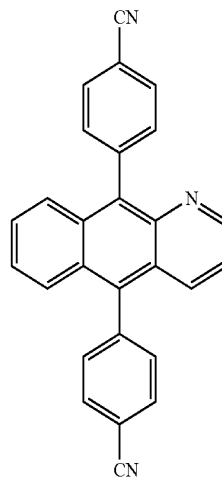
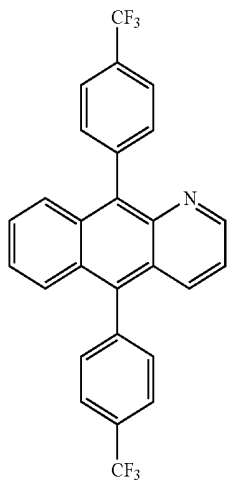
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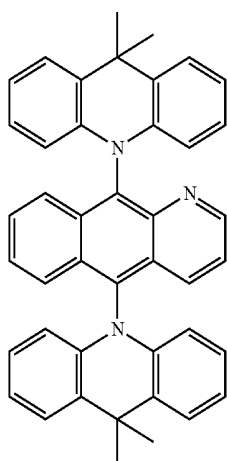
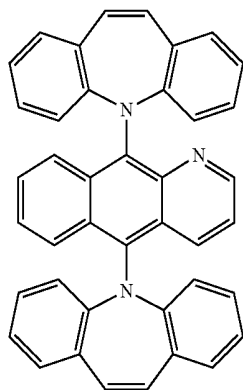
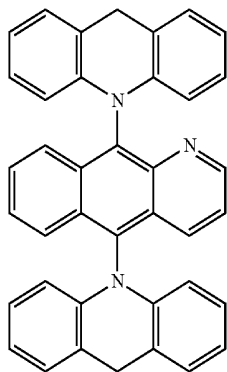
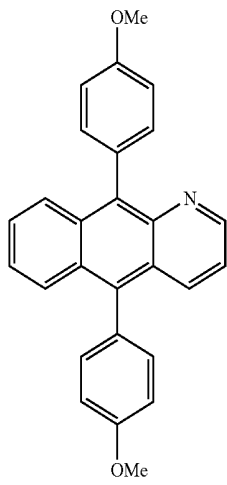


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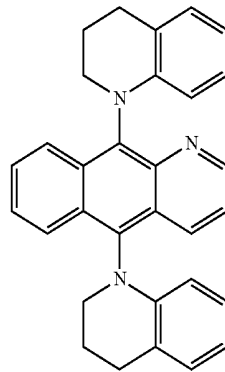
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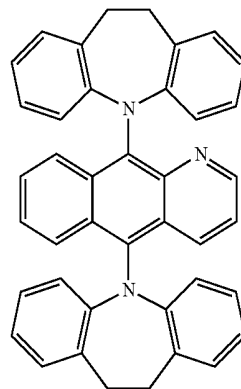
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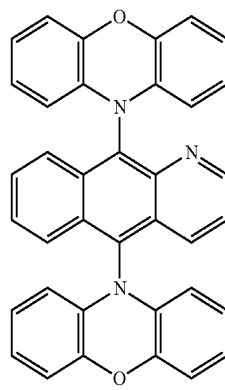
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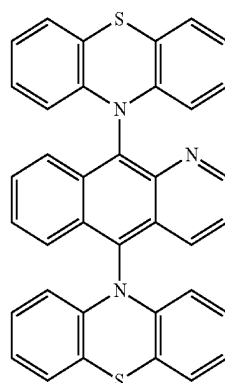
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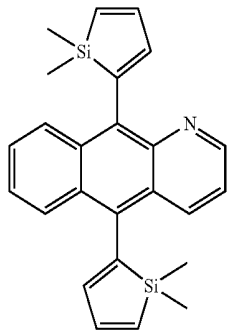
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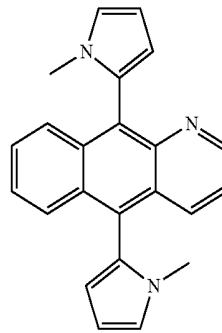
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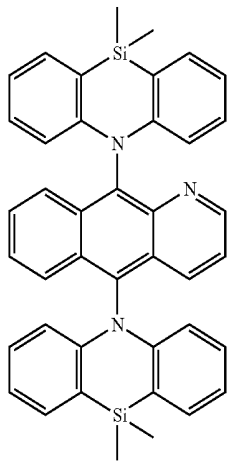
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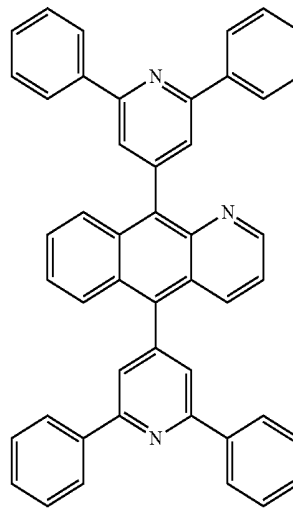
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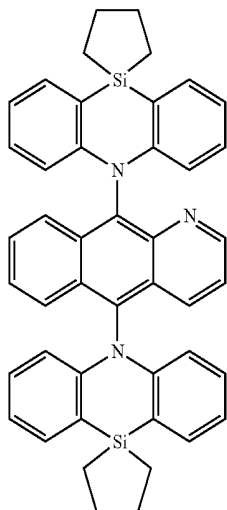
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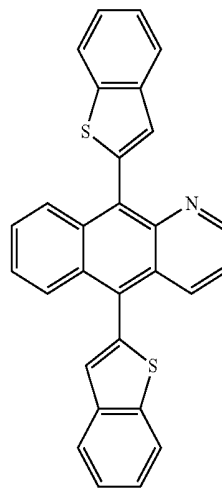
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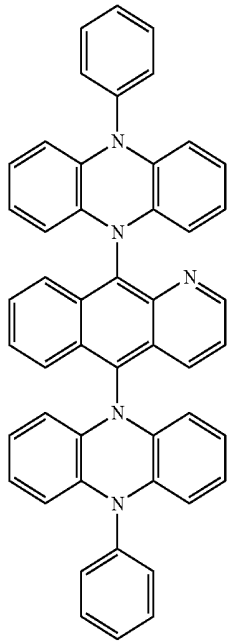


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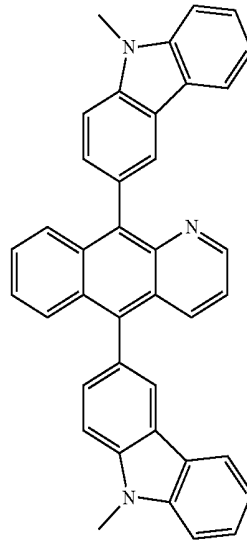


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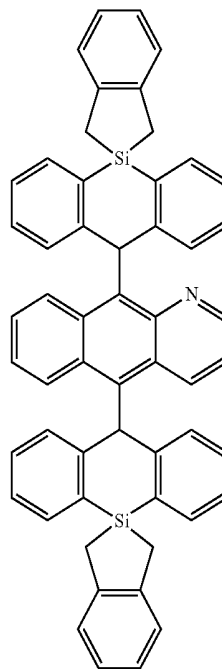
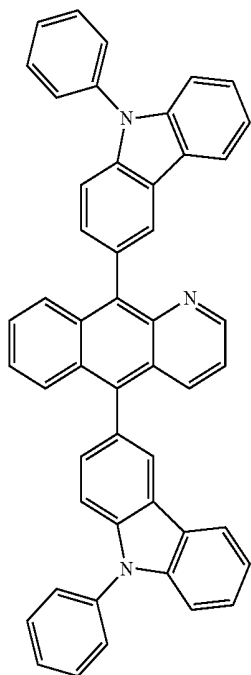
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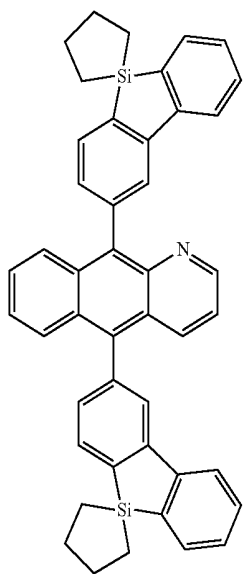
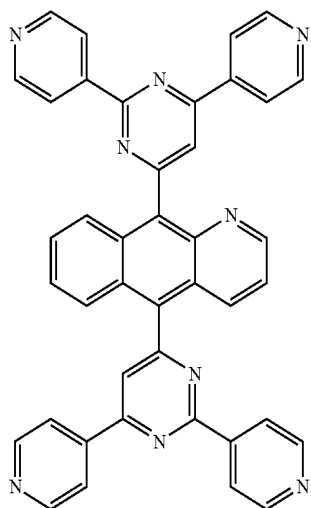
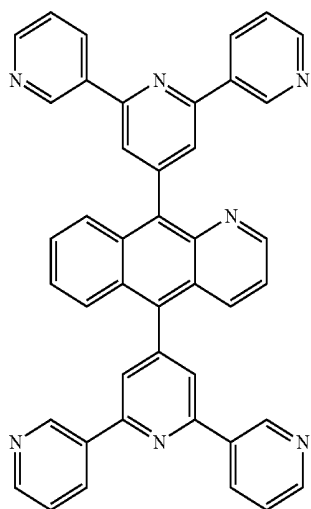


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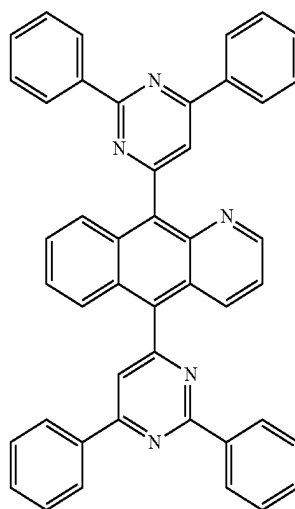
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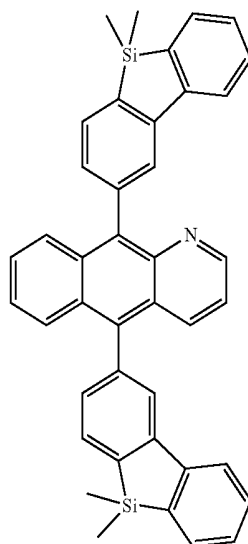
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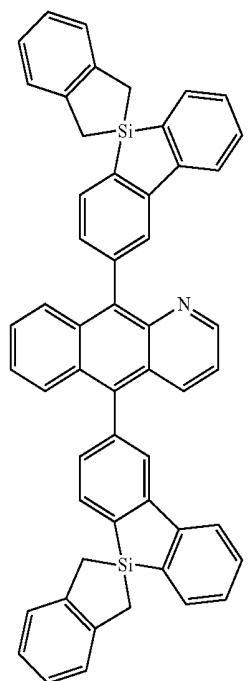
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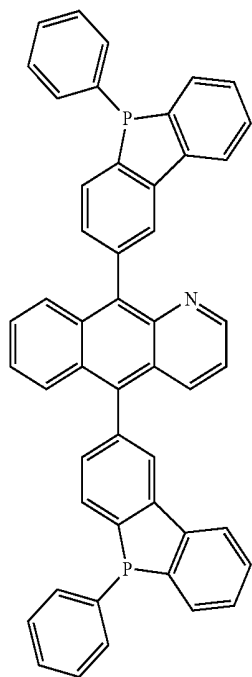


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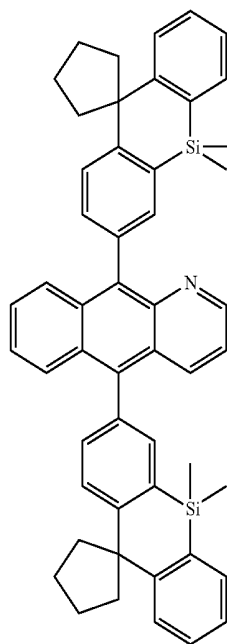


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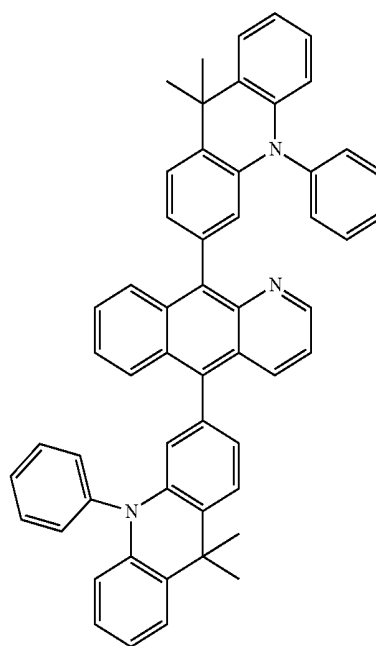
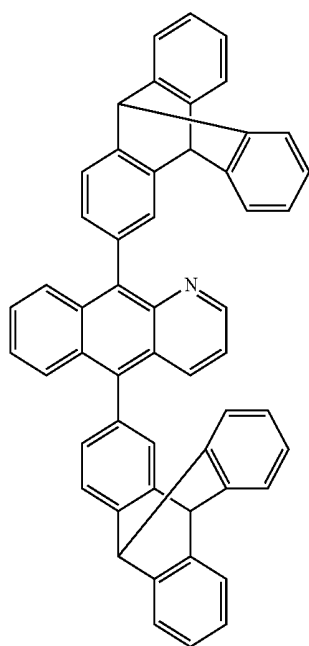
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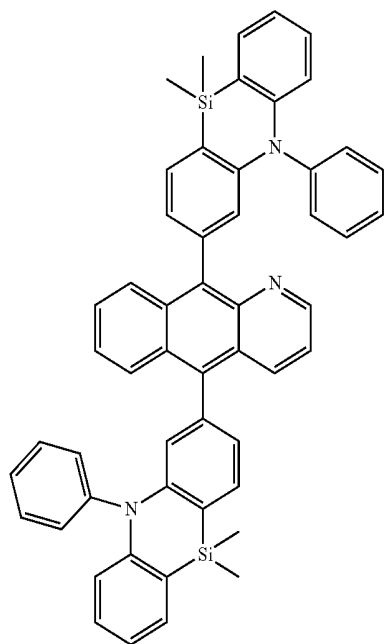


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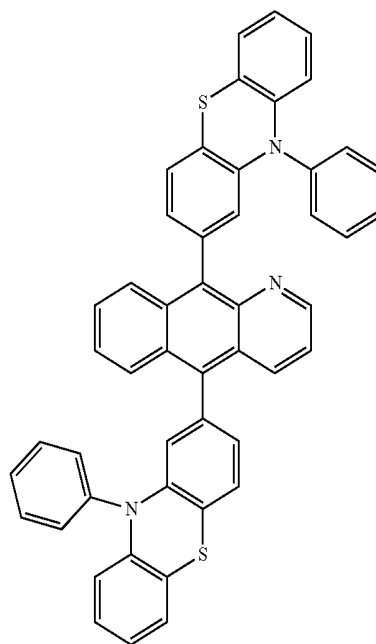
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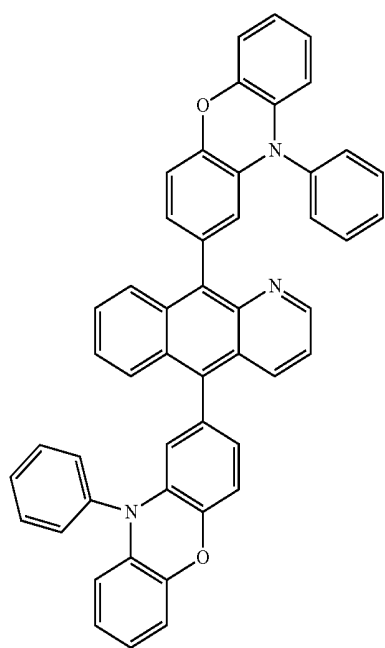
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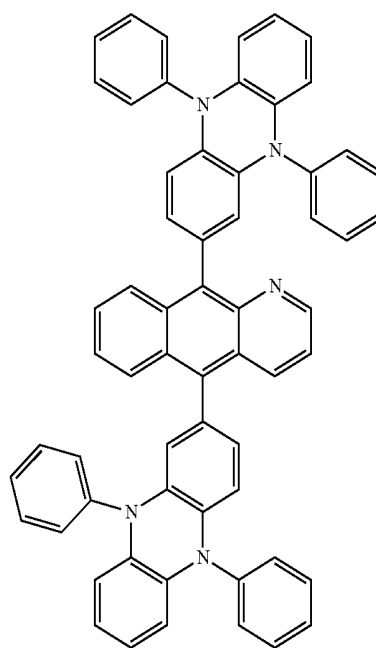


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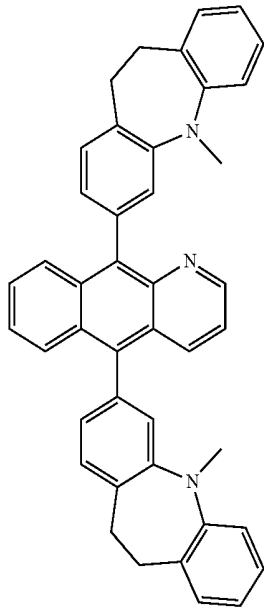
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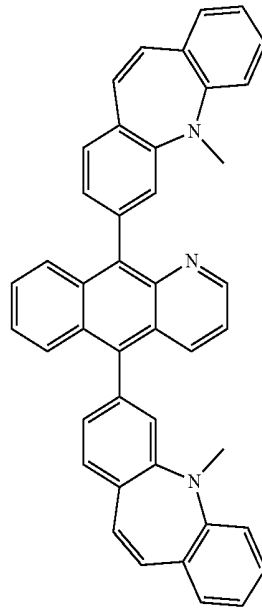


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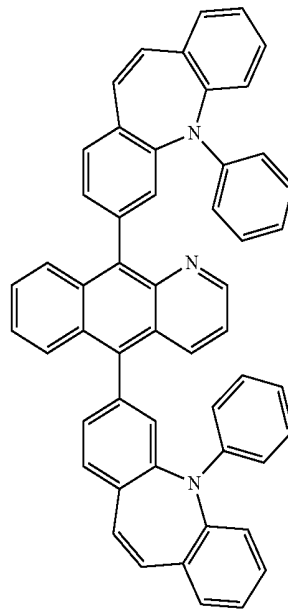
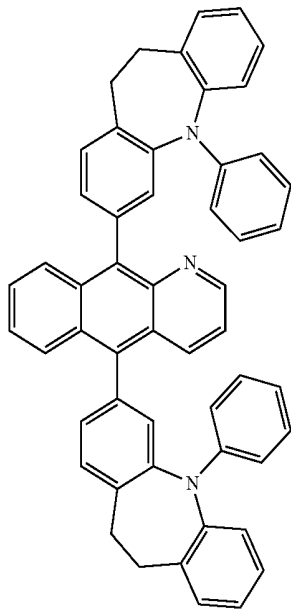
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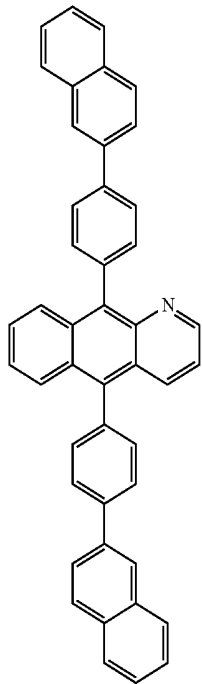


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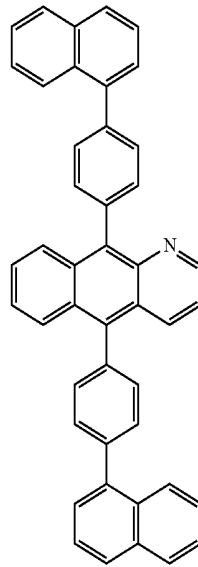


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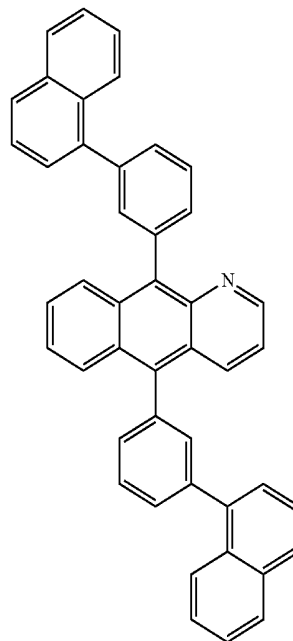
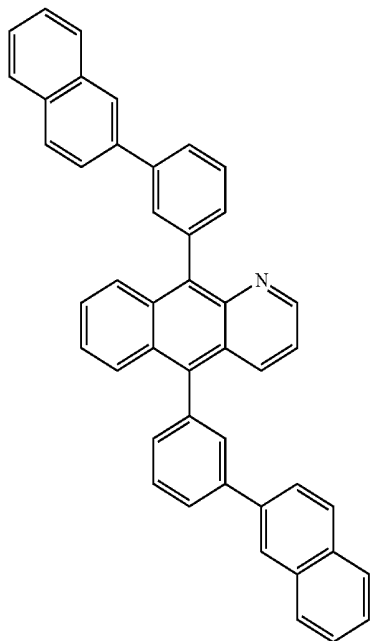
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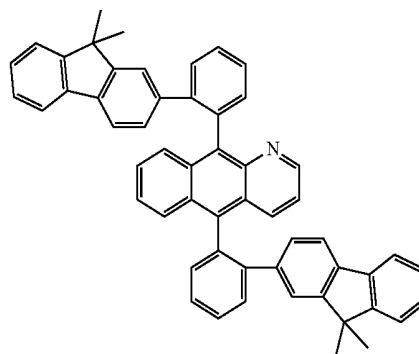
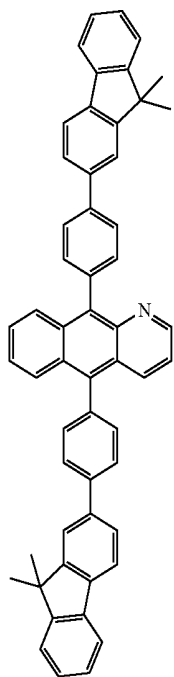
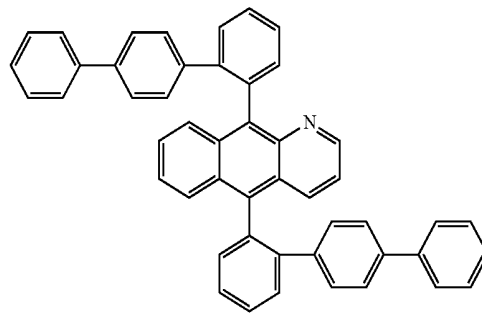
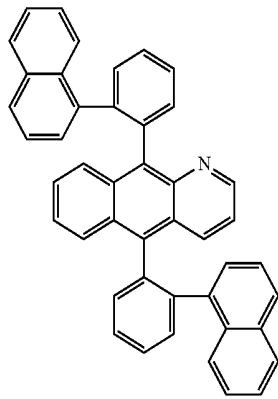
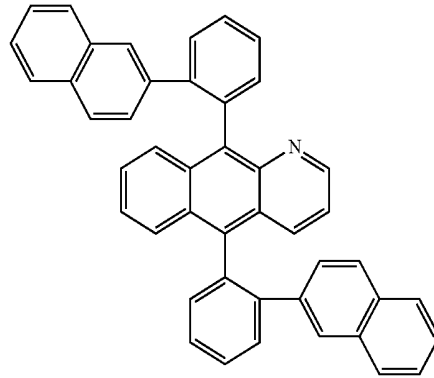
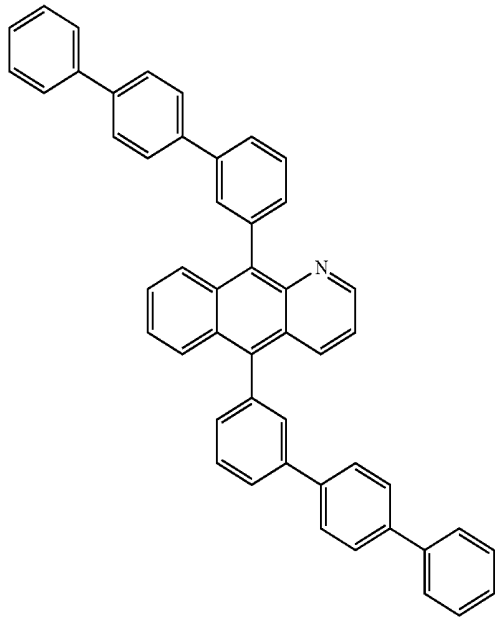
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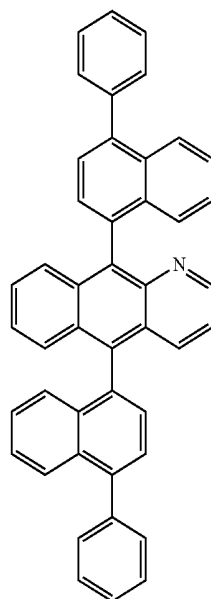
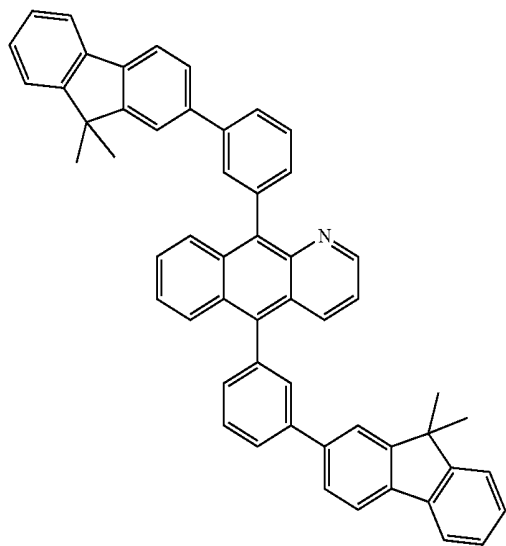
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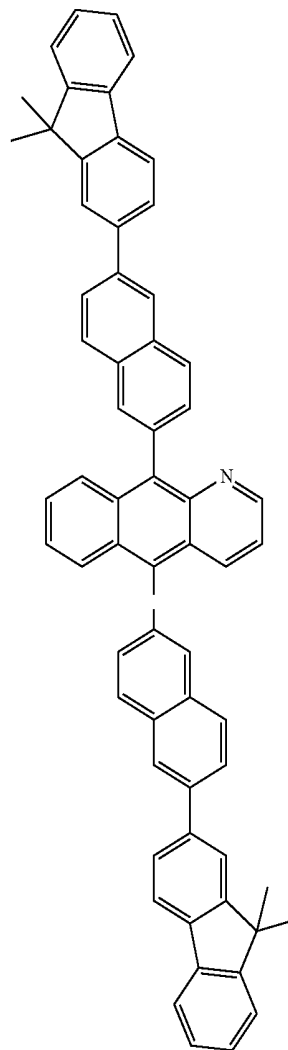
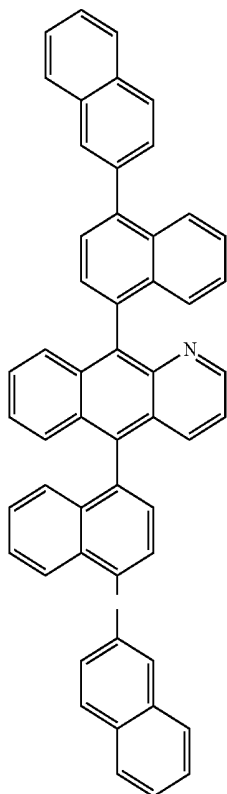
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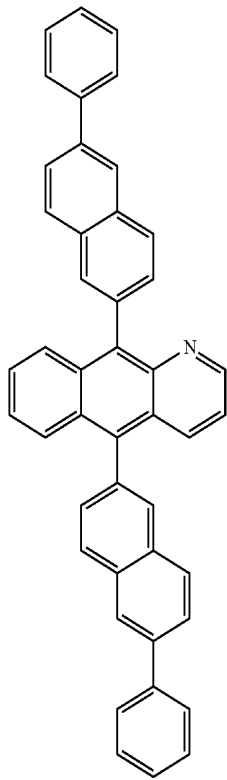


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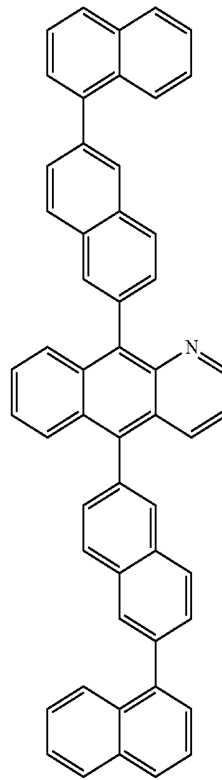


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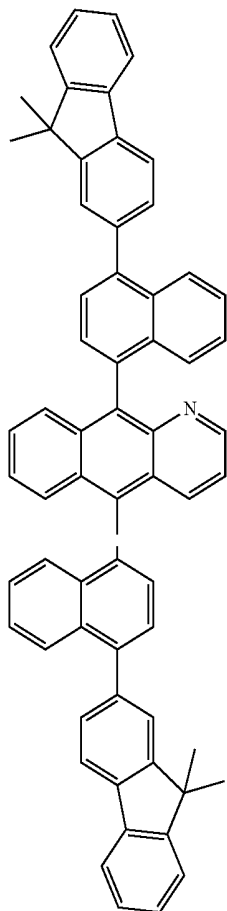
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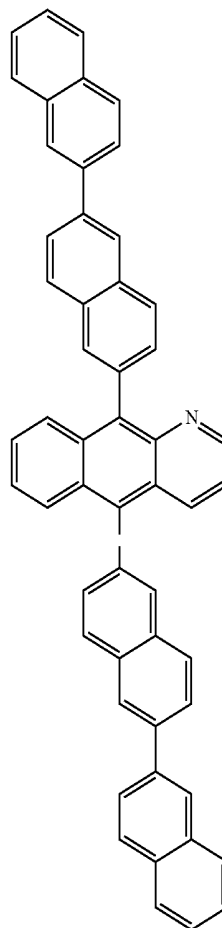


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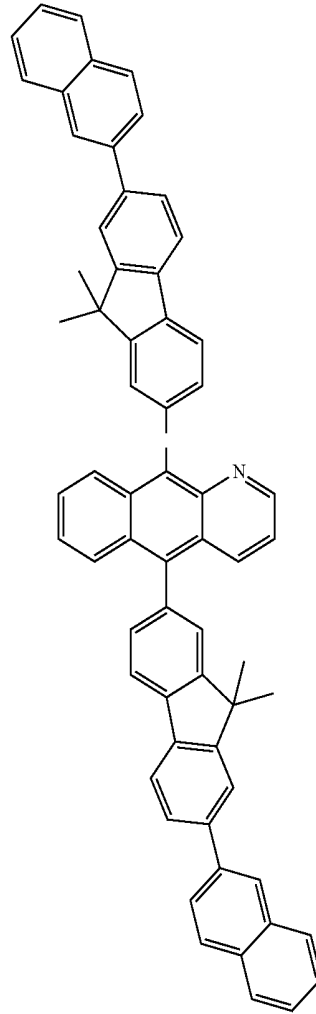
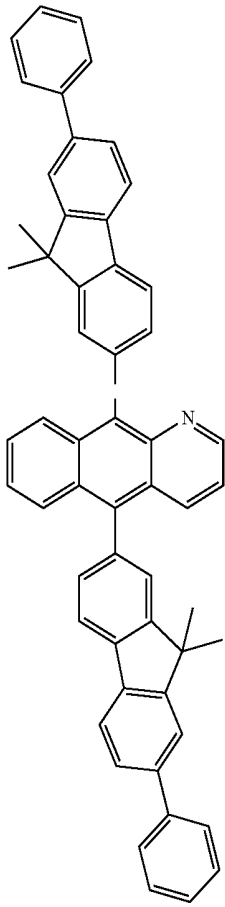
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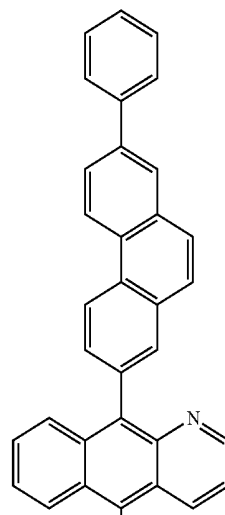
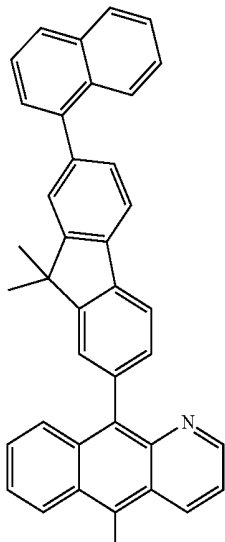
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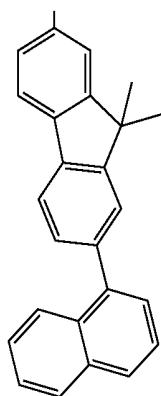


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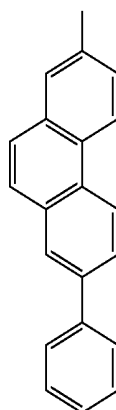


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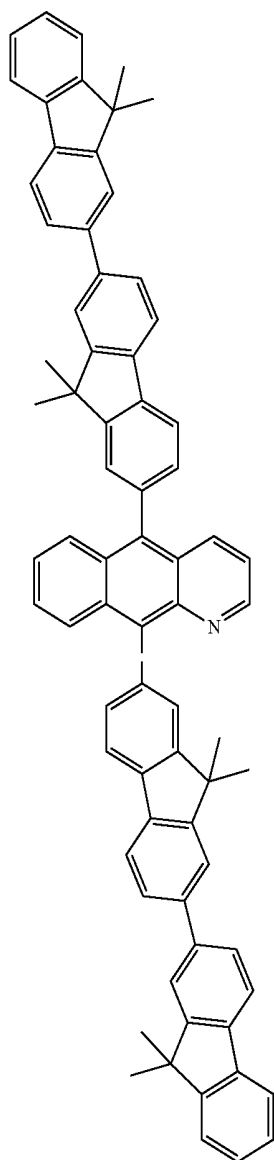


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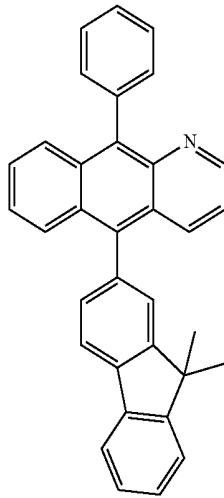
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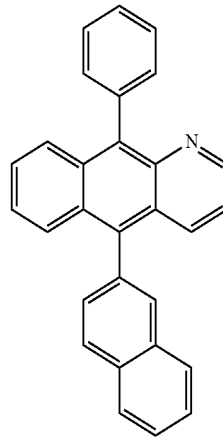


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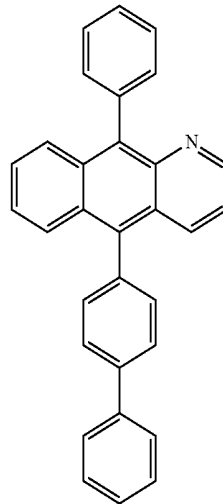
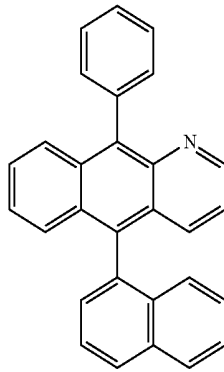
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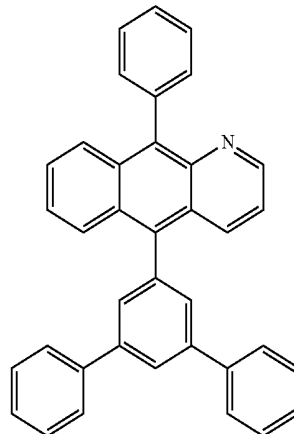
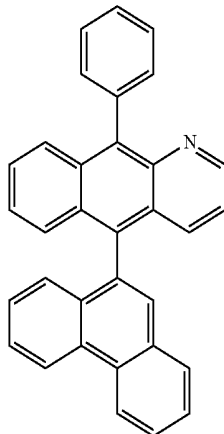
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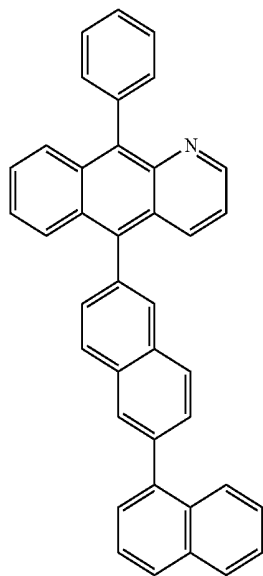


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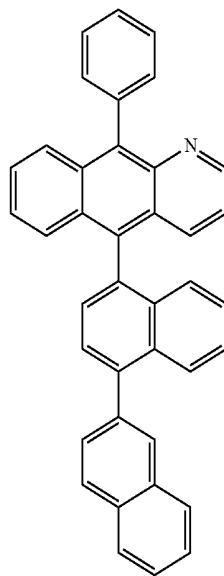
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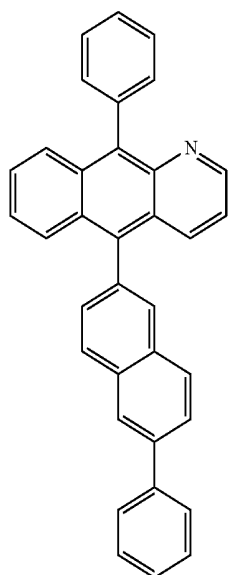
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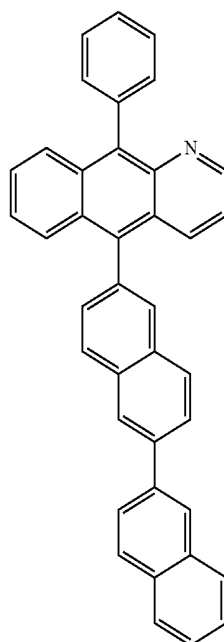


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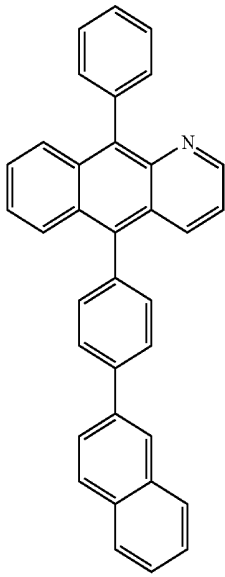
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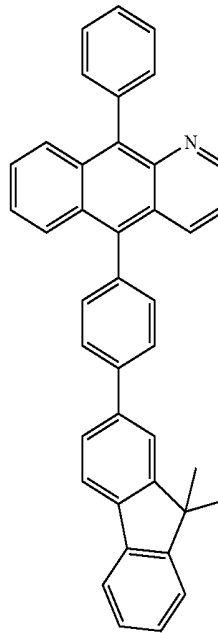
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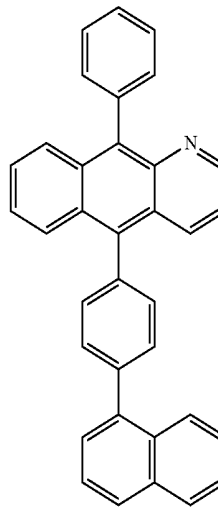
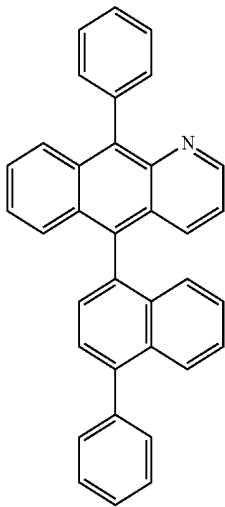
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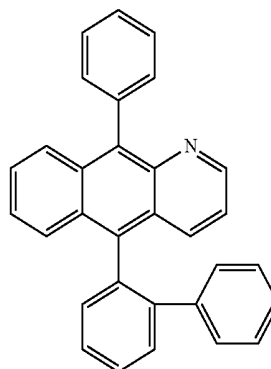
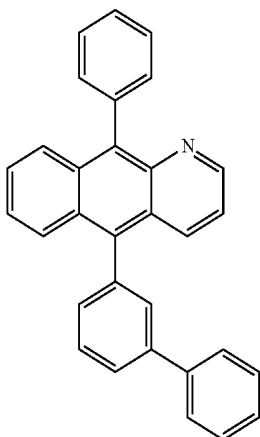
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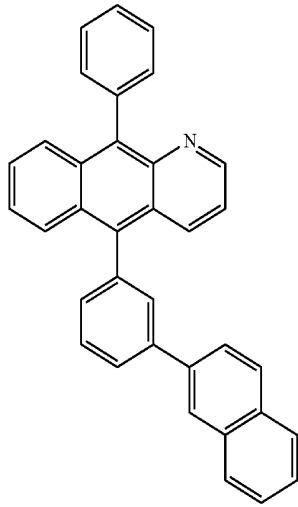


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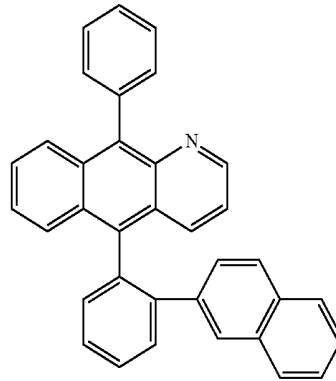
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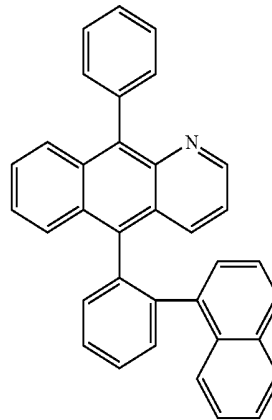
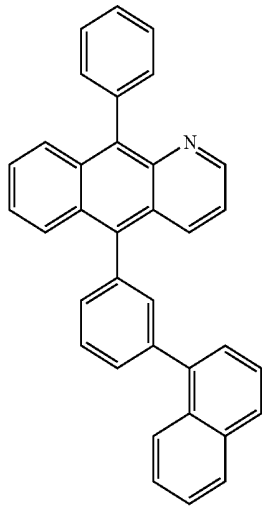
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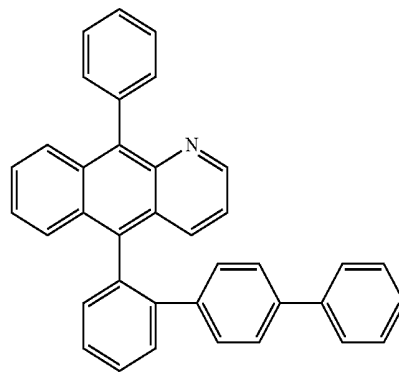
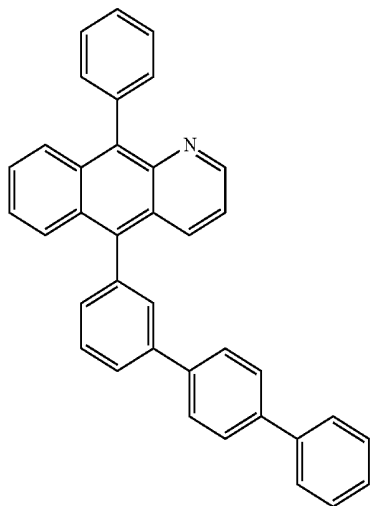
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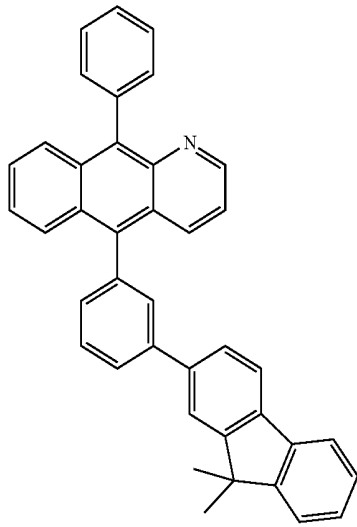


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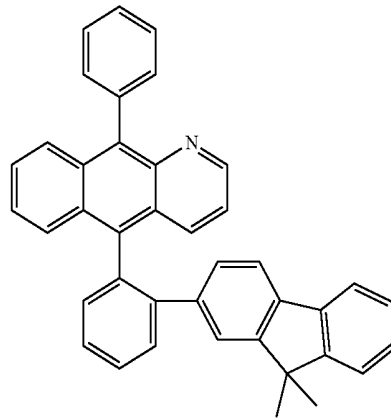


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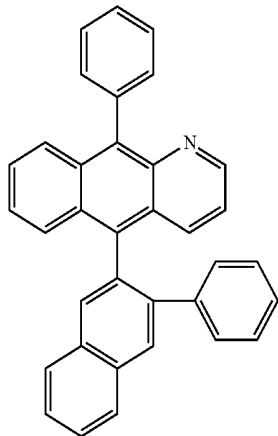


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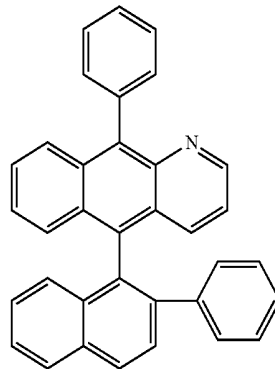
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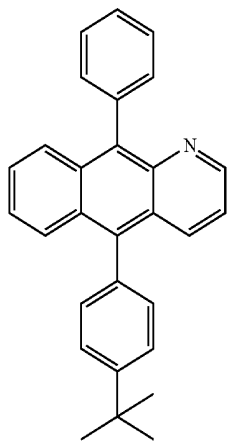
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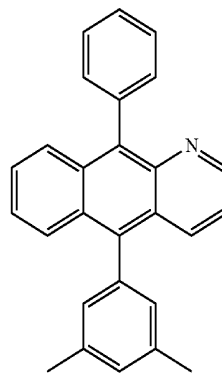
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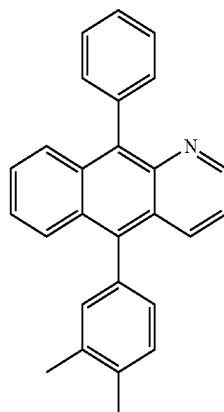
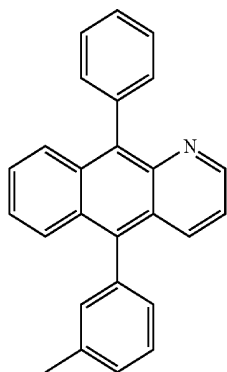
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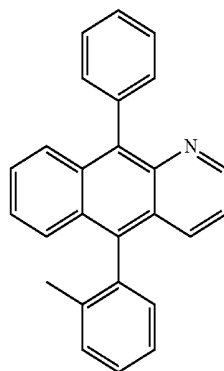
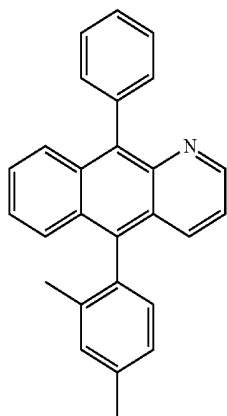
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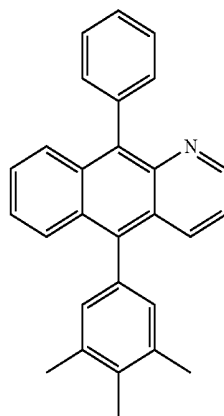
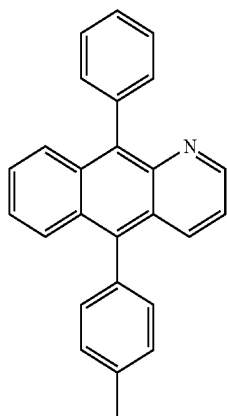
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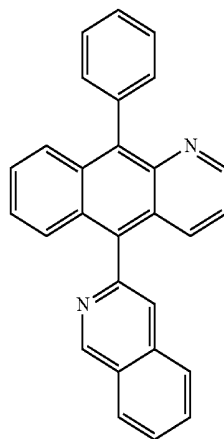
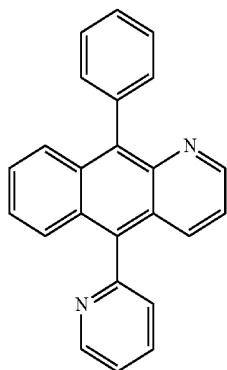
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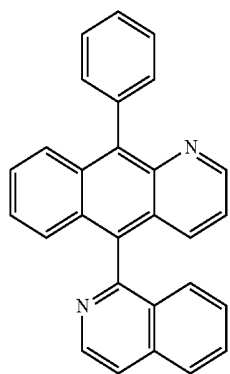


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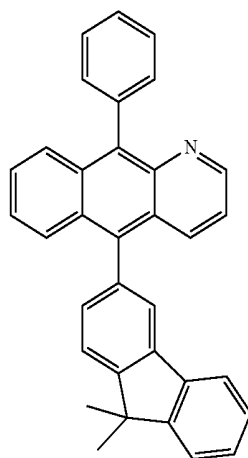


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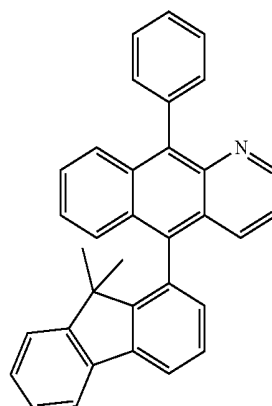
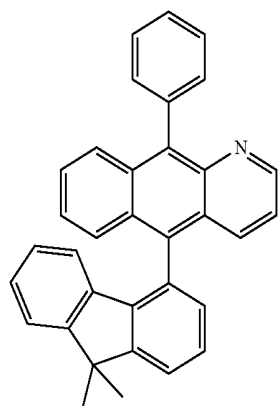
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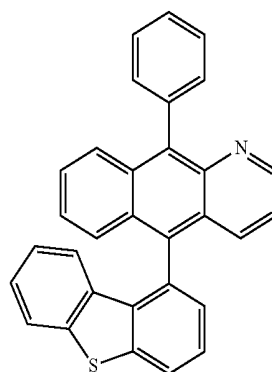
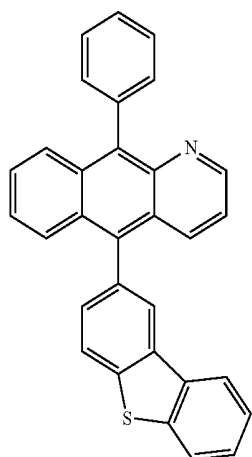
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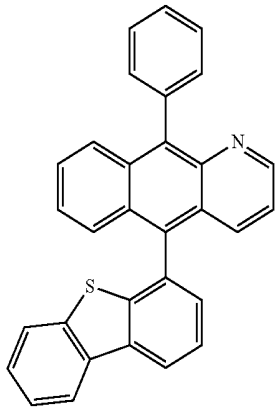


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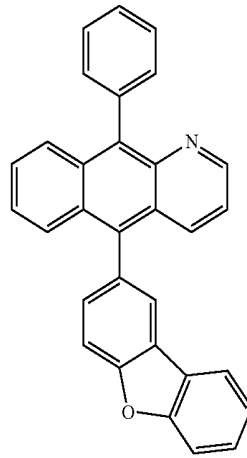
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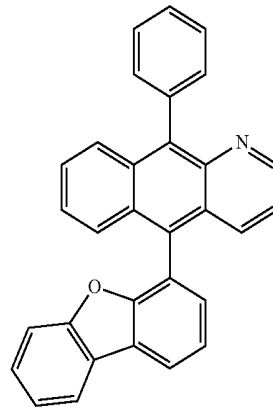
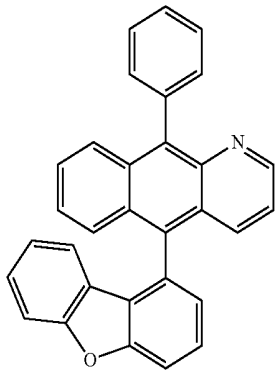
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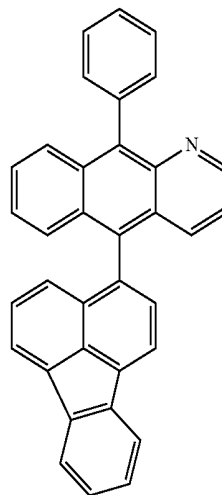
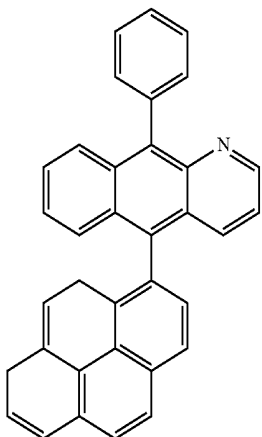
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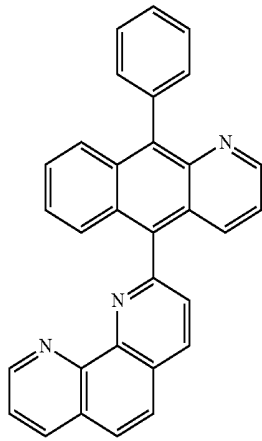


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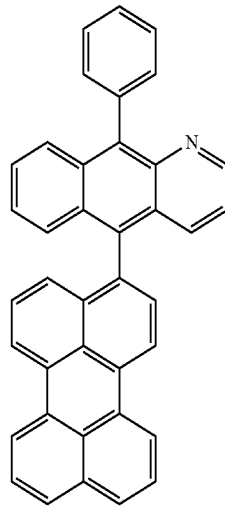
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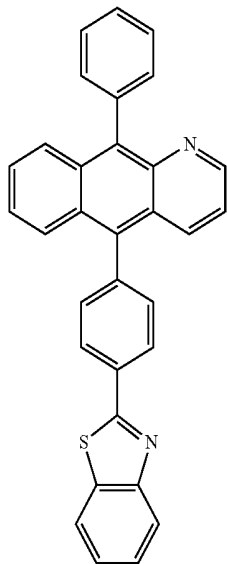


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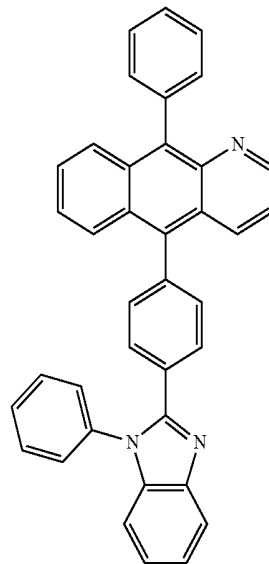


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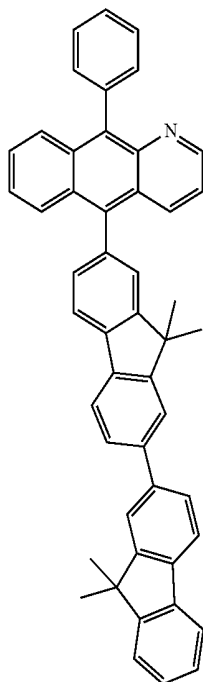
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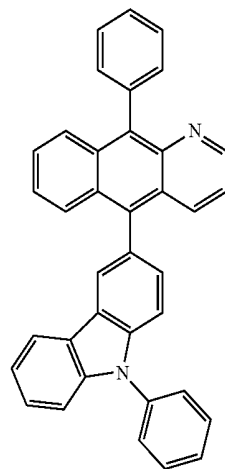
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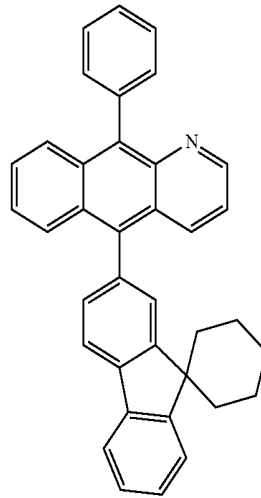
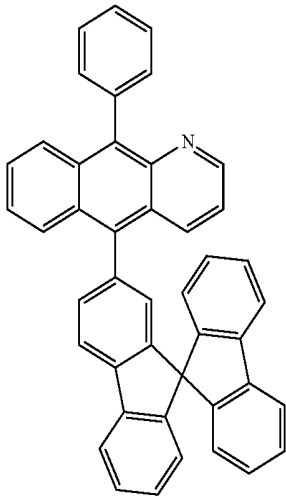
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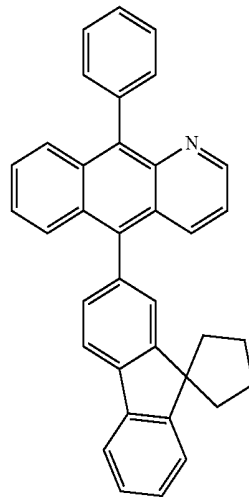
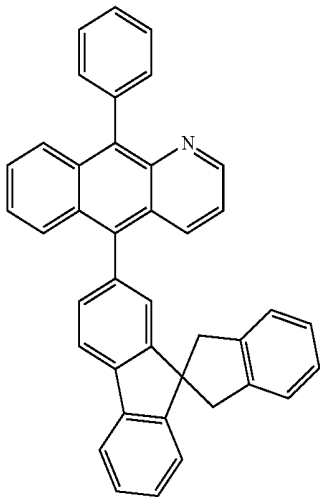
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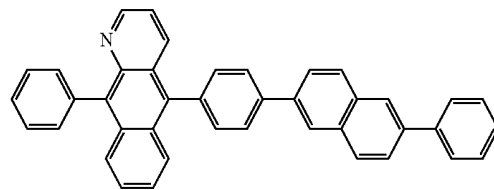
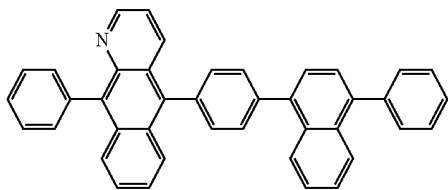
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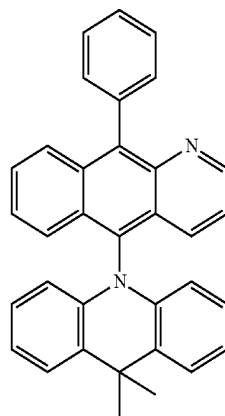
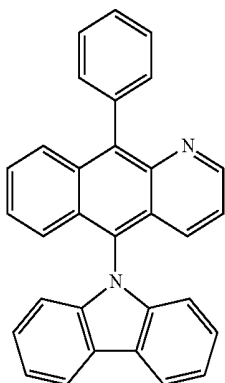
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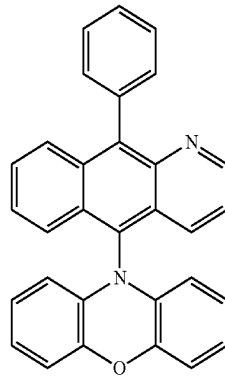
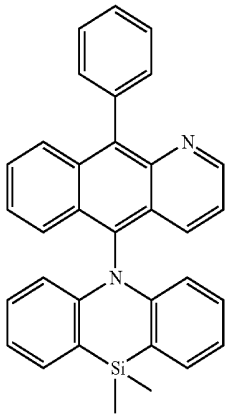
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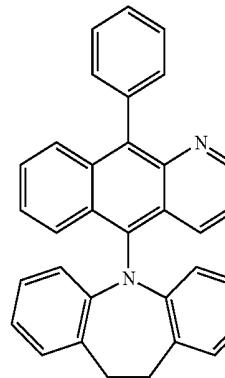
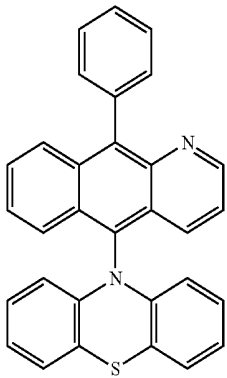
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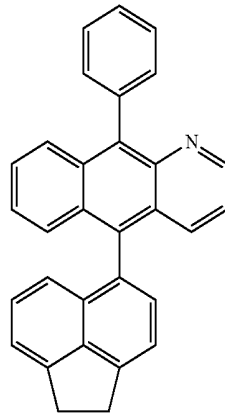
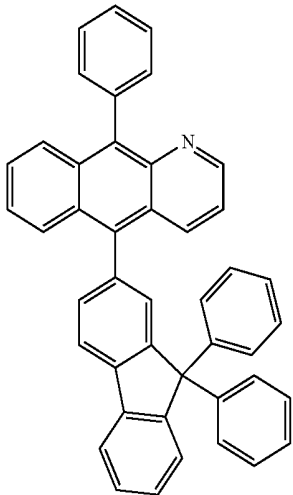
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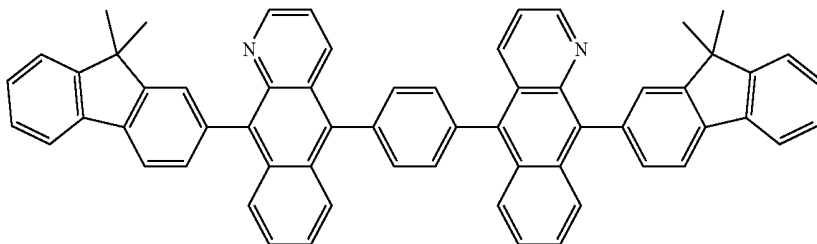


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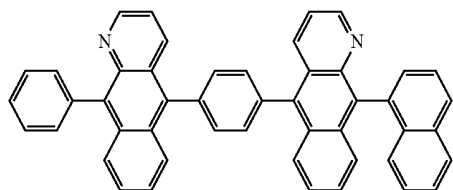
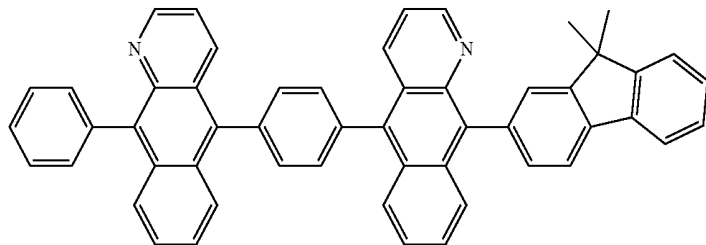
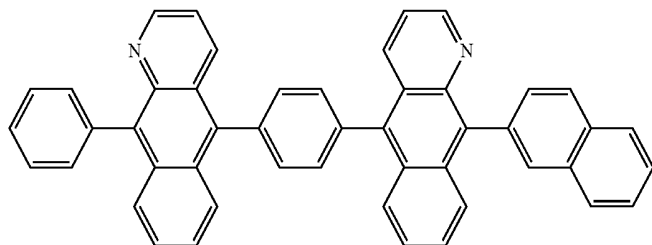
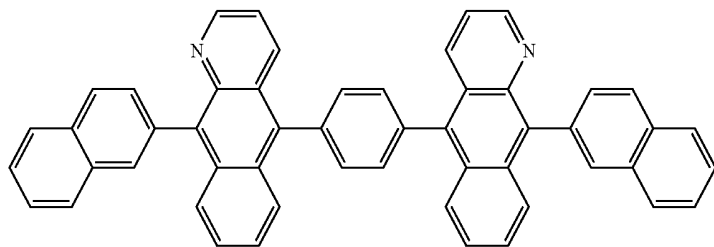
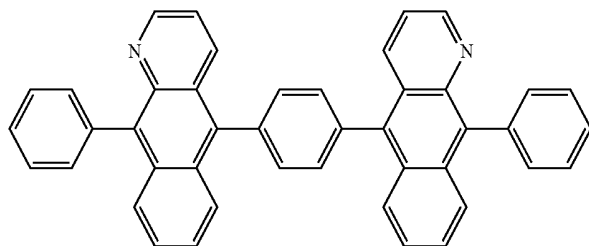
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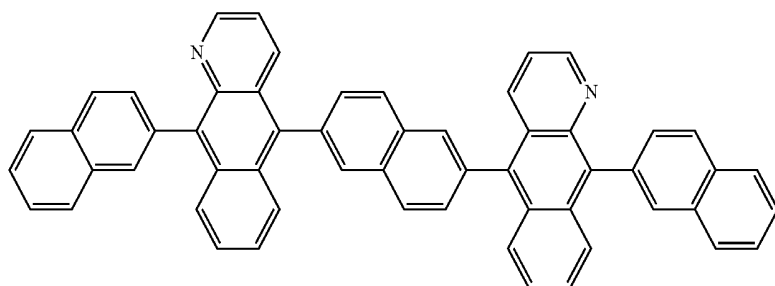
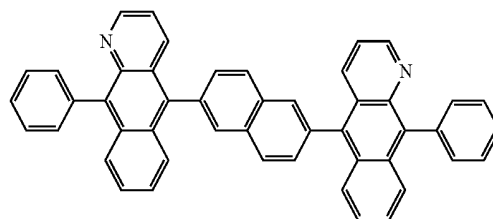
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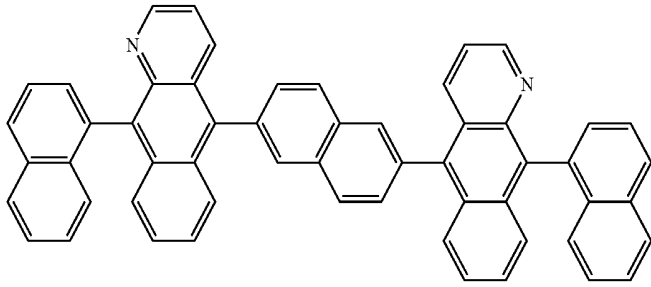


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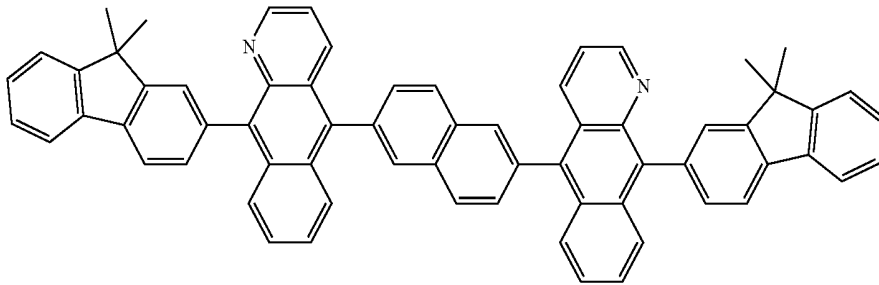
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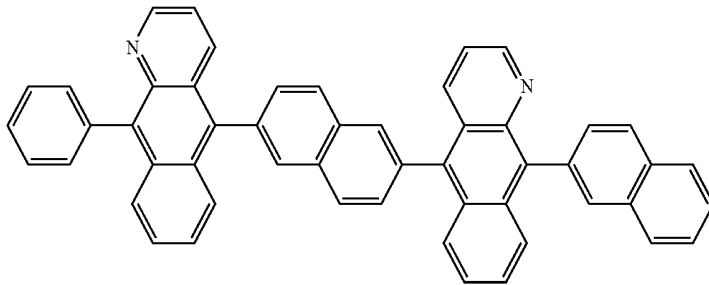
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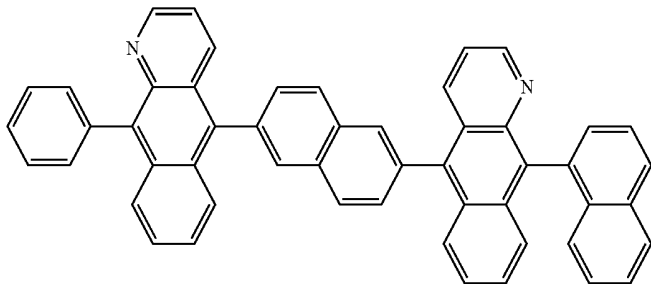
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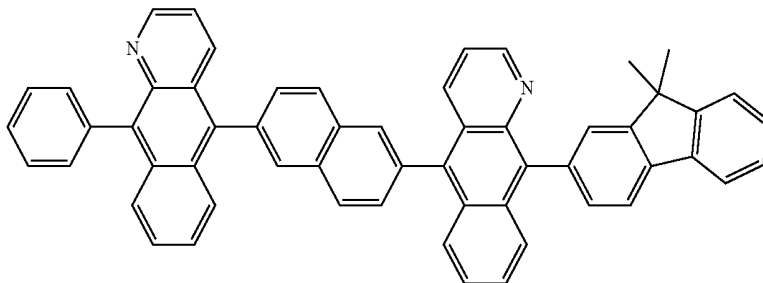
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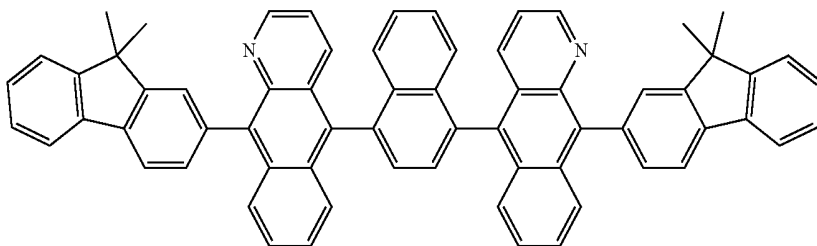
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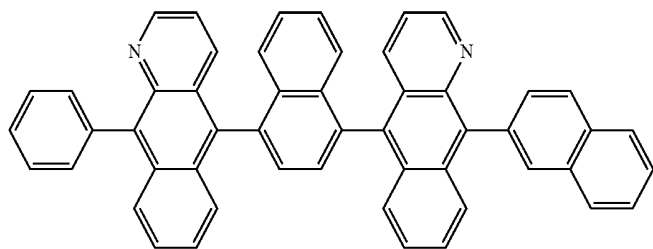


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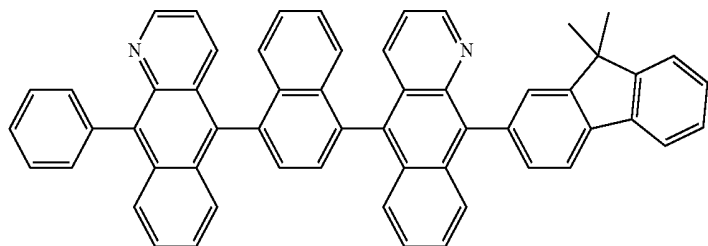
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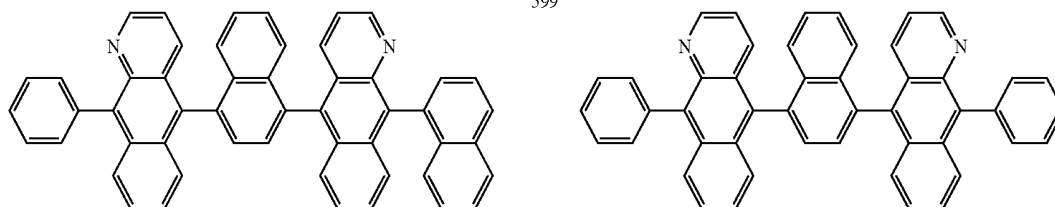


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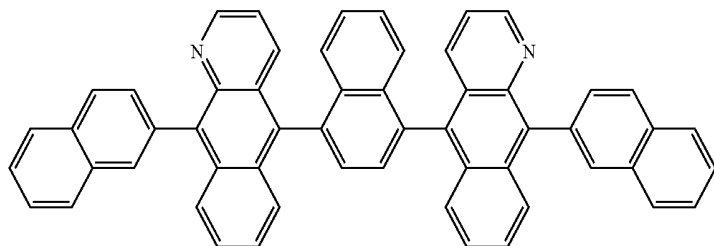


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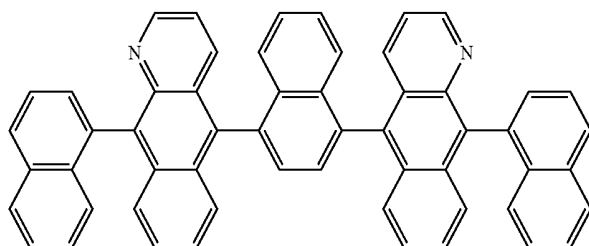
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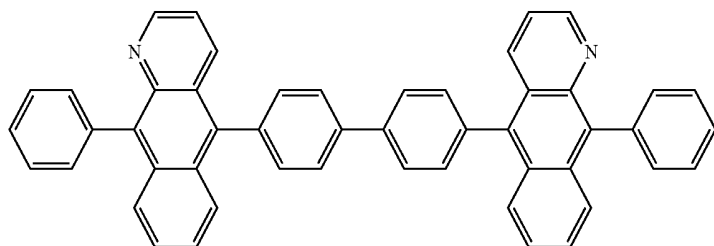
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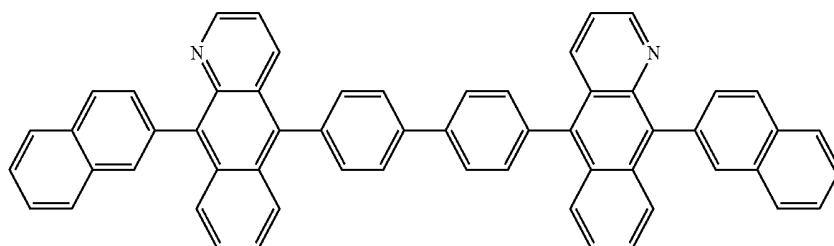
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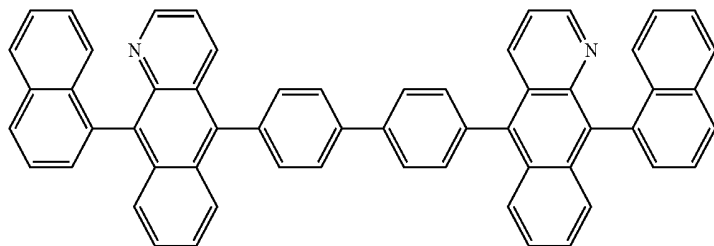
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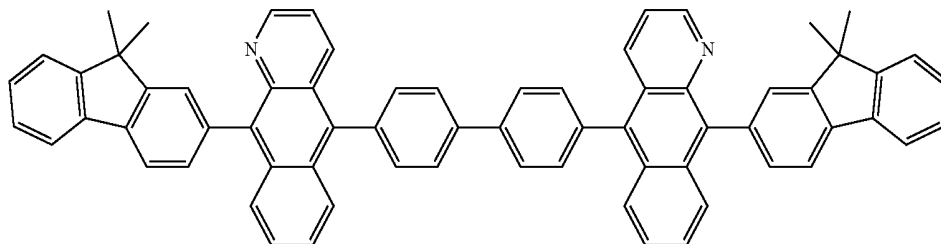
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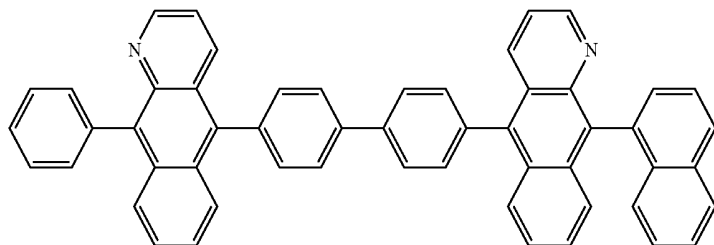
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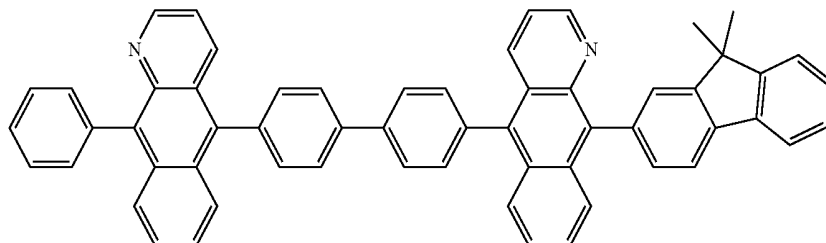
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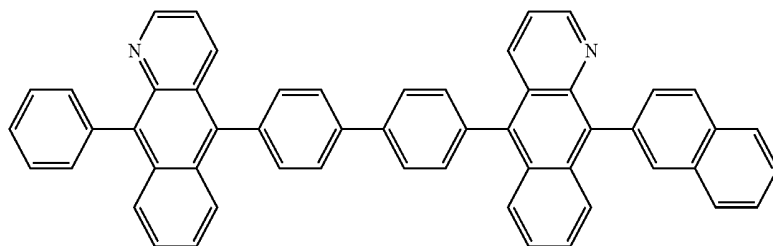
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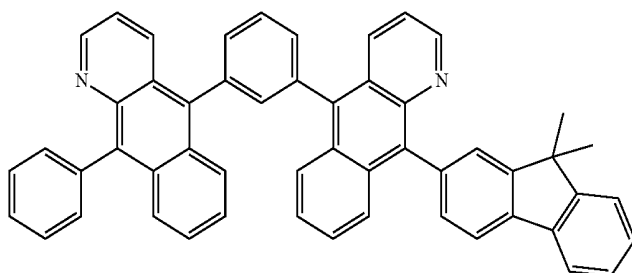
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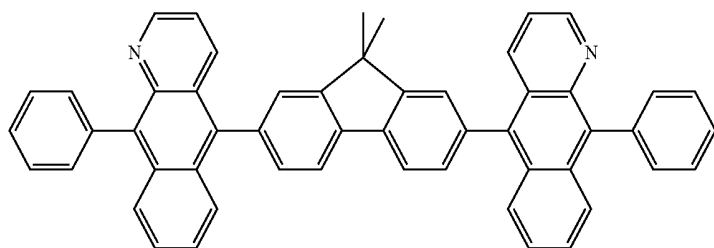


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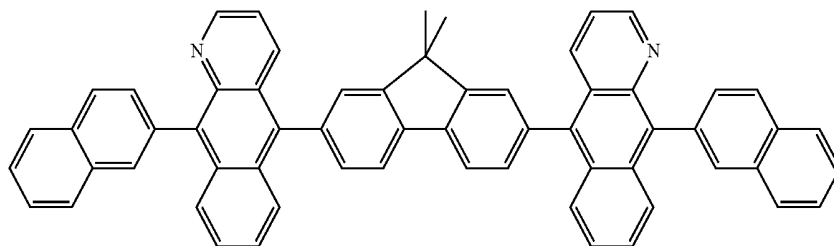
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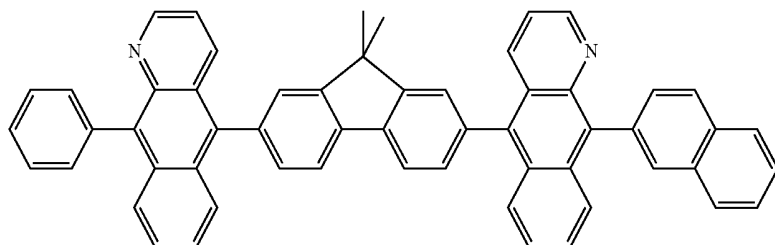
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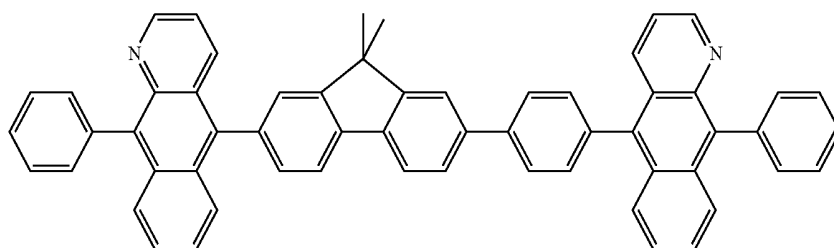
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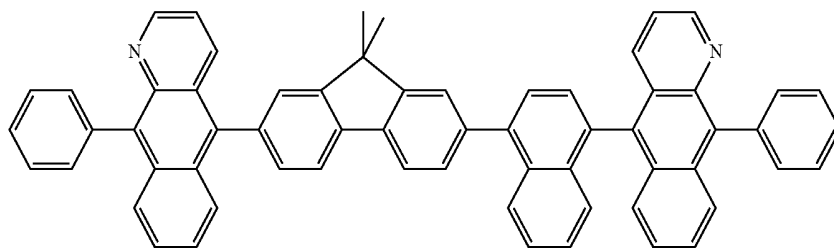
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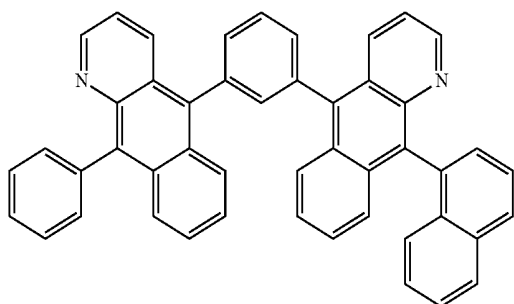
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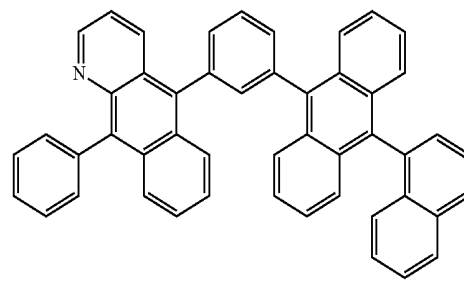
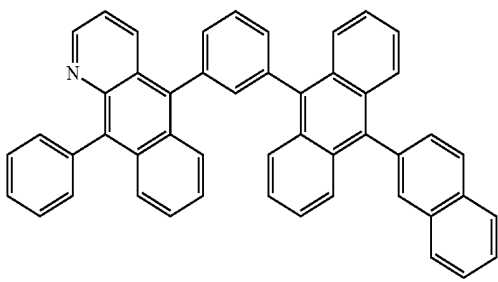
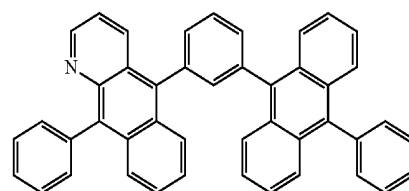
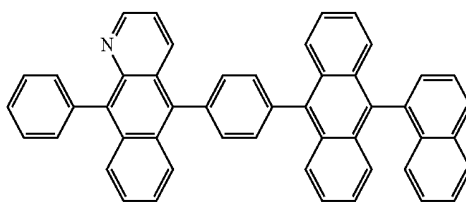
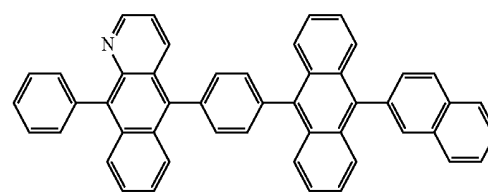
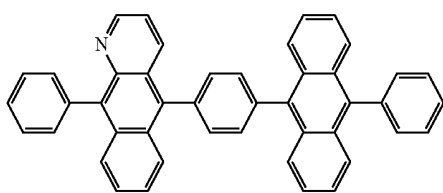
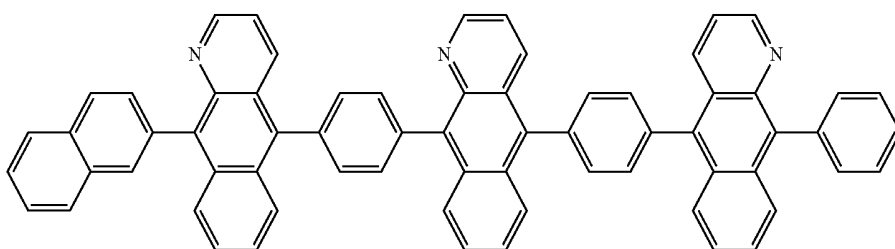
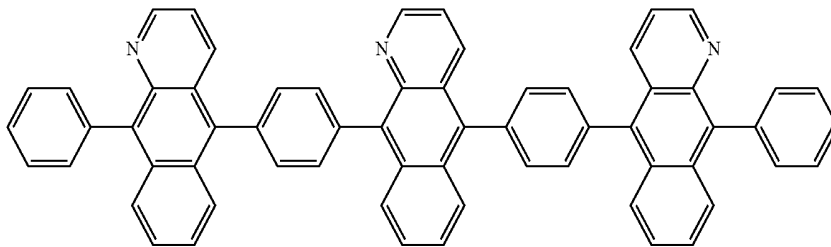
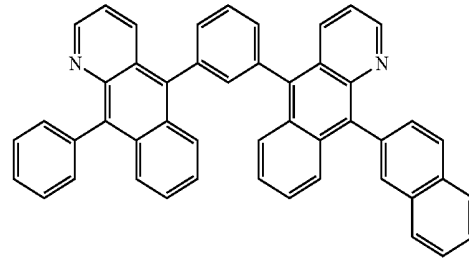
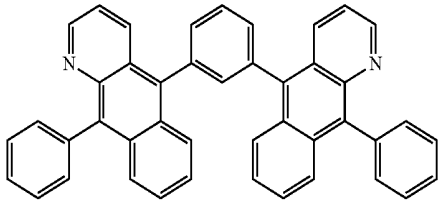
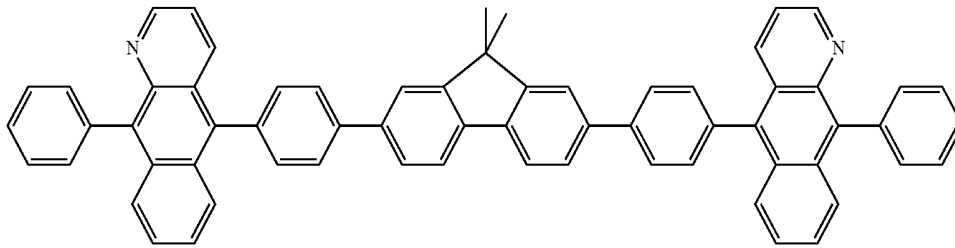


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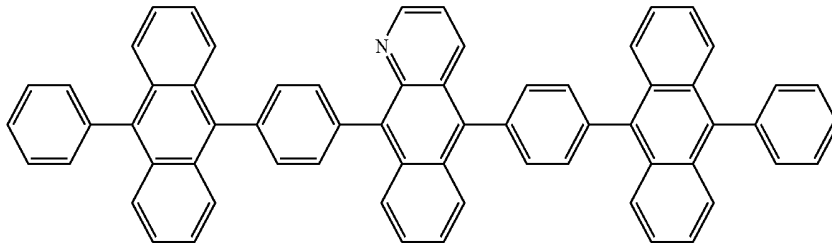


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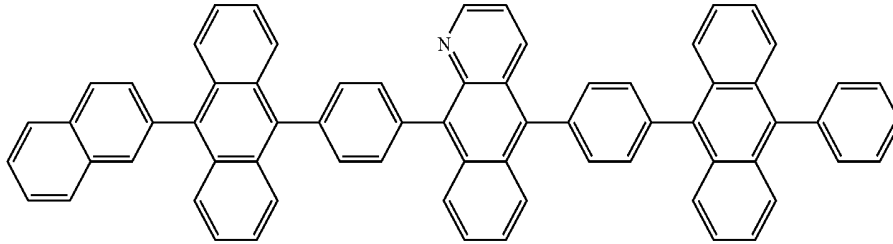
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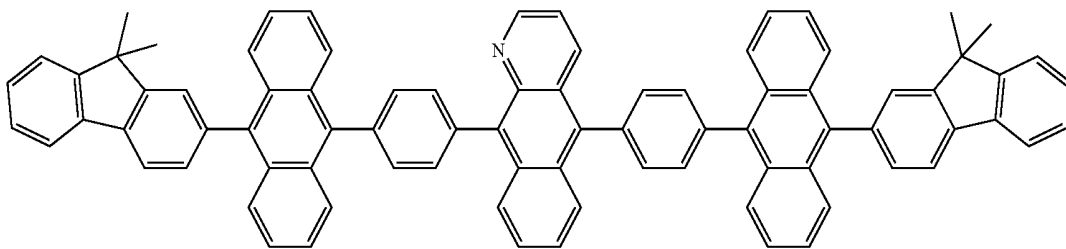
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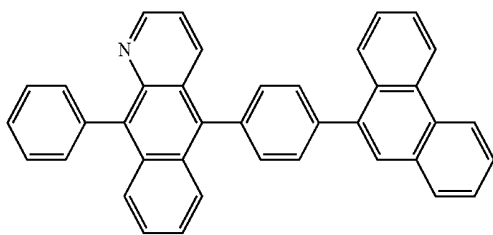
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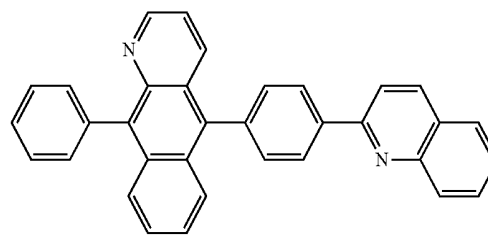
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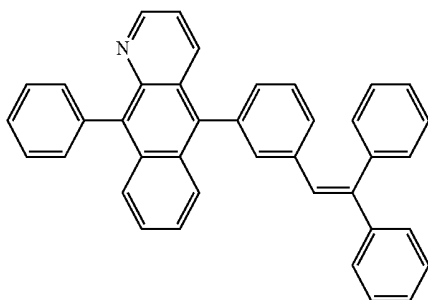
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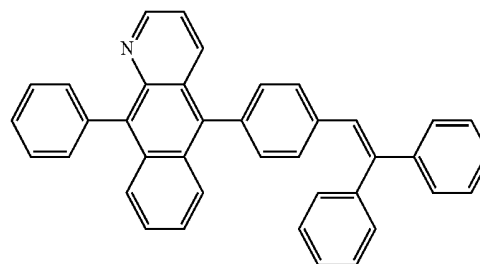
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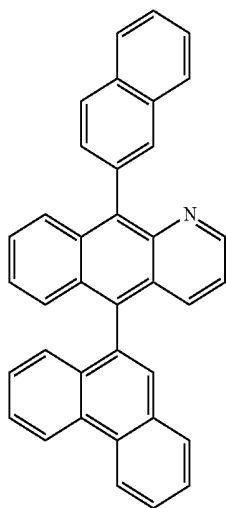
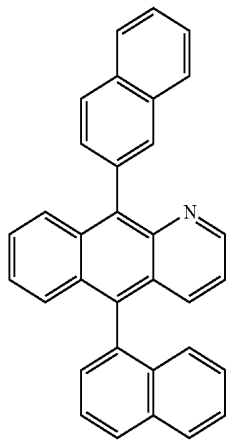
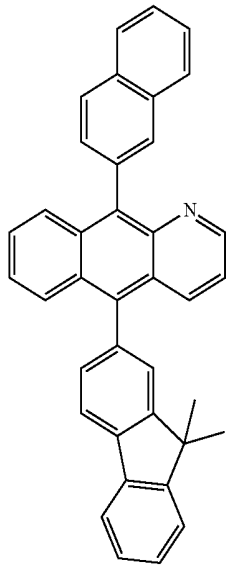
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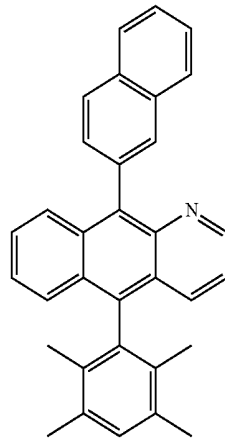
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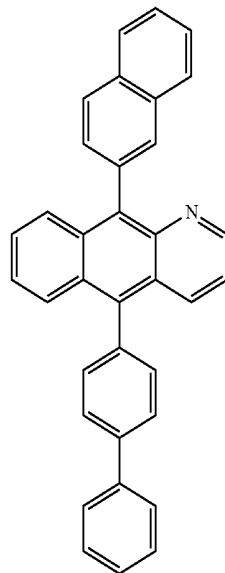
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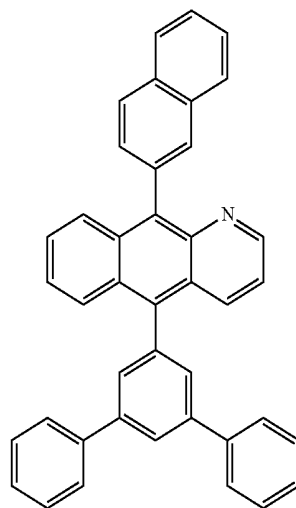
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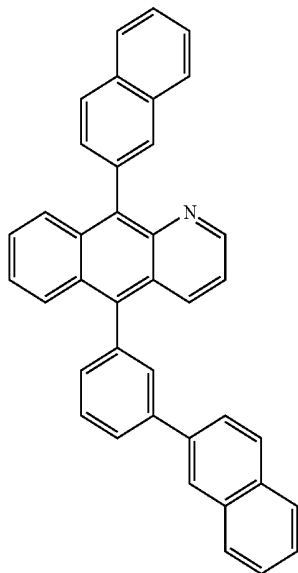
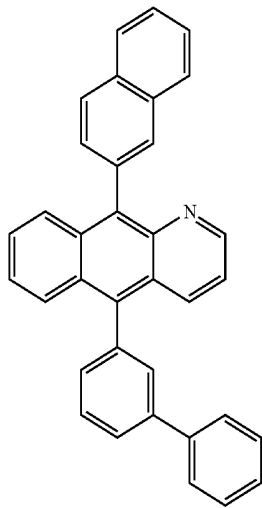
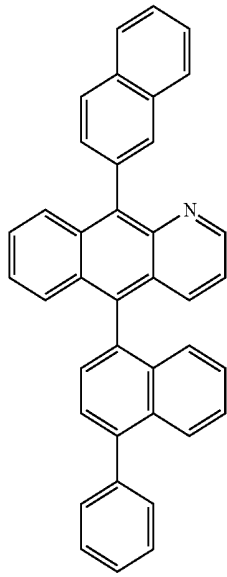
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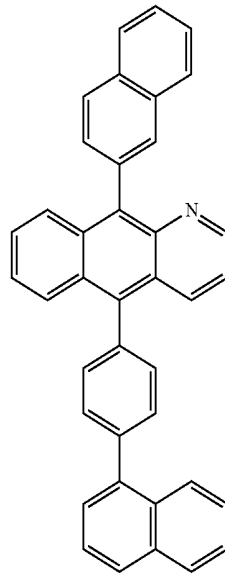
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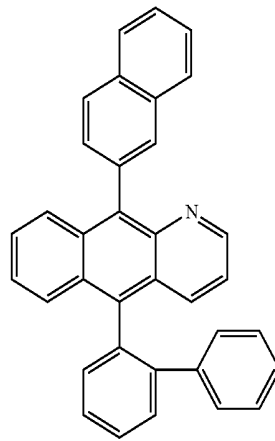
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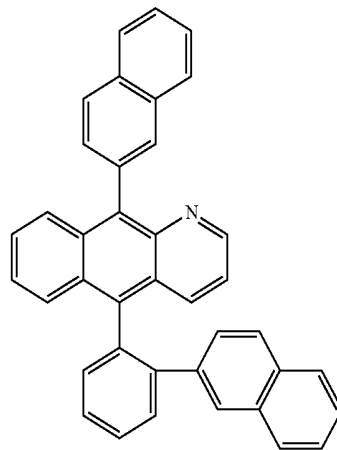
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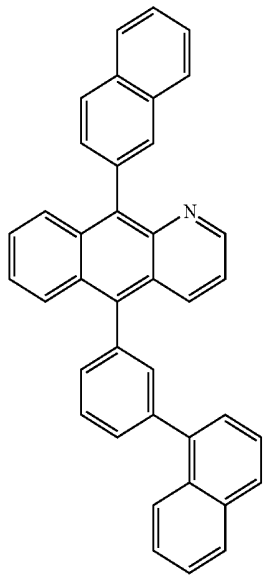


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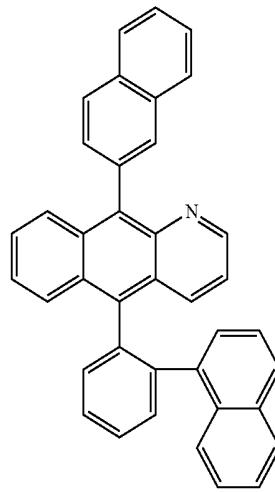
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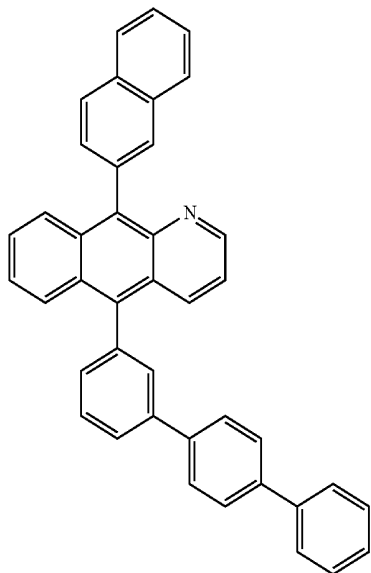
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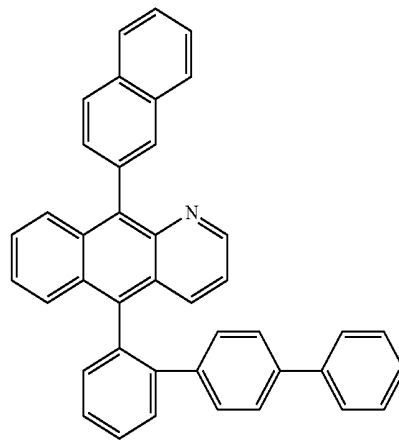


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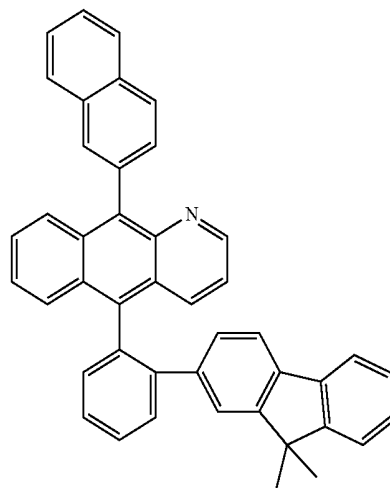
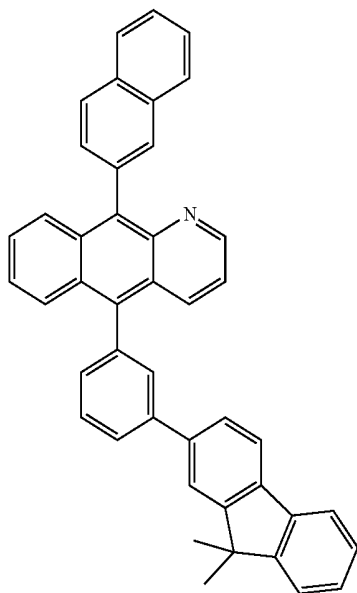
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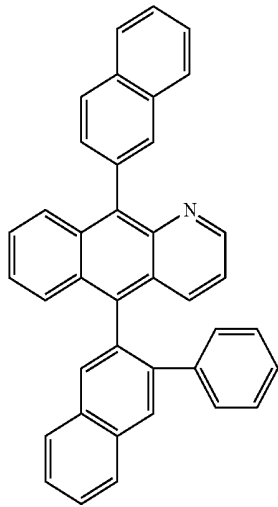


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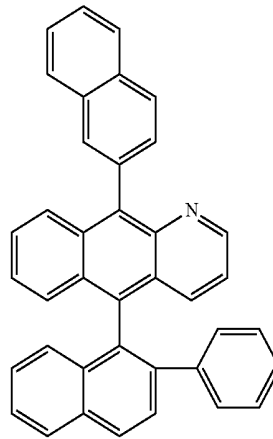


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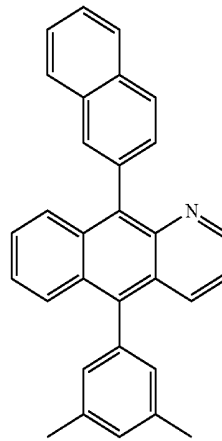
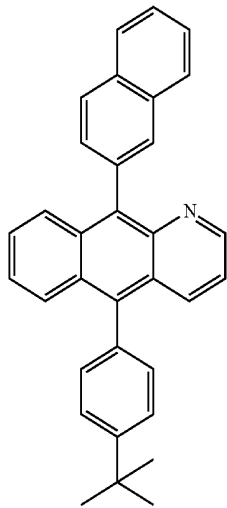
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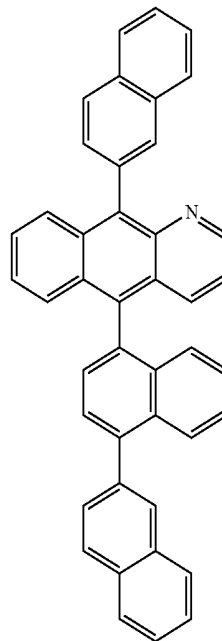
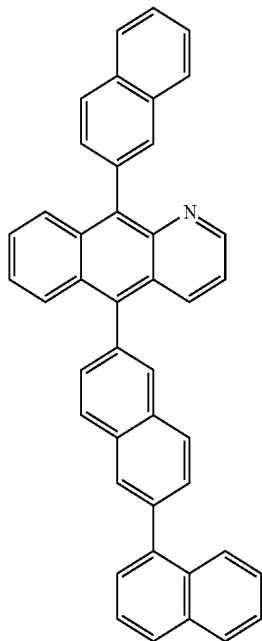
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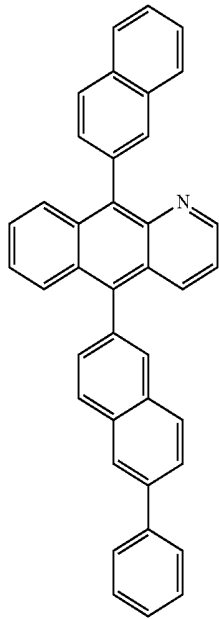


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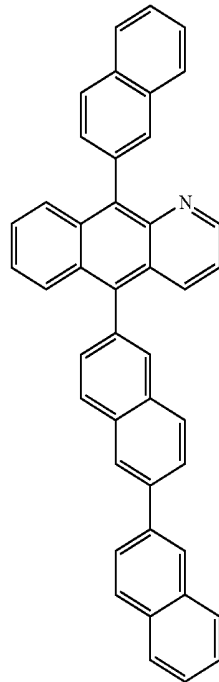


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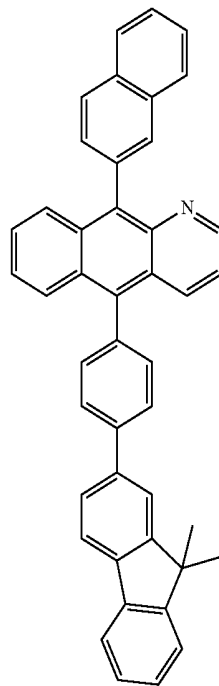
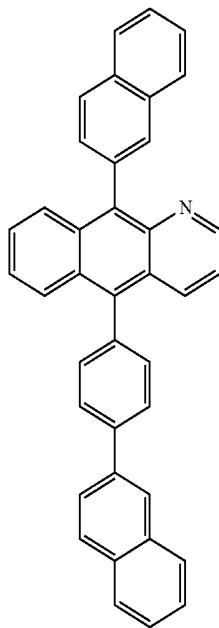
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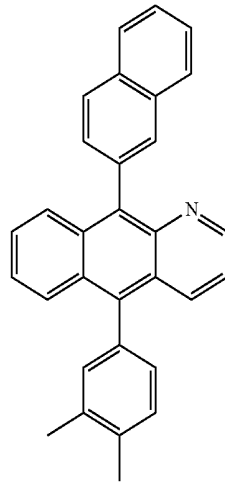
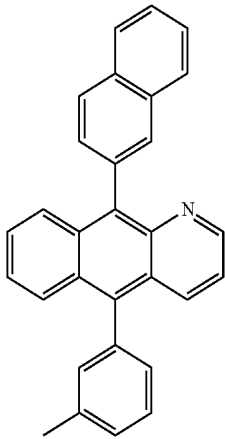
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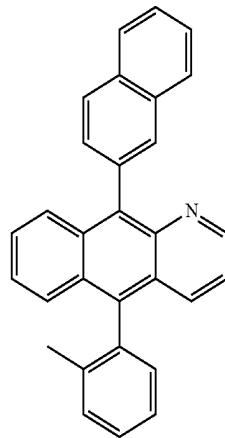
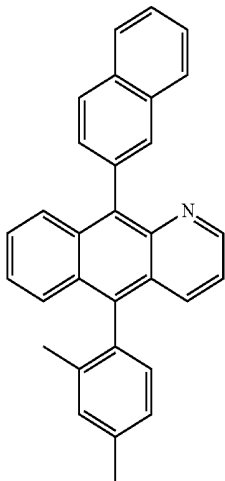
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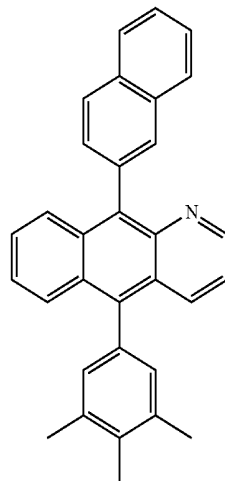
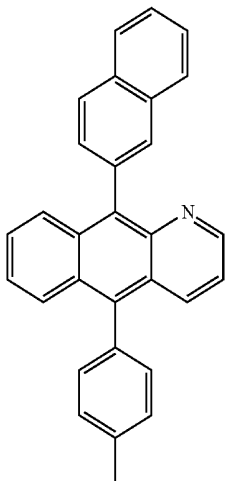
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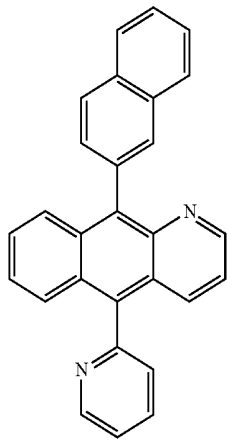


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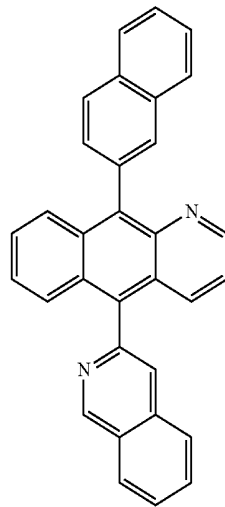


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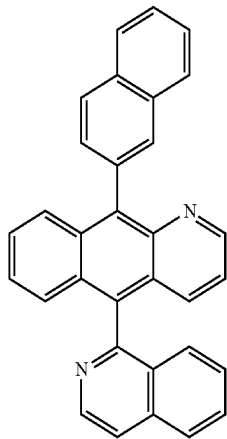
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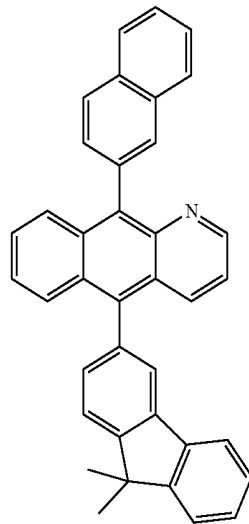


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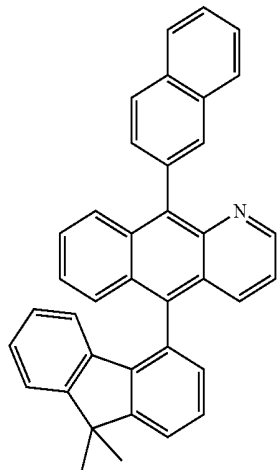
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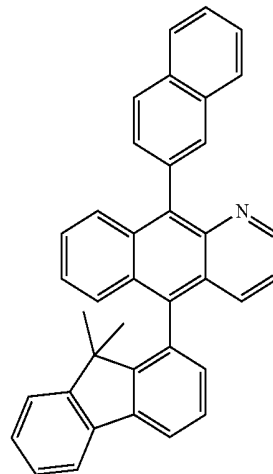
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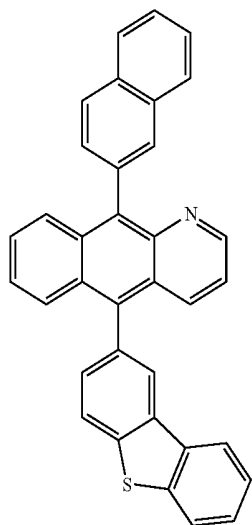
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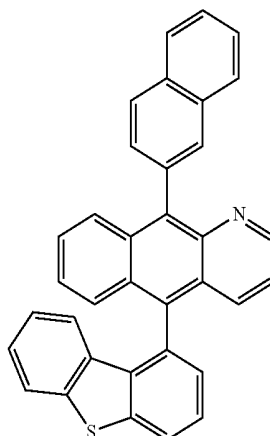


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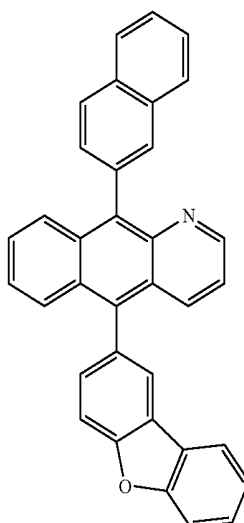
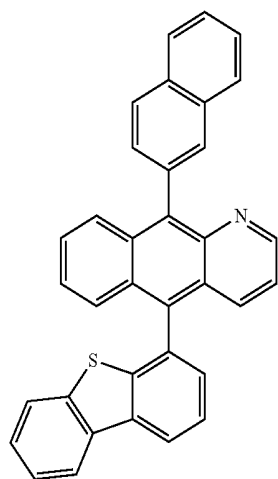
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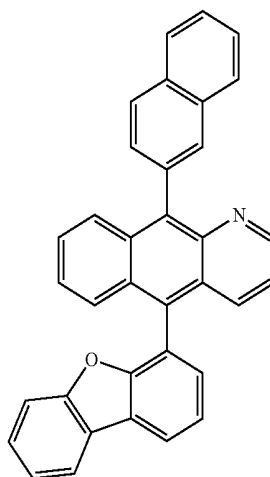
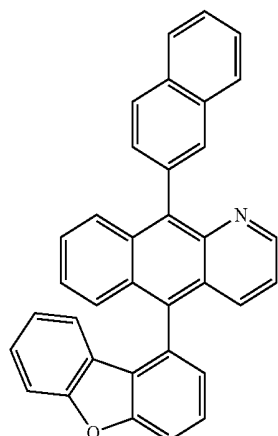
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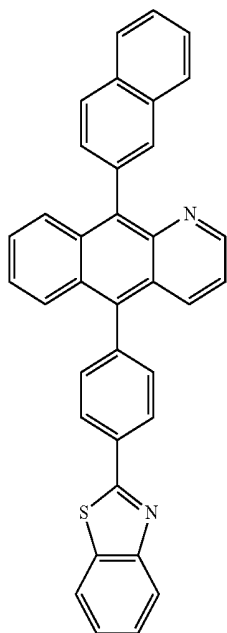
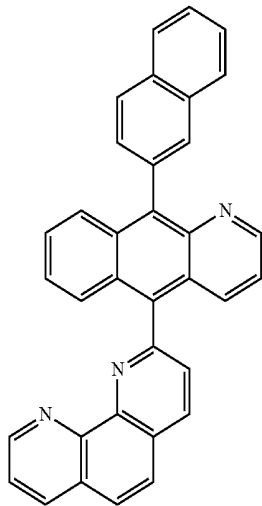
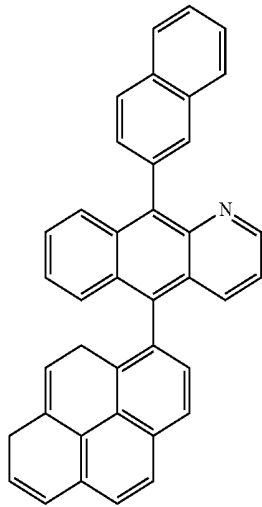


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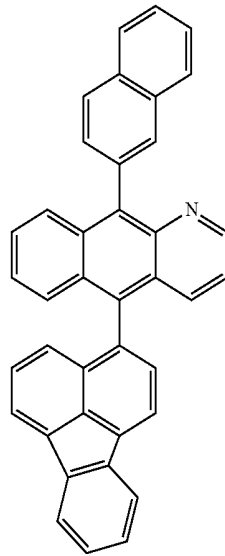


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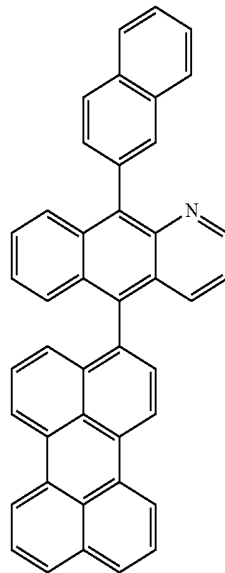


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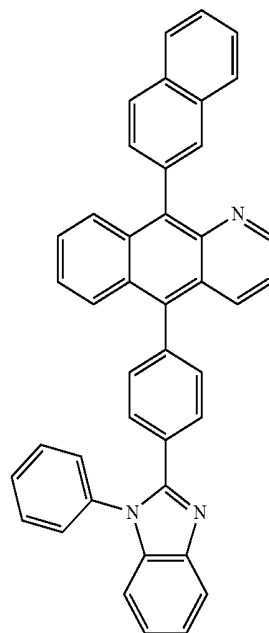
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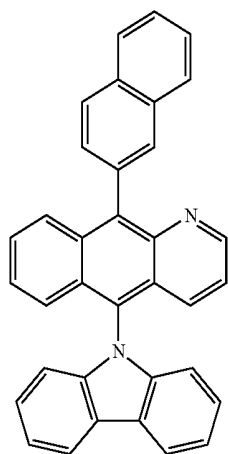


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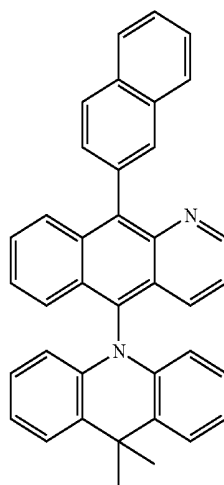


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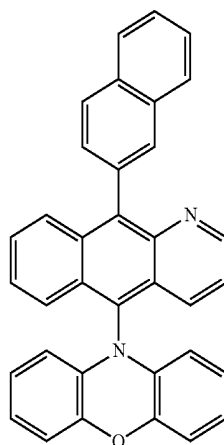
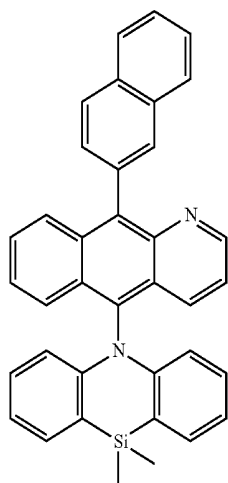
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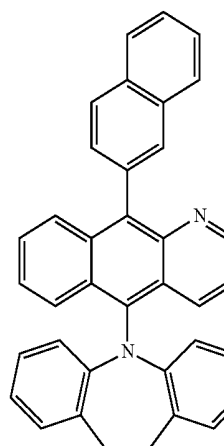
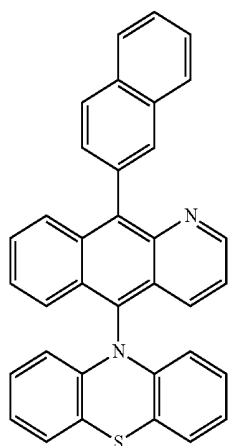
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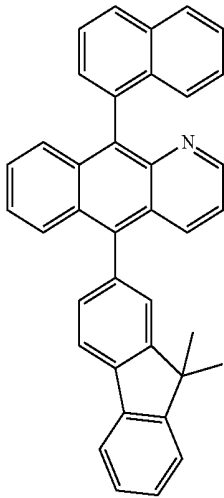


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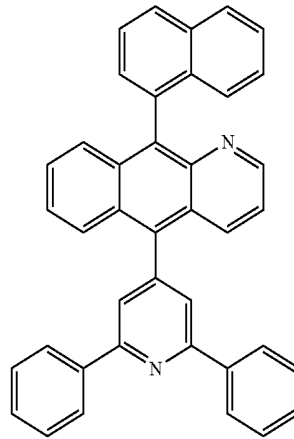
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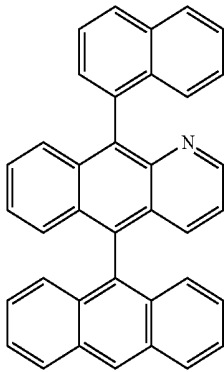
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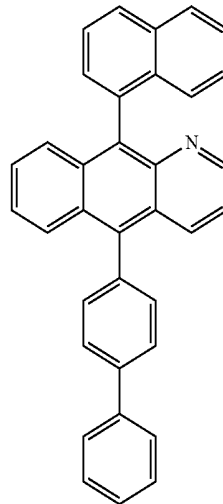
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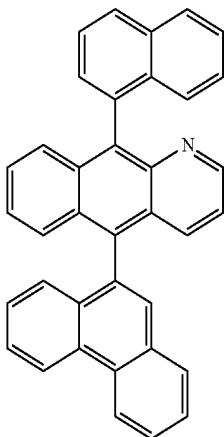
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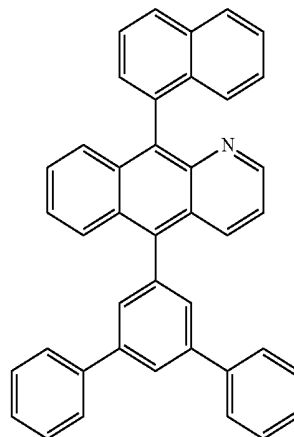
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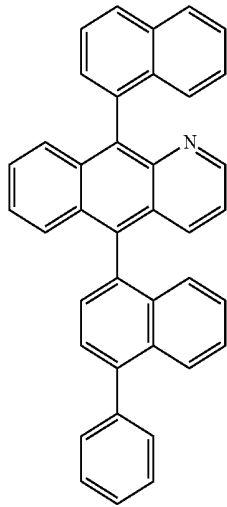


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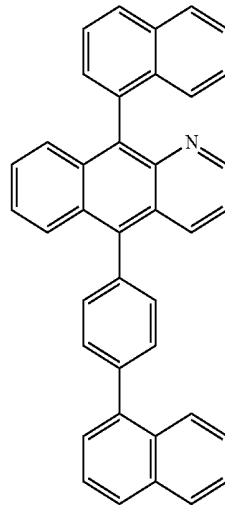


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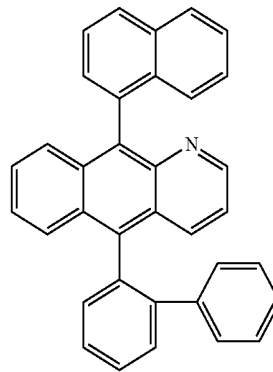
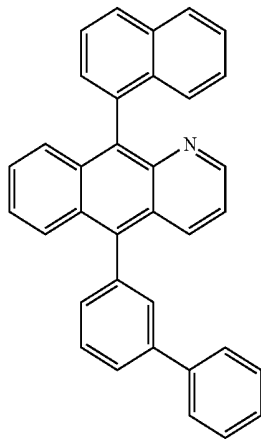
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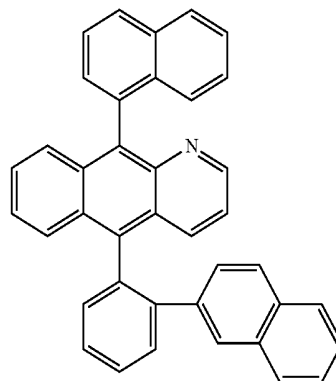
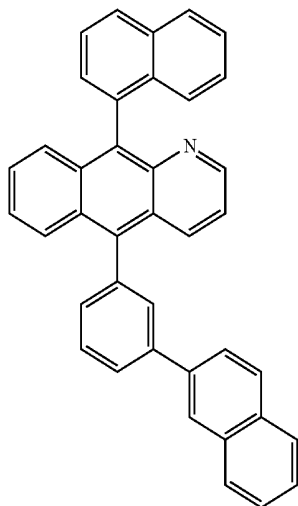
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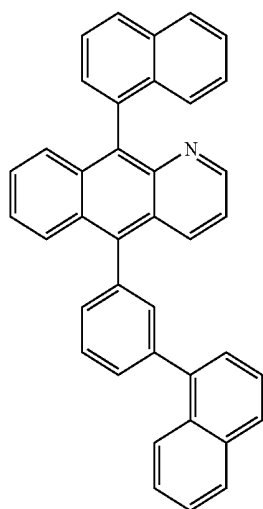


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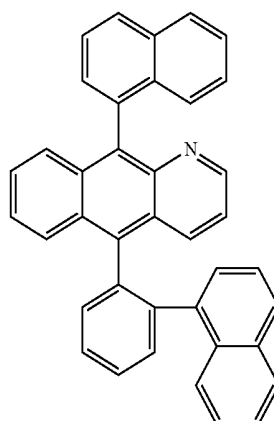


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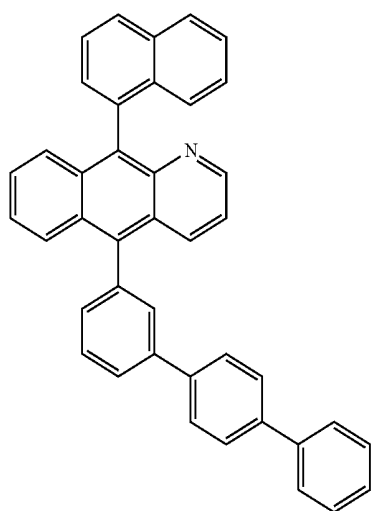


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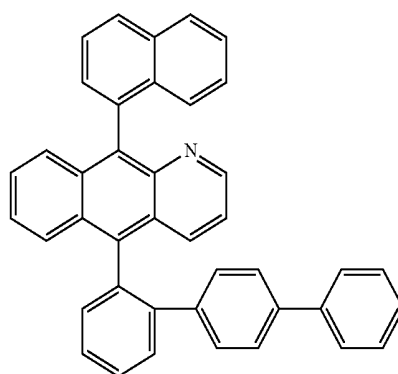
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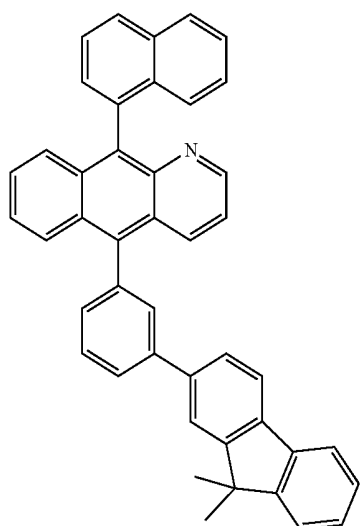
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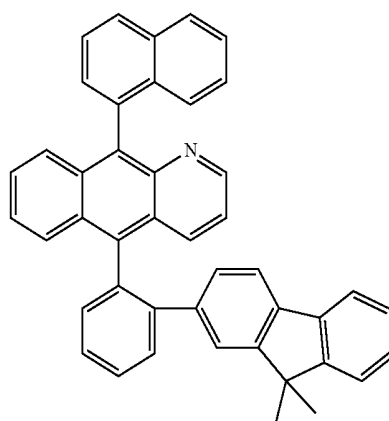
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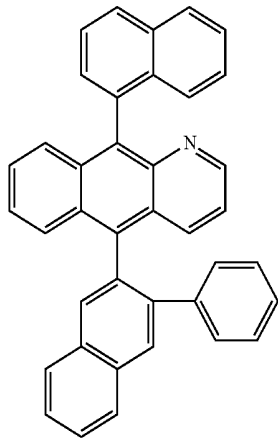


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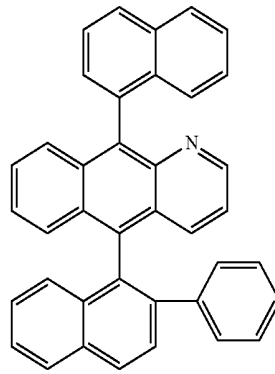


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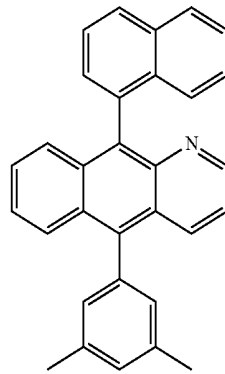
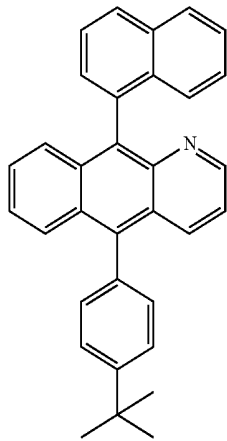
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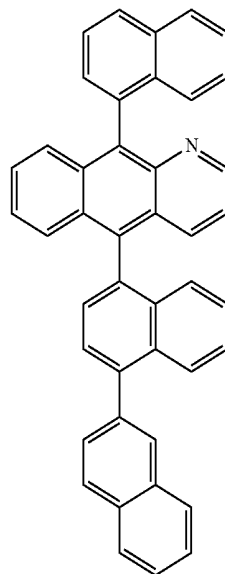
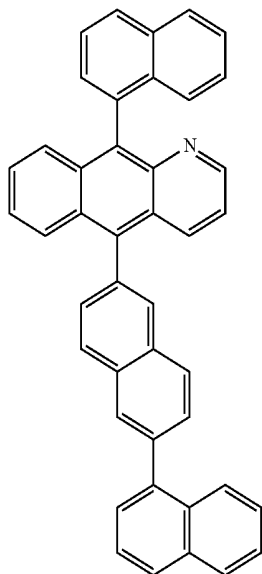
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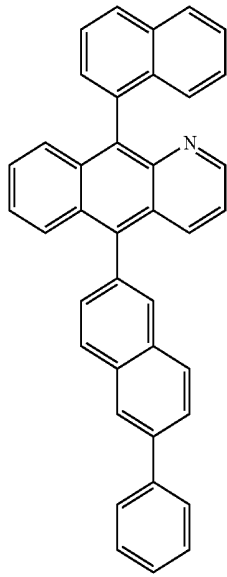


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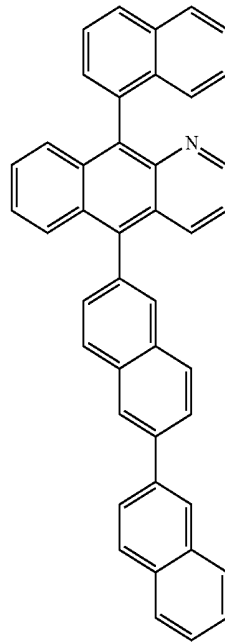


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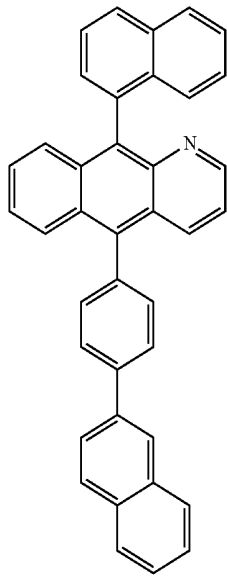


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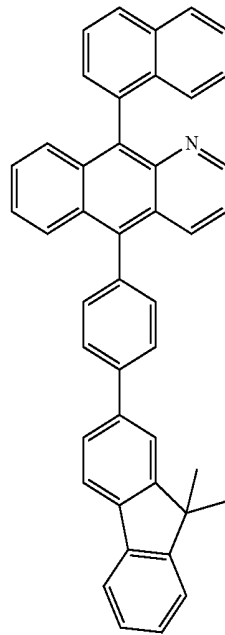
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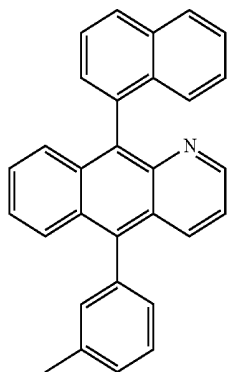
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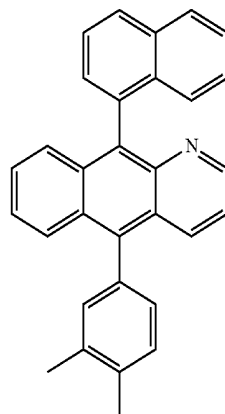
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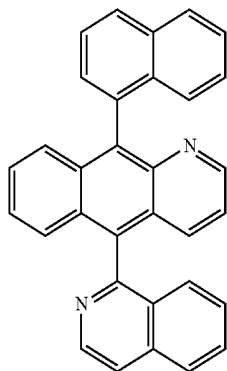
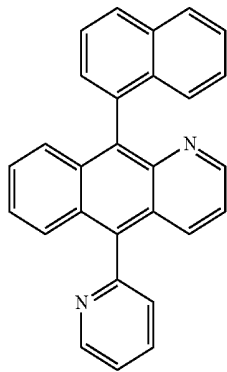
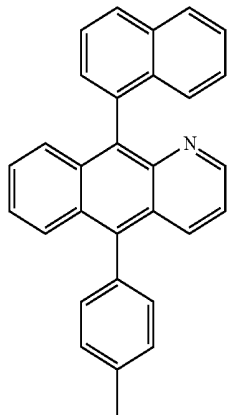
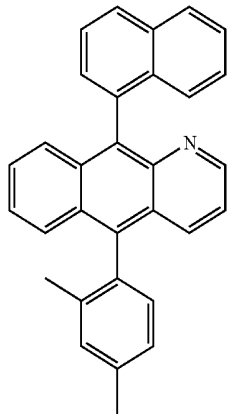


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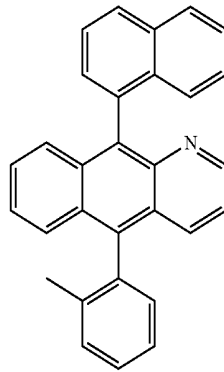
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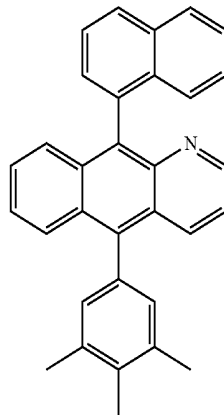


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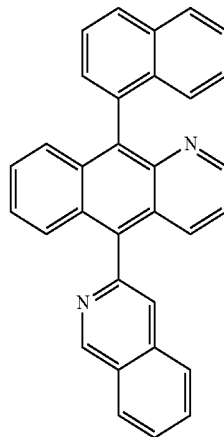
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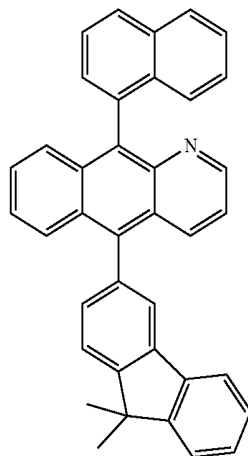
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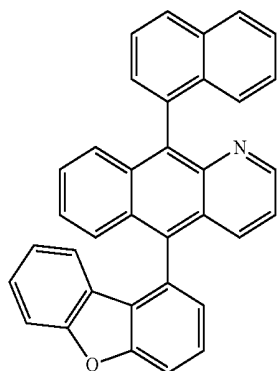
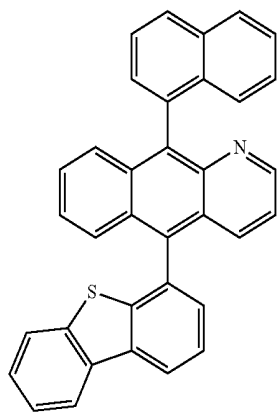
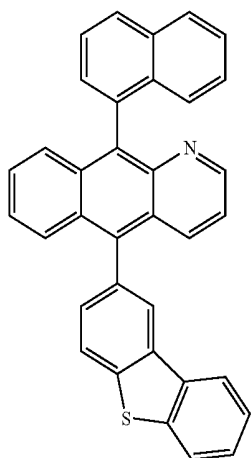
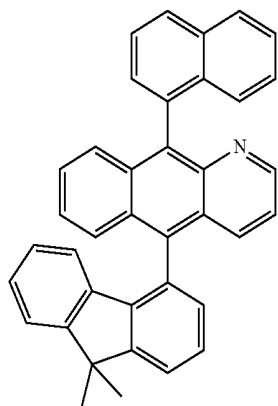
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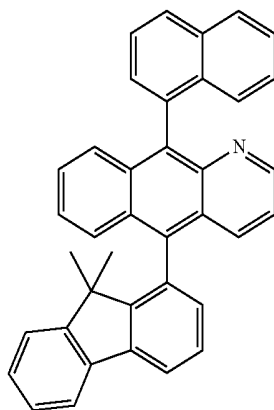
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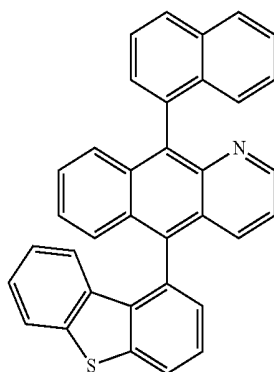


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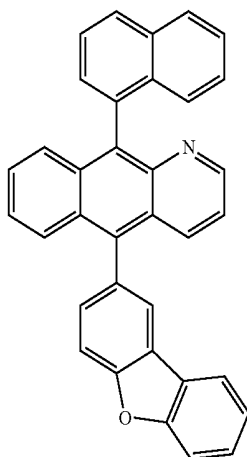
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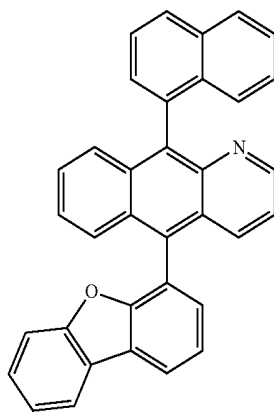
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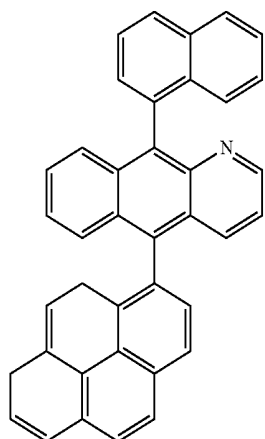
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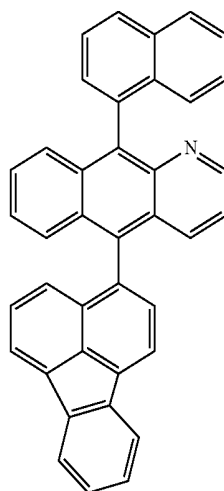
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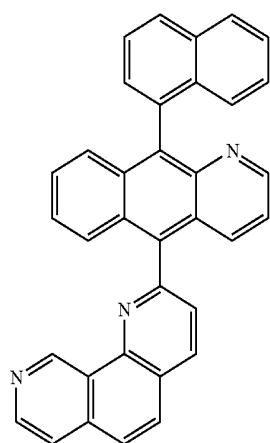
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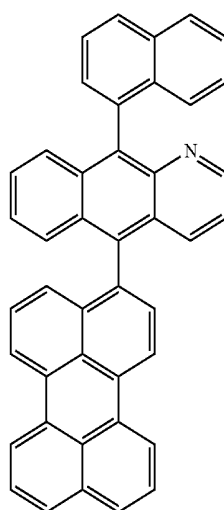
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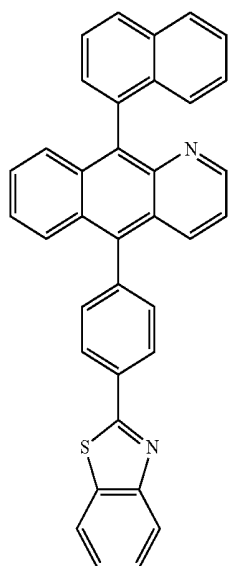
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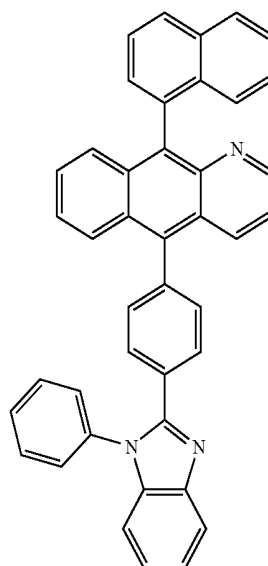
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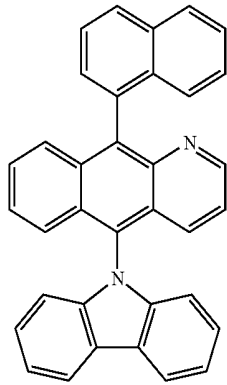


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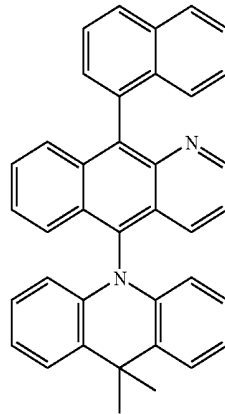
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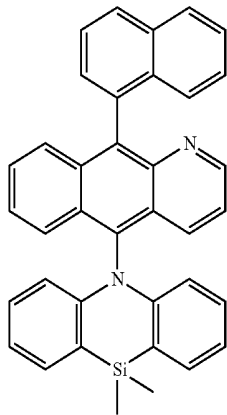


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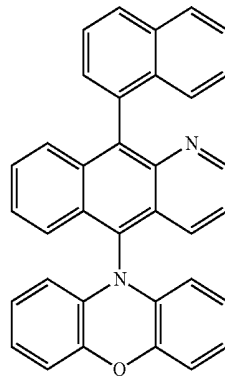
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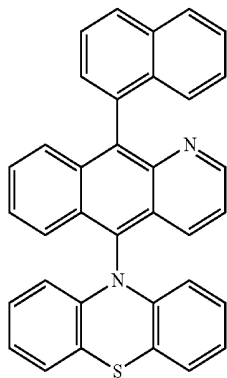
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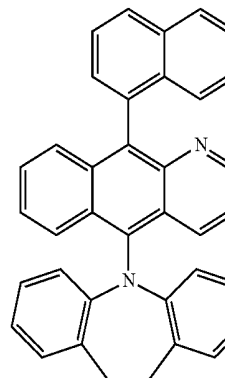
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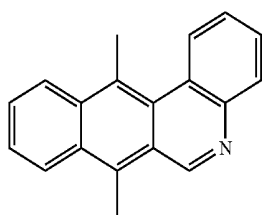
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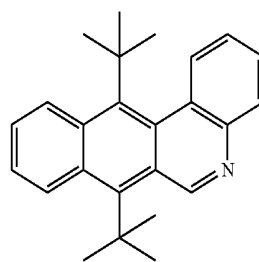
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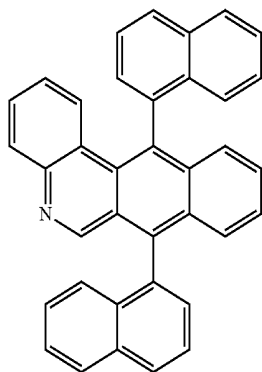
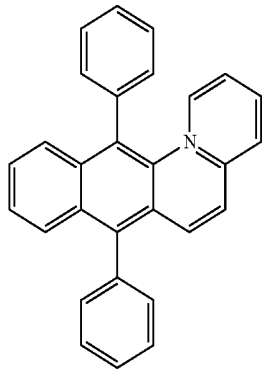
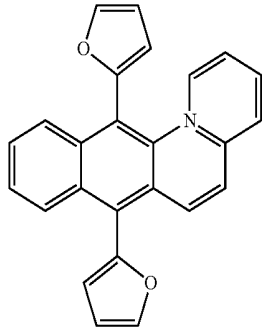
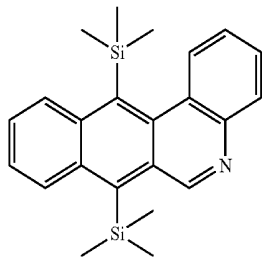


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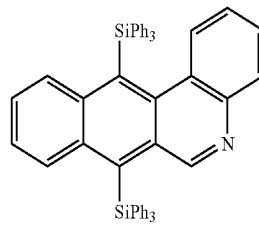
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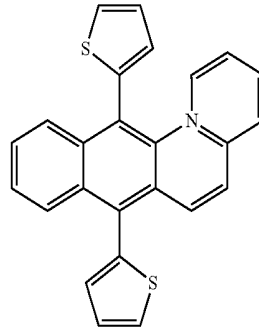
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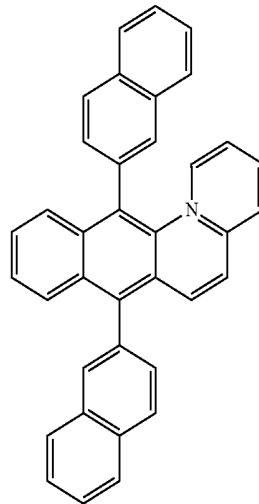
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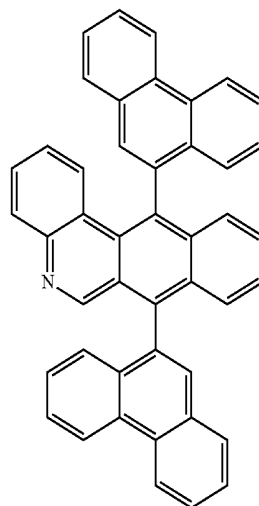
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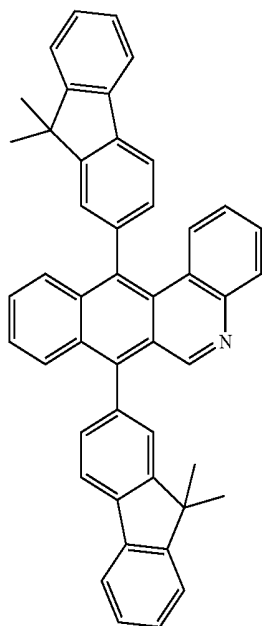
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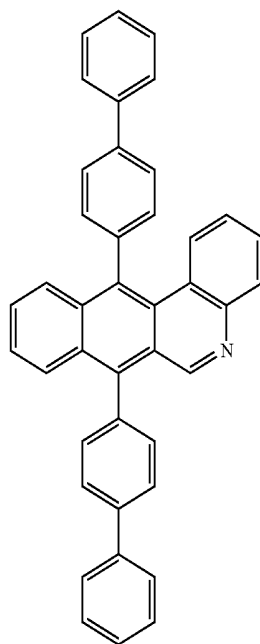
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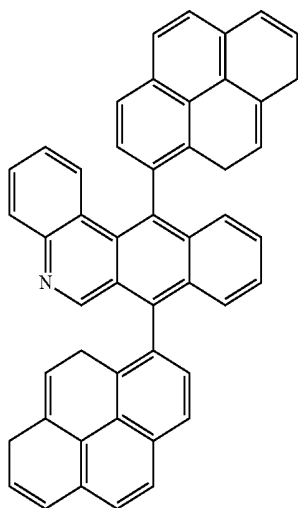
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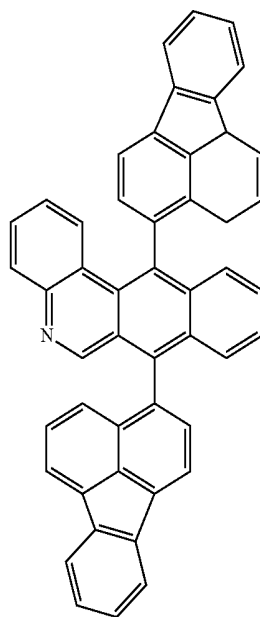
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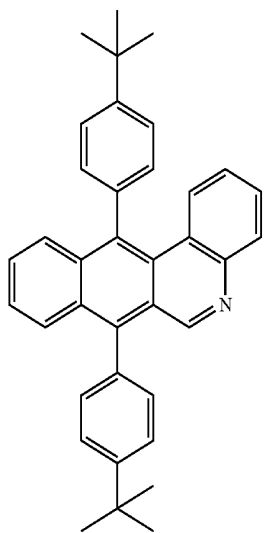
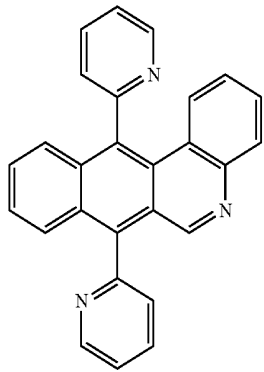
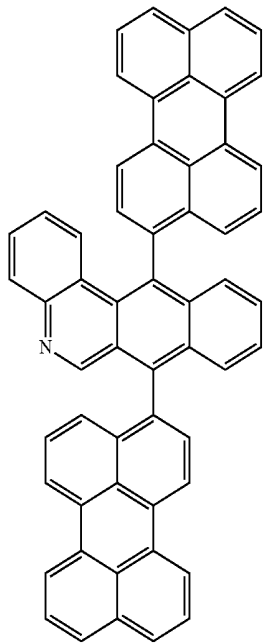


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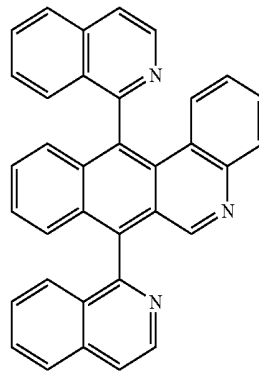
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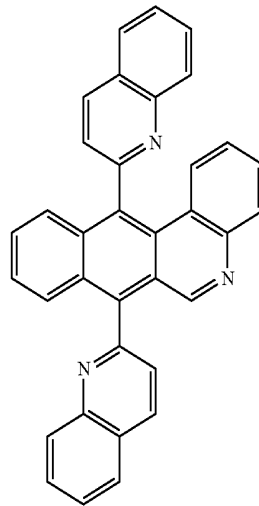
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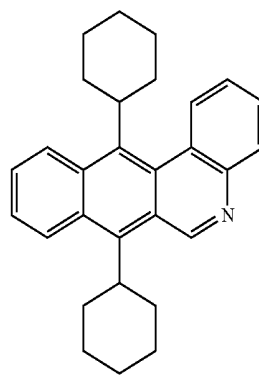
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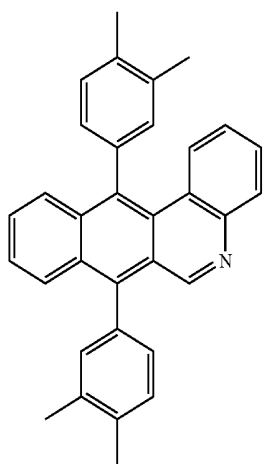
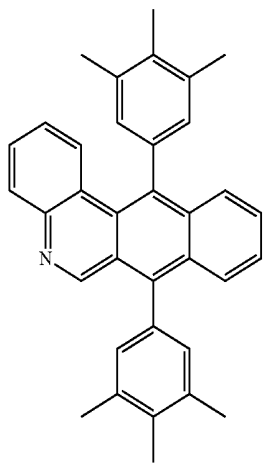
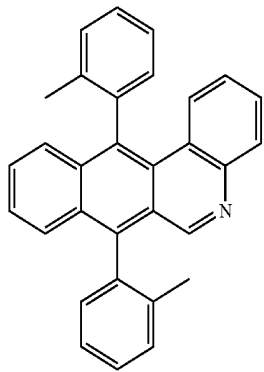
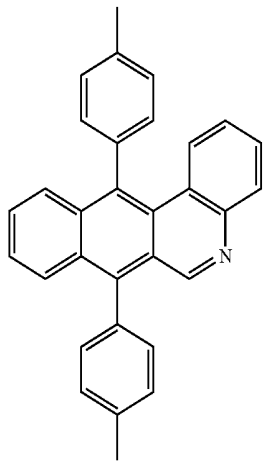
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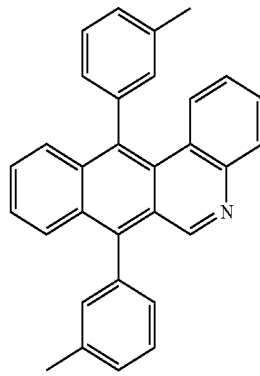
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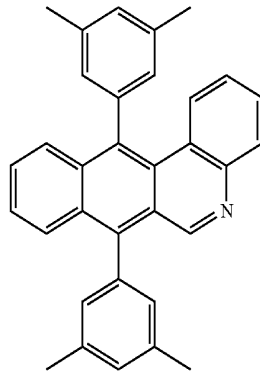
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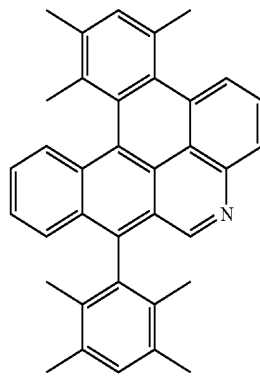
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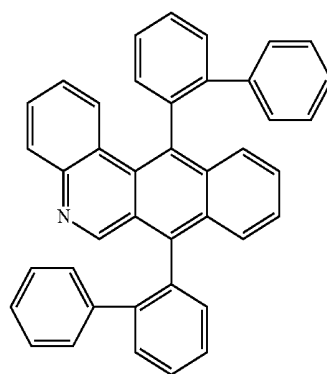
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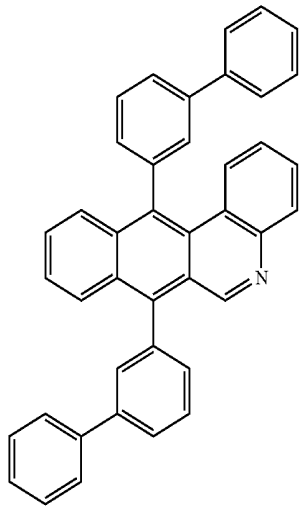
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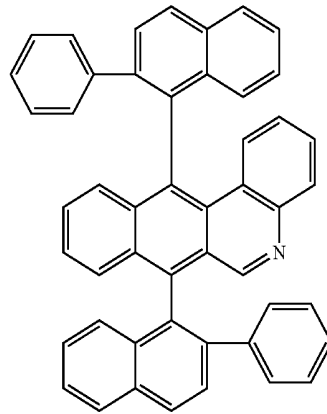
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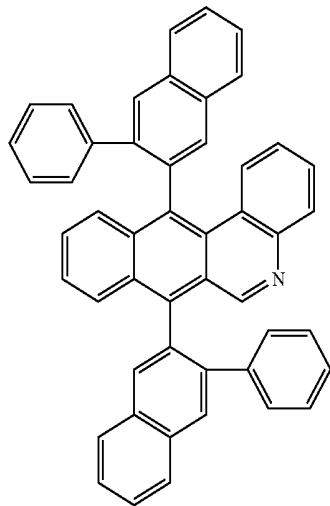
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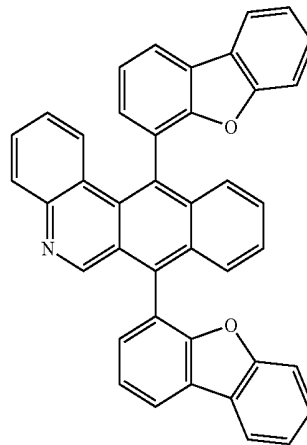


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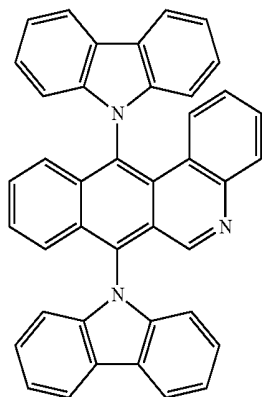
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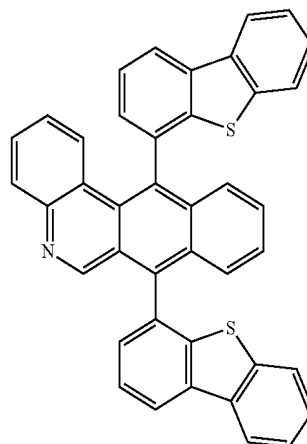
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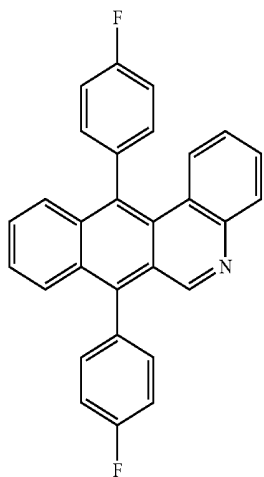
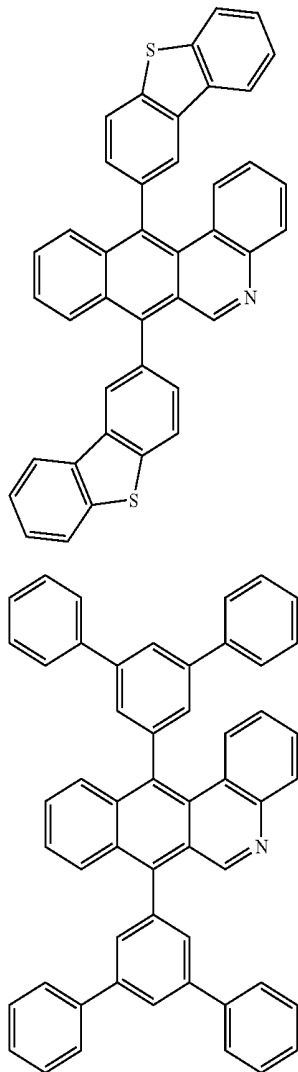
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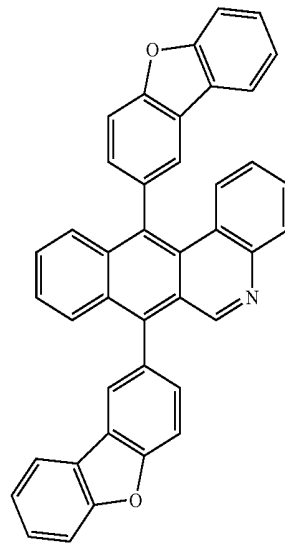


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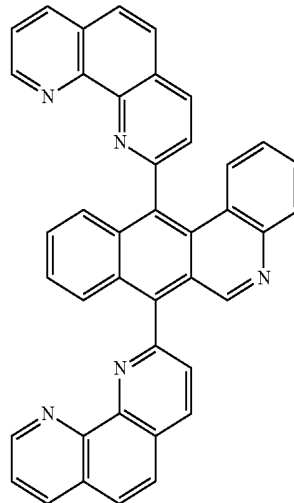


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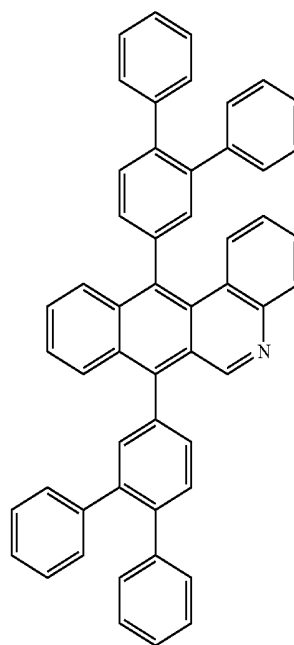
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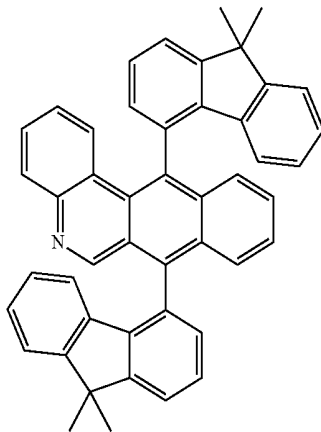


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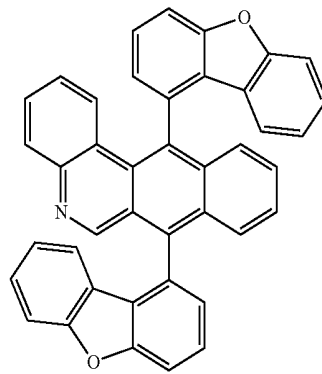
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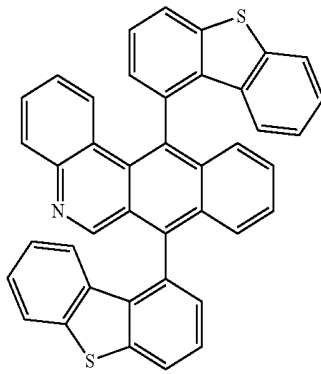
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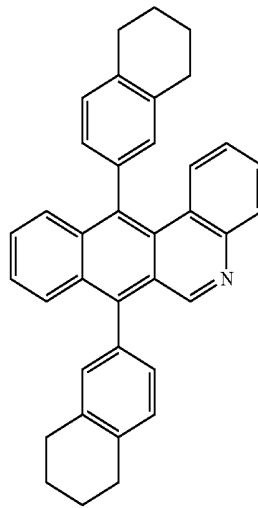


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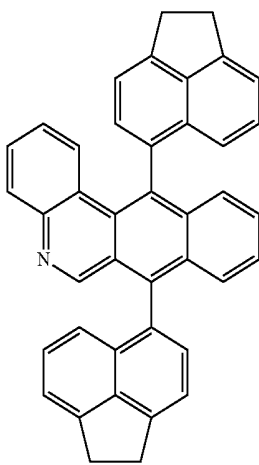
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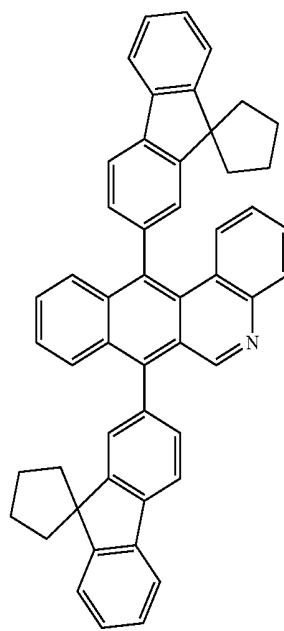
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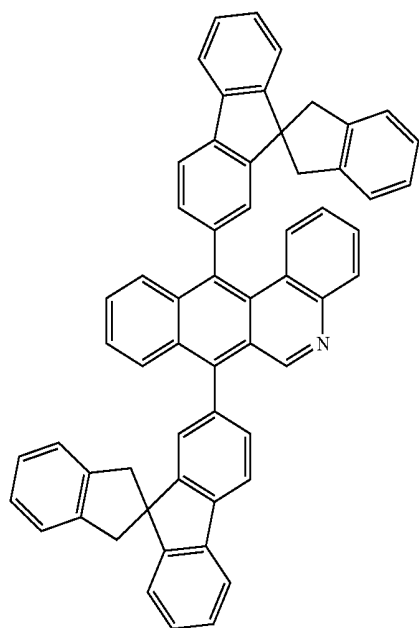
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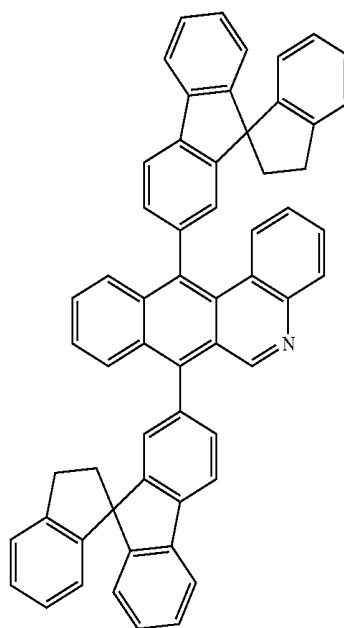
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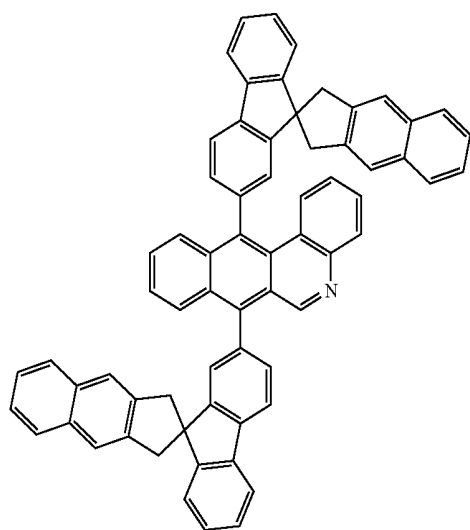
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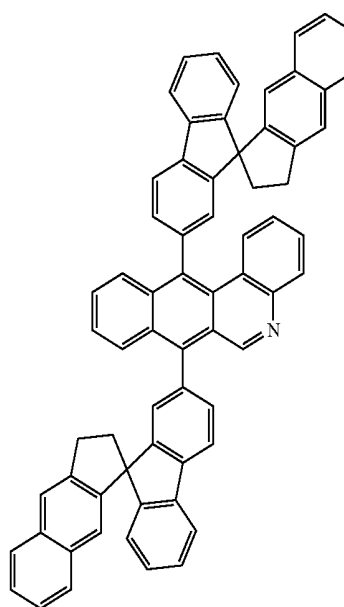


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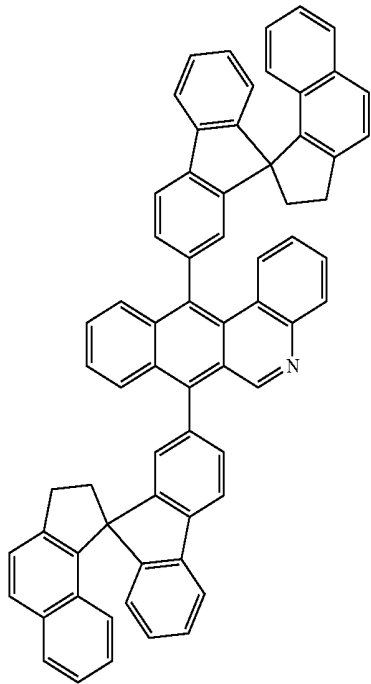
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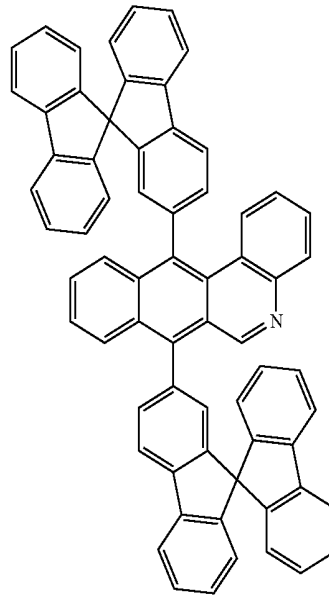


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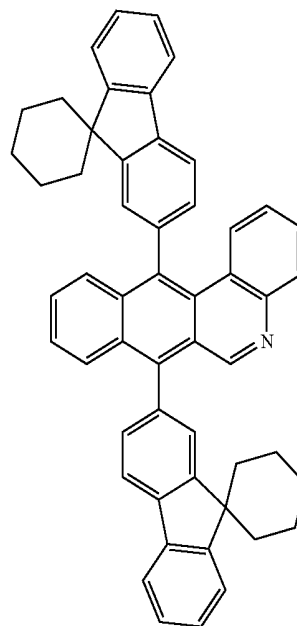
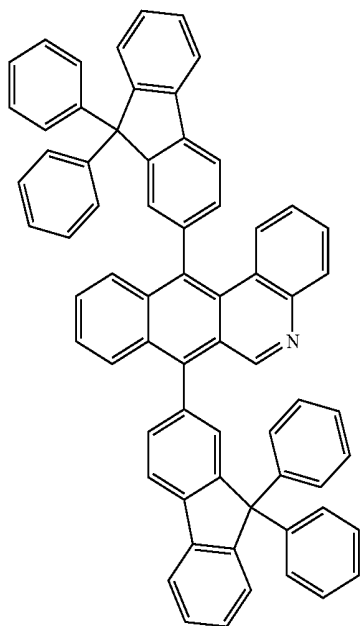
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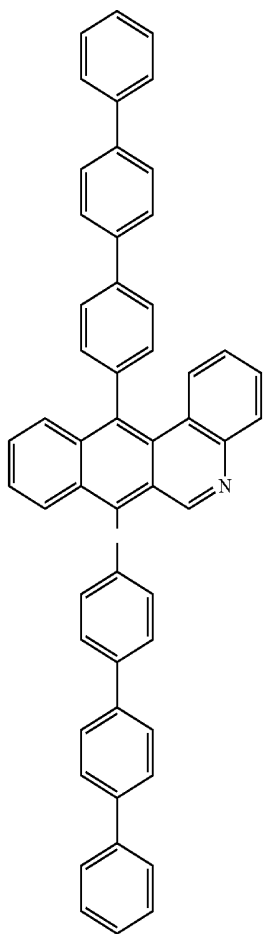


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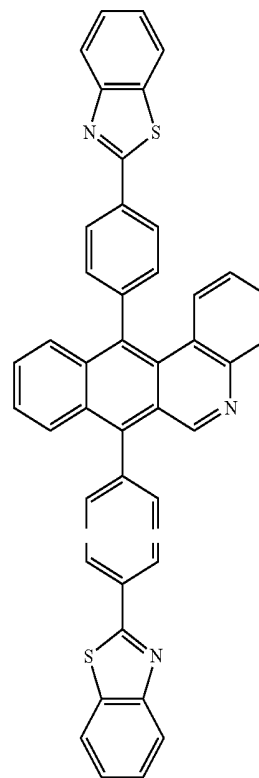
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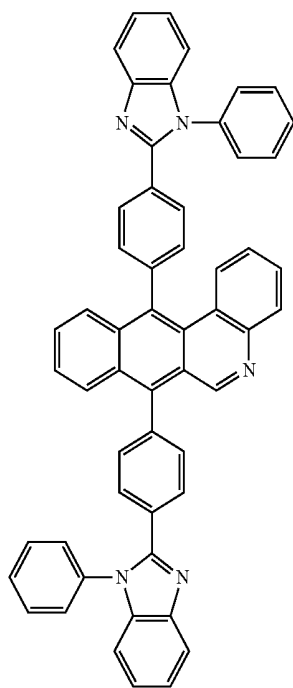
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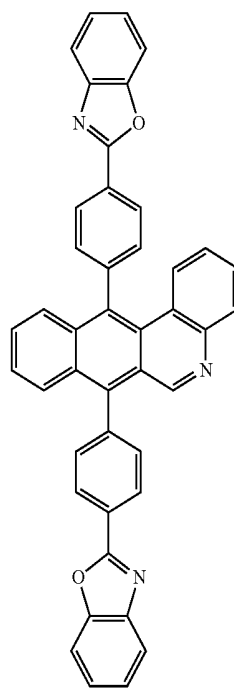


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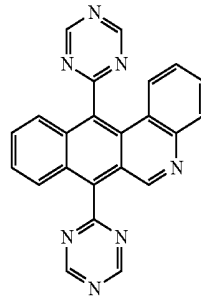
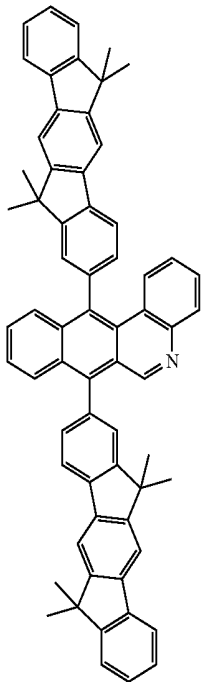
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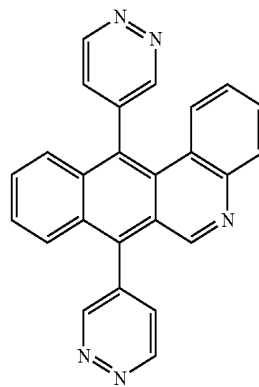
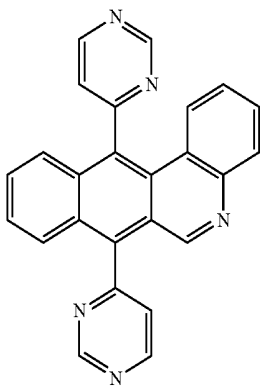
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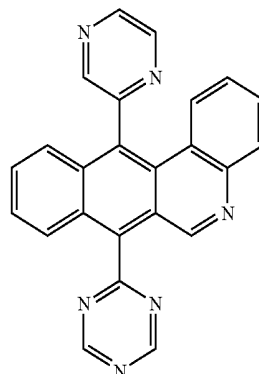
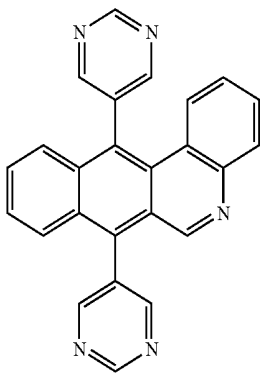
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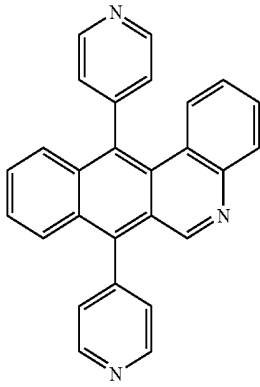


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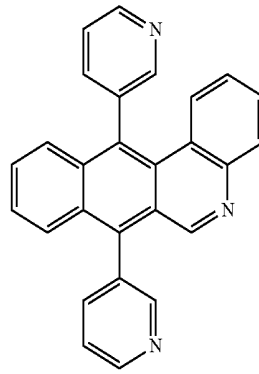
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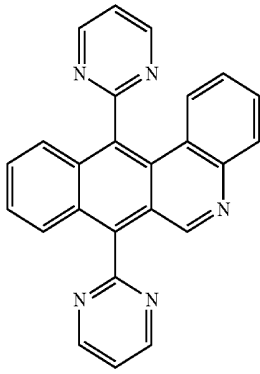
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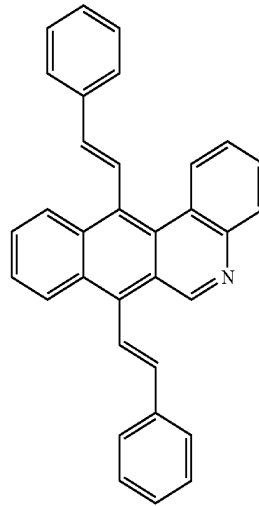
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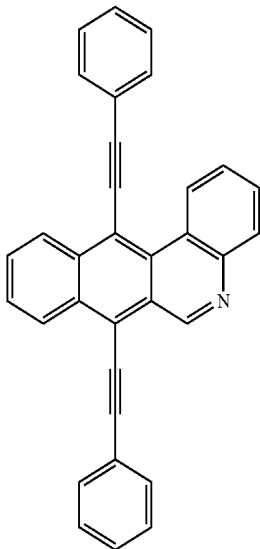
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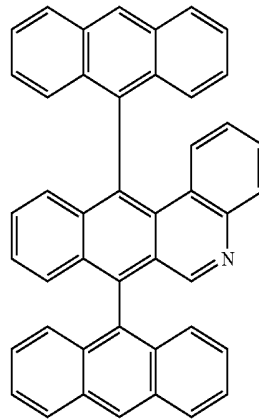
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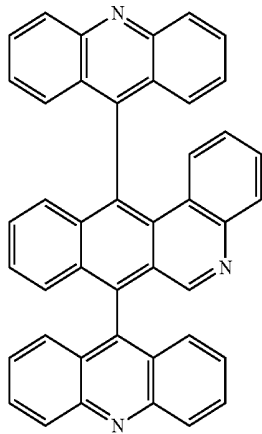


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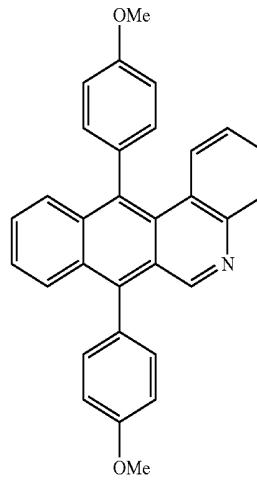


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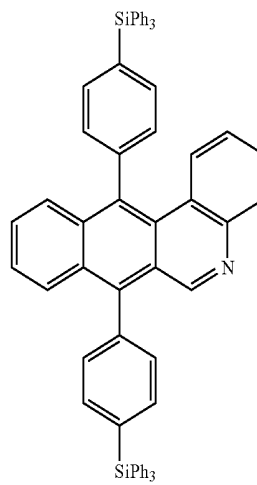
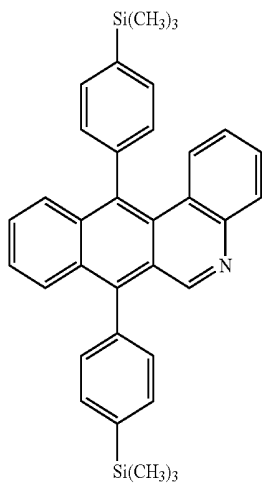
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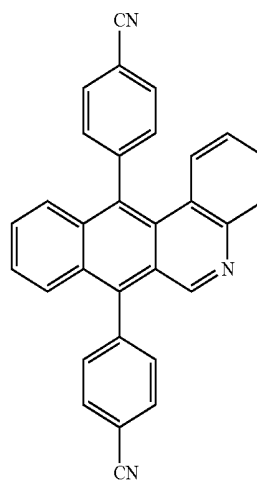
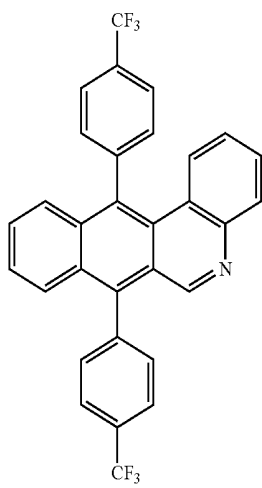
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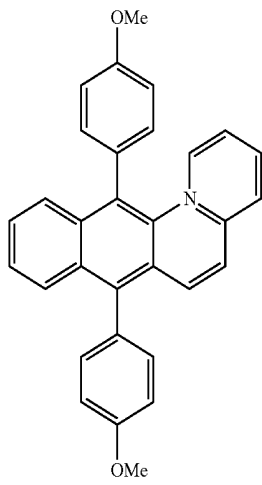


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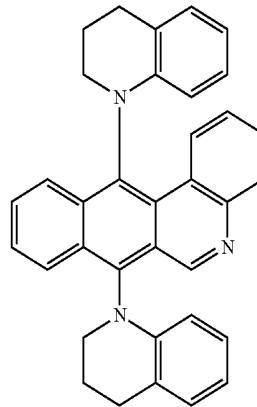


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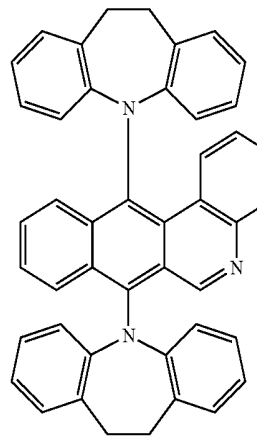
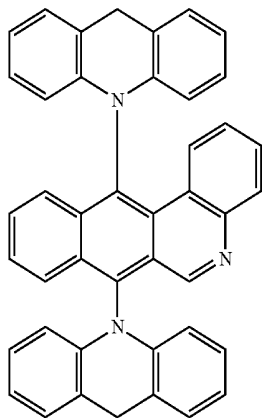
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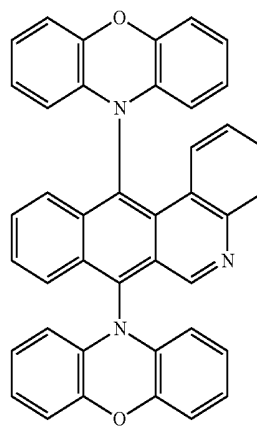
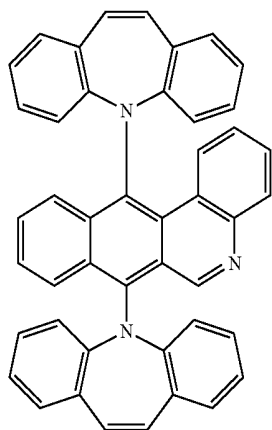
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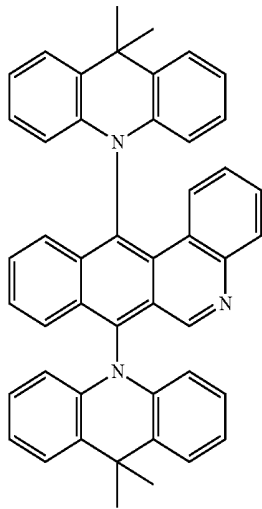


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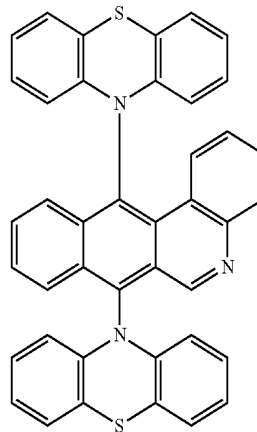
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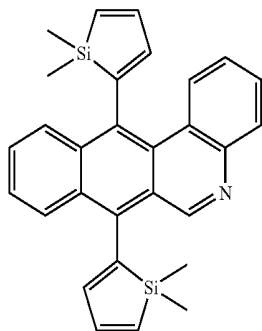
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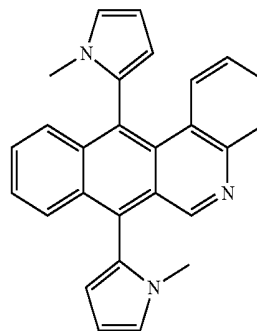


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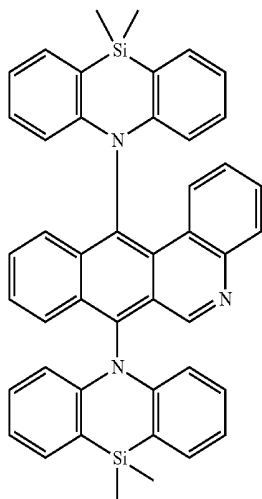
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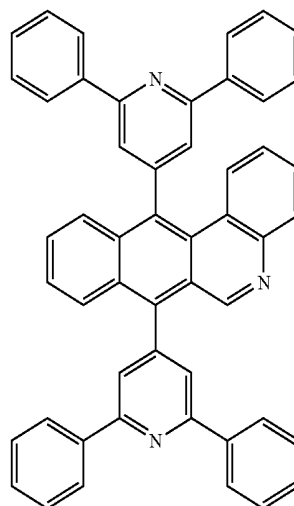
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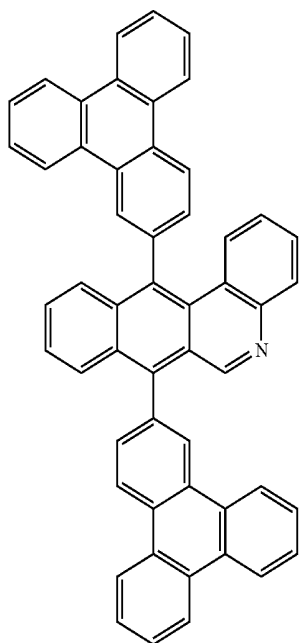
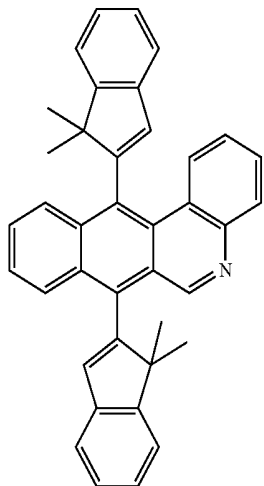
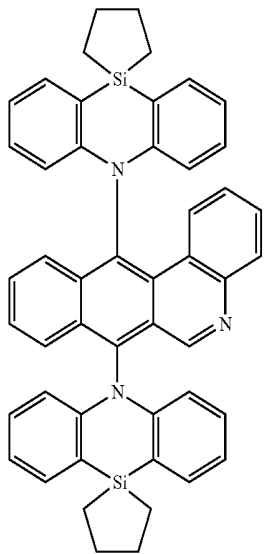
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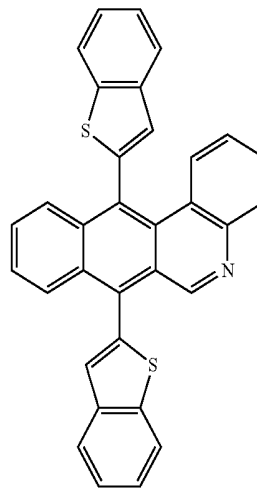
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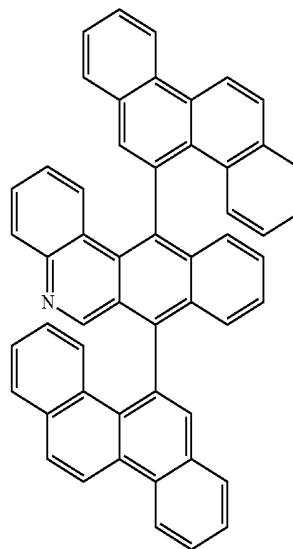
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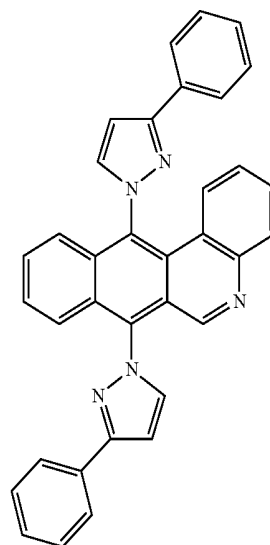
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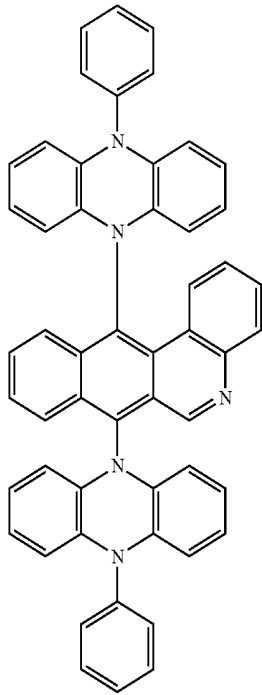
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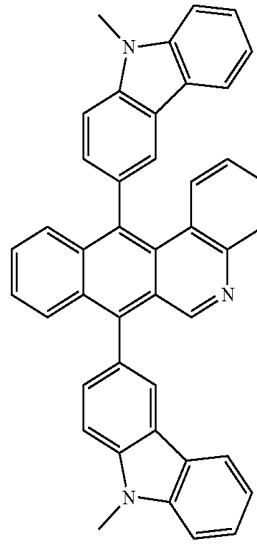


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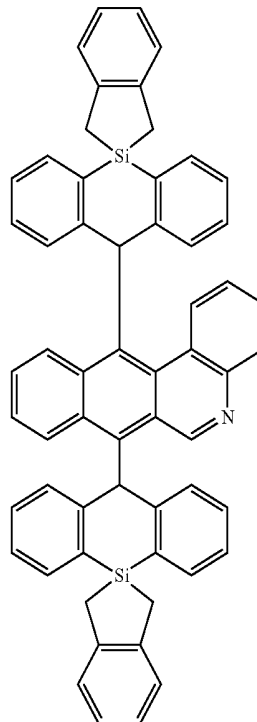
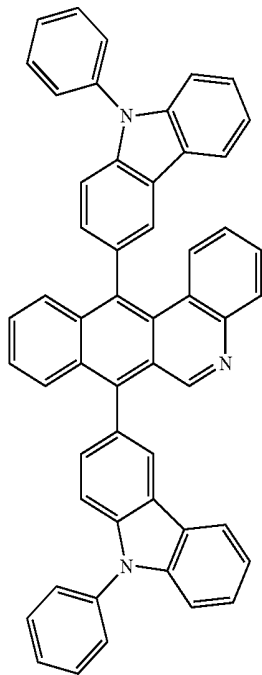
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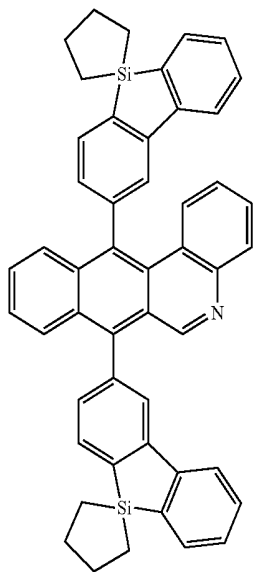
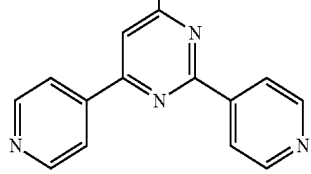
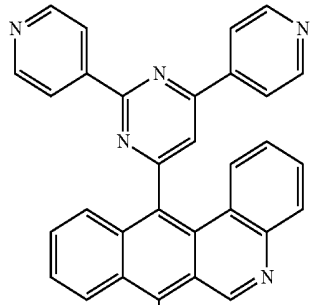
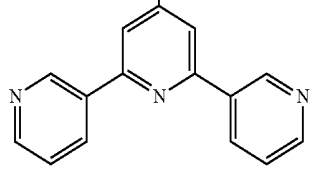
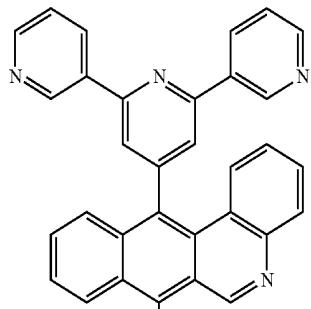


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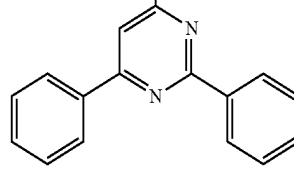
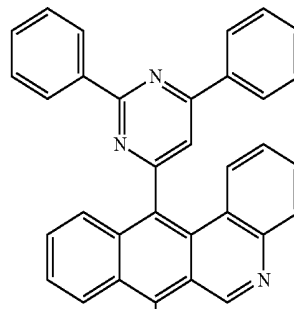
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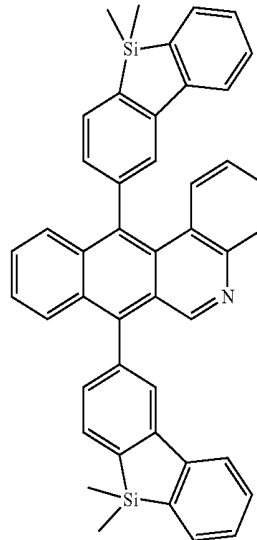
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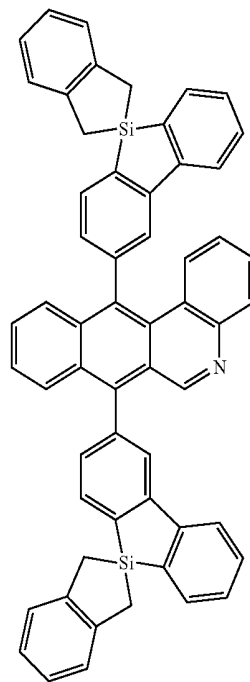
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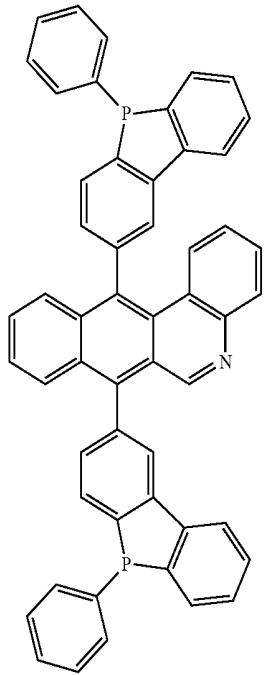
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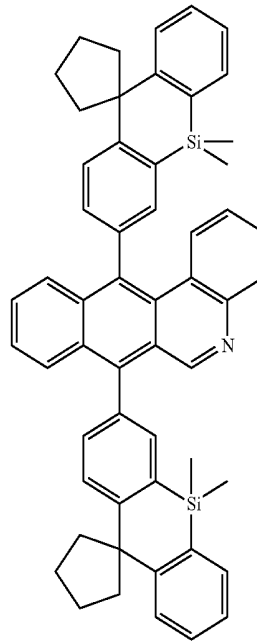
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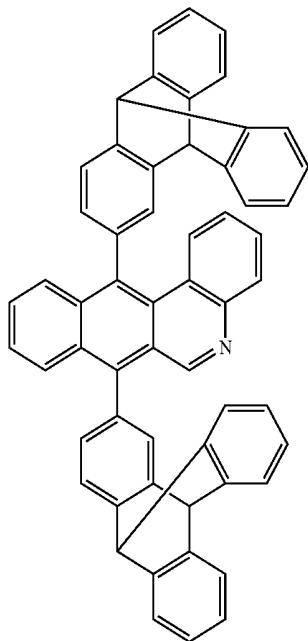
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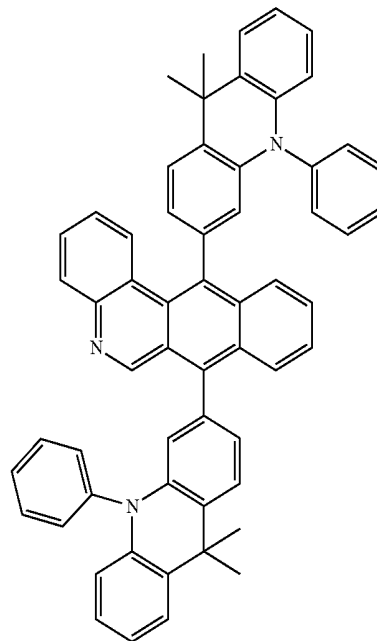


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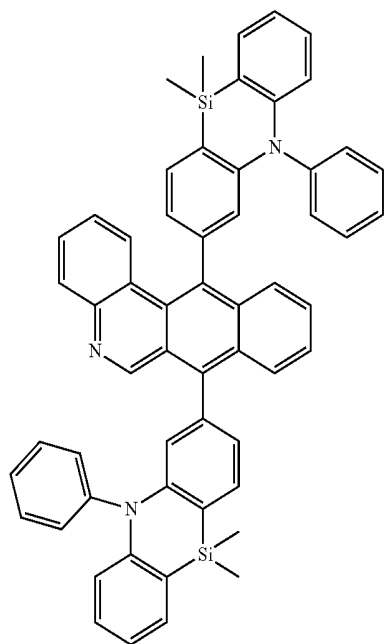
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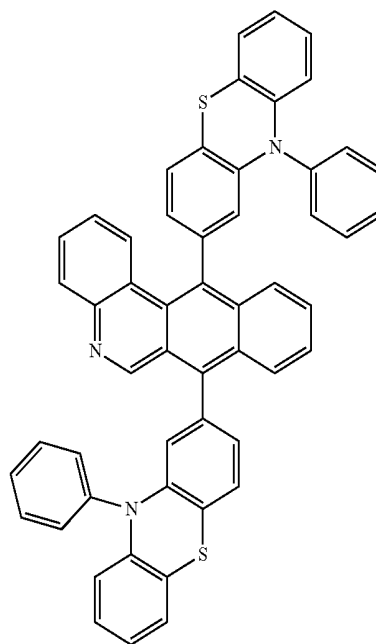


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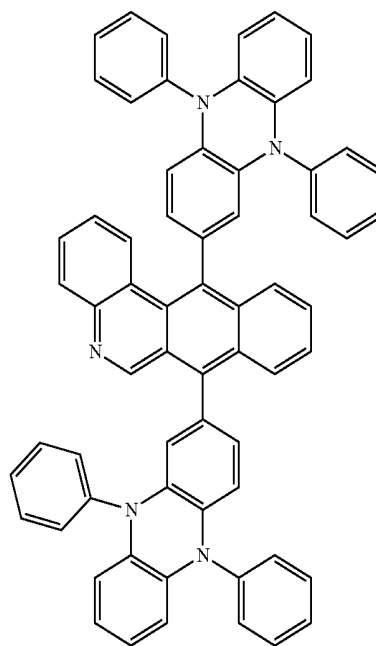
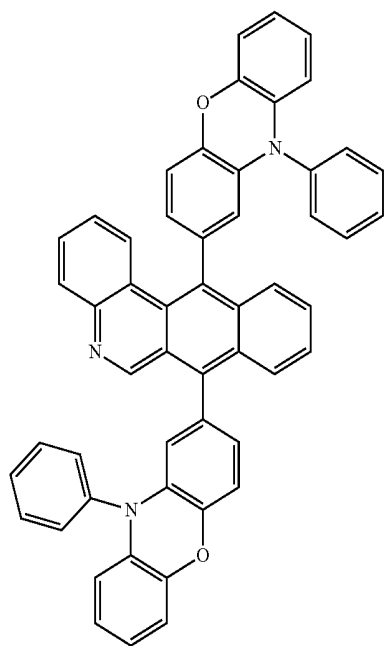
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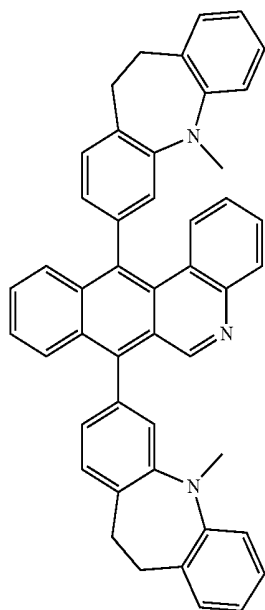


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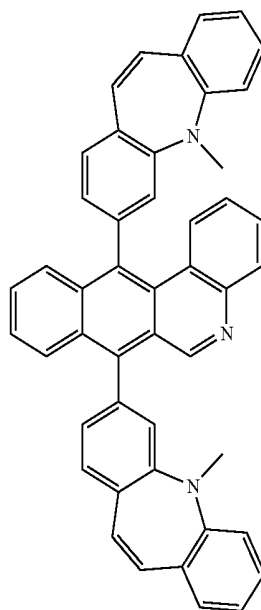
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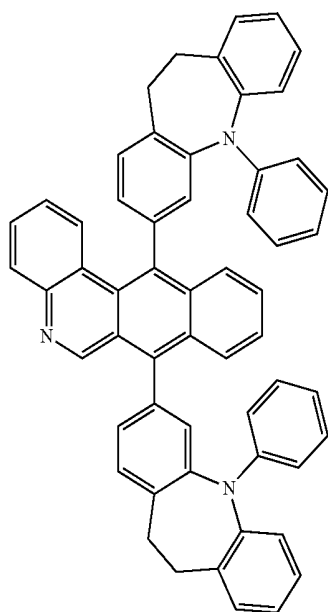
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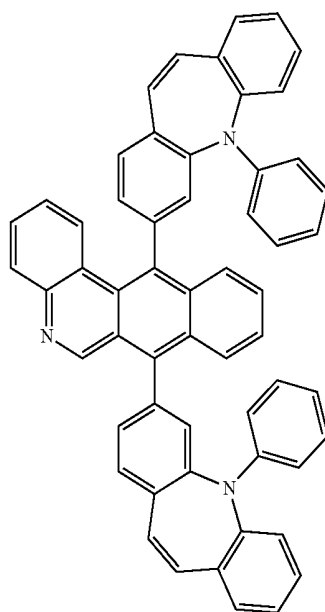
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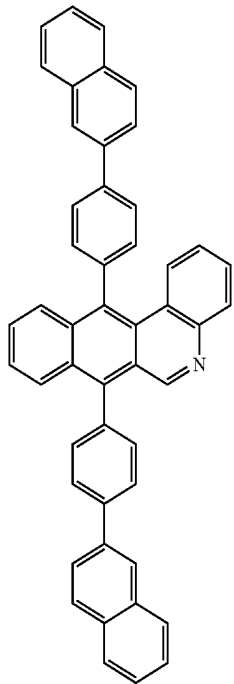


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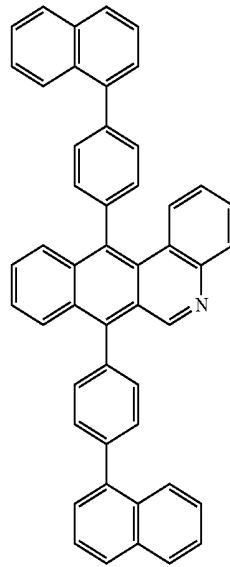


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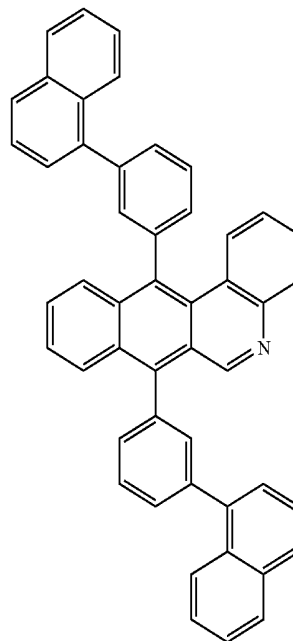
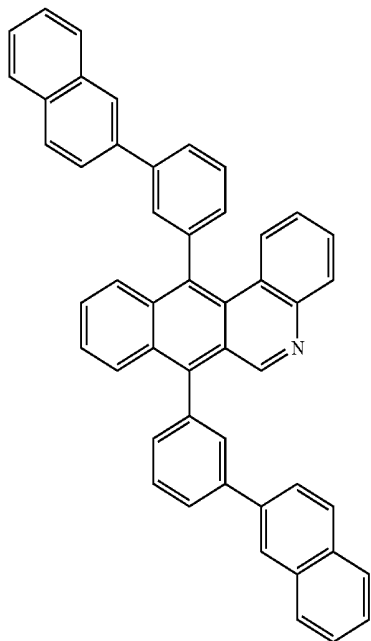
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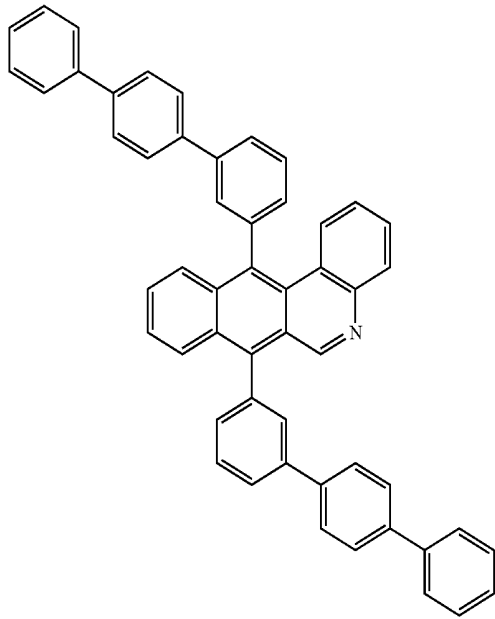


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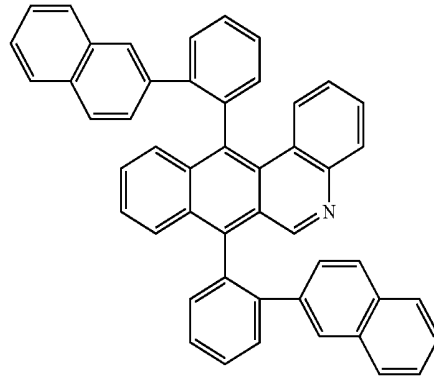


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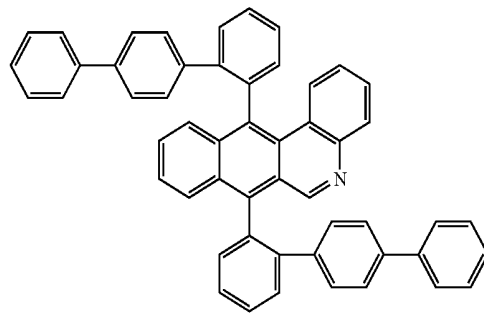
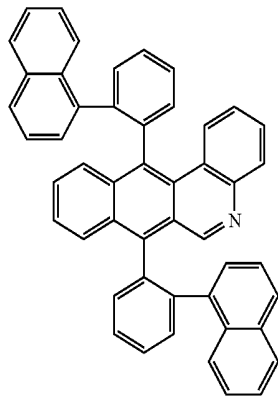
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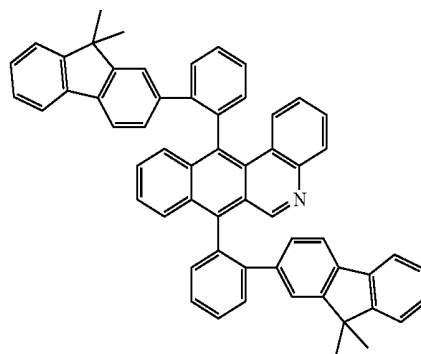
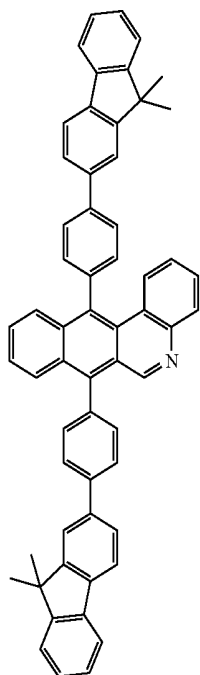
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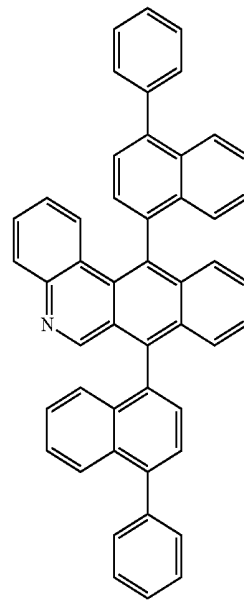
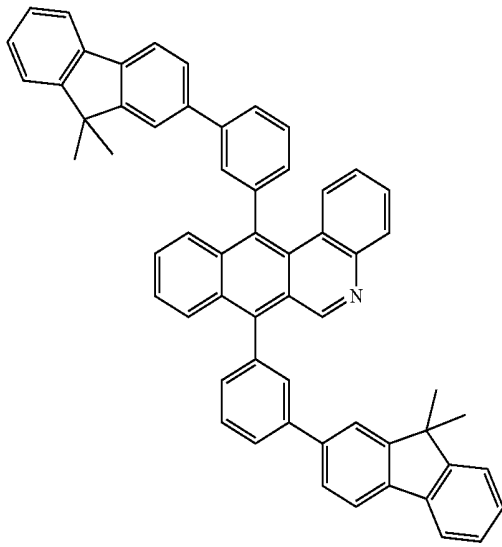
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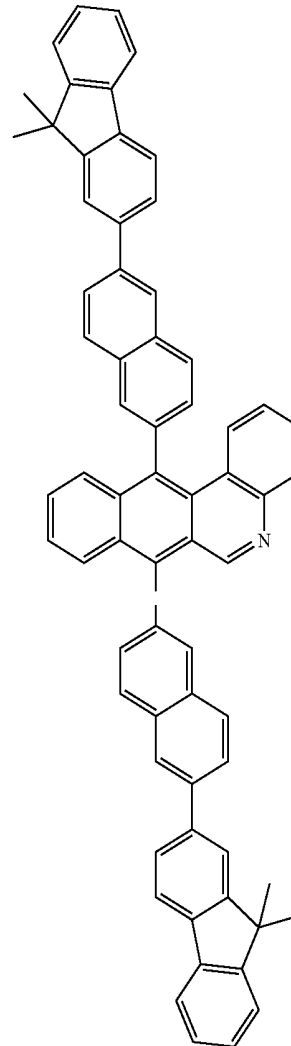
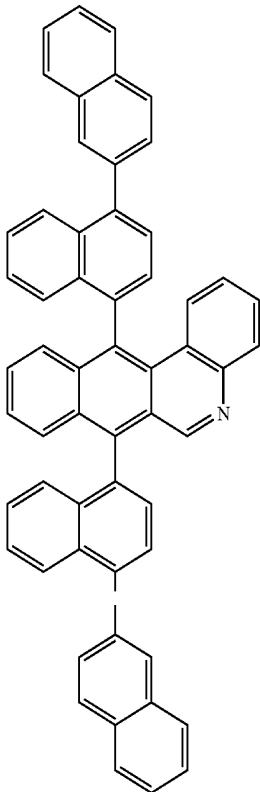
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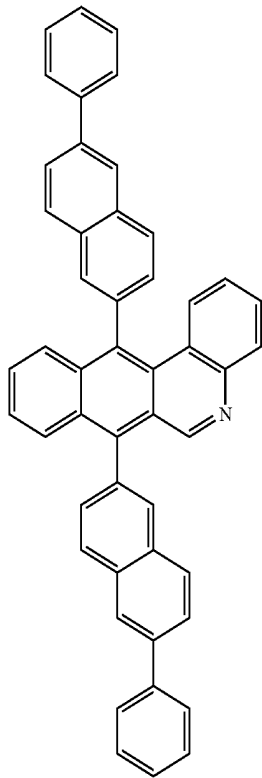


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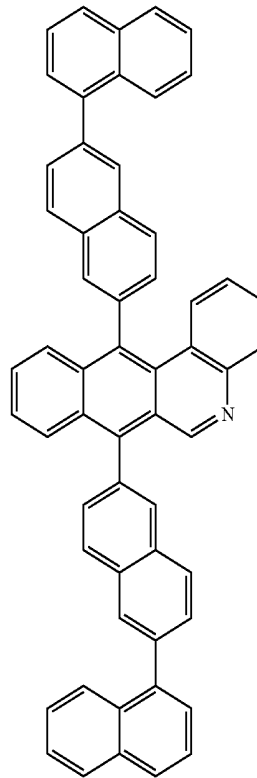


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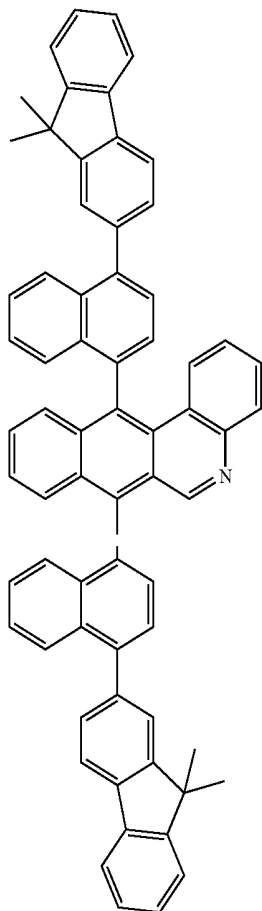
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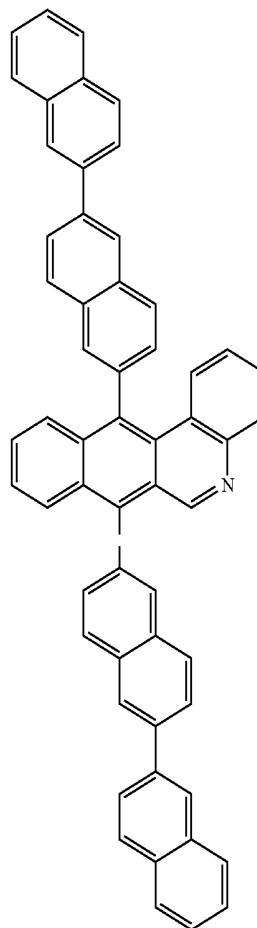


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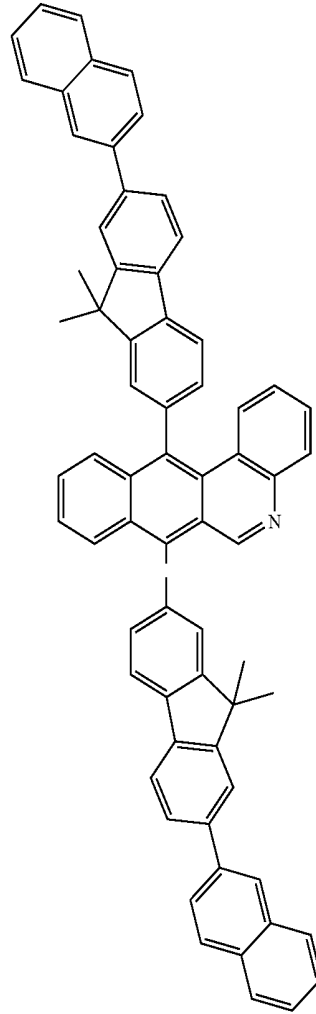
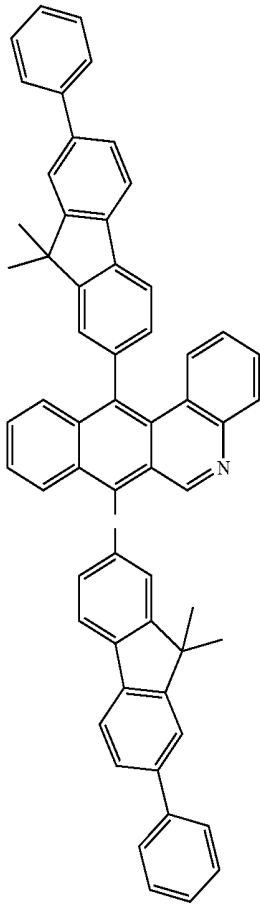
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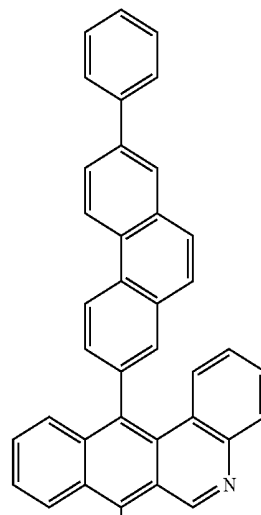
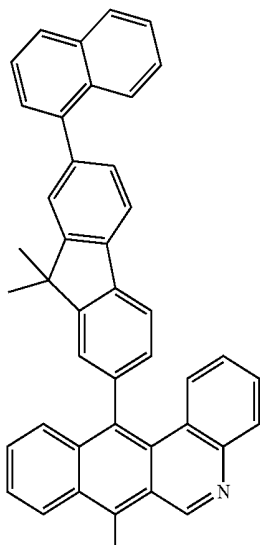
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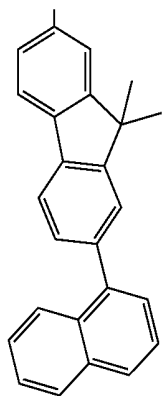


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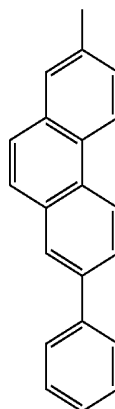


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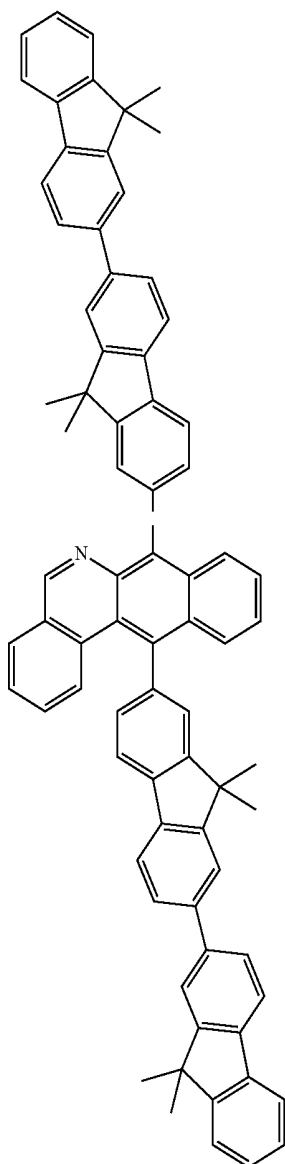


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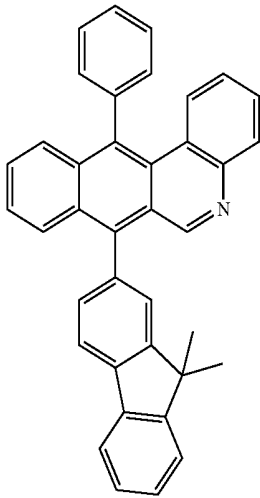
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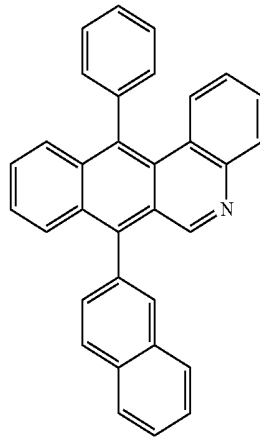


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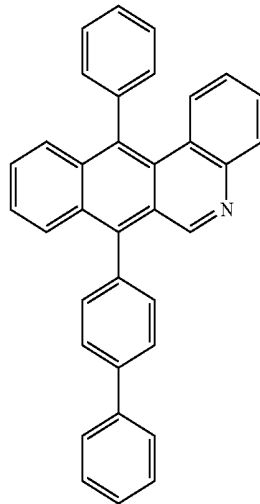
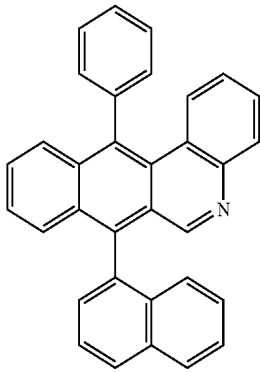
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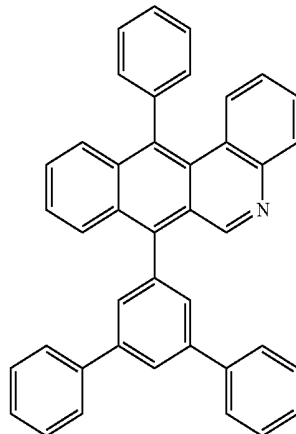
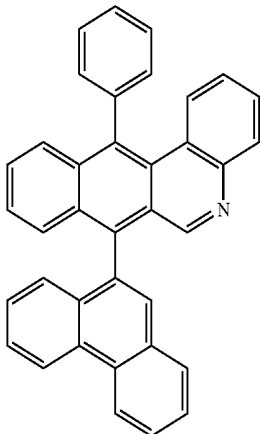
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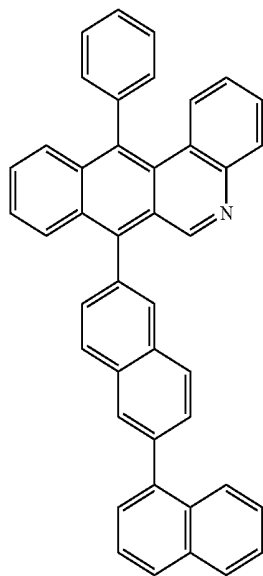


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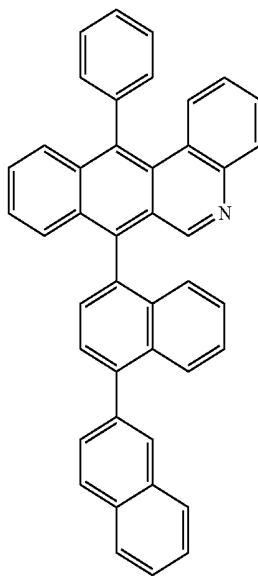
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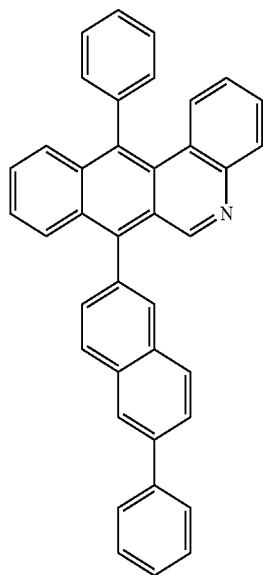
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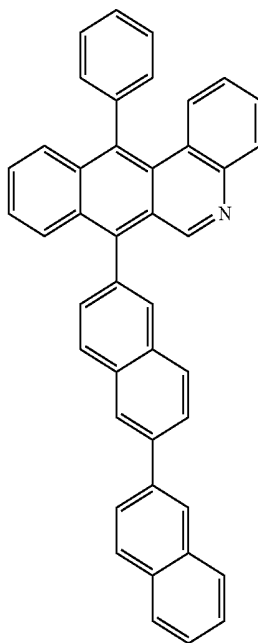
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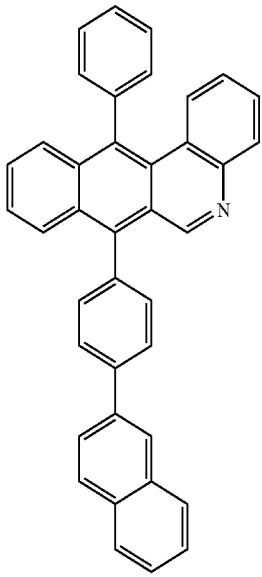


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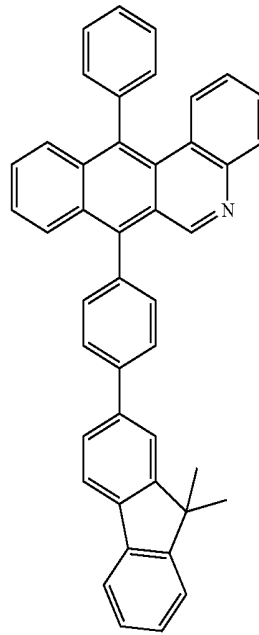
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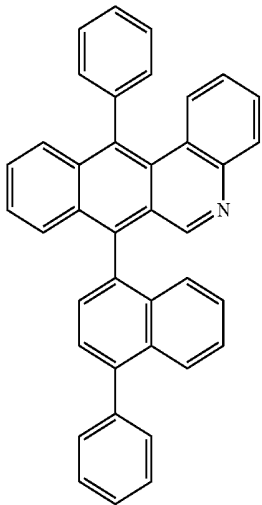


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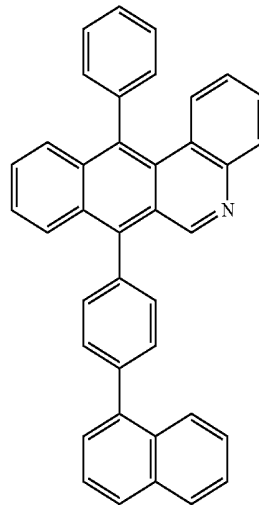
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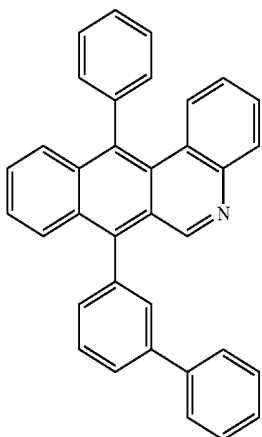
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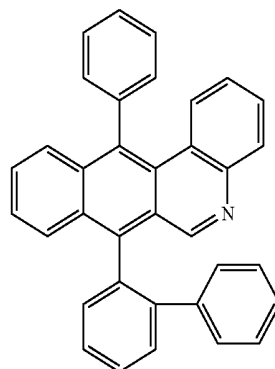
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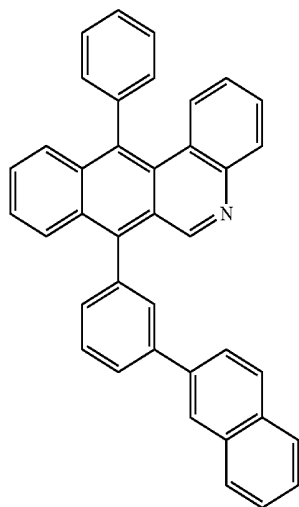


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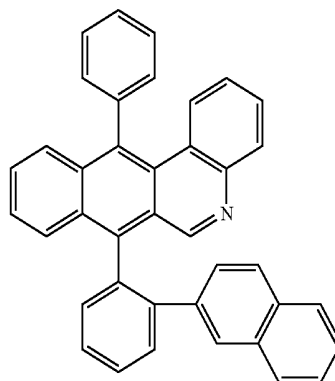
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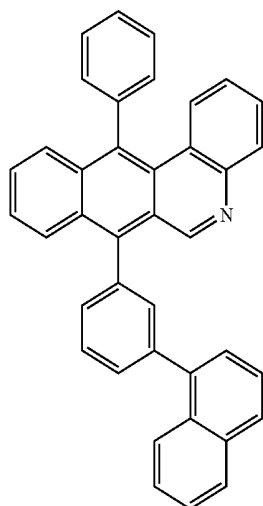
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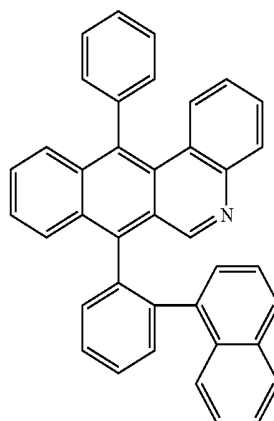


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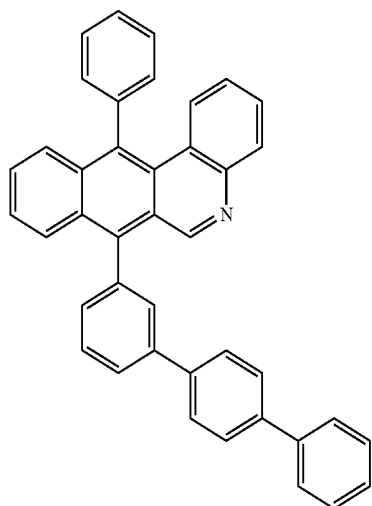
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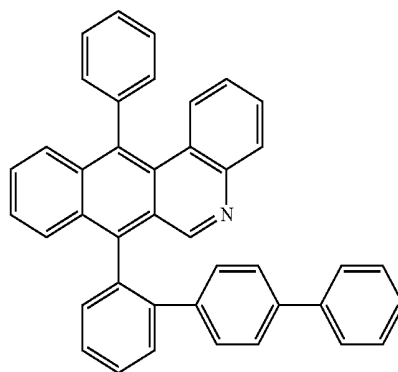
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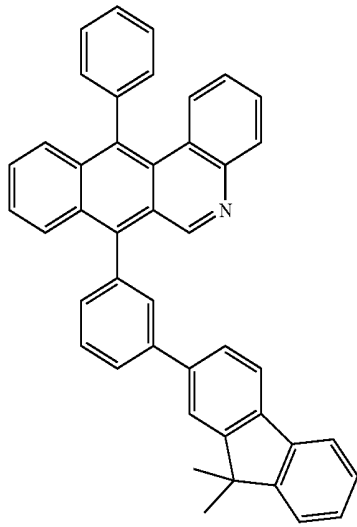
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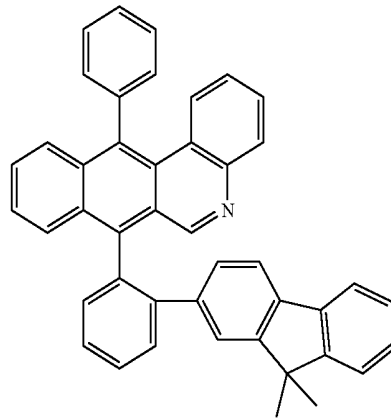


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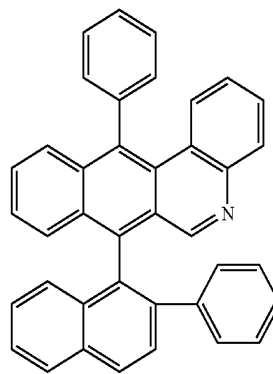
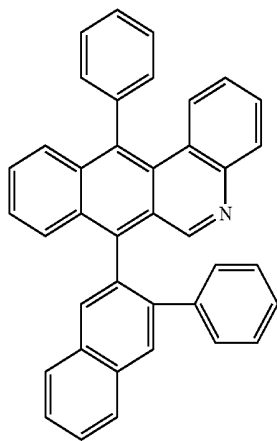
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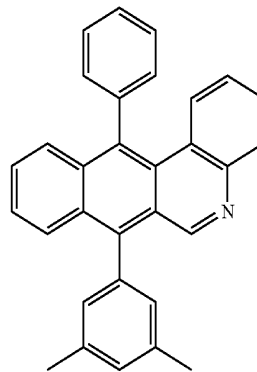
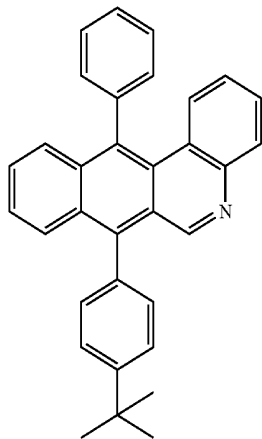
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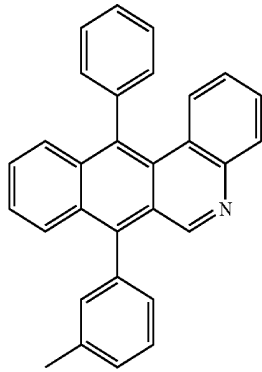


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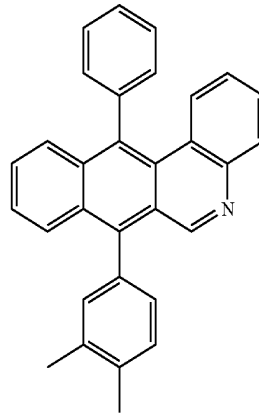
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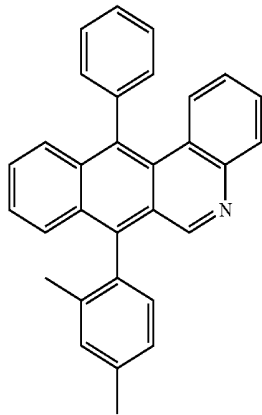
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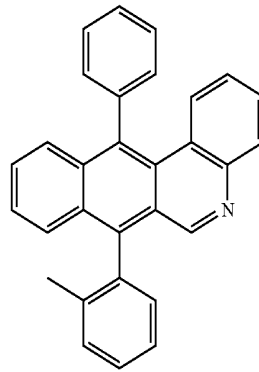


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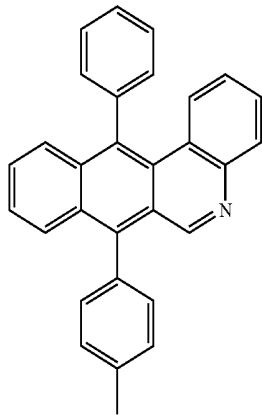
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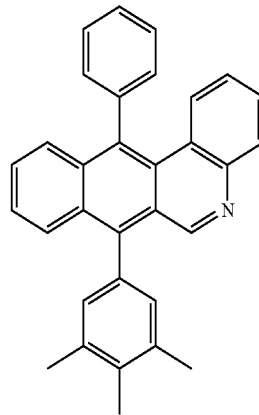
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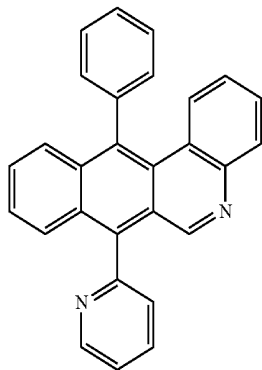
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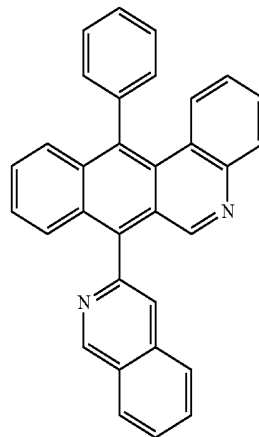
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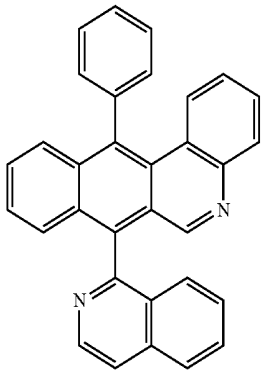
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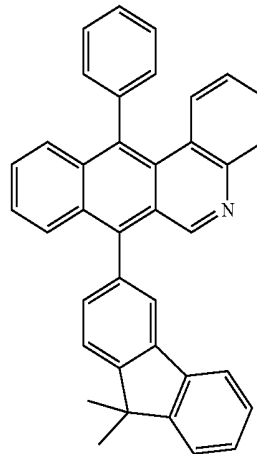
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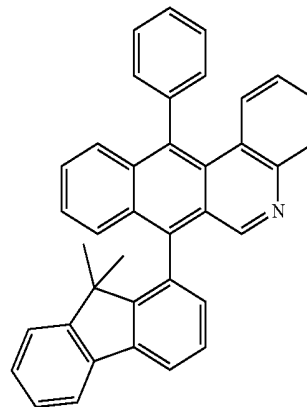
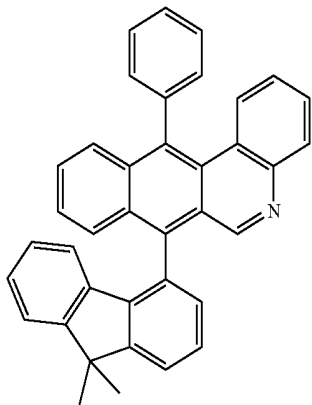
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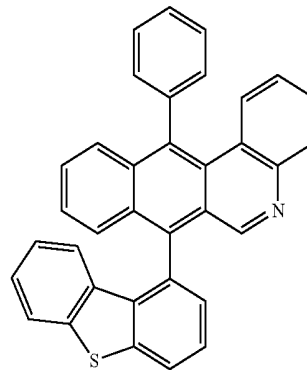
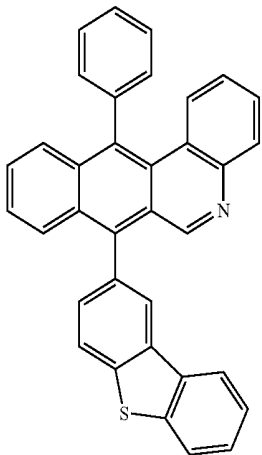
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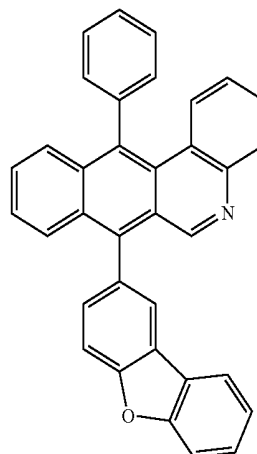
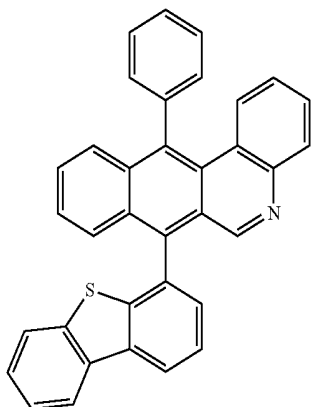
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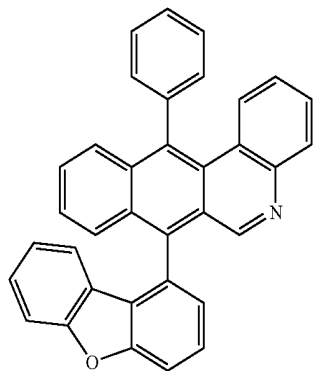


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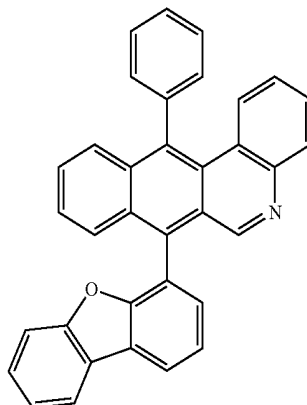


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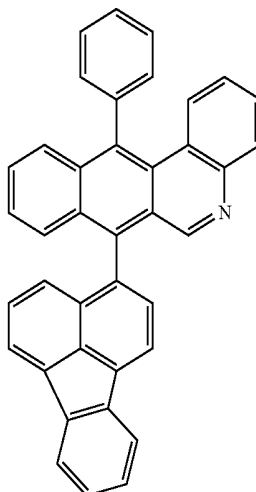
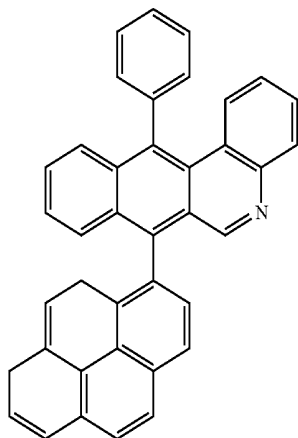
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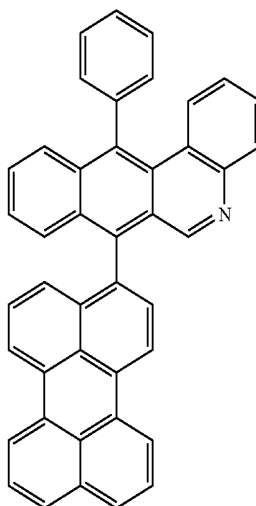
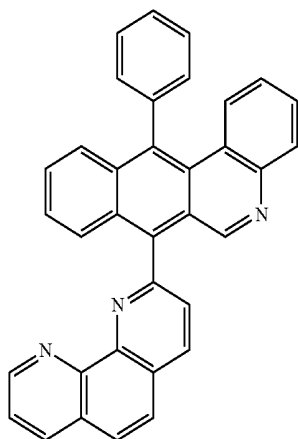
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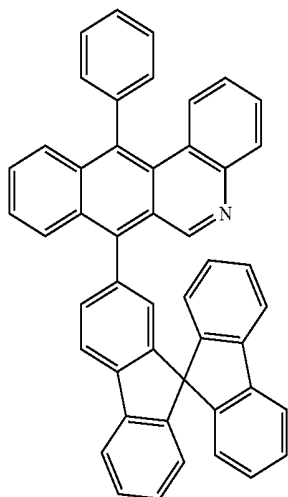
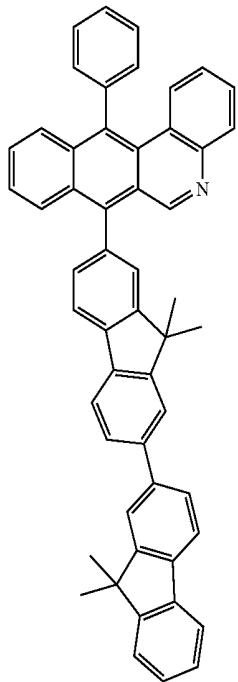
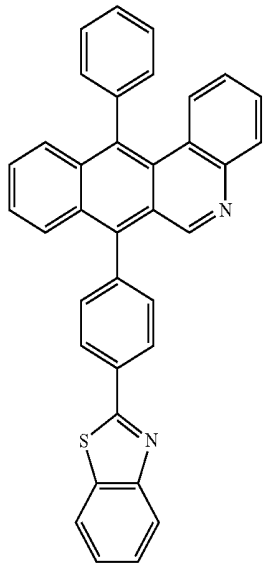


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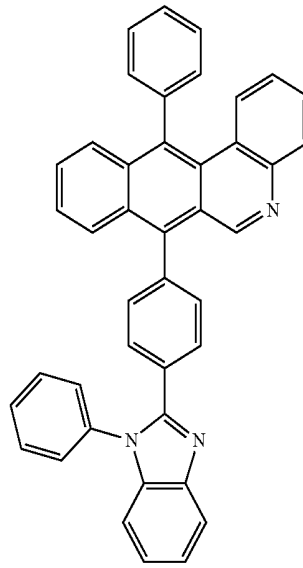


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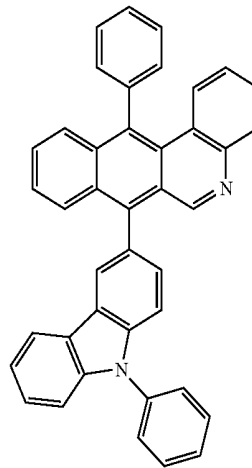


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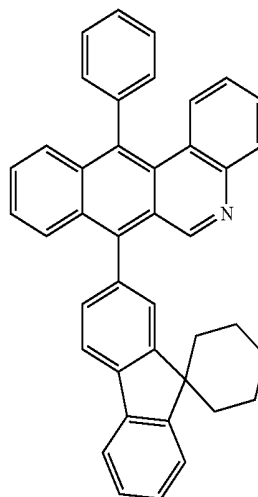
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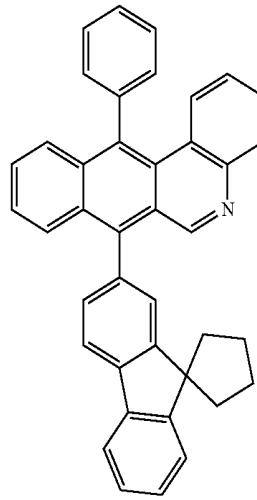
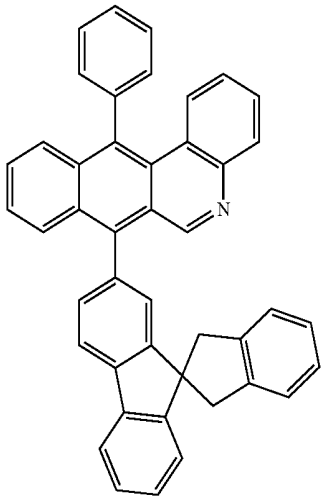
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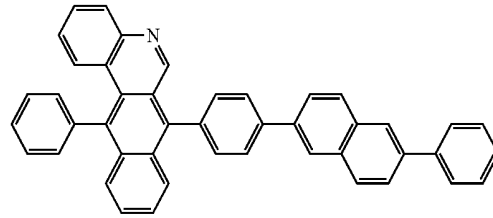
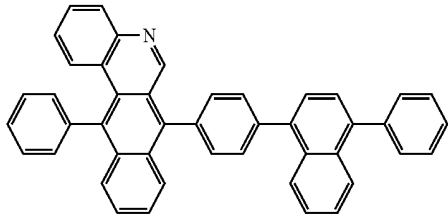
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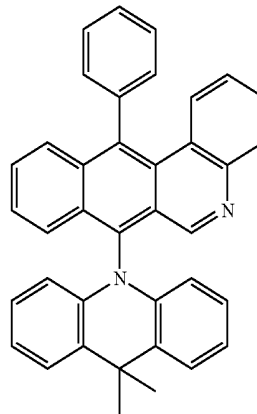
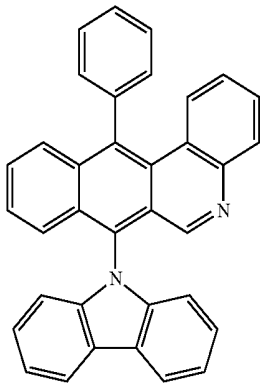
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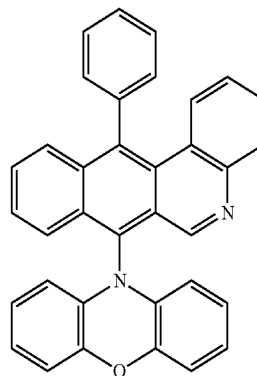
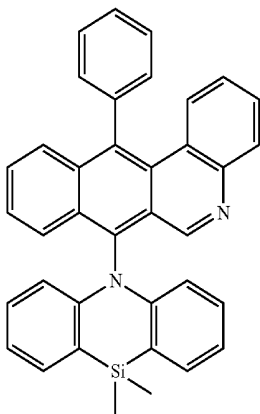
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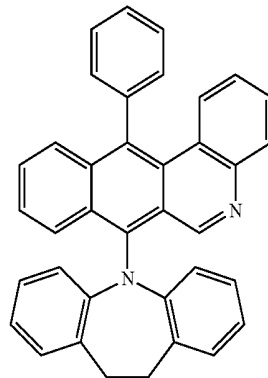
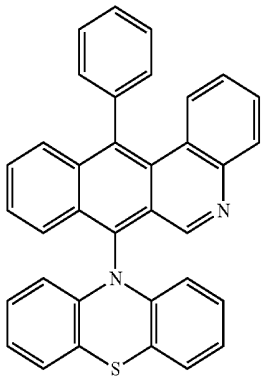


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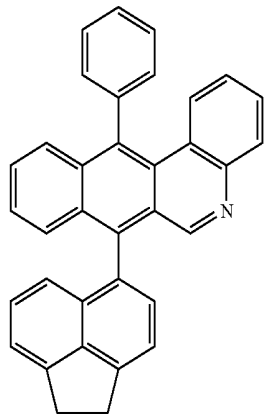
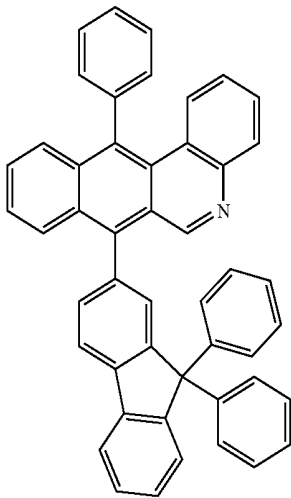
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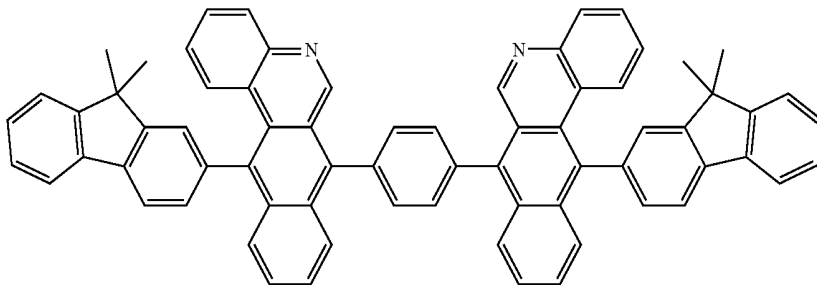


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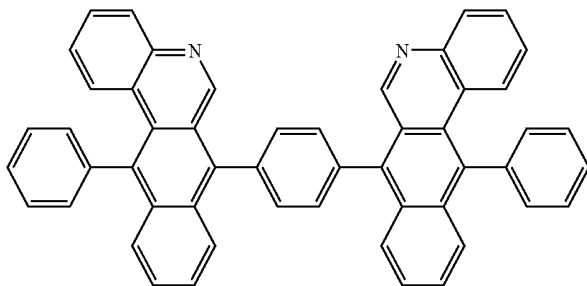
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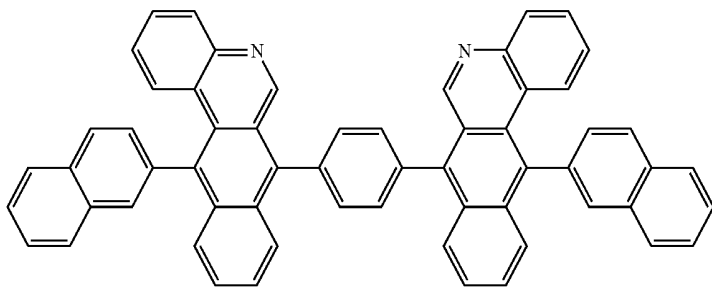
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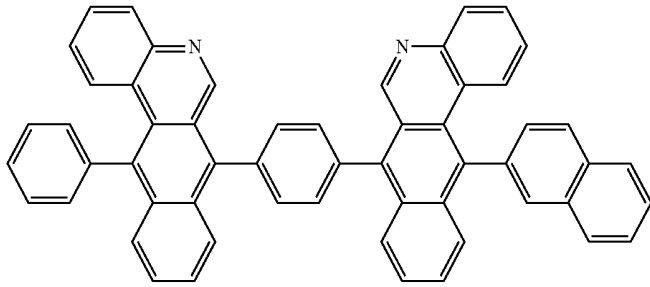


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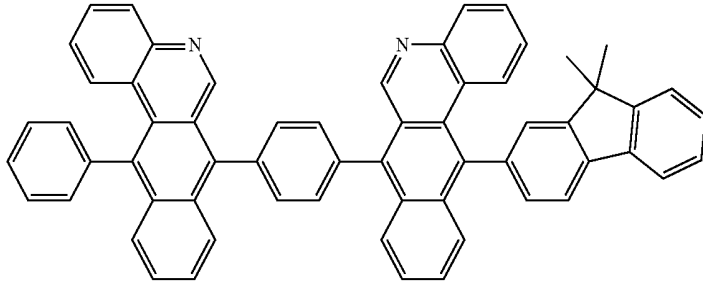
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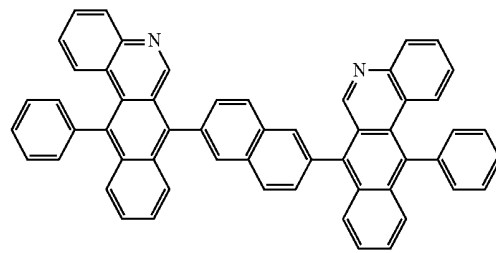
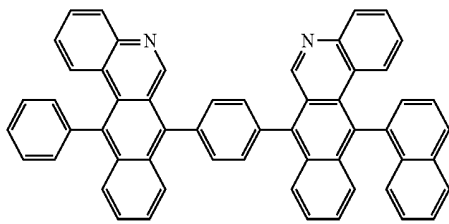


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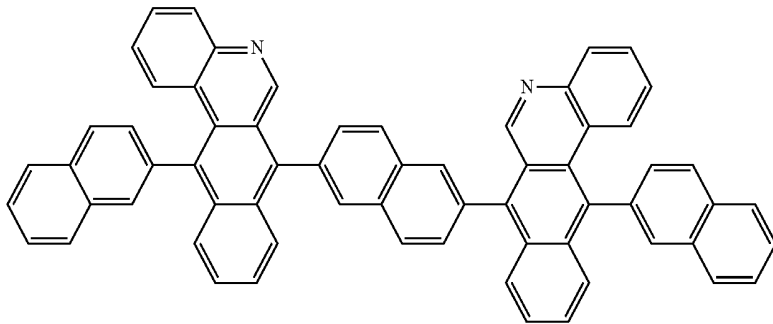


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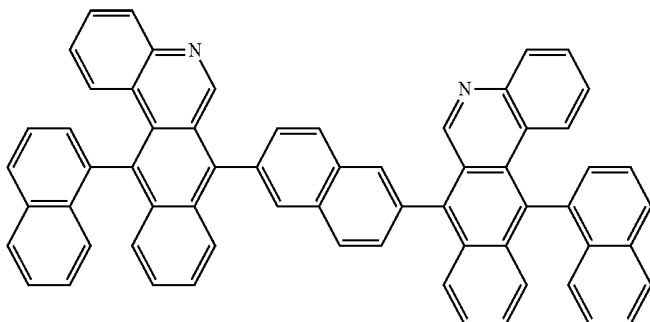
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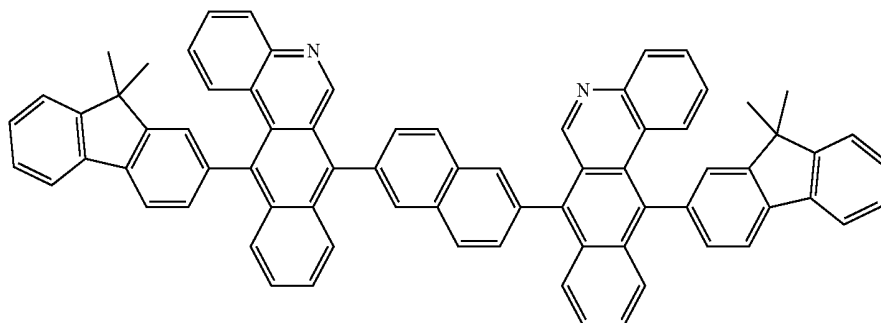


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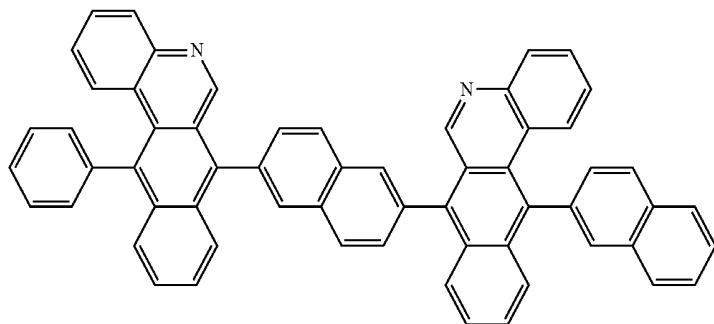
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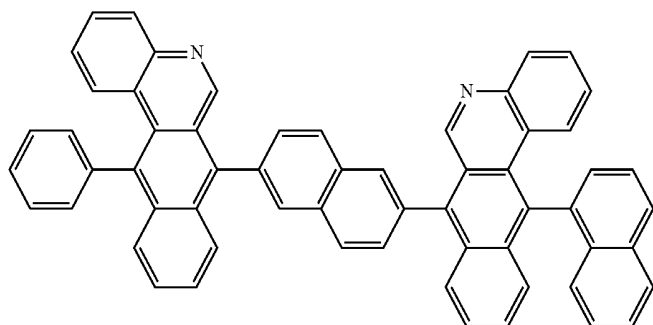
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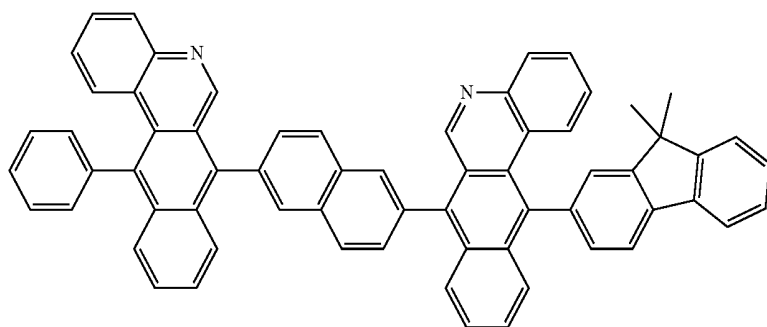
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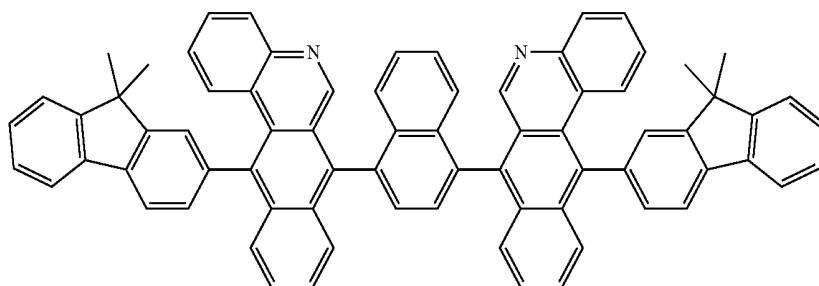
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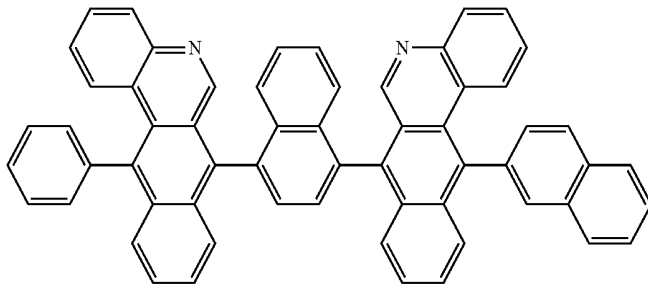
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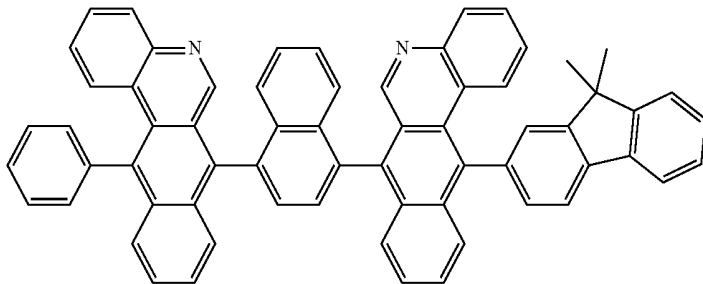
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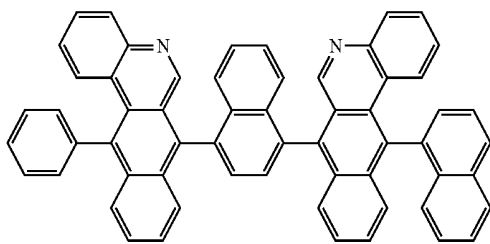
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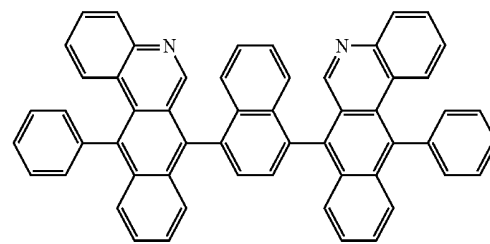
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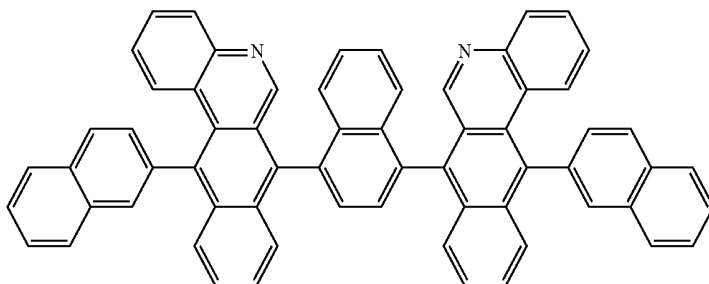
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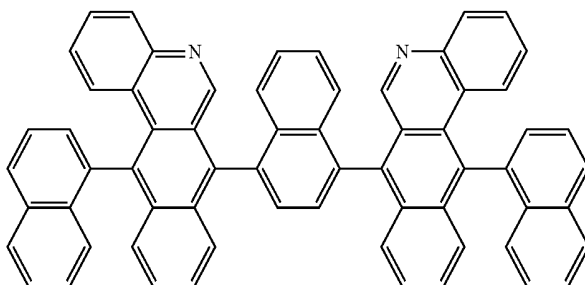
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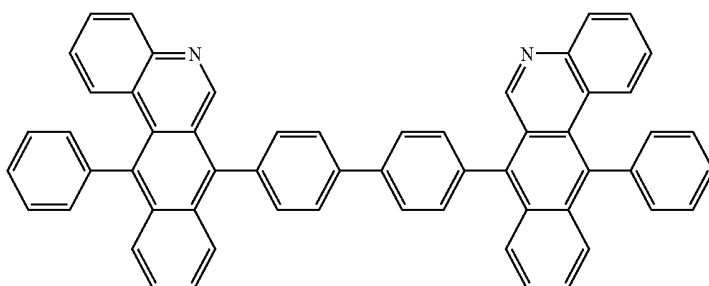
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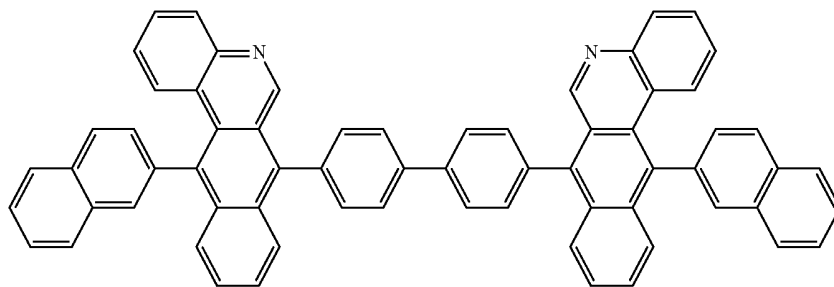
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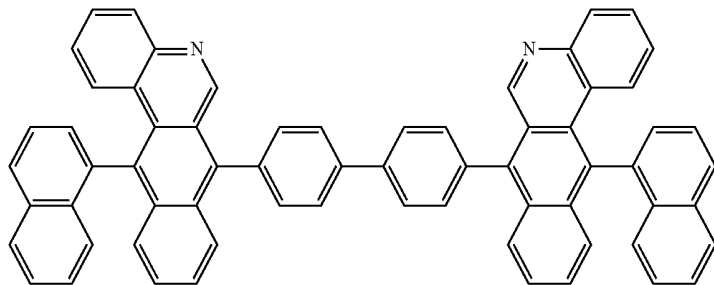
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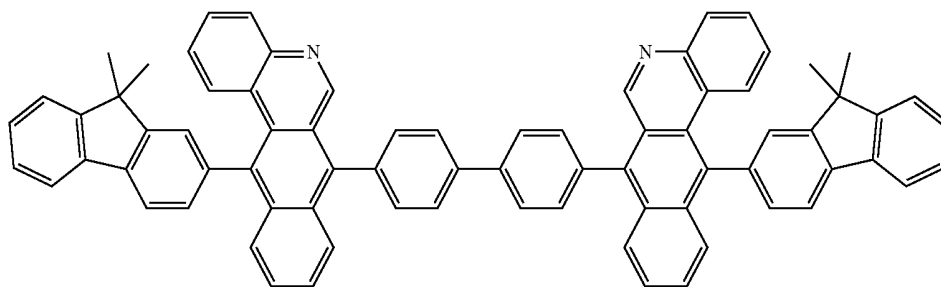
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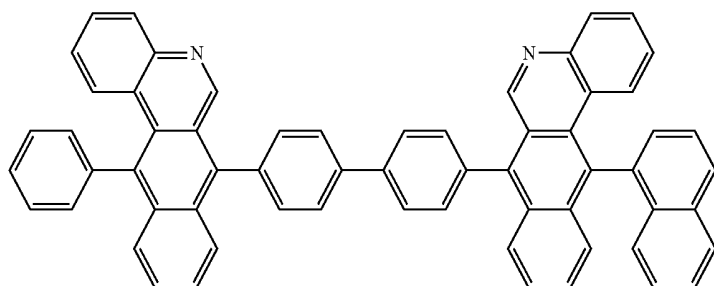
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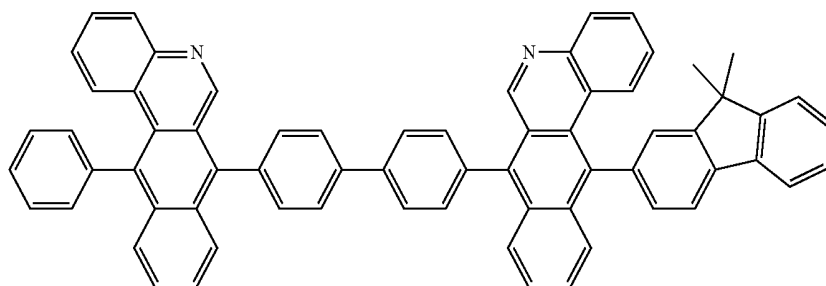
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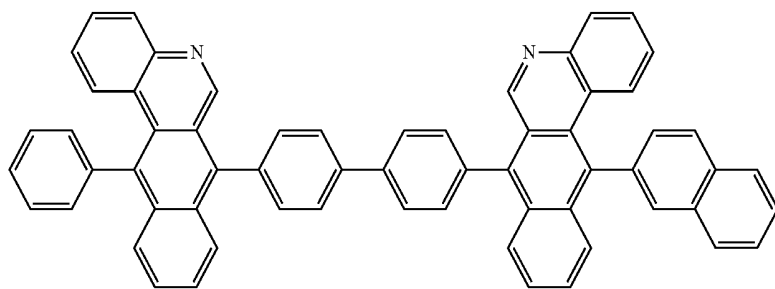
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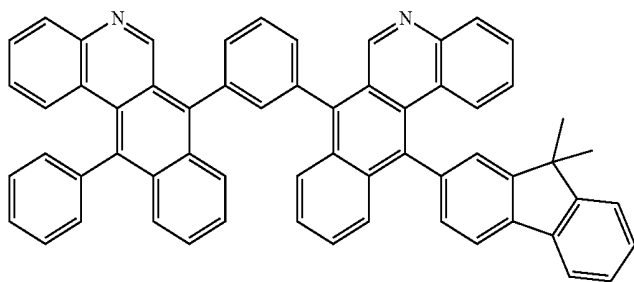
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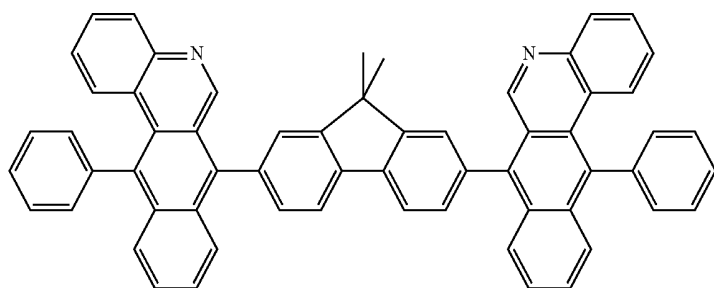
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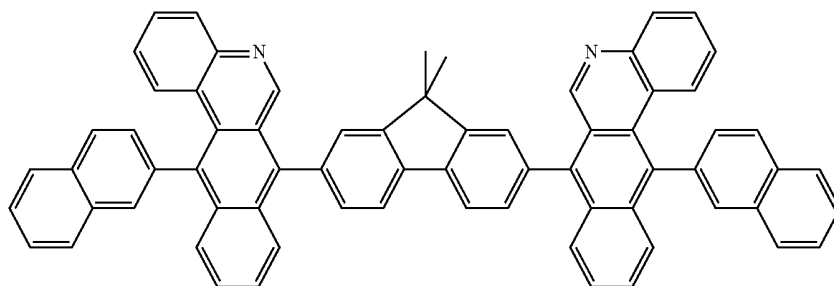
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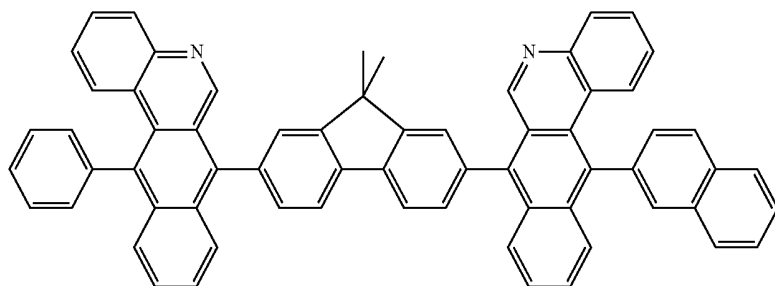
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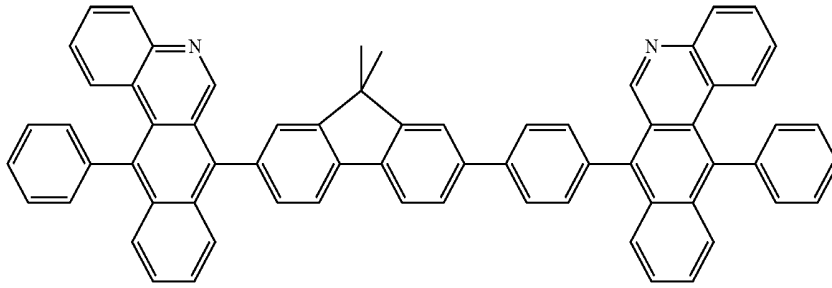
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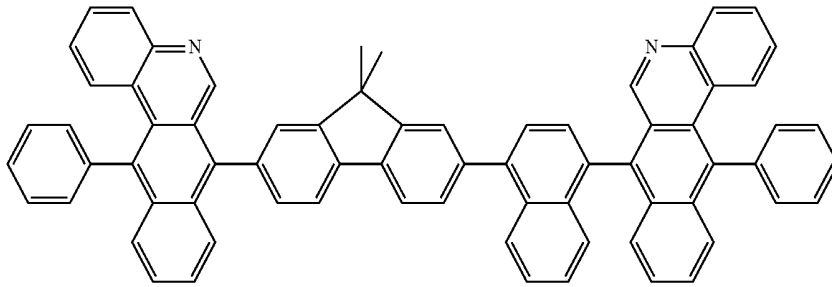
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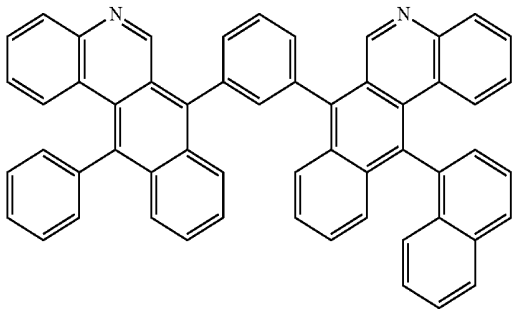
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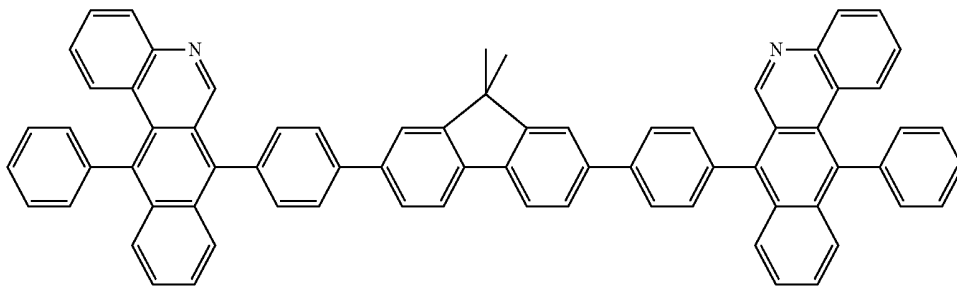
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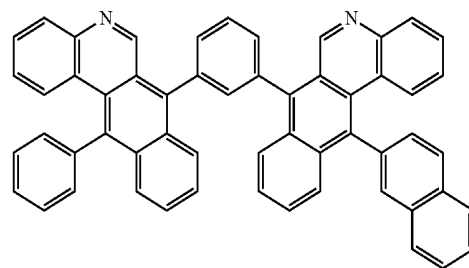
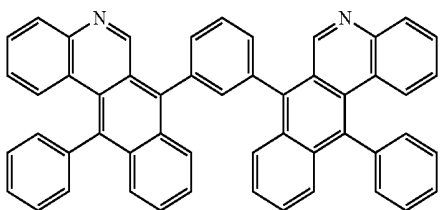


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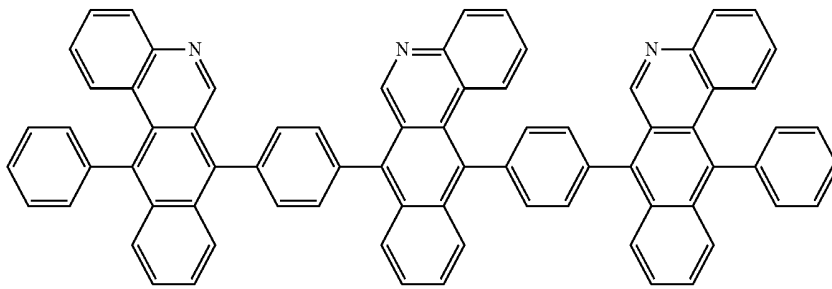


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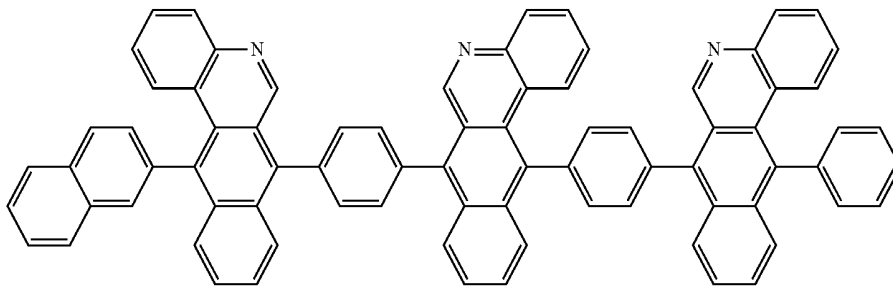
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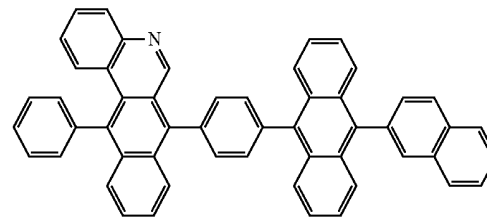
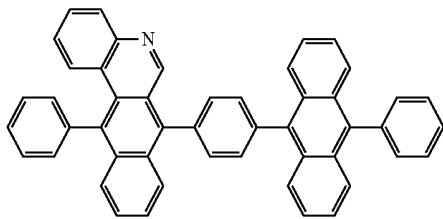


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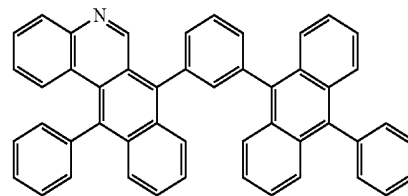
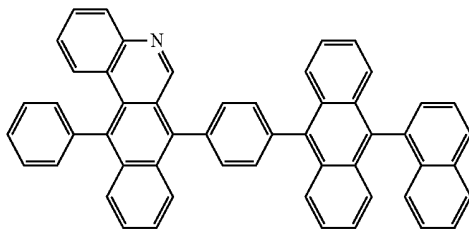
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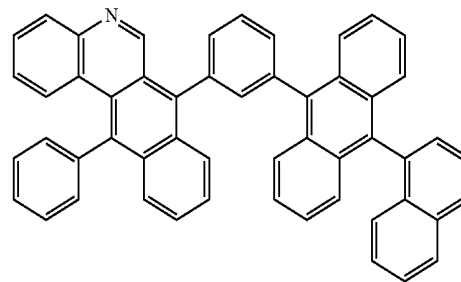
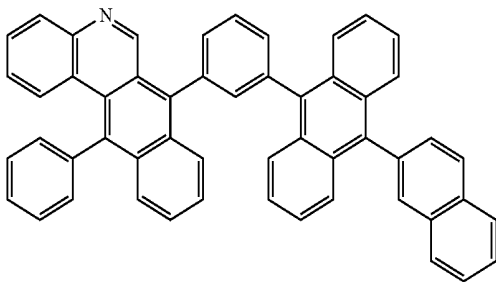
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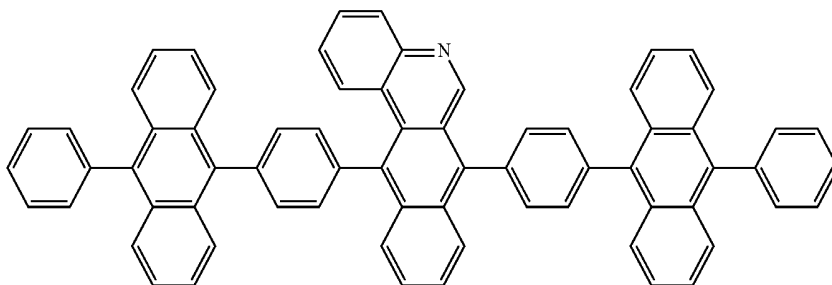


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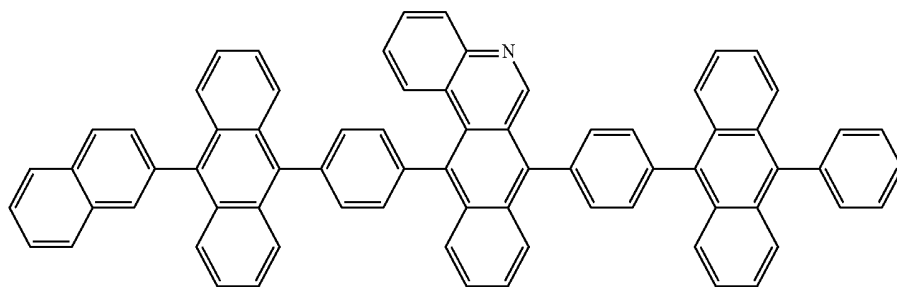


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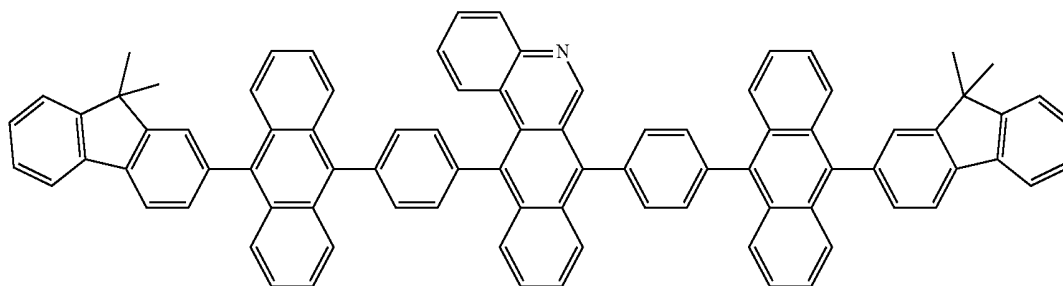
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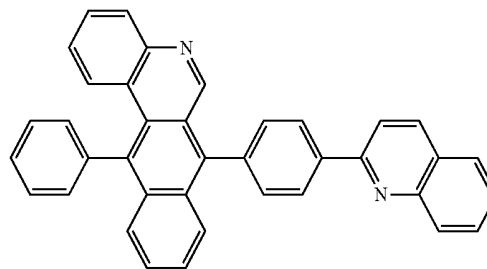
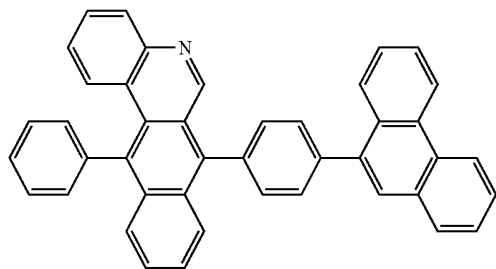


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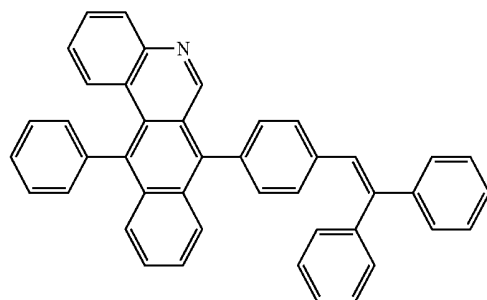
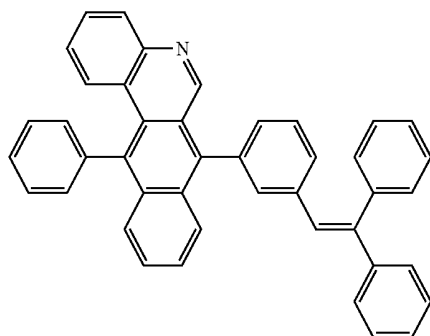
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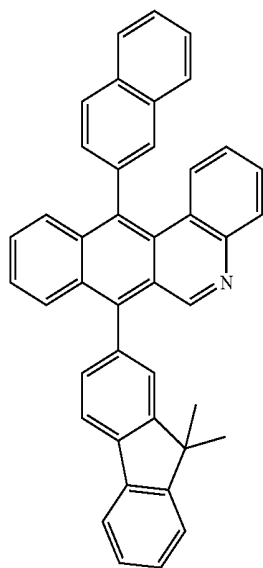


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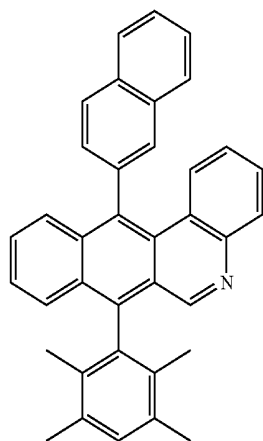
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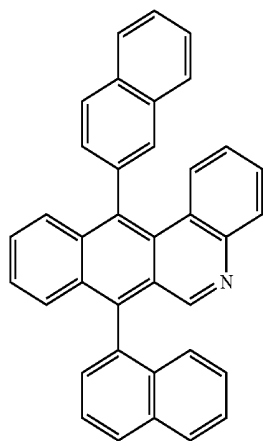
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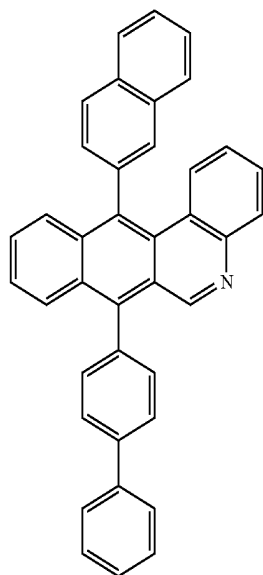


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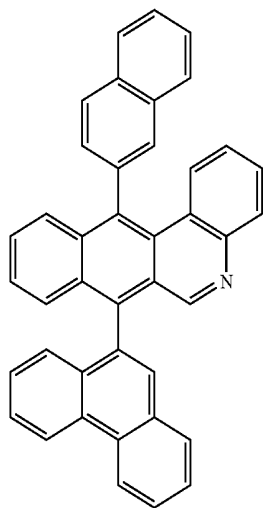
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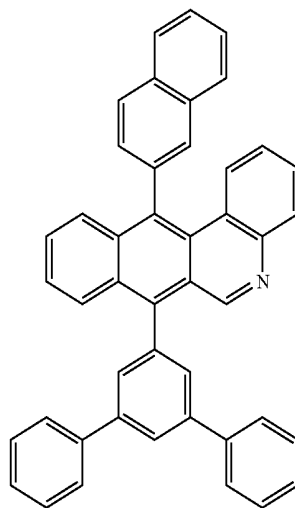
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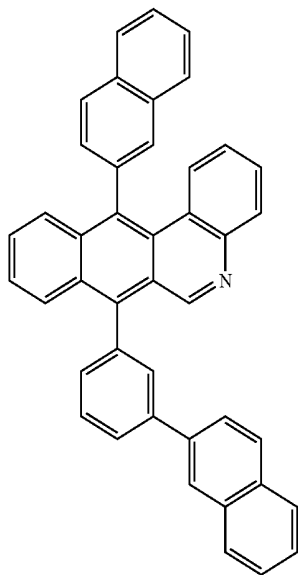
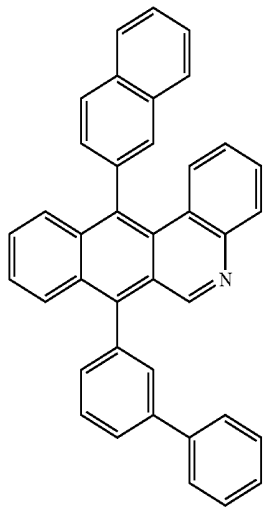
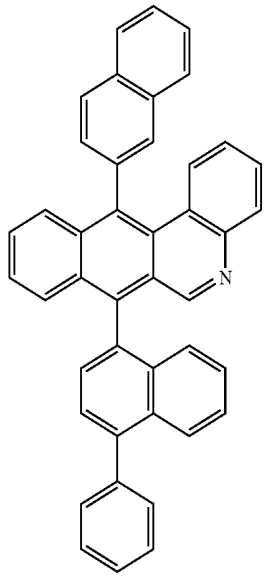
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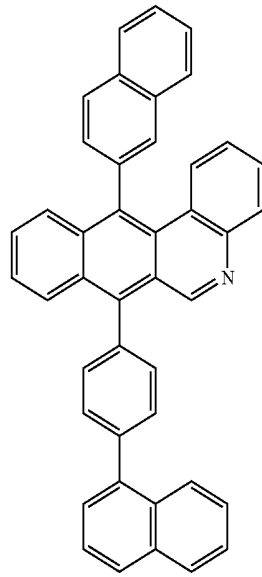
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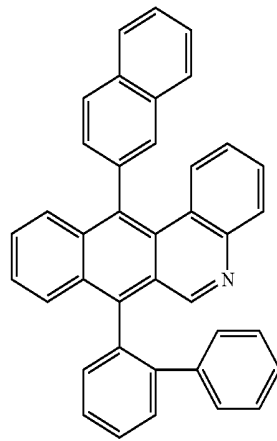
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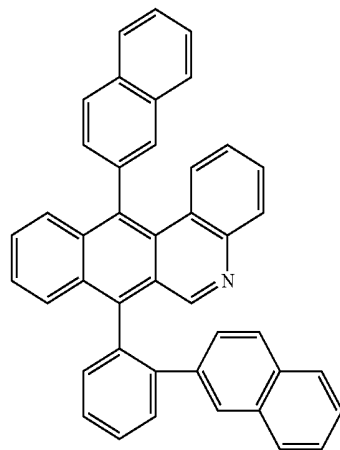
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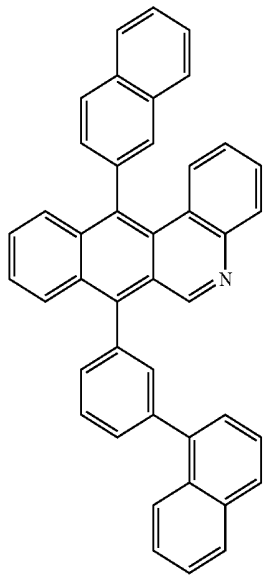


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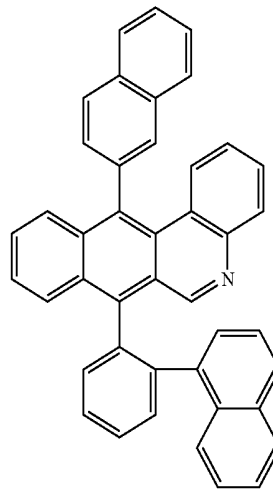
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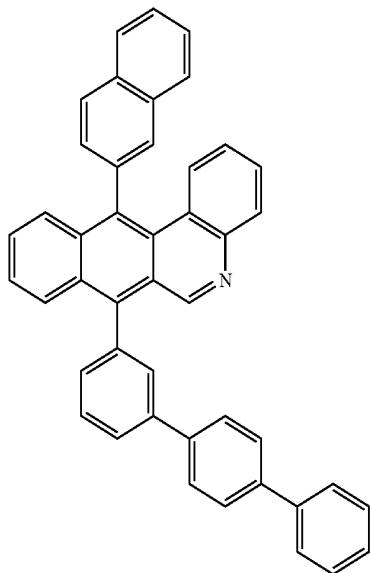
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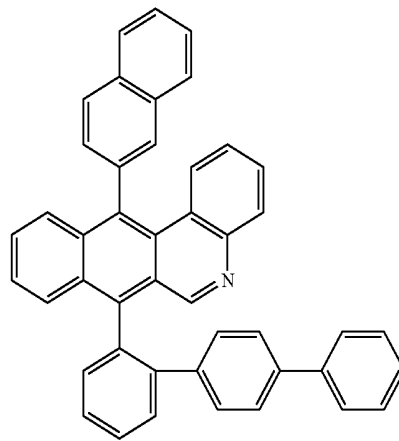


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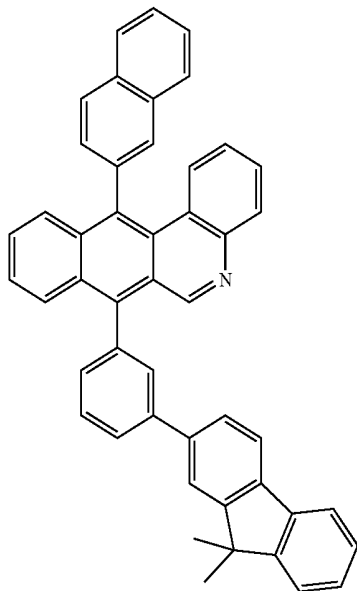
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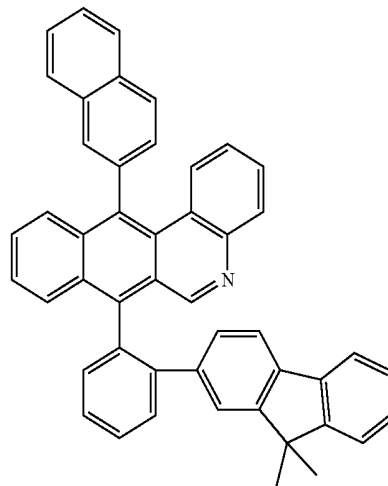
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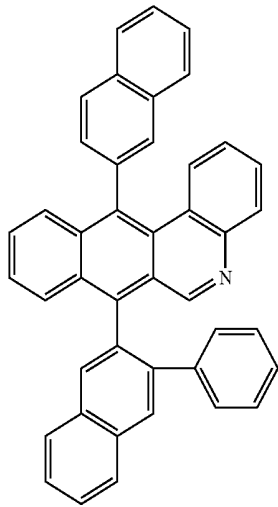
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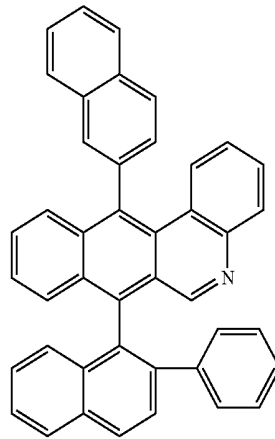


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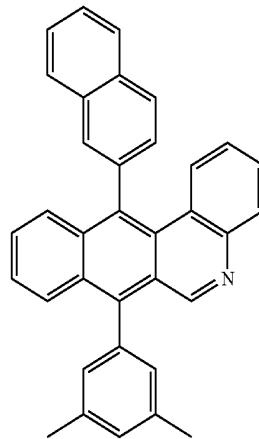
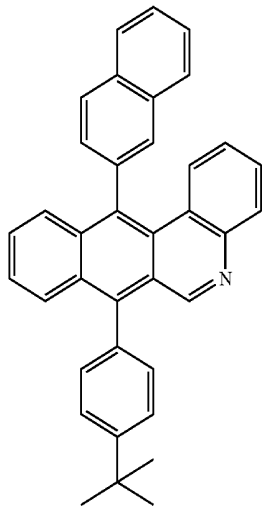
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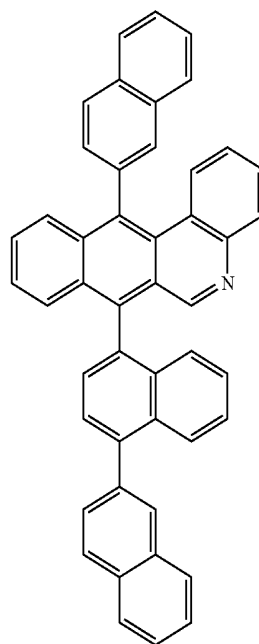
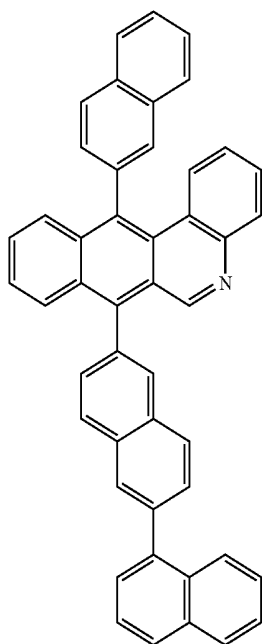
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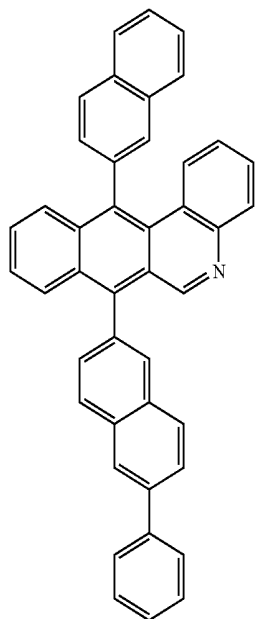


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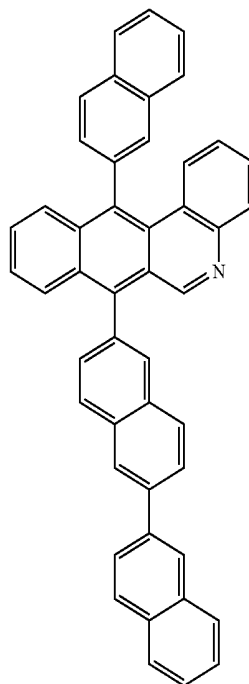


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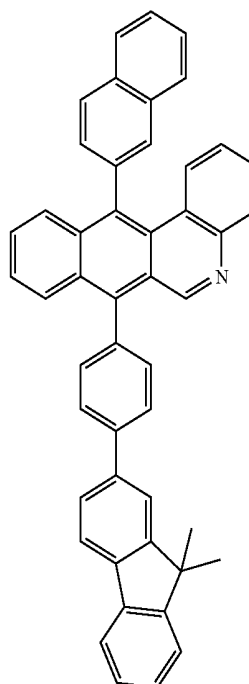
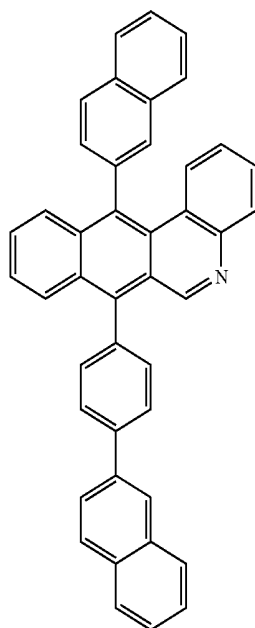
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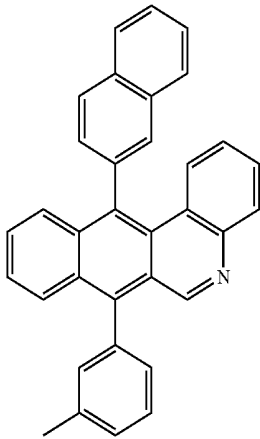


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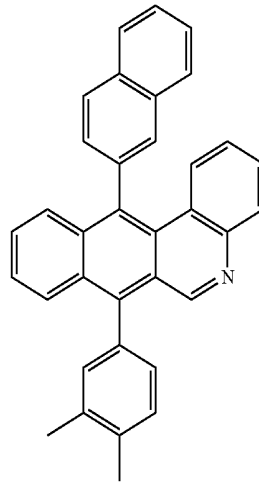


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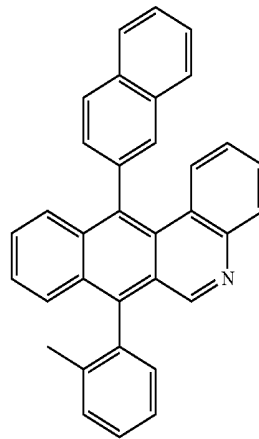
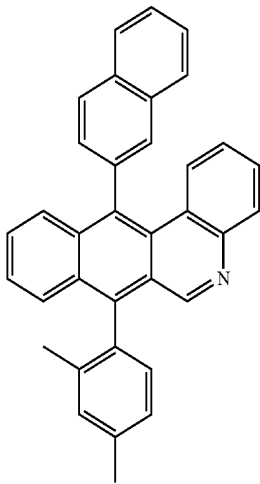
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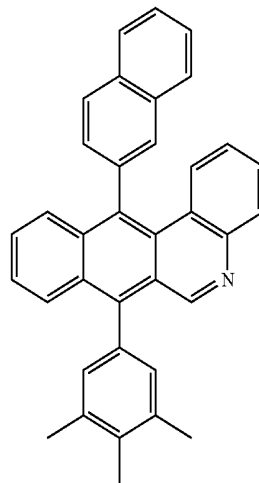
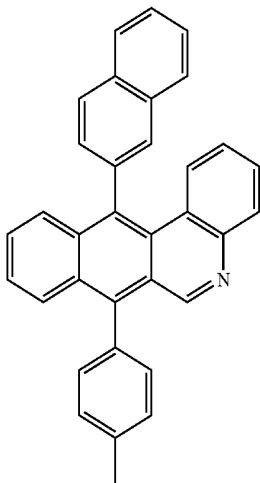
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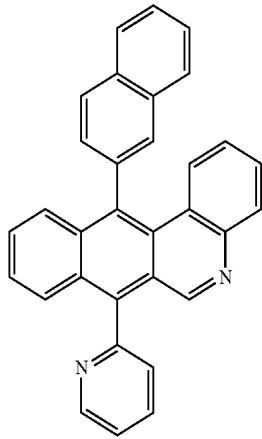


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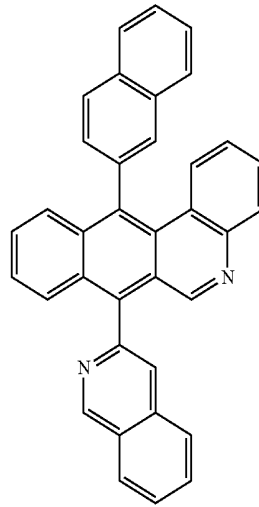


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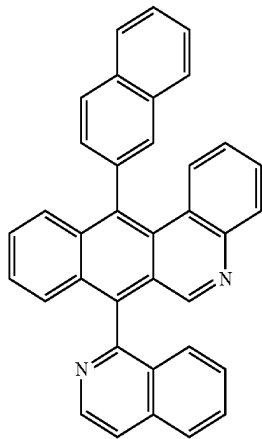
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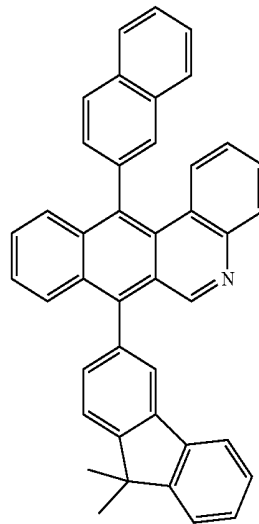


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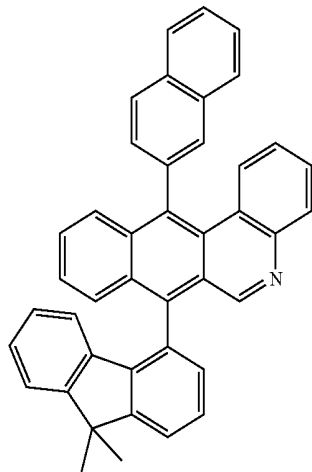
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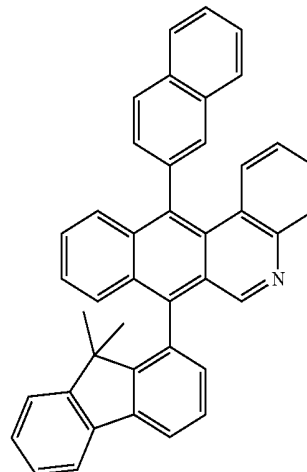
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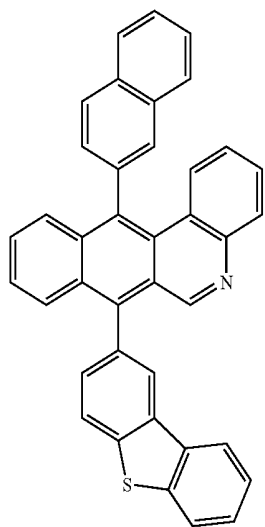
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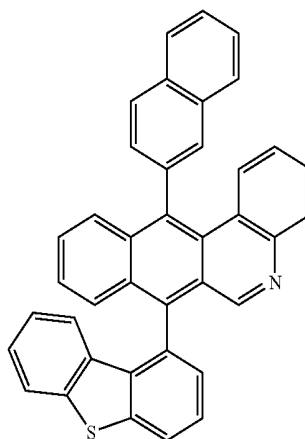


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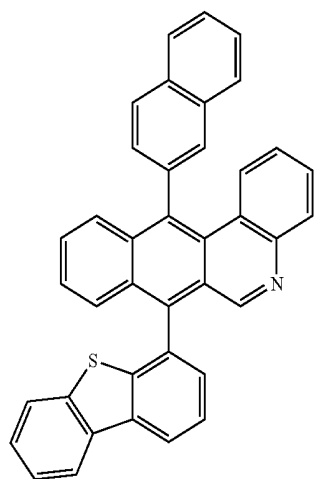
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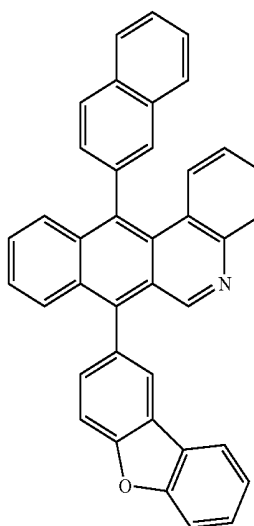


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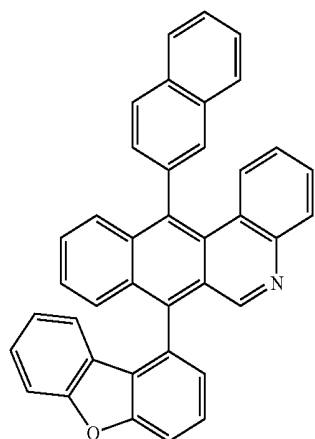
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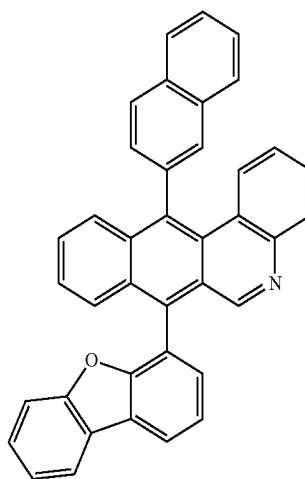
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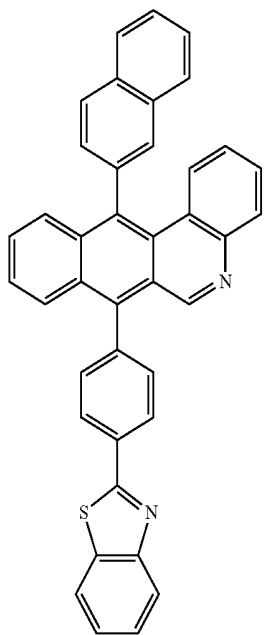
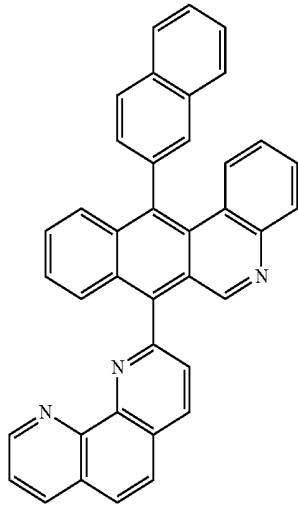
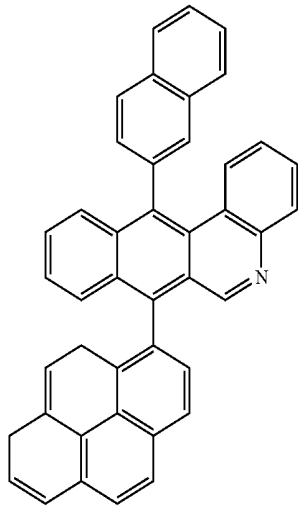
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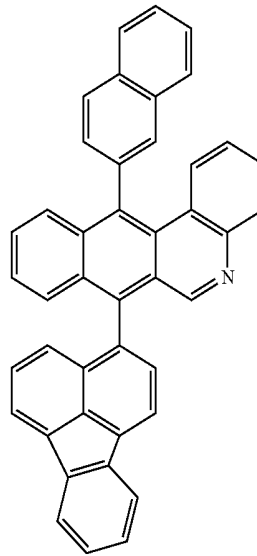


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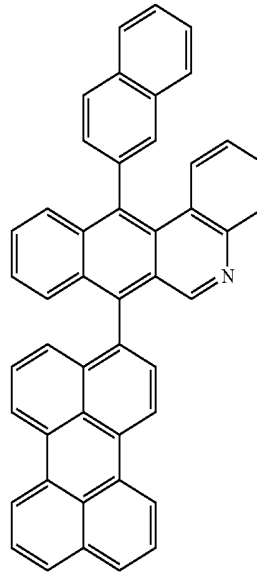


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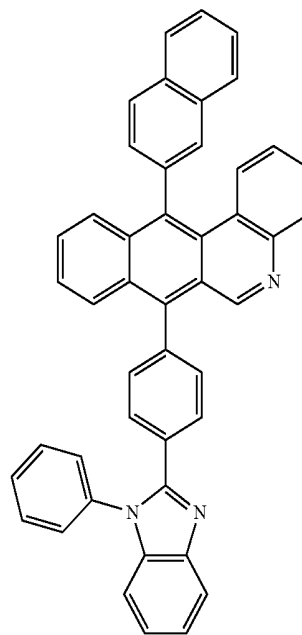
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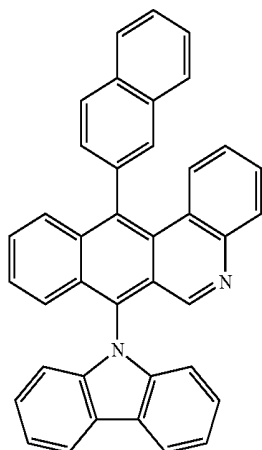
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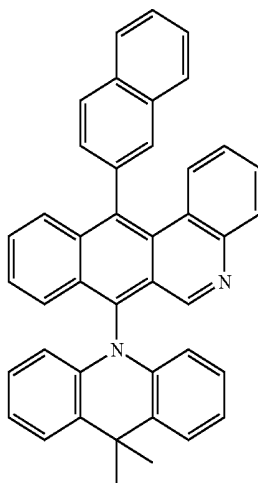


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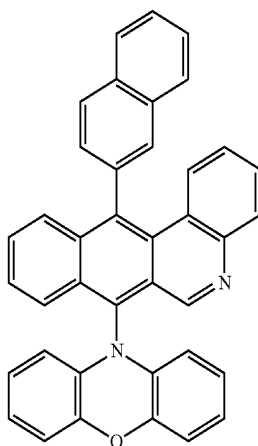
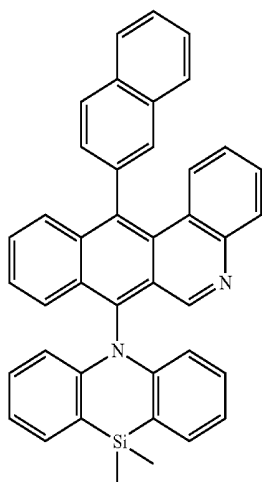
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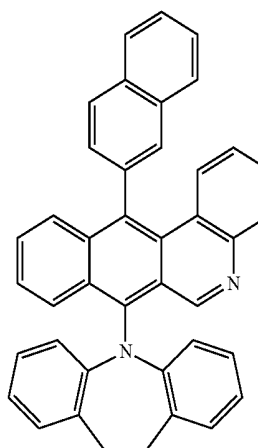
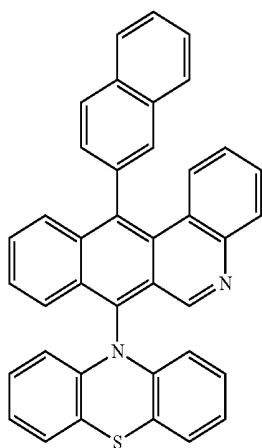
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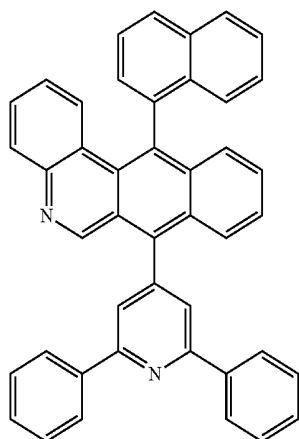


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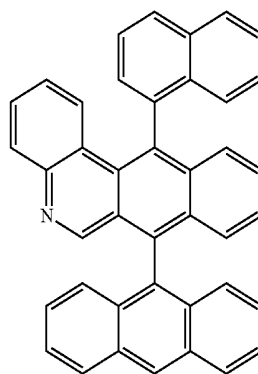


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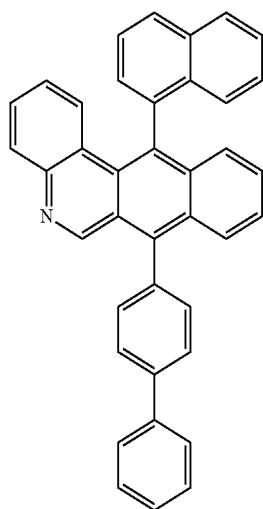
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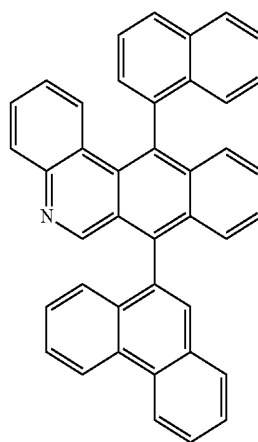


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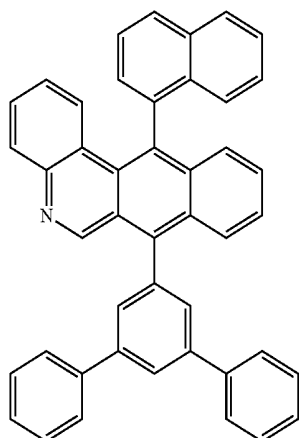
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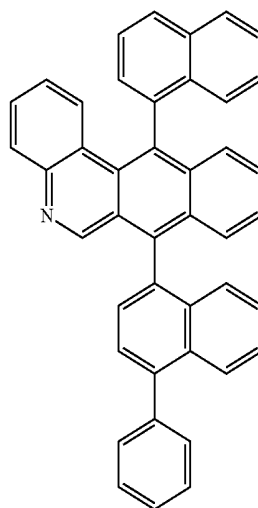
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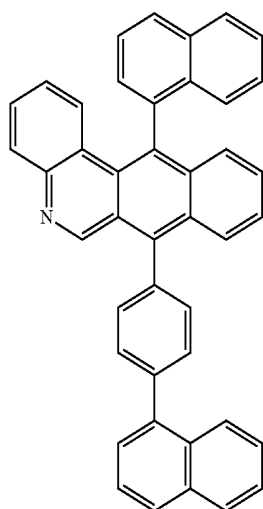
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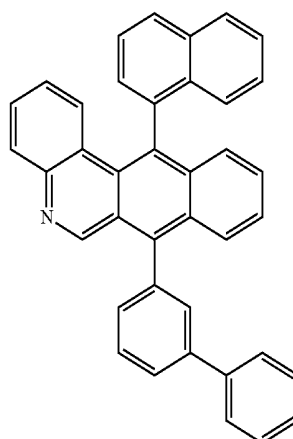


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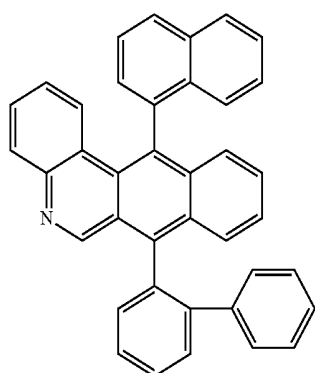


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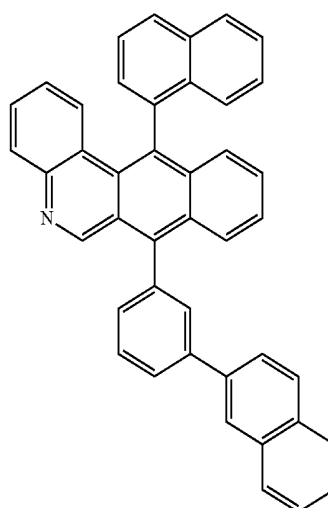
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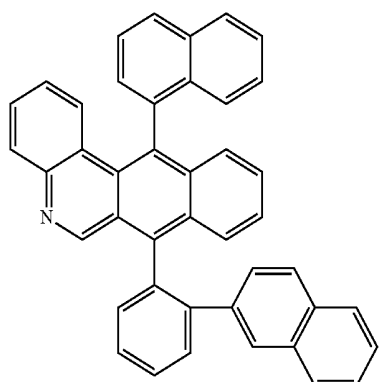
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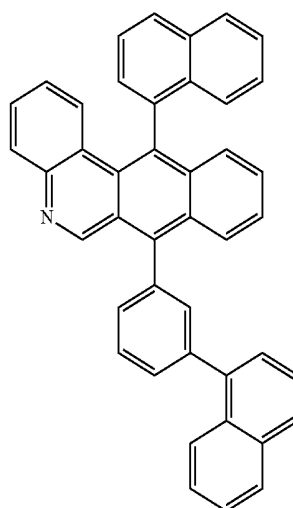
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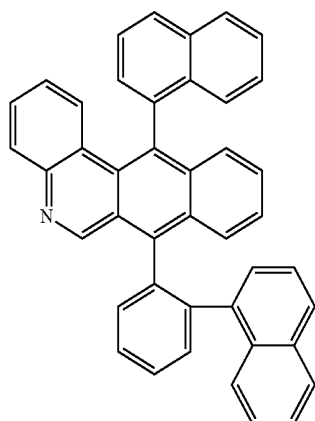


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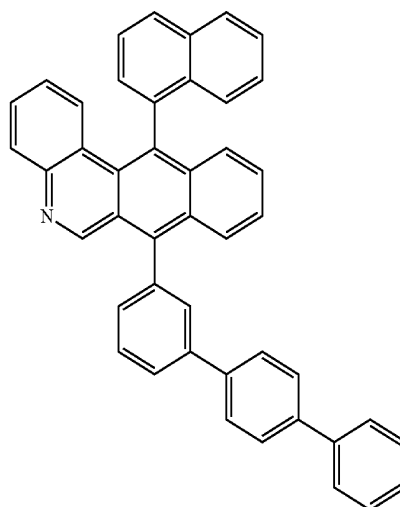


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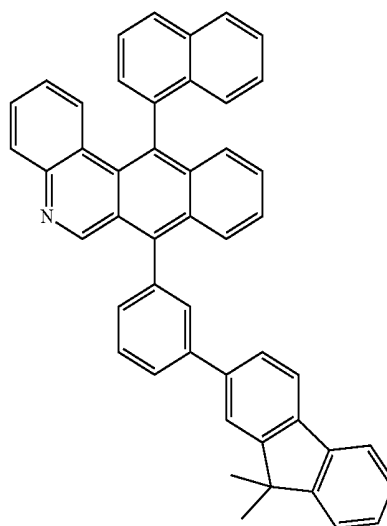
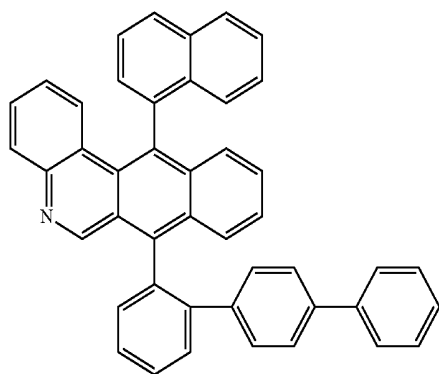
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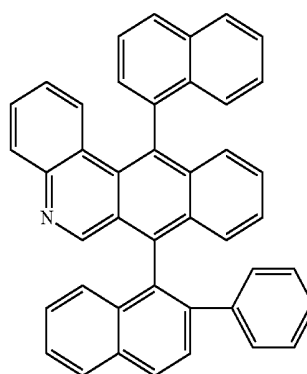
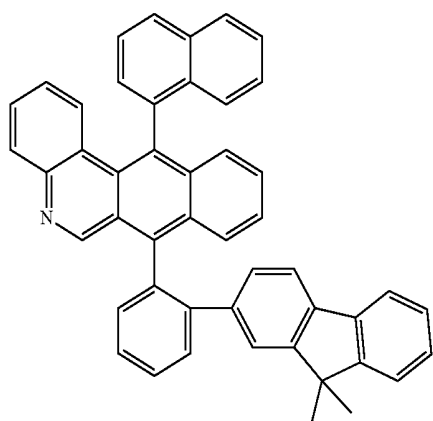
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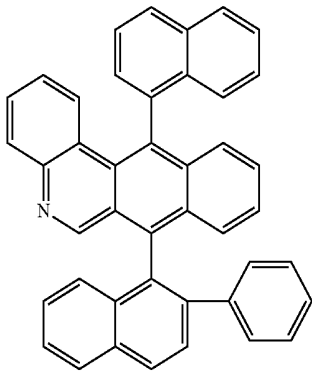


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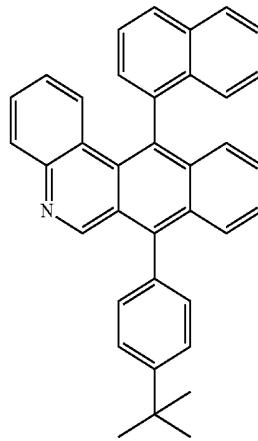


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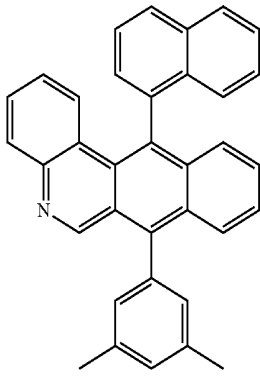


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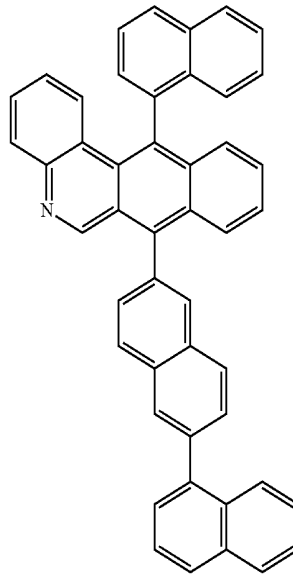
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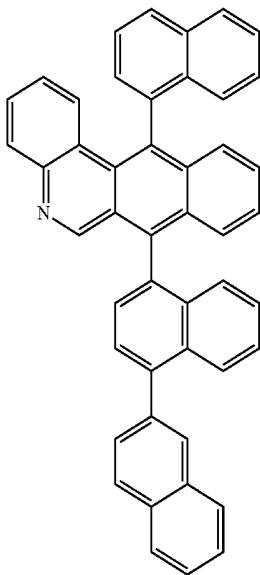
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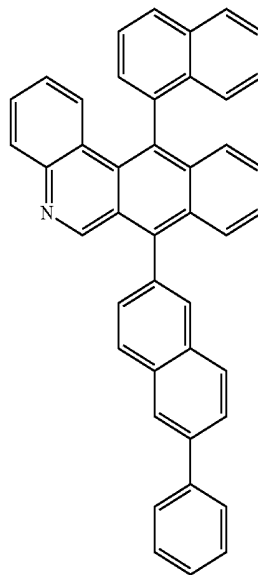
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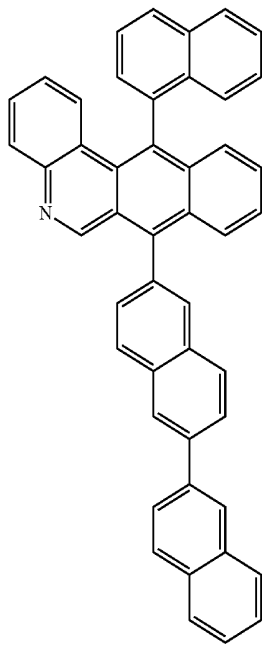


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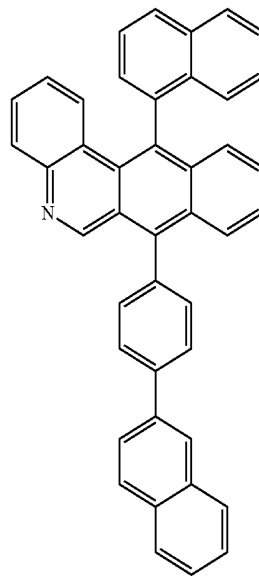
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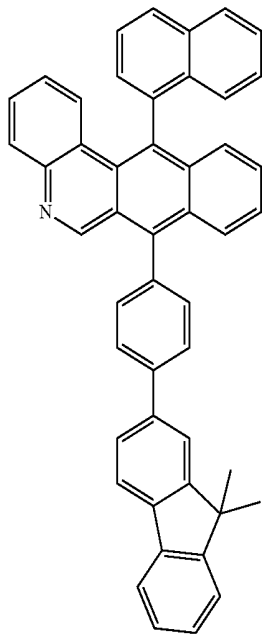
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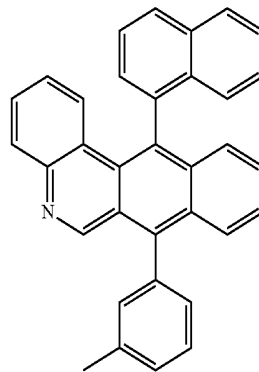


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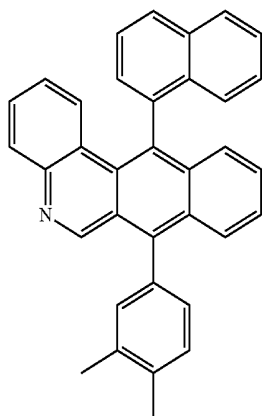
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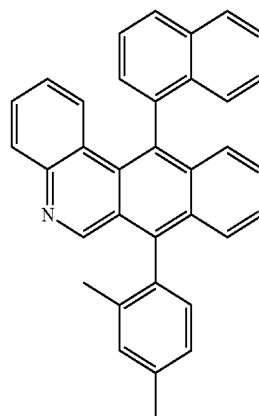
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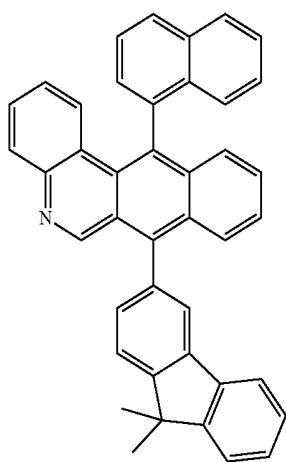
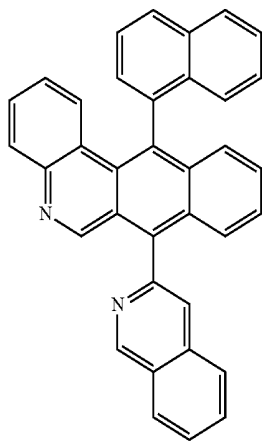
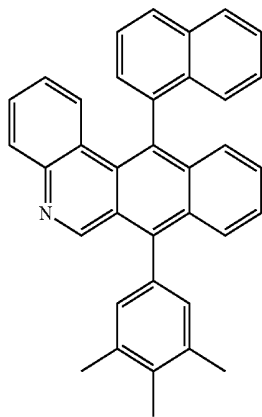
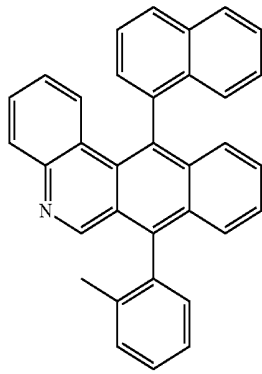
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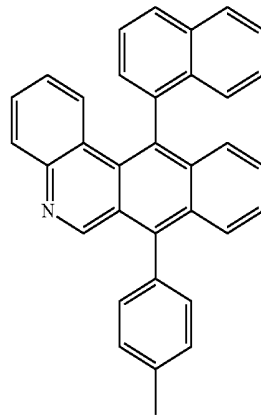


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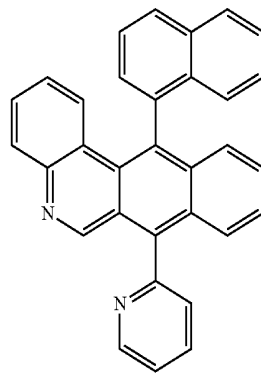


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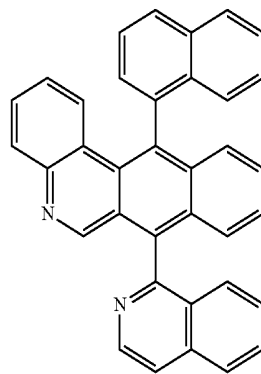
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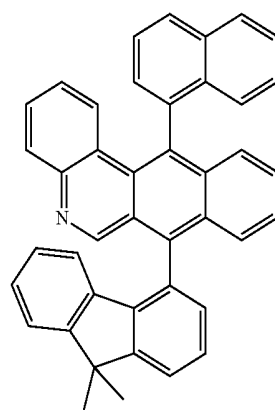
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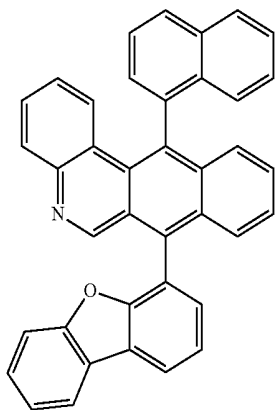
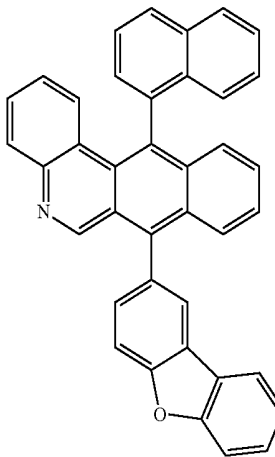
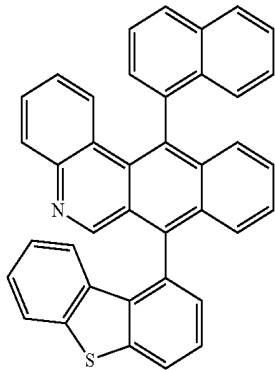
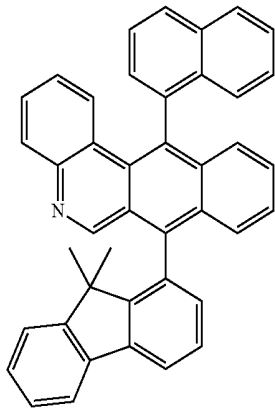
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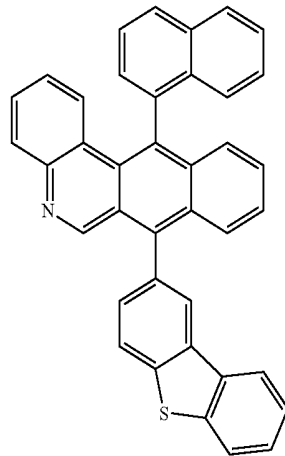
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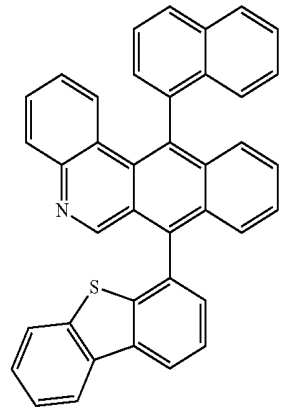


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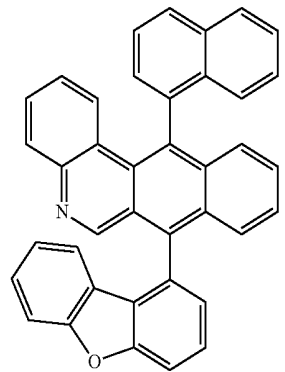
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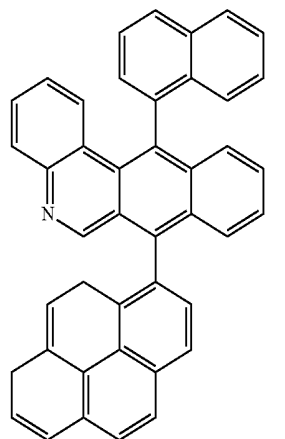
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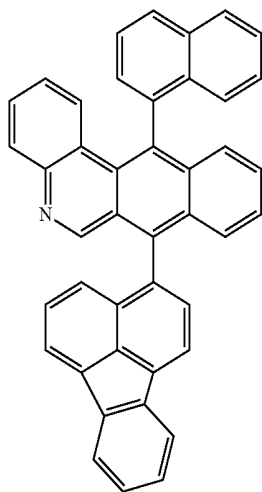
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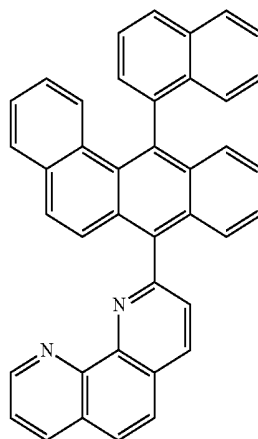
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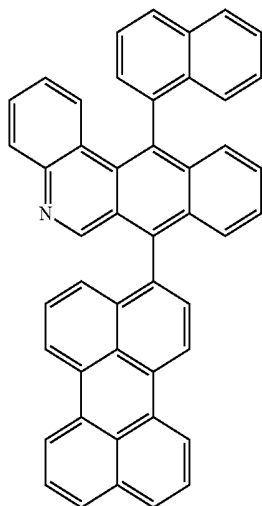
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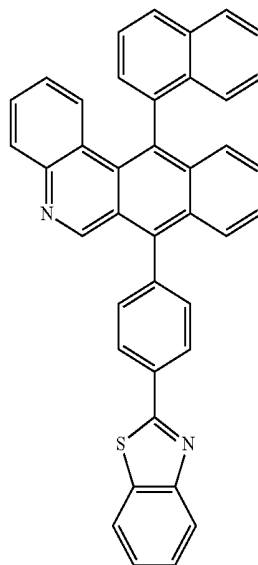


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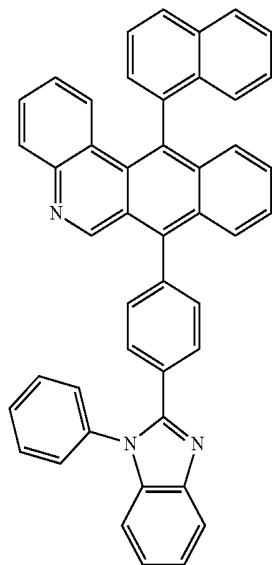
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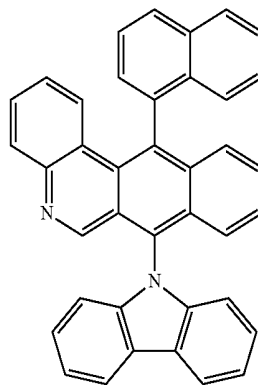
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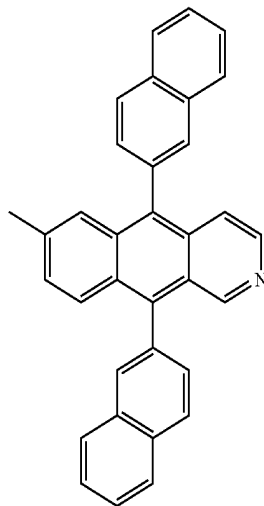
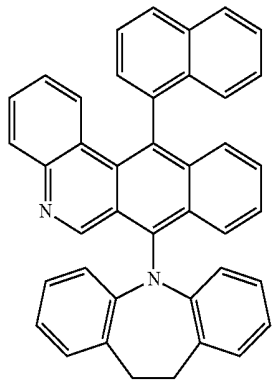
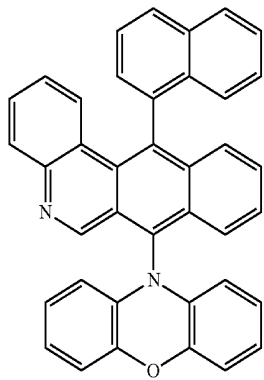
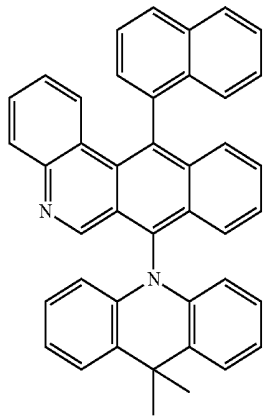
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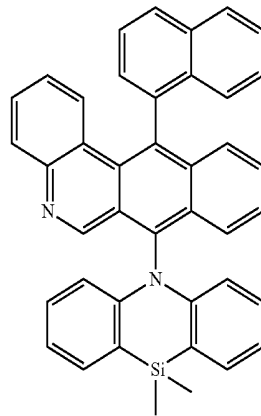
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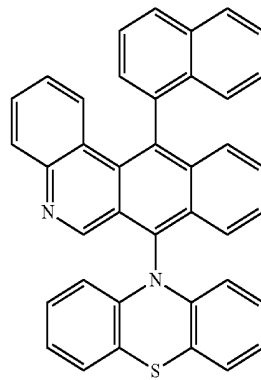
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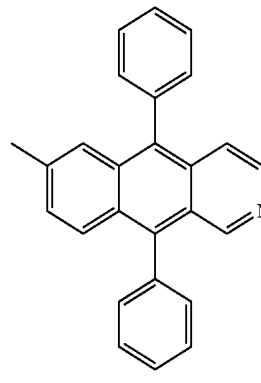
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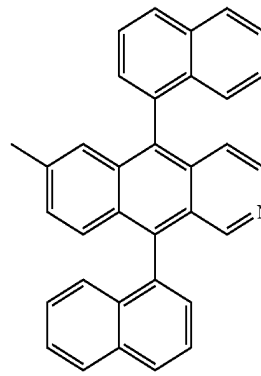
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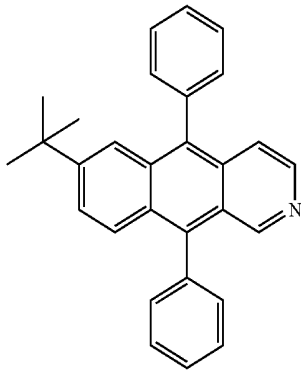
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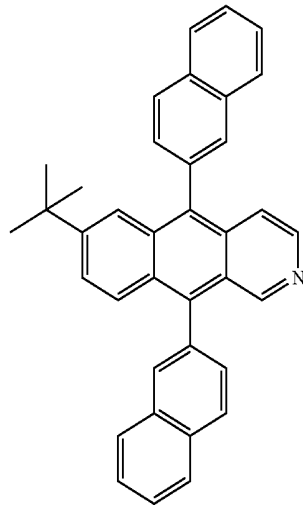


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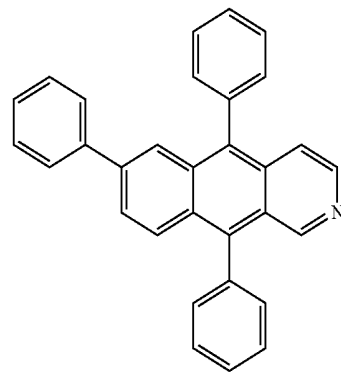
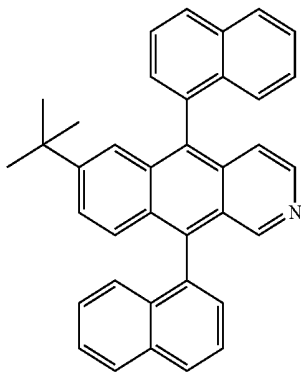
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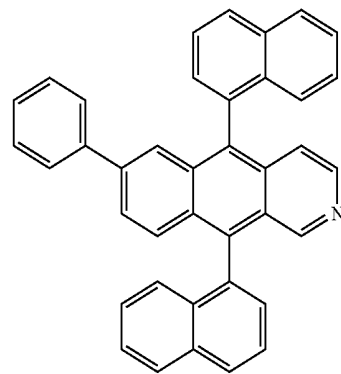
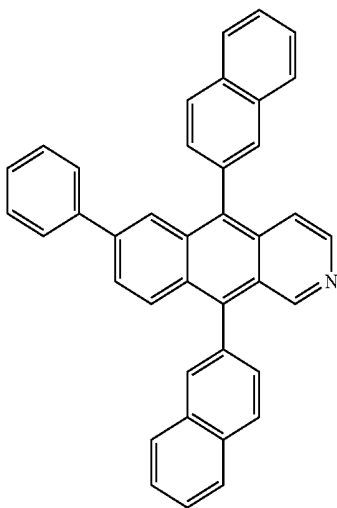
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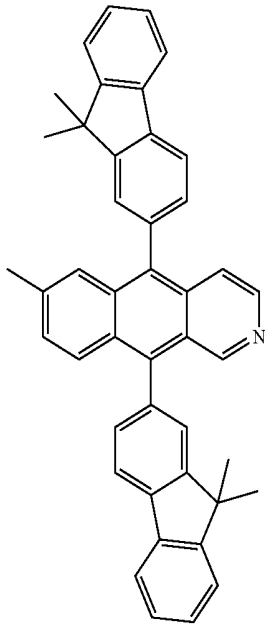


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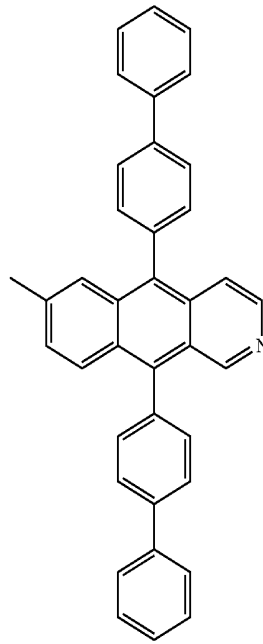
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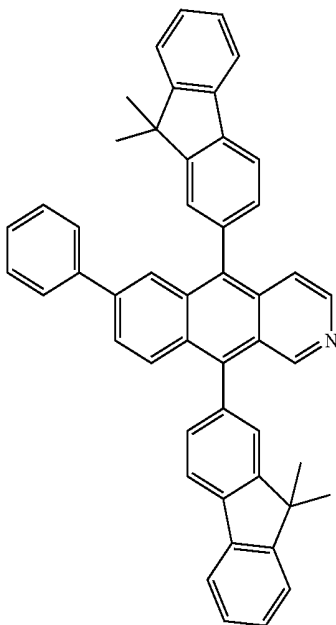
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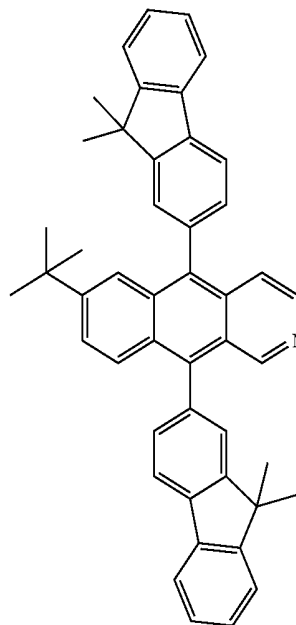


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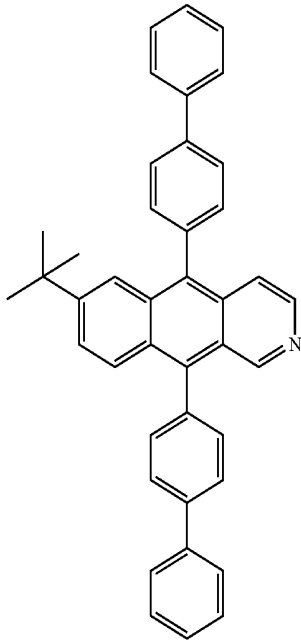
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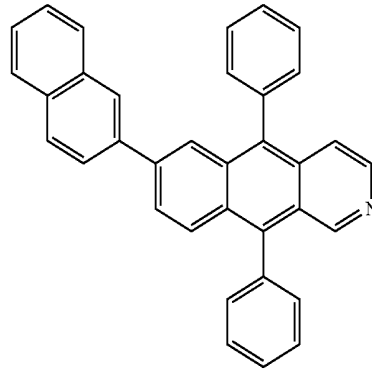


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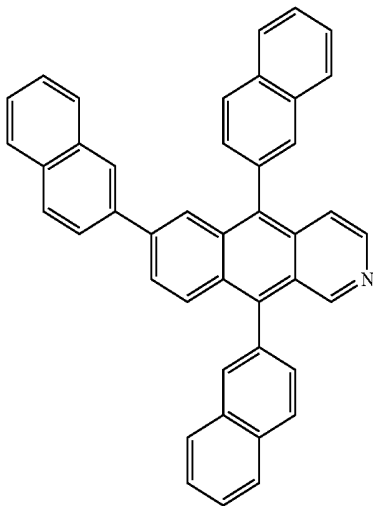


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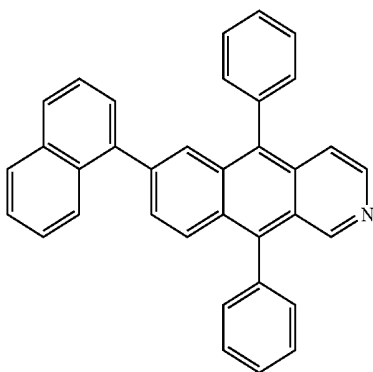
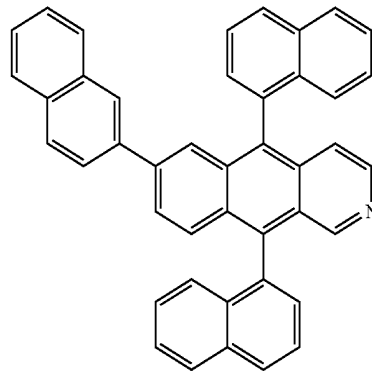


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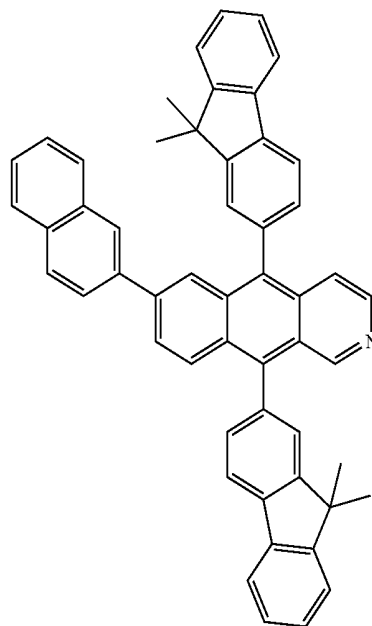
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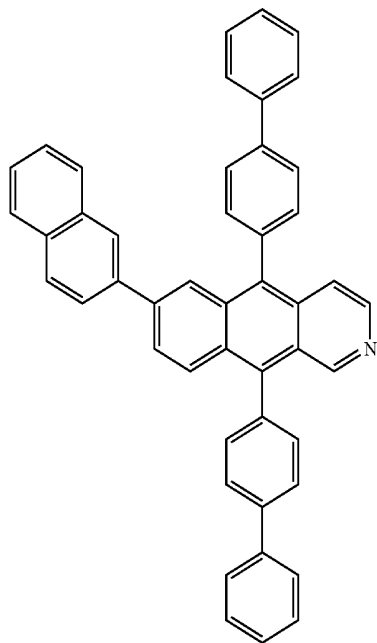


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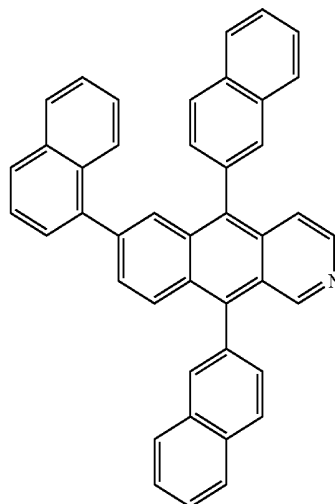
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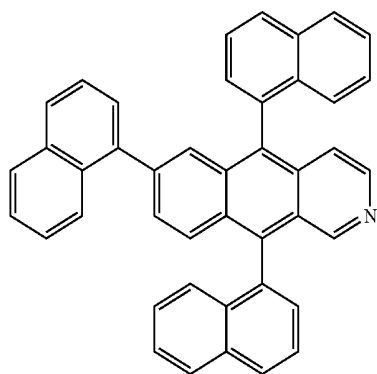
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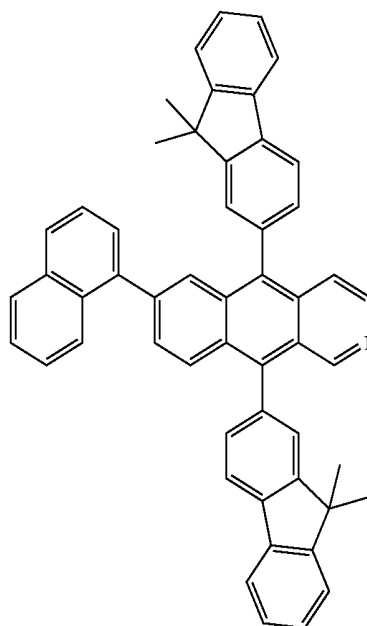
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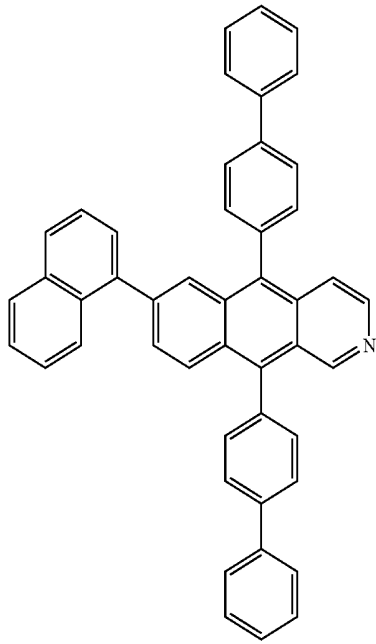


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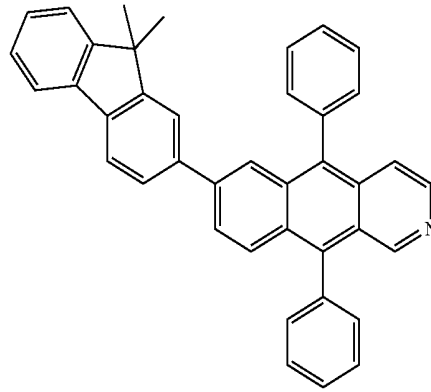


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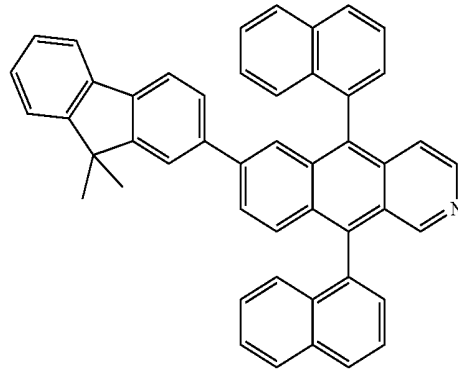
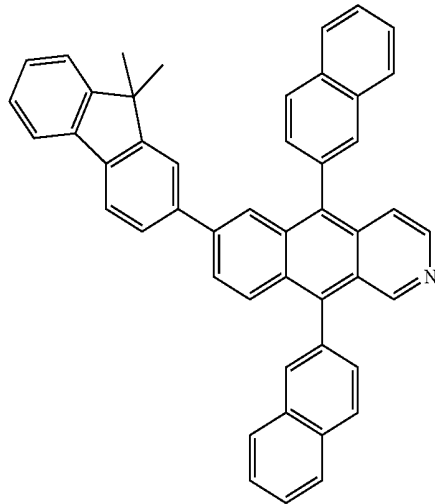
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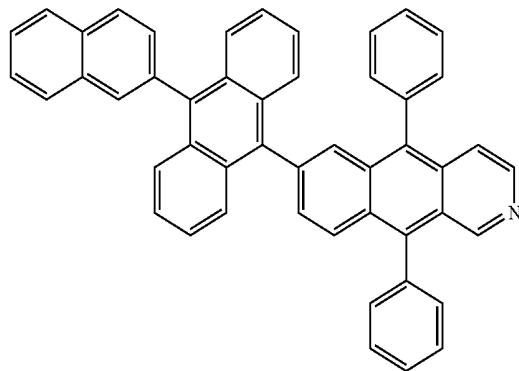
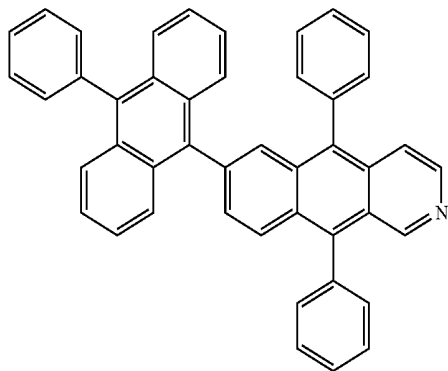
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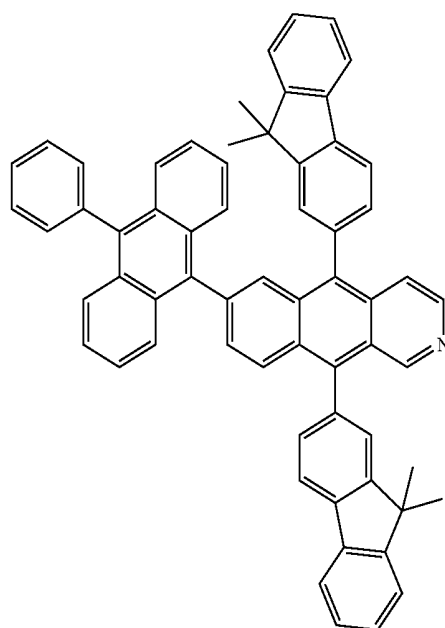
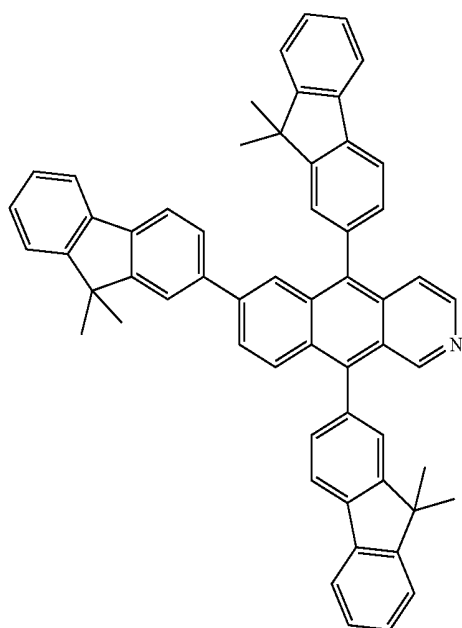
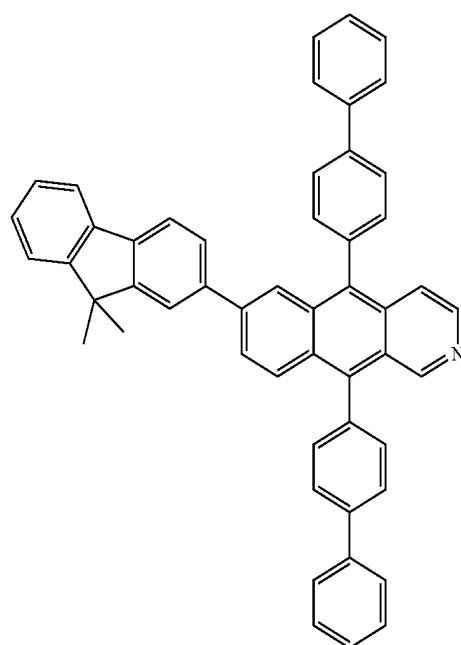
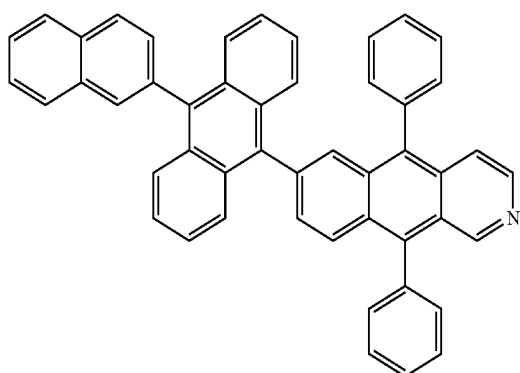
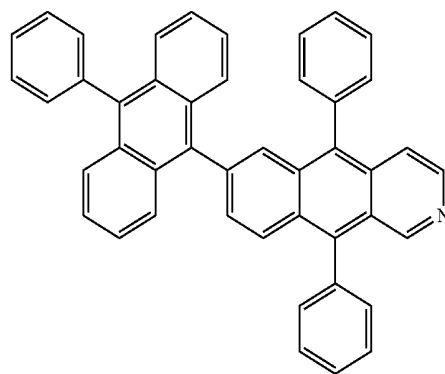
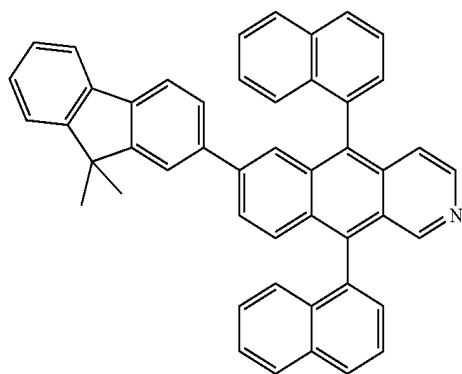
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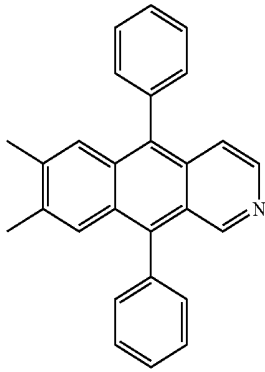
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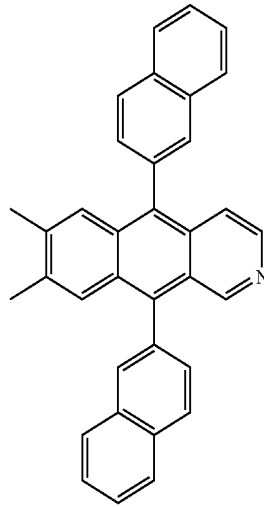


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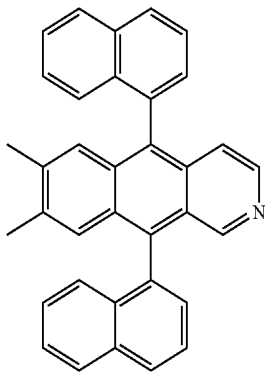
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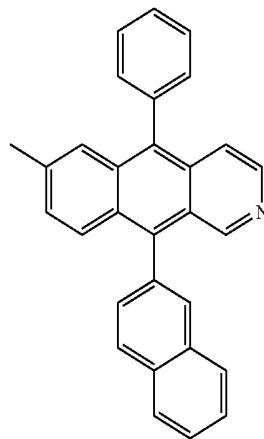
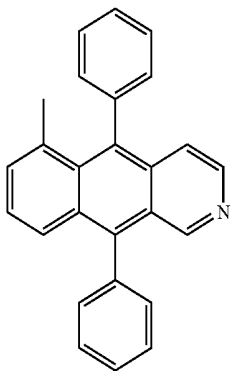
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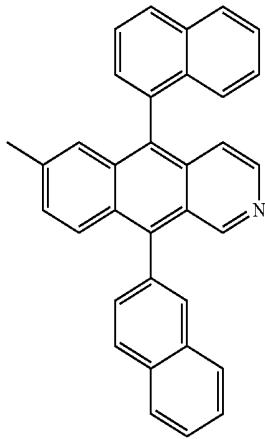


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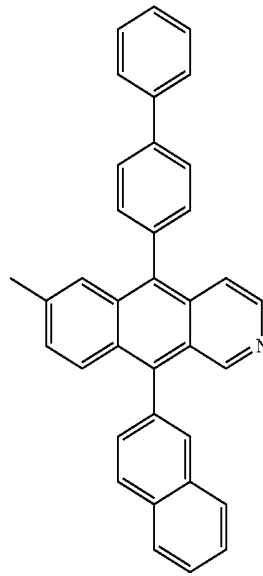


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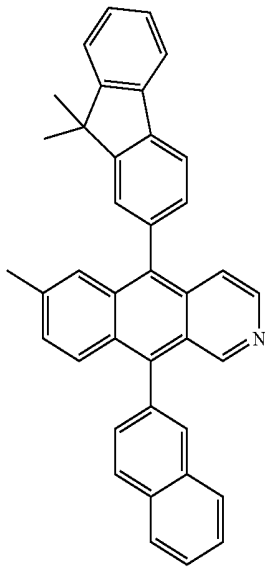
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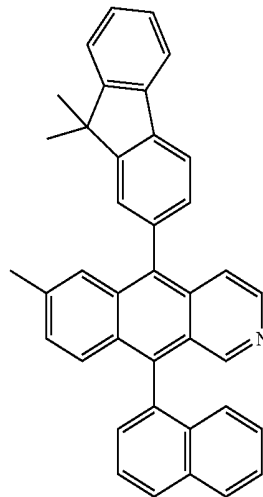


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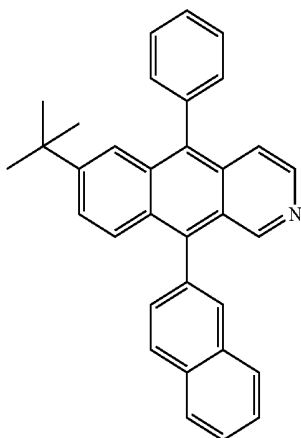
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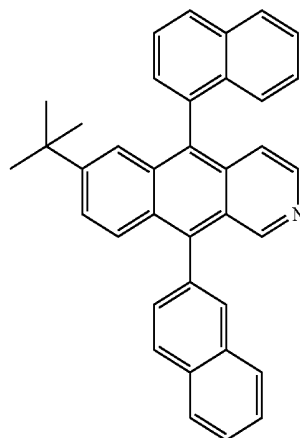
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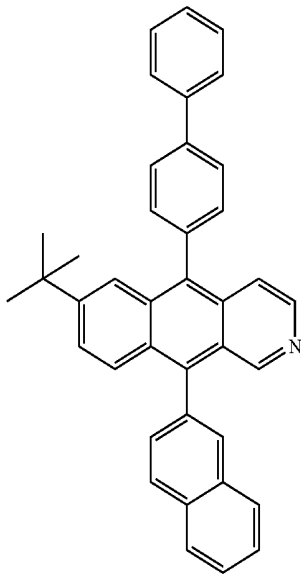
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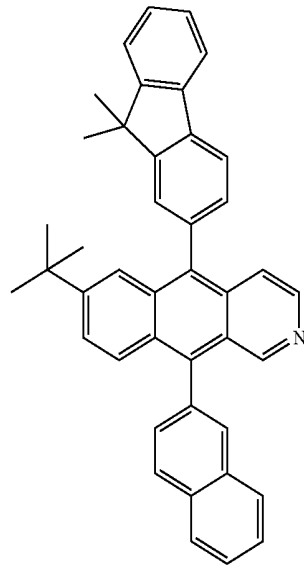


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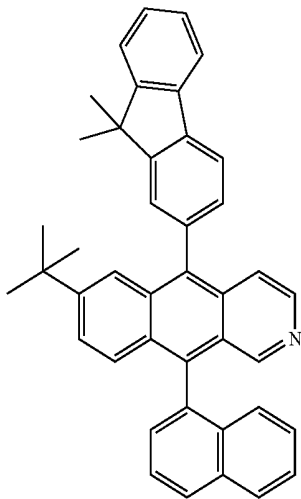


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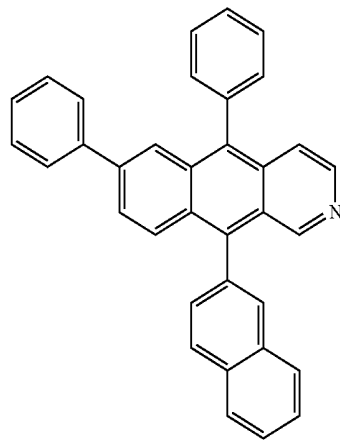
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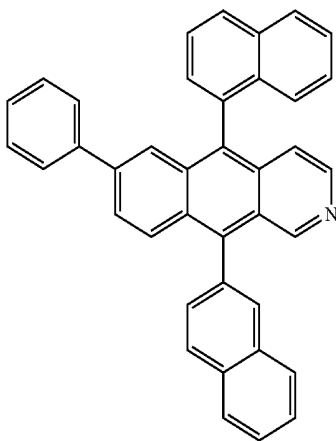
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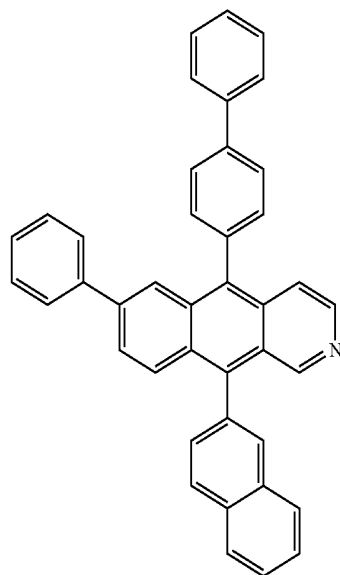
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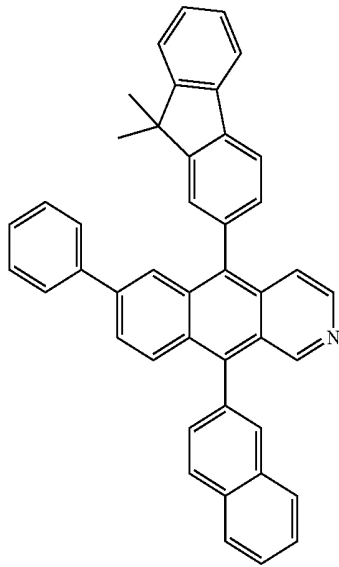


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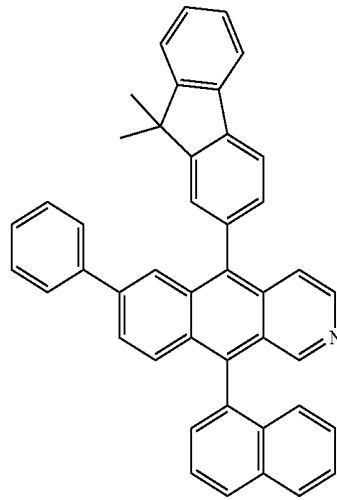
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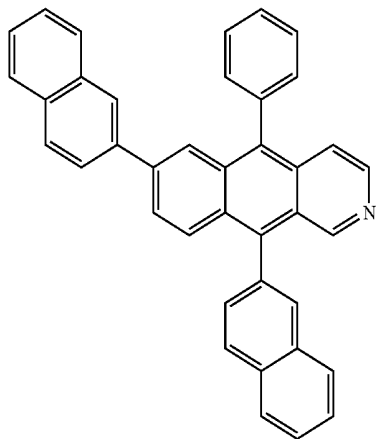


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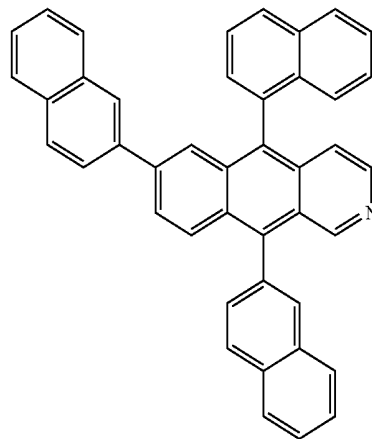
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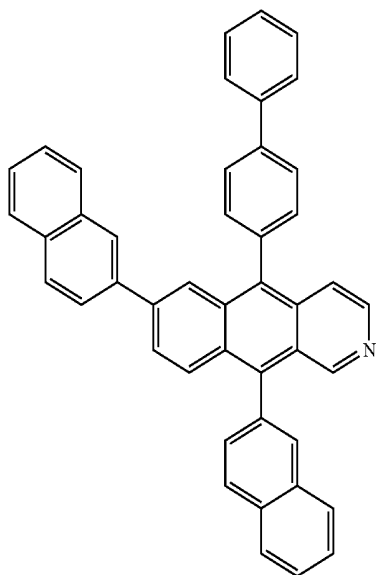
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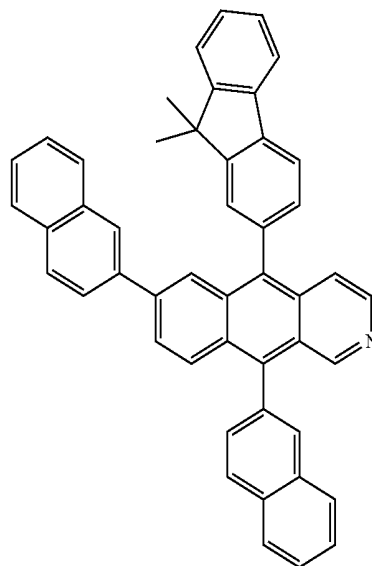
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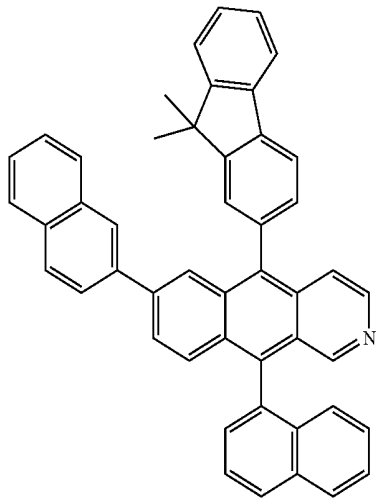


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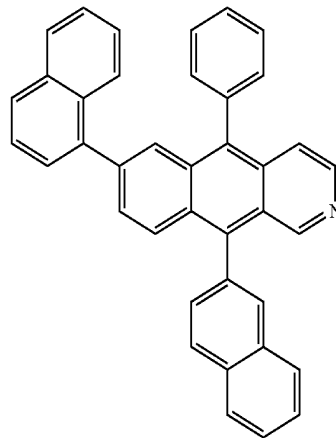
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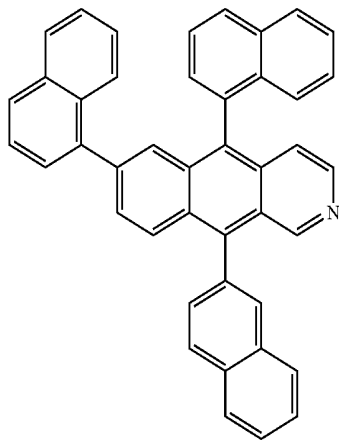
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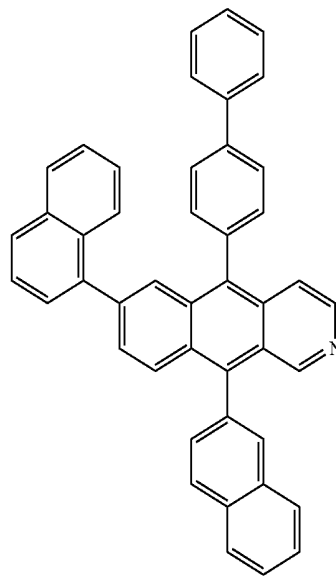


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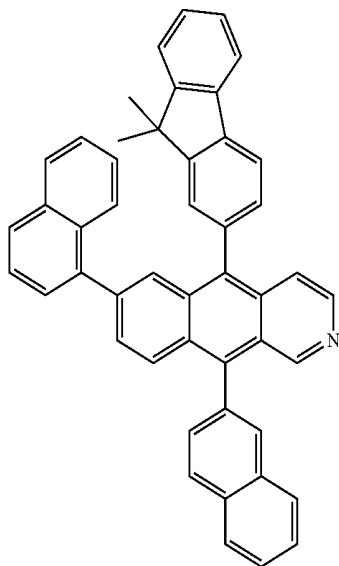
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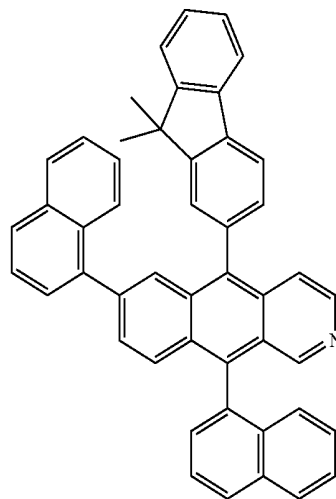
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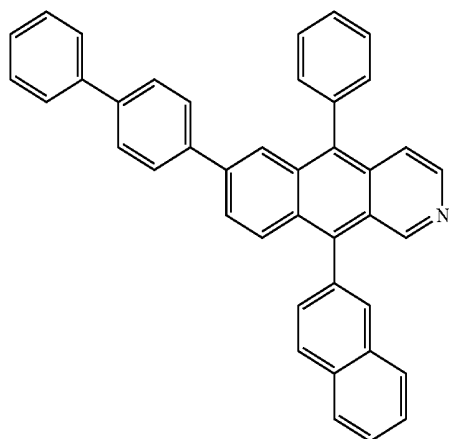
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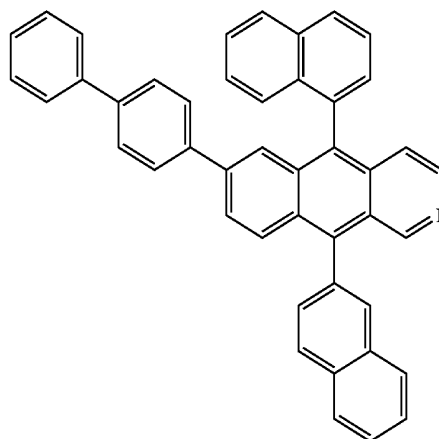
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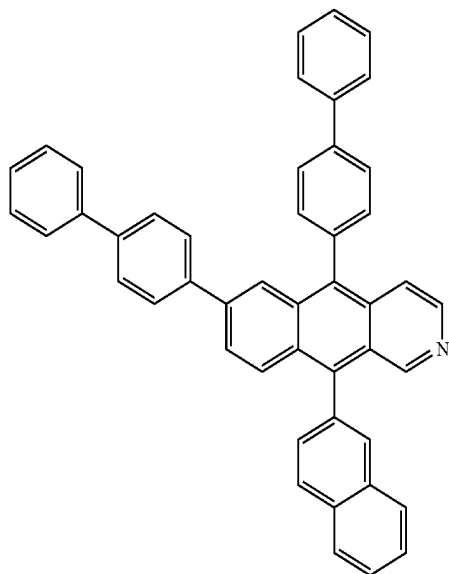
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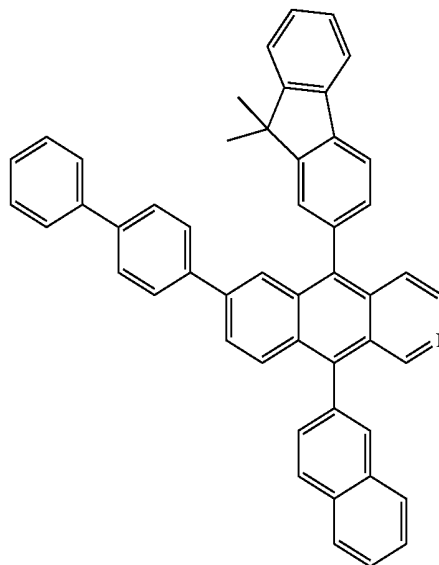


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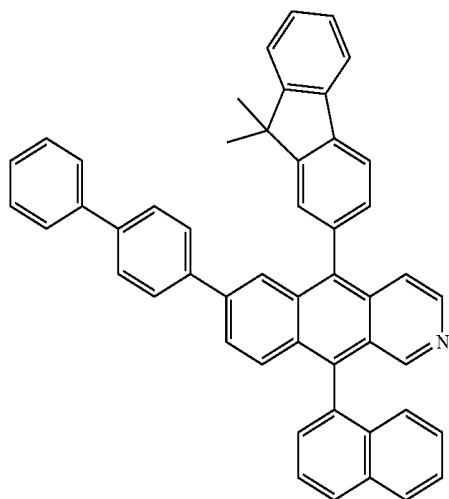
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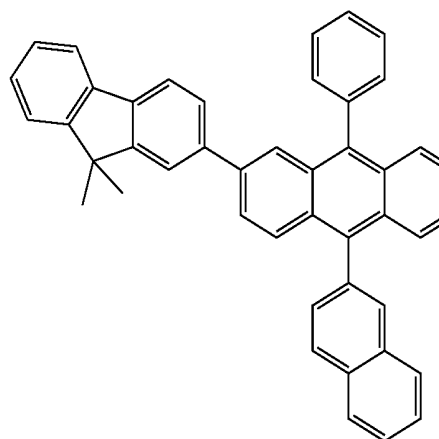
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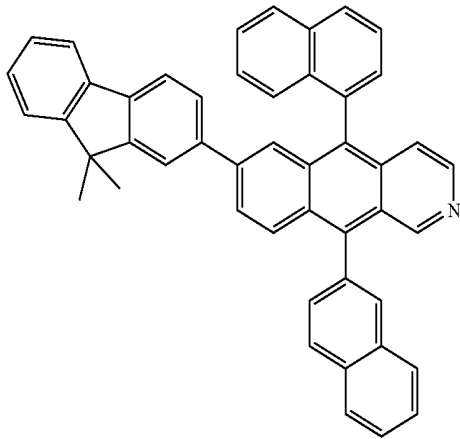
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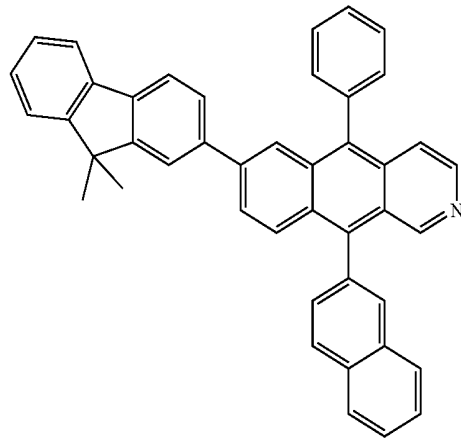
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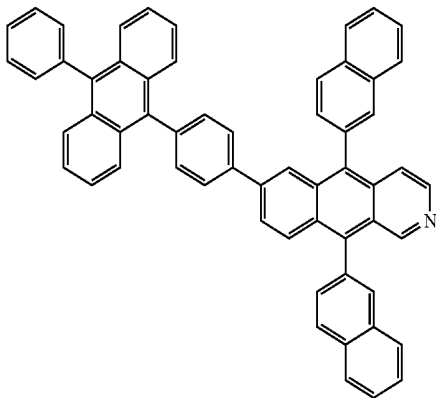
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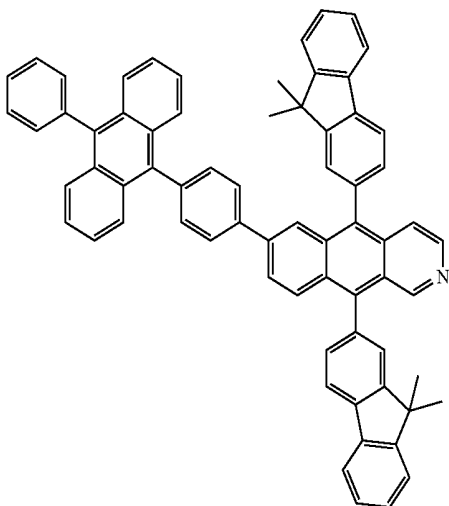
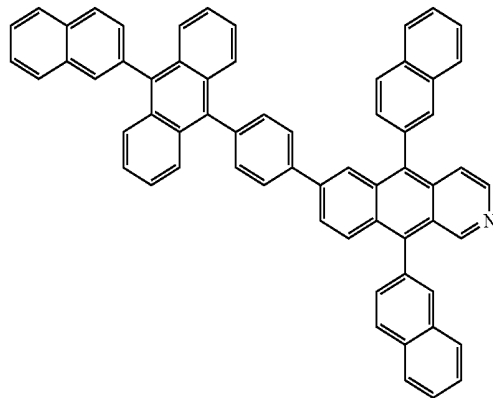


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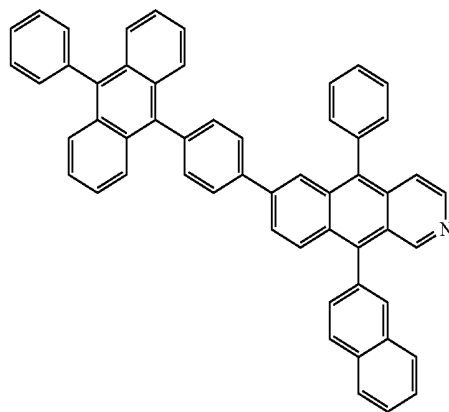
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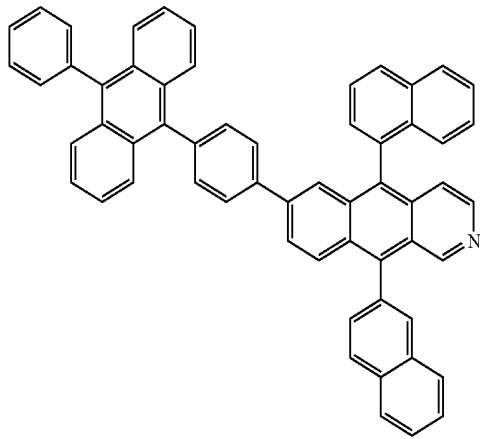


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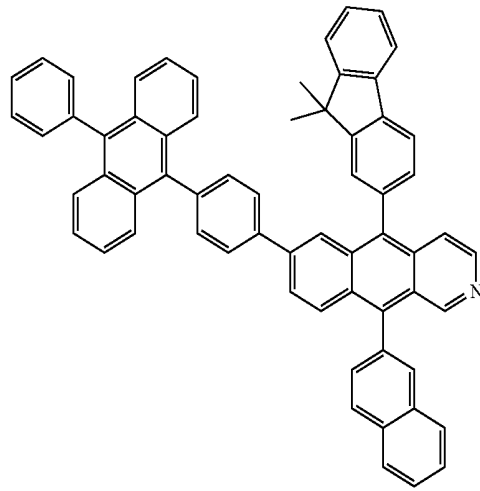


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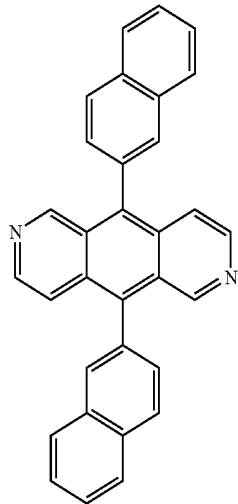


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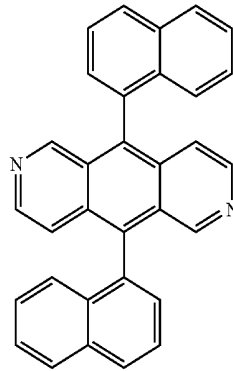
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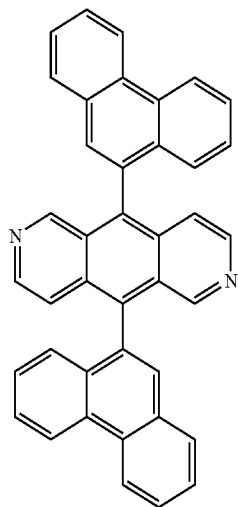
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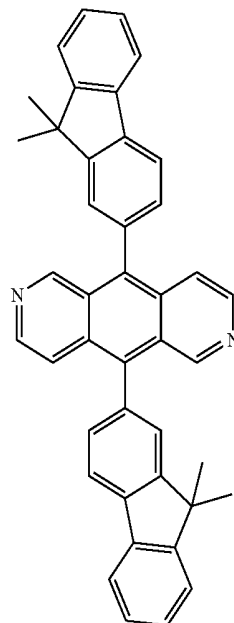
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1205

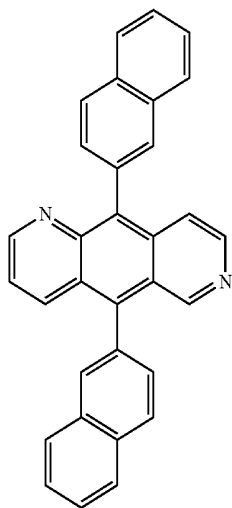
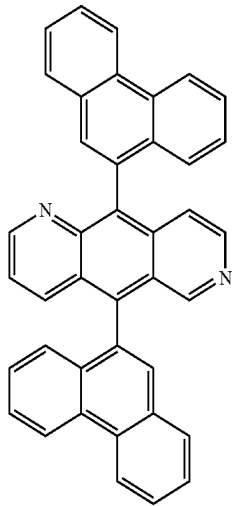
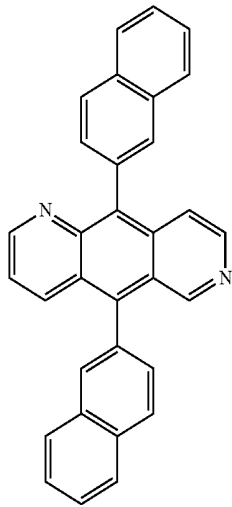


1206



1207

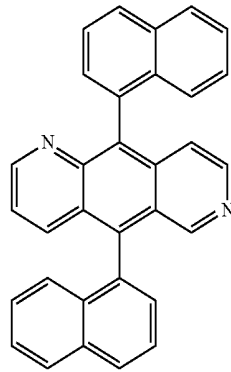
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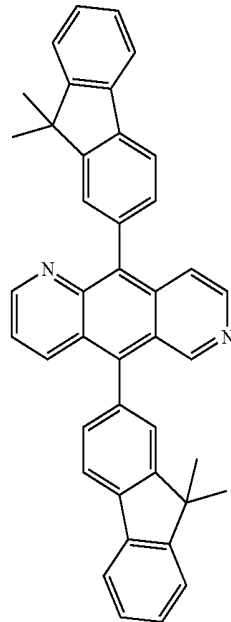
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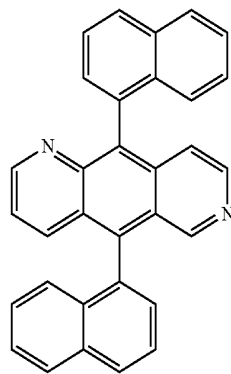
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1210



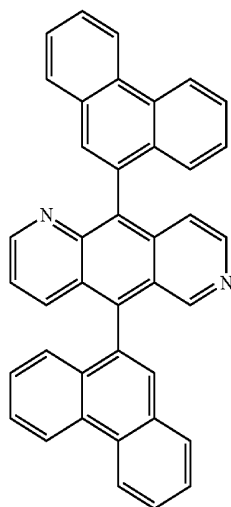
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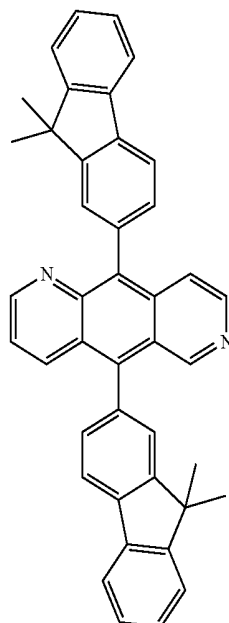
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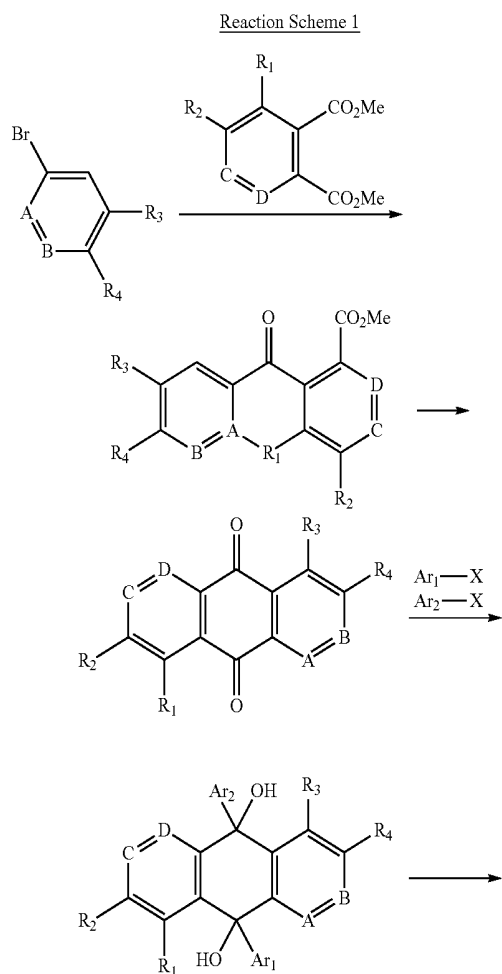
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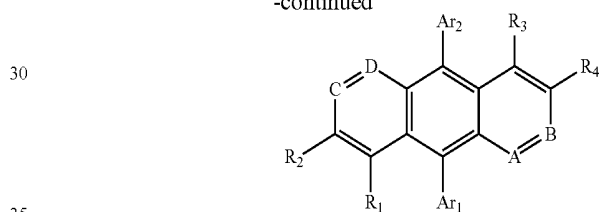


1215

The organic electroluminescent compounds of the present invention can be prepared according to the procedure illustrated by Reaction Scheme (1):



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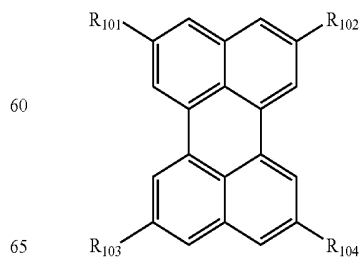
wherein, A, B, C, D, Ar₁, Ar₂ and R₁ through R₄ are defined as in Chemical Formula (1), and X represents halogen.

The present invention also provides organic solar cells, which comprises one or more organic electroluminescent compound(s) represented by Chemical Formula (1).

The present invention also provides an organic electroluminescent device which is comprised of a first electrode; a second electrode; and at least one organic layer(s) interposed between the first electrode and the second electrode; wherein the organic layer comprises one or more organic electroluminescent compound(s) represented by Chemical Formula (1).

The organic electroluminescent device according to the present invention is characterized in that the organic layer comprises an electroluminescent layer, which comprises one or more organic electroluminescent compound(s) represented by Chemical Formula (1) as electroluminescent host, and one or more dopant(s). The dopant to be applied to the organic electroluminescent device according to the invention is not particularly restricted, but preferably selected from the compounds represented by one of Chemical Formulas (8) to (10).

Chemical Formula 8

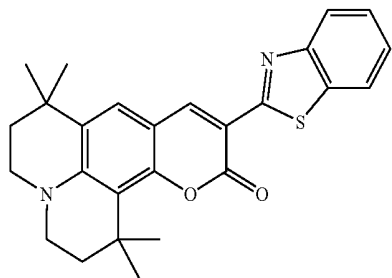


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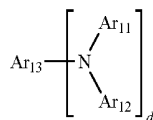
In Chemical Formula (8), R_{101} through R_{104} independently represent hydrogen, halogen, (C1-C60)alkyl, (C6-C60)aryl, (C4-C60)heteroaryl, 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O and S, (C3-C60)cycloalkyl, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl, tri(C6-C60)arylsilyl, adamantyl, (C7-C60)bicycloalkyl, (C2-C60)alkenyl, (C2-C60)alkynyl, (C1-C60)alkoxy, cyano, (C1-C60)alkylamino, (C6-C60)arylamino, (C6-C60)ar(C1-C60)alkyl, (C6-C60)aryloxy, (C1-C60)alkylthio, (C6-C60)arylthio, (C1-C60)alkoxycarbonyl, (C1-C60)alkylcarbonyl, (C6-C60)arylcarbonyl, carboxyl, nitro or hydroxyl; or each of R_{101} through R_{104} may be linked to an adjacent substituent via (C3-C60)alkylene or (C3-C60)alkenylene with or without fused ring to form an alicyclic ring, or a monocyclic or polycyclic aromatic ring;

the alkyl, alkenyl, alkynyl, cycloalkyl, heterocycloalkyl, aryl, heteroaryl, arylsilyl, alkylsilyl, alkoxy, aryloxy, arylthio, alkylamino, arylamino of R_{101} through R_{104} , or the alicyclic ring, or the monocyclic or polycyclic aromatic ring formed therefrom by linkage to an adjacent substituent via (C3-C60)alkylene or (C3-C60)alkenylene with or without a fused ring may be further substituted by one or more substituent(s) selected from halogen, (C1-C60)alkyl, (C6-C60)aryl, (C4-C60)heteroaryl, 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O and S, (C3-C60)cycloalkyl, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl, tri(C6-C60)arylsilyl, adamantyl, (C7-C60)bicycloalkyl, (C2-C60)alkenyl, (C2-C60)alkynyl, (C1-C60)alkoxy, cyano, (C1-C60)alkylamino, (C6-C60)arylamino, (C6-C60)ar(C1-C60)alkyl, (C6-C60)aryloxy, (C1-C60)alkylthio, (C6-C60)arylthio, (C1-C60)alkoxycarbonyl, (C1-C60)alkylcarbonyl, (C6-C60)arylcarbonyl, carboxyl, nitro and hydroxyl.

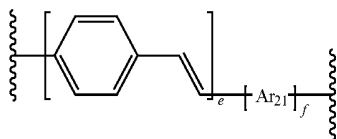
Chemical Formula 9



Chemical Formula 10

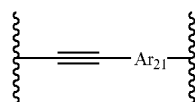


In Chemical Formula (10), Ar_{11} and Ar_{12} independently represent (C1-C60)alkyl, (C6-C60)aryl, (C4-C60)heteroaryl, (C6-C60)arylamino, (C1-C60)alkylamino, 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O and S, (C3-C60)cycloalkyl, or arylene having one of the structures shown below:



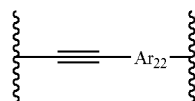
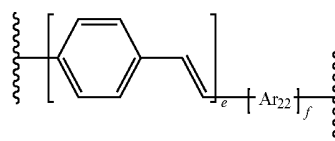
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Ar_{11} and Ar_{12} may be linked via (C3-C60)alkylene or (C3-C60)alkenylene with or without a fused ring to form an alicyclic ring, or a monocyclic or polycyclic aromatic ring;

Ar_{13} represents (C6-C60)arylene, (C4-C60)heteroarylene or arylene having one of the structures shown below:



wherein, Ar_{21} and Ar_{22} independently represent (C6-C60)arylene or (C4-C60)heteroarylene;

d is an integer from 1 to 4, e is an integer from 1 to 4, and f is an integer of 0 or 1; and

the alkyl, aryl, heteroaryl, arylamino, alkylamino, cycloalkyl or heterocycloalkyl of Ar_{11} and Ar_{12} ; or the arylene or heteroarylene of Ar_{13} , Ar_{21} and Ar_{22} may be further substituted by one or more substituent(s) selected from a group consisting of halogen, (C1-C60)alkyl, (C6-C60)aryl, (C4-C60)heteroaryl, 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O and S, (C3-C60)cycloalkyl, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl, tri(C6-C60)arylsilyl, adamantyl, (C7-C60)bicycloalkyl, (C2-C60)alkenyl, (C2-C60)alkynyl, (C1-C60)alkoxy, cyano, (C1-C60)alkylamino, (C6-C60)arylamino, (C6-C60)ar(C1-C60)alkyl, (C6-C60)aryloxy, (C6-C60)arylthio, (C1-C60)alkylthio, (C1-C60)alkoxycarbonyl, (C1-C60)alkylcarbonyl, (C6-C60)arylcarbonyl, carboxyl, nitro and hydroxyl.

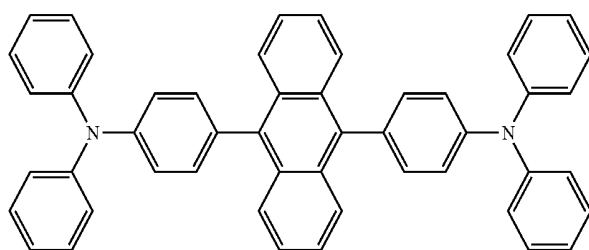
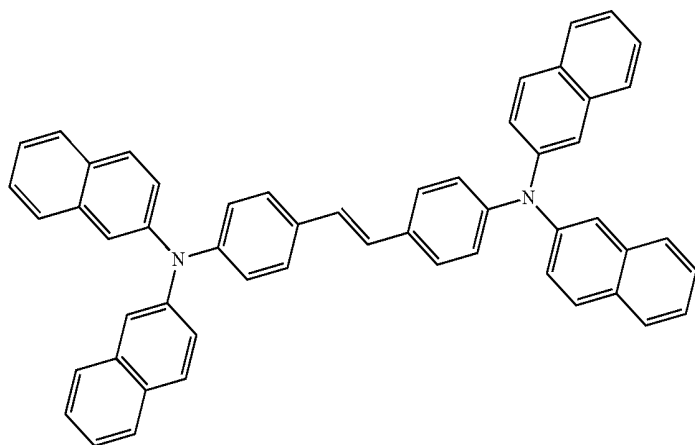
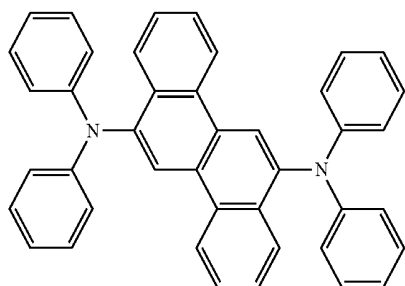
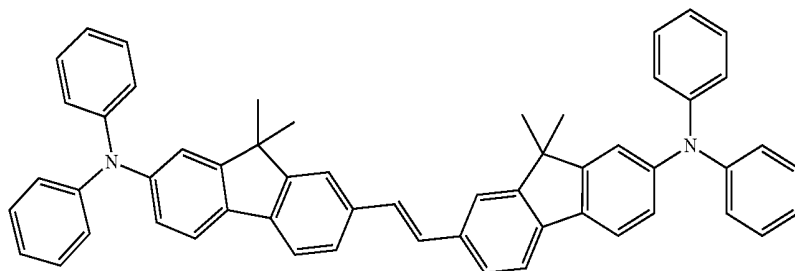
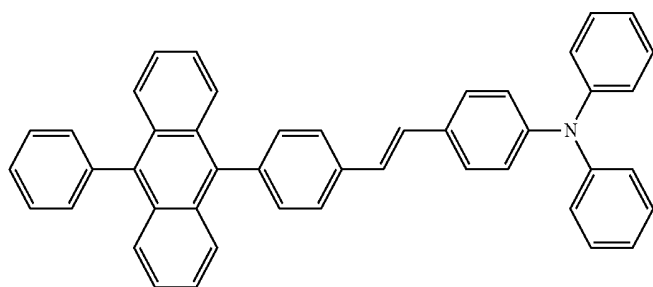
The electroluminescent layer means the layer where electroluminescence occurs, and it may be a single layer or a multi-layer consisting of two or more layers laminated. When a mixture of host-dopant is used according to the constitution of the present invention, noticeable improvement in luminous efficiency by the electroluminescent host according to the invention could be confirmed. Those results can be achieved by doping concentration of 0.5 to 20% by weight. The host according to the present invention exhibits higher hole and electron conductivity, and excellent stability of the material as compared to other conventional host materials, and provides improved device life as well as luminous efficiency.

Thus, it can be described that use of the compound represented by one of Chemical Formulas (8) to (10) as an electroluminescent dopant significantly supplements electronic drawback of the organic electroluminescent compounds of Chemical Formula (1) according to the present invention.

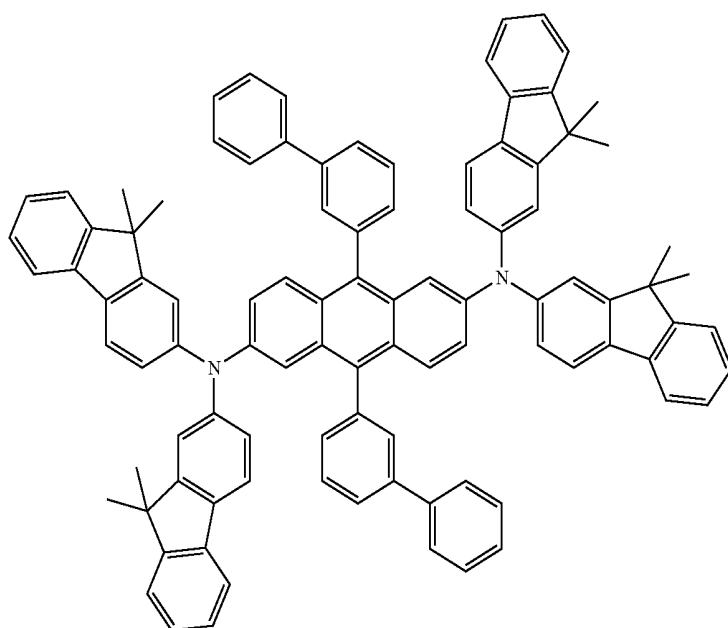
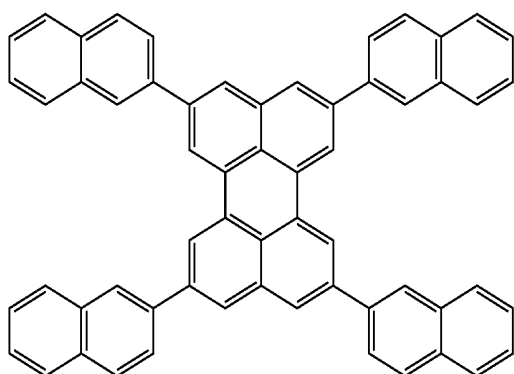
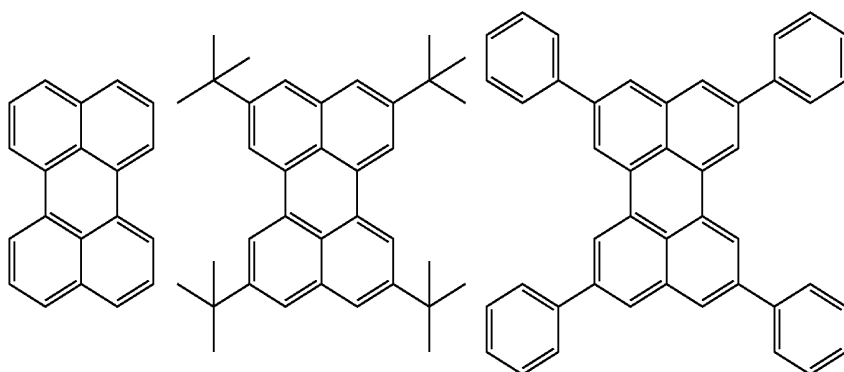
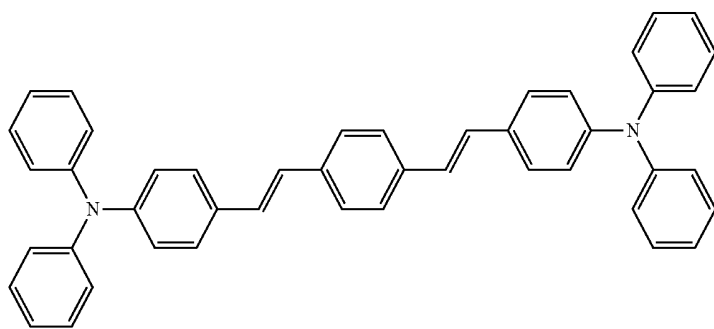
The dopant compounds represented by one of Chemical Formulas (8) to (10) can be exemplified by the following compounds, but are not restricted thereto.

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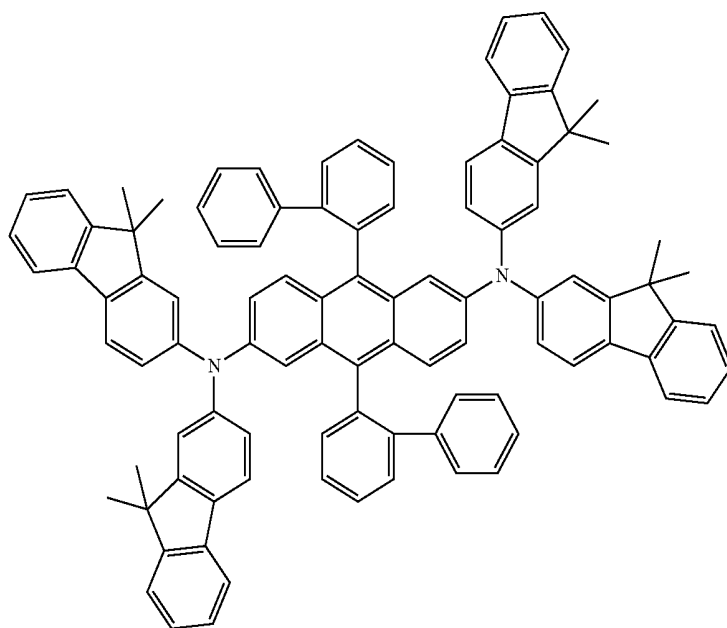
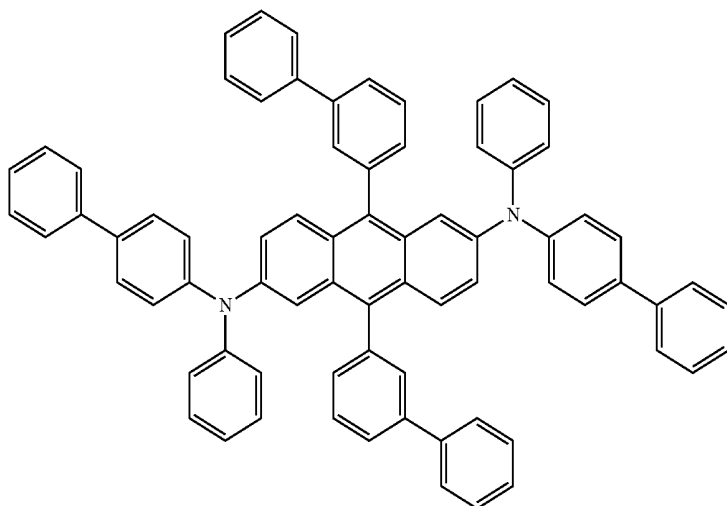
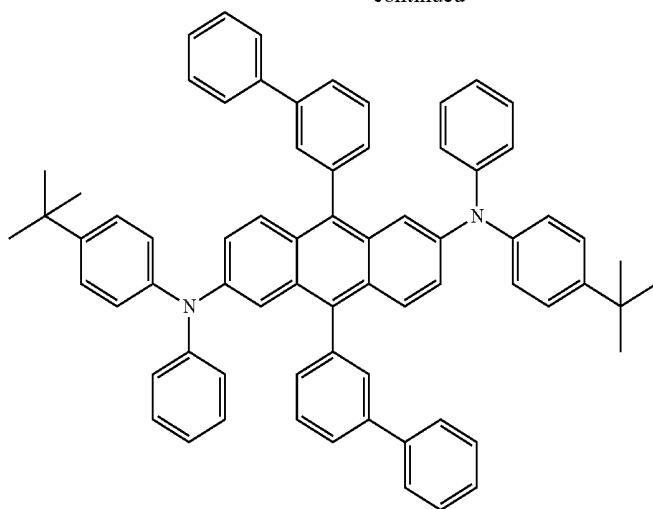
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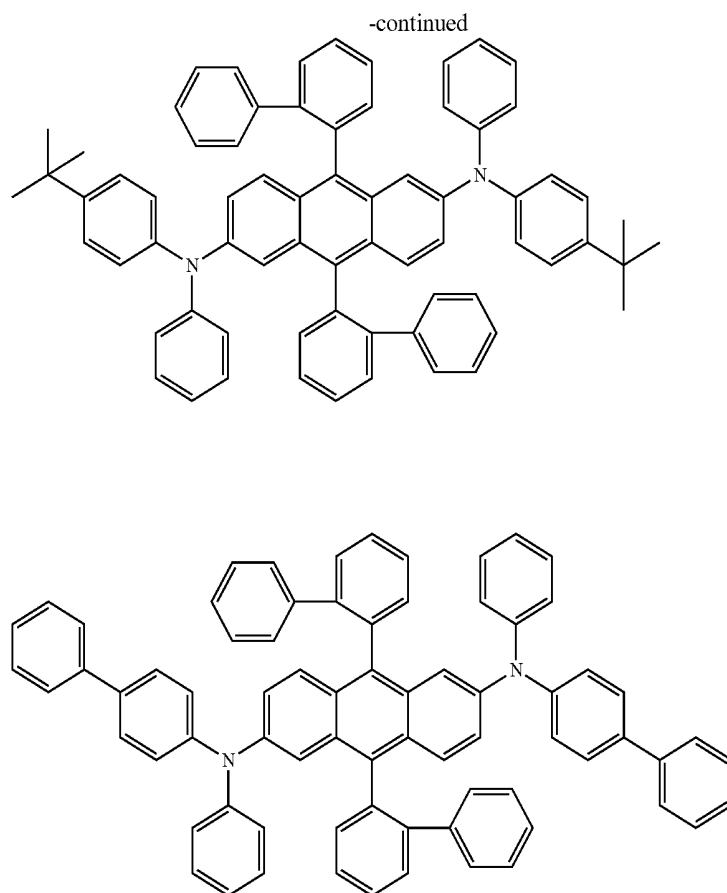


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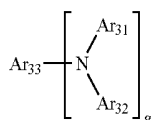
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The organic electroluminescent device according to the invention may further comprise one or more compound(s) selected from a group consisting of arylamine compounds and styrylarylamine compounds, as well as the organic electroluminescent compound represented by Chemical Formula (1). Examples of the arylamine or styrylarylamine compounds include the compounds represented by Chemical Formula (11), but they are not restricted thereto:



wherein, Ar_{31} and Ar_{32} independently represent (C1-C60) alkyl, (C6-C60)aryl, (C4-C60)heteroaryl, (C6-C60)arylamino, (C1-C60)alkylamino, morpholino, thiomorpholino, 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O and S, or (C3-C60)cycloalkyl, or Ar_{31} and Ar_{32} may be linked via (C3-C60)alkylene or (C3-C60)alkenylene with or without a fused ring to form an alicyclic ring, or a monocyclic or polycyclic aromatic ring; the aryl, heteroaryl, arylamino or heterocycloalkyl of Ar_{31} and Ar_{32} may be further substituted by one or more substituent(s) selected from halogen, (C1-C60)alkyl, (C2-

Chemical Formula 11

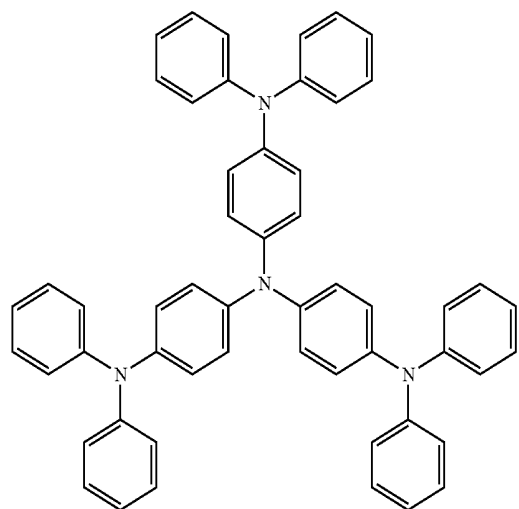
40 C60)alkenyl, (C2-C60)alkynyl, (C6-C60)aryl, (C4-C60)heteroaryl, 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O and S, (C3-C60)cycloalkyl, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl, tri(C6-C60)arylsilyl, adamantyl, (C7-C60)bicycloalkyl, (C1-C60)alkoxy, cyano, (C1-C60)alkylamino, (C6-C60)arylamino, (C6-C60)ar(C1-C60)alkyl, (C6-C60)aryloxy, (C1-C60)alkylthio, (C6-C60)arylthio, (C1-C60)alkoxycarbonyl, (C1-C60)alkylcarbonyl, (C6-C60)arylcarbonyl, carboxyl, nitro and hydroxyl;

45 Ar_{33} represents (C6-C60)aryl, (C5-C60)heteroaryl or (C6-C60)arylamino; the aryl, heteroaryl or arylamino of Ar_{33} may be further substituted by one or more substituent(s) selected from halogen, (C1-C60)alkyl, (C6-C60)aryl, (C4-C60)heteroaryl, 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O and S, (C3-C60)cycloalkyl, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl, tri(C6-C60)arylsilyl, adamantyl, (C7-C60)bicycloalkyl, (C2-C60)alkenyl, (C2-C60)alkynyl, (C1-C60)alkoxy, cyano, (C1-C60)alkylamino, (C6-C60)arylamino, (C6-C60)ar(C1-C60)alkyl, (C6-C60)aryloxy, (C1-C60)alkylthio, (C6-C60)arylthio, (C1-C60)alkoxycarbonyl, (C1-C60)alkylcarbonyl, (C6-C60)arylcarbonyl, carboxyl, nitro and hydroxyl; and

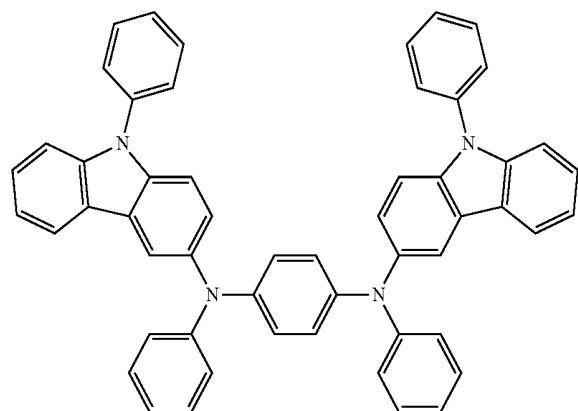
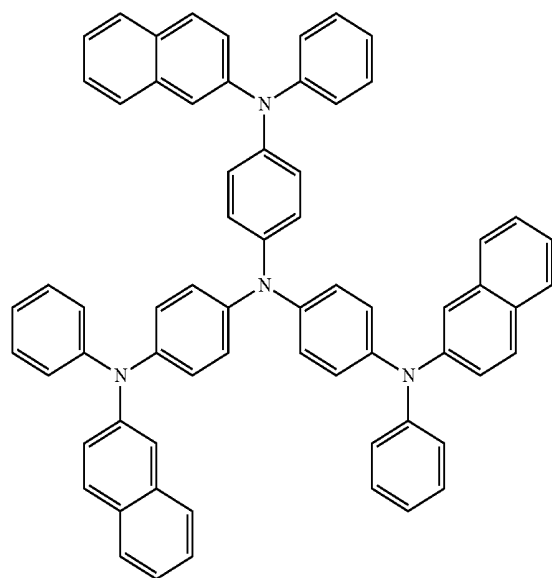
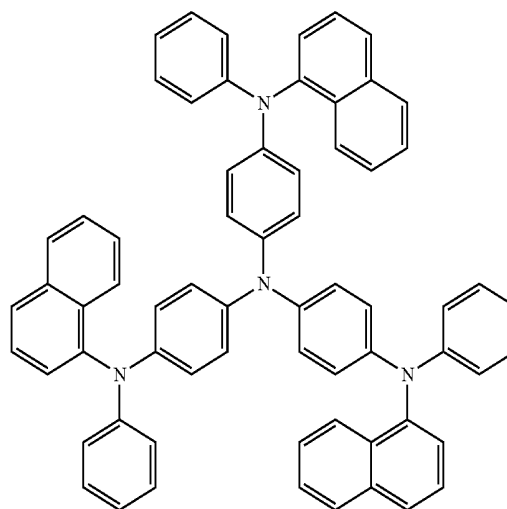
g is an integer from 1 to 4.

65 The arylamine compounds and styrylarylamine compounds may be more specifically exemplified by the following compounds, but are not restricted thereto.

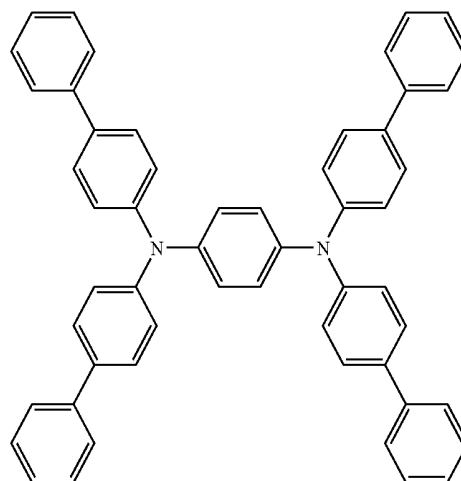
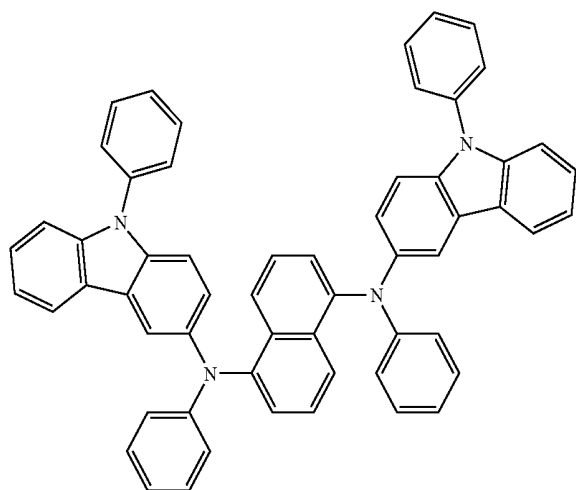
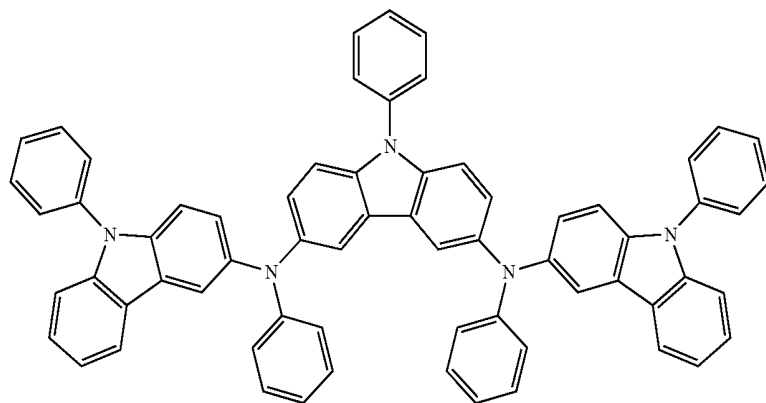
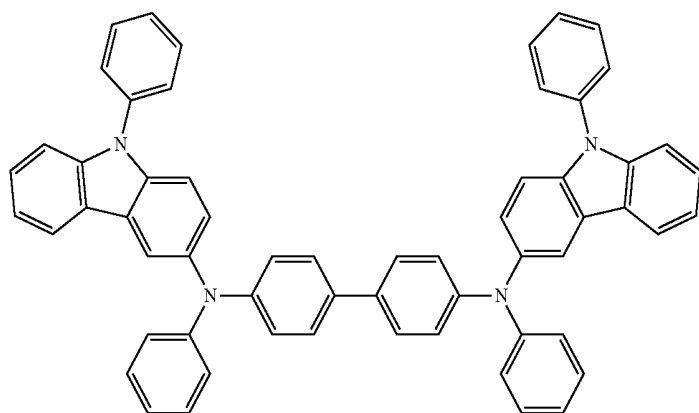
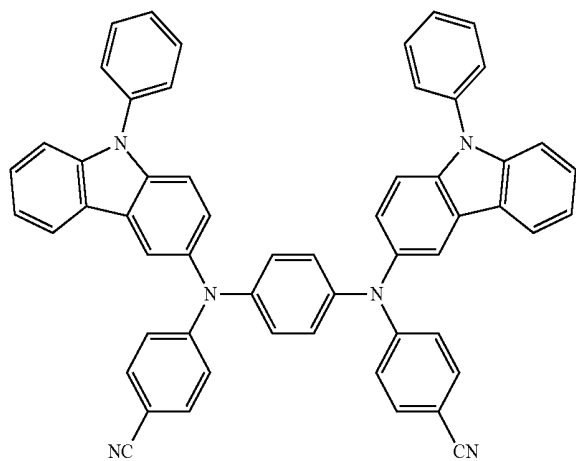
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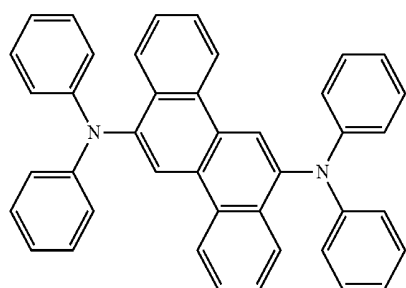
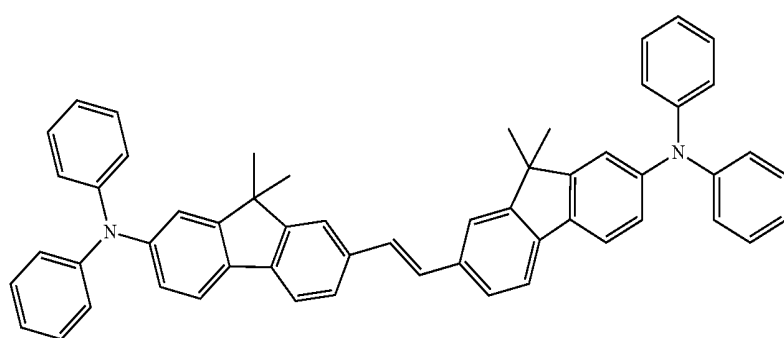
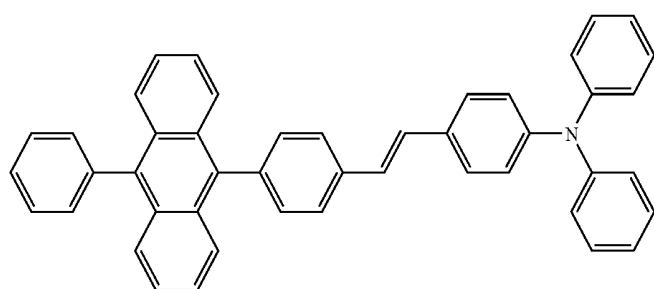
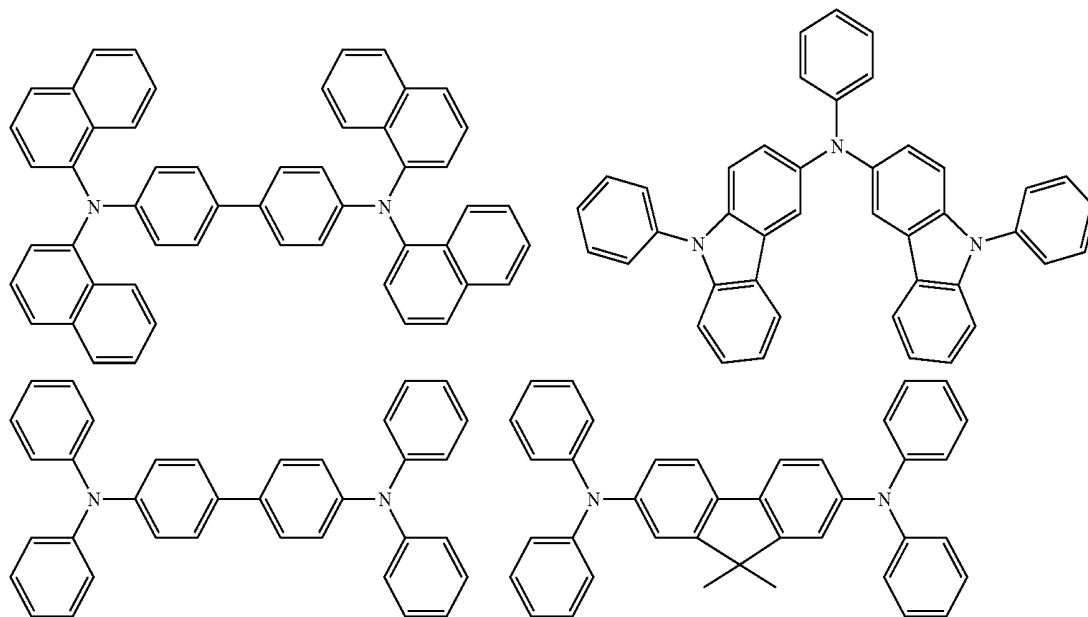
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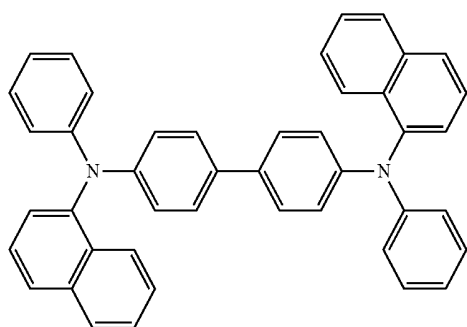
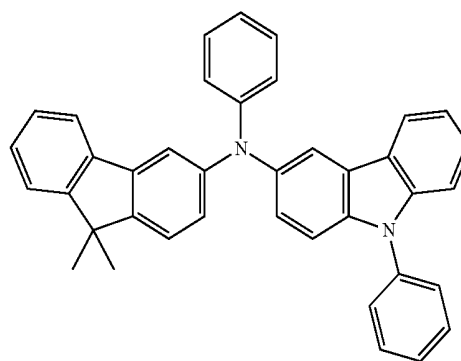
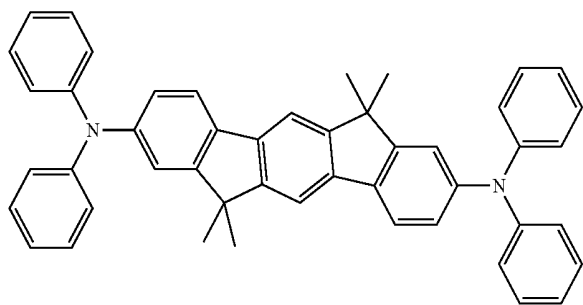
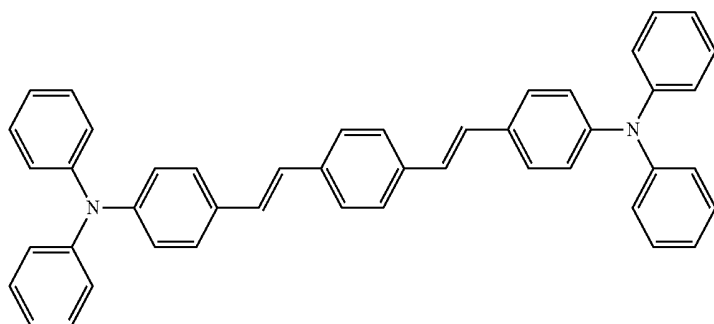
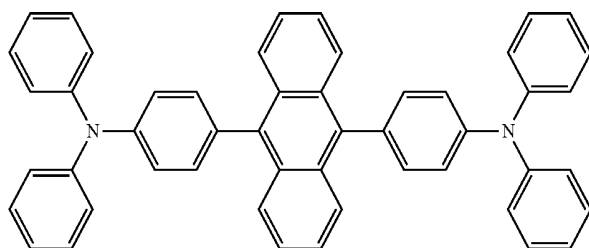
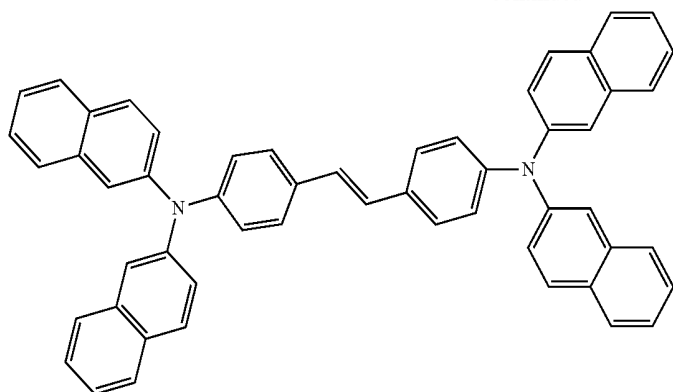
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In an organic electroluminescent device according to the present invention, the organic layer may further comprise one or more metal(s) selected from a group consisting of organic metals of Group 1, Group 2, 4th period and 5th period transition metals, lanthanide metals and d-transition elements from the Periodic Table of Elements, as well as the organic electroluminescent compound represented by Chemical Formula (1). The organic layer may comprise a charge generating layer in addition to the electroluminescent layer.

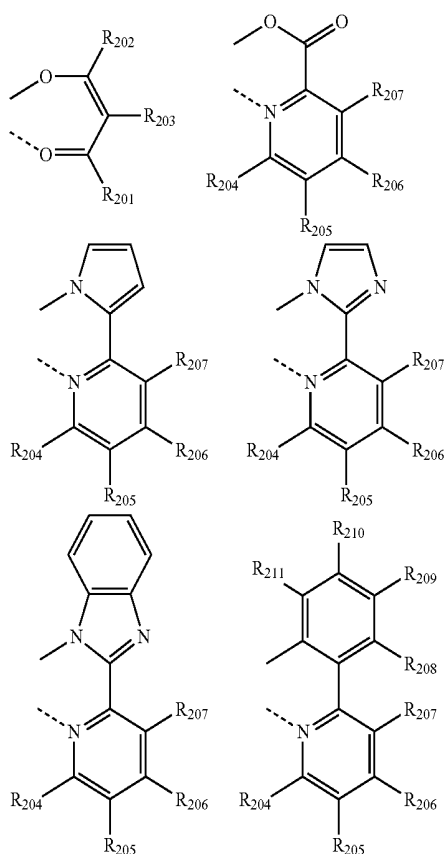
The present invention can realize an organic electroluminescent device having a pixel structure of independent light-emitting mode, which comprises an organic electroluminescent device containing the organic electroluminescent compound of Chemical Formula (1) as a sub-pixel and one or more sub-pixel(s) comprising one or more metallic compound(s) selected from a group consisting of Ir, Pt, Pd, Rh, Re, Os, Tl, Pb, Bi, In, Sn, Sb, Te, Au and Ag, patterned in parallel at the same time.

Further, the organic electroluminescent device is an organic display wherein the organic layer comprises, in addition to the organic electroluminescent compound represented by Chemical Formula (1), one or more compound(s) selected from compounds having the electroluminescent peak of wavelength of not less than 560 nm, at the same time. The compounds having the electroluminescent peak of wavelength of not less than 560 nm may be exemplified by the compounds represented by one of Chemical Formulas (12) to (16), but they are not restricted thereto.



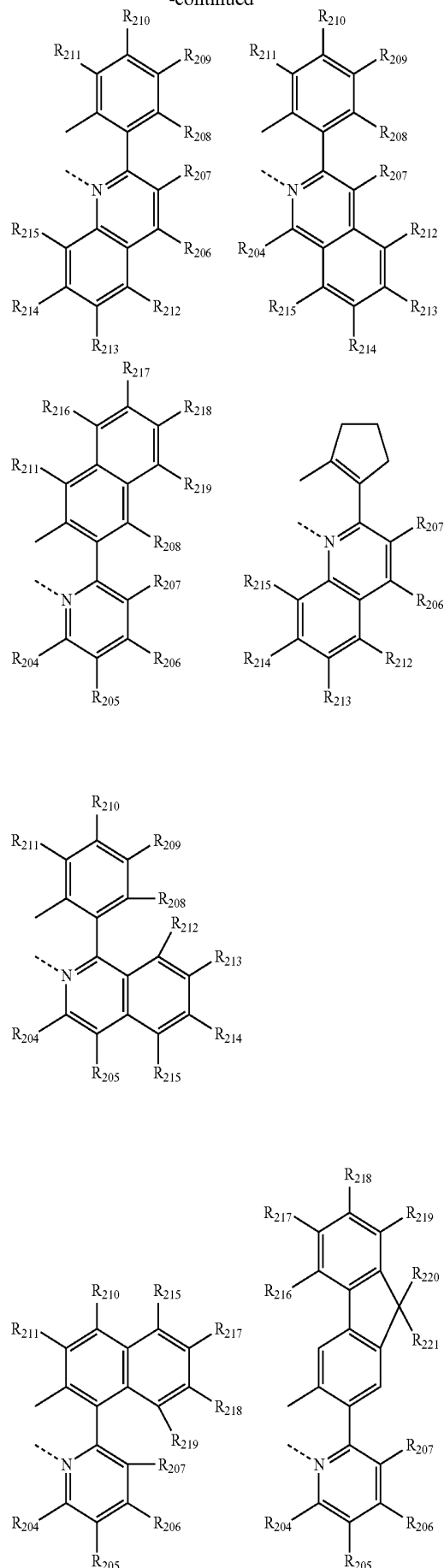
Chemical Formula 12

In Chemical Formula (12), M^1 is selected from metals of Groups 7, 8, 9, 10, 11, 13, 14, 15 and 16 in the Periodic Table of Elements, and ligands L^{11} , L^{12} and L^{13} are independently selected from the following structures:



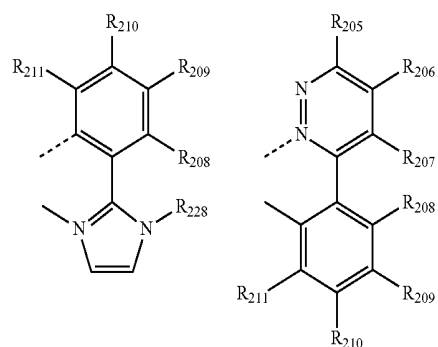
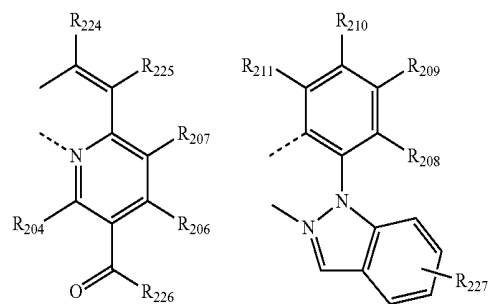
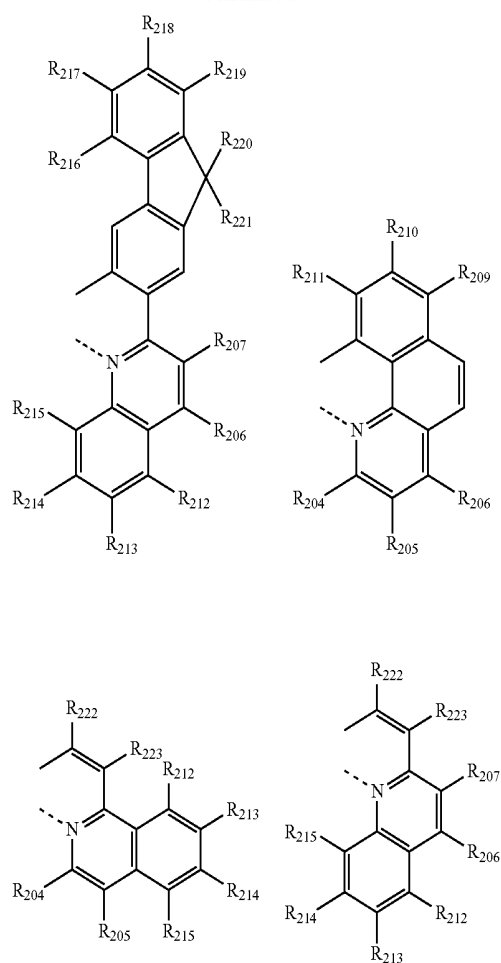
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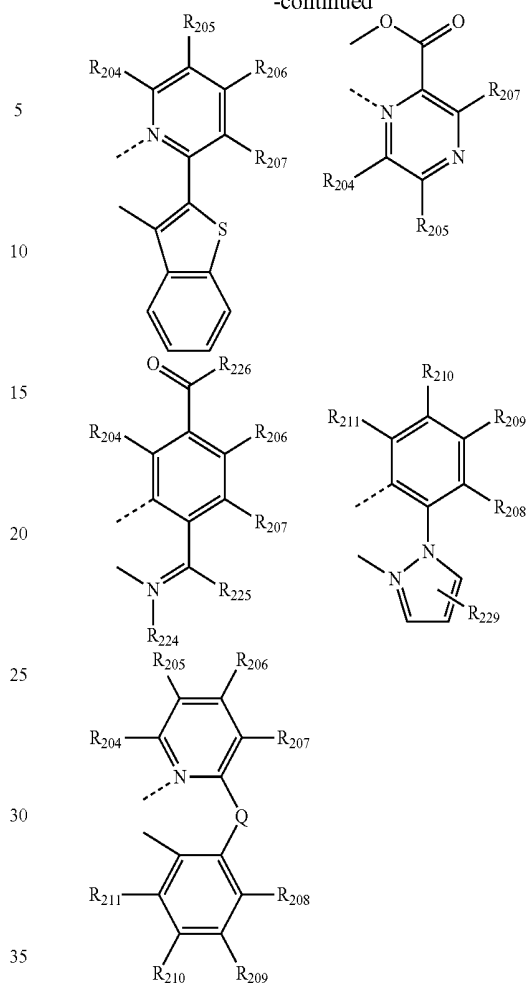
477

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wherein, R_{201} through R_{203} independently represent hydrogen, (C1-C60)alkyl with or without halogen substituent(s), (C6-C60)aryl with or without (C1-C60)alkyl substituent(s), or halogen;

R_{204} through R_{219} independently represent hydrogen, (C1-C60)alkyl, (C1-C30)alkoxy, (C3-C60)cycloalkyl, (C2-C30)alkenyl, (C6-C60)aryl, mono or di(C1-C30)alkylamino, mono or di(C6-C30)arylamino, SF_5 , tri(C1-C30)alkylsilyl, di(C1-C30)alkyl(C6-C30)arylsilyl, tri(C6-C30)arylsilyl, cyano or halogen; and the alkyl, cycloalkyl, alkenyl or aryl of R_{204} through R_{219} may be further substituted by one or more substituent(s) selected from (C1-C60)alkyl, (C6-C60)aryl and halogen;

R_{220} through R_{223} independently represent hydrogen, (C1-C60)alkyl with or without halogen substituent(s), (C6-C60)aryl with or without (C1-C60)alkyl substituent(s);

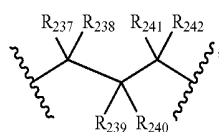
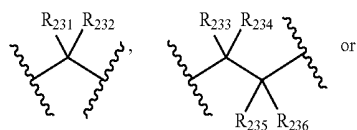
R_{224} and R_{225} independently represent hydrogen, (C1-C60)alkyl, (C6-C60)aryl or halogen, or R_{224} and R_{225} may be linked via (C3-C12)alkylene or (C3-C12)alkenylene with or without a fused ring to form an alicyclic ring, or a monocyclic or polycyclic aromatic ring; the alkyl or aryl of R_{224} and R_{225} , or the alicyclic ring, or the monocyclic or polycyclic aromatic ring formed therefrom via (C3-C12)alkylene or (C3-C12)alkenylene with or without a fused ring may be further substituted by one or more substituent(s) selected from (C1-C60)alkyl with or without halogen substituent(s), (C1-C30)alkoxy, halogen, tri(C1-C30)alkylsilyl, tri(C6-C30)arylsilyl and (C6-C60)aryl;

R_{226} represents (C1-C60)alkyl, (C6-C60)aryl, (C5-C60)heteroaryl or halogen;

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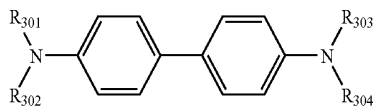
R_{227} through R_{229} independently represent hydrogen, (C1-C60)alkyl, (C6-C60)aryl or halogen; the alkyl or aryl of R_{226} through R_{229} may be further substituted by halogen or (C1-C60)alkyl;

Q represents



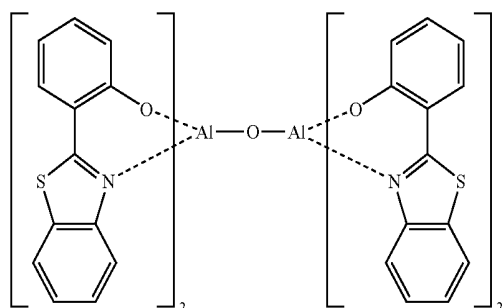
and R_{231} through R_{242} independently represent hydrogen, (C1-C60)alkyl with or without halogen substituent(s), (C1-C30)alkoxy, halogen, (C6-C60)aryl, cyano or (C5-C60)cycloalkyl, or each of R_{231} through R_{242} may be linked to an adjacent substituent via alkylene or alkenylene to form a (C5-C7) spiro-ring or a (C5-C9) fused ring, or each of them may be linked to R_{207} or R_{208} via alkylene or alkenylene to form a (C5-C7) fused ring.

Chemical Formula 13



In Chemical Formula (13), R_{301} through R_{304} independently represent (C1-C60)alkyl or (C6-C60)aryl, or each of them may be linked to an adjacent substituent via (C3-C60)alkylene or (C3-C60)alkenylene with or without a fused ring to form an alicyclic ring, or a monocyclic or polycyclic aromatic ring; and the alkyl or aryl of R_{301} through R_{304} , or the alicyclic ring, or the monocyclic or polycyclic aromatic ring formed therefrom by linkage via (C3-C60)alkylene or (C3-C60)alkenylene with or without a fused ring may be further substituted by one or more substituent(s) selected from (C1-C60)alkyl with or without halogen substituent(s), (C1-C60)alkoxy, halogen, tri(C1-C60)alkylsilyl, tri(C6-C60)arylsilyl and (C6-C60)aryl.

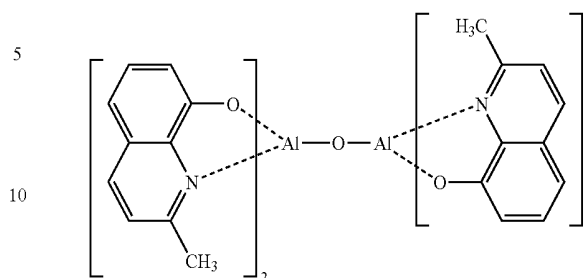
Chemical Formula 14



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Chemical Formula 15

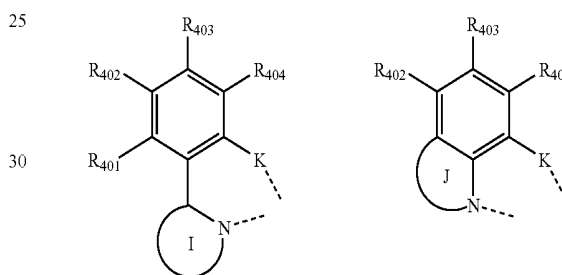


15

 $L^{24}L^{25}M^2(T)_h$

Chemical Formula 16

In Chemical Formula (16), the ligands, L^{24} and L^{25} are independently selected from the following structures:



35

M^2 is a bivalent or trivalent metal;

h is 0 when M^2 is a bivalent metal, while h is 1 when M^2 is a trivalent metal;

T represents (C6-C60)aryloxy or tri(C6-C60)arylsilyl, and the aryloxy and triarylsilyl of T may be further substituted by (C1-C60)alkyl or (C6-C60)aryl;

K represents O, S or Se;

ring I represents oxazole, thiazole, imidazole, oxadiazole, thiadiazole, benzoxazole, benzothiazole, benzimidazole, pyridine or quinoline;

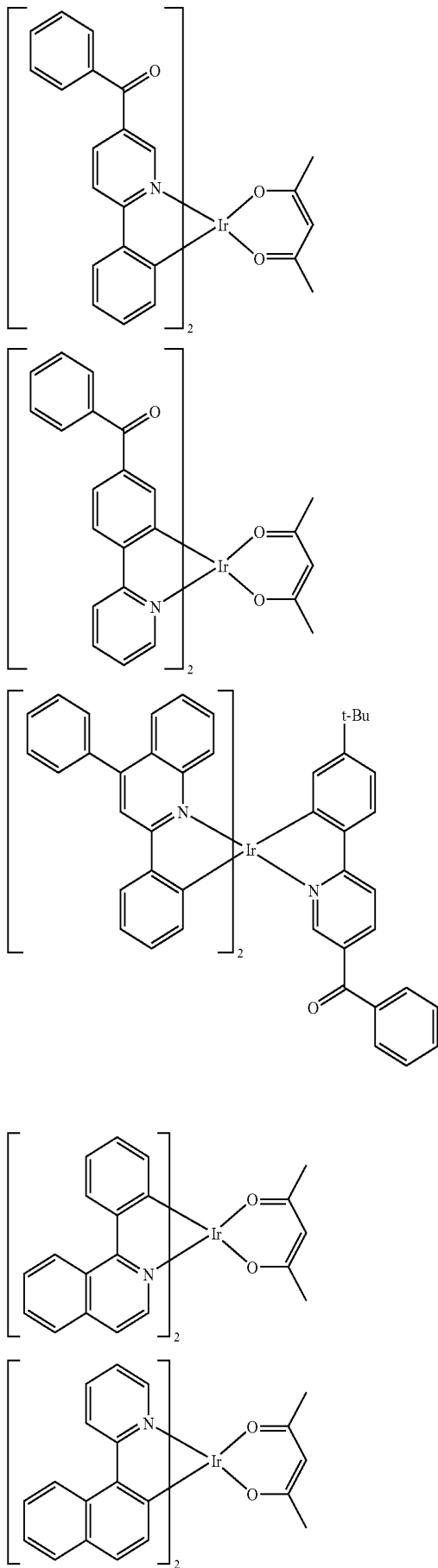
ring J represents pyridine or quinoline, and ring J may be further substituted by (C1-C60)alkyl, or phenyl or naphthyl with or without (C1-C60)alkyl substituent(s);

R_{401} through R_{404} independently represent hydrogen, (C1-C60)alkyl, halogen, tri(C1-C60)alkylsilyl, tri(C6-C60)arylsilyl or (C6-C60)aryl, or each of them may be linked to an adjacent substituent via (C3-C60)alkylene or (C3-C60)alkenylene to form a fused ring; the pyridine or quinoline may form a chemical bond with R_{401} to form a fused ring; and

ring I or the aryl group of R_{401} through R_{404} may be further substituted by (C1-C60)alkyl, halogen, (C1-C60)alkyl with halogen substituent(s), phenyl, naphthyl, tri(C1-C60)alkylsilyl, tri(C6-C60)arylsilyl or amino group.

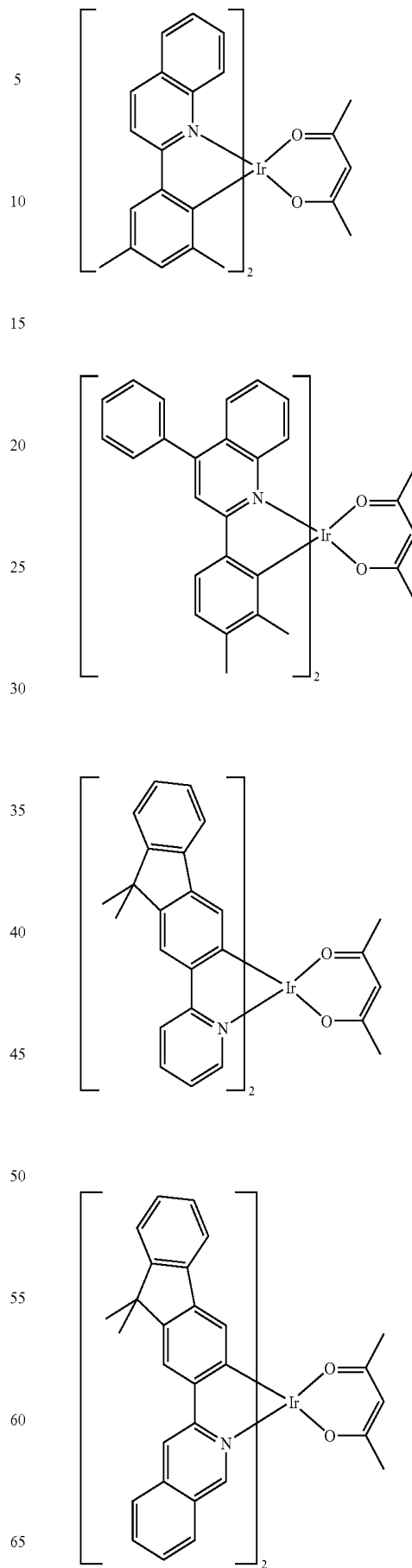
The compounds having electroluminescent peak of wavelength of not less than 560 nm, can be exemplified by the following compounds, but they are not restricted thereto.

481



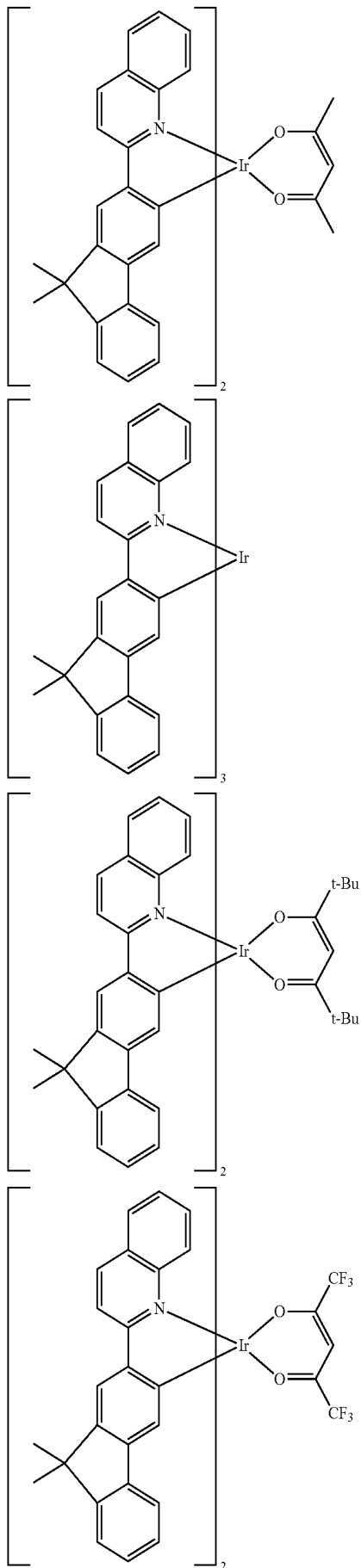
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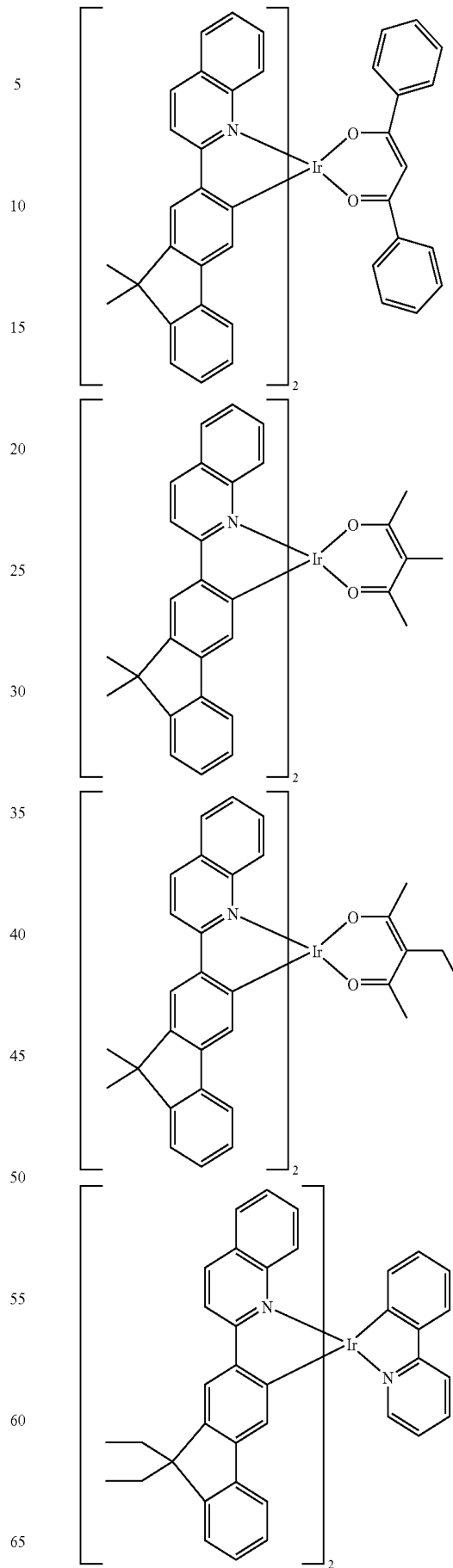
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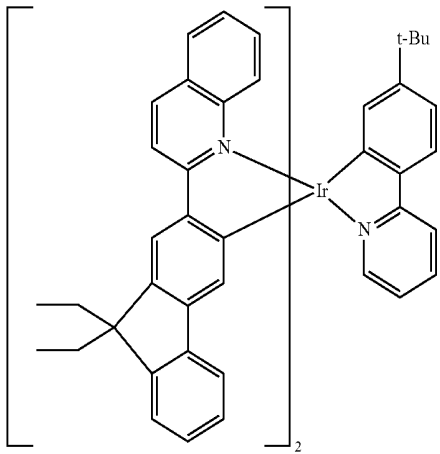
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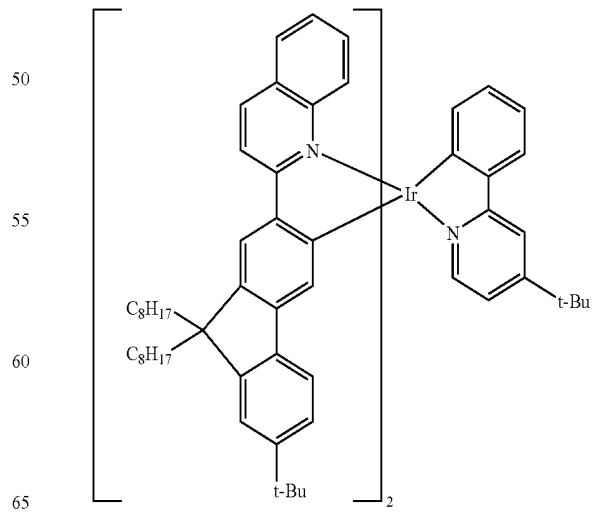
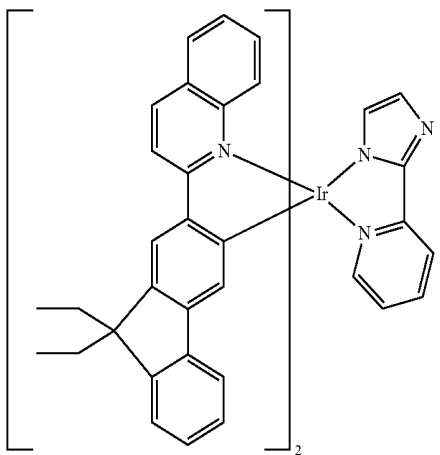
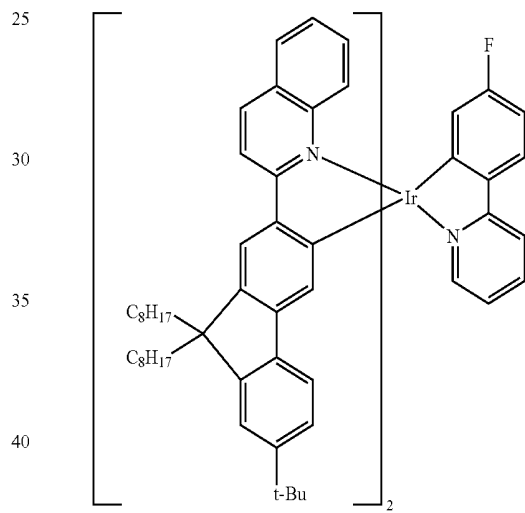
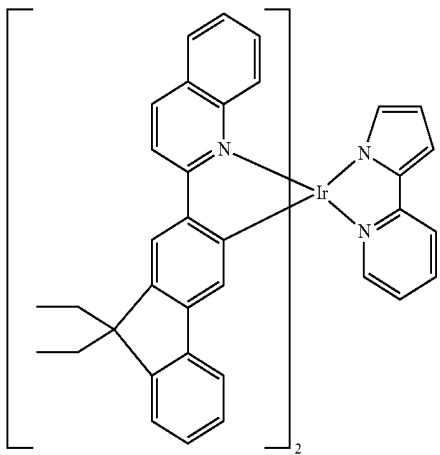
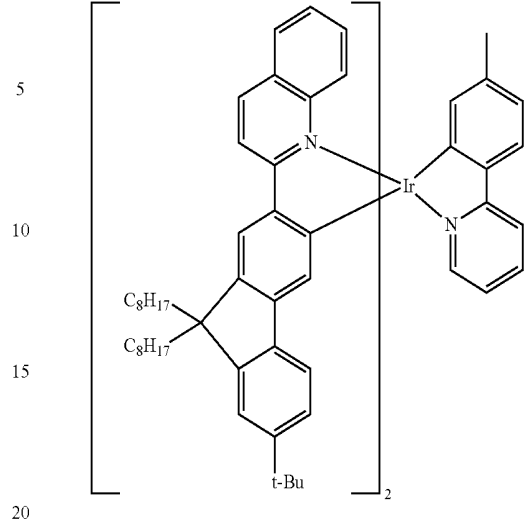
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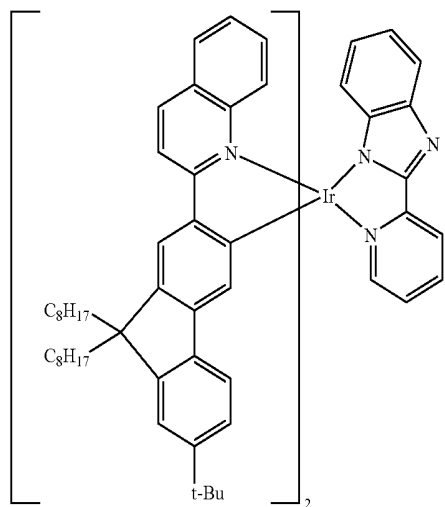
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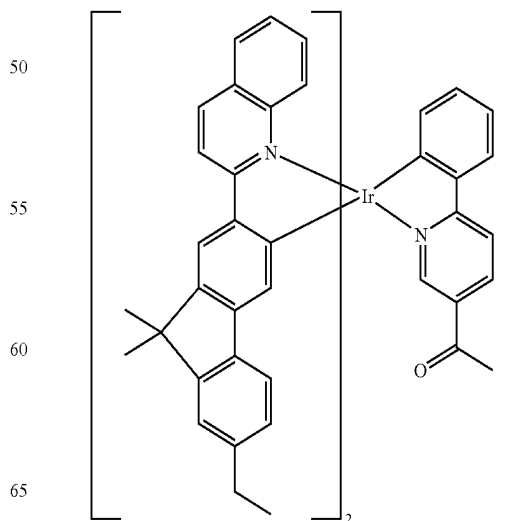
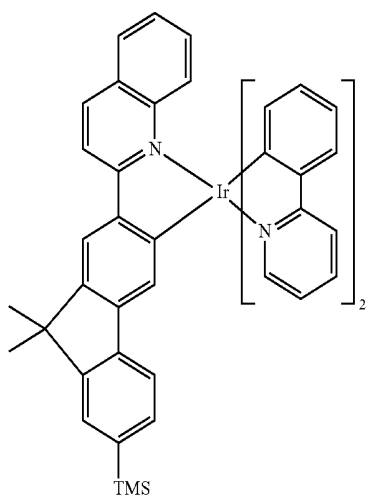
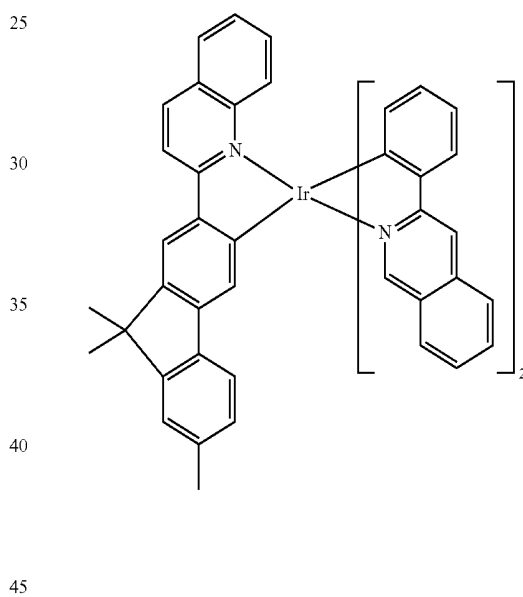
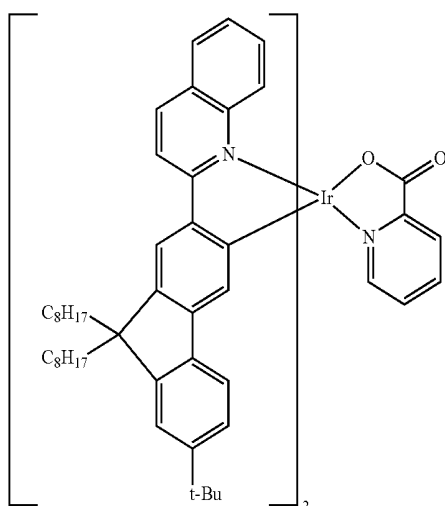
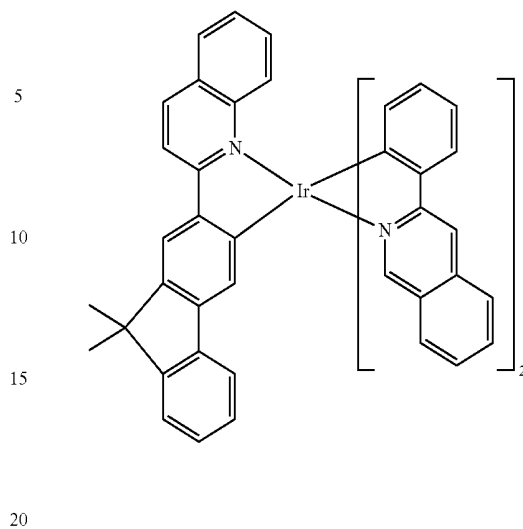
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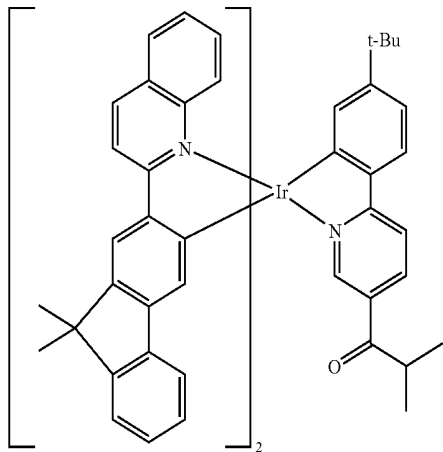
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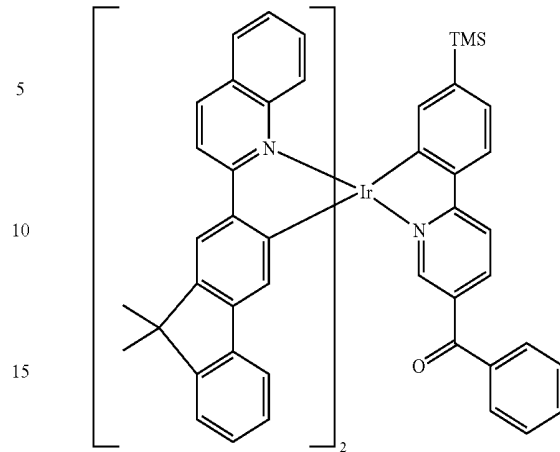
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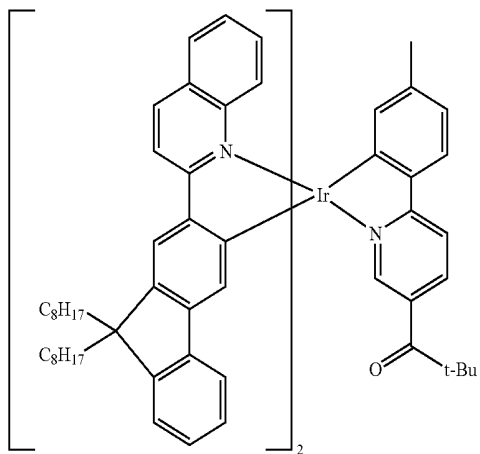


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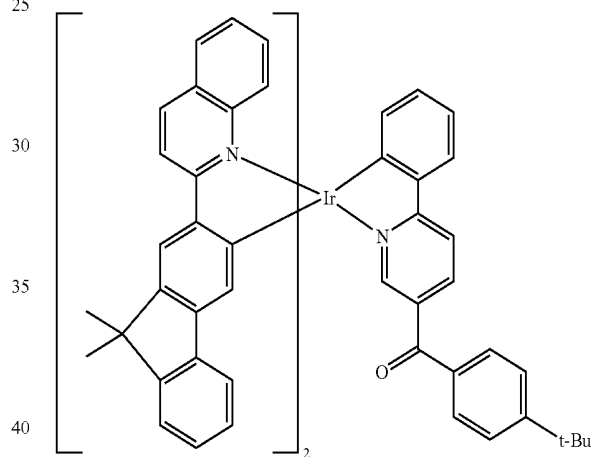
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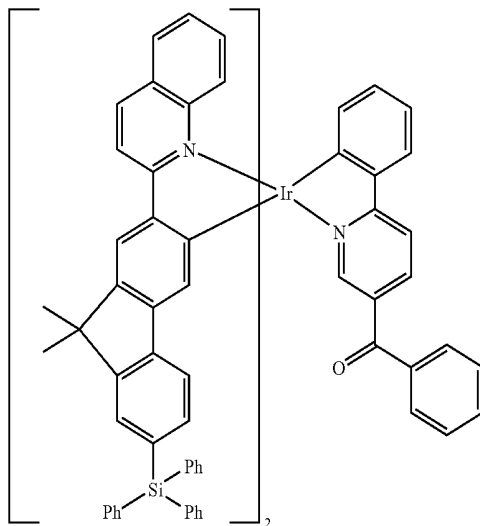
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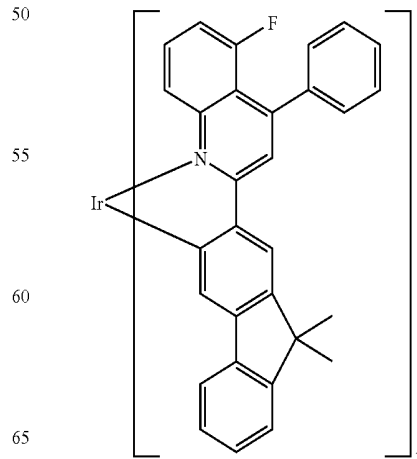
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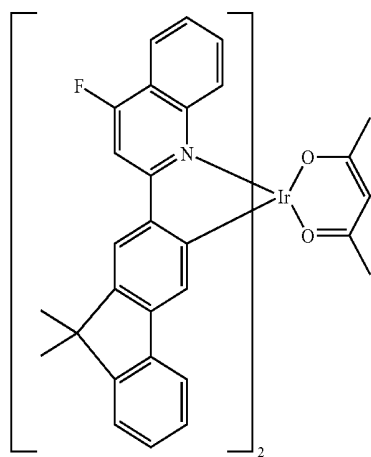
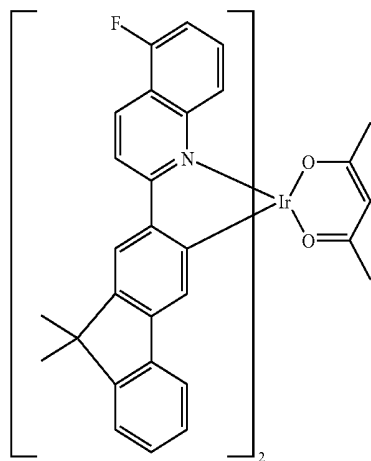
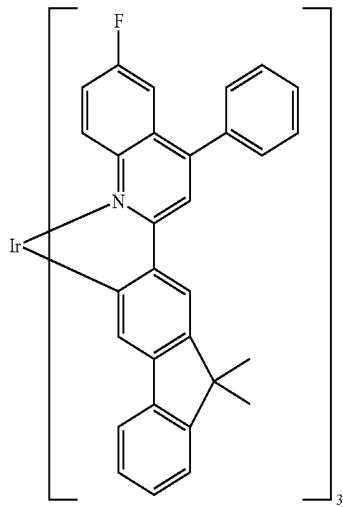
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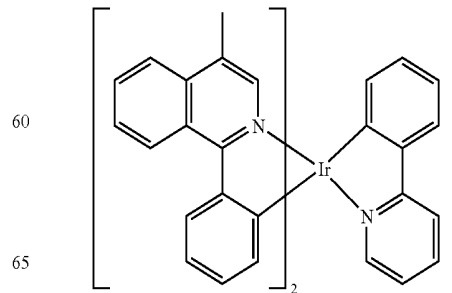
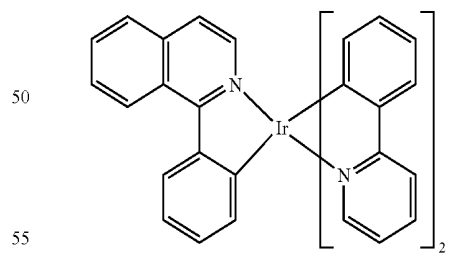
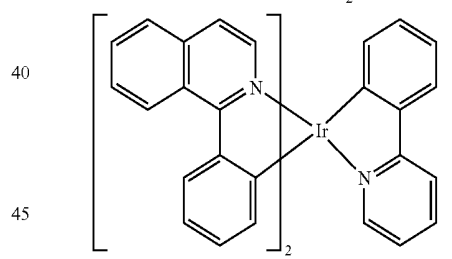
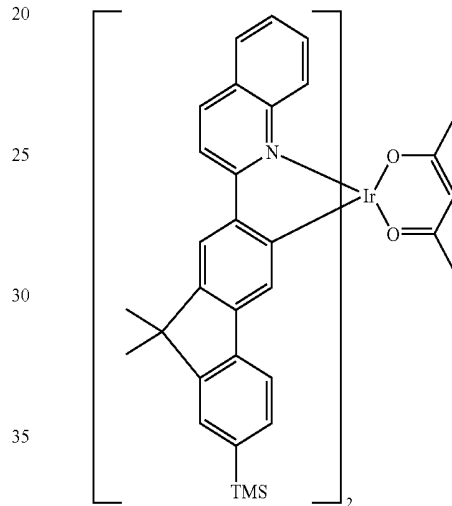
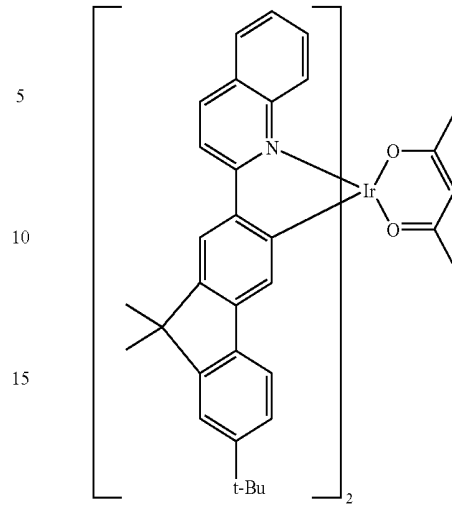
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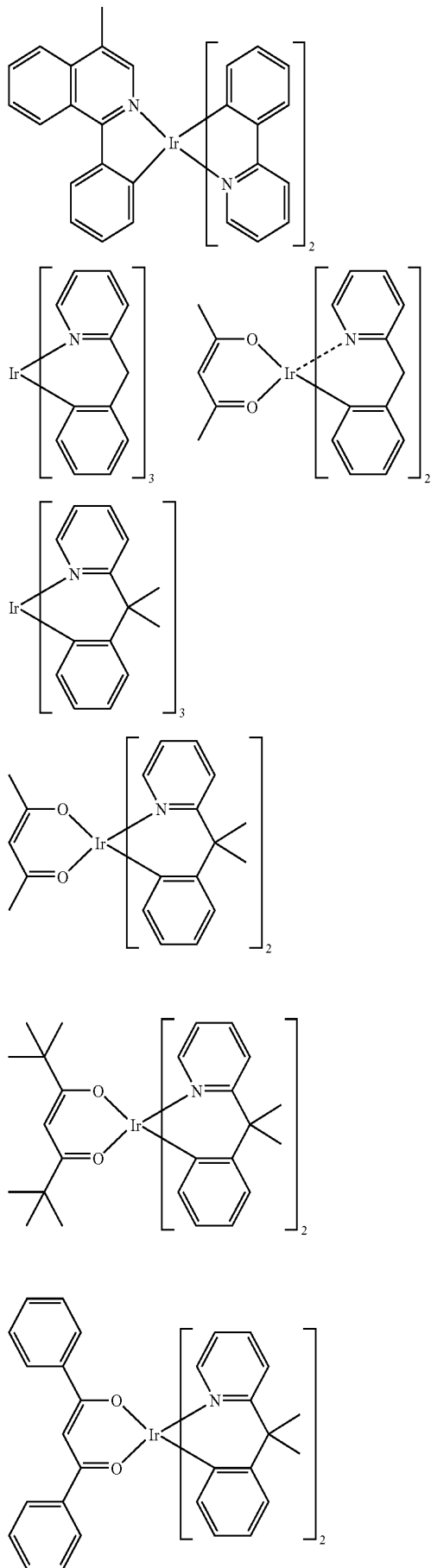
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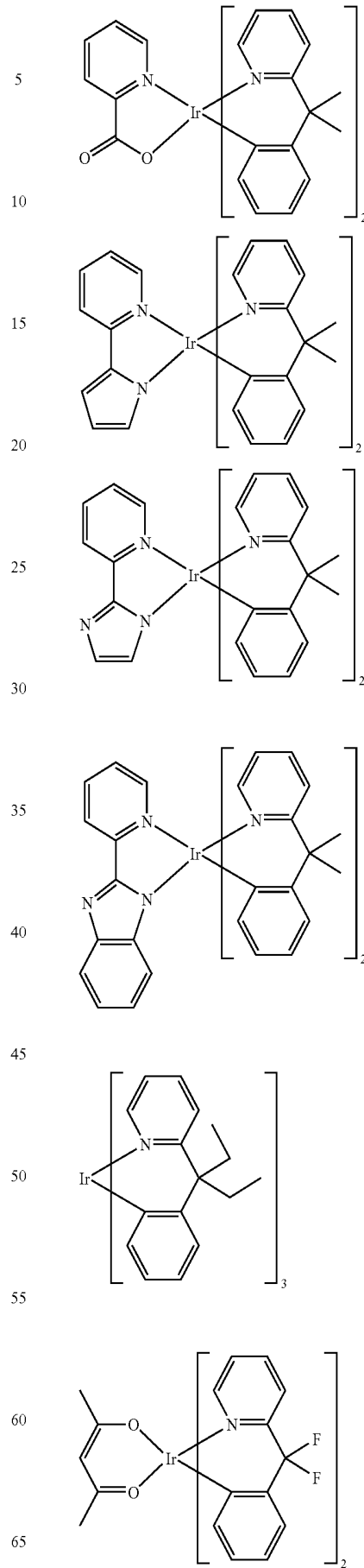
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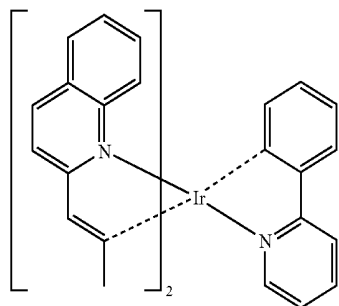
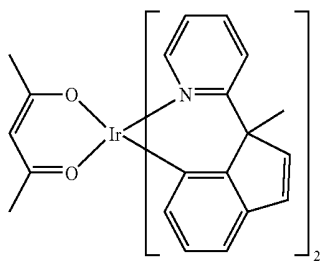
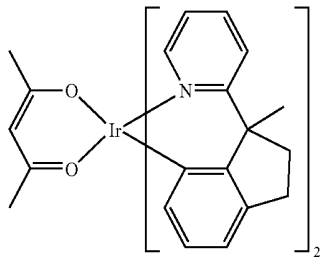
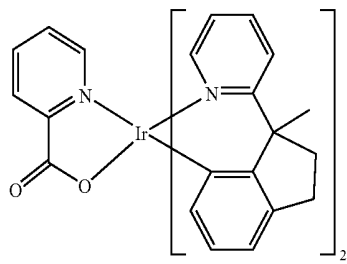
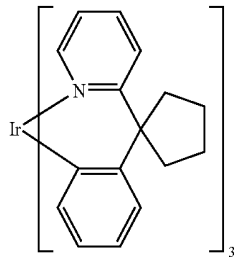
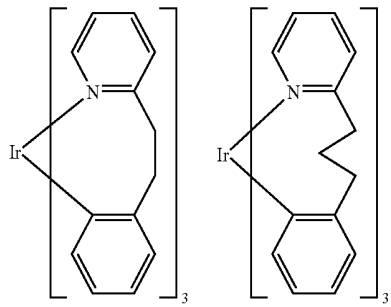
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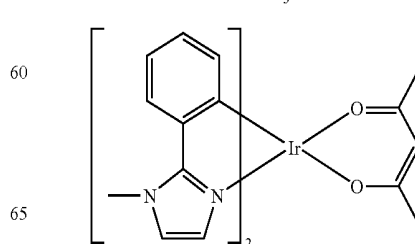
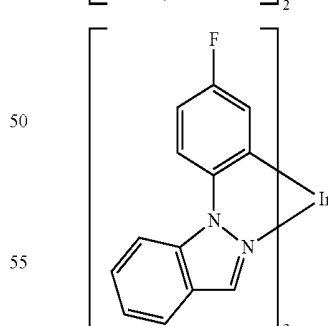
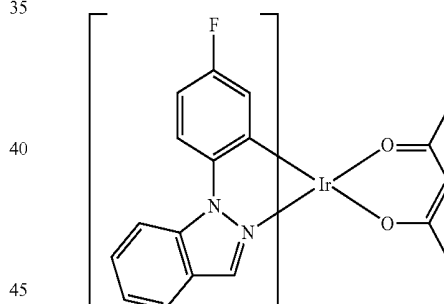
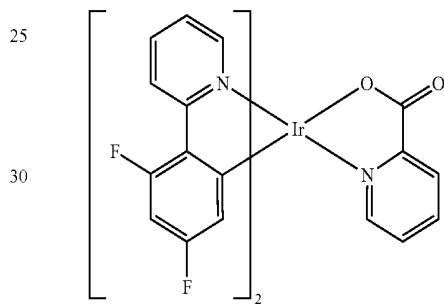
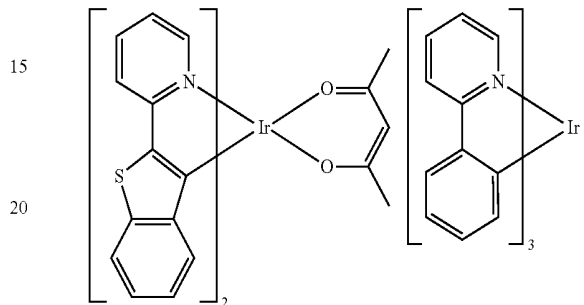
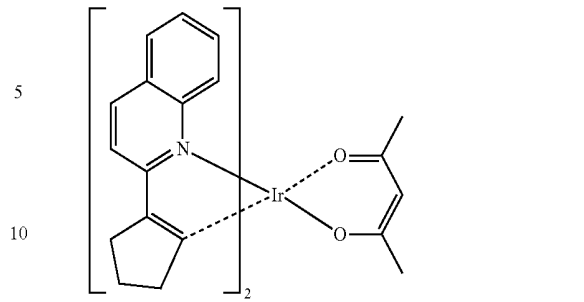
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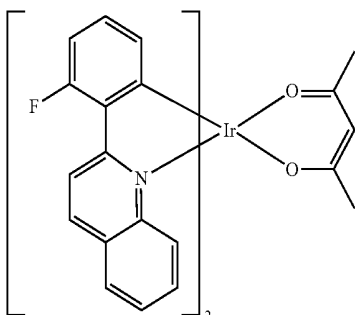
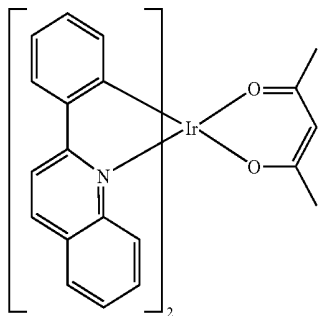
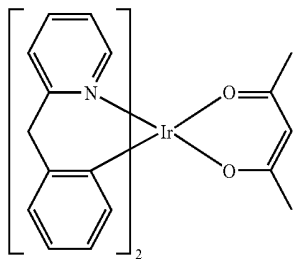
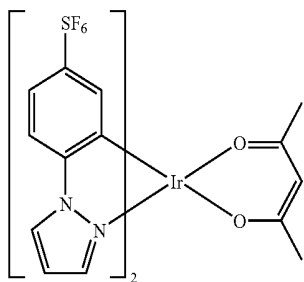
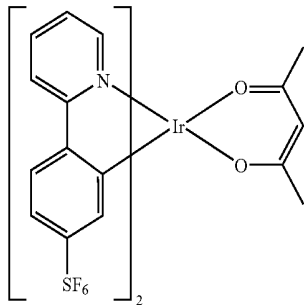
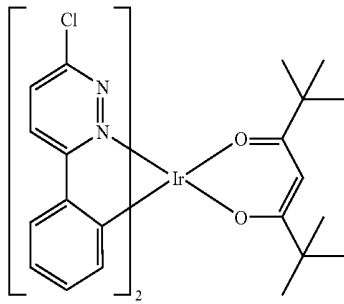
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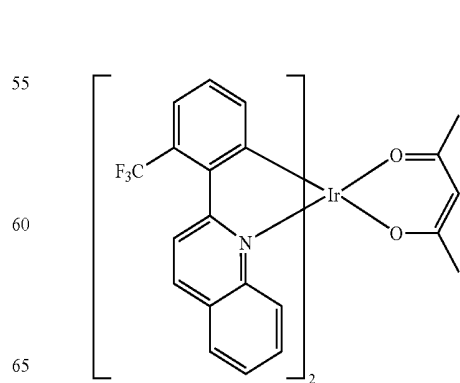
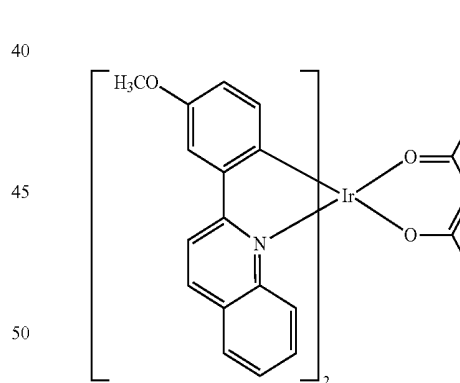
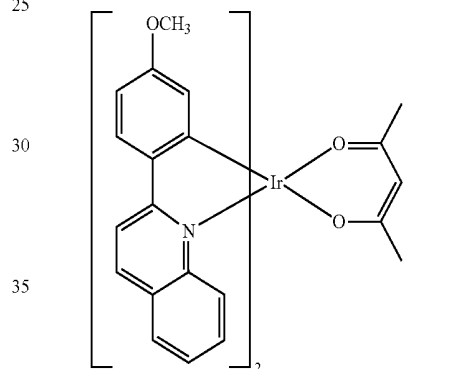
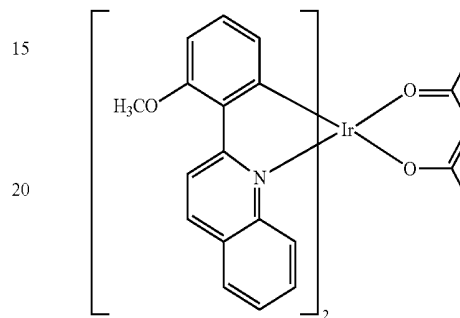
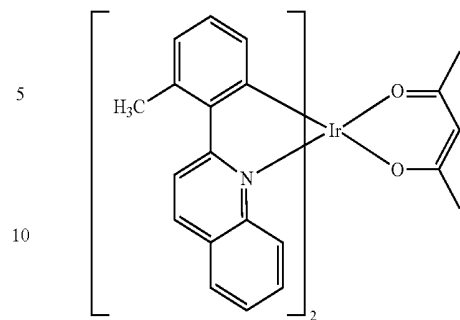
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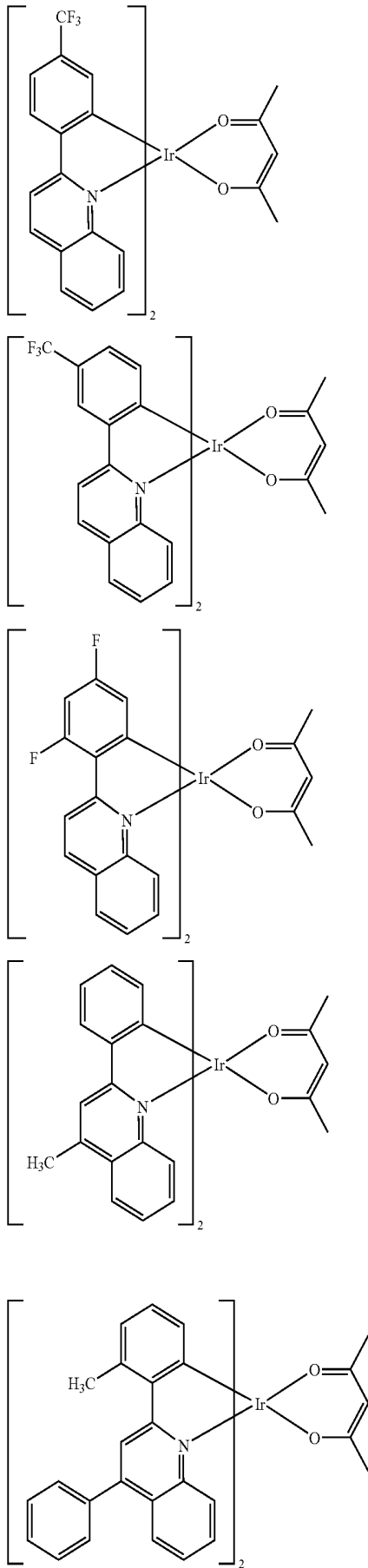
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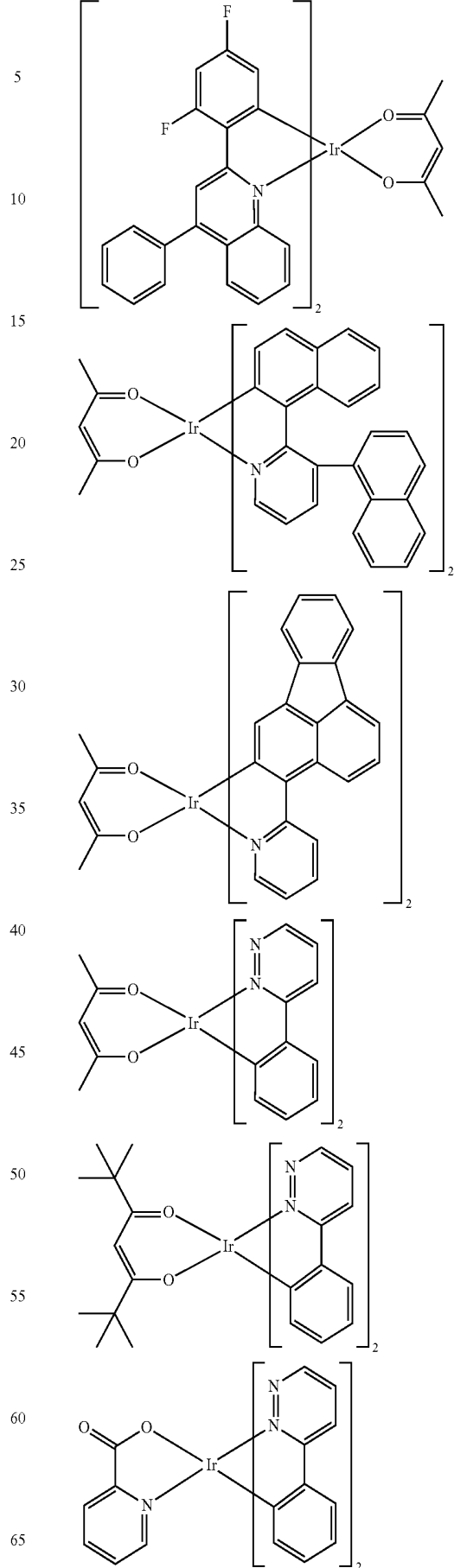
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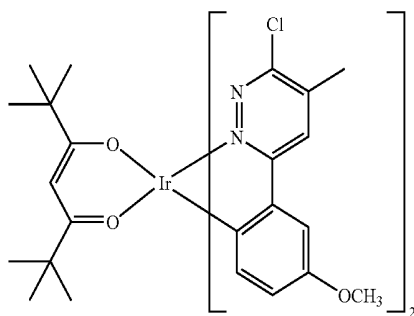
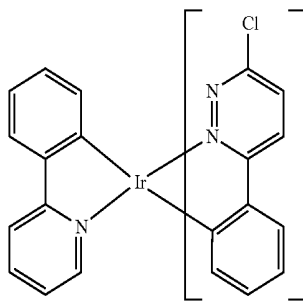
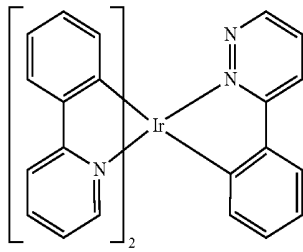
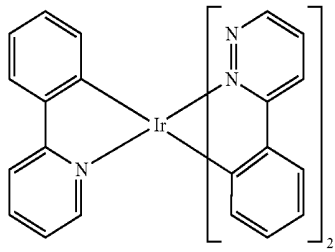
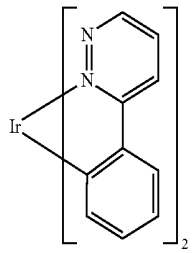
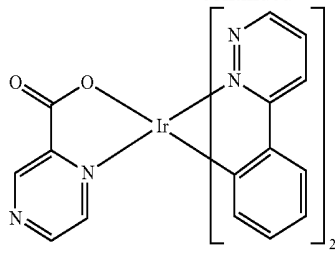
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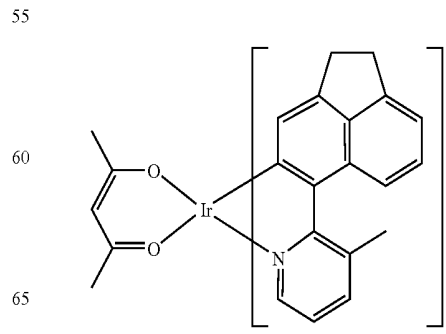
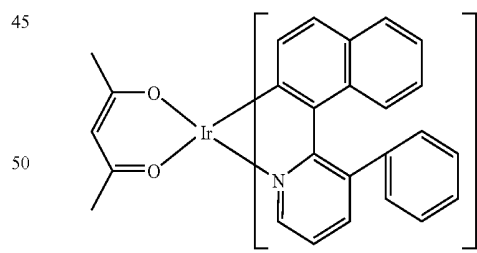
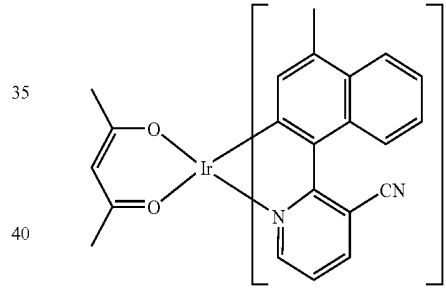
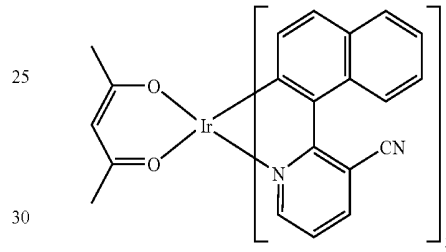
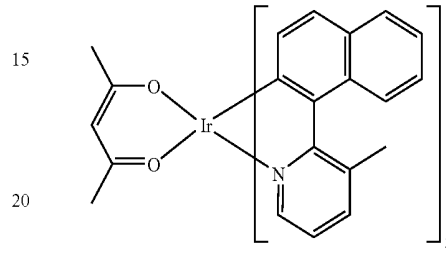
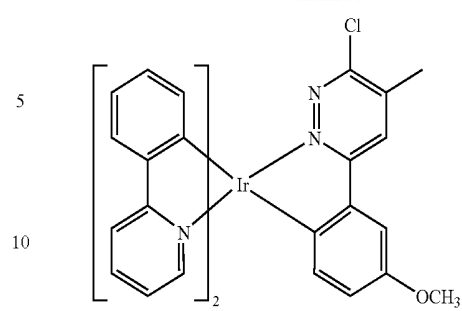
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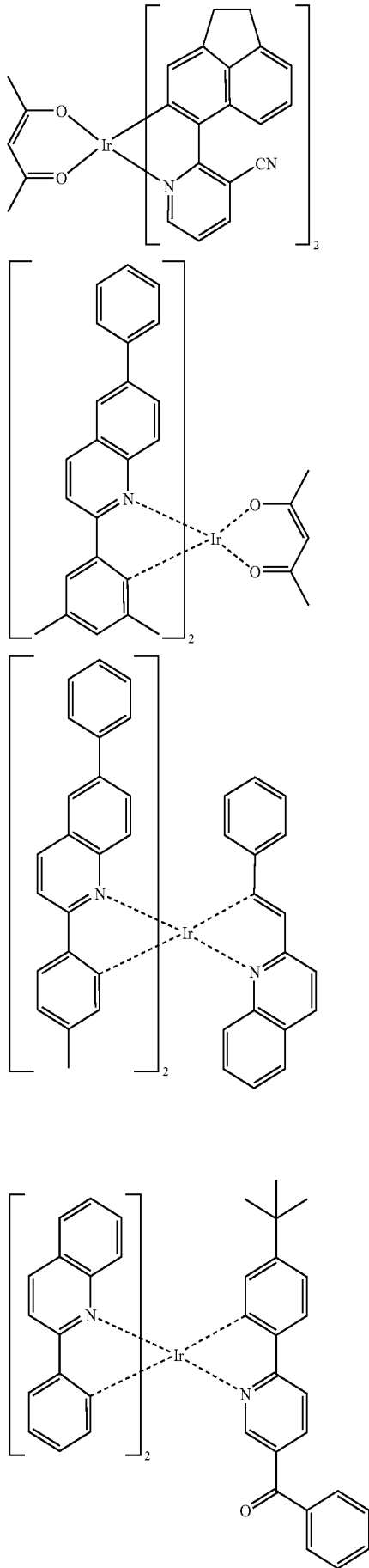
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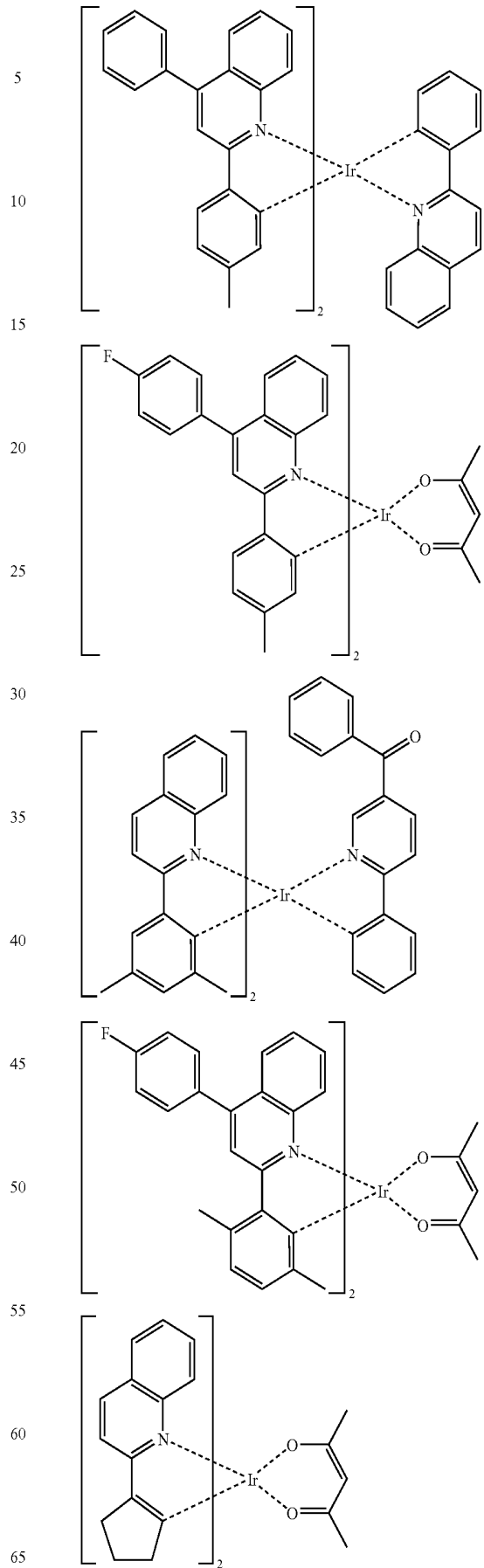
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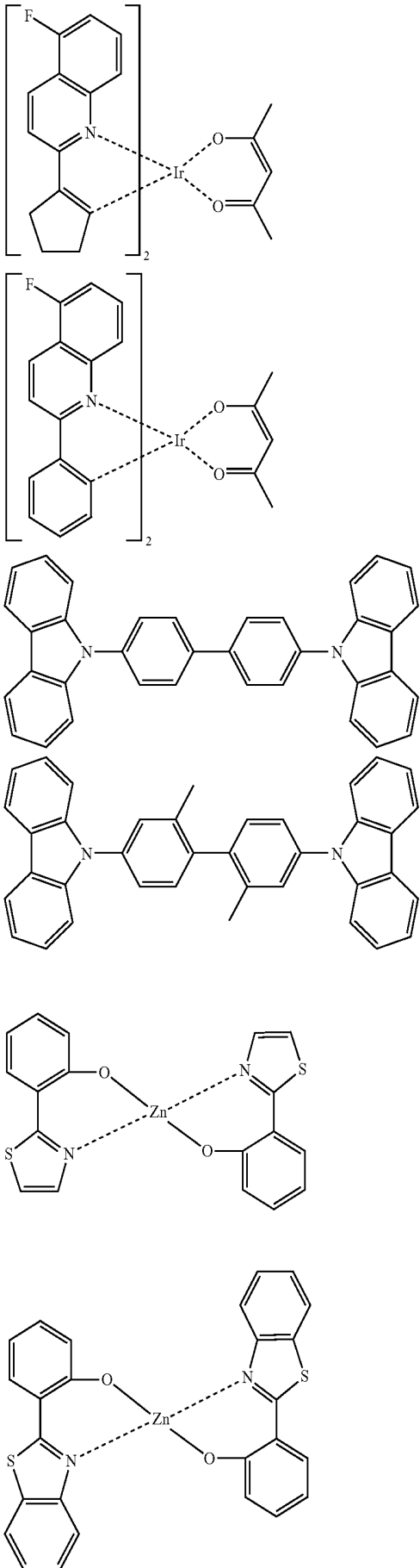
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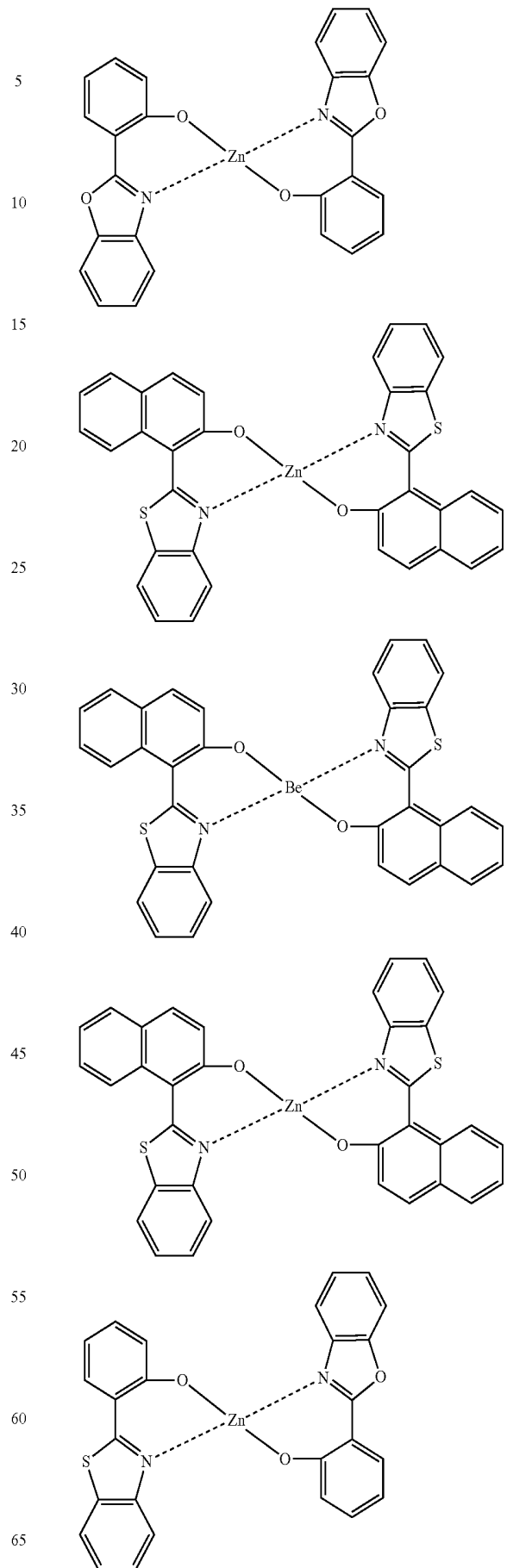
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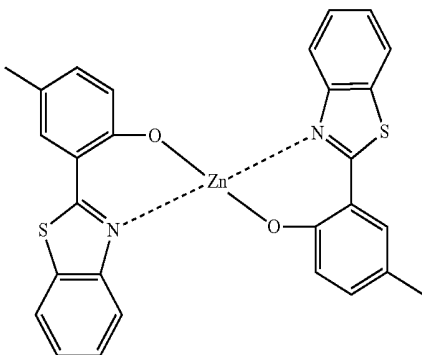
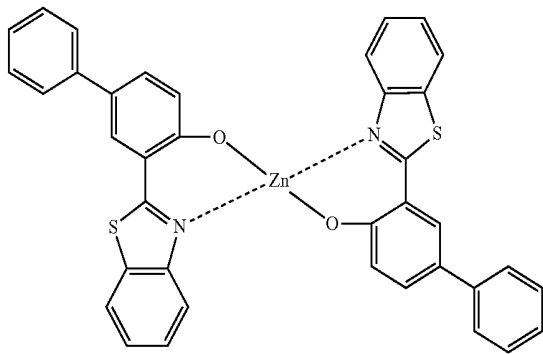
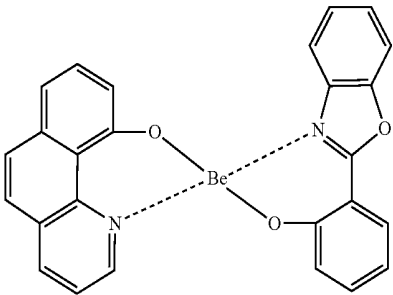
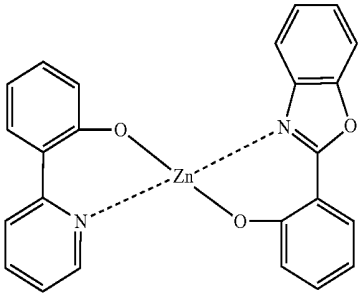
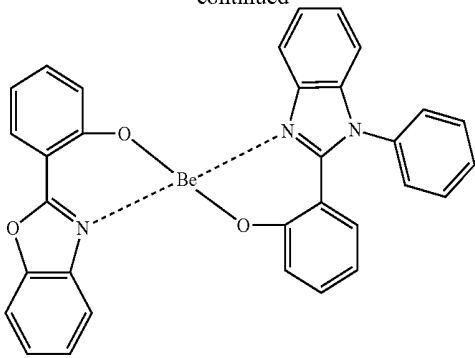


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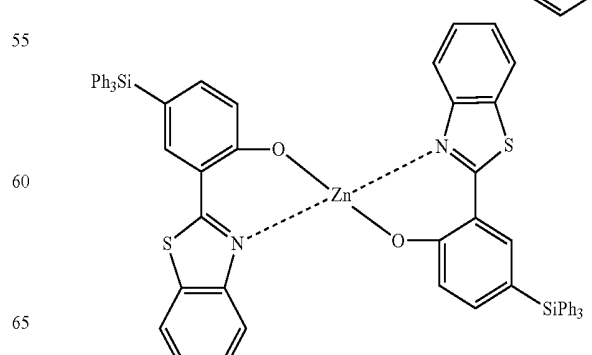
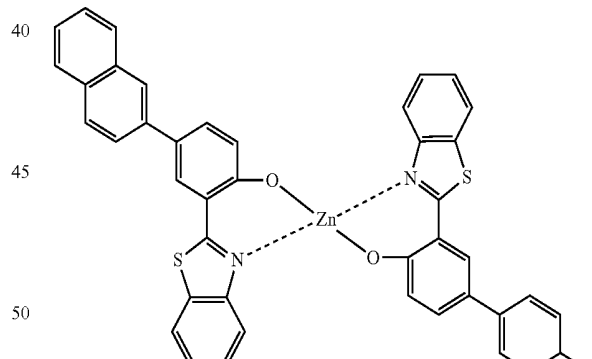
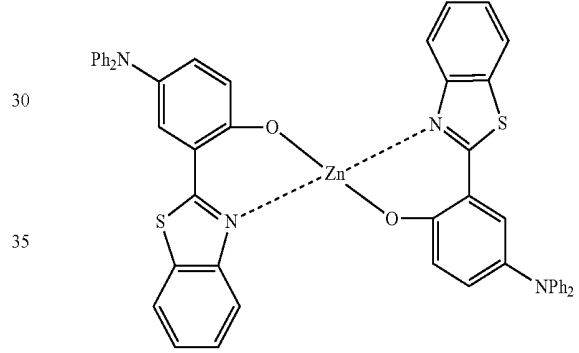
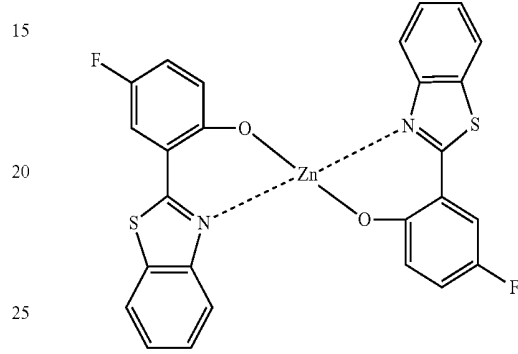
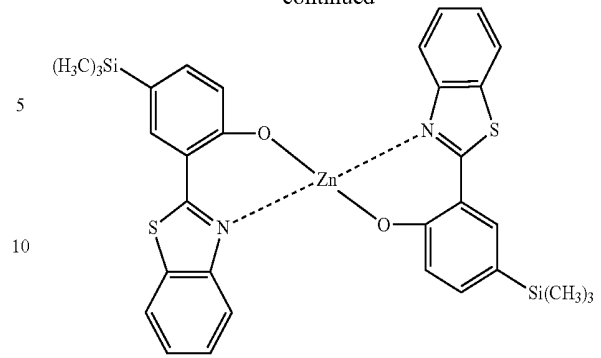
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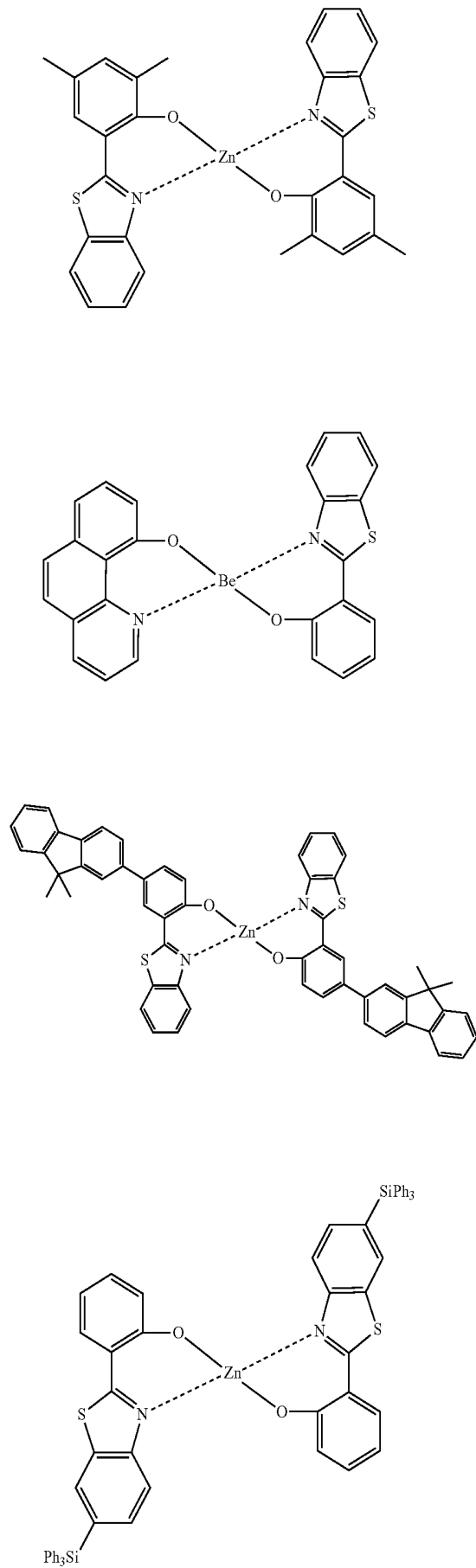
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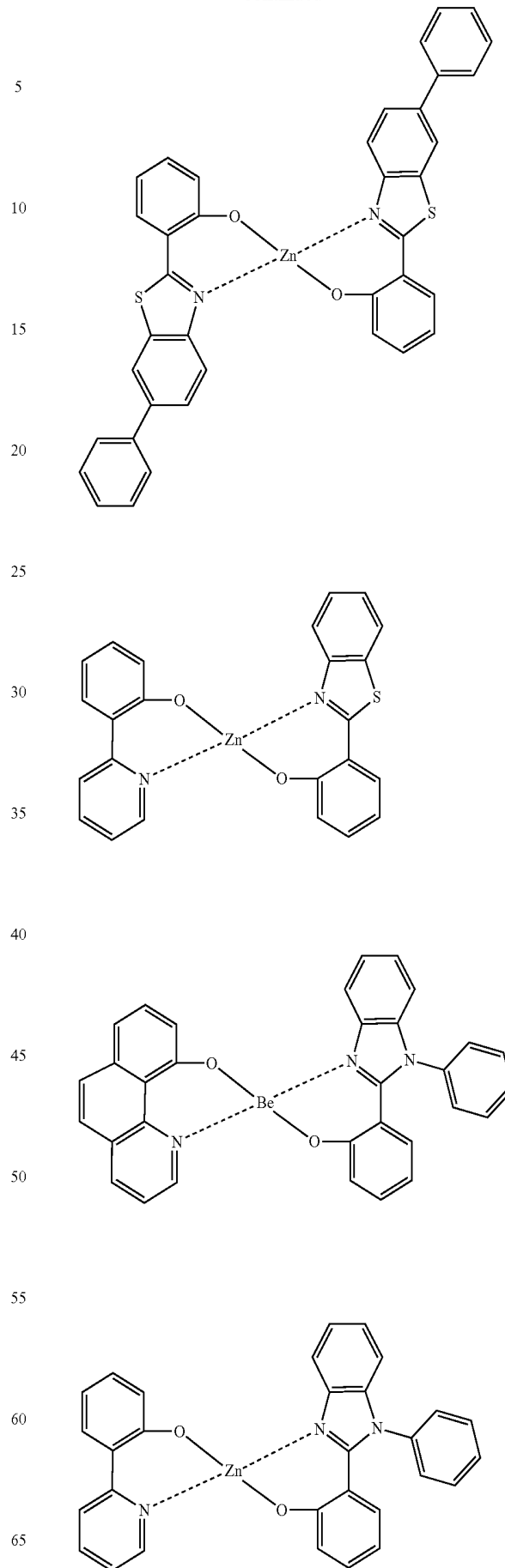
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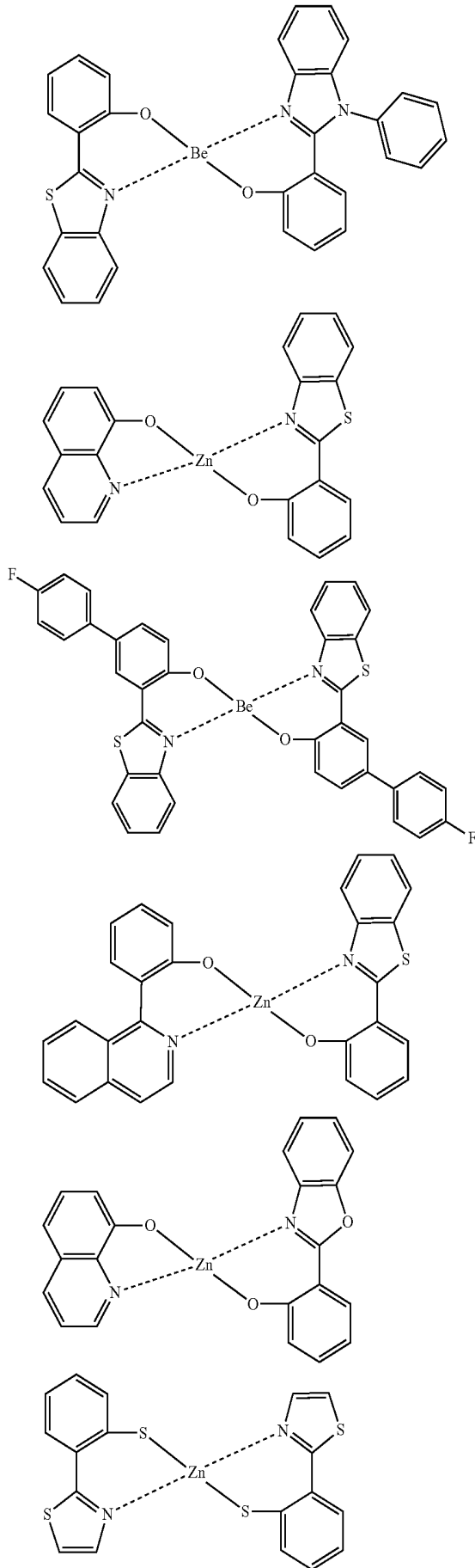
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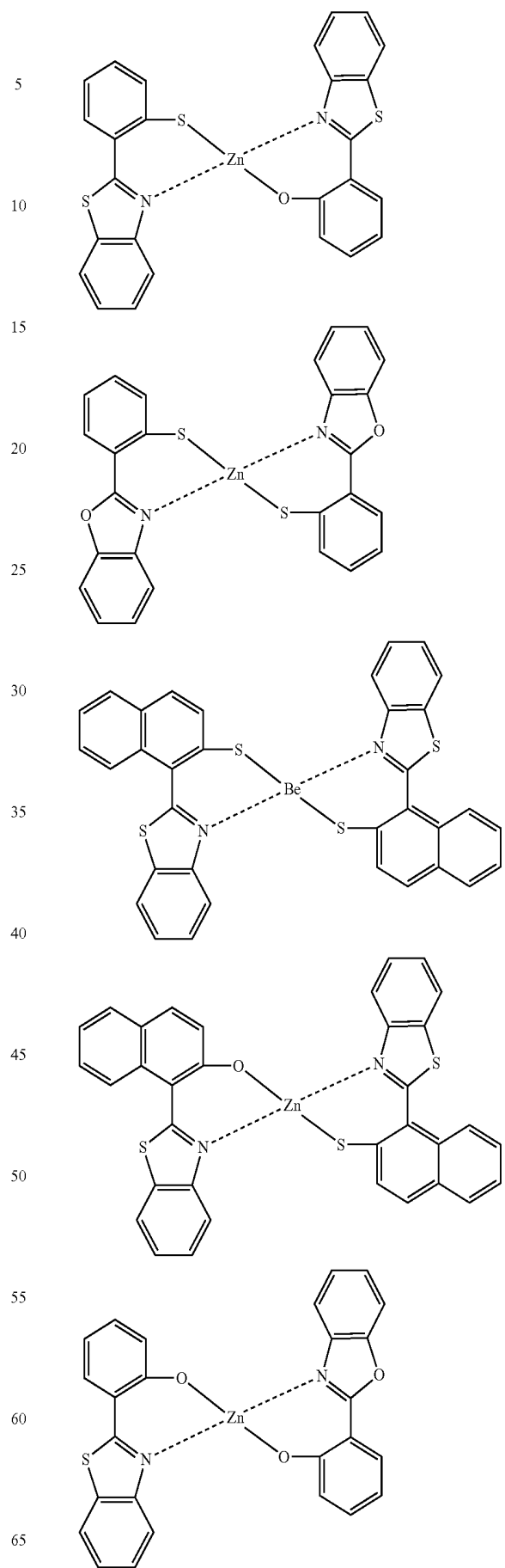
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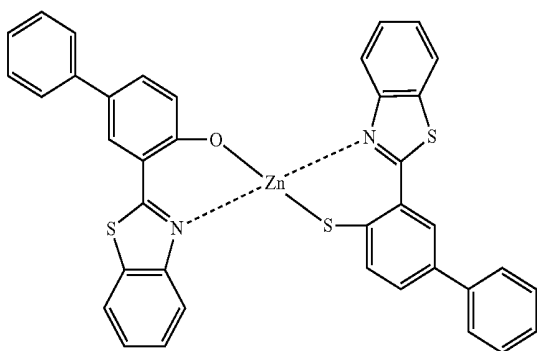
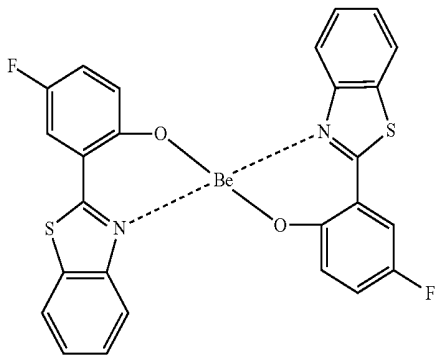
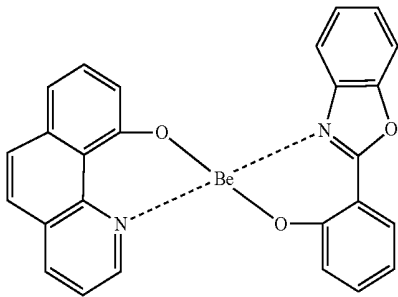
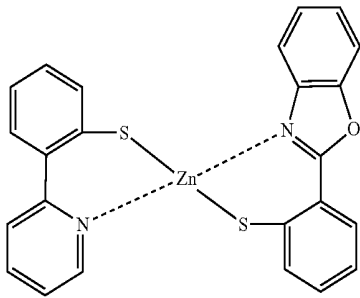
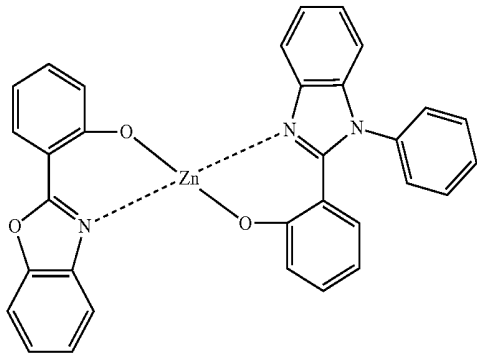
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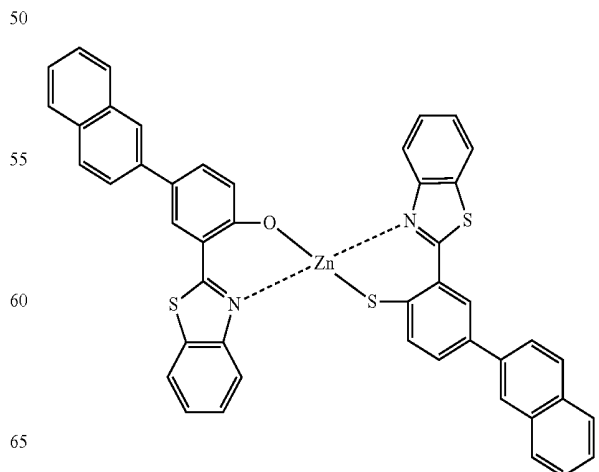
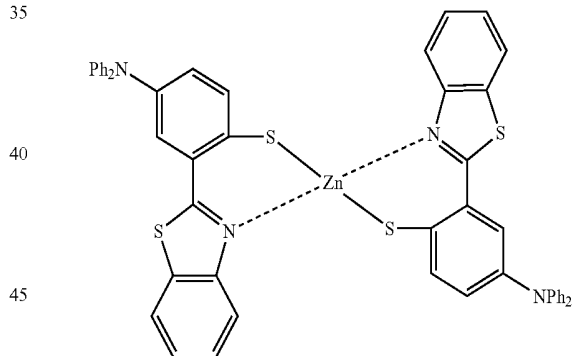
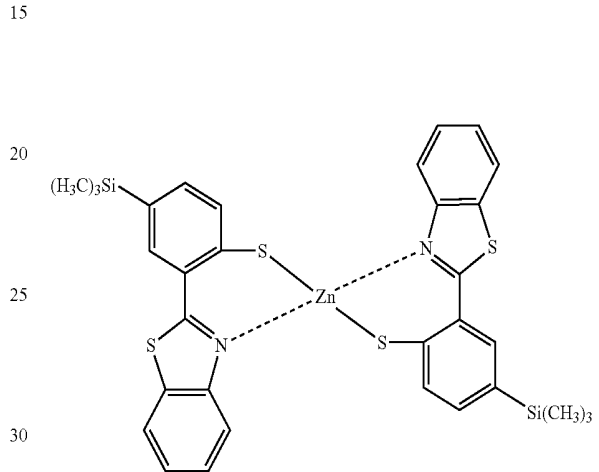
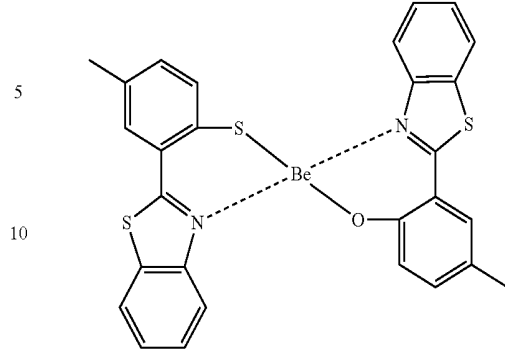
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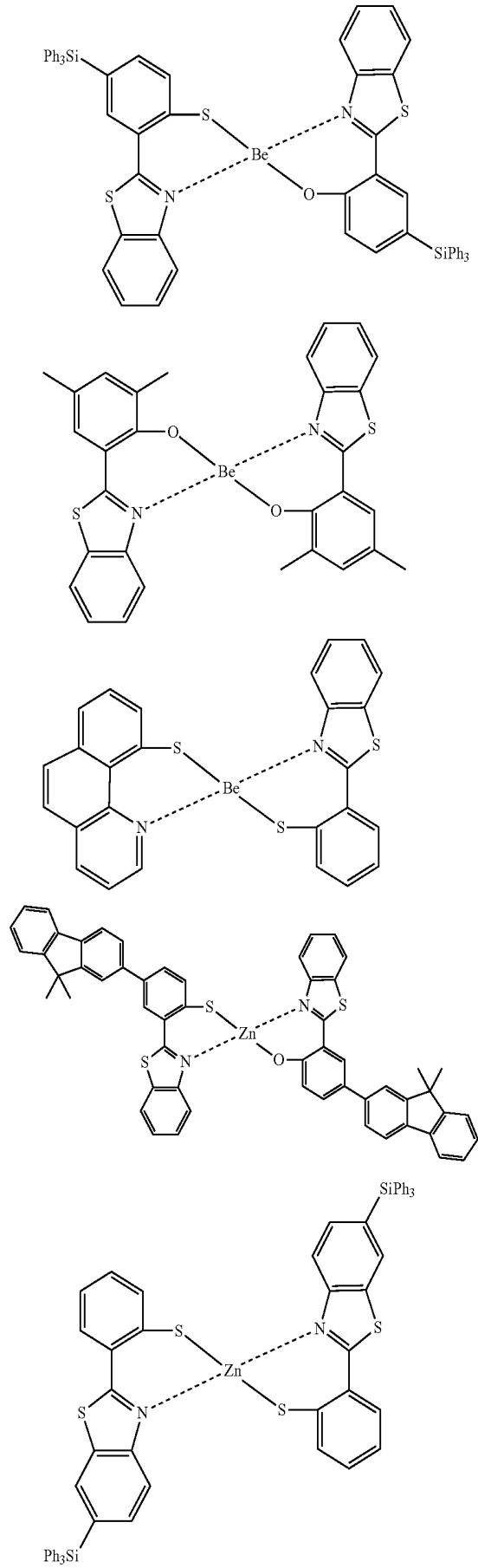
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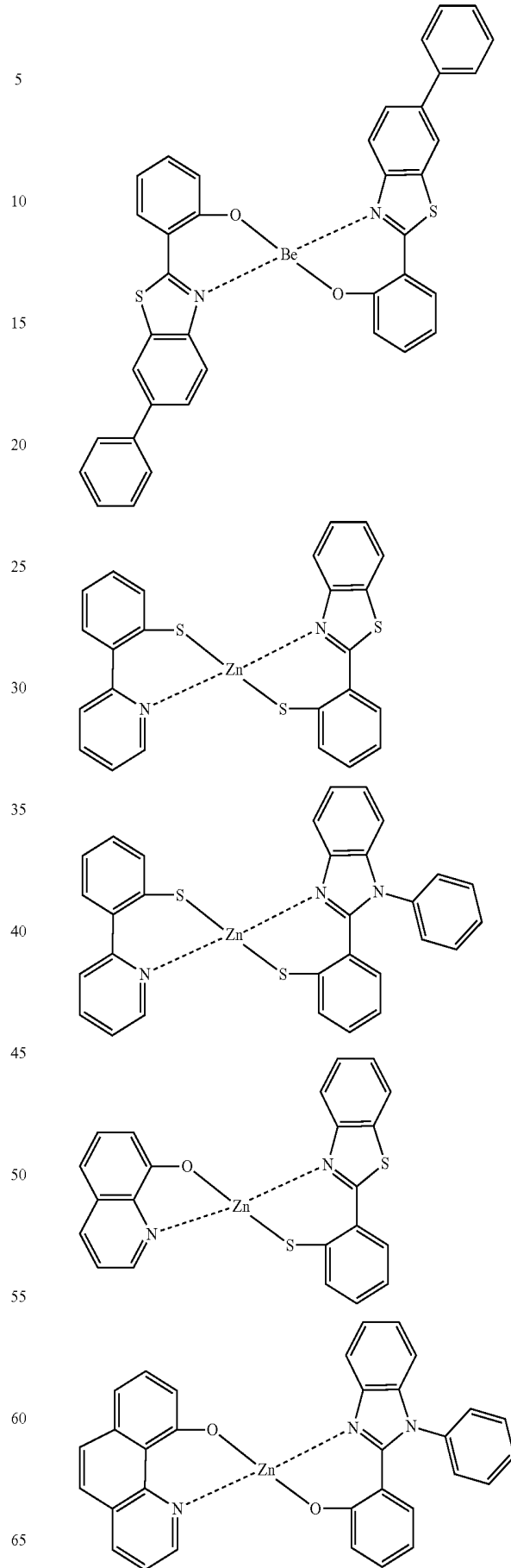
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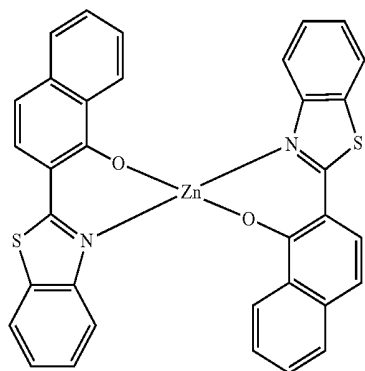
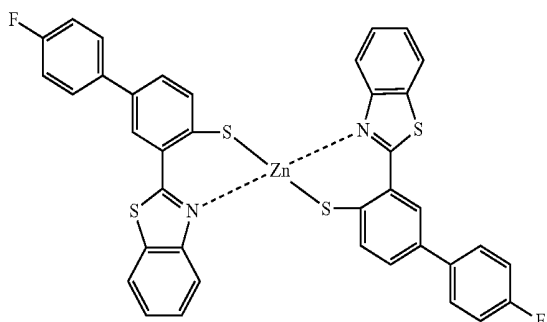
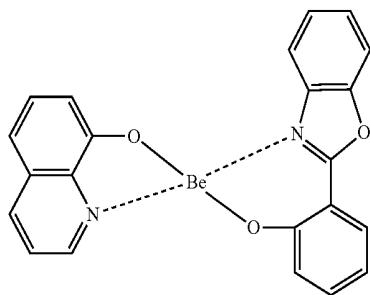
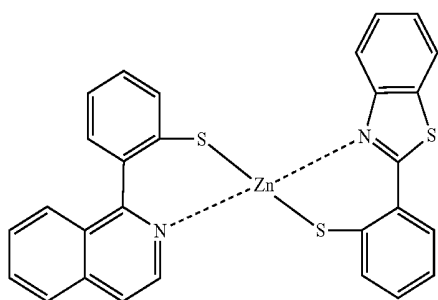
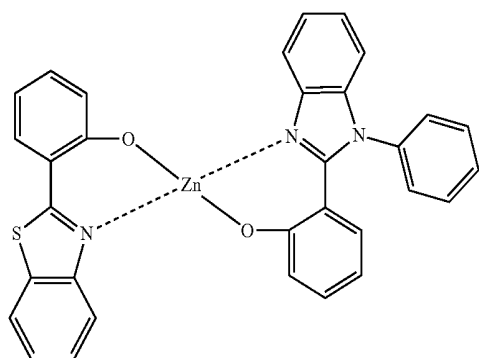
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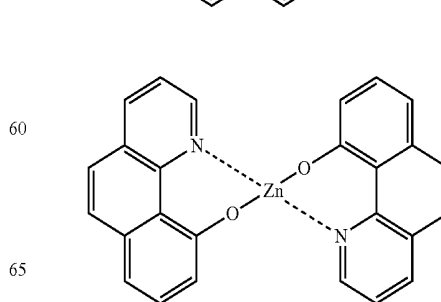
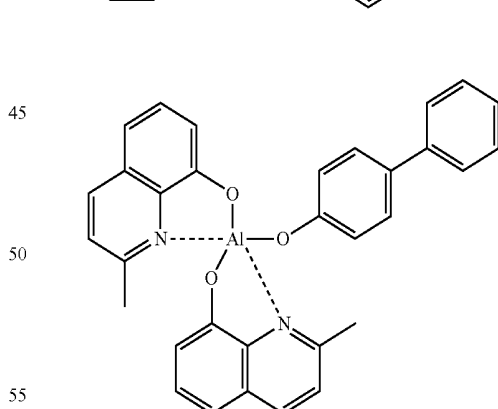
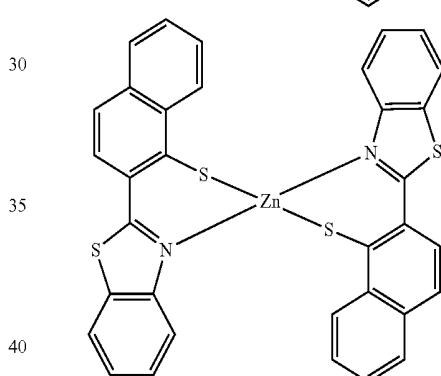
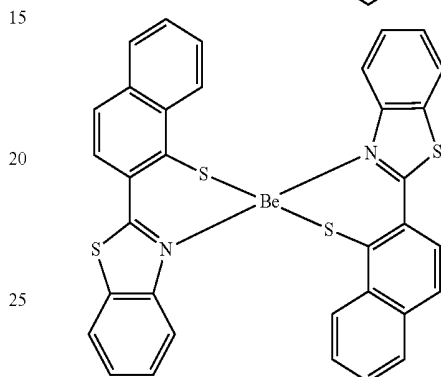
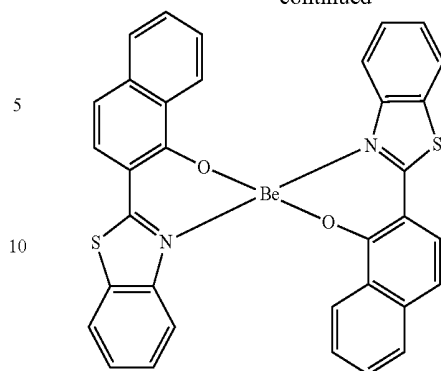
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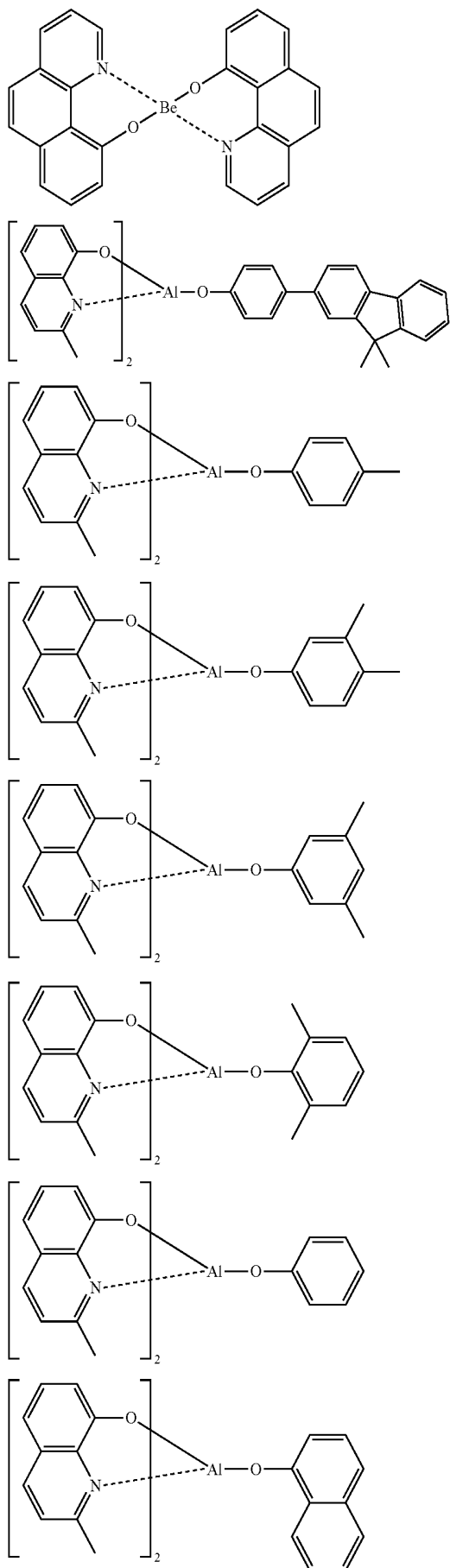


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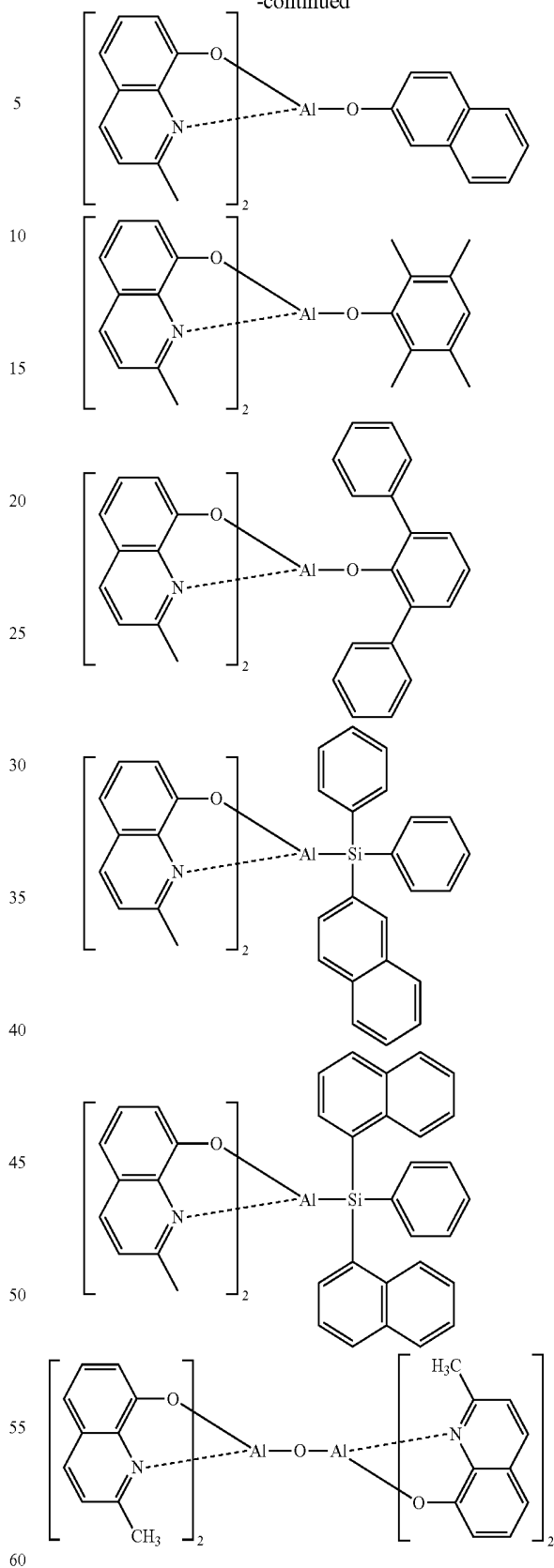
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In an organic electroluminescent device according to the present invention, it is preferable to place one or more layer(s) (here-in-below, referred to as the "surface layer") selected from chalcogenide layers, metal halide layers and metal oxide layers, on the inner surface of at least one side of the pair of electrodes. Specifically, it is preferable to arrange a chalc-

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genide layer of silicon and aluminum metal (including oxides) on the anode surface of the EL medium layer, and a metal halide layer or a metal oxide layer on the cathode surface of the EL medium layer. As the result, stability in operation can be obtained.

Examples of chalcogenides preferably include SiO_x ($1 \leq x \leq 2$), AlO_x ($1 \leq x \leq 1.5$), SiON , SiAlON , or the like. Examples of metal halides preferably include LiF , MgF_2 , CaF_2 , fluorides of rare earth metal, or the like. Examples of metal oxides preferably include Cs_2O , Li_2O , MgO , SrO , BaO , CaO , or the like.

In an organic electroluminescent device according to the present invention, it is also preferable to arrange, on at least one surface of the pair of electrodes thus manufactured, a mixed region of electron transport compound and a reductive dopant, or a mixed region of a hole transport compound with an oxidative dopant. Accordingly, the electron transport compound is reduced to an anion, so that injection and transportation of electrons from the mixed region to an EL medium are facilitated. In addition, since the hole transport compound is oxidized to form a cation, injection and transportation of holes from the mixed region to an EL medium are facilitated. Preferable oxidative dopants include various Lewis acids and acceptor compounds. Preferable reductive dopants include alkali metals, alkali metal compounds, alkaline earth metals, rare-earth metals, and mixtures thereof.

The organic electroluminescent compounds according to the invention, having high luminous efficiency and excellent color purity and life property of material, can be advantageously employed for manufacturing OLED's having very good operation life.

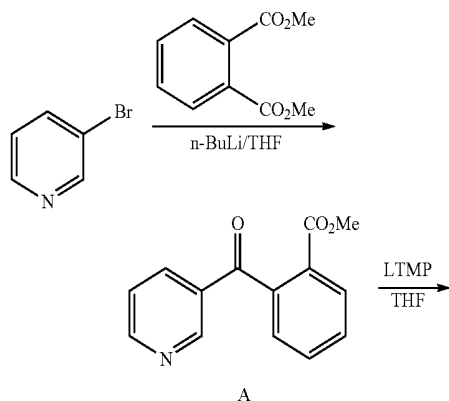
BEST MODE

The present invention is further described with respect to the representative compounds of the invention, by describing the organic electroluminescent compounds, the processes for preparing the same, and luminescent properties of the device manufactured therefrom in the Examples below, which are provided for illustration of the embodiments only but are not intended to limit the scope of the invention by any means.

PREPARATION EXAMPLES

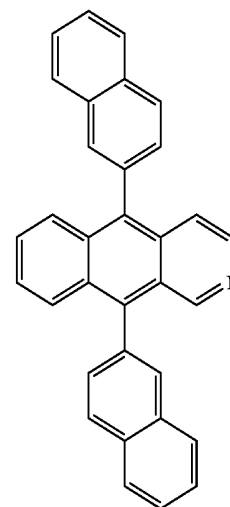
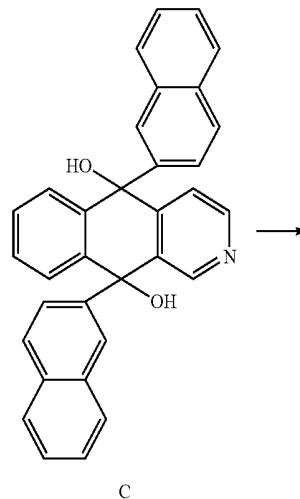
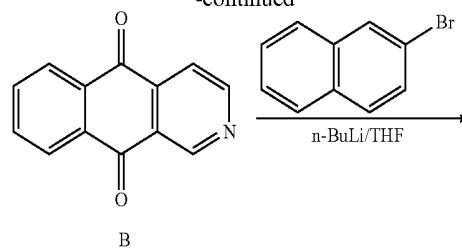
Preparation Example 1

Preparation of Compound (8)



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Preparation of Compound (A)

Under nitrogen atmosphere, a 50 mL round-bottomed flask was charged with 3-bromopyridine (96 μL , 1 mmol) and diethyl ether (10 mL), and the mixture was stirred. After chilling the mixture to -78°C ., butyllithium (2.5 mL, 1 mmol, 2.5 M in hexane) was slowly added thereto. After stirring for 1 hour at -78°C ., dimethyl phthalate (0.17 mL, 1 mmol) was slowly added at the same temperature. After stirring at -78°C for 2 hours, the temperature was slowly raised to room temperature, and water (5 mL) was added thereto to carry out hydrolysis. The organic layers obtained therefrom by extraction with ether were combined and dried. After removing the solvent, the residue was purified via column chromatography to obtain Compound (A) (0.14 g, 56%) as solid product.

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Preparation of Compound (B)

Under nitrogen atmosphere, a 50 mL round-bottomed flask was charged with Compound (A) (0.11 g, 0.44 mmol) and THF (5 mL), and the mixture was stirred. LTMP solution (10 mL) was added thereto at 0° C., and the resultant mixture was stirred at the same temperature for 2 hours. Then the temperature was slowly raised to room temperature, and water (5 mL) was added thereto to carry out hydrolysis. The mixture was extracted with ethyl acetate and the combined organic layer was dried and evaporated to remove the solvent. The residue was purified via column chromatography to obtain Compound (B) (41 mg, 44%) as solid product.

Preparation of Compound (C)

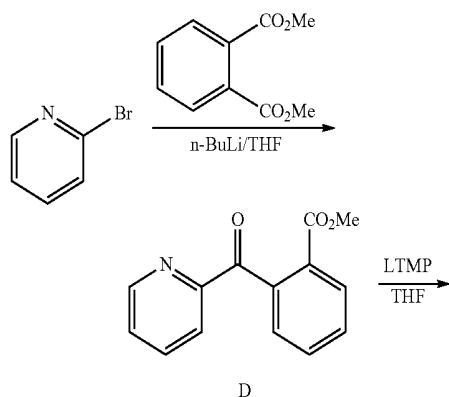
Under nitrogen atmosphere, a 250 mL round-bottomed flask was charged with 2-bromonaphthalene (3 g, 14.5 mmol) and THF (80 mL), and the mixture was stirred. After chilling the mixture to -78° C., n-butyllithium (30 mL, 12 mmol, 2.5 M in hexane) was slowly added thereto. The resultant mixture was stirred at -78° C. for 1 hour, and Compound (B) (1 g, 4.83 mmol) was slowly added thereto at the same temperature. The mixture was stirred for 12 hours while slowly raising the temperature to room temperature. The combined organic layer obtained therefrom by extraction with ethyl acetate was dried and evaporated to remove the solvent. The residue was purified via column chromatography to obtain Compound (C) (1.4 g, 63%) as solid product.

Preparation of Compound (8)

Under nitrogen atmosphere, a 100 mL round-bottomed flask was charged with Compound (C) (1 g, 2.15 mmol), potassium iodide (1.4 g, 8.59 mmol), sodium dihydrophosphate (1.37 g, 12.89 mmol) and acetic acid (40 mL). The mixture was stirred under reflux for 24 hours, and the solid generated was filtered, and washed sequentially with acetic acid, water and hexane. The solid was dried and recrystallized from ethyl acetate to obtain Compound (8) (0.53 g, 57%) as solid product.

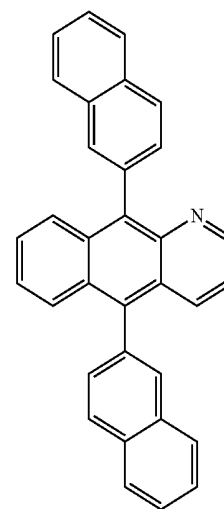
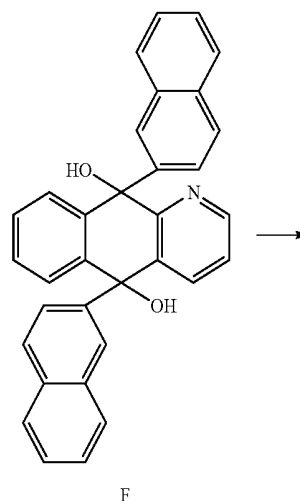
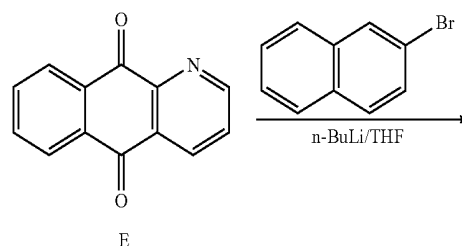
Preparation Example 2

Preparation of Compound (383)



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383

Preparation of Compound (D)

Under nitrogen atmosphere, a 50 mL round-bottomed flask was charged with 2-bromopyridine (96 μ L, 1 mmol) and diethyl ether (10 mL), and the mixture was stirred. After chilling the mixture to -78° C., butyllithium (2.5 mL, 1 mmol, 2.5 M in hexane) was slowly added thereto. After stirring at -78° C. for 1 hour, dimethyl phthalate (0.17 mL, 1 mmol) was slowly added at the same temperature. After stirring at -78° C. for 2 hours, the temperature was slowly raised to room temperature, and water (5 mL) was added thereto to carry out hydrolysis. The combined organic layer obtained therefrom by extraction with ether was dried. After removing the solvent, the residue was purified via column chromatography to obtain Compound (D) (0.14 g, 56%) as solid product.

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Preparation of Compound (E)

Under nitrogen atmosphere, a 50 mL round-bottomed flask was charged with Compound (D) (0.11 g, 0.44 mmol) and THF (5 mL), and the mixture was stirred. LTMP solution (10 mL) was added thereto at 0° C., and the resultant mixture was stirred at the same temperature for 2 hours. Then the temperature was slowly raised to room temperature, and water (5 mL) was added thereto to carry out hydrolysis. The mixture was extracted with ethyl acetate and the combined organic layer was dried and evaporated to remove the solvent. The residue was purified via column chromatography to obtain Compound (E) (41 mg, 44%) as solid product.

Preparation of Compound (F)

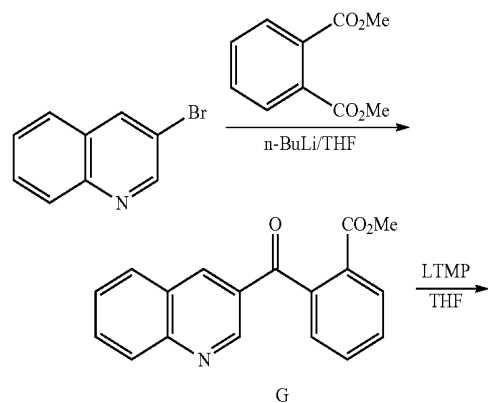
Under nitrogen atmosphere, a 250 mL round-bottomed flask was charged with 2-bromonaphthalene (3 g, 14.5 mmol) and THF (80 mL), and the mixture was stirred. After chilling the mixture to -78° C., butyllithium (30 mL, 12 mmol, 2.5 M in hexane) was slowly added thereto. The resultant mixture was stirred at -78° C. for 1 hour, and Compound (E) (1 g, 4.83 mmol) was slowly added thereto at the same temperature. The mixture was stirred for 12 hours while slowly raising the temperature to room temperature. The combined organic layer obtained therefrom by extraction with ethyl acetate was dried and evaporated to remove the solvent. The residue was purified via column chromatography to obtain Compound (F) (1.4 g, 63%) as solid product.

Preparation of Compound (383)

Under nitrogen atmosphere, a 100 mL round-bottomed flask was charged with Compound (F) (1 g, 2.15 mmol), potassium iodide (1.4 g, 8.59 mmol), sodium dihydrophosphate (1.37 g, 12.89 mmol) and acetic acid (40 mL). The mixture was stirred under reflux for 24 hours, and the solid generated was filtered, and washed sequentially with acetic acid, water and hexane. The solid was dried and recrystallized from ethyl acetate to obtain Compound (383) (0.53 g, 57%) as solid product.

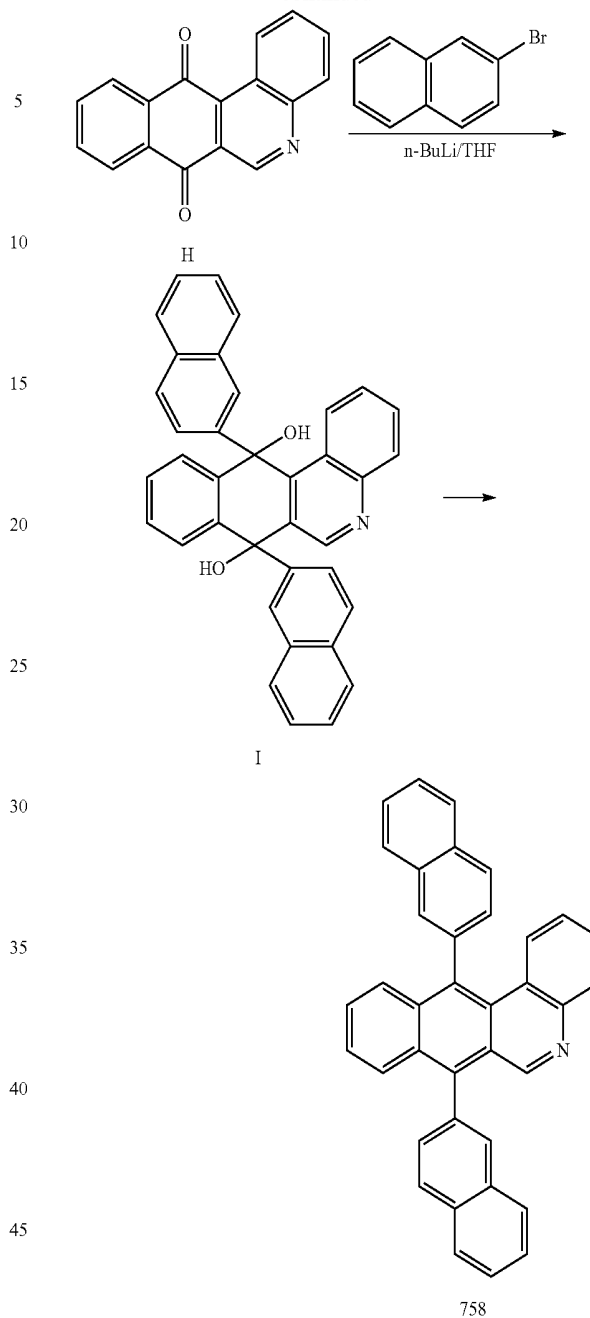
Preparation Example 3

Preparation of Compound (758)



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Preparation of Compound (G)

Under nitrogen atmosphere, a 50 mL round-bottomed flask was charged with 3-bromoquinoline (96 μL , 1 mmol) and diethyl ether (10 mL), and the mixture was stirred. After chilling the mixture to -78° C., butyllithium (2.5 mL, 1 mmol, 2.5 M in hexane) was slowly added thereto. After stirring at -78° C. for 1 hour, dimethyl phthalate (0.17 mL, 1 mmol) was slowly added at the same temperature. After stirring at -78° C. for 2 hours, the temperature was slowly raised to room temperature, and water (5 mL) was added thereto to carry out hydrolysis. The combined organic layer obtained therefrom by extraction with ether was dried. After removing the solvent, the residue was purified via column chromatography to obtain Compound (G) (0.14 g, 56%) as solid product.

Preparation of Compound (H)

Under nitrogen atmosphere, a 50 mL round-bottomed flask was charged with Compound (G) (0.11 g, 0.44 mmol) and THF (5 mL), and the mixture was stirred. LTMP solution (10 mL) was added thereto at 0° C., and the resultant mixture was stirred at the same temperature for 2 hours. Then the temperature was slowly raised to room temperature, and water (5 mL) was added thereto to carry out hydrolysis. The mixture was extracted with ethyl acetate and the combined organic layer was dried and evaporated to remove the solvent. The residue was purified via column chromatography to obtain Compound (H) (41 mg, 44%) as solid product.

Preparation of Compound (I)

Under nitrogen atmosphere, a 250 mL round-bottomed flask was charged with 2-bromonaphthalene (3 g, 14.5 mmol) and THF (80 mL), and the mixture was stirred. After chilling the mixture to -78° C., butyllithium (30 mL, 12 mmol, 2.5 M in hexane) was slowly added thereto. The resultant mixture was stirred at -78° C. for 1 hour, and Compound (H) (1 g, 4.83

mmol) was slowly added thereto at the same temperature. The mixture was stirred for 12 hours while slowly raising the temperature to room temperature. The combined organic layer obtained therefrom by extraction with ethyl acetate was dried and evaporated to remove the solvent. The residue was purified via column chromatography to obtain Compound (I) (1.4 g, 63%) as solid product.

Preparation of Compound (758)

Under nitrogen atmosphere, a 100 mL round-bottomed flask was charged with Compound (I) (1 g, 2.15 mmol), potassium iodide (1.4 g, 8.59 mmol), sodium dihydrophosphate (1.37 g, 12.89 mmol) and acetic acid (40 mL). The mixture was stirred under reflux for 24 hours, and the solid generated was filtered, and washed sequentially with acetic acid, water and hexane. The solid was dried and recrystallized from ethyl acetate to obtain Compound (758) (0.53 g, 57%) as solid product.

According to the procedure of Preparation Examples 1 to 3, organic electroluminescent compounds (Compounds 1 to 1215) were prepared, and the ¹H NMR and MS/FAB data are shown in Table 1.

TABLE 1

compound	¹ H NMR(CDCl ₃ , 200 MHz)	MS/FAB	
		found	calculated
1	δ = 2.64 (6H, s), 7.57 (1H, m), 7.67 (2H, m), 8.16 (2H, m), 8.41 (1H, m), 8.98 (1H, m)	207.27	207.10
7	δ = 7.41 (2H, m), 7.5~7.52 (9H, m), 7.67 (2H, m), 8.45 (1H, m), 8.54 (2H, m), 8.91 (1H, s)	331.41	331.14
8	δ = 7.5 (1H, m), 7.58~7.59 (6H, m), 7.67 (2H, m), 7.73 (2H, m), 7.92 (2H, m), 8 (4H, m), 8.45 (1H, m), 8.54 (2H, m), 8.91 (1H, s)	431.53	431.17
9	δ = 7.50~7.55 (5H, m), 7.61~7.67 (4H, m), 8.04~8.08 (4H, m), 8.42~8.45 (3H, m), 8.54~8.55 (4H, m), 8.91 (1H, s)	431.53	431.17
10	δ = 7.5 (1H, m), 7.67 (2H, m), 7.82~7.93 (10H, m), 8.12 (4H, m), 8.45 (1H, m), 8.54 (2H, m), 8.91~8.93 (5H, m)	531.64	531.20
11	δ = 1.72 (12H, s), 7.28 (2H, m), 7.38 (2H, m), 7.5~7.55 (3H, m), 7.63~7.67 (4H, m), 7.77 (2H, m), 7.87~7.93 (4H, m), 8.45 (1H, m), 8.54 (2H, m), 8.91 (1H, s)	563.73	563.26
12	δ = 7.25 (8H, m), 7.41 (2H, m), 7.5~7.52 (9H, m), 7.67 (2H, m), 8.45 (1H, m), 8.54 (2H, m), 8.91 (1H, s)	483.60	483.20
20	δ = 1.35 (18H, s), 7.37~7.38 (8H, m), 7.5 (1H, m), 7.67 (2H, m), 8.45 (1H, m), 8.54 (2H, m), 8.91 (1H, m)	443.62	443.26
24	δ = 2.34 (12H, s), 7.31 (2H, m), 7.5 (1H, m), 7.6 (4H, m), 7.67 (2H, m), 8.45 (1H, m), 8.54 (2H, m), 8.91 (1H, s)	387.52	387.20
41	δ = 1.72 (12H, s), 7.28~7.38 (6H, m), 7.5~7.55 (5H, m), 7.63~7.67 (4H, m), 7.87 (2H, m), 8.45 (1H, m), 8.54 (2H, m), 8.91 (1H, s)	563.73	563.26
80	δ = 2.88 (8H, m), 6.58 (4H, m), 6.76 (4H, m), 7.02~7.04 (8H, m), 7.43 (1H, m), 7.67 (2H, m), 8.16 (2H, m), 8.42 (1H, m), 8.84 (1H, s)	565.70	565.25
117	δ = 7.25 (8H, m), 7.5 (1H, m), 7.58~7.59 (6H, m), 7.67 (2H, m), 7.73 (2H, m), 7.92 (2H, m), 8 (4H, m), 8.45 (1H, m), 8.54 (2H, m), 8.91 (1H, s)	583.72	583.23
118	δ = 7.25 (8H, m), 7.50~7.55 (5H, m), 7.61~7.67 (4H, m), 8.04~8.08 (4H, m), 8.42~8.45 (3H, m), 8.54~8.55 (4H, m), 8.91 (1H, s)	583.72	583.23
120	δ = 7.48~7.7 (17H, m), 8.04~8.08 (4H, m), 8.42~8.45 (3H, m), 8.54~8.55 (4H, m), 8.91 (1H, s)	583.72	583.23
122	δ = 7.47~7.5 (5H, m), 7.58~7.59 (6H, m), 7.67 (2H, m), 7.73 (2H, m), 7.85 (4H, m), 7.92 (2H, m), 8 (4H, m), 8.45 (1H, m), 8.54 (2H, m), 8.91 (1H, s)	583.72	583.23
124	δ = 7.25 (8H, m), 7.41~7.52 (15H, m), 7.67 (2H, m), 7.85 (4H, m), 8.45 (1H, m), 8.54 (2H, m), 8.91 (1H, s)	635.79	635.26
126	δ = 1.72 (12H, s), 7.28 (2H, m), 7.38 (2H, m), 7.47~7.55 (7H, m), 7.63~7.67 (4H, m), 7.77 (2H, m), 7.85~7.93 (8H, m), 8.45 (1H, m), 8.54 (2H, m), 8.91 (1H, s)	715.92	715.32
140	δ = 1.72 (6H, s), 7.28 (1H, m), 7.38~7.41 (2H, m), 7.5~7.55 (6H, m), 7.63~7.67 (3H, m), 7.77 (1H, m), 7.87~7.93 (2H, m), 8.45 (1H, m), 8.54 (2H, m), 8.91 (1H, s)	447.57	447.20

TABLE 1-continued

compound	¹ H NMR(CDCl ₃ , 200 MHz)	MS/FAB	
		found	calculated
152	δ = 7.41 (2H, m), 7.5~7.55 (9H, m), 7.67 (2H, m), 7.79 (2H, m), 8.01 (2H, m), 8.45 (1H, m), 8.54~8.55 (4H, m), 8.91 (1H, s)	457.56	457.18
153	δ = 7.25 (4H, m), 7.41 (1H, m), 7.5~7.55 (7H, m), 7.61~7.67 (3H, m), 8.04~8.08 (2H, m), 8.42~8.45 (2H, m), 8.54~8.55 (3H, m), 8.91 (1H, s)	457.56	457.18
156	δ = 7.41 (1H, m), 7.48~7.59 (11H, m), 7.67~7.73 (4H, m), 7.92 (1H, m), 8 (2H, m), 8.45 (1H, m), 8.54 (2H, m), 8.91 (1H, s)	457.56	457.18
157	δ = 7.41~7.52 (8H, m), 7.58~7.59 (3H, m), 7.67 (2H, m), 7.73 (1H, m), 7.85 (2H, m), 7.92 (1H, m), 8 (2H, m), 8.45 (1H, m), 8.54 (2H, m), 8.91 (1H, s)	457.56	457.18
209	δ = 7.25 (4H, m), 7.41 (2H, m), 7.5~7.52 (10H, m), 7.67 (4H, m), 8.45 (2H, m), 8.54 (4H, m), 8.91 (2H, s)	584.71	584.23
235	δ = 1.72 (6H, s), 7.28 (1H, m), 7.38~7.41 (2H, m), 7.48 (2H, m), 7.5~7.55 (14H, m), 7.77 (1H, m), 7.87~7.93 (2H, m), 8.45 (2H, m), 8.54 (4H, m), 8.91 (2H, s)	700.87	700.29
265	δ = 7.41 (2H, m), 7.5~7.52 (9H, m), 7.58~7.59 (3H, m), 7.66~7.67 (5H, m), 7.73 (1H, m), 7.92 (1H, m), 8 (2H, m), 8.45 (1H, m), 8.54 (2H, m), 8.91 (1H, s)	533.66	533.21
266	δ = 7.41 (1H, m), 7.5~7.59 (8H, m), 7.67 (2H, m), 7.73~7.79 (3H, m), 7.92 (1H, m), 8~8.01 (4H, m), 8.45 (1H, m), 8.54~8.55 (4H, m), 8.91 (1H, s)	507.62	507.20
267	δ = 7.25 (4H, m), 7.5~7.67 (9H, m), 7.73 (1H, m), 7.92 (1H, m), 8~8.08 (4H, m), 8.42~8.45 (2H, m), 8.54~8.55 (3H, m), 8.91 (1H, s)	507.62	507.20
303	δ = 7.32~7.38 (2H, m), 7.5 (1H, m), 7.58~7.59 (3H, m), 7.66~7.73 (6H, m), 7.81 (1H, m), 7.89~7.92 (2H, m), 8 (2H, m), 8.45 (1H, m), 8.54 (2H, m), 8.91 (1H, s)	471.55	471.16
354	δ = 7.25 (4H, m), 7.5~7.67 (9H, m), 7.73 (1H, m), 7.92 (1H, m), 8~8.08 (4H, m), 8.42~8.45 (2H, m), 8.54~8.55 (3H, m), 8.91 (1H, s)	507.62	507.20
383	δ = 7.58~7.59 (7H, m), 7.67 (2H, m), 7.73 (2H, m), 7.92 (2H, m), 8 (4H, m), 8.38 (1H, m), 8.54 (2H, m), 8.83 (1H, m)	431.53	431.17
384	δ = 7.55~7.67 (9H, m), 8.04~8.08 (4H, m), 8.38~8.42 (3H, m), 8.54~8.55 (4H, m), 8.83 (1H, m)	431.53	431.17
493	δ = 7.25 (8H, m), 7.55~7.67 (9H, m), 8.04~8.08 (4H, m), 8.38~8.42 (3H, m), 8.54~8.55 (4H, m), 8.83 (1H, m)	583.72	583.23
497	δ = 7.47 (4H, m), 7.58~7.59 (7H, m), 7.67 (2H, m), 7.73 (2H, m), 7.85 (4H, m), 7.92 (2H, m), 8 (4H, m), 8.38 (1H, m), 8.54 (2H, m), 8.83 (1H, m)	583.72	583.23
515	δ = 1.72 (6H, s), 7.28 (1H, m), 7.38~7.41 (2H, m), 7.51~7.67 (9H, m), 7.77 (1H, m), 7.87~7.93 (2H, m), 8.38 (1H, m), 8.54 (2H, m), 8.83 (1H, m)	447.57	447.20
518	δ = 7.25 (4H, m), 7.41 (2H, m), 7.51~7.52 (8H, m), 7.58 (1H, m), 7.67 (2H, m), 8.38 (1H, m), 8.54 (2H, m), 8.83 (1H, m)	407.51	407.17
525	δ = 7.25 (4H, m), 7.41 (1H, m), 7.51~7.52 (4H, m), 7.58~7.59 (4H, m), 7.67 (2H, m), 7.73 (1H, m), 7.92 (1H, m), 8 (2H, m), 8.38 (1H, m), 8.54 (2H, m), 8.83 (1H, m)	457.56	457.18
528	δ = 7.25 (4H, m), 7.41 (1H, m), 7.51~7.67 (10H, m), 8.04~8.08 (2H, m), 8.38~8.42 (2H, m), 8.54~8.55 (3H, m), 8.83 (1H, m)	457.56	457.18
531	δ = 7.41 (1H, m), 7.48~7.59 (11H, m), 7.67~7.73 (4H, m), 7.92 (1H, m), 8 (2H, m), 8.38 (1H, m), 8.54 (2H, m), 8.83 (1H, m)	457.56	457.18
532	δ = 7.41~7.52 (7H, m), 7.58~7.59 (4H, m), 7.67 (2H, m), 7.73 (1H, m), 7.85 (2H, m), 7.92 (1H, m), 8 (2H, m), 8.38 (1H, m), 8.54 (2H, m), 8.83 (1H, m)	457.56	457.18
635	δ = 1.72 (6H, s), 7.28 (1H, m), 7.38 (1H, m), 7.55~7.67 (8H, m), 7.73~7.77 (2H, m), 7.87~7.93 (3H, m), 8 (2H, m), 8.38 (1H, m), 8.54 (2H, m), 8.83 (1H, m)	497.63	497.21
637	δ = 7.55~7.67 (9H, m), 7.73 (1H, m), 7.92 (1H, m), 8~8.08 (4H, m), 8.38~8.42 (2H, m), 8.54~8.55 (3H, m), 8.83 (1H, m)	431.53	431.17
638	δ = 7.25 (4H, m), 7.41 (1H, m), 7.51~7.52 (4H, m), 7.58~7.59 (4H, m), 7.67 (2H, m), 7.73 (1H, m), 7.92 (1H, m), 8 (2H, m), 8.38 (1H, m), 8.54 (2H, m), 8.83 (1H, m)	457.56	457.18
650	δ = 7.25 (4H, m), 7.41~7.52 (7H, m), 7.58~7.59 (4H, m), 7.67 (2H, m), 7.73 (1H, m), 7.85 (2H, m), 7.92 (1H, m), 8 (2H, m), 8.38 (1H, m), 8.54 (2H, m), 8.83 (1H, m)	533.66	533.21
693	δ = 1.72 (6H, s), 7.28 (1H, m), 7.38 (1H, m), 7.55~7.67 (8H, m), 7.77 (1H, m), 7.87~7.93 (2H, m), 8.04~8.08 (2H, m), 8.38~8.42 (2H, m), 8.54~8.55 (3H, m), 8.83 (1H, m)	497.63	497.21
717	δ = 7.41 (1H, m), 7.51~7.67 (12H, m), 7.73 (2H, m), 7.92 (2H, m), 8.04~8.08 (2H, m), 8.38~8.42 (2H, m), 8.54~8.55 (3H, m), 8.83 (1H, m)	507.62	507.20

TABLE 1-continued

compound	¹ H NMR(CDCl ₃ , 200 MHz)	MS/FAB	
		found	calculated
733	δ = 7.5~7.67 (8H, m), 7.86 (1H, m), 7.98~8.08 (5H, m), 8.38~8.45 (3H, m), 8.54~8.55 (3H, m), 8.83 (1H, m)	487.61	487.14
757	δ = 7.41 (2H, m), 7.51~7.52 (8H, m), 7.6 (1H, m), 7.67 (2H, m), 7.78 (1H, m), 7.98 (1H, m), 8.06 (1H, m), 8.35 (1H, s), 8.54 (2H, m)	381.47	381.15
758	δ = 7.58~7.6 (7H, m), 7.67 (2H, m), 7.73~7.78 (3H, m), 7.92 (2H, m), 7.98~8 (5H, m), 8.06 (1H, m), 8.35 (1H, s), 8.54 (2H, m)	481.59	481.18
759	δ = 7.55~7.67 (9H, m), 7.78 (1H, m), 7.98~8.08 (6H, m), 8.35 (1H, s), 8.42 (2H, m), 8.54~8.55 (4H, m)	481.59	481.18
761	δ = 1.72 (12H, s), 7.28 (2H, m), 7.38 (2H, m), 7.55~7.67 (7H, m), 7.77~7.78 (3H, m), 7.87~7.98 (5H, m), 8.06 (1H, m), 8.35 (1H, s), 8.54 (2H, m)	623.79	623.28
762	δ = 7.25 (8H, m), 7.41 (2H, m), 7.51~7.52 (8H, m), 7.6 (1H, m), 7.67 (2H, m), 7.78 (1H, m), 7.98 (1H, m), 8.06 (1H, m), 8.35 (1H, s), 8.54 (2H, m)	533.66	533.21
787	δ = 7.41 (4H, m), 7.51~7.52 (16H, m), 7.6 (1H, m), 7.66~7.67 (8H, m), 7.78 (1H, m), 7.98 (1H, m), 8.06 (1H, m), 8.35 (1H, s), 8.54 (2H, m)	685.85	685.28
840	δ = 7.5~7.52 (4H, m), 7.6 (1H, m), 7.67~7.7 (4H, m), 7.78~7.79 (3H, m), 7.98 (3H, m), 8.06 (1H, m), 8.35 (1H, s), 8.54 (2H, m)	493.64	493.10
875	δ = 1.72 (12H, s), 7.25~7.28 (10H, m), 7.38 (2H, m), 7.55~7.67 (7H, m), 7.77~7.78 (3H, m), 7.87~7.98 (5H, m), 8.06 (1H, m), 8.35 (1H, s), 8.54 (2H, m)	765.98	765.34
876	δ = 1.72 (12H, s), 7.28 (2H, m), 7.38 (2H, m), 7.47 (4H, m), 7.55~7.67 (7H, m), 7.77~7.78 (3H, m), 7.85~7.98 (9H, m), 8.06 (1H, m), 8.35 (1H, s), 8.54 (2H, m)	765.98	765.34
890	δ = 1.72 (6H, s), 7.28 (1H, m), 7.38~7.41 (2H, m), 7.51~7.67 (9H, m), 7.77~7.78 (2H, m), 7.87~7.98 (3H, m), 8.06 (1H, m), 8.35 (1H, s), 8.54 (2H, m)	497.63	497.23
898	δ = 7.41 (2H, m), 7.51~7.52 (8H, m), 7.58~7.6 (3H, m), 7.67 (2H, m), 7.73~7.78 (3H, m), 7.92 (2H, m), 7.98 (1H, m), 8.06 (1H, m), 8.35 (1H, s), 8.54 (2H, m)	507.62	507.20
912	δ = 1.72 (6H, s), 7.28 (1H, m), 7.38~7.41 (2H, m), 7.48 (2H, m), 7.51~7.57 (11H, m), 7.77~7.78 (2H, m), 7.87~7.98 (3H, m), 8.06 (1H, m), 8.35 (1H, s), 8.54 (2H, m)	573.72	573.25
1084	δ = 1.72 (6H, s), 7.28 (1H, m), 7.38 (1H, m), 7.47 (2H, m), 7.55~7.67 (8H, m), 7.77~7.78 (2H, m), 7.85~8.08 (8H, m), 8.35 (1H, s), 8.42 (1H, m), 8.54~8.55 (3H, m)	623.78	623.26
1126	δ = 2.45 (3H, s), 7.18 (1H, m), 7.46~7.5 (2H, m), 7.58~7.59 (6H, m), 7.73 (2H, m), 7.92~8 (7H, m), 8.45 (1H, m), 8.91 (1H, m)	445.55	445.18
1127	δ = 2.45 (3H, s), 7.18 (1H, m), 7.46~7.55 (6H, m), 7.61 (2H, m), 7.94 (1H, m), 8.04~8.08 (4H, m), 8.42~8.45 (3H, m), 8.55 (2H, m), 8.91 (1H, m)	445.55	445.18
1129	δ = 1.41 (9H, s), 7.18 (1H, m), 7.46~7.5 (2H, m), 7.58~7.59 (6H, m), 7.73 (2H, m), 7.92~8 (7H, m), 8.45 (1H, m), 8.91 (1H, m)	487.63	487.23
1132	δ = 7.41 (1H, m), 7.5~7.52 (5H, m), 7.58~7.59 (6H, m), 7.73 (3H, m), 7.92 (2H, m), 8 (4H, m), 8.06 (1H, m), 8.34 (1H, m), 8.45 (1H, m), 8.91 (1H, m)	507.62	507.20
1133	δ = 7.41 (1H, m), 7.5~7.55 (9H, m), 7.61 (2H, m), 7.73 (1H, m), 8.04~8.08 (5H, m), 8.34 (1H, m), 8.42~8.45 (3H, m), 8.55 (2H, m), 8.91 (1H, m)	507.62	507.20
1134	δ = 1.72 (12H, s), 2.45 (3H, s), 7.18 (1H, m), 7.28 (2H, m), 7.38 (2H, m), 7.46~7.55 (4H, m), 7.63 (2H, m), 7.77 (2H, m), 7.87~7.94 (5H, m), 8.45 (1H, m), 8.91 (1H, m)	577.76	577.28
1136	δ = 1.72 (12H, s), 7.28 (2H, m), 7.38~7.41 (3H, m), 7.5~7.55 (7H, m), 7.63 (2H, m), 7.73~7.77 (3H, m), 7.87~7.93 (4H, m), 8.06 (1H, m), 8.34 (1H, m), 8.45 (1H, m), 8.91 (1H, m)	639.82	639.29
1140	δ = 7.5 (1H, m), 7.58~7.59 (9H, m), 7.73 (4H, m), 7.92 (3H, m), 8 (6H, m), 8.06 (1H, m), 8.34 (1H, m), 8.45 (1H, m), 8.91 (1H, m)	557.68	557.21
1141	δ = 7.5~7.61 (10H, m), 7.73 (2H, m), 7.92 (1H, m), 8~8.08 (7H, m), 8.34 (1H, m), 8.42~8.45 (3H, m), 8.55 (2H, m), 8.91 (1H, m)	557.68	557.21
1144	δ = 7.25 (8H, m), 7.41 (2H, m), 7.5~7.52 (9H, m), 7.58~7.59 (3H, m), 7.73 (2H, m), 7.92 (1H, m), 8 (2H, m), 8.06 (1H, m), 8.34 (1H, m), 8.45 (1H, m), 8.91 (1H, m)	609.76	609.25
1146	δ = 7.5~7.55 (7H, m), 7.61 (3H, m), 7.73 (1H, m), 8.04~8.08 (7H, m), 8.34 (1H, m), 8.42~8.45 (4H, m), 8.55 (3H, m), 8.91 (1H, m)	557.68	557.21

TABLE 1-continued

compound	¹ H NMR(CDCl ₃ , 200 MHz)	MS/FAB	
		found	calculated
1150	δ = 1.72 (6H, s), 7.28 (1H, m), 7.38 (1H, m), 7.5~7.63 (9H, m), 7.73~7.77 (4H, m), 7.87~7.93 (4H, m), 8 (4H, m), 8.06 (1H, m), 8.34 (1H, m), 8.45 (1H, m), 8.91 (1H, m)	623.78	623.26
1156	δ = 7.39~7.41 (6H, m), 7.5~7.52 (9H, m), 7.58~7.59 (3H, m), 7.73 (2H, m), 7.91~7.92 (5H, m), 8 (2H, m), 8.06 (1H, m), 8.34 (1H, m), 8.45 (1H, m), 8.91 (1H, m)	633.78	633.25
1157	δ = 1.72 (6H, s), 7.25~7.28 (9H, m), 7.38~7.41 (3H, m), 7.5~7.55 (10H, m), 7.63 (1H, m), 7.73~7.77 (2H, m), 7.87~7.93 (2H, m), 8.06 (1H, m), 8.34 (1H, m), 8.45 (1H, m), 8.91 (1H, m)	675.86	675.29
1158	δ = 1.72 (18H, s), 7.28 (3H, m), 7.38 (3H, m), 7.5~7.55 (4H, m), 7.63 (3H, m), 7.73~7.77 (4H, m), 7.87~7.93 (6H, m), 8.06 (1H, m), 8.34 (1H, m), 8.45 (1H, m), 8.91 (1H, m)	755.98	755.36
1159	δ = 1.72 (12H, s), 7.28 (2H, m), 7.38~7.41 (7H, m), 7.5~7.55 (7H, m), 7.63 (2H, m), 7.73~7.77 (3H, m), 7.87~7.93 (8H, m), 8.06 (1H, m), 8.34 (1H, m), 8.45 (1H, m), 8.91 (1H, m)	816.04	815.36
1160	δ = 2.45 (6H, s), 7.4 (2H, s), 7.41 (2H, m), 7.5~7.52 (9H, m), 8.45 (1H, m), 8.91 (1H, m)	359.46	359.17
1165	δ = 2.45 (3H, s), 7.18 (1H, m), 7.41~7.52 (7H, m), 7.58~7.59 (3H, m), 7.73 (1H, m), 7.92~8 (4H, m), 8.45 (1H, m), 8.91 (1H, m)	395.49	395.17
1168	δ = 1.72 (6H, s), 2.45 (3H, s), 7.18 (1H, m), 7.28 (1H, m), 7.38 (1H, m), 7.46~7.63 (7H, m), 7.73~7.77 (2H, m), 7.87~8 (6H, m), 8.45 (1H, m), 8.91 (1H, m)	511.65	511.23
1173	δ = 1.41 (9H, s), 1.72 (2H, s), 7.18 (1H, m), 7.28 (1H, m), 7.38 (1H, m), 7.46~7.63 (7H, m), 7.73~7.77 (2H, m), 7.87~8 (6H, m), 8.45 (1H, m), 8.91 (1H, m)	553.73	553.28
1178	δ = 1.72 (6H, s), 7.28 (1H, m), 7.38~7.41 (2H, m), 7.5~7.63 (10H, m), 7.73~7.77 (3H, m), 7.87~7.93 (3H, m), 8 (2H, m), 8.06 (1H, m), 8.34 (1H, m), 8.45 (1H, m), 8.91 (1H, m)	573.72	573.25
1183	δ = 1.72 (6H, s), 7.28 (1H, m), 7.38 (1H, m), 7.5~7.63 (9H, m), 7.73~7.77 (4H, m), 7.87~7.93 (4H, m), 8 (4H, m), 8.06 (1H, m), 8.34 (1H, m), 8.45 (1H, m), 8.91 (1H, m)	623.78	623.26
1185	δ = 7.41 (1H, m), 7.5~7.61 (11H, m), 7.73 (2H, m), 7.92 (1H, m), 8~8.08 (5H, m), 8.34 (1H, m), 8.42~8.45 (2H, m), 8.55 (1H, m), 8.91 (1H, m)	507.62	507.20
1190	δ = 7.25 (4H, m), 7.41 (2H, m), 7.5~7.52 (9H, m), 7.58~7.59 (3H, m), 7.73 (2H, m), 7.92 (1H, m), 8 (2H, m), 8.06 (1H, m), 8.34 (1H, m), 8.45 (1H, m), 8.91 (1H, m)	533.66	533.21
1195	δ = 1.72 (6H, s), 7.28 (1H, m), 7.38~7.41 (2H, m), 7.5~7.63 (10H, m), 7.73~7.77 (3H, m), 7.87~7.93 (3H, m), 8 (2H, m), 8.06 (1H, m), 8.34 (1H, m), 8.45 (1H, m), 8.91 (1H, m)	573.72	573.25
1198	δ = 7.25 (4H, m), 7.39~7.41 (5H, m), 7.5~7.52 (5H, m), 7.58~7.59 (6H, m), 7.73 (3H, m), 7.91~7.92 (6H, m), 8 (4H, m), 8.06 (1H, m), 8.34 (1H, m), 8.45 (1H, m), 8.91 (1H, m)	759.93	759.29
1201	δ = 7.25 (4H, m), 7.39~7.41 (6H, m), 7.5~7.52 (9H, m), 7.58~7.59 (3H, m), 7.73 (2H, m), 7.91~7.92 (5H, m), 8 (2H, m), 8.06 (1H, m), 8.34 (1H, m), 8.45 (1H, m), 8.91 (1H, m)	709.87	709.28
1203	δ = 1.72 (6H, s), 7.257.28 (5H, m), 7.38~7.41 (6H, m), 7.5~7.63 (10H, m), 7.73~7.77 (3H, m), 7.87~7.93 (7H, m), 8.0 (2H, m), 8.06 (1H, m), 8.34 (1H, m), 8.45 (1H, m), 8.91 (1H, m)	826.03	825.34
1204	δ = 7.5 (2H, m), 7.58~7.59 (6H, m), 7.73 (2H, m), 7.92 (2H, m), 8 (4H, m), 8.45 (2H, m), 8.91 (2H, m)	432.51	432.16
1209	δ = 7.55~7.61 (8H, m), 8.04~8.08 (4H, m), 8.38~8.42 (4H, m), 8.55 (2H, m), 8.83 (2H, m)	432.51	432.16
1215	δ = 1.72 (12H, s), 7.28 (2H, m), 7.38 (2H, m), 7.5~7.63 (6H, m), 7.77 (2H, m), 7.87~7.93 (4H, m), 8.38 (1H, m), 8.45 (1H, m), 8.83 (1H, m), 8.91 (1H, m)	564.72	564.26

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Example 1

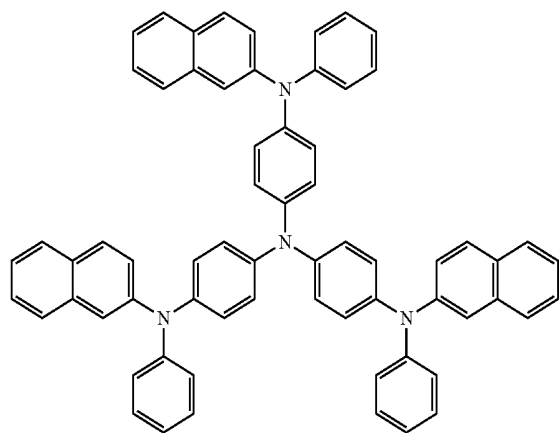
Manufacture of an OLED Employing Organic
Electroluminescent Compound According to the
Invention

An OLED device was manufactured by using an electroluminescent material according to the invention.

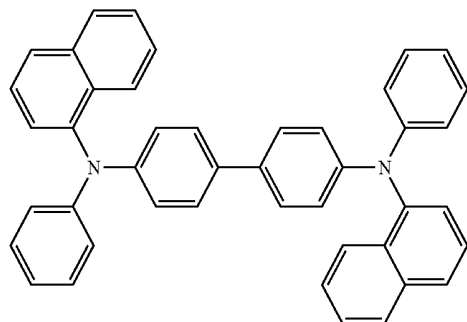
First, a transparent electrode ITO thin film ($15\Omega/\square$) (2) prepared from glass for OLED (produced by Samsung-Corning) (1) was subjected to ultrasonic washing with trichloroethylene, acetone, ethanol and distilled water, sequentially, and stored in isopropanol before use.

Then, an ITO substrate was equipped in a substrate folder of a vacuum vapor-deposit device, and 4,4',4''-tris(N,N-(2-naphthyl)-phenylamino)triphenylamine (2-TNATA, the structure is shown below) was placed in a cell of the vacuum vapor-deposit device, which was then ventilated up to 10^{-6} torr vacuum in the chamber. Electric current was applied to the cell to evaporate 2-TNATA, thereby providing vapor-deposit of a hole injecting layer (3) having 60 nm of thickness on the ITO substrate.

Then, to another cell of the vacuum vapor-deposit device, charged was N,N'-bis(α -naphthyl)-N,N'-diphenyl-4,4'-diamine (NPB, the structure is shown below), and electric current was applied to the cell to evaporate NPB, thereby providing vapor-deposit of a hole transport layer (4) with 20 nm of thickness on the hole injecting layer.



2-TNATA

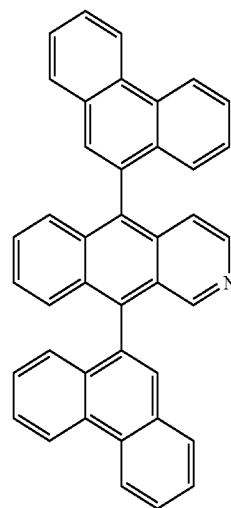


NPB

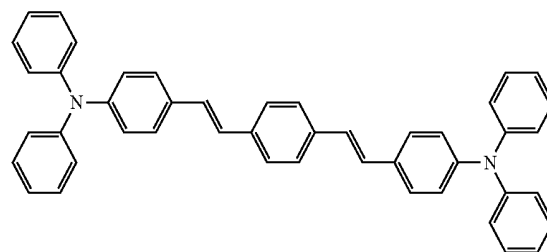
After forming the hole injecting layer and the hole transport layer, an electroluminescent layer was formed according

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to the following procedure. To one cell of a vacuum vapor-deposit device, charged was a compound according to the present invention (e.g. Compound 10) as electroluminescent material, while DSA-Ph (of which the structure is shown below) was charged to another cell. The two cells were simultaneously heated to carry out vapor-deposition at the rate of vapor-deposition of DSA-Ph of 2 to 5 wt %, thereby forming a vapor-deposit of an electroluminescent layer (5) having 30 nm thickness on the hole transport layer.

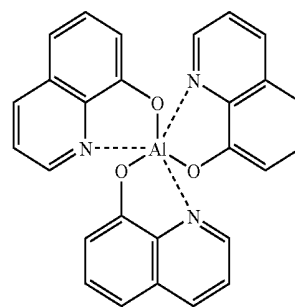


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DSA-Ph

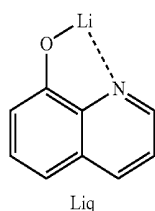
Then, tris(8-hydroxyquinoline)aluminum (III) (Alq) (of which the structure is shown below) was vapor-deposited as an electron transport layer (6) in a thickness of 20 nm, and then lithium quinolate (Liq) was vapor-deposited as an electron injecting layer (7) with a thickness of 1 to 2 nm. Thereafter, an Al cathode (8) was vapor-deposited in a thickness of 150 nm by using another vacuum vapor-deposit device to manufacture an OLED.



Alq

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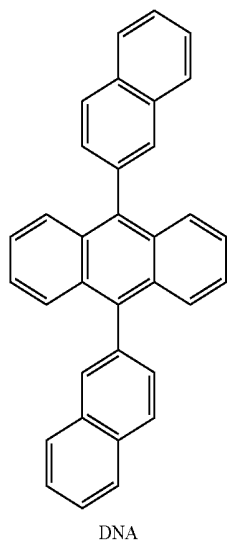


Each compound was employed as electroluminescent material for an OLED after purifying via vacuum sublimation at 10^{-6} torr.

Comparative Example 1

Manufacture of an OLED by Using Conventional Electroluminescent Material

After forming a hole injecting layer (3) and a hole transport layer (4) according to the same procedure as described in Example 1, dinaphthylanthracene (DNA) was charged to another cell of said vacuum vapor-deposit device, and DSA-Ph (as was in Example 1) was charged to still another cell. Then an electroluminescent layer (5) with a thickness of 30 nm was vapor-deposited on the hole transport layer at a vapor-deposition rate of 100:3.



Then, an electron transport layer (6) and an electron injecting layer (7) were vapor-deposited according to the same procedure as in Example 1, and an Al cathode (8) was vapor-deposited thereon with a thickness of 150 nm by using another vacuum vapor-deposit device to manufacture an OLED.

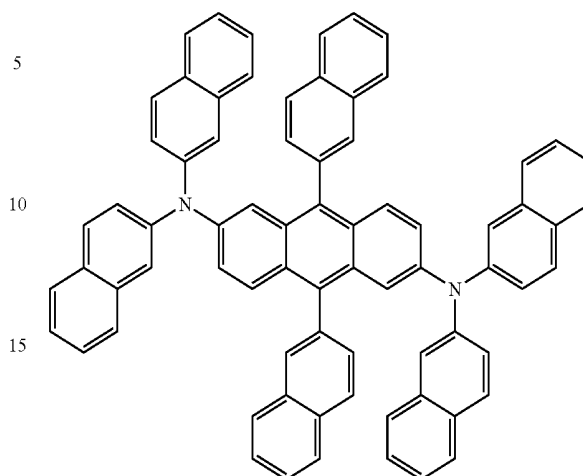
Example 2

Manufacture of an OLED Employing Organic Electroluminescent Compound According to the Invention

After forming a hole injecting layer and a hole transport layer according to the same procedure as in Example 1, a compound according to the present invention (e.g., Compound 10) was charged to one cell of said vacuum vapor-deposit device as electroluminescent material, and Compound (E) (of which the structure is shown below) was charged to another cell. The two substances were evaporated at different rates to provide doping at 2 to 5% by weight on the basis of the host, thereby vapor-depositing an electroluminescent layer with the thickness of 30 nm on the hole transport layer.

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Compound E

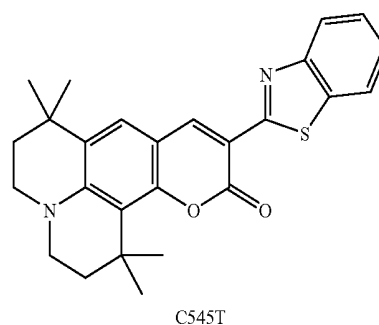


After vapor-depositing an electron transport layer and an electron injecting layer according to the same procedure as in Example 1, an Al cathode was vapor-deposited with a thickness of 150 nm by using another vacuum vapor-deposit device to manufacture an OLED.

Comparative Example 2

Manufacture of an OLED by Using Conventional Electroluminescent Material

After forming a hole injecting layer and a hole transport layer according to the same procedure as described in Example 1, tris(8-hydroxyquinoline)-aluminum (III) (Alq) was charged to another cell of said vacuum vapor-deposit device, and Coumarin 545T (C545T, of which the structure is shown below) was charged to still another cell. The two substances were evaporated at different rates to carry out doping, thereby vapor-depositing an electroluminescent layer with a thickness of 30 nm on the hole transport layer. The doping concentration preferably is from 1 to 3% by weight on the basis of Alq.



After vapor-depositing an electron transport layer and an electron injecting layer according to the same procedure as in Example 1, an Al cathode was vapor-deposited with a thickness of 150 nm by using another vacuum vapor-deposit device to manufacture an OLED.

Example 3

Electroluminescent Properties of OLED's Manufactured

The luminous efficiencies of the OLED's comprising the organic electroluminescent compounds according to the present invention (Examples 1 and 2) or conventional EL compound (Comparative Examples 1 and 2) were measured at $5,000 \text{ cd/m}^2$, respectively, and the results are shown in Table 2.

TABLE 2

No.	Host	Dopant	Doping concentration (wt %)	Luminous efficiency (cd/A) @5000 cd/m ²	Color
1	Compound 12	DSA-Ph	3	8.5	Blue
2	Compound 41	DSA-Ph	3	8.2	Blue
3	Compound 122	DSA-Ph	3	7.6	Blue
4	Compound 223	DSA-Ph	3	7.4	Blue
5	Compound 231	DSA-Ph	3	7.6	Blue
6	Compound 267	DSA-Ph	3	7.8	Blue
7	Compound 345	DSA-Ph	3	8.2	Blue
8	Compound 502	DSA-Ph	3	8.1	Blue
9	Compound 598	DSA-Ph	3	8.0	Blue
10	Compound 877	Compound E	3	18.3	Green
11	Compound 895	Compound E	3	19.2	Green
12	Compound 963	Compound E	3	20.2	Green
13	Compound 1024	Compound E	3	21.6	Green
14	Compound 1141	Compound E	3	18.1	Green
15	Compound 1179	Compound E	3	19.6	Green
16	Compound 1199	Compound E	3	18.7	Green
Comp. 1	DNA	DSA-Ph	3	7.3	Jade green
Comp. 2	Alq	Compound C545T	1	10.3	Green

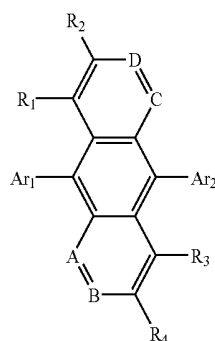
As can be seen from Table 2, when the organic electroluminescent compound according to the invention was applied to a blue electroluminescent device, with same type of doping of DSA-Ph, the device realized far better color purity as compared to the device employing DNA according to Comparative Example 1 (conventional electroluminescent material), while having comparable luminous efficiency.

Further, the material according to the invention was applied to green electroluminescent devices. As can be seen from Table 2, the device employing Compound (1024) (an organic electroluminescent compound according to the invention) with 3.0% doping of Compound (E) showed more than twice of luminous efficiency as compared to the device employing Alq:C545T as conventional material (Comparative Example 2).

Accordingly, the organic electroluminescent compounds according to the present invention can be used as blue or green electroluminescent material of high efficiency. Moreover, the device, to which the host material according to the invention was applied, showed noticeable improvement in view of color purity. The improvement in both color purity and luminous efficiency proves that the materials of the present invention have excellent properties.

The invention claimed is:

1. An organic electroluminescent compound represented by Chemical Formula (1):



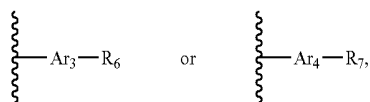
Chemical Formula 1

In Chemical Formula (1), A, B, C and D independently represent CR₅ or N, provided that A, B, C and D cannot represent CR₅ all at the same time;

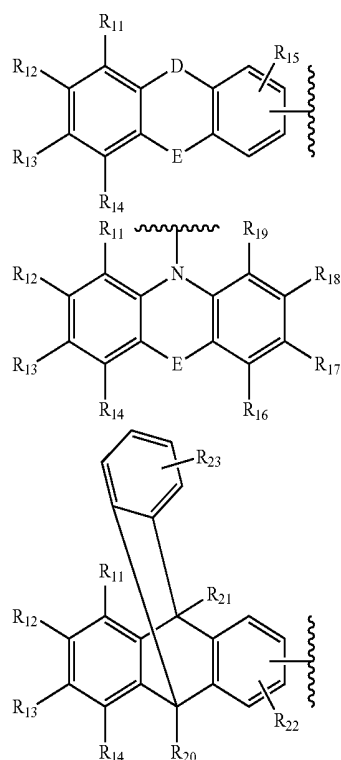
R₁ through R₅ independently represent hydrogen, halogen, (C1-C60)alkyl, (C6-C60)aryl, (C3-C60)heteroaryl, 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O, S and Si, (C3-C60)cycloalkyl, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl, tri(C6-C60)arylsilyl, adamantyl, (C7-C60)bicycloalkyl, (C2-C60)alkenyl, (C2-C60)alkynyl, (C1-C60)alkoxy, cyano, (C1-C60)alkylamino, (C6-C60)arylamino, (C6-C60)ar(C1-C60)alkyl, (C6-C60)aryloxy, (C6-C60)arylthio, (C1-C60)alkylthio, (C1-C60)alkoxycarbonyl, (C1-C60)alkylcarbonyl, (C6-C60)arylcarbonyl, carboxyl, nitro or hydroxyl, or R₁ and R₂ or R₃ and R₄ may be independently linked via (C3-C60)alkylene or (C3-C60)alkenylene with or without a fused ring to form an alicyclic ring, a mono- or polycyclic aromatic ring; the alkylene or alkenylene may be further substituted by one or more substituent(s) selected from halogen, (C1-C60)alkyl, (C6-C60)aryl, (C3-C60)heteroaryl, 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O, S and Si, (C3-C60)cycloalkyl, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl, tri(C6-C60)arylsilyl, adamantyl, (C7-C60)bicycloalkyl, (C2-C60)alkenyl, (C2-C60)alkynyl, (C1-C60)alkoxy, cyano, (C1-C60)alkylamino, (C6-C60)arylamino, (C6-C60)ar(C1-C60)alkyl, (C6-C60)aryloxy, (C1-C60)alkylthio, (C6-C60)arylthio, (C1-C60)alkoxycarbonyl, (C1-C60)alkylcarbonyl, (C6-C60)arylcarbonyl, carboxyl, nitro and hydroxyl;

Ar₁ and Ar₂ independently represent (C1-C60)alkyl, (C6-C60)aryl, (C3-C60)heteroaryl, 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O, S and Si, (C3-C60)cycloalkyl, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl, tri(C6-C60)arylsilyl, adamantyl, (C7-C60)bicycloalkyl, (C2-C60)alkenyl, (C2-C60)alkynyl, (C1-C60)alkoxy, cyano, (C1-C60)alkylamino, (C6-C60)arylamino, (C6-C60)ar(C1-C60)alkyl, (C6-C60)aryloxy, (C6-C60)arylthio, (C1-C60)alkylthio, (C1-C60)alkoxycarbonyl, (C1-C60)alkylcarbonyl, (C6-C60)arylcarbonyl, carboxyl, nitro, hydroxyl,

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or a substituent represented by one of the following structural formulas:



Ar_3 and Ar_4 independently represent (C1-C60)alkylenoxy, (C1-C60)alkylenethio, (C6-C60)arylenoxy, (C6-C60)arylenethio, (C6-C60)arylene or (C3-C60)heteroarylene;

R_6 and R_7 independently represent (C1-C60)alkyl, (C6-C60)aryl, (C3-C60)heteroaryl, 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O, S and Si, (C3-C60)cycloalkyl, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl, tri(C6-C60)arylsilyl, adamantyl, (C7-C60)bicycloalkyl, (C2-C60)alkenyl, (C2-C60)alkynyl, (C1-C60)alkoxy, cyano, (C1-C60)alkylamino, (C6-C60)arylamino, (C6-C60)ar(C1-C60)alkyl, (C6-C60)aryloxy, (C6-C60)arylthio, (C1-C60)alkylthio, (C1-C60)alkoxycarbonyl, (C1-C60)alkylcarbonyl, (C6-C60)arylcarbonyl, carboxyl, nitro or hydroxyl;

R_{11} through R_{23} independently represent hydrogen, halogen, (C1-C60)alkyl, (C6-C60)aryl, (C3-C60)heteroaryl, 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O, S and Si, (C3-C60)cycloalkyl, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl, tri(C6-C60)arylsilyl, adamantyl, (C7-C60)bicycloalkyl, (C2-C60)alkenyl, (C2-C60)alkynyl, (C1-C60)alkoxy, cyano, (C1-C60)alkylamino, (C6-C60)arylamino, (C6-C60)ar(C1-C60)alkyl, (C6-C60)aryloxy, (C6-C60)arylthio, (C1-C60)alkylthio, (C1-C60)alkoxycarbonyl, (C1-C60)alkylcarbonyl, (C6-C60)arylcarbonyl, carboxyl, nitro or hydroxyl; or each

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of R_{11} through R_{23} may be linked to an adjacent substituent via (C3-C60)alkylene or (C3-C60)alkenylylene with or without a fused ring to form an alicyclic ring, a monocyclic or polycyclic aromatic ring;

D and E independently represent a chemical bond, $-(CR_{31}R_{32})_a-$, $-N(R_{33})-$, $-S-$, $-O-$, $-Si(R_{34})(R_{35})-$, $-P(R_{36})-$, $-C(=O)-$, $-B(R_{37})-$, $-In(R_{38})-$, $-Se-$, $-Ge(R_{39})(R_{40})-$, $-Sn(R_{41})(R_{42})-$, $-Ga(R_{43})-$ or $-(R_{44})C=C(R_{45})-$;

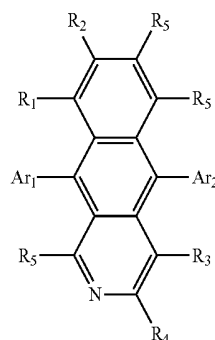
R_{31} through R_{45} independently represent hydrogen, halogen, (C1-C60)alkyl, (C6-C60)aryl, (C3-C60)heteroaryl, 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O, S and Si, (C3-C60)cycloalkyl, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl, tri(C6-C60)arylsilyl, adamantyl, (C7-C60)bicycloalkyl, (C2-C60)alkenyl, (C2-C60)alkynyl, (C1-C60)alkoxy, cyano, (C1-C60)alkylamino, (C6-C60)arylamino, (C6-C60)ar(C1-C60)alkyl, (C6-C60)aryloxy, (C6-C60)arylthio, (C1-C60)alkylthio, (C1-C60)alkoxycarbonyl, (C1-C60)alkylcarbonyl, (C6-C60)arylcarbonyl, carboxyl, nitro or hydroxyl; or R_{31} and R_{32} , R_{34} and R_{35} , R_{39} and R_{40} , R_{41} and R_{42} , or R_{44} and R_{45} may be linked via (C3-C60)alkylene or (C3-C60)alkenylylene with or without a fused ring to form an alicyclic ring, or a monocyclic or polycyclic aromatic ring;

the alkyl, aryl, heteroaryl, heterocycloalkyl, cycloalkyl, trialkylsilyl, dialkylarylsilyl, triarylsilyl, adamantyl, bicycloalkyl, alkenyl, alkynyl, alkylamino, arylamino, alkylthio, aryloxy, arylthio of R_1 through R_9 , Ar_1 , Ar_2 , R_1 through R_{23} and R_{31} through R_{45} ; and alkylenoxy, alkylenethio, arylenoxy, arylenethio, arylylene or heteroarylylene of Ar_3 and Ar_4 may be further substituted by one or more substituent(s) selected from halogen, (C1-C60)alkyl with or without halogen substituent(s), (C6-C60)aryl, (C3-C60)heteroaryl with or without (C6-C60)aryl substituent(s), 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O, S and Si, (C3-C60)cycloalkyl, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl, tri(C6-C60)arylsilyl, adamantyl, (C7-C60)bicycloalkyl, (C2-C60)alkenyl, (C2-C60)alkynyl, (C1-C60)alkoxy, cyano, (C1-C60)alkylamino, (C6-C60)arylamino, (C6-C60)ar(C1-C60)alkyl, (C6-C60)aryloxy, (C6-C60)arylthio, (C1-C60)alkylthio, (C1-C60)alkoxycarbonyl, (C1-C60)alkylcarbonyl, (C6-C60)arylcarbonyl, carboxyl, nitro and hydroxyl; and

a is an integer from 0 to 4.

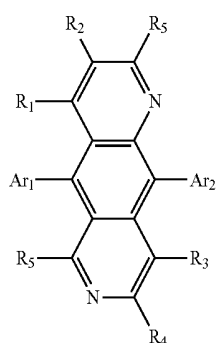
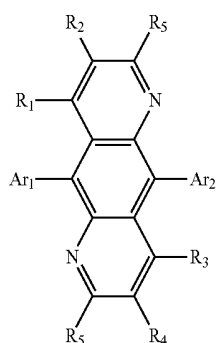
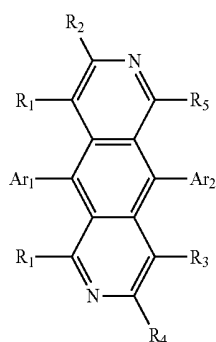
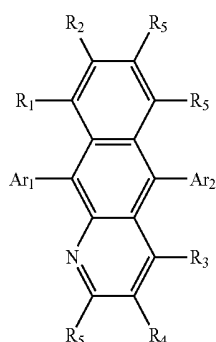
2. The organic electroluminescent compound according to claim 1, which is selected from the compounds represented by one of Chemical Formulas (2) to (7):

Chemical Formula 2



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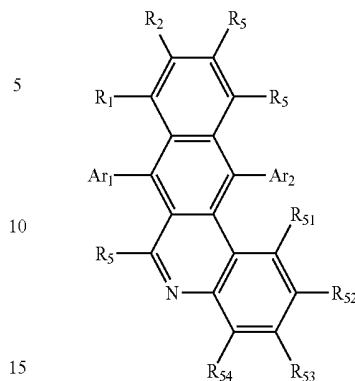
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Chemical Formula 3



Chemical Formula 7

Chemical Formula 4

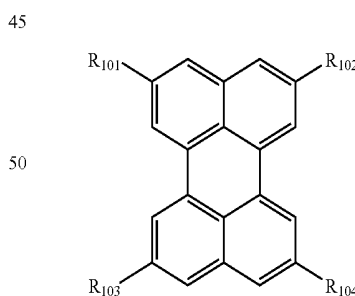
Chemical Formula 5

Chemical Formula 6

wherein, Ar₁, Ar₂ and R₁ through R₅ are defined as in claim 1; and

R₅₁ through R₅₄ independently represent hydrogen, halogen, (C1-C60)alkyl, (C6-C60)aryl, (C3-C60)heteroaryl, 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O, S and Si, (C3-C60)cycloalkyl, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl (C6-C60)arylsilyl, tri(C6-C60)arylsilyl, adamantyl, (C7-C60)bicycloalkyl, (C2-C60)alkenyl, (C2-C60)alkynyl, (C1-C60)alkoxy, cyano, (C1-C60)alkylamino, (C6-C60)arylamino, (C6-C60)ar(C1-C60)alkyl, (C6-C60)aryloxy, (C1-C60)alkylthio, (C6-C60)arylthio, (C1-C60)alkoxycarbonyl, (C1-C60)alkylcarbonyl, (C6-C60)arylcabonyl, carboxyl, nitro or hydroxyl, or R₅₂ and R₅₃ may be linked via (C3-C60)alkylene or (C3-C60)alkenylene with or without a fused ring to form an alicyclic ring, or a monocyclic or polycyclic aromatic ring.

3. The organic electroluminescent device according to claim 2, which is comprised of a first electrode; a second electrode; and at least one organic layer(s) interposed between the first electrode and the second electrode; wherein the organic layer comprises one or more organic electroluminescent compound(s) according to claim 1 or 2, and one or more dopant(s) selected from the compounds represented by one of Chemical Formulas (8) to (10):



Chemical Formula 8

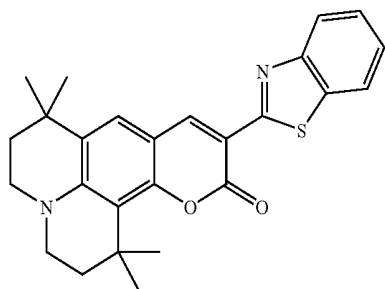
wherein, R₁₀₁ through R₁₀₄ independently represent hydrogen, halogen, (C1-C60)alkyl, (C6-C60)aryl, (C4-C60)heteroaryl, 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O and S, (C3-C60)cycloalkyl, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl, tri(C6-C60)arylsilyl, adamantyl, (C7-C60)bicycloalkyl, (C2-C60)alkenyl, (C2-C60)alkynyl, (C1-C60)alkoxy, cyano, (C1-C60)alkylamino, (C6-C60)arylamino, (C6-C60)ar(C1-C60)alkyl, (C6-C60)aryloxy, (C1-C60)alkylthio, (C6-C60)arylthio, (C1-C60)alkoxycarbonyl, (C1-C60)

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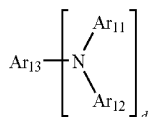
alkylcarbonyl, (C6-C60)arylcarbonyl, carboxyl, nitro or hydroxyl; or each of R₁₀₁ through R₁₀₄ may be linked to an adjacent substituent via (C3-C60)alkylene or (C3-C60)alkenylene with or without fused ring to form an alicyclic ring, or a monocyclic or polycyclic aromatic ring;

the alkyl, alkenyl, alkynyl, cycloalkyl, heterocycloalkyl, aryl, heteroaryl, arylsilyl, alkylsilyl, alkoxy, aryloxy, arylthio, alkylamino, arylamino of R₁₀₁ through R₁₀₄, or the alicyclic ring, or the monocyclic or polycyclic aromatic ring formed therefrom by linkage to an adjacent substituent via (C3-C60)alkylene or (C3-C60)alkenylene with or without a fused ring may be further substituted by one or more substituent(s) selected from halogen, (C1-C60)alkyl, (C6-C60)aryl, (C4-C60)heteroaryl, 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O and S, (C3-C60)cycloalkyl, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl, tri(C6-C60)arylsilyl, adamantyl, (C7-C60)bicycloalkyl, (C2-C60)alkenyl, (C2-C60)alkynyl, (C1-C60)alkoxy, cyano, (C1-C60)alkylamino, (C6-C60)arylamino, (C6-C60)ar(C1-C60)alkyl, (C6-C60)aryloxy, (C1-C60)alkylthio, (C6-C60)arylthio, (C1-C60)alkoxycarbonyl, (C1-C60)alkylcarbonyl, (C6-C60)arylcarbonyl, carboxyl, nitro and hydroxyl;

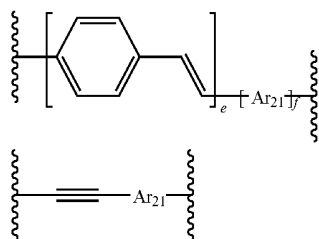
Chemical Formula 9



Chemical Formula 10



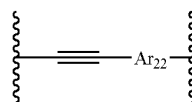
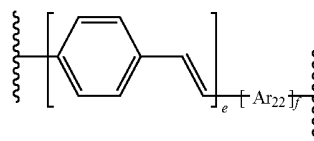
wherein, Ar₁₁ and Ar₁₂ independently represent (C1-C60)alkyl, (C6-C60)aryl, (C4-C60)heteroaryl, (C6-C60)aryl-amino, (C1-C60)alkylamino, 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O and S, (C3-C60)cycloalkyl, or arylene having one of the structures shown below: or



Ar₁₁ and Ar₁₂ may be linked via (C3-C60)alkylene or (C3-C60)alkenylene with or without a fused ring to form an alicyclic ring, or a monocyclic or polycyclic aromatic ring;

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Ar₁₃ represents (C6-C60)arylene, (C4-C60)heteroarylene or an arylene having one of the structures shown below:



wherein, Ar₂₁ and Ar₂₂ independently represent (C6-C60)arylene or (C4-C60)heteroarylene;

d is an integer from 1 to 4, e is an integer from 1 to 4, and f is an integer of 0 or 1; and

the alkyl, aryl, heteroaryl, arylamino, alkylamino, cycloalkyl or heterocycloalkyl of Ar₁₁ and Ar₁₂; or the arylene or heteroarylene of Ar₁₃, Ar₂₁ and Ar₂₂ may be further substituted by one or more substituent(s) selected from a group consisting of halogen, (C1-C60)alkyl, (C6-C60)aryl, (C4-C60)heteroaryl, 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O and S, (C3-C60)cycloalkyl, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl, tri(C6-C60)arylsilyl, adamantyl, (C7-C60)bicycloalkyl, (C2-C60)alkenyl, (C2-C60)alkynyl, (C1-C60)alkoxy, cyano, (C1-C60)alkylamino, (C6-C60)aryl-amino, (C6-C60)ar(C1-C60)alkyl, (C6-C60)aryloxy, (C6-C60)arylthio, (C1-C60)alkylthio, (C1-C60)alkoxycarbonyl, (C1-C60)alkylcarbonyl, (C6-C60)arylcarbonyl, carboxyl, nitro and hydroxyl.

4. The organic electroluminescent device according to claim 3, wherein the organic layer comprises one or more compounds selected from a group consisting of arylamine compounds and styrylarylamine compounds.

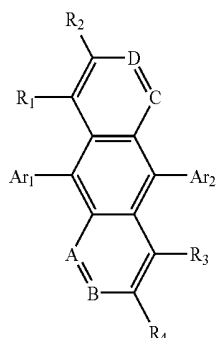
5. The organic electroluminescent device according to claim 3, wherein the organic layer comprises one or more metal(s) selected from a group consisting of organic metals of Group 1, Group 2, 4th period and 5th period transition metals, lanthanide metals and d-transition elements in the Periodic Table of Elements.

6. The organic electroluminescent device according to claim 3, which is an organic electroluminescent display comprising the organic electroluminescent compound according to claim 1 or 2 and a compound having the electroluminescent peak at wavelength of not less than 560 nm.

7. The organic electroluminescent device according to claim 3, wherein the organic layer comprises a charge generating layer as well as the electroluminescent layer.

8. An organic electroluminescent device according to claim 4, wherein a mixed region of reductive dopant and organic substance, or a mixed region of oxidative dopant and organic substance is placed on the inner surface of one or both electrode(s) among the pair of electrodes.

9. An organic solar cell which comprises an organic electroluminescent compound represented by Chemical Formula (1):

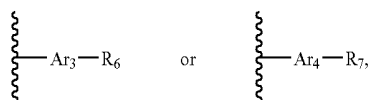


Chemical Formula 1

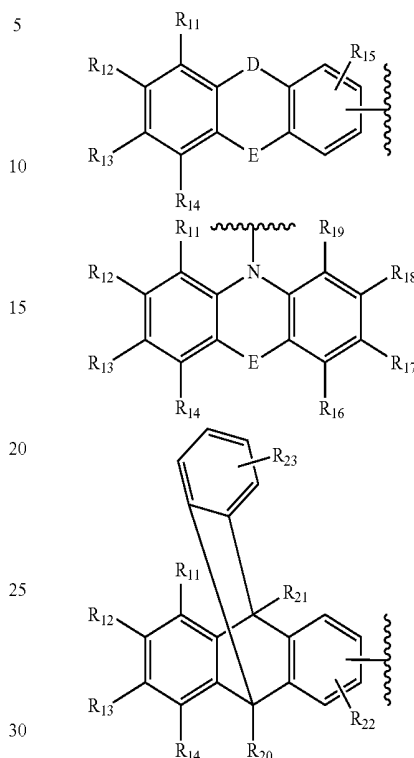
In Chemical Formula (1), A, B, C and D independently represent CR₅ or N, provided that A, B, C and D cannot represent CR₅ all at the same time;

R₁ through R₅ independently represent hydrogen, halogen, (C1-C60)alkyl, (C6-C60)aryl, (C3-C60)heteroaryl, 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O, S and Si, (C3-C60)cycloalkyl, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl, tri(C6-C60)arylsilyl, adamantyl, (C7-C60)bicycloalkyl, (C2-C60)alkenyl, (C2-C60)alkynyl, (C1-C60)alkoxy, cyano, (C1-C60)alkylamino, (C6-C60)arylamino, (C6-C60)ar(C1-C60)alkyl, (C6-C60)aryloxy, (C6-C60)arylthio, (C1-C60)alkylthio, (C1-C60)alkoxycarbonyl, (C1-C60)alkylcarbonyl, (C6-C60)arylcarbonyl, carboxyl, nitro or hydroxyl, or R₁ and R₂ or R₃ and R₄ may be independently linked via (C3-C60)alkylene or (C3-C60)alkenylene with or without a fused ring to form an alicyclic ring, a mono- or polycyclic aromatic ring; the alkylene or alkenylene may be further substituted by one or more substituent(s) selected from halogen, (C1-C60)alkyl, (C6-C60)aryl, (C3-C60)heteroaryl, 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O, S and Si, (C3-C60)cycloalkyl, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl, tri(C6-C60)arylsilyl, adamantyl, (C7-C60)bicycloalkyl, (C2-C60)alkenyl, (C2-C60)alkynyl, (C1-C60)alkoxy, cyano, (C1-C60)alkylamino, (C6-C60)arylamino, (C6-C60)ar(C1-C60)alkyl, (C6-C60)aryloxy, (C1-C60)alkylthio, (C6-C60)arylthio, (C1-C60)alkoxycarbonyl, (C1-C60)alkylcarbonyl, (C6-C60)arylcarbonyl, carboxyl, nitro and hydroxyl;

Ar₁ and Ar₂ independently represent (C1-C60)alkyl, (C6-C60)aryl, (C3-C60)heteroaryl, 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O, S and Si, (C3-C60)cycloalkyl, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl, tri(C6-C60)arylsilyl, adamantyl, (C7-C60)bicycloalkyl, (C2-C60)alkenyl, (C2-C60)alkynyl, (C1-C60)alkoxy, cyano, (C1-C60)alkylamino, (C6-C60)arylamino, (C6-C60)ar(C1-C60)alkyl, (C6-C60)aryloxy, (C6-C60)arylthio, (C1-C60)alkylthio, (C1-C60)alkoxycarbonyl, (C1-C60)alkylcarbonyl, (C6-C60)arylcarbonyl, carboxyl, nitro, hydroxyl,



or a substituent represented by one of the following structural formulas:



Ar₃ and Ar₄ independently represent (C1-C60)alkylenoxy, (C1-C60)alkylenethio, (C6-C60)arylenoxy, (C6-C60)arylenethio, (C6-C60)arylene or (C3-C60)heteroarylene;

R₆ and R₇ independently represent (C1-C60)alkyl, (C6-C60)aryl, (C3-C60)heteroaryl, 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O, S and Si, (C3-C60)cycloalkyl, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl, tri(C6-C60)arylsilyl, adamantyl, (C7-C60)bicycloalkyl, (C2-C60)alkenyl, (C2-C60)alkynyl, (C1-C60)alkoxy, cyano, (C1-C60)alkylamino, (C6-C60)arylamino, (C6-C60)ar(C1-C60)alkyl, (C6-C60)aryloxy, (C6-C60)arylthio, (C1-C60)alkylthio, (C1-C60)alkoxycarbonyl, (C1-C60)alkylcarbonyl, (C6-C60)arylcarbonyl, carboxyl, nitro or hydroxyl;

R₁₁ through R₂₃ independently represent hydrogen, halogen, (C1-C60)alkyl, (C6-C60)aryl, (C3-C60)heteroaryl, 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O, S and Si, (C3-C60)cycloalkyl, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl, tri(C6-C60)arylsilyl, adamantyl, (C7-C60)bicycloalkyl, (C2-C60)alkenyl, (C2-C60)alkynyl, (C1-C60)alkoxy, cyano, (C1-C60)alkylamino, (C6-C60)arylamino, (C6-C60)ar(C1-C60)alkyl, (C6-C60)aryloxy, (C6-C60)arylthio, (C1-C60)alkylthio, (C1-C60)alkoxycarbonyl, (C1-C60)alkylcarbonyl, (C6-C60)arylcarbonyl, carboxyl, nitro or hydroxyl; or each of R₁₁ through R₂₃ may be linked to an adjacent substituent via (C3-C60)alkylene or (C3-C60)alkenylene with or without a fused ring to form an alicyclic ring, a monocyclic or polycyclic aromatic ring;

D and E independently represent a chemical bond, —(CR₃₁R₃₂)_a—, —N(R₃₃)—, —S—, —O—, —Si

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$(R_{34})(R_{35})-$, $-P(R_{36})-$, $-C(=O)-$, $-B(R_{37})-$,
 $-In(R_{38})-$, $-Se-$, $-Ge(R_{39})(R_{40})-$, $-Sn(R_{41})$
 $(R_{42})-$, $-Ga(R_{43})-$ or $-(R_{44})C=C(R_{45})-$;
 R_{31} through R_{45} independently represent hydrogen, halo- 5
 gen, (C1-C60)alkyl, (C6-C60)aryl, (C3-C60)heteroaryl,
 5- or 6-membered heterocycloalkyl containing one or
 more heteroatom(s) selected from N, O, S and Si, (C3-
 C60)cycloalkyl, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl
 (C6-C60)arylsilyl, tri(C6-C60)arylsilyl, adamantyl,
 (C7-C60)bicycloalkyl, (C2-C60)alkenyl, (C2-C60) 10
 alkynyl, (C1-C60)alkoxy, cyano, (C1-C60)alkylamino,
 (C6-C60)arylamino, (C6-C60)ar(C1-C60)alkyl, (C6-
 C60)aryloxy, (C6-C60)arylthio, (C1-C60)alkylthio,
 (C1-C60)alkoxycarbonyl, (C1-C60)alkylcarbonyl, (C6-
 C60)arylcarbonyl, carboxyl, nitro or hydroxyl; or R_{31} 15
 and R_{32} , R_{34} and R_{35} , R_{39} and R_{40} , R_{41} and R_{42} , or R_{44}
 and R_{45} may be linked via (C3-C60)alkylene or (C3-
 C60)alkenylene with or without a fused ring to form an
 alicyclic ring, or a monocyclic or polycyclic aromatic
 ring; 20
 the alkyl, aryl, heteroaryl, heterocycloalkyl, cycloalkyl,
 trialkylsilyl, dialkylarylsilyl, triarylsilyl, adamantyl,

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bicycloalkyl, alkenyl, alkynyl, alkylamino, arylamino,
 alkylthio, aryloxy, arylthio of R_1 through R_9 , Ar_1 , Ar_2 ,
 R_{11} through R_{23} and R_{31} through R_{45} ; and alkyleneoxy,
 alkyleneethio, aryloxy, arylenethio, arylene or hetero-
 aryleno of Ar_3 and Ar_4 may be further substituted by
 one or more substituent(s) selected from halogen, (C1-
 C60)alkyl with or without halogen substituent(s), (C6-
 C60)aryl, (C3-C60)heteroaryl with or without (C6-C60)
 aryl substituent(s), 5- or 6-membered heterocycloalkyl
 containing one or more heteroatom(s) selected from N,
 O, S and Si, (C3-C60)cycloalkyl, tri(C1-C60)alkylsilyl,
 di(C1-C60)alkyl(C6-C60)arylsilyl, tri(C6-C60)arylsi-
 lyl, adamantyl, (C7-C60)bicycloalkyl, (C2-C60)alk-
 enyl, (C2-C60)alkynyl, (C1-C60)alkoxy, cyano, (C1-
 C60)alkylamino, (C6-C60)arylamino, (C6-C60)ar(C1-
 C60)alkyl, (C6-C60)aryloxy, (C6-C60)arylthio, (C1-
 C60)alkylthio, (C1-C60)alkoxycarbonyl, (C1-C60)
 alkylcarbonyl, (C6-C60)arylcarbonyl, carboxyl, nitro
 and hydroxyl; and
 a is an integer from 0 to 4.

* * * * *

专利名称(译)	有机电致发光化合物和使用其的有机电致发光器件		
公开(公告)号	US8153279	公开(公告)日	2012-04-10
申请号	US12/456844	申请日	2009-06-23
申请(专利权)人(译)	GRACEL显示增量.		
当前申请(专利权)人(译)	GRACEL显示增量.		
[标]发明人	EUM SUNG JIN CHO YOUNG JUN KWON HYUCK JOO KIM BONG OK KIM SUNG MIN YOON SEUNG SOO		
发明人	EUM, SUNG JIN CHO, YOUNG JUN KWON, HYUCK JOO KIM, BONG OK KIM, SUNG MIN YOON, SEUNG SOO		
IPC分类号	H01L51/54		
CPC分类号	C09K11/06 C09K2211/1007 C09K2211/1011 C09K2211/1029 C09K2211/1033 C09K2211/1037 Y10S428/917 C09K2211/1044 C09K2211/1059 C09K2211/1088 C09K2211/1092 C09K2211/1096 Y02E10/549 C09K2211/104		
代理机构(译)	哦，埃德温		
助理审查员(译)	CLARK, GREGORY		
优先权	1020080059496 2008-06-24 KR		
其他公开文献	US20100033083A1		
外部链接	Espacenet USPTO		

摘要(译)

本发明提供新型有机电致发光化合物，以及使用其的有机电致发光器件和有机太阳能电池。具体地，根据本发明的有机电致发光化合物的特征在于它们由化学式(1)表示：其中，A，B，C和D独立地代表CR5或N，条件是A，B，C和D不能同时代表CR5。由于根据本发明的有机电致发光化合物具有良好的发光效率和优异的色纯度和材料的寿命特性，因此可以由其制造具有非常好的使用寿命的OLED。

