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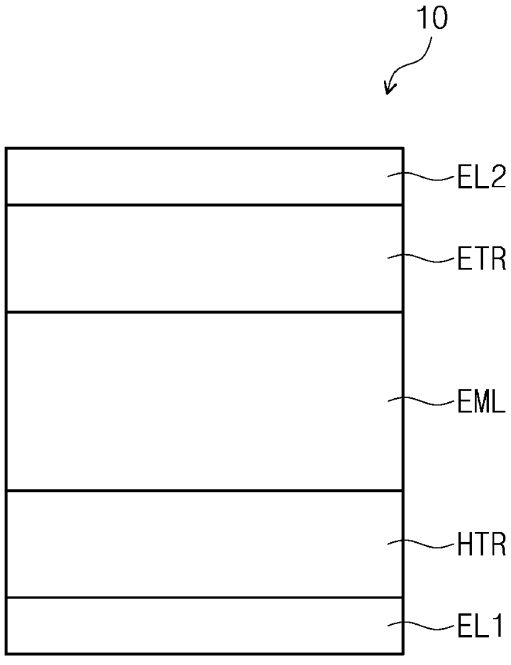
(54) N-(4-(8-(PHENYL)NAPHTHALEN-2-YL)PHENYL)-N,N'-DI(PHENYL)-AMINE DERIVATIVES AND RELATED COMPOUNDS FOR USE IN ORGANIC ELECTROLUMINESCENCE DEVICES

(57) Provided is an organic electroluminescence device including a first electrode, a hole transport region disposed on the first electrode, an emission layer disposed on the hole transport region, an electron transport region disposed on the emission layer, and a second electrode disposed on the electron transport region, in which the hole transport region includes a monoamine compound represented by Formula 1, such as e.g. an N-(4-(8-(phenyl)naphthalen-2-yl)phenyl)-N,N'-di(phenyl)-amine derivative or a structurally related compound, thereby attaining high emission efficiency.

FIG. 1

FIG. 1



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Description

BACKGROUND

[0001] The present disclosure herein relates to an organic electroluminescence device and a monoamine compound for an organic electroluminescence device.

[0002] Development on an organic electroluminescence display as an image display is being actively conducted. An organic electroluminescence display is different from a liquid crystal display and is so called a self-luminescent display which accomplishes display by recombining holes and electrons injected from a first electrode and a second electrode in an emission layer and emitting light from a luminescent material which includes an organic compound in the emission layer.

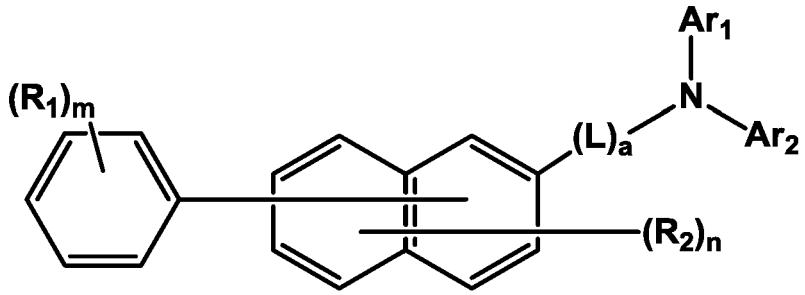
[0003] In an application of an organic electroluminescence device to a display, decrease of a driving voltage, increase of emission efficiency and extension of life for the organic electroluminescence device are required, and development of a material which may stably implement these requirements in the organic electroluminescence device is also continuously required.

SUMMARY

[0004] The present disclosure provides an organic electroluminescence device and a monoamine compound for an organic electroluminescence device. More specifically, the present disclosure provides an organic electroluminescence device with high efficiency and a monoamine compound included in a hole transport region of an organic electroluminescence device.

[0005] An embodiment of the inventive concept provides an organic electroluminescence device including a first electrode, a hole transport region disposed on the first electrode, an emission layer disposed on the hole transport region, an electron transport region disposed on the emission layer and a second electrode disposed on the electron transport region, in which the hole transport region includes a monoamine compound represented by the following Formula 1.

[Formula 1]



[0006] In Formula 1, Ar_1 and Ar_2 are each independently a substituted or unsubstituted alkyl group having 1 to 10 carbon atoms, a substituted or unsubstituted cycloalkyl group having 3 to 20 carbon atoms for forming a ring, a substituted or unsubstituted aryl group having 6 to 30 carbon atoms for forming a ring, or a substituted or unsubstituted heteroaryl group having 2 to 30 carbon atoms for forming a ring, L is a substituted or unsubstituted arylene group having 6 to 30 carbon atoms for forming a ring, or a substituted or unsubstituted heteroarylene group having 2 to 30 carbon atoms for forming a ring, R_1 is a hydrogen atom, a deuterium atom, a halogen atom, a substituted or unsubstituted alkyl group having 1 to 20 carbon atoms, a substituted or unsubstituted cycloalkyl group having 3 to 20 carbon atoms for forming a ring, or a substituted or unsubstituted aryl group having 6 to 30 carbon atoms for forming a ring, R_2 is a hydrogen atom, a deuterium atom, a halogen atom, a substituted or unsubstituted alkyl group having 1 to 20 carbon atoms, or a substituted or unsubstituted cycloalkyl group having 3 to 20 carbon atoms for forming a ring, a is an integer of 0 to 3, m is an integer of 0 or 1, n is an integer of 0 to 6, and in case any one of Ar_1 and Ar_2 is 3-dibenzofuranyl, the other is not 9-phenanthryl.

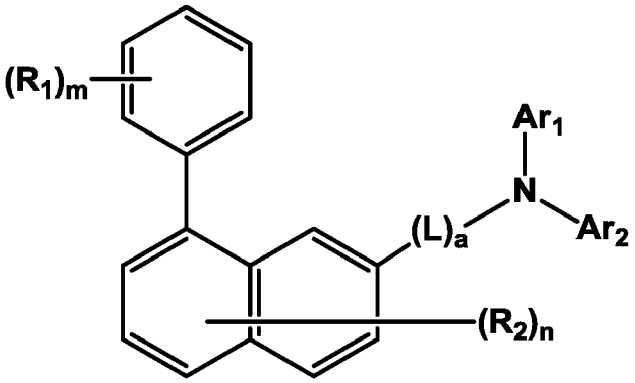
[0007] In an embodiment, the hole transport region may have a multilayer structure having a plurality of layers, and a layer of the plurality of layers contacting with the emission layer may include the monoamine compound according to an embodiment of the inventive concept.

[0008] In an embodiment, the hole transport region may include a hole injection layer disposed on the first electrode, a hole transport layer disposed on the hole injection layer, and an electron blocking layer disposed on the hole transport layer, and the electron blocking layer may include the monoamine compound according to an embodiment of the inventive concept.

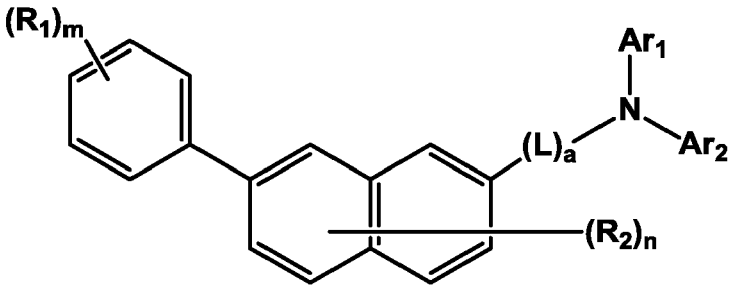
[0009] In an embodiment, the electron transport region may include a hole blocking layer disposed on the emission layer, an electron transport layer disposed on the hole blocking layer, and an electron injection layer disposed on the electron transport layer.

[0010] In an embodiment, Formula 1 may be represented by any one of the following Formulae 2 to 8.

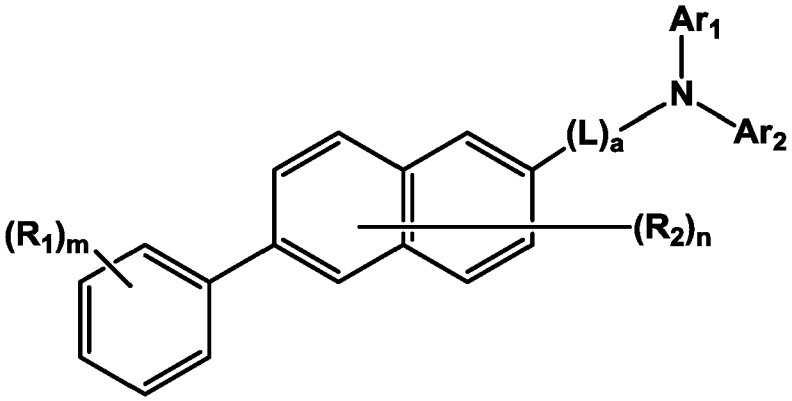
[Formula 2]



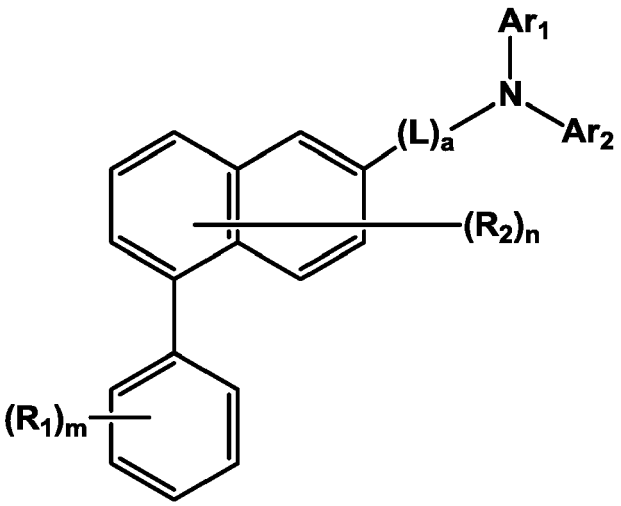
[Formula 3]



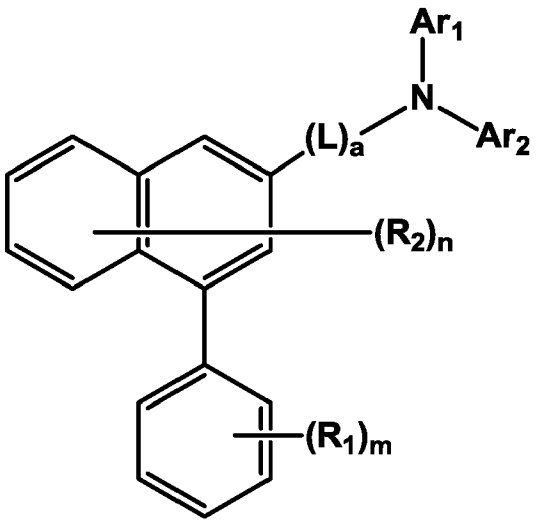
[Formula 4]



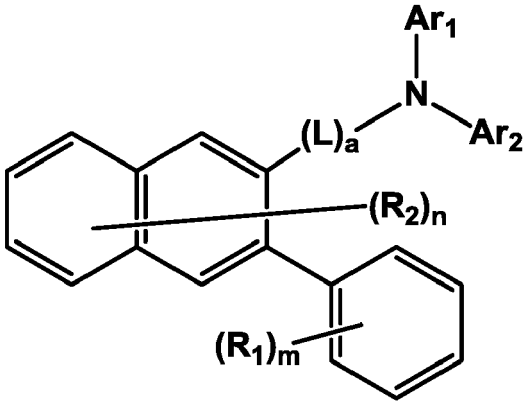
[Formula 5]



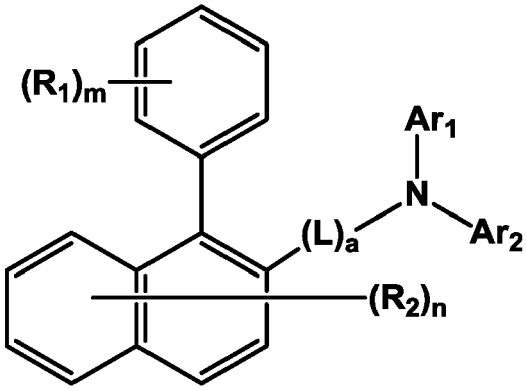
[Formula 6]



[Formula 7]



[Formula 8]



[0011] In Formulae 2 to 8, Ar_1, Ar_2, L, R_1, R_2, a, m, and n are the same as defined in Formula 1.

[0012] In an embodiment, L may be a substituted or unsubstituted arylene group having 6 to 12 carbon atoms for forming a ring.

[0013] In an embodiment, L may be a substituted or unsubstituted phenylene group.

[0014] In an embodiment, Ar_1 and Ar_2 may be each independently a substituted or unsubstituted aryl group having 6 to 12 carbon atoms for forming a ring.

[0015] In an embodiment, Ar_1 and Ar_2 may be each independently a substituted or unsubstituted phenyl group, a substituted or unsubstituted biphenyl group, a substituted or unsubstituted naphthylene group, or a substituted or unsubstituted fluorenyl group.

[0016] In an embodiment, Ar_1 and Ar_2 may be each independently a substituted or unsubstituted heteroaryl group having 5 to 12 carbon atoms for forming a ring.

[0017] In an embodiment, Ar_1 and Ar_2 may be each independently a substituted or unsubstituted dibenzofuran group, a substituted or unsubstituted dibenzothiophene group, or a substituted or unsubstituted carbazole group.

[0018] An embodiment of the inventive concept provides a monoamine compound represented by the above Formula 1.

[0019] At least some of the above and other features of the invention are set out in the claims.

BRIEF DESCRIPTION OF THE FIGURES

[0020] The accompanying drawings are included to provide a further understanding of the inventive concept, and are incorporated in and constitute a part of this specification. The drawings illustrate embodiments of the inventive concept and, together with the description, serve to explain principles of the inventive concept. In the drawings:

FIG. 1 is a schematic cross-sectional view of an organic electroluminescence device according to an embodiment of the inventive concept;

FIG. 2 is a schematic cross-sectional view of an organic electroluminescence device according to an embodiment of the inventive concept; and

FIG. 3 is a schematic cross-sectional view of an organic electroluminescence device according to an embodiment of the inventive concept.

DETAILED DESCRIPTION

[0021] The above objects, other objects, features and advantages of the inventive concept will be easily understood from preferred embodiments with reference to the accompanying drawings. The inventive concept may, however, be embodied in different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the inventive concept to those skilled in the art.

[0022] Like reference numerals refer to like elements for explaining each drawing. In the drawings, the sizes of elements may be enlarged for clarity of the inventive concept. It will be understood that, although the terms first, second, etc. may be used herein to describe various elements, these elements should not be limited by these terms. These terms are only used to distinguish one element from another element. For example, a first element discussed below could be termed a second element, and similarly, a second element could be termed a first element. As used herein, the singular forms are intended to include the plural forms as well, unless the context clearly indicates otherwise.

[0023] It will be further understood that the terms "comprise" or "have," when used in this specification, specify the presence of stated features, numerals, steps, operations, elements, parts, or a combination thereof, but do not preclude the presence or addition of one or more other features, numerals, steps, operations, elements, parts, or a combination thereof. It will also be understood that when a layer, a film, a region, a plate, etc. is referred to as being "on" another part, it can be "directly on" the other part, or intervening layers may also be present. On the contrary, when a layer, a film, a region, a plate, etc. is referred to as being "under" another part, it can be "directly under" the other part, or intervening layers may also be present.

[0024] First of all, an organic electroluminescence device according to an embodiment of the inventive concept will be explained referring to FIGS. 1 to 3.

[0025] FIG. 1 is a schematic cross-sectional view illustrating an organic electroluminescence device according to an embodiment of the inventive concept. FIG. 2 is a schematic cross-sectional view illustrating an organic electroluminescence device according to an embodiment of the inventive concept. FIG. 3 is a schematic cross-sectional view illustrating an organic electroluminescence device according to an embodiment of the inventive concept.

[0026] Referring to FIGS. 1 to 3, an organic electroluminescence device 10 according to an embodiment of the inventive concept includes a first electrode EL1, a hole transport region HTR, an emission layer EML, an electron transport region ETR, and a second electrode EL2.

[0027] The hole transport region HTR includes the monoamine compound according to an embodiment of the inventive concept. Hereinafter, the monoamine compound according to an embodiment of the inventive concept will be specifically explained, and then each layer of the organic electroluminescence device 10 will be explained.

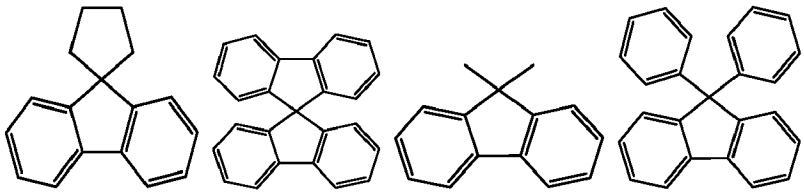
[0028] In the present disclosure, "substituted or unsubstituted" may mean unsubstituted or substituted with at least one substituent selected from the group consisting of deuterium, halogen, cyano, nitro, silyl, boron, phosphine, alkyl, alkenyl, aryl and heterocyclic group. In addition, each of the substituents illustrated above may be substituted or unsubstituted. For example, biphenyl may be interpreted as aryl, or phenyl substituted with phenyl.

[0029] In the present disclosure, examples of a halogen atom are a fluorine atom, a chlorine atom, a bromine atom, or an iodine atom.

[0030] In the present disclosure, the alkyl group may have a linear, branched or cyclic form. The carbon number of the alkyl group may be 1 to 30, 1 to 20, 1 to 10, or 1 to 4. Examples of the alkyl group may include methyl, ethyl, n-propyl, isopropyl, n-butyl, s-butyl, t-butyl, i-butyl, 2-ethylbutyl, 3,3-dimethylbutyl, n-pentyl, i-pentyl, neopentyl, t-pentyl, cyclopentyl, 1-methylpentyl, 3-methylpentyl, 2-ethylpentyl, 4-methyl-2-pentyl, n-hexyl, 1-methylhexyl, 2-ethylhexyl, 2-butylhexyl, cyclohexyl, 4-methylcyclohexyl, 4-t-butylcyclohexyl, n-heptyl, 1-methylheptyl, 2,2-dimethylheptyl, 2-ethylheptyl, 2-butylheptyl, n-octyl, t-octyl, 2-ethyloctyl, 2-butyloctyl, 2-hexyloctyl, 3,7-dimethyloctyl, cyclooctyl, n-nonyl, n-decyl, adamantyl, 2-ethyldecyl, 2-butyldecyl, 2-hexyldecyl, 2-octyldecyl, n-undecyl, n-dodecyl, 2-ethyldodecyl, 2-butyldodecyl, 2-hexyldodecyl, 2-octyldodecyl, n-tridecyl, n-tetradecyl, n-pentadecyl, n-hexadecyl, 2-ethylhexadecyl, 2-butylhexadecyl, 2-hexylhexadecyl, 2-octylhexadecyl, n-heptadecyl, n-octadecyl, n-nonadecyl, n-eicosyl, 2-ethyl eicosyl, 2-butyl eicosyl, 2-hexyl eicosyl, 2-octyl eicosyl, n-heneicosyl, n-docosyl, n-tricosyl, n-tetracosyl, n-pentacosyl, n-hexacosyl, n-heptacosyl, n-octacosyl, n-nonacosyl, n-triacontyl, etc., without limitation.

[0031] In the present disclosure, the aryl group means any functional group or substituent derived from an aromatic hydrocarbon ring. The aryl group may be monocyclic aryl or polycyclic aryl. The carbon number of the aryl group for forming a ring may be 6 to 36, 6 to 30, 6 to 20, or 6 to 12. Examples of the aryl group may include phenyl, naphthyl, fluorenyl, anthracenyl, phenanthryl, biphenyl, terphenyl, quaterphenyl, quinqphenyl, sexiphenyl, biphenylene, triphenylene, pyrenyl, benzofluoranthenyl, chrysenyl, etc., without limitation.

[0032] In the present disclosure, the fluorenyl group may be substituted, and two substituents may be combined with each other to form a spiro structure. Examples of the substituted fluorenyl group may include the following groups, without limitation.



[0033] In the present disclosure, the heteroaryl group may be heteroaryl including at least one of O, N, P, Si, or S as a heteroatom. When the heteroaryl group includes two heteroatoms, the two heteroatoms may be the same or different from each other. The carbon number of the heteroaryl group for forming a ring may be 2 to 30, or 5 to 12. The heteroaryl group may be monocyclic heteroaryl or polycyclic heteroaryl. Polycyclic heteroaryl may have a bicyclic or tricyclic structure, for example. Examples of the heteroaryl group may include thiophene, furan, pyrrole, imidazole, thiazole, oxazole,

oxadiazole, triazole, pyridine, bipyridine, pyrimidine, triazine, triazole, acridyl, pyridazine, pyrazinyl, quinoline, quinazoline, quinoxaline, phenoxazine, phthalazine, pyrido pyrimidine, pyrido pyrazine, pyrazino pyrazine, isoquinoline, indole, carbazole, N-aryl carbazole, N-heteroaryl carbazole, N-alkyl carbazole, benzoxazole, benzoimidazole, benzothiazole, benzocarbazole, benzothiophene, dibenzothiophene, thienothiophene, benzofuran, phenanthroline, thiazole, isoxazole, oxadiazole, thiadiazole, phenothiazine, dibenzosilole, dibenzofuran, etc., without limitation.

[0034] In the present disclosure, the silyl group may include alkyl silyl and aryl silyl. Examples of the silyl group may include trimethylsilyl, triethylsilyl, t-butyl dimethylsilyl, vinyl dimethylsilyl, propyl dimethylsilyl, triphenylsilyl, diphenylsilyl, phenylsilyl, etc., without limitation.

[0035] In the present disclosure, the boron group may include alkyl boron and aryl boron. Examples of the boron group may include trimethyl boron, triethyl boron, t-butyl dimethyl boron, triphenyl boron, diphenyl boron, phenyl boron, etc., without limitation.

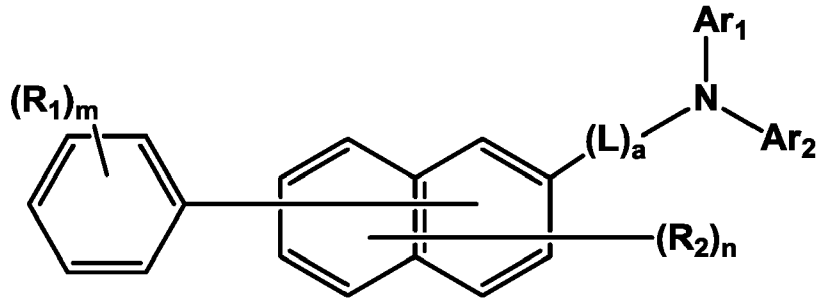
[0036] In the present disclosure, the alkenyl group may be linear or branched. The carbon number is not specifically limited, and may be 2 to 30, 2 to 20, or 2 to 10. Examples of the alkenyl group may include vinyl, 1-butenyl, 1-pentenyl, 1,3-butadienyl aryl, styrenyl, styrylvinyl, etc., without limitation.

[0037] The above explanation on the aryl group may be applied to the arylene group, except that the arylene group is divalent.

[0038] The above explanation on the heteroaryl group may be applied to the heteroarylene group, except that the heteroarylene group is divalent.

[0039] The monoamine compound according to an embodiment of the inventive concept is represented by the following Formula 1.

[Formula 1]



[0040] In Formula 1, Ar_1 and Ar_2 are each independently a substituted or unsubstituted alkyl group having 1 to 10 carbon atoms, a substituted or unsubstituted cycloalkyl group having 3 to 20 carbon atoms for forming a ring, a substituted or unsubstituted aryl group having 6 to 30 carbon atoms for forming a ring, or a substituted or unsubstituted heteroaryl group having 2 to 30 carbon atoms for forming a ring. For example, Ar_1 and Ar_2 may each independently be a substituted or unsubstituted alkyl group having 1 to 5 carbon atoms, a substituted or unsubstituted cycloalkyl group having 3 to 10 carbon atoms for forming a ring, a substituted or unsubstituted aryl group having 6 to 20 (*e.g.* 6 to 12) carbon atoms for forming a ring, or a substituted or unsubstituted heteroaryl group having 2 to 20 (*e.g.* 5 to 12) carbon atoms for forming a ring.

[0041] In Formula 1, L is a substituted or unsubstituted arylene group having 6 to 30 carbon atoms for forming a ring, or a substituted or unsubstituted heteroarylene group having 2 to 30 carbon atoms for forming a ring. For example, L may be a substituted or unsubstituted arylene group having 6 to 20 (*e.g.* 6 to 12) carbon atoms for forming a ring, or a substituted or unsubstituted heteroarylene group having 2 to 20 (*e.g.* 5 to 12) carbon atoms for forming a ring.

[0042] In Formula 1, R_1 is a hydrogen atom, a deuterium atom, a halogen atom, a substituted or unsubstituted alkyl group having 1 to 20 carbon atoms, a substituted or unsubstituted cycloalkyl group having 3 to 20 carbon atoms for forming a ring, or a substituted or unsubstituted aryl group having 6 to 30 carbon atoms for forming a ring. For example, R_1 may be a hydrogen atom, a deuterium atom, a halogen atom, a substituted or unsubstituted alkyl group having 1 to 10 (*e.g.* 1 to 5) carbon atoms, a substituted or unsubstituted cycloalkyl group having 3 to 10 carbon atoms for forming a ring, or a substituted or unsubstituted aryl group having 6 to 20 (*e.g.* 6 to 12) carbon atoms for forming a ring.

[0043] In Formula 1, R_2 is a hydrogen atom, a deuterium atom, a halogen atom, a substituted or unsubstituted alkyl group having 1 to 20 carbon atoms, or a substituted or unsubstituted cycloalkyl group having 3 to 20 carbon atoms for forming a ring. For example, R_2 may be a hydrogen atom, a deuterium atom, a halogen atom, a substituted or unsubstituted alkyl group having 1 to 10 (*e.g.* 1 to 5) carbon atoms, or a substituted or unsubstituted cycloalkyl group having 3 to 10 carbon atoms for forming a ring. Meanwhile, R_2 is neither an aryl group nor a heteroaryl group. In the compound of Formula 1, where R_2 is an aryl group or a heteroaryl group, the naphthalene structure would have largely distributed

HOMO (highest occupied molecular orbital) and the amine group could not maintain the property of extending device life due to the relatively decreased electron density, thereby decreasing life of the organic electroluminescence device including the compound. When R_2 is referred to as being neither an aryl group nor a heteroaryl group, it may include both the case where R_2 is neither an aryl group nor a heteroaryl group and the case where R_2 is substituted with neither an aryl group nor a heteroaryl group.

[0044] In Formula 1, a is an integer of 0 to 3. In case a is an integer of 2 or more, a plurality of L may be the same or different from each other.

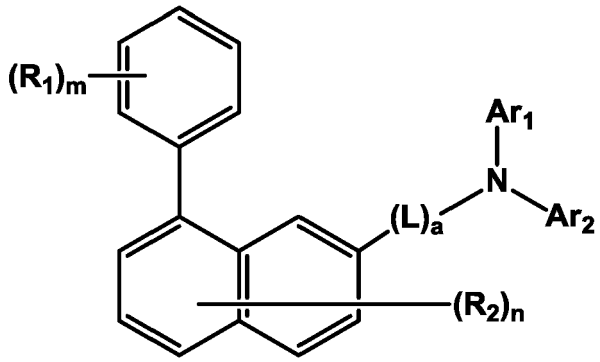
[0045] In Formula 1, m is an integer of 0 or 1. For example, m may be 0. For example m may be 1.

[0046] In Formula 1, n is an integer of 0 to 6. In case n is an integer of 2 or more, a plurality of R_2 may be the same or different from each other.

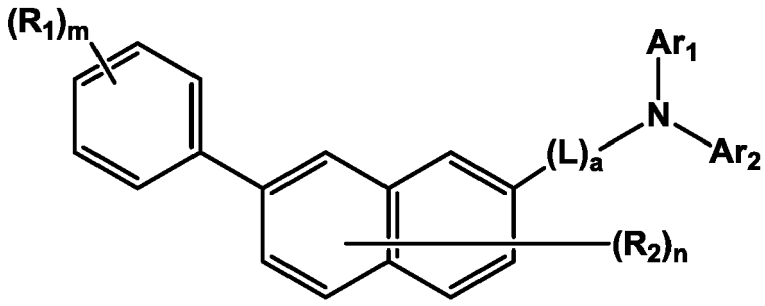
[0047] In Formula 1, in case any one of Ar_1 and Ar_2 is 3-dibenzofuranyl, the other is not 9-phenanthryl. That is, when Ar_1 is 3-dibenzofuranyl, Ar_2 is not 9-phenanthryl, and when Ar_2 is 3-dibenzofuranyl, Ar_1 is not 9-phenanthryl. Furthermore, the compound of Formula 1, where the nitrogen atom is substituted with both of 3-dibenzofuranyl and 9-phenanthryl, is excluded. The compound of Formula 1, where the nitrogen atom is substituted with both of 3-dibenzofuranyl and 9-phenanthryl, would have a strong molecular stacking and increased deposition temperature, which results in thermal decomposition, thereby degrading the quality of organic electroluminescence device including the compound.

[0048] In an embodiment, Formula 1 may be represented by any one of the following Formulae 2 to 8.

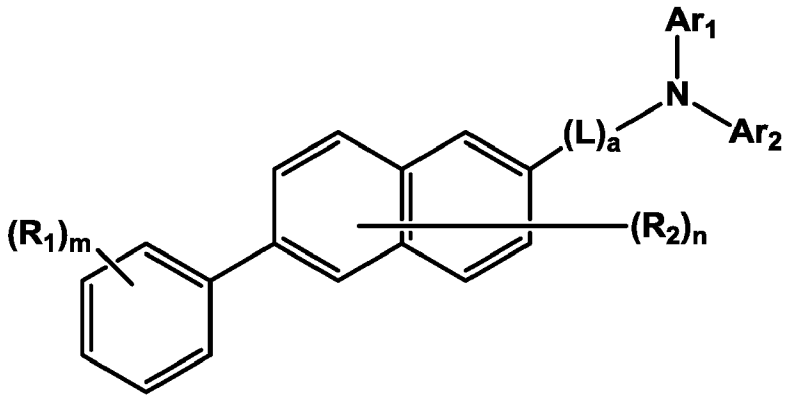
[Formula 2]



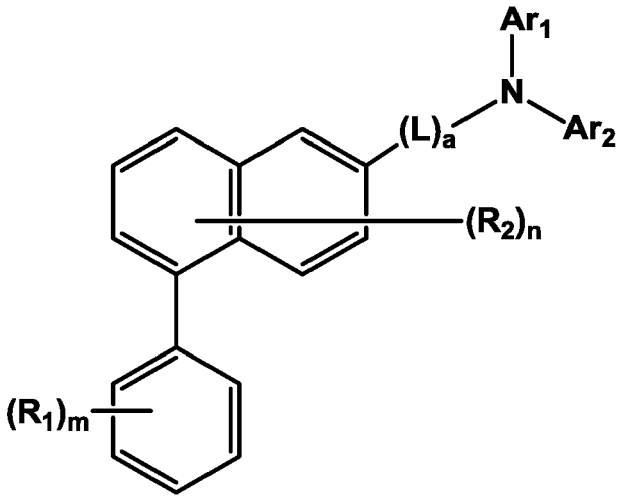
[Formula 3]



[Formula 4]



[Formula 5]



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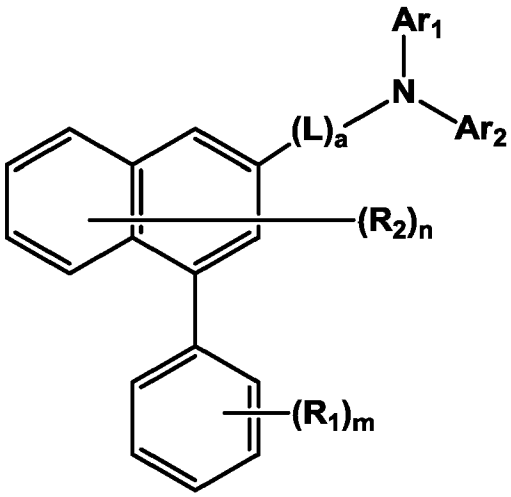
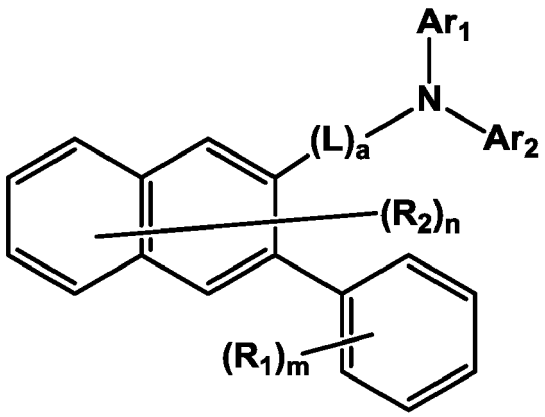
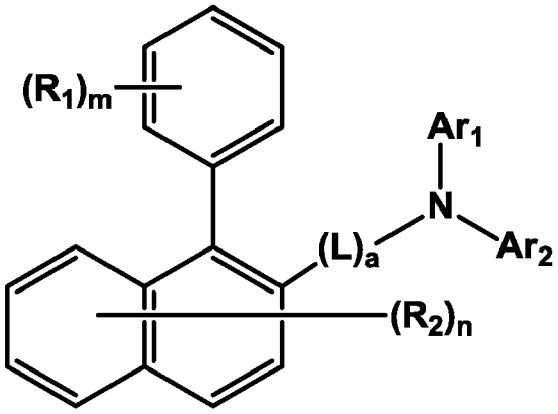


[Formula 7]



[Formula 8]



[0049] In Formulae 2 to 8, Ar_1, Ar_2, L, R_1, R_2, a, m, and n are the same as defined in Formula 1.

[0050] In Formula 1, L may be a substituted or unsubstituted arylene group having 6 to 12 carbon atoms for forming a ring. For example, L may be a substituted or unsubstituted phenylene group. However, an embodiment of the inventive concept is not limited thereto.

[0051] In Formula 1, m may be 1, and L may be a substituted or unsubstituted arylene group having 6 to 12 carbon atoms for forming a ring. For example, L may be a substituted or unsubstituted phenylene group. However, an embodiment of the inventive concept is not limited thereto.

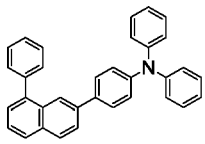
[0052] In Formula 1, Ar_1 and Ar_2 may be each independently a substituted or unsubstituted aryl group having 6 to 12 carbon atoms for forming a ring. For example, Ar_1 and Ar_2 may be each independently a substituted or unsubstituted phenyl group, a substituted or unsubstituted biphenyl group, a substituted or unsubstituted naphthylene group, or a substituted or unsubstituted fluorenyl group. However, an embodiment of the inventive concept is not limited thereto.

[0053] In Formula 1, Ar_1 and Ar_2 may be each independently a substituted or unsubstituted heteroaryl group having 5 to 12 carbon atoms for forming a ring. For example, Ar_1 and Ar_2 may be each independently a substituted or unsubstituted dibenzofuran group, a substituted or unsubstituted dibenzothiophene group, or a substituted or unsubstituted carbazole group. However, an embodiment of the inventive concept is not limited thereto.

[0054] In Formula 1, R_2 may be a hydrogen atom or a deuterium atom.

[0055] The monoamine compound represented by Formula 1 according to an embodiment of the inventive concept may be any one selected from the group consisting of compounds represented in the following Compound Groups 1 to 7. However, an embodiment of the inventive concept is not limited thereto.

[Compound Group 1]



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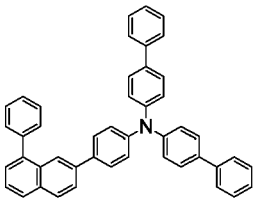

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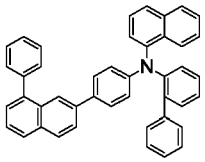

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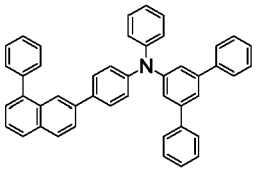

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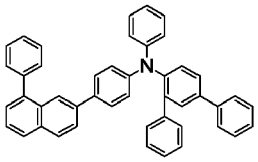

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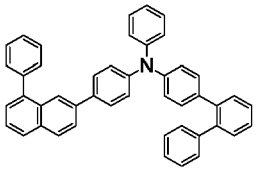

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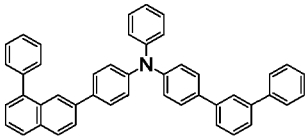

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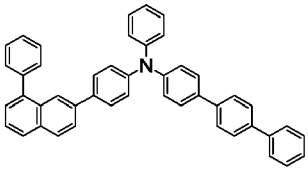

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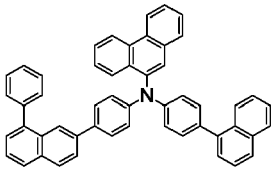

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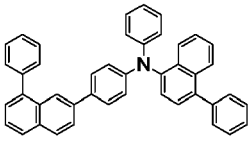

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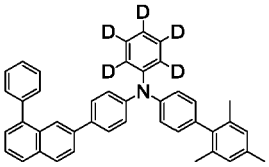

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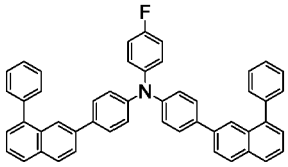

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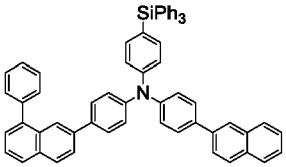

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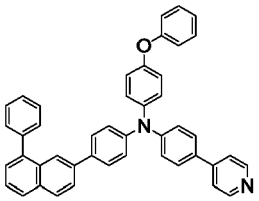

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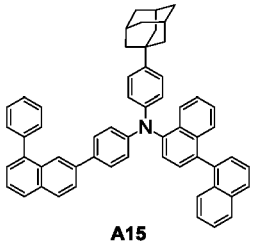

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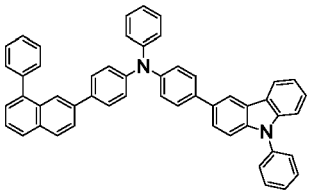

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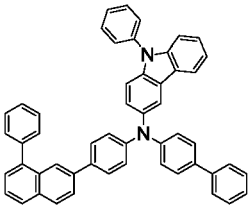

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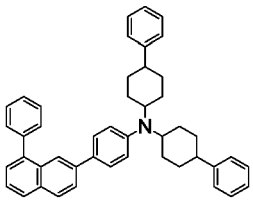

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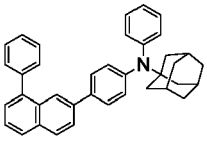

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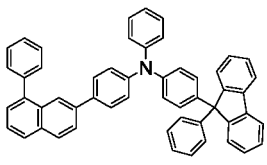

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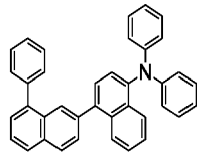

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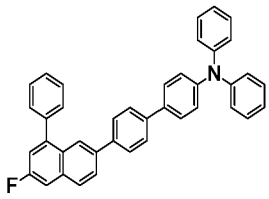

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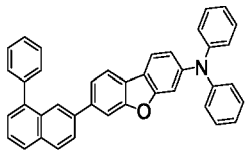

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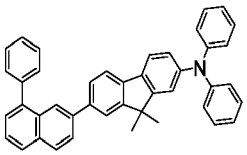

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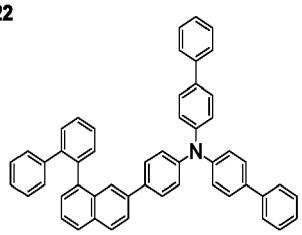

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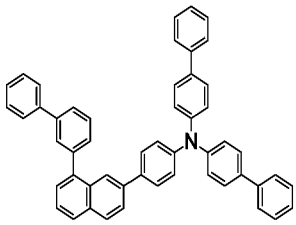

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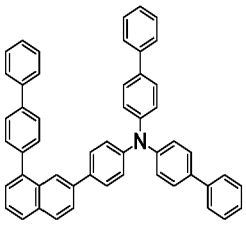

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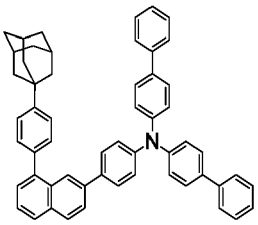

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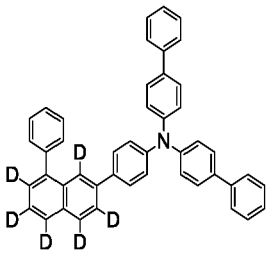

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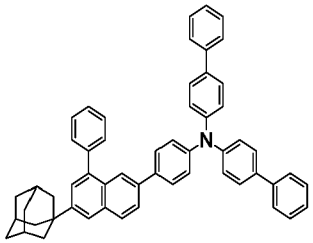

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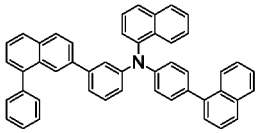

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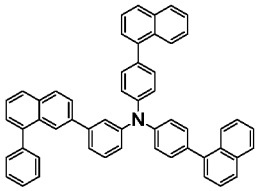

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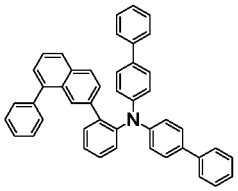

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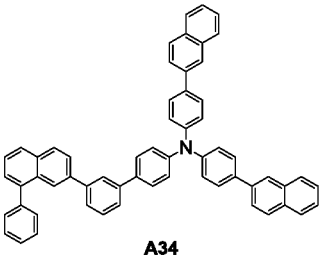

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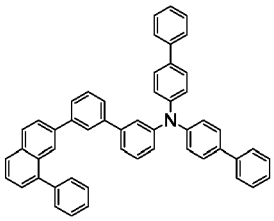

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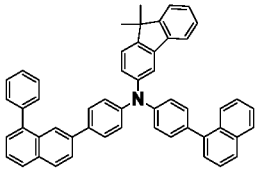

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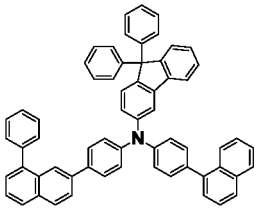

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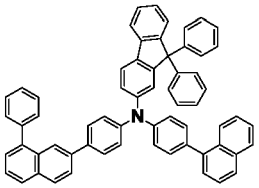

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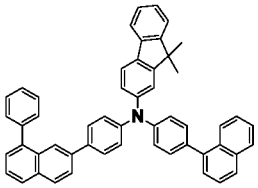

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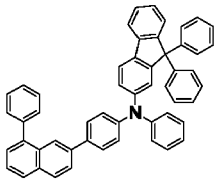

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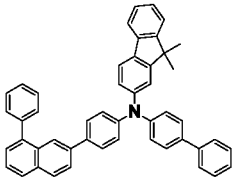

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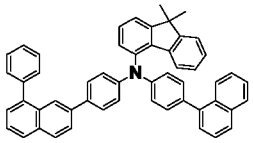

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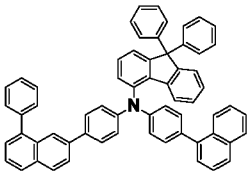

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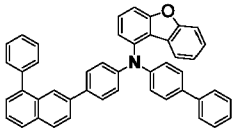

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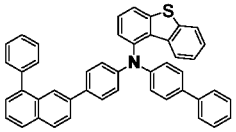

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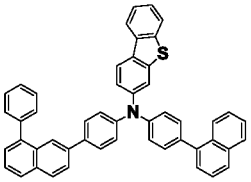

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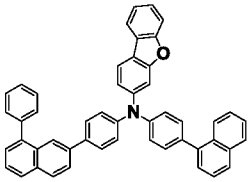

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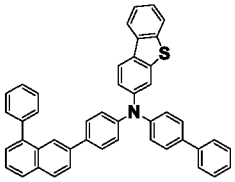

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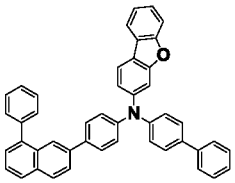

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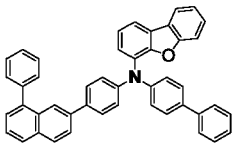

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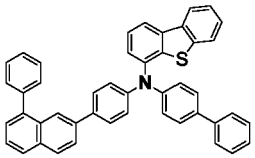

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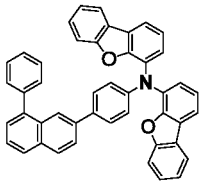

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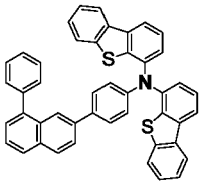

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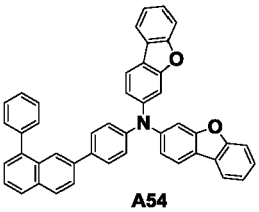

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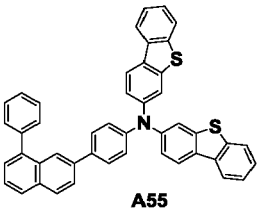

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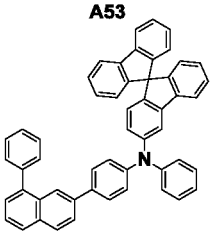

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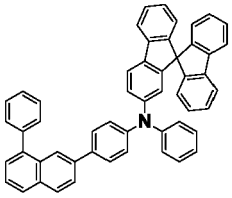

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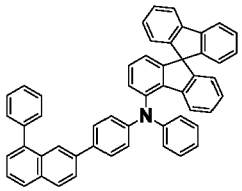

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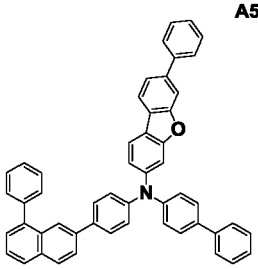

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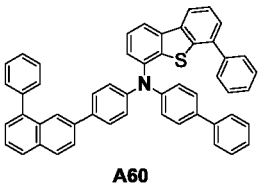
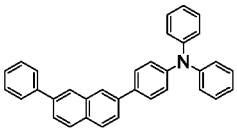


A60

[Compound Group 2]



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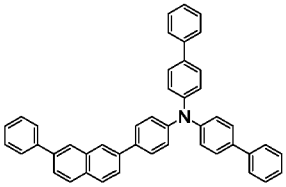

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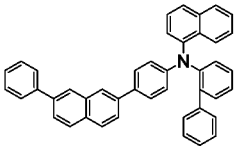

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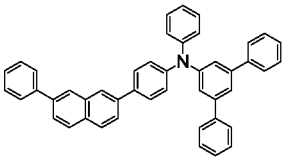

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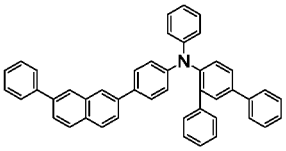

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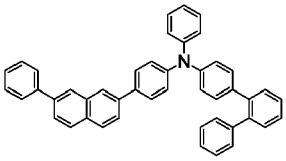

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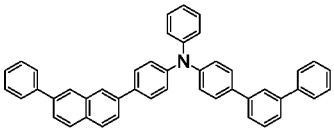

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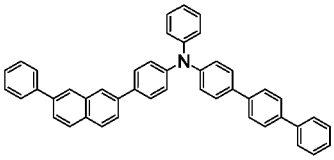

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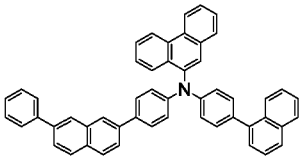

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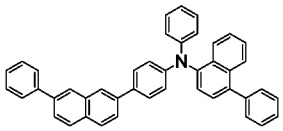

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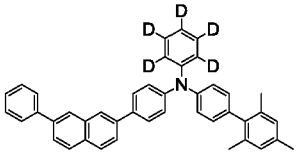

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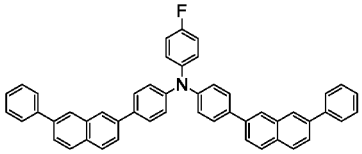

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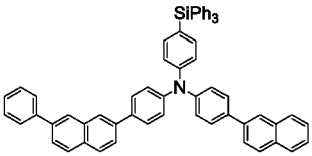

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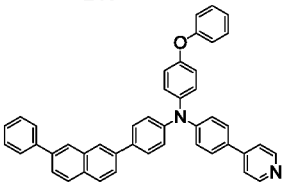

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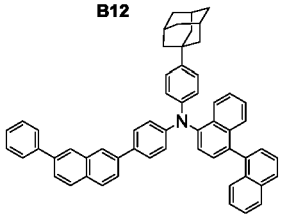

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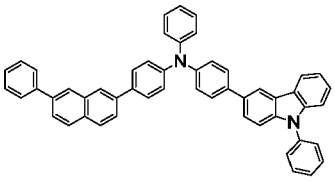

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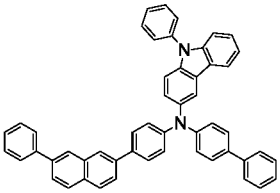

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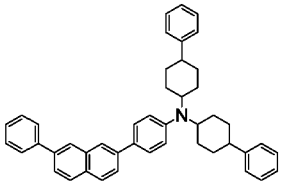

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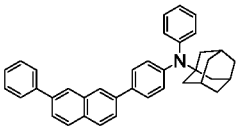

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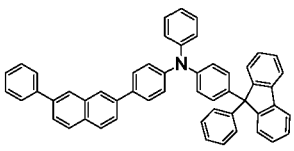

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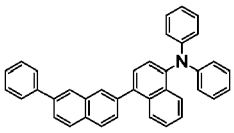

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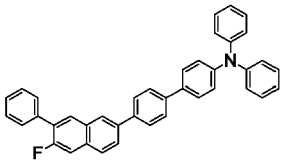

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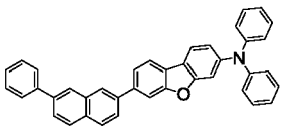

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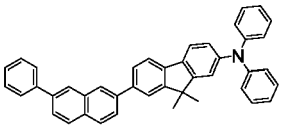

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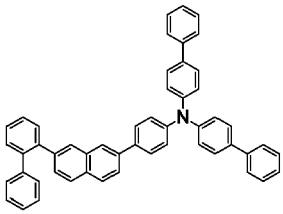

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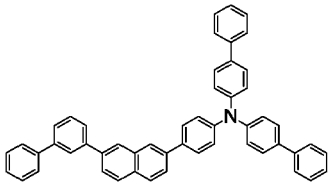

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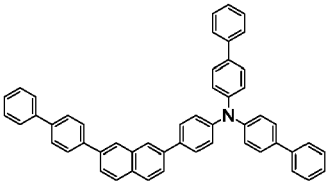

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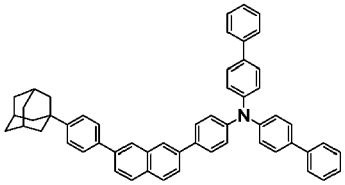

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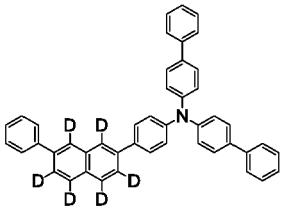

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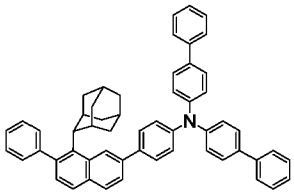

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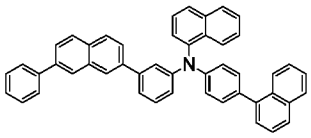

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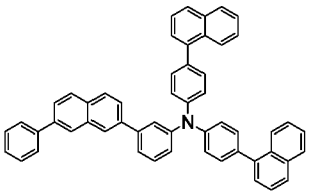

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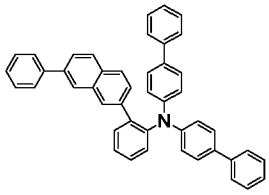

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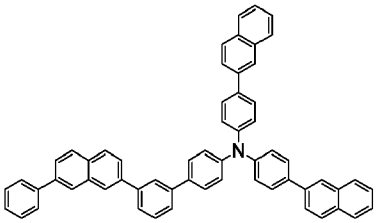

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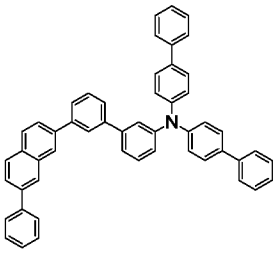

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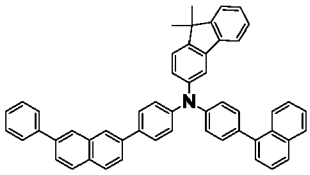

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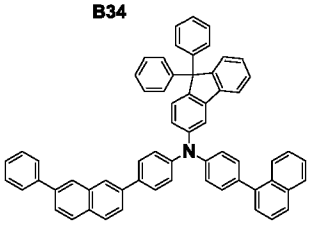

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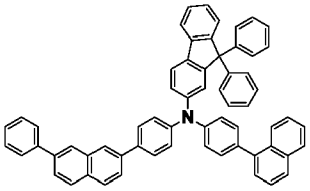

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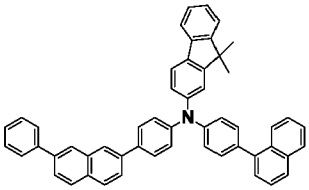

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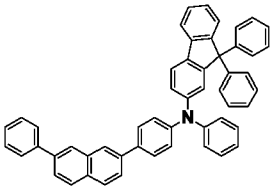

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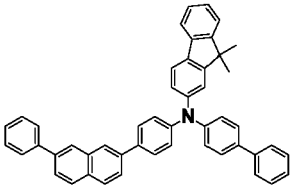

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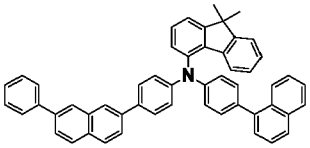

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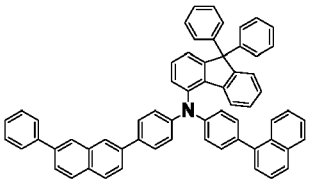

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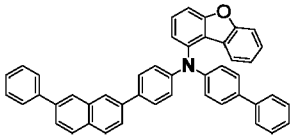

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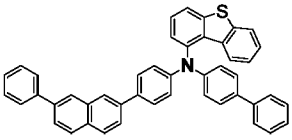

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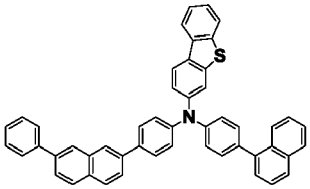

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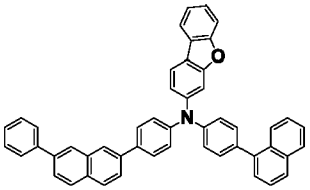

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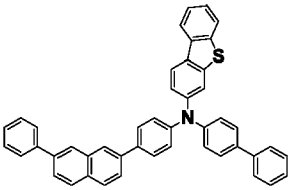

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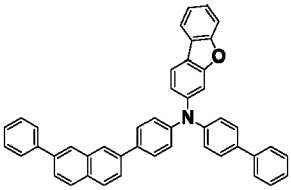

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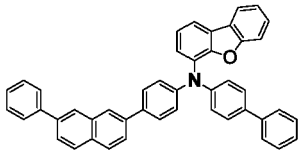

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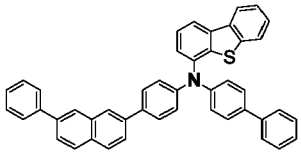

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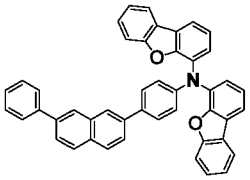

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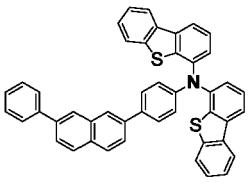

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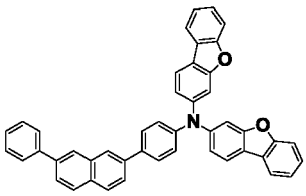

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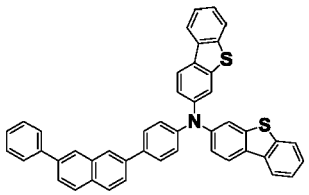

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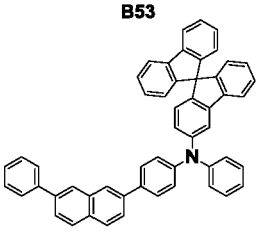
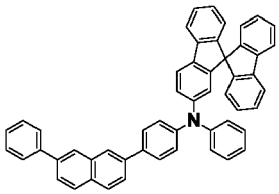


B56



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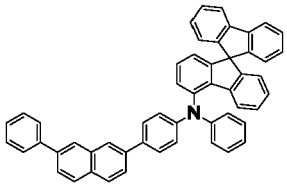

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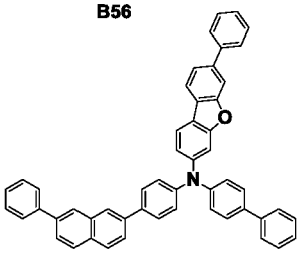

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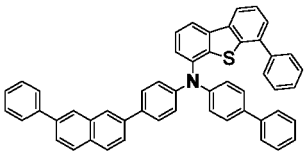
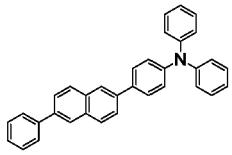


B60

[Compound Group 3]



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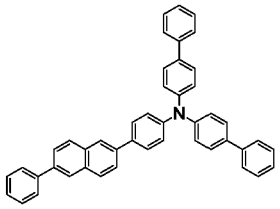

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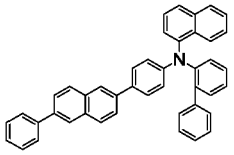

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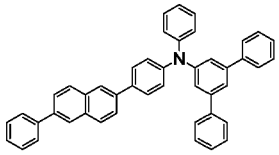

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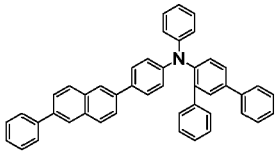

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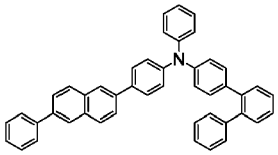

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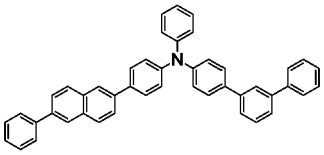

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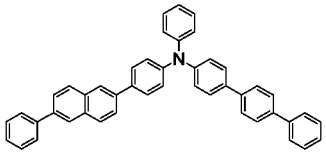

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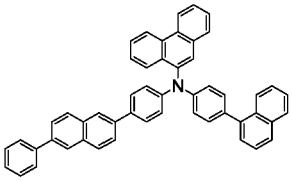

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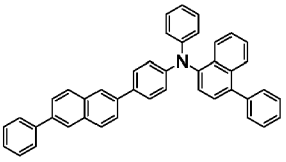

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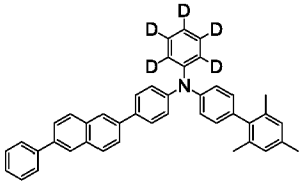
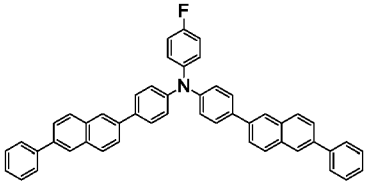


C11



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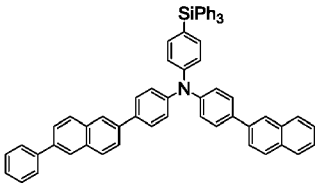

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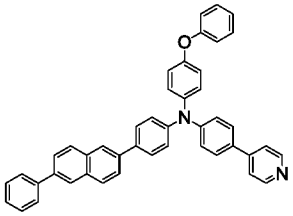

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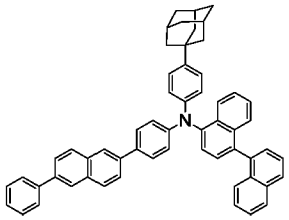

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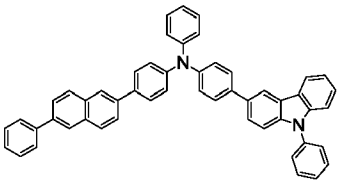

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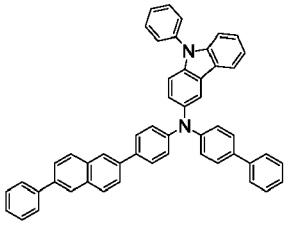

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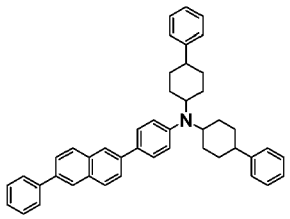

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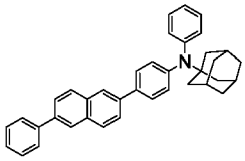

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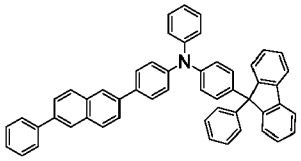

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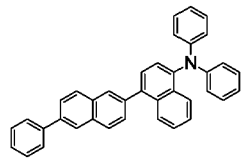

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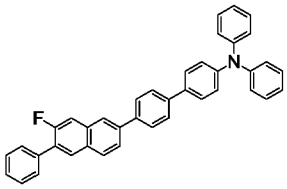

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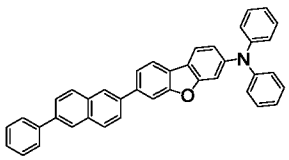

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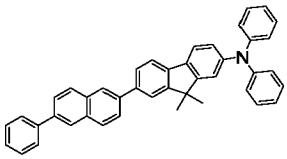

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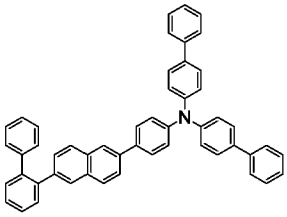

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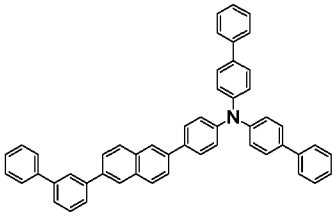

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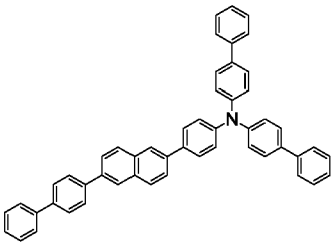

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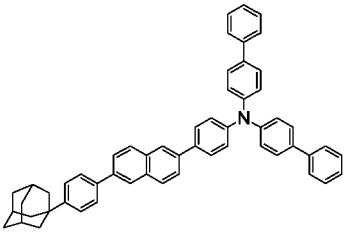

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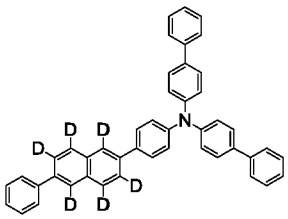

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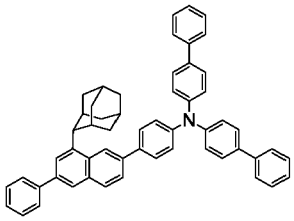

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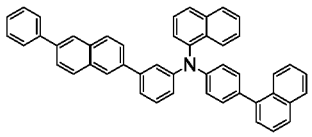

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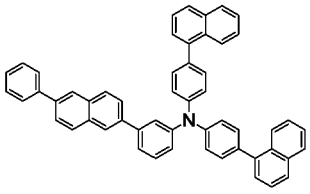

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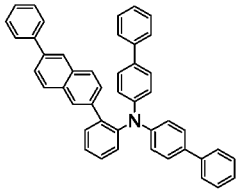

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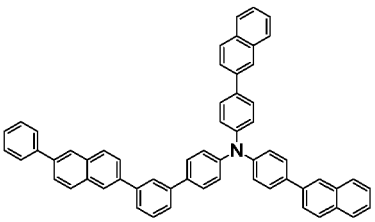

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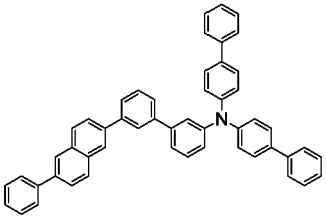

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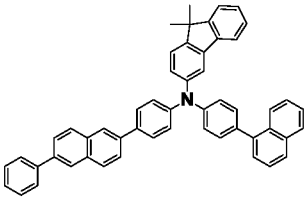

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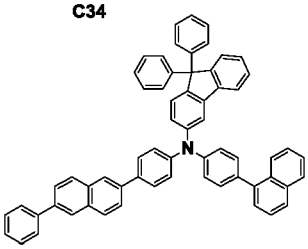

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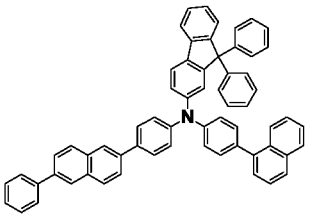

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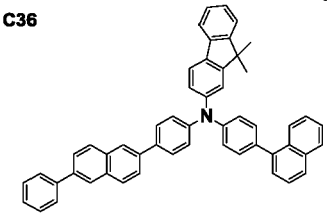

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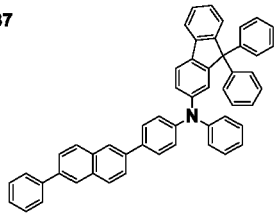
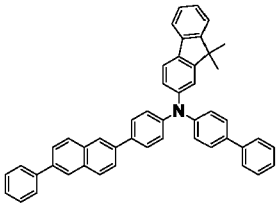


C40



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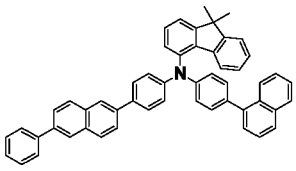

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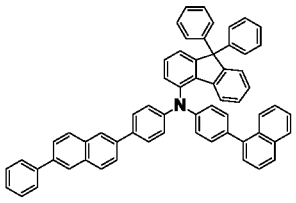

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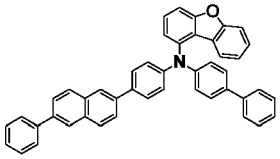

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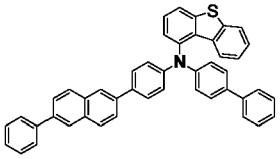

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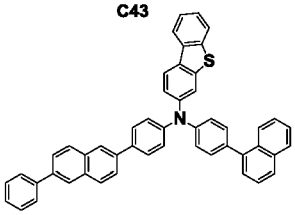

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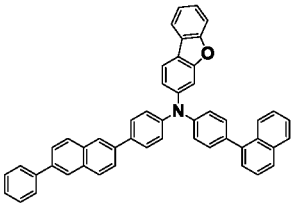

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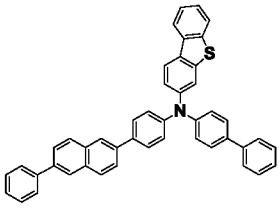

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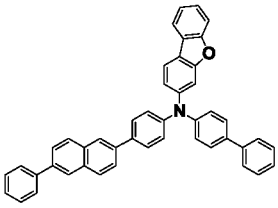
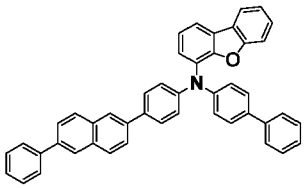
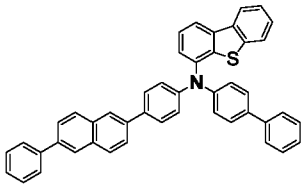


C49



C50



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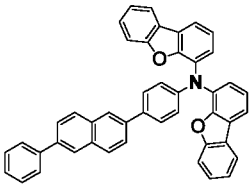

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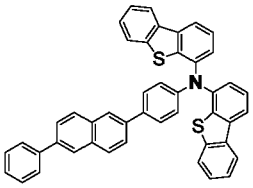

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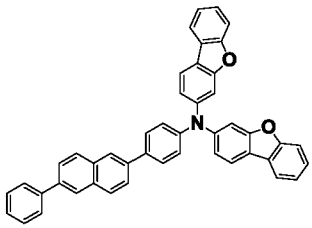

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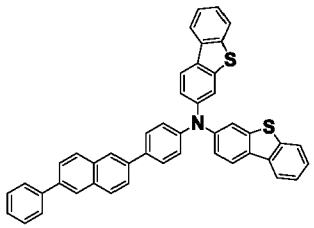
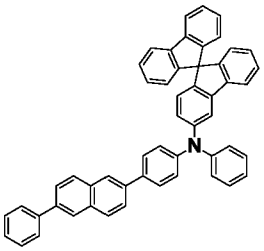
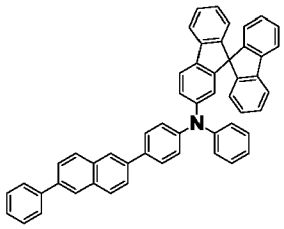


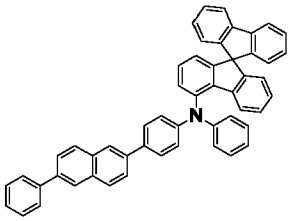
C55



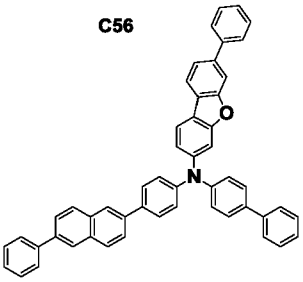
C56



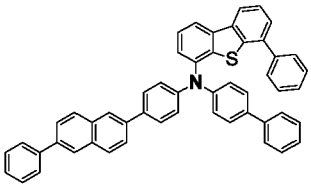
C57



C58

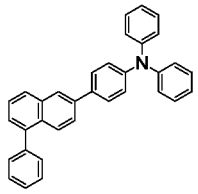


C59

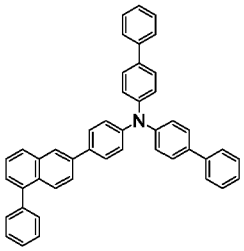


C60

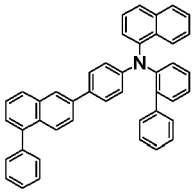
[Compound Group 4]



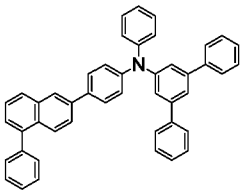
D1



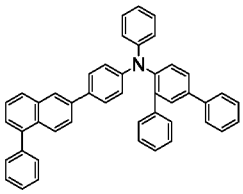
D2



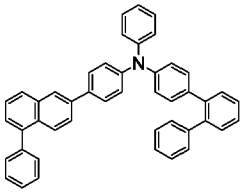
D3



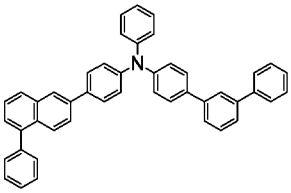
D4



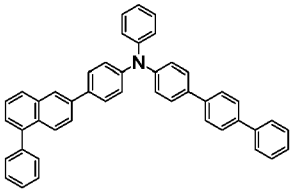
D5



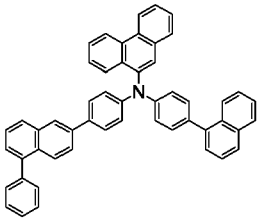
D6



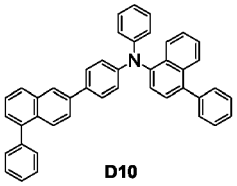
D7



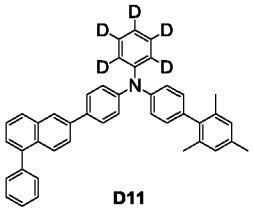
D8



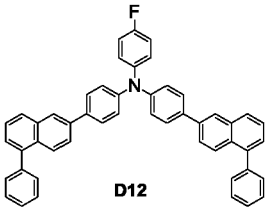
D9



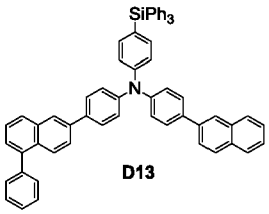
D10



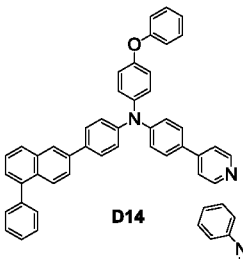
D11



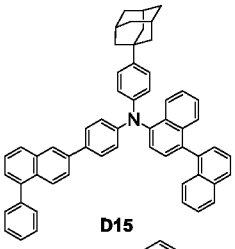
D12



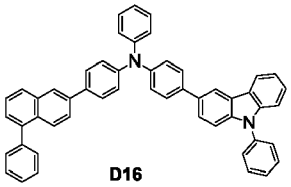
D13



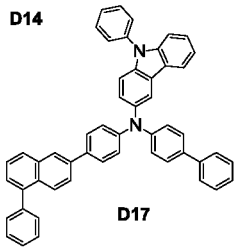
D14



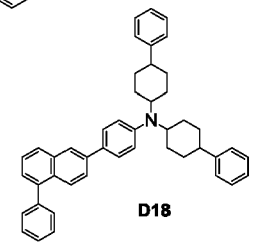
D15



D16



D17



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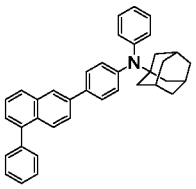

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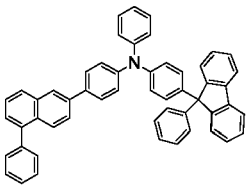

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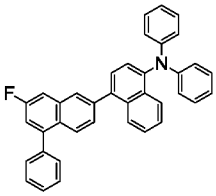

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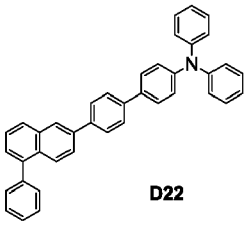

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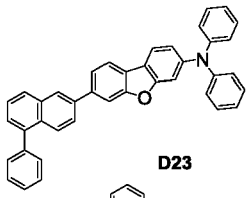

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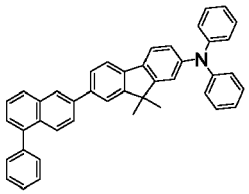

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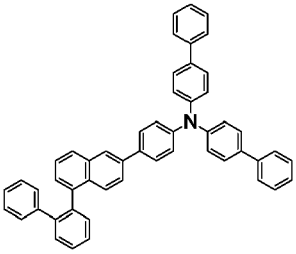

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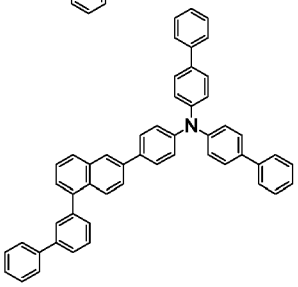

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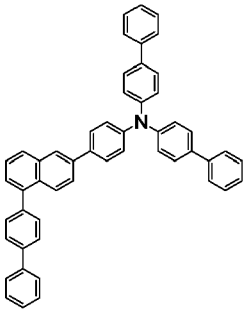
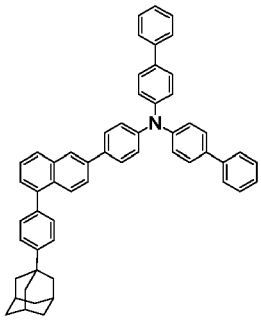
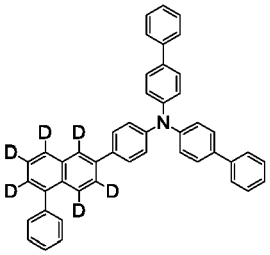


D27



D28



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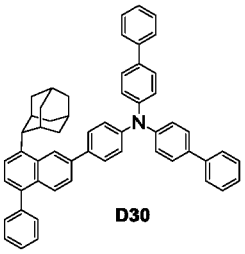
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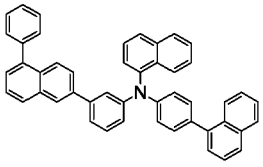
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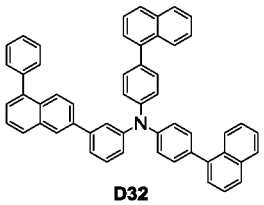
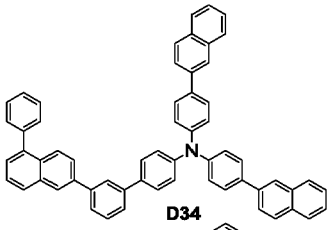

D32


D33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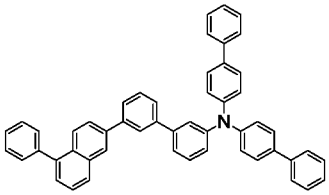
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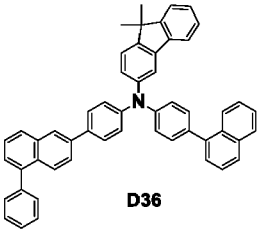
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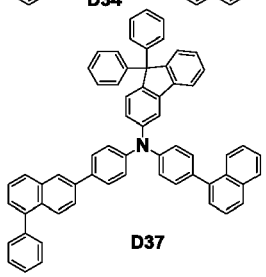
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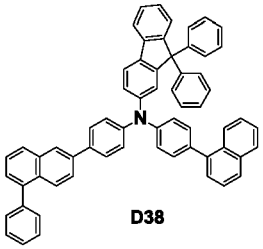
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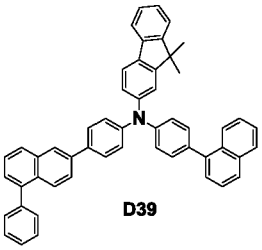
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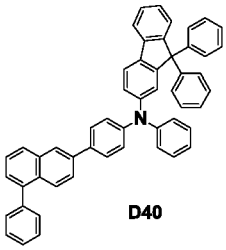
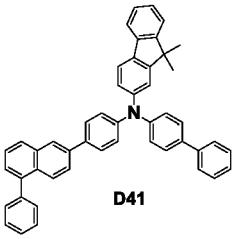
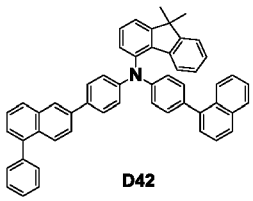
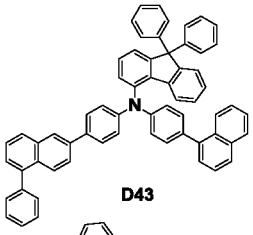
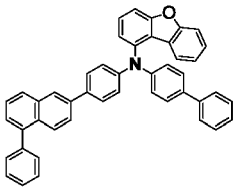
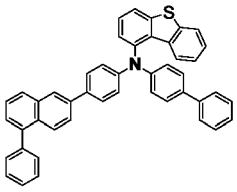

D40

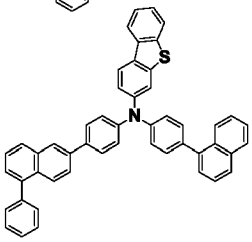

D41


D42


D43


D44


D45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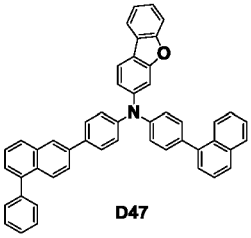
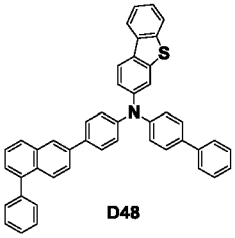
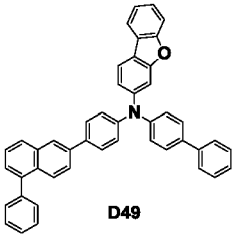
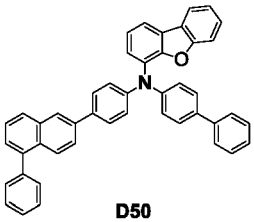
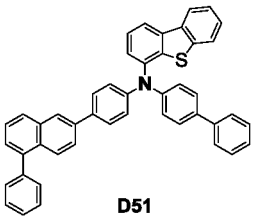
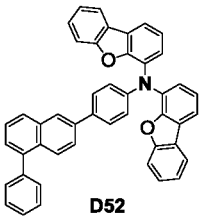

D47

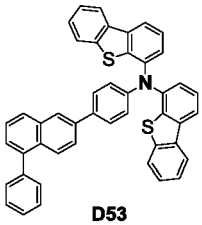

D48

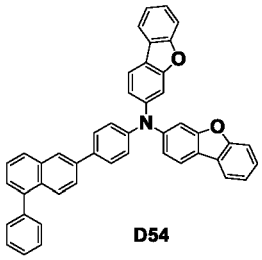

D49


D50


D51


D52


D53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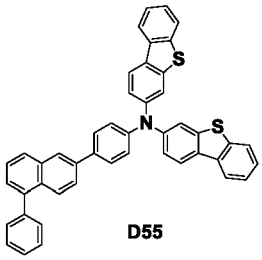
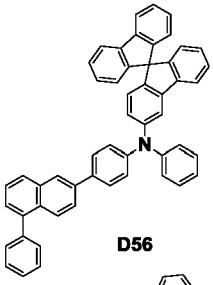

D55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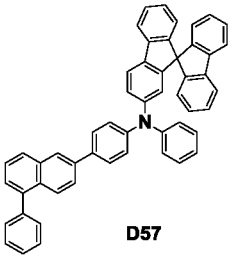
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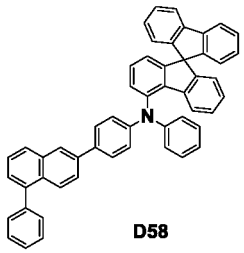
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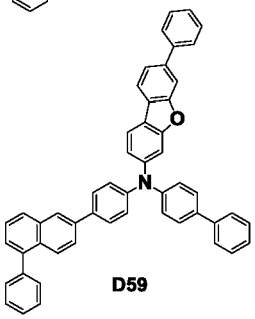
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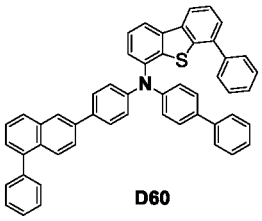
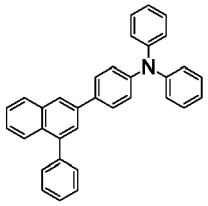

D60

[Compound Group 5]



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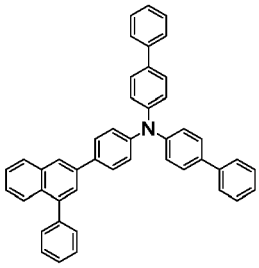

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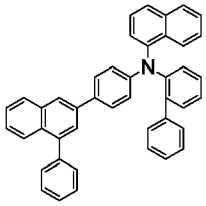

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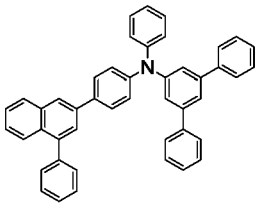

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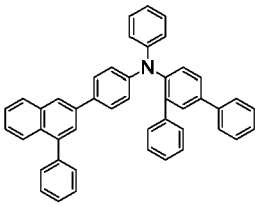

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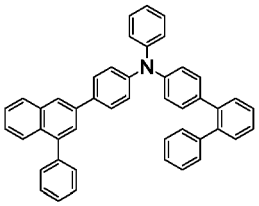

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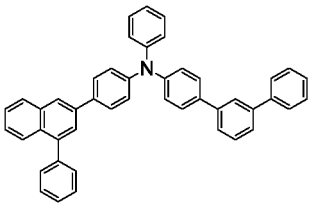

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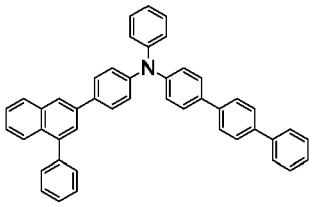

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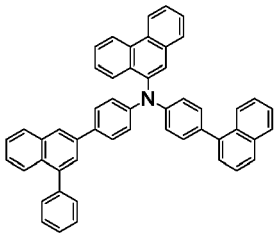

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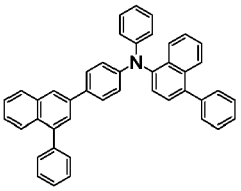

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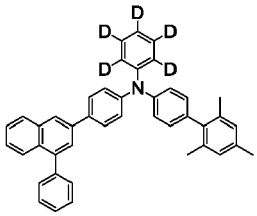

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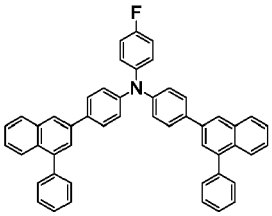

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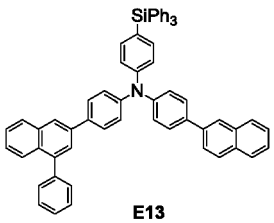

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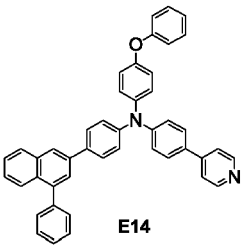

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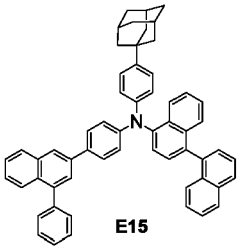

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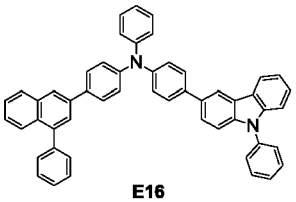

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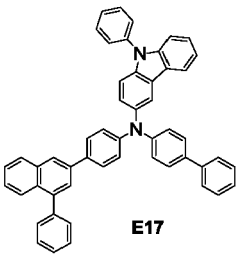

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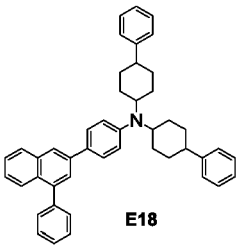

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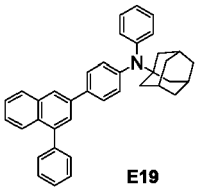

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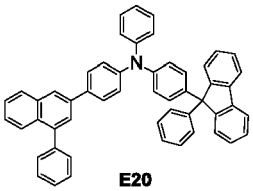

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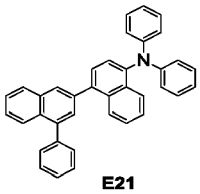

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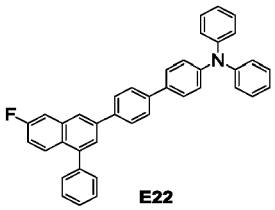

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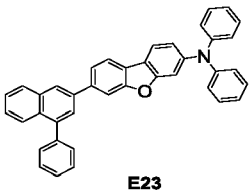

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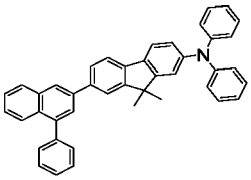

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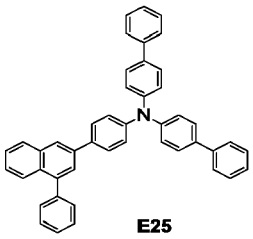

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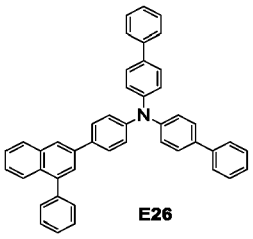

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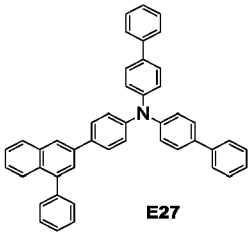

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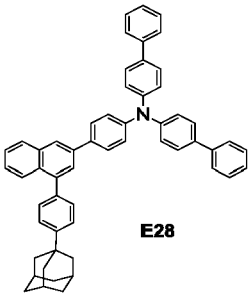

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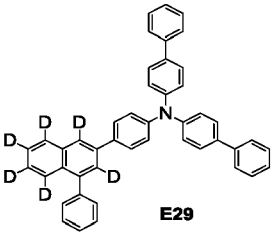

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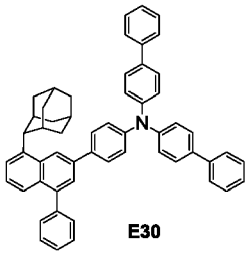

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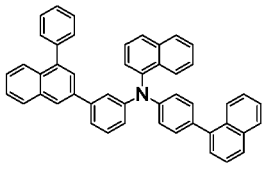

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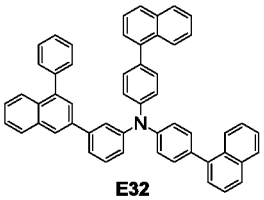

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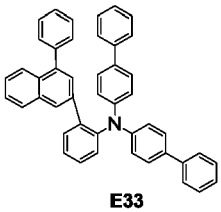

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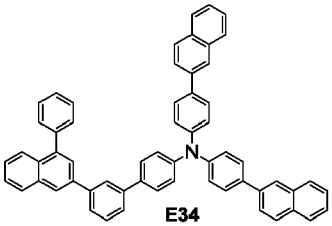

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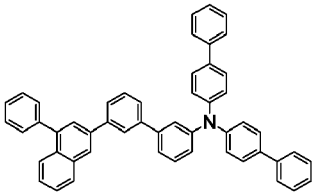

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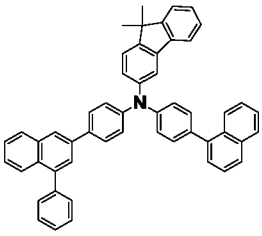

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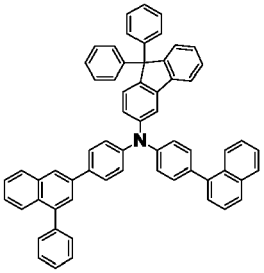

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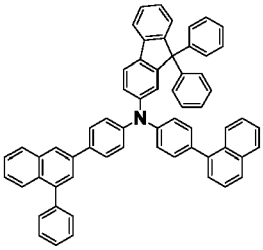

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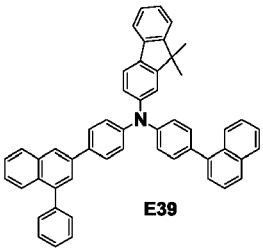

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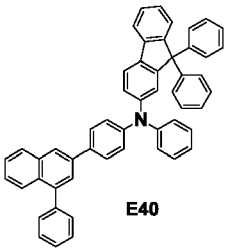

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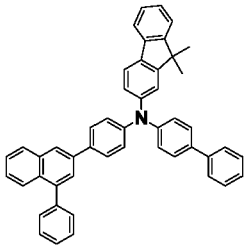

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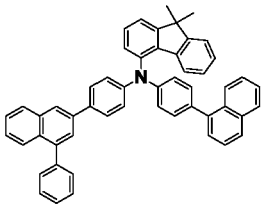

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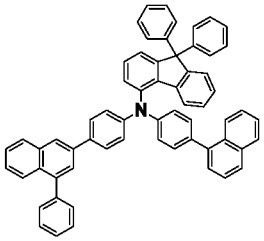

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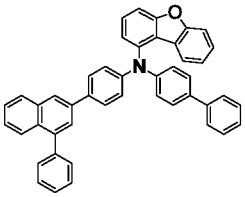

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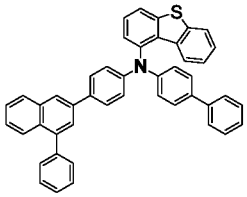

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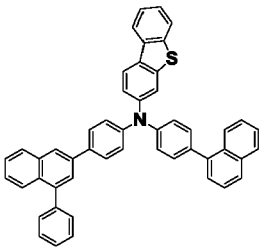

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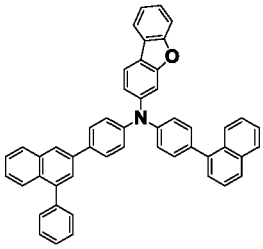

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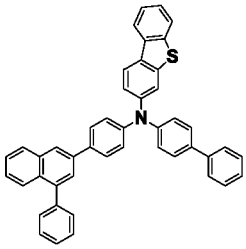

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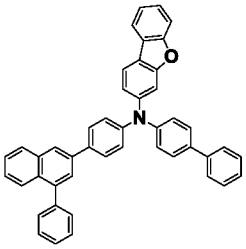

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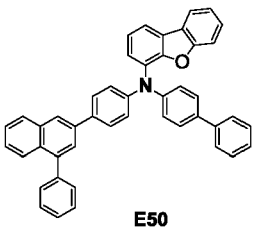
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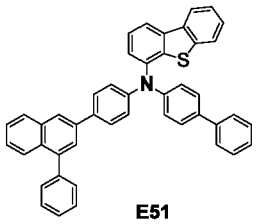
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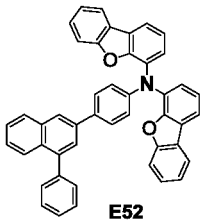
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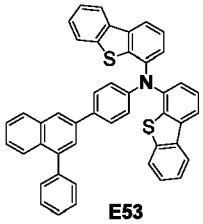
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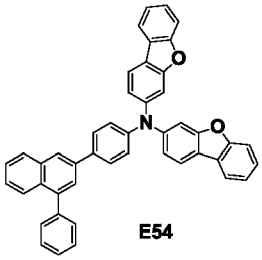
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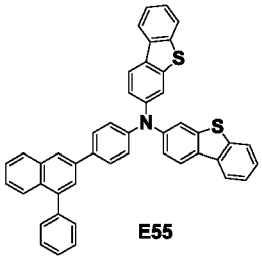
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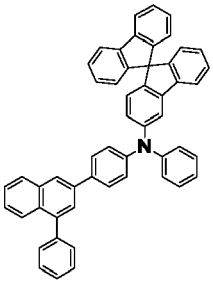
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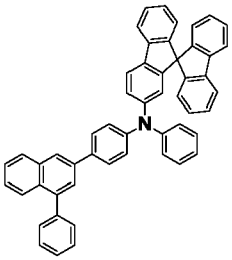
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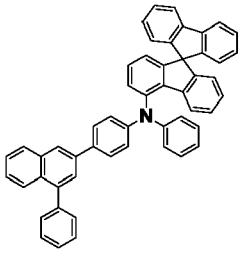
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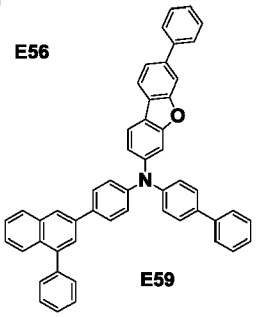
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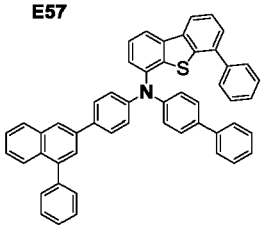
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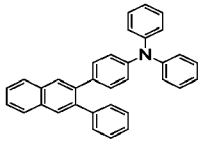
[Compound Group 6]



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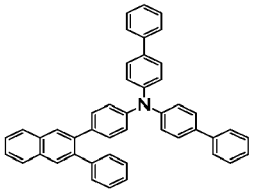

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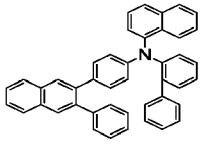

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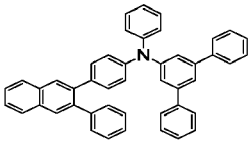

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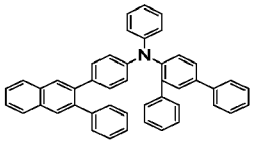

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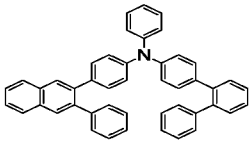

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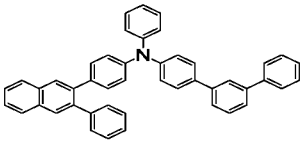

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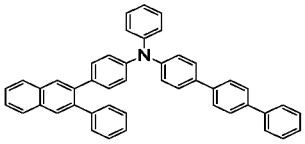

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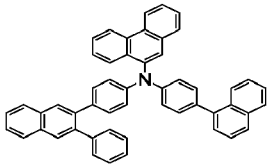

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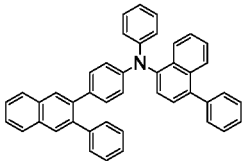

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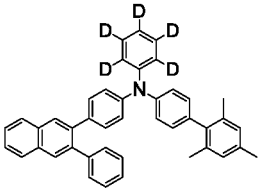

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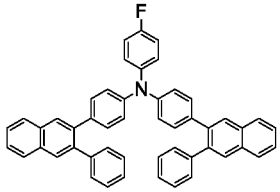

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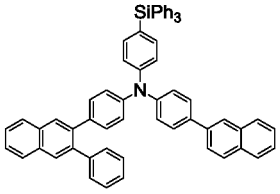

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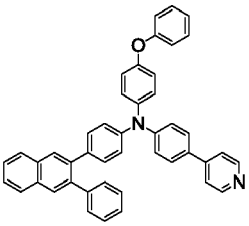

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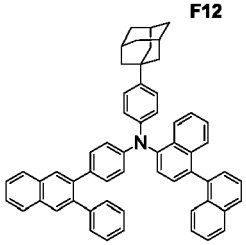

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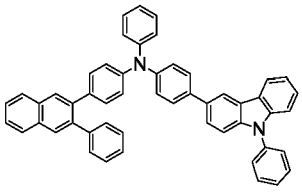

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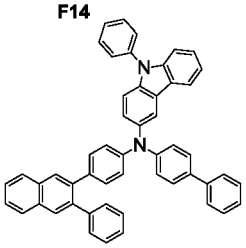

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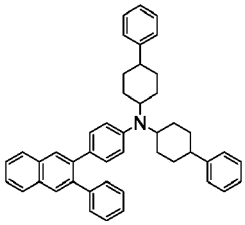

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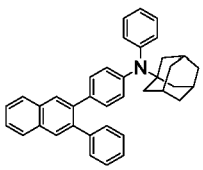

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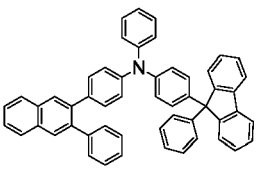

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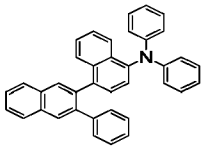

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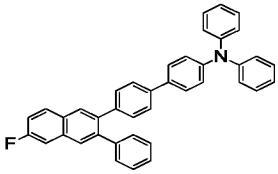

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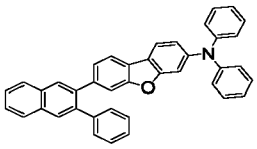

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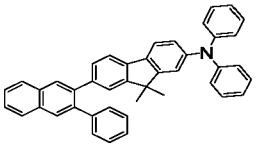

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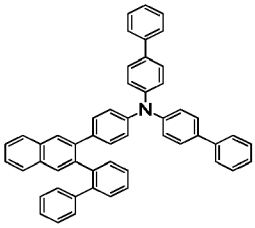

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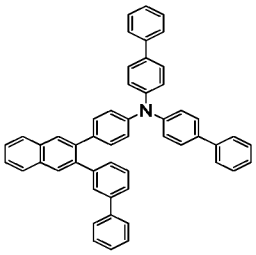

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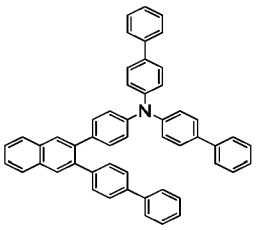

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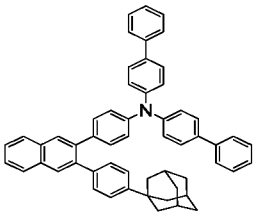

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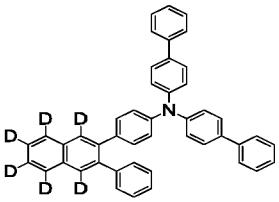

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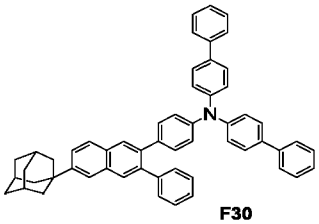

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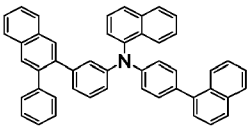

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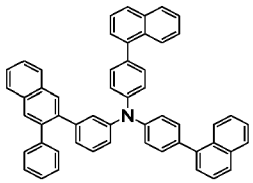

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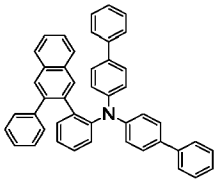

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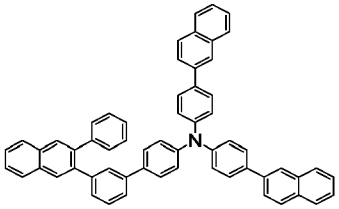

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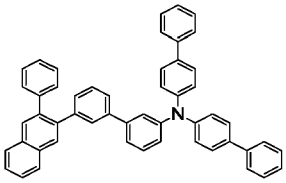

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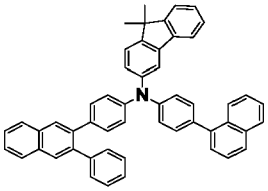

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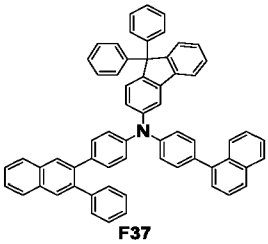

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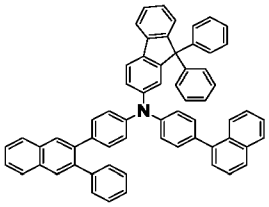

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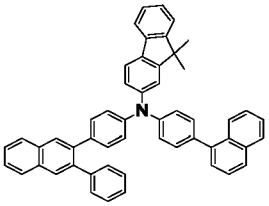

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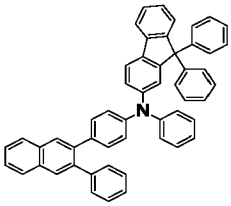

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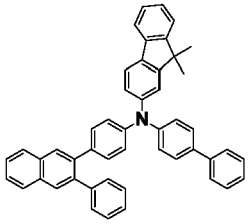

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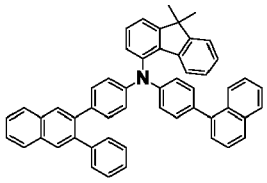

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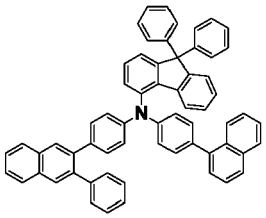

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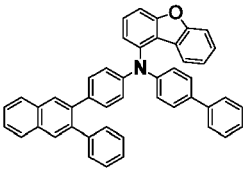

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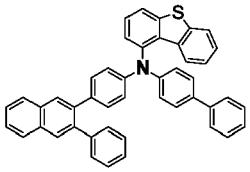

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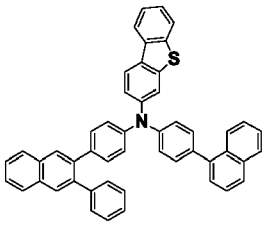

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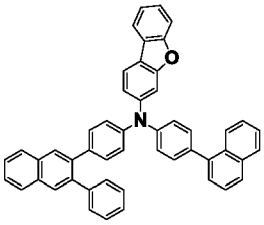

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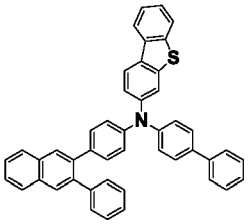

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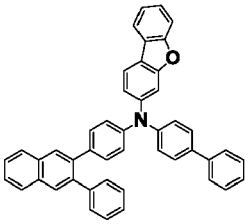

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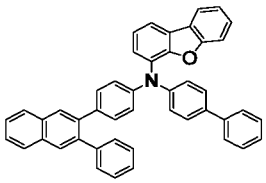

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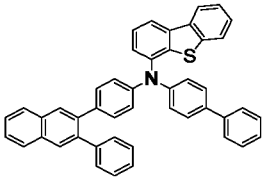

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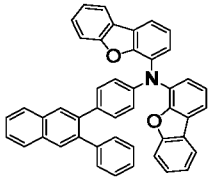

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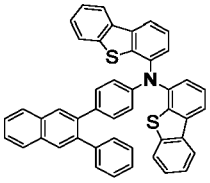
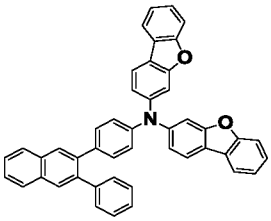
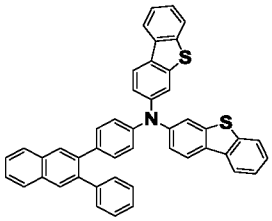


F53



F54



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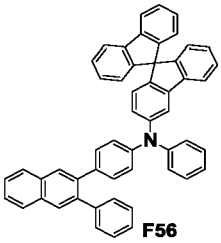

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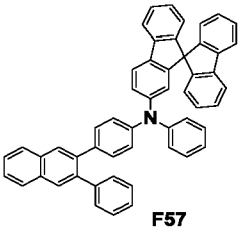

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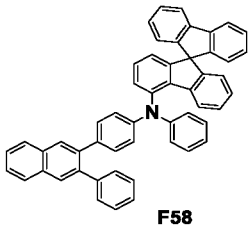

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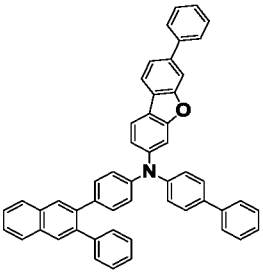

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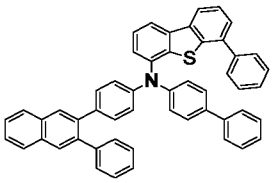
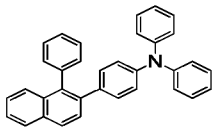
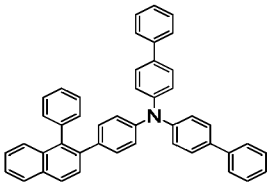


F60

[Compound Group 7]



G1



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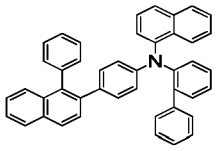
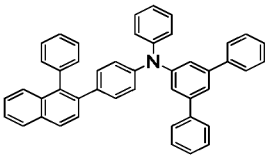


G3



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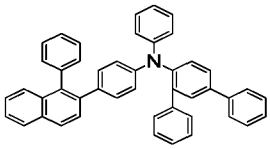

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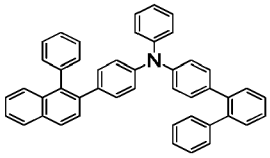
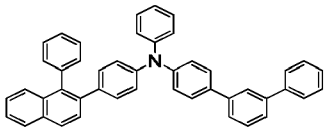


G6



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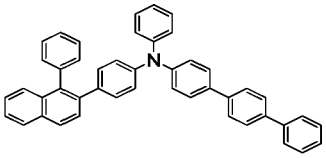

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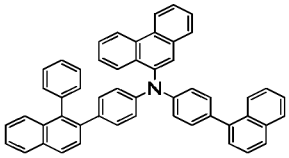
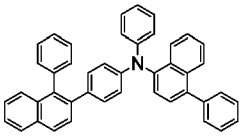


G9



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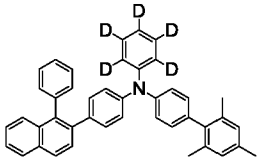
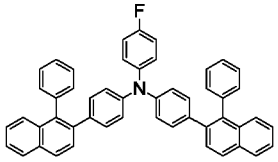
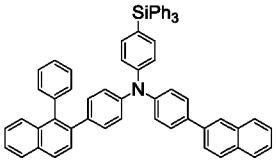


G11



G12



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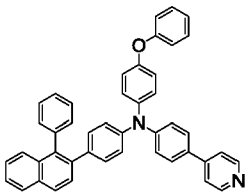

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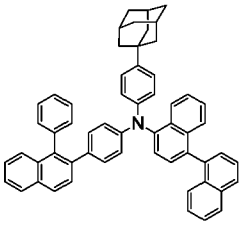
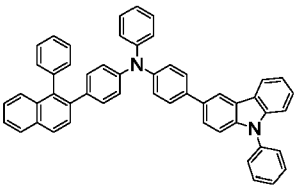
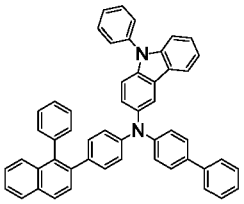


G15



G16



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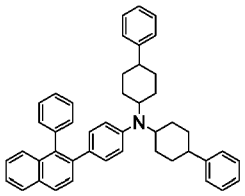

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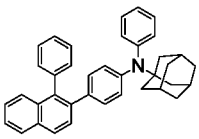

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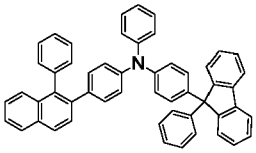

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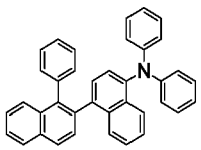

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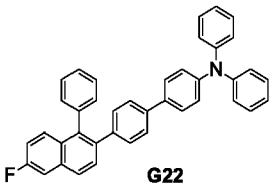

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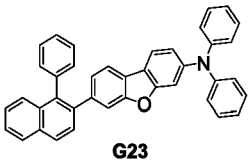

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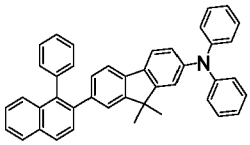

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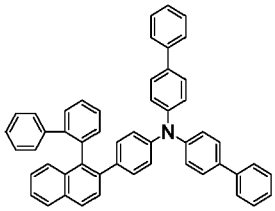

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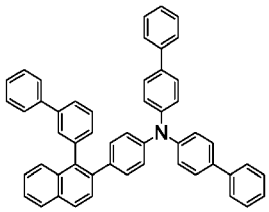

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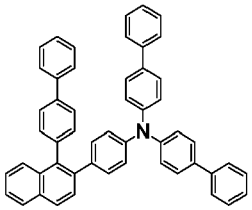

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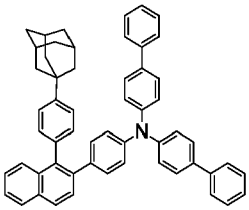

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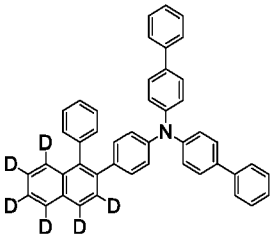

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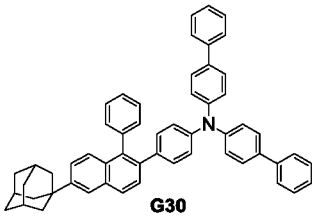

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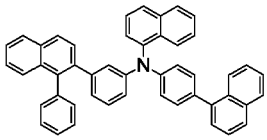

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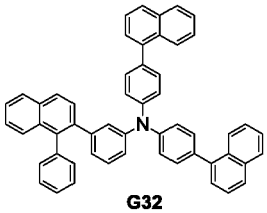

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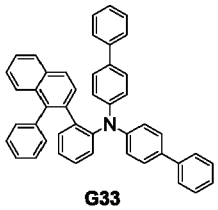

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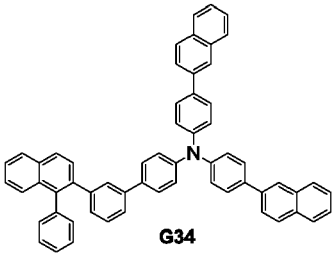

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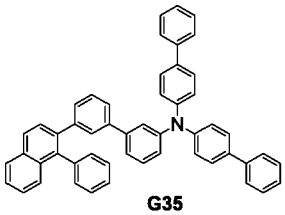
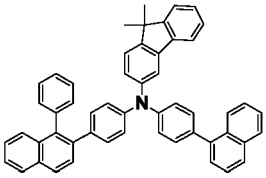
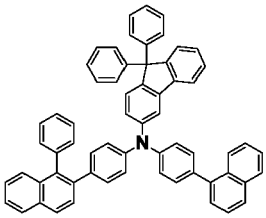


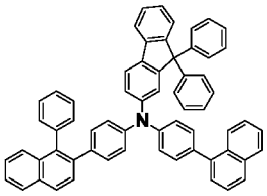
G35



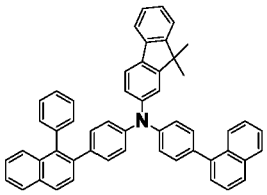
G36



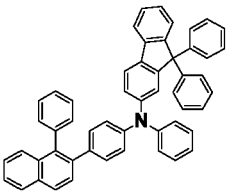
G37



G38



G39



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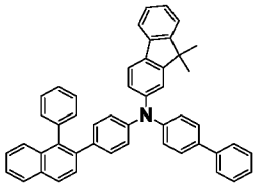
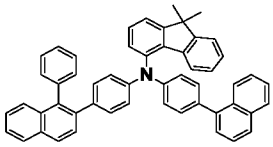


G41



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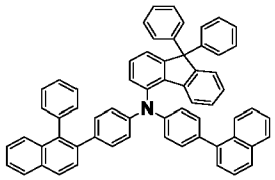
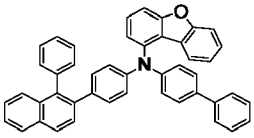


G43



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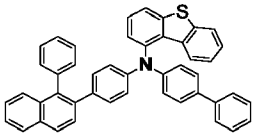

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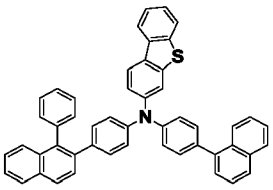
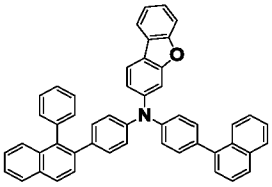
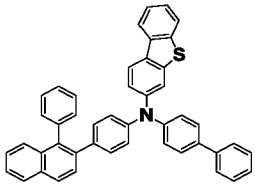


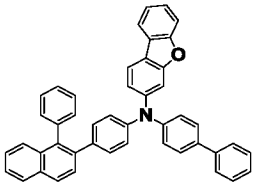
G46



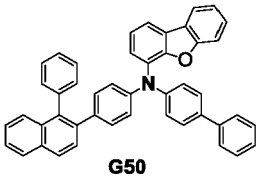
G47

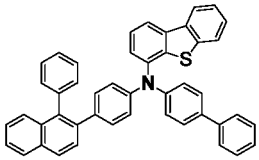


G48



G49


G50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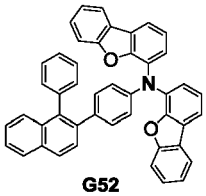
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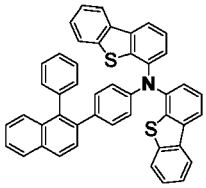
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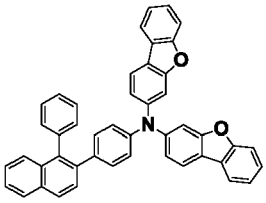
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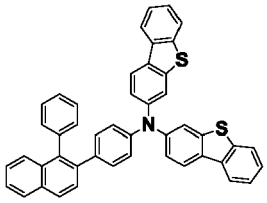
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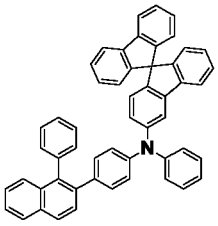
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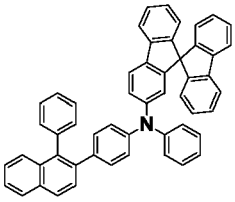
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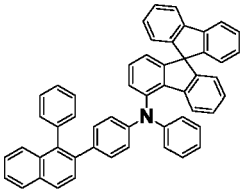
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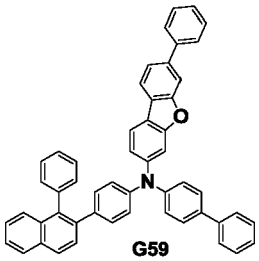
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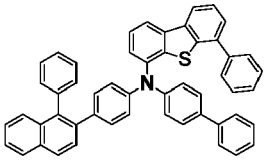

G60

[0056] The monoamine compound according to an embodiment of the inventive concept includes a fused ring and a phenylnaphthyl group with a high thermal resistance and electric charge resistance, and therefore, it may be used as a material for an organic electroluminescence device to extend a device life. When used as a material for an organic electroluminescence device, the monoamine compound may also enhance the quality of layers due to the bulky phenylnaphthyl group which decreases symmetry of molecule and inhibits crystallization, thereby contributing to securing high efficiency.

[0057] Hereinafter, an organic electroluminescence device according to an embodiment of the inventive concept will be explained again, referring to FIGS. 1 to 3. The organic electroluminescence device according to an embodiment of the inventive concept includes the monoamine compound according to an embodiment of the inventive concept. For example, a hole transport region HTR includes the monoamine compound represented by Formula 1.

[0058] The following explanation will be mainly given with features different from the monoamine compound according to an embodiment of the inventive concept, and unexplained parts will follow the above description on the monoamine compound according to an embodiment of the inventive concept.

[0059] The first electrode EL1 has conductivity. The first electrode EL1 may be a pixel electrode or an anode. The first electrode EL1 may be a transmissive electrode, a transflective electrode, or a reflective electrode. In case the first electrode EL1 is the transmissive electrode, the first electrode EL1 may include a transparent metal oxide such as indium tin oxide (ITO), indium zinc oxide (IZO), zinc oxide (ZnO), or indium tin zinc oxide (ITZO). In case the first electrode EL1 is the transflective electrode or reflective electrode, the first electrode EL1 may include Ag, Mg, Cu, Al, Pt, Pd, Au, Ni, Nd, Ir, Cr, Li, Ca, LiF/Ca, LiF/Al, Mo, Ti, a compound thereof, or a mixture thereof (for example, a mixture of Ag and Mg). Also, the first electrode EL1 may have a structure including a plurality of layers including a reflective layer or transflective layer formed using the above materials, and a transparent conductive layer formed using ITO, IZO, ZnO, or ITZO. For example, the first electrode EL1 may have a triple-layer structure of ITO/Ag/ITO. However, an embodiment

of the inventive concept is not limited thereto.

[0060] The thickness of the first electrode EL1 may be from about 1,000 Å to about 10,000 Å, for example, from about 1,000 Å to about 3,000 Å.

[0061] The hole transport region HTR is disposed on the first electrode EL1. The hole transport region HTR may include at least one of a hole injection layer HIL, a hole transport layer HTL, a hole buffer layer, or an electron blocking layer EBL.

[0062] The hole transport region HTR includes the monoamine compound according to an embodiment of the inventive concept, as described above.

[0063] The hole transport region HTR may have a single layer formed using a single material, a single layer formed using a plurality of different materials, or a multilayer structure including a plurality of layers formed using a plurality of different materials.

[0064] For example, the hole transport region HTR may have a single layer structure of a hole injection layer HIL or a hole transport layer HTL, or may have a single layer structure formed using a hole injection material and a hole transport material. In addition, the hole transport region HTR may have a single layer structure formed using a plurality of different materials, or a laminated structure of hole injection layer HIL/hole transport layer HTL, hole injection layer HIL/hole transport layer HTL/hole buffer layer, hole injection layer HIL/hole buffer layer, hole transport layer HTL/hole buffer layer, or hole injection layer HIL/hole transport layer HTL/electron blocking layer EBL, laminated in order from the first electrode EL1, without limitation.

[0065] As described above, the hole transport region HTR may have a multilayer structure having a plurality of layers, and a layer of the plurality of layers contacting with the emission layer EML may include the monoamine compound represented by Formula 1. For example, the hole transport region HTR may include a hole injection layer HIL disposed on the first electrode EL1, a hole transport layer HTL disposed on the hole injection layer HIL, and an electron blocking layer EBL disposed on the hole transport layer HTL, and the electron blocking layer EBL may include the monoamine compound represented by Formula 1. However, an embodiment of the inventive concept is not limited thereto. In another example, the hole transport region HTR may include a hole injection layer HIL and a hole transport layer HTL, and the hole transport layer HTL may include the monoamine compound represented by Formula 1.

[0066] The hole transport region HTR may include one or more of the monoamine compound represented by Formula 1. For example, the hole transport region HTR may include at least one selected from the group consisting of compounds represented in the above-described Compound Groups 1 to 7.

[0067] The hole transport region HTR may be formed using various methods such as a vacuum deposition method, a spin coating method, a cast method, a Langmuir-Blodgett (LB) method, an inkjet printing method, a laser printing method, and a laser induced thermal imaging (LITI) method.

[0068] Furthermore, the hole transport region HTR may include the following materials in each layer.

[0069] The hole injection layer HIL may include, for example, a phthalocyanine compound such as copper phthalocyanine; N,N'-diphenyl-N,N'-bis-[4-(phenyl-m-tolyl-amino)-phenyl]-biphenyl-4,4'-diamine (DNTPD), 4,4',4"-tris(3-methylphenylphenylamino)triphenylamine (m-MTDATA), 4,4' ,4"-tris(N,N-diphenylamino)triphenylamine (TDATA), 4,4' ,4"-tris {N-(2-naphthyl)-N-phenylamino } -triphenylamine (2-TNATA), poly(3,4-ethylenedioxythiophene)/poly(4-styrenesulfonate) (PEDOT/PSS), polyaniline/dodecylbenzenesulfonic acid (PANI/DBSA), polyaniline/camphor sulfonic acid (PANI/CSA), polyaniline/poly(4-styrenesulfonate) (PANI/PSS), N,N'-di(naphthalen-1-yl)-N,N'-diphenyl-benzidine (NPD), triphenylamine-containing polyether ketone (TPAPEK), 4-isopropyl-4'-methyldiphenyliodonium tetrakis(pentafluorophenyl)borate, dipyrazino[2,3-f: 2',3'-h] quinoxaline-2,3,6,7,10,11-hexacarbonitrile (HAT-CN), etc.

[0070] The hole transport layer HTL may include, for example, carbazole derivatives such as N-phenyl carbazole, polyvinyl carbazole, fluorene-based derivatives, N,N'-bis(3-methylphenyl)-N,N'-diphenyl-[1,1-biphenyl]-4,4'-diamine (TPD), triphenylamine-based derivatives such as 4,4',4"-tris(N-carbazolyl)triphenylamine (TCTA), N,N'-di(naphthalen-1-yl)-N,N'-diphenyl-benzidine (NPD), 4,4'-cyclohexylidene bis[N,N-bis(4-methylphenyl)benzenamine] (TAPC), 4,4'-bis[N,N'-(3-tolyl)amino]-3,3'-dimethylbiphenyl (HMTPD), etc.

[0071] The electron blocking layer EBL may include the monoamine compound represented by Formula 1, as described above. However, an embodiment of the inventive concept is not limited thereto. The electron blocking layer EBL may include a known material in the art. The electron blocking layer EBL may include, for example, carbazole derivatives such as N-phenyl carbazole, polyvinyl carbazole, fluorene-based derivatives, N,N'-bis(3-methylphenyl)-N,N'-diphenyl-[1,1-biphenyl]-4,4'-diamine (TPD), triphenylamine-based derivatives such as 4,4',4"-tris(N-carbazolyl)triphenylamine (TCTA), N,N'-di(naphthalen-1-yl)-N,N'-diphenyl-benzidine (NPD), 4,4'-cyclohexylidene bis[N,N-bis(4-methylphenyl)benzenamine] (TAPC), 4,4'-bis[N,N'-(3-tolyl)amino]-3,3'-dimethylbiphenyl (HMTPD) or mCP, etc.

[0072] The thickness of the hole transport region HTR may be from about 100 Å to about 10,000 Å, for example, from about 100 Å to about 5,000 Å, about 100 Å to about 3000 Å, or about 100 Å to about 2,000 Å. The thickness of the hole injection layer HIL may be, for example, from about 30 Å to about 1,000 Å, about 30 Å to about 500 Å or about 30 Å to about 200 Å, and the thickness of the hole transport layer HTL may be from about 30 Å to about 1,500 Å or about 30 Å to about 1,000 Å. For example, the thickness of the electron blocking layer EBL may be from about 10 Å to about 1,000

Å, about 10 Å to about 500 Å or about 10 Å to about 200 Å. In case the thicknesses of the hole transport region HTR, the hole injection layer HIL, the hole transport layer HTL and the electron blocking layer EBL satisfy the above-described ranges, satisfactory hole transport properties may be obtained without substantial increase of a driving voltage.

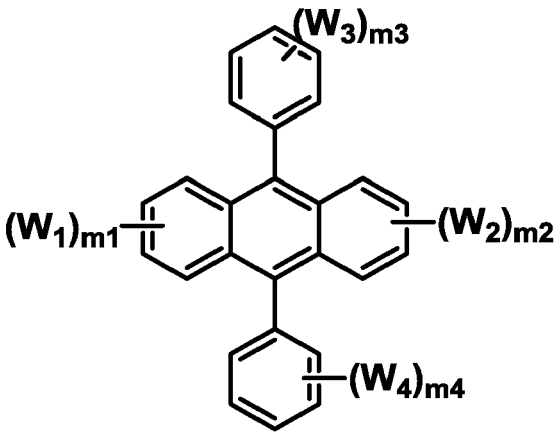
[0073] The hole transport region HTR may further include a charge generating material in addition to the above-described materials to improve conductivity. The charge generating material may be dispersed in the hole transport region HTR uniformly or non-uniformly. The charge generating material may be, for example, a p-dopant. The p-dopant may be one of quinone derivatives, metal oxides, or cyano group-containing compounds, without limitation. For example, non-limiting examples of the p-dopant may include quinone derivatives such as tetracyanoquinodimethane (TCNQ), and 2,3,5,6-tetrafluoro-tetracyanoquinodimethane (F4-TCNQ), metal oxides such as tungsten oxide and molybdenum oxide, without limitation.

[0074] As described above, the hole transport region HTR may further include at least one of a hole buffer layer or an electron blocking layer EBL. The hole buffer layer may compensate an optical resonance distance according to the wavelength of light emitted from the emission layer EML and increase light emission efficiency. Materials included in the hole transport region HTR may be used as materials included in the hole buffer layer. The electron blocking layer EBL is a layer preventing electron injection from the electron transport region ETR into the hole transport region HTR.

[0075] The emission layer EML is disposed on the hole transport region HTR. The thickness of the emission layer EML may be, for example, from about 100 Å to about 1,000 Å, about 100 Å to about 800 Å, about 100 Å to about 600 Å or about 200 Å to about 400 Å. The emission layer EML may have a single layer formed using a single material, a single layer formed using a plurality of different materials, or a multilayer structure having a plurality of layers formed using a plurality of different materials.

[0076] A known emission material in the art may be used as a material for the emission layer EML. The material for the emission layer EML is not specifically limited, and may be selected from fluoranthene derivatives, pyrene derivatives, arylacetylene derivatives, anthracene derivatives, fluorene derivatives, perylene derivatives, chrysene derivatives, or the like, and preferably, from pyrene derivatives, perylene derivatives, or anthracene derivatives. For example, as the host material of the emission layer EML, anthracene derivatives represented by the following Formula 10 may be used.

[Formula 10]

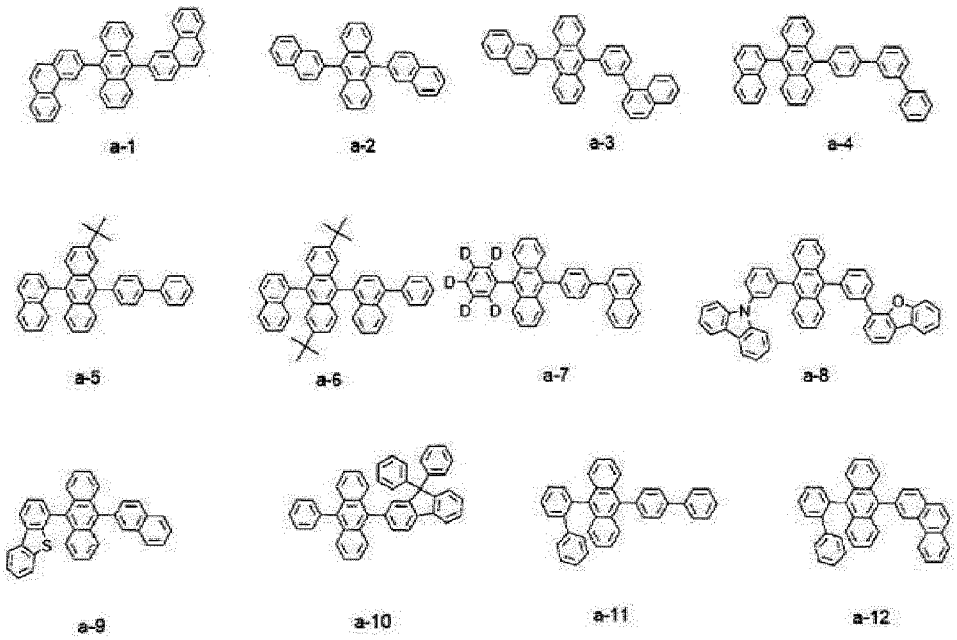


[0077] In Formula 10, W_1 to W_4 are each independently a hydrogen atom, a deuterium atom, a halogen atom, a substituted or unsubstituted silyl group, a substituted or unsubstituted alkyl group having 1 to 20 carbon atoms, a substituted or unsubstituted aryl group having 6 to 30 carbon atoms for forming a ring, or a substituted or unsubstituted heteroaryl group having 2 to 30 carbon atoms for forming a ring, or may form a ring by combining adjacent groups with each other, m_1 and m_2 are each independently an integer of 0 to 4, and m_3 and m_4 are each independently an integer of 0 to 5.

[0078] When m1 is 1, W_1 may not be a hydrogen atom. When m2 is 1, W_2 may not be a hydrogen atom. When m3 is 1, W_3 may not be a hydrogen atom. When m4 is 1, W_4 may not be a hydrogen atom.

[0079] When m1 is an integer of 2 or more, a plurality of W_1 may be the same or different from each other. When m2 is an integer of 2 or more, a plurality of W_2 may be the same or different from each other. When m3 is an integer of 2 or more, a plurality of W_3 may be the same or different from each other. When m4 is an integer of 2 or more, a plurality of W_4 may be the same or different from each other.

[0080] The compound represented by Formula 10 may include the compounds represented by the following structures. However, examples of the compound represented by Formula 10 are not limited thereto.



[0081] The emission layer EML may include a fluorescent material including any one selected from the group consisting of spiro-DPVBi, 2,2',7,7'-tetrakis(biphenyl-4-yl)-9,9'-spirobifluorene (spiro-sexiphenyl) (spiro-6P), distyryl-benzene (DSB), distyryl-arylene (DSA), polyfluorene (PFO)-based polymer and poly(p-phenylene vinylene) (PPV)-based polymer, for example.

[0082] The emission layer EML may further include a dopant, and the dopant may be a known material in the art. For example, styryl derivatives (for example, 1,4-bis[2-(3-N-ethylcarbazolyl)vinyl]benzene (BCzVB), 4-(di-p-tolylamino)-4'-[(dip-tolylamino)styryl]stilbene (DPAVB), N-(4-((E)-2-(6-((E)-4-(diphenylamino)styryl)naphthalen-2-yl)vinyl)phenyl)-N-phenylbenzenamine (N-BDAVBi)), perylene and the derivatives thereof (for example, 2,5,8,11-tetra-t-butylperylene (TBPe)), pyrene and the derivatives thereof (for example, 1,1-dipyrene, 1,4-dipyrenylbenzene, 1,4-bis(N,N-diphenylamino)pyrene, 1,6-bis(N,N-diphenylamino)pyrene), 2,5,8,11-tetra-t-butylperylene (TBP), 1,3,5-tris(N-phenylbenzimidazole-2-yl)benzene) (TPBi), etc. may be used as a dopant.

[0083] The emission layer EML may include, for example, tris(8-hydroxyquinolino)aluminium (Alq_3), 4,4'-bis(N-carbazolyl)-1,1'-biphenyl (CBP), poly(N-vinylcarbazole) (PVK), 9,10-di(naphthalen-2-yl)anthracene (ADN), 4,4',4"-tris(carbazol-9-yl)-triphenylamine (TCTA), 1,3,5-tris(N-phenylbenzimidazol-2-yl)benzene (TPBi), 3-tert-butyl-9,10-di(naphth-2-yl)anthracene (TBADN), distyrylarylene (DSA), 4,4'-bis(9-carbazolyl)-2,2'-dimethyl-biphenyl (CDBP), 2-methyl-9,10-bis(naphthalen-2-yl)anthracene (MADN), bis[2-(diphenylphosphino)phenyl] ether oxide (DPEPO), hexaphenyl cyclotriphosphazene (CP1), 1,4-bis(triphenylsilyl)benzene (UGH2), hexaphenylcyclotrisiloxane ($DPSiO_3$), octaphenylcyclotetrasiloxane ($DPSiO_4$), 2,8-bis(diphenylphosphoryl)dibenzofuran (PPF), etc.

[0084] The electron transport region ETR is provided on the emission layer EML. The electron transport region ETR may include at least one of a hole blocking layer HBL, an electron transport layer ETL or an electron injection layer EIL, without limitation.

[0085] The electron transport region ETR may have a single layer formed using a single material, a single layer formed using a plurality of different materials, or a multilayer structure having a plurality of layers formed using a plurality of different materials.

[0086] For example, the electron transport region ETR may have a single layer structure of an electron injection layer EIL or an electron transport layer ETL, or a single layer structure formed using an electron injection material and an electron transport material. In addition, the electron transport region ETR may have a single layer structure having a plurality of different materials, or a laminated structure of electron transport layer ETL/electron injection layer EIL, or hole blocking layer HBL/electron transport layer ETL/electron injection layer EIL, laminated in order from the emission layer EML, without limitation. The thickness of the electron transport region ETR may be, for example, from about 100 Å to about 1,500 Å.

[0087] The electron transport region ETR may be formed using various methods such as a vacuum deposition method, a spin coating method, a cast method, a Langmuir-Blodgett (LB) method, an inkjet printing method, a laser printing method, and a laser induced thermal imaging (LITI) method.

[0088] In case the electron transport region ETR includes the electron transport layer ETL, the electron transport region ETR may include tris(8-hydroxyquinolinato)aluminium (Alq_3), 1,3,5-tri[(3-pyridyl)-phen-3-yl]benzene, 2,4,6-

tris(3'-(pyridin-3-yl)biphenyl-3-yl)-1,3,5-triazine, bis[2-(diphenylphosphino)phenyl] ether oxide (DPEPO), 2-(4-(N-phenylbenzoimidazolyl-1-ylphenyl)-9,10-dinaphthylanthracene, 1,3,5-tri(1-phenyl-1H-benzo[d]imidazol-2-yl)phenyl (TPBi), 2,9-dimethyl-4,7-diphenyl-1,10-phenanthroline (BCP), 4,7-diphenyl-1,10-phenanthroline (Bphen), 3-(4-biphenylyl)-4-phenyl-5-tert-butylphenyl-1,2,4-triazole (TAZ), 4-(naphthalen-1-yl)-3,5-diphenyl-4H-1,2,4-triazole (NTAZ), 2-(4-biphenylyl)-5-(4-tert-butylphenyl)-1,3,4-oxadiazole (tBu-PBD), bis(2-methyl-8-quinolinolato-N1,O8)-(1,1'-Biphenyl-4-olato)aluminium (BAlq), berylliumbis (benzoquinolin-10-olate) ($Bebq_2$), 9,10-di(naphthalen-2-yl)anthracene (ADN) and a mixture thereof, without limitation. The thickness of the electron transport layer ETL may be from about 100 Å to about 1,000 Å, for example, from about 150 Å to about 500 Å or about 150 Å to about 250 Å. If the thickness of the electron transport layer ETL satisfies the above-described range, satisfactory electron transport properties may be obtained without substantial increase of a driving voltage.

[0089] When the electron transport region ETR includes the electron injection layer EIL, the electron transport region ETR may use LiF, lithium quinolate (LIQ), Li_2O, BaO, NaCl, CsF, a lanthanide metal such as Yb, or a metal halide such as RbCl and RbI, without limitation. The electron injection layer EIL also may be formed using a mixture material of an electron transport material and an insulating organometallic salt. The organometallic salt may be a material having an energy band gap of about 4 eV or more. Particularly, the organometallic salt may include, for example, a metal acetate, a metal benzoate, a metal acetoacetate, a metal acetylacetonate, or a metal stearate. The thickness of the electron injection layer EIL may be from about 1 Å to about 100 Å, for example, from about 3 Å to about 90 Å or about 3 Å to about 20 Å. In case the thickness of the electron injection layer EIL satisfies the above described range, satisfactory electron injection properties may be obtained without inducing the substantial increase of a driving voltage.

[0090] The electron transport region ETR may include a hole blocking layer HBL, as described above. The hole blocking layer HBL may include, for example, 2,9-dimethyl-4,7-diphenyl-1,10-phenanthroline (BCP), 4,7-diphenyl-1,10-phenanthroline (Bphen), or bis[2-(diphenylphosphino)phenyl]ether oxide (DPEPO), without limitation.

[0091] The second electrode EL2 is disposed on the electron transport region ETR. The second electrode EL2 may be a common electrode or a cathode. The second electrode EL2 may be a transmissive electrode, a transflective electrode or a reflective electrode. In case the second electrode EL2 is the transmissive electrode, the second electrode EL2 may be formed using transparent metal oxides, for example, ITO, IZO, ZnO, ITZO, etc.

[0092] In case the second electrode EL2 is the transflective electrode or the reflective electrode, the second electrode EL2 may include Ag, Mg, Cu, Al, Pt, Pd, Au, Ni, Nd, Ir, Cr, Li, Ca, LiF/Ca, LiF/Al, Mo, Ti, a compound thereof, or a mixture thereof (for example, a mixture of Ag and Mg). The second electrode EL2 may have a multilayer structure including a reflective layer or a transflective layer formed using the above-described materials and a transparent conductive layer formed using ITO, IZO, ZnO, ITZO, etc.

[0093] Even though not shown, the second electrode EL2 may be connected with an auxiliary electrode. In case the second electrode EL2 is connected with the auxiliary electrode, the resistance of the second electrode EL2 may decrease.

[0094] In the organic electroluminescence device 10, according to the application of a voltage to each of the first electrode EL1 and the second electrode EL2, holes injected from the first electrode EL1 may move via the hole transport region HTR to the emission layer EML, and electrons injected from the second electrode EL2 may move via the electron transport region ETR to the emission layer EML. The electrons and the holes are recombined in the emission layer EML to generate excitons, and light may be emitted via the transition of the excitons from an excited state to a ground state.

[0095] In case the organic electroluminescence device 10 is a top emission type, the first electrode EL1 may be a reflective electrode, and the second electrode EL2 may be a transmissive electrode or a transflective electrode. In case the organic electroluminescence device 10 is a bottom emission type, the first electrode EL1 may be a transmissive electrode or a transflective electrode, and the second electrode EL2 may be a reflective electrode.

[0096] The organic electroluminescence device 10 according to an embodiment of the inventive concept includes the monoamine compound represented by Formula 1, thereby securing high efficiency and a long device life, as well as a decreased driving voltage.

[0097] Hereinafter, the inventive concept will be explained in more detail with reference to specific embodiments and comparative embodiments. The following embodiments are illustrated only for assisting the understanding of the inventive concept, and the scope of the inventive concept is not limited thereto.

(Synthesis Examples)

[0098] The monoamine compound according to an embodiment of the inventive concept may be synthesized, for example, as follows. However, the synthetic method of the monoamine compound according to an embodiment of the inventive concept is not limited thereto.

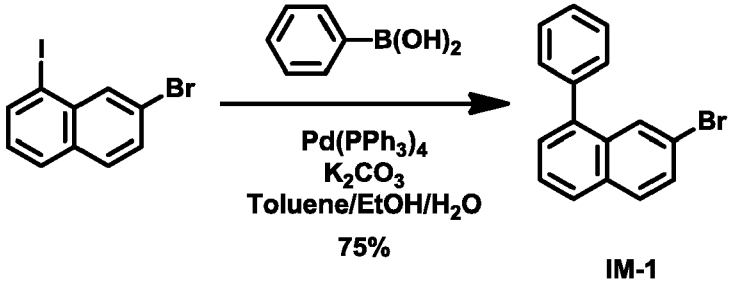
1. Synthesis of Compound A4

[0099] Compound A4, a monoamine compound according to an embodiment of the inventive concept, may be syn-

thesized, for example, as follows.

(Synthesis of Intermediate IM-1)

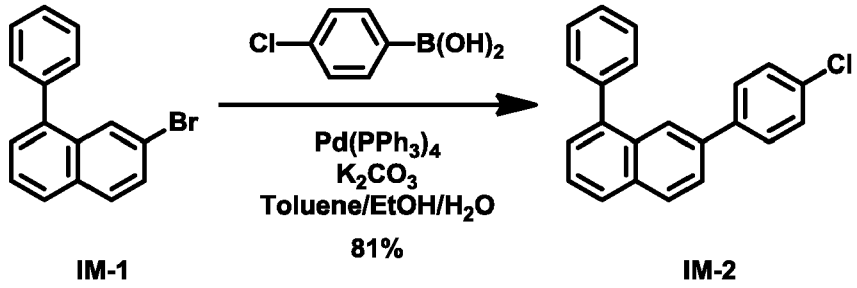
[0100]



[0101] Under an Ar atmosphere, 7-bromo-1-iodonaphthalene (25.00 g, 75.1 mmol), phenylboronic acid (10.07 g, 1.1 equiv, 82.6 mmol), K_2CO_3 (31.13 g, 3.0 equiv, 225.2 mmol), $Pd(PPh_3)_4$ (4.34 g, 0.05 eq, 3.8 mmol), and a mixture solution of toluene/EtOH/H_2O (4/2/1) (525 mL) were added in order to a 1 L three-neck flask, and the mixture was stirred and heated at about 80°C. After cooling in the air to room temperature, the reaction solution was extracted with toluene. After removing the aqueous layer, the organic layer was washed with saturated brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Intermediate IM-1 (15.95 g, yield 75%). Intermediate IM-1 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass m/z=283.

(Synthesis of Intermediate IM-2)

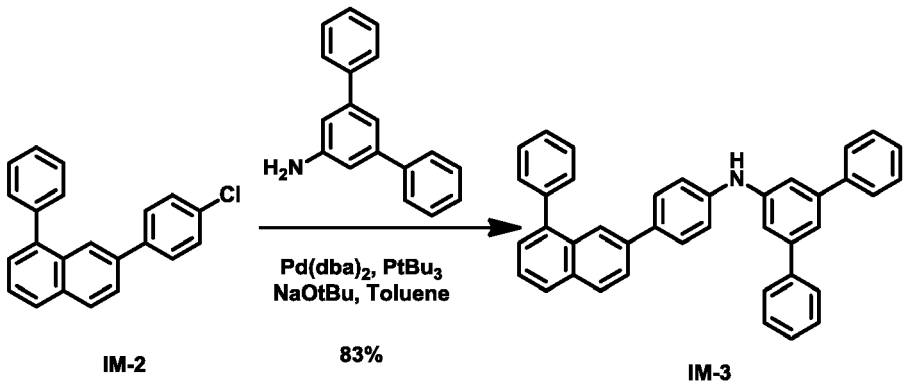
[0102]



[0103] Under an Ar atmosphere, IM-1 (13.00 g, 45.9 mmol), 4-chlorophenylboronic acid (7.90 g, 1.1 equiv, 50.5 mmol), K_2CO_3 (19.04 g, 3.0 equiv, 60.7 mmol), $Pd(PPh_3)_4$ (2.65 g, 0.05 eq, 2.3 mmol), and a mixture solution of toluene/EtOH/H_2O (4/2/1) (321 mL) were added in order to a 1 L three-neck flask, and the mixture was stirred and heated at about 80°C. After cooling in the air to room temperature, the reaction solution was extracted with toluene. After removing the aqueous layer, the organic layer was washed with saturated brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Intermediate IM-2 (11.71 g, yield 81%). Intermediate IM-2 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass m/z=314.

(Synthesis of Intermediate IM-3)

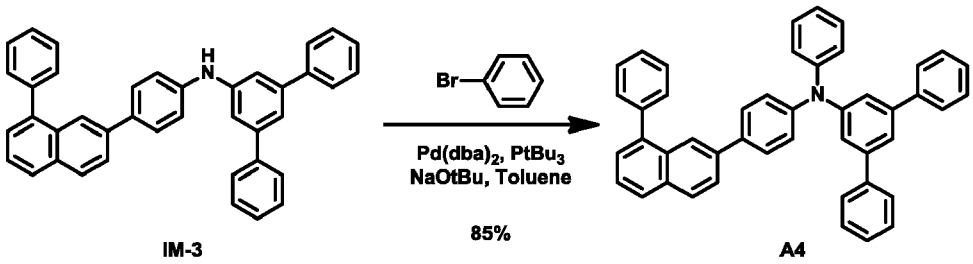
[0104]



[0105] Under an Ar atmosphere, IM-2 (10.00 g, 31.8 mmol), $Pd(dba)_2$ (0.55 g, 0.03 equiv, 1.0 mmol), NaOtBu (3.05 g, 1.0 equiv, 31.8 mmol), toluene (159 mL), 3,5-diphenylaniline (8.57 g, 1.1 equiv, 34.9 mmol) and tBu_3P (0.64 g, 0.1 equiv, 3.2 mmol) were added in order to a 300 mL three-neck flask, and the mixture was stirred and heated to reflux. After cooling in the air to room temperature, water was added to the reaction solvent and an organic layer was separated and taken. Toluene was added to the remaining aqueous layer, followed by extraction of the aqueous layer to obtain another organic layer. The organic layers were combined and washed with brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Intermediate IM-3 (13.81 g, yield 83%). Intermediate IM-3 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass m/z=523.

(Synthesis of Compound A4)

[0106]



[0107] Under an Ar atmosphere, IM-3 (8.00 g, 15.3 mmol), $Pd(dba)_2$ (0.26 g, 0.03 equiv, 0.5 mmol), NaOtBu (2.94 g, 2.0 equiv, 30.6 mmol), toluene (76 mL), bromobenzene (2.64 g, 1.1 equiv, 16.8 mmol) and tBu_3P (0.31 g, 0.1 equiv, 1.5 mmol) were added in order to a 300 mL three-neck flask, and the mixture was stirred and heated to reflux. After cooling in the air to room temperature, water was added to the reaction solvent and an organic layer was separated and taken. Toluene was added to the remaining aqueous layer, followed by extraction of the aqueous layer to obtain another organic layer. The organic layers were combined and washed with brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Compound A4 (7.79 g, yield 85%).

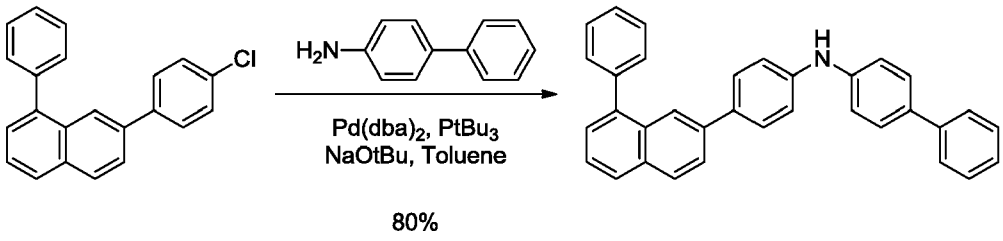
[0108] Compound A4 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass m/z=599.

2. Synthesis of Compound A17

[0109] Compound A17, a monoamine compound according to an embodiment of the inventive concept, may be synthesized, for example, as follows.

(Synthesis of Intermediate IM-4)

[0110]

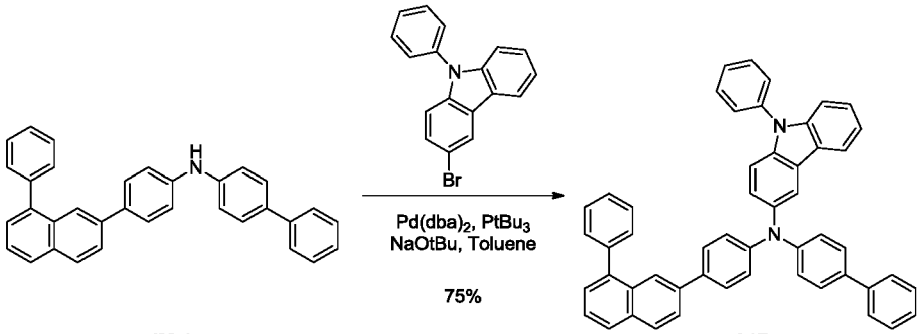


IM-2 IM-4

[0111] Under an Ar atmosphere, IM-2 (10.00 g, 31.8 mmol), $Pd(dba)_2$ (0.55 g, 0.03 equiv, 1.0 mmol), NaOtBu (3.05 g, 1.0 equiv, 31.8 mmol), toluene (159 mL), p-biphenylamine (5.91 g, 1.1 equiv, 34.9 mmol) and tBu_3P (0.64 g, 0.1 equiv, 3.2 mmol) were added in order to a 300 mL three-neck flask, and the mixture was stirred and heated to reflux. After cooling in the air to room temperature, water was added to the reaction solvent and an organic layer was separated and taken. Toluene was added to the remaining aqueous layer, followed by extraction of the aqueous layer to obtain another organic layer. The organic layers were combined and washed with brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Intermediate IM-4 (11.37 g, yield 80%). Intermediate IM-4 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass m/z=447.

(Synthesis of Compound A17)

[0112]



IM-4 A17

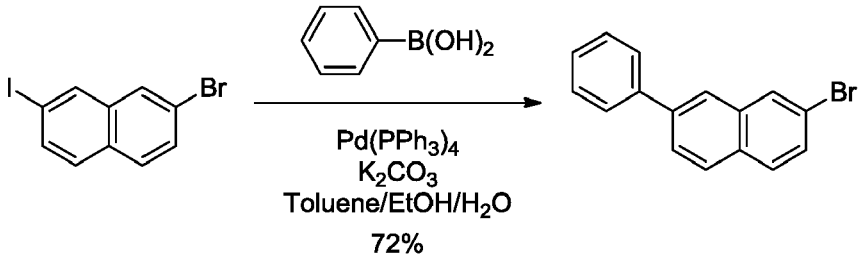
[0113] Under an Ar atmosphere, IM-4 (8.00 g, 17.9 mmol), $Pd(dba)_2$ (0.31 g, 0.03 equiv, 0.5 mmol), NaOtBu (3.44 g, 2.0 equiv, 35.7 mmol), toluene (89 mL), 3-bromo-9-phenyl-9H-carbazole (6.33 g, 1.1 equiv, 19.7 mmol) and tBu_3P (0.36 g, 0.1 equiv, 1.8 mmol) were added in order to a 300 mL three-neck flask, and the mixture was stirred and heated to reflux. After cooling in the air to room temperature, water was added to the reaction solvent and an organic layer was separated and taken. Toluene was added to the remaining aqueous layer, followed by extraction of the aqueous layer to obtain another organic layer. The organic layers were combined and washed with brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Compound A17 (9.23 g, yield 75%). Compound A17 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass m/z=688.

3. Synthesis of Compound B13

[0114] Compound B13, a monoamine compound according to an embodiment of the inventive concept, may be synthesized, for example, as follows.

(Synthesis of Intermediate IM-5)

[0115]

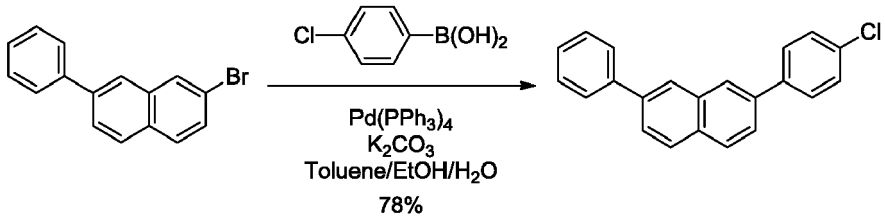


IM-5

[0116] Under an Ar atmosphere, 7-bromo-2-iodonaphthalene (25.00 g, 75.1 mmol), phenylboronic acid (10.07 g, 1.1 equiv, 82.6 mmol), K_2CO_3 (31.13 g, 3.0 equiv, 225.2 mmol), $Pd(PPh_3)_4$ (4.34 g, 0.05 eq, 3.8 mmol), and a mixture solution of toluene/EtOH/H_2O (4/2/1) (525 mL) were added in order to a 1 L three-neck flask, and the mixture was stirred and heated at about 80°C. After cooling in the air to room temperature, the reaction solution was extracted with toluene. After removing the aqueous layer, the organic layer was washed with saturated brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Intermediate IM-5 (15.31 g, yield 72%). Intermediate IM-5 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass m/z=283.

(Synthesis of Intermediate IM-6)

[0117]

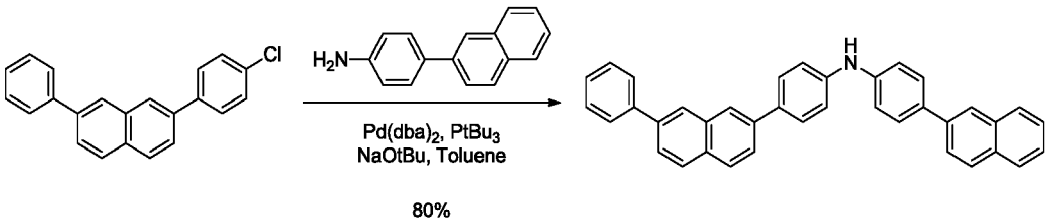


IM-5 **IM-6**

[0118] Under an Ar atmosphere, IM-5 (13.00 g, 45.9 mmol), 4-chlorophenylboronic acid (7.90 g, 1.1 equiv, 50.5 mmol), K_2CO_3 (19.04 g, 3.0 equiv, 60.7 mmol), $Pd(PPh_3)_4$ (2.65 g, 0.05 eq, 2.3 mmol), and a mixture solution of toluene/EtOH/H_2O (4/2/1) (321 mL) were added in order to a 1 L three-neck flask, and the mixture was stirred and heated at about 80°C. After cooling in the air to room temperature, the reaction solution was extracted with toluene. After removing the aqueous layer, the organic layer was washed with saturated brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Intermediate IM-6 (11.27 g, yield 78%). Intermediate IM-6 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass m/z=314.

(Synthesis of Intermediate IM-7)

[0119]



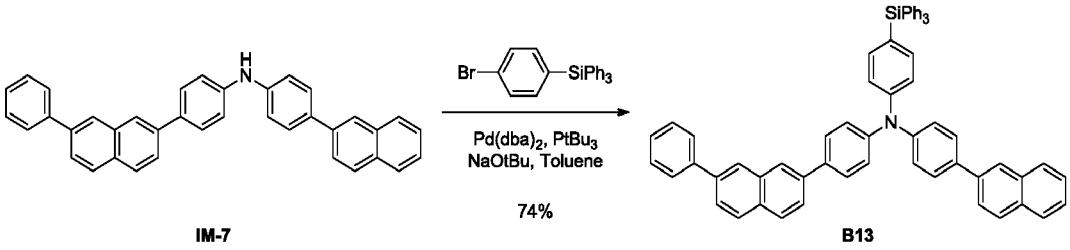
IM-6 **IM-7**

[0120] Under an Ar atmosphere, IM-6 (10.00 g, 31.8 mmol), $Pd(dba)_2$ (0.55 g, 0.03 equiv, 1.0 mmol), NaOtBu (3.05 g, 1.0 equiv, 31.8 mmol), toluene (159 mL), 4-(naphthalen-2-yl)aniline (7.66 g, 1.1 equiv, 34.9 mmol) and tBu_3P (0.64

g, 0.1 equiv, 3.2 mmol) were added in order to a 300 mL three-neck flask, and the mixture was stirred and heated to reflux. After cooling in the air to room temperature, water was added to the reaction solvent and an organic layer was separated and taken. Toluene was added to the remaining aqueous layer, followed by extraction of the aqueous layer to obtain another organic layer. The organic layers were combined and washed with brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Intermediate IM-7 (12.65 g, yield 80%). Intermediate IM-7 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass m/z=497.

(Synthesis of Compound B13)

[0121]



IM-7 B13

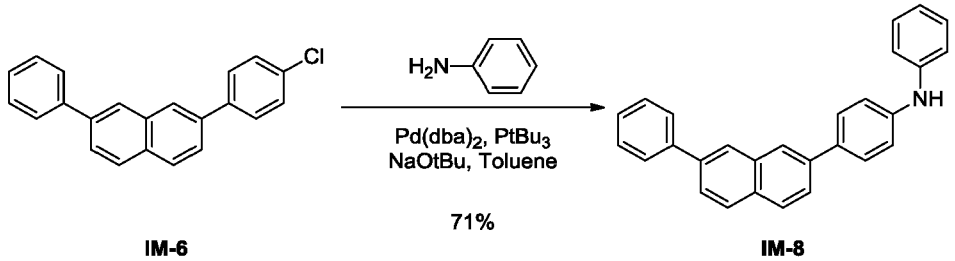
[0122] Under an Ar atmosphere, IM-7 (8.00 g, 16.1 mmol), $Pd(dba)_2$ (0.27 g, 0.03 equiv, 0.5 mmol), NaOtBu (3.09 g, 2.0 equiv, 32.2 mmol), toluene (80 mL), 1-bromo-4-triphenylsilylbenzene (7.35 g, 1.1 equiv, 17.7 mmol) and tBu_3P (0.33 g, 0.1 equiv, 1.6 mmol) were added in order to a 300 mL three-neck flask, and the mixture was stirred and heated to reflux. After cooling in the air to room temperature, water was added to the reaction solvent and an organic layer was separated and taken. Toluene was added to the remaining aqueous layer, followed by extraction of the aqueous layer to obtain another organic layer. The organic layers were combined and washed with brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Compound B13 (9.90 g, yield 74%). Compound B13 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass m/z=832.

4. Synthesis of Compound B20

[0123] Compound B20, a monoamine compound according to an embodiment of the inventive concept, may be synthesized, for example, as follows.

(Synthesis of Intermediate IM-8)

[0124]



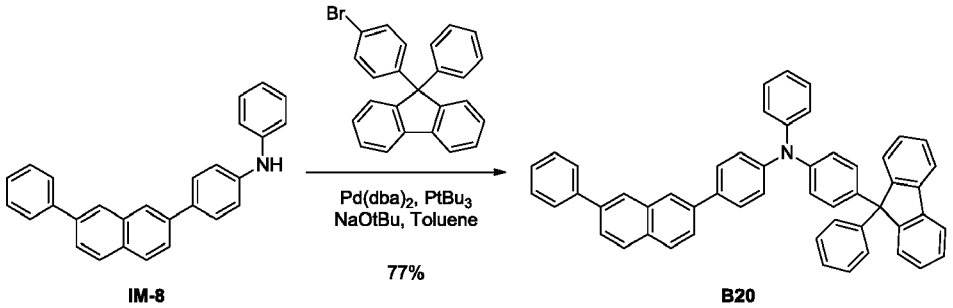
IM-6 IM-8

[0125] Under an Ar atmosphere, IM-6 (10.00 g, 31.8 mmol), $Pd(dba)_2$ (0.55 g, 0.03 equiv, 1.0 mmol), NaOtBu (3.05 g, 1.0 equiv, 31.8 mmol), toluene (159 mL), aniline (3.25 g, 1.1 equiv, 34.9 mmol) and tBu_3P (0.64 g, 0.1 equiv, 3.2 mmol) were added in order to a 300 mL three-neck flask, and the mixture was stirred and heated to reflux. After cooling in the air to room temperature, water was added to the reaction solvent and an organic layer was separated and taken. Toluene was added to the remaining aqueous layer, followed by extraction of the aqueous layer to obtain another organic layer. The organic layers were combined and washed with brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out

and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Intermediate IM-8 (8.38 g, yield 71%). Intermediate IM-8 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass m/z=371.

(Synthesis of Compound B20)

[0126]



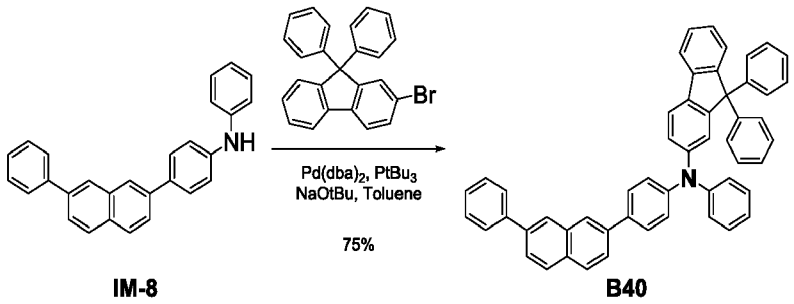
[0127] Under an Ar atmosphere, IM-8 (8.00 g, 21.5 mmol), $Pd(dba)_2$ (0.37 g, 0.03 equiv, 0.6 mmol), NaOtBu (4.14 g, 2.0 equiv, 43.1 mmol), toluene (108 mL), 9-(4-bromophenyl)-9-phenyl-9H-fluorene (9.41 g, 1.1 equiv, 23.7 mmol) and tBu_3P (0.44 g, 0.1 equiv, 2.1 mmol) were added in order to a 300 mL three-neck flask, and the mixture was stirred and heated to reflux. After cooling in the air to room temperature, water was added to the reaction solvent and an organic layer was separated and taken. Toluene was added to the remaining aqueous layer, followed by extraction of the aqueous layer to obtain another organic layer. The organic layers were combined and washed with brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Compound B20 (11.41 g, yield 77%). Compound B20 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass m/z=687.

5. Synthesis of Compound B40

[0128] Compound B40, a monoamine compound according to an embodiment of the inventive concept, may be synthesized, for example, as follows.

(Synthesis of Compound B40)

[0129]



[0130] Under an Ar atmosphere, IM-8 (8.00 g, 21.5 mmol), $Pd(dba)_2$ (0.37 g, 0.03 equiv, 0.6 mmol), NaOtBu (4.14 g, 2.0 equiv, 43.1 mmol), toluene (108 mL), 2-bromo-9,9-diphenyl-9H-fluorene (9.41 g, 1.1 equiv, 23.7 mmol) and tBu_3P (0.44 g, 0.1 equiv, 2.1 mmol) were added in order to a 300 mL three-neck flask, and the mixture was stirred and heated to reflux. After cooling in the air to room temperature, water was added to the reaction solvent and an organic layer was separated and taken. Toluene was added to the remaining aqueous layer, followed by extraction of the aqueous layer to obtain another organic layer. The organic layers were combined and washed with brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Compound B40

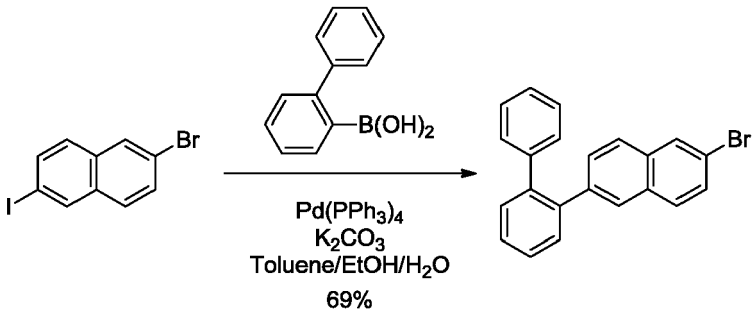
(11.42 g, yield 75%). Compound B40 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass m/z=687.

6. Synthesis of Compound C25

[0131] Compound C25, a monoamine compound according to an embodiment of the inventive concept, may be synthesized, for example, as follows.

(Synthesis of Intermediate IM-9)

[0132]

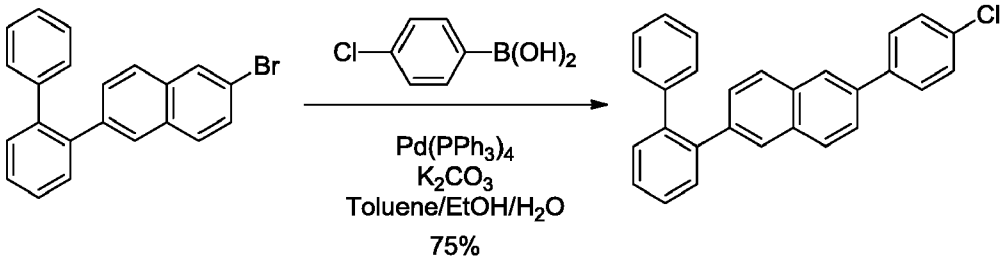


IM-9

[0133] Under an Ar atmosphere, 2-bromo-6-iodonaphthalene (25.00 g, 75.1 mmol), 2-biphenylboronic acid (16.35 g, 1.1 equiv, 82.6 mmol), K_2CO_3 (31.13 g, 3.0 equiv, 225.2 mmol), $Pd(PPh_3)_4$ (4.34 g, 0.05 eq, 3.8 mmol), and a mixture solution of toluene/EtOH/H_2O (4/2/1) (525 mL) were added in order to a 1 L three-neck flask, and the mixture was stirred and heated at about 80°C. After cooling in the air to room temperature, the reaction solution was extracted with toluene. After removing the aqueous layer, the organic layer was washed with saturated brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Intermediate IM-9 (18.61 g, yield 69%). Intermediate IM-9 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass m/z=359.

(Synthesis of Intermediate IM-10)

[0134]



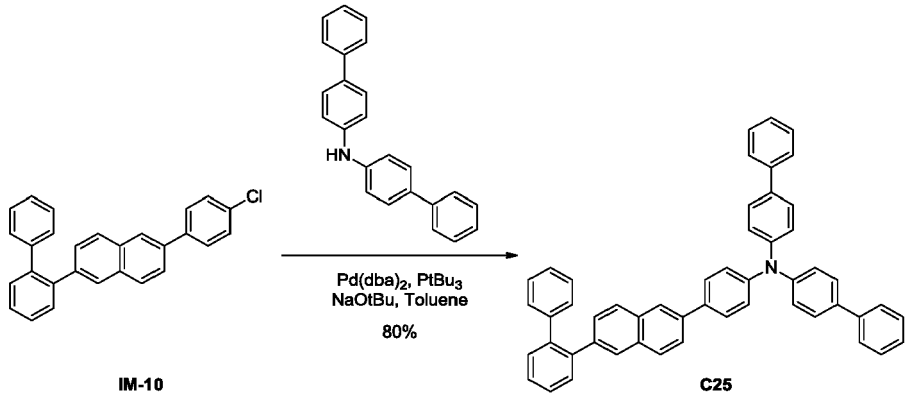
IM-9 **IM-10**

[0135] Under an Ar atmosphere, IM-9 (15.00 g, 41.8 mmol), 4-chlorophenylboronic acid (7.18 g, 1.1 equiv, 45.9 mmol), K_2CO_3 (17.31 g, 3.0 equiv, 125.3 mmol), $Pd(PPh_3)_4$ (2.41 g, 0.05 eq, 3.8 mmol), and a mixture solution of toluene/EtOH/H_2O (4/2/1) (525 mL) were added in order to a 1 L three-neck flask, and the mixture was stirred and heated at about 80°C. After cooling in the air to room temperature, the reaction solution was extracted with toluene. After removing the aqueous layer, the organic layer was washed with saturated brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Intermediate IM-10

(12.24 g, yield 75%). Intermediate IM-10 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass m/z=390.

(Synthesis of Compound C25)

[0136]



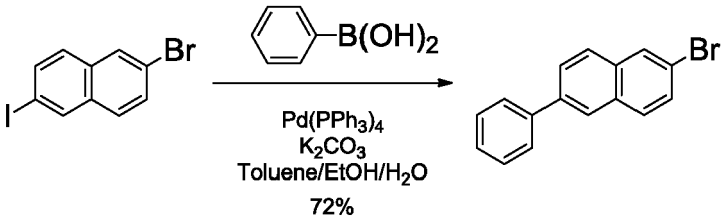
[0137] Under an Ar atmosphere, IM-10 (10.00 g, 25.6 mmol), $Pd(dba)_2$ (0.44 g, 0.03 equiv, 0.6 mmol), NaOtBu (4.92 g, 2.0 equiv, 51.2 mmol), toluene (128 mL), bis(4-biphenyl)amine (9.04 g, 1.1 equiv, 28.1 mmol) and tBu_3P (0.52 g, 0.1 equiv, 2.6 mmol) were added in order to a 300 mL three-neck flask, and the mixture was stirred and heated to reflux. After cooling in the air to room temperature, water was added to the reaction solvent and an organic layer was separated and taken. Toluene was added to the remaining aqueous layer, followed by extraction of the aqueous layer to obtain another organic layer. The organic layers were combined and washed with brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Compound C25 (13.83 g, yield 80%). Compound C25 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass m/z=675.

7. Synthesis of Compound C51

[0138] Compound C51, a monoamine compound according to an embodiment of the inventive concept, may be synthesized, for example, as follows.

(Synthesis of Intermediate IM-11)

[0139]



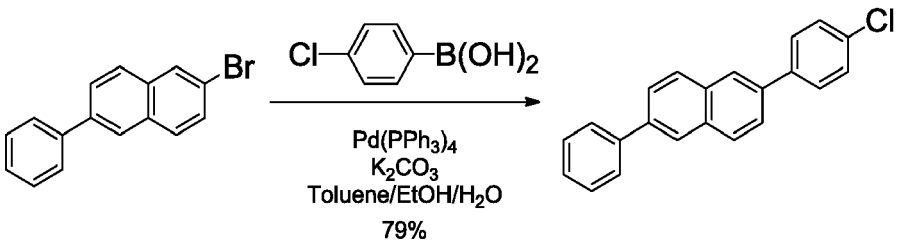
IM-11

[0140] Under an Ar atmosphere, 2-bromo-6-iodonaphthalene (25.00 g, 75.1 mmol), phenylboronic acid (10.07 g, 1.1 equiv, 82.6 mmol), K_2CO_3 (31.13 g, 3.0 equiv, 225.2 mmol), $Pd(PPh_3)_4$ (4.34 g, 0.05 eq, 3.8 mmol), and a mixture solution of toluene/EtOH/H_2O (4/2/1) (525 mL) were added in order to a 1 L three-neck flask, and the mixture was stirred and heated at about 80°C. After cooling in the air to room temperature, the reaction solution was extracted with toluene. After removing the aqueous layer, the organic layer was washed with saturated brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Intermediate IM-

11 (15.31 g, yield 72%). Intermediate IM-11 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass m/z=283.

(Synthesis of Intermediate IM-12)

[0141]



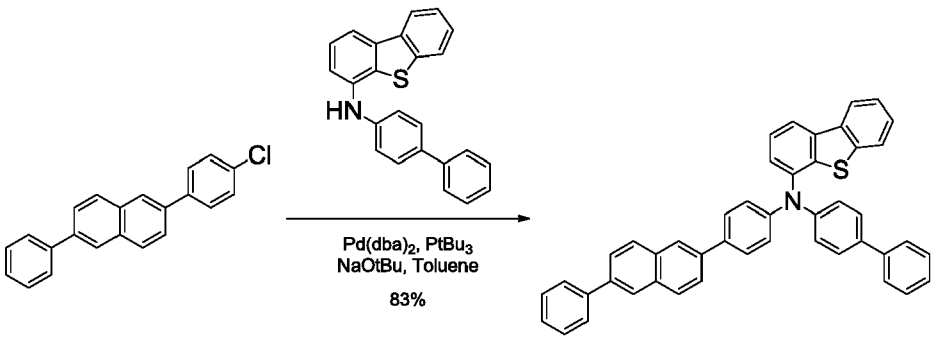
IM-11 **IM-12**

[0142] Under an Ar atmosphere, IM-11 (13.00 g, 45.9 mmol), 4-chlorophenylboronic acid (7.90 g, 1.1 equiv, 50.5 mmol), K_2CO_3 (19.04 g, 3.0 equiv, 60.7 mmol), $Pd(PPh_3)_4$ (2.65 g, 0.05 eq, 2.3 mmol), and a mixture solution of toluene/EtOH/H_2O (4/2/1) (321 mL) were added in order to a 1 L three-neck flask, and the mixture was stirred and heated at about 80°C. After cooling in the air to room temperature, the reaction solution was extracted with toluene. After removing the aqueous layer, the organic layer was washed with saturated brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Intermediate IM-12 (11.42 g, yield 79%).

[0143] Intermediate IM-12 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass m/z=314.

(Synthesis of Compound C51)

[0144]



IM-12 **C51**

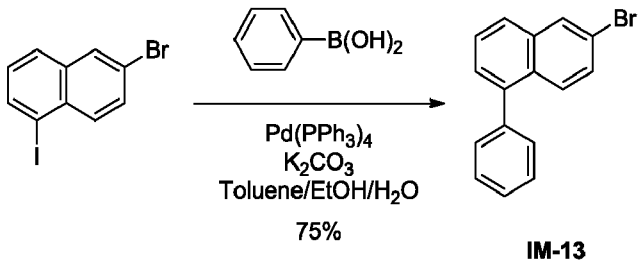
[0145] Under an Ar atmosphere, IM-12 (8.00 g, 25.4 mmol), $Pd(dba)_2$ (0.44 g, 0.03 equiv, 0.8 mmol), NaOtBu (4.88 g, 2.0 equiv, 50.8 mmol), toluene (128 mL), N-([1,1-biphenyl]-4-yl)dibenzothiophen-4-amine (9.82 g, 1.1 equiv, 28.0 mmol) and tBu_3P (0.51 g, 0.1 equiv, 2.5 mmol) were added in order to a 300 mL three-neck flask, and the mixture was stirred and heated to reflux. After cooling in the air to room temperature, water was added to the reaction solvent and an organic layer was separated and taken. Toluene was added to the remaining aqueous layer, followed by extraction of the aqueous layer to obtain another organic layer. The organic layers were combined and washed with brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Compound C51 (13.28 g, yield 83%). Compound C51 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass m/z=629.

8. Synthesis of Compound D12

[0146] Compound D12, a monoamine compound according to an embodiment of the inventive concept, may be synthesized, for example, as follows.

(Synthesis of Intermediate IM-13)

[0147]



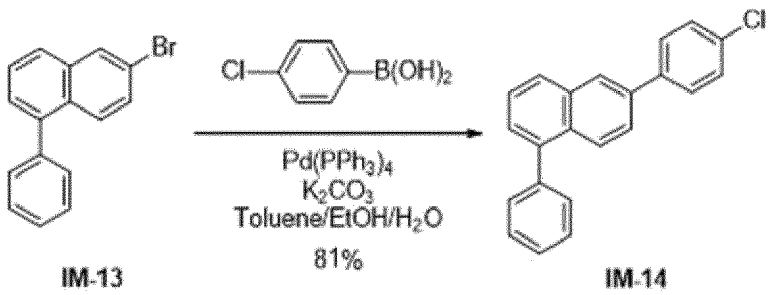
IM-13

[0148] Under an Ar atmosphere, 2-bromo-5-iodonaphthalene (25.00 g, 75.1 mmol), phenylboronic acid (10.07 g, 1.1 equiv, 82.6 mmol), K_2CO_3 (31.13 g, 3.0 equiv, 225.2 mmol), $Pd(PPh_3)_4$ (4.34 g, 0.05 eq, 3.8 mmol), and a mixture solution of toluene/EtOH/H_2O (4/2/1) (525 mL) were added in order to a 1 L three-neck flask, and the mixture was stirred and heated at about 80°C. After cooling in the air to room temperature, the reaction solution was extracted with toluene. After removing the aqueous layer, the organic layer was washed with saturated brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Intermediate IM-13 (15.95 g, yield 75%).

[0149] Intermediate IM-13 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass m/z=283.

(Synthesis of Intermediate IM-14)

[0150]

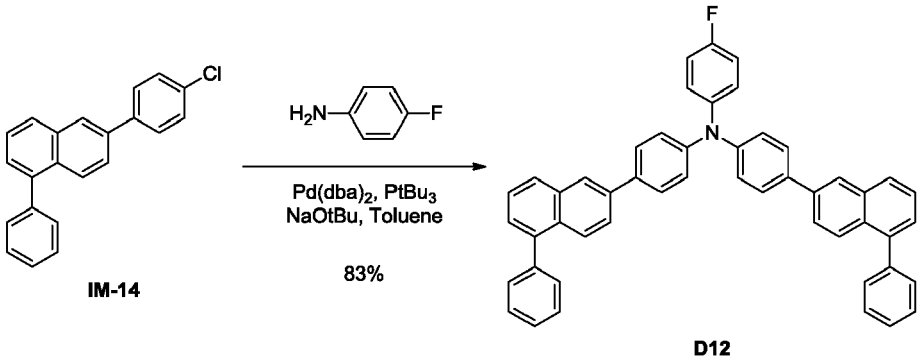


IM-13 IM-14

[0151] Under an Ar atmosphere, IM-13 (13.00 g, 45.9 mmol), 4-chlorophenylboronic acid (7.90 g, 1.1 equiv, 50.5 mmol), K_2CO_3 (19.04 g, 3.0 equiv, 60.7 mmol), $Pd(PPh_3)_4$ (2.65 g, 0.05 eq, 2.3 mmol), and a mixture solution of toluene/EtOH/H_2O (4/2/1) (321 mL) were added in order to a 1 L three-neck flask, and the mixture was stirred and heated at about 80°C. After cooling in the air to room temperature, the reaction solution was extracted with toluene. After removing the aqueous layer, the organic layer was washed with saturated brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Intermediate IM-14 (11.71 g, yield 81%). Intermediate IM-14 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass m/z=314.

(Synthesis of Compound D12)

[0152]



[0153] Under an Ar atmosphere, IM-14 (9.35 g, 2.2 equiv, 29.7 mmol), $Pd(dba)_2$ (0.23 g, 0.03 equiv, 0.4 mmol), NaOtBu (2.59 g, 2.0 equiv, 27.0 mmol), toluene (67 mL), 4-fluoroaniline (1.5 g, 13.5 mmol) and tBu_3P (0.27 g, 0.1 equiv, 1.3 mmol) were added in order to a 300 mL three-neck flask, and the mixture was stirred and heated to reflux. After cooling in the air to room temperature, water was added to the reaction solvent and an organic layer was separated and taken. Toluene was added to the remaining aqueous layer, followed by extraction of the aqueous layer to obtain another organic layer. The organic layers were combined and washed with brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Compound D12 (7.48 g, yield 83%).

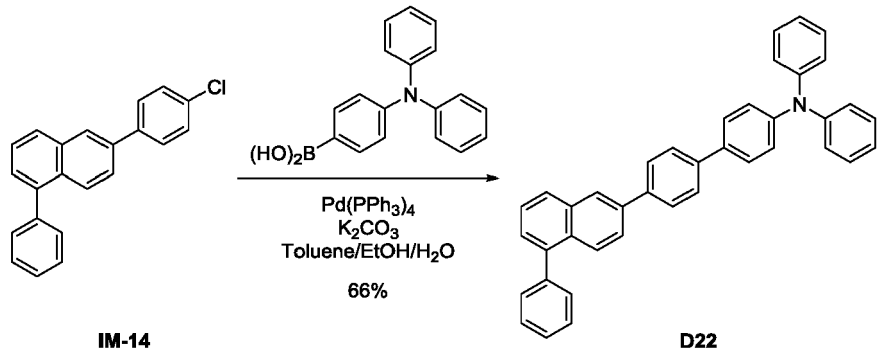
[0154] Compound D12 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass m/z=667.

9. Synthesis of Compound D22

[0155] Compound D22, a monoamine compound according to an embodiment of the inventive concept, may be synthesized, for example, as follows.

(Synthesis of Compound D22)

[0156]



[0157] Under an Ar atmosphere, IM-14 (10.00 g, 31.8 mmol), (4-(diphenylamino)phenyl)boronic acid (10.10 g, 1.1 equiv, 34.9 mmol), K_2CO_3 (13.17 g, 3.0 equiv, 95.3 mmol), $Pd(PPh_3)_4$ (1.84 g, 0.05 eq, 1.6 mmol), and a mixture solution of toluene/EtOH/H_2O (4/2/1) (222 mL) were added in order to a 1 L three-neck flask, and the mixture was stirred and heated at about 80°C. After cooling in the air to room temperature, the reaction solution was extracted with toluene. After removing the aqueous layer, the organic layer was washed with saturated brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Compound D22 (10.98 g, yield 66%).

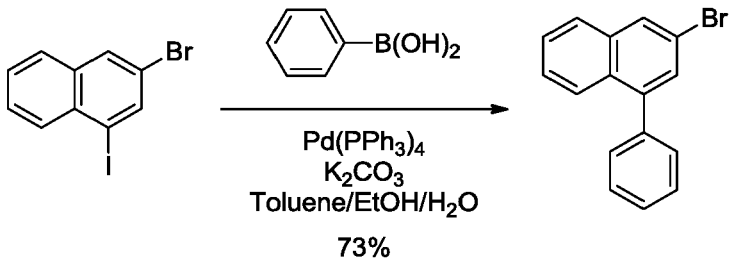
[0158] Compound D22 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass m/z=523.

10. Synthesis of Compound E3

[0159] Compound E3, a monoamine compound according to an embodiment of the inventive concept, may be synthesized, for example, as follows.

(Synthesis of Intermediate IM-15)

[0160]



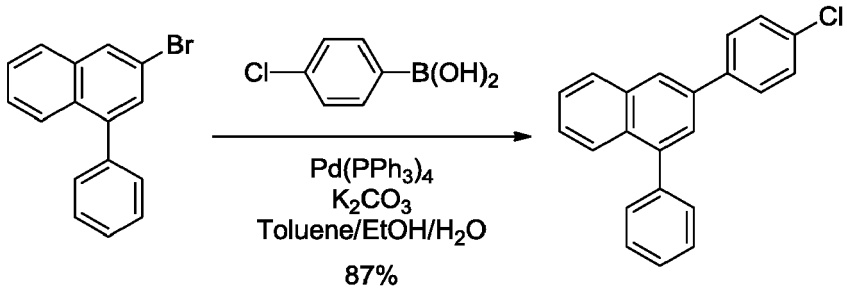
IM-15

[0161] Under an Ar atmosphere, 3-bromo-1-iodonaphthalene (25.00 g, 75.1 mmol), phenylboronic acid (10.07 g, 1.1 equiv, 82.6 mmol), K_2CO_3 (31.13 g, 3.0 equiv, 225.2 mmol), $Pd(PPh_3)_4$ (4.34 g, 0.05 eq, 3.8 mmol), and a mixture solution of toluene/EtOH/H_2O (4/2/1) (525 mL) were added in order to a 1 L three-neck flask, and the mixture was stirred and heated at about 80°C. After cooling in the air to room temperature, the reaction solution was extracted with toluene. After removing the aqueous layer, the organic layer was washed with saturated brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Intermediate IM-15 (15.52 g, yield 73%).

[0162] Intermediate IM-15 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass m/z=283.

(Synthesis of Intermediate IM-16)

[0163]



IM-15 **IM-16**

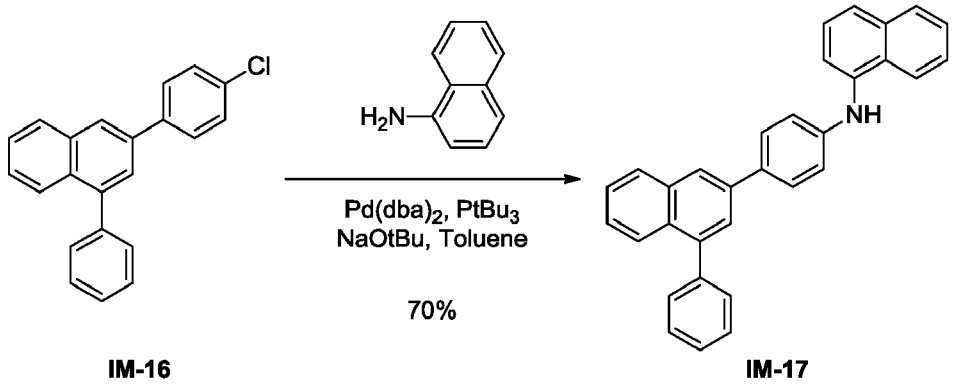
[0164] Under an Ar atmosphere, IM-15 (13.00 g, 45.9 mmol), 4-chlorophenylboronic acid (7.90 g, 1.1 equiv, 50.5 mmol), K_2CO_3 (19.04 g, 3.0 equiv, 60.7 mmol), $Pd(PPh_3)_4$ (2.65 g, 0.05 eq, 2.3 mmol), and a mixture solution of toluene/EtOH/H_2O (4/2/1) (321 mL) were added in order to a 1 L three-neck flask, and the mixture was stirred and heated at about 80°C. After cooling in the air to room temperature, the reaction solution was extracted with toluene. After removing the aqueous layer, the organic layer was washed with saturated brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Intermediate IM-16 (12.57 g, yield 87%).

[0165] Intermediate IM-16 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass

m/z=314.

(Synthesis of Intermediate IM-17)

[0166]



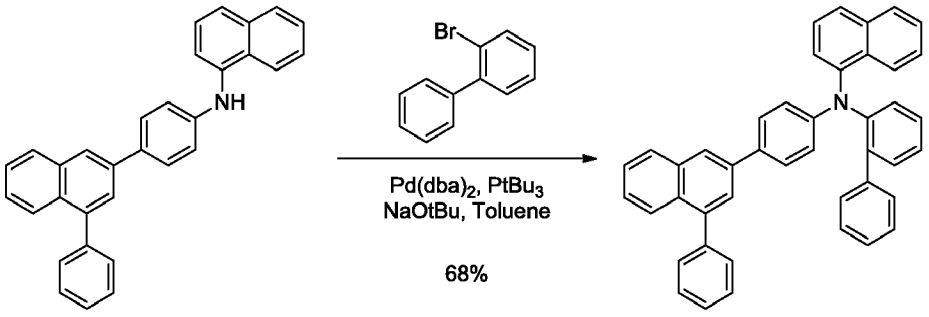
IM-16 **IM-17**

[0167] Under an Ar atmosphere, IM-16 (10.00 g, 31.8 mmol), $Pd(dba)_2$ (0.55 g, 0.03 equiv, 1.0 mmol), NaOtBu (3.05 g, 1.0 equiv, 31.8 mmol), toluene (159 mL), 1-naphthylamine (5.00 g, 1.1 equiv, 34.9 mmol) and tBu_3P (0.64 g, 0.1 equiv, 3.2 mmol) were added in order to a 300 mL three-neck flask, and the mixture was stirred and heated to reflux. After cooling in the air to room temperature, water was added to the reaction solvent and an organic layer was separated and taken. Toluene was added to the remaining aqueous layer, followed by extraction of the aqueous layer to obtain another organic layer. The organic layers were combined and washed with brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Intermediate IM-17 (9.37 g, yield 70%).

[0168] Intermediate IM-17 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass m/z=421.

(Synthesis of Compound E3)

[0169]



IM-17 **E3**

[0170] Under an Ar atmosphere, IM-17 (8.00 g, 19.0 mmol), $Pd(dba)_2$ (0.33 g, 0.03 equiv, 0.6 mmol), NaOtBu (3.65 g, 2.0 equiv, 38.0 mmol), toluene (95 mL), 2-bromobiphenyl (4.87 g, 1.1 equiv, 20.9 mmol) and tBu_3P (0.39 g, 0.1 equiv, 1.9 mmol) were added in order to a 300 mL three-neck flask, and the mixture was stirred and heated to reflux. After cooling in the air to room temperature, water was added to the reaction solvent and an organic layer was separated and taken. Toluene was added to the remaining aqueous layer, followed by extraction of the aqueous layer to obtain another organic layer. The organic layers were combined and washed with brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Compound E3 (7.40 g, yield 68%).

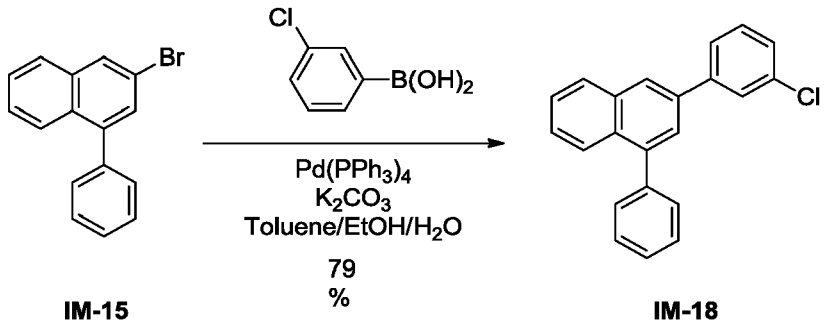
[0171] Compound E3 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass m/z=573.

11. Synthesis of Compound E32

[0172] Compound E32, a monoamine compound according to an embodiment of the inventive concept, may be synthesized, for example, as follows.

(Synthesis of Intermediate IM-18)

[0173]



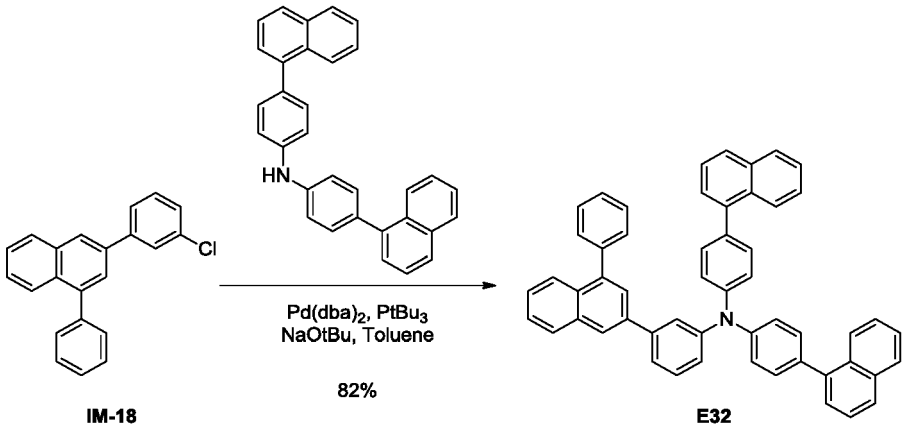
IM-15 **IM-18**

[0174] Under an Ar atmosphere, IM-15 (13.00 g, 45.9 mmol), 3-chlorophenylboronic acid (7.90 g, 1.1 equiv, 50.5 mmol), K_2CO_3 (19.04 g, 3.0 equiv, 60.7 mmol), $Pd(PPh_3)_4$ (2.65 g, 0.05 eq, 2.3 mmol), and a mixture solution of toluene/EtOH/H_2O (4/2/1) (321 mL) were added in order to a 1 L three-neck flask, and the mixture was stirred and heated at about 80°C. After cooling in the air to room temperature, the reaction solution was extracted with toluene. After removing the aqueous layer, the organic layer was washed with saturated brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Intermediate IM-18 (11.42 g, yield 79%).

[0175] Intermediate IM-18 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass m/z=314.

(Synthesis of Compound E32)

[0176]



IM-18 **E32**

[0177] Under an Ar atmosphere, IM-18 (10.00 g, 31.8 mmol), $Pd(dba)_2$ (0.55 g, 0.03 equiv, 1.0 mmol), NaOtBu (6.11 g, 2.0 equiv, 63.5 mmol), toluene (158 mL), bis(4-(naphthalen-1-yl)phenyl)amine (14.73 g, 1.1 equiv, 34.9 mmol) and tBu_3P (0.64 g, 0.1 equiv, 3.2 mmol) were added in order to a 300 mL three-neck flask, and the mixture was stirred and heated to reflux. After cooling in the air to room temperature, water was added to the reaction solvent and an organic layer was separated and taken. Toluene was added to the remaining aqueous layer, followed by extraction of the aqueous layer to obtain another organic layer. The organic layers were combined and washed with brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified

by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Compound E32 (18.23 g, yield 82%).

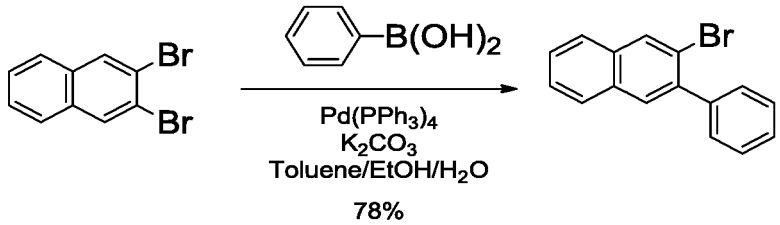
[0178] Compound E32 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass m/z=699.

12. Synthesis of Compound F46

[0179] Compound F46, a monoamine compound according to an embodiment of the inventive concept, may be synthesized, for example, as follows.

(Synthesis of Intermediate IM-19)

[0180]



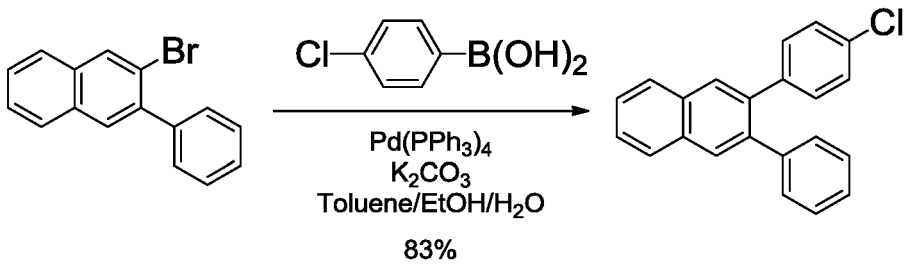
IM-19

[0181] Under an Ar atmosphere, 2,3-dibromonaphthalene (25.00 g, 87.4 mmol), phenylboronic acid (11.73 g, 1.1 equiv, 96.2 mmol), K_2CO_3 (36.2 g, 3.0 equiv, 262.3 mmol), $Pd(PPh_3)_4$ (5.05 g, 0.05 eq, 3.4 mmol), and a mixture solution of toluene/EtOH/H_2O (4/2/1) (612 mL) were added in order to a 1 L three-neck flask, and the mixture was stirred and heated at about 80°C. After cooling in the air to room temperature, the reaction solution was extracted with toluene. After removing the aqueous layer, the organic layer was washed with saturated brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Intermediate IM-19 (19.31 g, yield 78%).

[0182] Intermediate IM-19 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass m/z=283.

(Synthesis of Intermediate IM-20)

[0183]



IM-19 **IM-20**

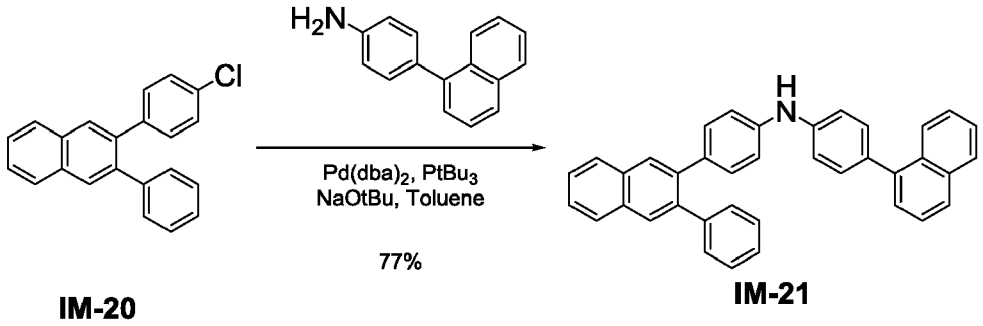
[0184] Under an Ar atmosphere, IM-19 (13.00 g, 45.9 mmol), 4-chlorophenylboronic acid (7.90 g, 1.1 equiv, 50.5 mmol), K_2CO_3 (19.04 g, 3.0 equiv, 60.7 mmol), $Pd(PPh_3)_4$ (2.65 g, 0.05 eq, 2.3 mmol), and a mixture solution of toluene/EtOH/H_2O (4/2/1) (321 mL) were added in order to a 1 L three-neck flask, and the mixture was stirred and heated at about 80°C. After cooling in the air to room temperature, the reaction solution was extracted with toluene. After removing the aqueous layer, the organic layer was washed with saturated brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Intermediate IM-20

(12.00 g, yield 83%).

[0185] Intermediate IM-20 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass m/z=314.

(Synthesis of Intermediate IM-21)

[0186]

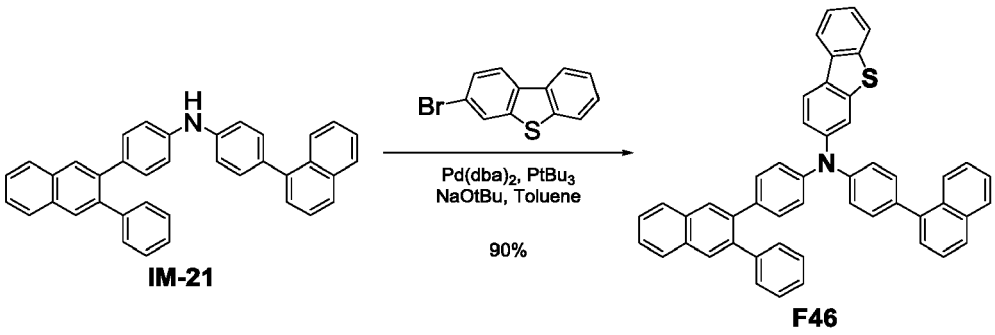


[0187] Under an Ar atmosphere, IM-20 (10.00 g, 31.8 mmol), $Pd(dba)_2$ (0.55 g, 0.03 equiv, 1.0 mmol), NaOtBu (3.05 g, 1.0 equiv, 31.8 mmol), toluene (159 mL), 4-(naphthalen-1-yl)aniline (7.66 g, 1.1 equiv, 34.9 mmol) and tBu_3P (0.64 g, 0.1 equiv, 3.2 mmol) were added in order to a 300 mL three-neck flask, and the mixture was stirred and heated to reflux. After cooling in the air to room temperature, water was added to the reaction solvent and an organic layer was separated and taken. Toluene was added to the remaining aqueous layer, followed by extraction of the aqueous layer to obtain another organic layer. The organic layers were combined and washed with brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Intermediate IM-21 (10.31 g, yield 77%).

[0188] Intermediate IM-21 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass m/z=421.

(Synthesis of Compound F46)

[0189]



[0190] Under an Ar atmosphere, IM-21 (8.00 g, 19.0 mmol), $Pd(dba)_2$ (0.33 g, 0.03 equiv, 0.6 mmol), NaOtBu (3.65 g, 2.0 equiv, 38.0 mmol), toluene (95 mL), 3-bromo-dibenzothiophen (5.49 g, 1.1 equiv, 20.9 mmol) and tBu_3P (0.39 g, 0.1 equiv, 1.9 mmol) were added in order to a 300 mL three-neck flask, and the mixture was stirred and heated to reflux. After cooling in the air to room temperature, water was added to the reaction solvent and an organic layer was separated and taken. Toluene was added to the remaining aqueous layer, followed by extraction of the aqueous layer to obtain another organic layer. The organic layers were combined and washed with brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Compound F46 (11.61 g, yield 90%).

[0191] Compound F46 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass

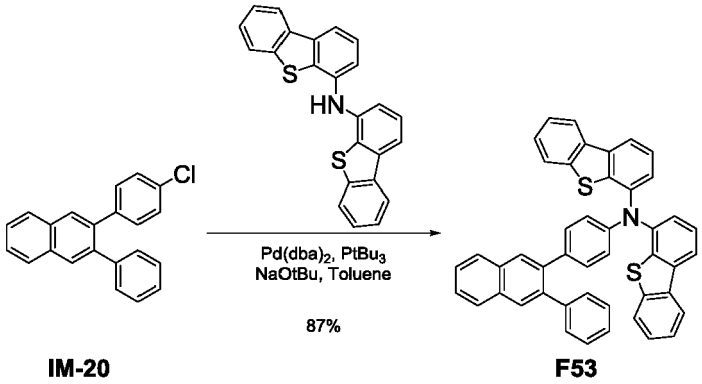
m/z=679.

13. Synthesis of Compound F53

[0192] Compound F53, a monoamine compound according to an embodiment of the inventive concept, may be synthesized, for example, as follows.

(Synthesis of Compound F53)

[0193]



IM-20 **F53**

[0194] Under an Ar atmosphere, IM-20 (8.00 g, 23.4 mmol), $Pd(dba)_2$ (0.40 g, 0.03 equiv, 0.7 mmol), NaOtBu (4.50 g, 2.0 equiv, 46.8 mmol), toluene (117 mL), bis(dibenzothiophen-4-yl)amine (9.82 g, 1.1 equiv, 25.7 mmol) and tBu_3P (0.47 g, 0.1 equiv, 2.3 mmol) were added in order to a 300 mL three-neck flask, and the mixture was stirred and heated to reflux. After cooling in the air to room temperature, water was added to the reaction solvent and an organic layer was separated and taken. Toluene was added to the remaining aqueous layer, followed by extraction of the aqueous layer to obtain another organic layer. The organic layers were combined and washed with brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Compound F53 (13.44 g, yield 87%).

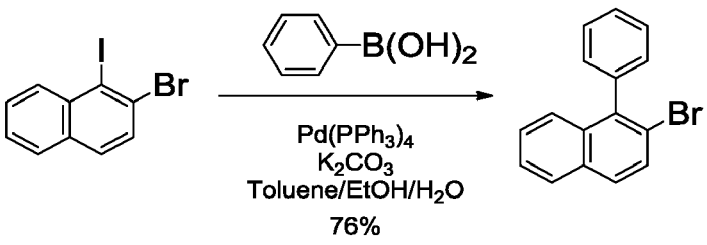
[0195] Compound F53 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass m/z=659.

14. Synthesis of Compound G54

[0196] Compound G54, a monoamine compound according to an embodiment of the inventive concept, may be synthesized, for example, as follows.

(Synthesis of Intermediate IM-22)

[0197]



IM-22

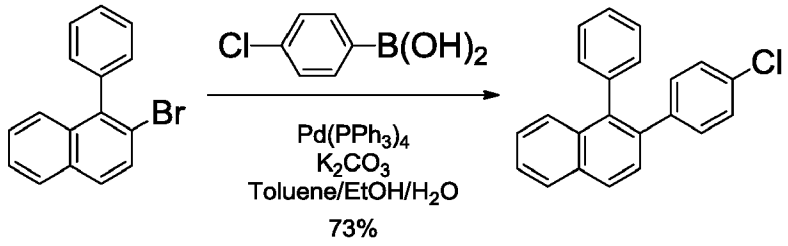
[0198] Under an Ar atmosphere, 2-bromo-1-iodo-naphthalene (25.00 g, 75.1 mmol), phenylboronic acid (10.07 g, 1.1

equiv, 82.6 mmol), K_2CO_3 (31.1 g, 3.0 equiv, 225.2 mmol), $Pd(PPh_3)_4$ (4.34 g, 0.05 eq, 3.8 mmol), and a mixture solution of toluene/EtOH/H_2O (4/2/1) (525 mL) were added in order to a 1 L three-neck flask, and the mixture was stirred and heated at about 80°C. After cooling in the air to room temperature, the reaction solution was extracted with toluene. After removing the aqueous layer, the organic layer was washed with saturated brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Intermediate IM-22 (16.16 g, yield 76%).

[0199] Intermediate IM-22 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass m/z=283.

(Synthesis of Intermediate IM-23)

[0200]



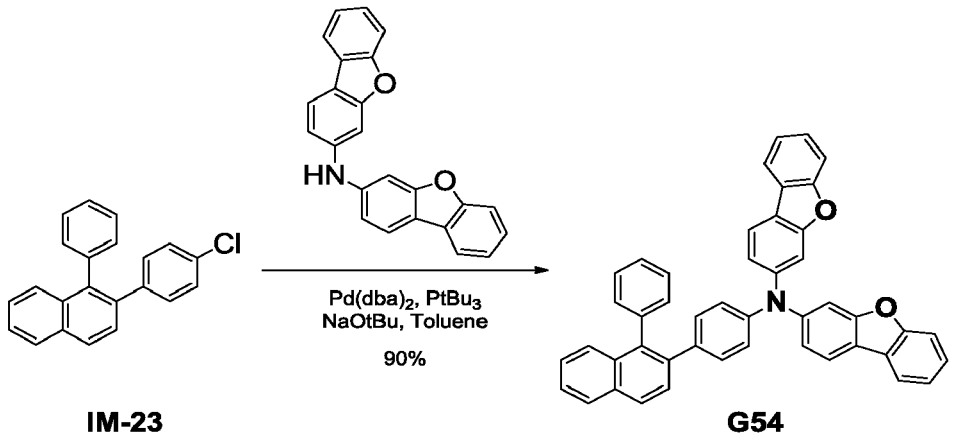
IM-22 **IM-23**

[0201] Under an Ar atmosphere, IM-22 (13.00 g, 45.9 mmol), 4-chlorophenylboronic acid (7.90 g, 1.1 equiv, 50.5 mmol), K_2CO_3 (19.04 g, 3.0 equiv, 60.7 mmol), $Pd(PPh_3)_4$ (2.65 g, 0.05 eq, 2.3 mmol), and a mixture solution of toluene/EtOH/H_2O (4/2/1) (321 mL) were added in order to a 1 L three-neck flask, and the mixture was stirred and heated at about 80°C. After cooling in the air to room temperature, the reaction solution was extracted with toluene. After removing the aqueous layer, the organic layer was washed with saturated brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Intermediate IM-23 (10.55 g, yield 73%).

[0202] Intermediate IM-23 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass m/z=314.

(Synthesis of Compound G54)

[0203]



IM-23 **G54**

[0204] Under an Ar atmosphere, IM-23 (8.00 g, 25.4 mmol), $Pd(dba)_2$ (0.44 g, 0.03 equiv, 0.8 mmol), NaOtBu (4.88 g, 2.0 equiv, 50.8 mmol), toluene (127 mL), bis(dibenzofuran-3-yl)amine (9.77 g, 1.1 equiv, 28.0 mmol) and tBu_3P (0.51 g, 0.1 equiv, 2.5 mmol) were added in order to a 300 mL three-neck flask, and the mixture was stirred and heated to

reflux. After cooling in the air to room temperature, water was added to the reaction solvent and an organic layer was separated and taken. Toluene was added to the remaining aqueous layer, followed by extraction of the aqueous layer to obtain another organic layer. The organic layers were combined and washed with brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Compound G54 (14.4 g, yield 90%).

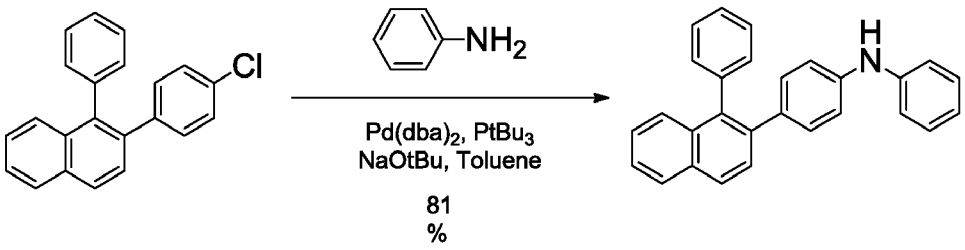
[0205] Compound G54 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass m/z=627.

15. Synthesis of Compound G58

[0206] Compound G58, a monoamine compound according to an embodiment of the inventive concept, may be synthesized, for example, as follows.

(Synthesis of Intermediate IM-24)

[0207]



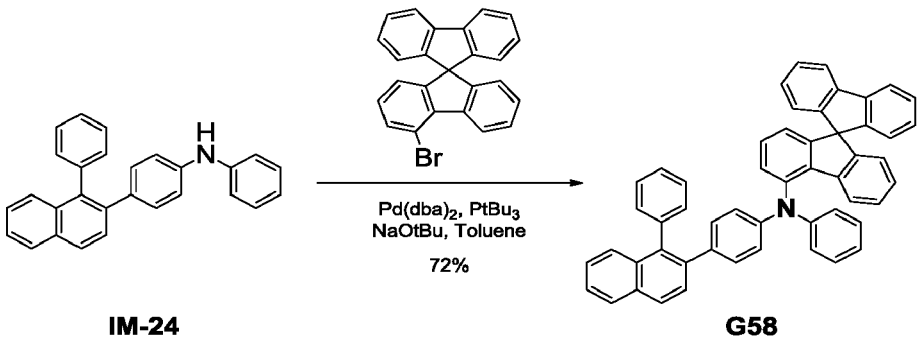
IM-23 **IM-24**

[0208] Under an Ar atmosphere, IM-23 (10.00 g, 31.8 mmol), $Pd(dba)_2$ (0.55 g, 0.03 equiv, 1.0 mmol), NaOtBu (3.05 g, 1.0 equiv, 31.8 mmol), toluene (159 mL), aniline (3.25 g, 1.1 equiv, 34.9 mmol) and tBu_3P (0.64 g, 0.1 equiv, 3.2 mmol) were added in order to a 300 mL three-neck flask, and the mixture was stirred and heated to reflux. After cooling in the air to room temperature, water was added to the reaction solvent and an organic layer was separated and taken. Toluene was added to the remaining aqueous layer, followed by extraction of the aqueous layer to obtain another organic layer. The organic layers were combined and washed with brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Intermediate IM-24 (9.56 g, yield 81%).

[0209] Intermediate IM-24 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass m/z=371.

(Synthesis of Compound G58)

[0210]



IM-24 **G58**

[0211] Under an Ar atmosphere, IM-24 (8.00 g, 21.5 mmol), $Pd(dba)_2$ (0.37 g, 0.03 equiv, 0.6 mmol), NaOtBu (4.14 g, 2.0 equiv, 43.1 mmol), toluene (108 mL), 4-bromo-9,9'-spirobifluorene (9.36 g, 1.1 equiv, 23.7 mmol) and tBu_3P (0.44

g, 0.1 equiv, 2.2 mmol) were added in order to a 300 mL three-neck flask, and the mixture was stirred and heated to reflux. After cooling in the air to room temperature, water was added to the reaction solvent and an organic layer was separated and taken. Toluene was added to the remaining aqueous layer, followed by extraction of the aqueous layer to obtain another organic layer. The organic layers were combined and washed with brine, and then dried over $MgSO_4$. $MgSO_4$ was filtered out and the organic layer was concentrated. The crude product thus obtained was purified by silica gel column chromatography (using a mixture of hexane and toluene as developing solvent) to obtain Compound G58 (10.63 g, yield 72%).

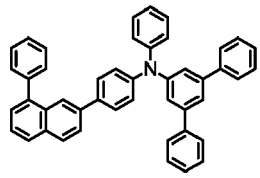
[0212] Compound G58 was identified by measuring FAB-MS in which a molecular ion peak was observed at mass m/z=685.

(Device manufacturing example)

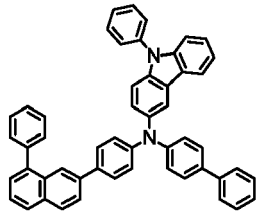
[0213] Organic electroluminescence devices of Examples 1 to 15 were manufactured by using the above Compounds A4, A17, B13, B20, B40, C25, C51, D12, D22, E3, E32, F46, F53, G54 and G58 as an electron blocking material.

[Example Compounds]

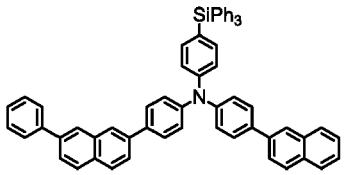
[0214]



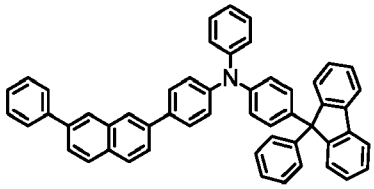
A4



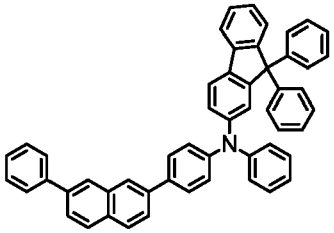
A17



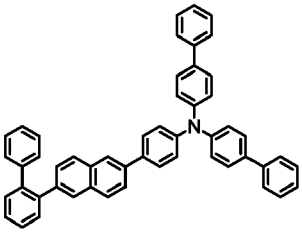
B13



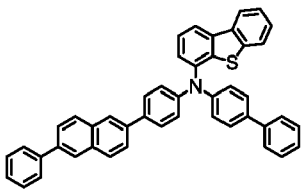
B20



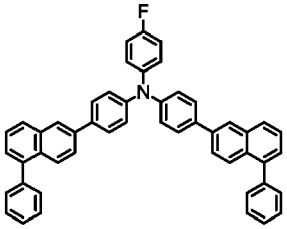
B40



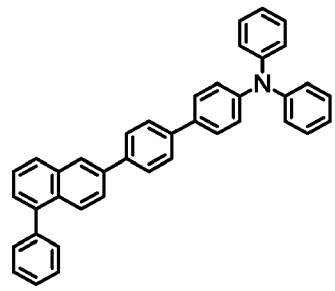
C25



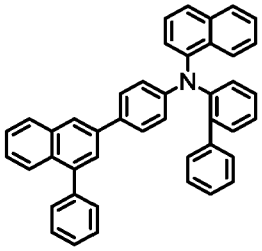
C51



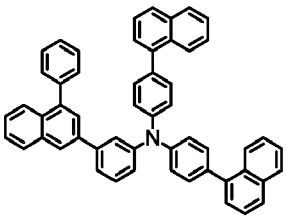
D12



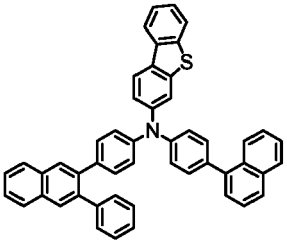
D22



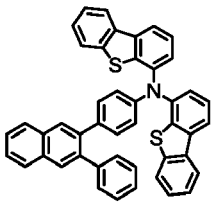
E3



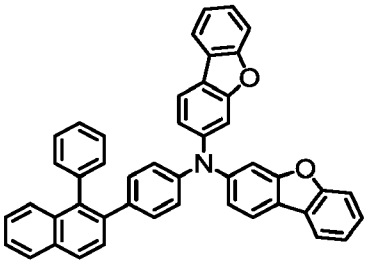
E32



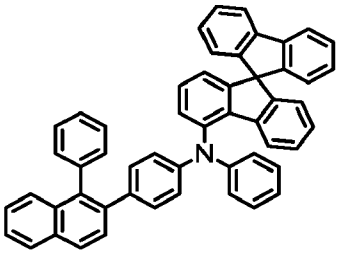
F46



F53



G54

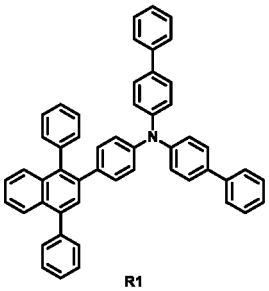


G58

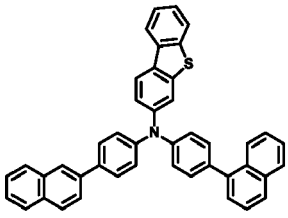
[0215] Organic electroluminescent devices of Comparative Examples 1 to 8 were manufactured by using the following Comparative Compounds R-1 to R-8.

[Comparative Compounds]

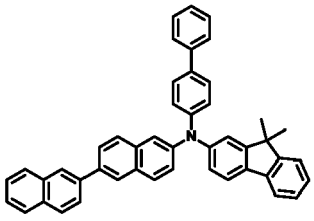
[0216]



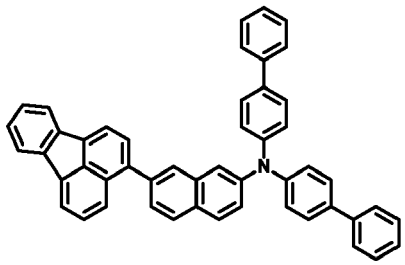
R1



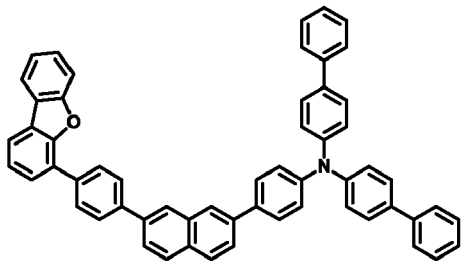
R2



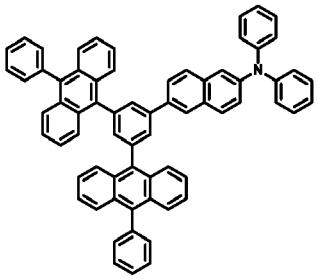
R3



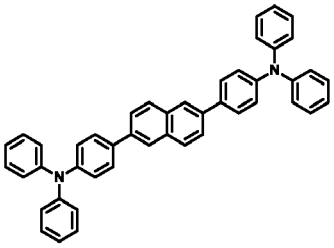
R4



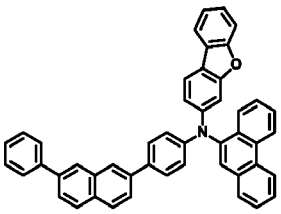
R5



R6

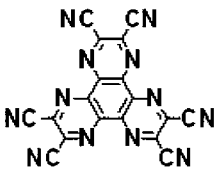


R7

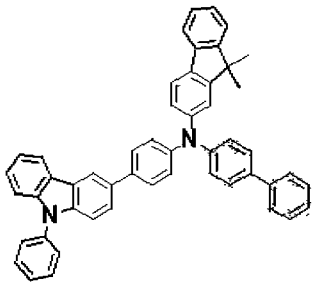


R8

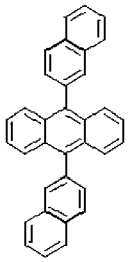
[0217] The organic electroluminescence devices according to Examples 1 to 15 and Comparative Examples 1 to 8 were manufactured by forming a first electrode using ITO to a thickness of about 150 nm, a hole injection layer using HT1 doped with 2% HIL-M to a thickness of about 10 nm, a hole transport layer using HT1 to a thickness of about 120 nm, an electron blocking layer using the example compounds or the comparative compounds to a thickness of about 10 nm, an emission layer using BH doped with 2% BD to a thickness of about 30 nm, a hole blocking layer using ET1 to a thickness of about 10 nm, an electron transport layer using ET2 to a thickness of about 20 nm, an electron injection layer using LiF to a thickness of about 1 nm, and a second electrode using a Mg/Ag alloy co-deposited at a volumetric ratio of 9:1 to a thickness of about 120 nm. Each layer was formed by a vacuum deposition method.



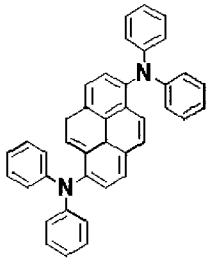
HIL-M



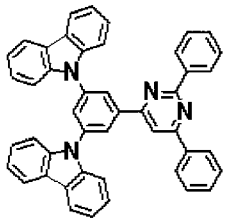
HT1



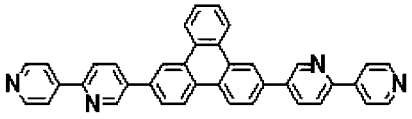
BH



BD



ET1



ET2

[0218] The voltage, half-life, emission efficiency, and color coordinate of the organic electroluminescence devices manufactured in Examples 1 to 15 and Comparative Examples 1 to 8 are shown in Table 1 below.

[Table 1]

	Electron blocking layer	Voltage (V)	Life LT50 (h)	Emission efficiency (cd/A)	Color coordinate CIE (x,y)
Example 1	Example Compound A4	4.8	5.5	189	0.141, 0.051
Example 2	Example Compound A17	4.6	5.5	190	0.142, 0.051
Example 3	Example Compound B13	4.7	5.6	196	0.141, 0.051
Example 4	Example Compound B20	4.6	5.5	195	0.141, 0.052
Example 5	Example Compound B40	4.6	5.4	197	0.142, 0.052
Example 6	Example Compound C22	4.6	5.4	199	0.142, 0.051
Example 7	Example Compound C51	4.8	5.4	196	0.141, 0.051
Example 8	Example Compound D12	4.8	5.5	188	0.142, 0.052
Example 9	Example Compound D22	4.7	5.4	190	0.142, 0.051
Example 10	Example Compound E3	4.8	5.6	184	0.141, 0.052
Example 11	Example Compound E32	4.8	5.6	189	0.141, 0.052
Example 12	Example Compound F46	4.7	5.3	193	0.141, 0.051
Example 13	Example Compound F53	4.8	5.5	192	0.141, 0.051
Example 14	Example Compound G54	4.8	5.6	197	0.141, 0.052
Example 15	Example Compound G58	4.8	5.6	185	0.142, 0.052
Comparative Example 1	Comparative Compound R1	5.0	4.9	167	0.140, 0.052
Comparative Example 2	Comparative Compound R2	5.2	3.8	165	0.141, 0.053
Comparative Example 3	Comparative Compound R3	5.1	4.0	167	0.142, 0.051
Comparative Example 4	Comparative Compound R4	5.3	4.2	163	0.139, 0.049
Comparative Example 5	Comparative Compound R5	5.1	5.0	168	0.140, 0.050
Comparative Example 6	Comparative Compound R6	5.5	3.5	155	0.137, 0.047

(continued)

	Electron blocking layer	Voltage (V)	Life LT50 (h)	Emission efficiency (cd/A)	Color coordinate CIE (x,y)
Comparative Example 7	Comparative Compound R7	4.9	5.0	157	0.143, 0.053
Comparative Example 8	Comparative Compound R8	4.9	4.9	169	0.142, 0.052

[0219] In the above table, the emission efficiency was a measured value at a current density of about 10 mA/cm^2, and the half-life was a value at about 1.0 mA/cm^2.

[0220] Referring to the results in Table 1, it may be found that the organic electroluminescence devices of Examples 1 to 15 have decreased driving voltage, extended life and enhanced efficiency when compared with those of Comparative Examples 1 to 8. The monoamine compound according to an embodiment of the inventive concept includes a substituted β-phenylnaphthyl group, thereby attaining decreased driving voltage, extended life and enhanced efficiency of the device. Specifically, the monoamine compound may achieve an extended device life by the introduction of a naphthyl group having a high thermal resistance and electric charge resistance, with the maintenance of the property of amine group. Furthermore, the monoamine compound has a bulky naphthyl group substituted with a phenyl group, which decreases symmetry of molecule and inhibits crystallization, thereby enhancing quality of layers and attaining high efficiency of the device.

[0221] It may be found that the organic electroluminescence devices of Examples 1, 2, 8 to 11, 14 and 15 have enhanced efficiency and extended device life when compared with those of Comparative Examples 1 to 8. It seems that Example Compounds A4, A17, D12, D22, E3, E32, G54 and G58 includes a substituent at α position of the naphthyl group, which results in steric electron repulsion between the substituent of α position and the hydrogen atom of other α' position, and distortion of the naphthyl structure and phenyl group substituted therein leads to decreased planarity of the whole molecule and inhibits crystallization, thereby improving hole transport property and enhancing the chance of recombining holes and electrons in an emission layer.

[0222] Furthermore, it may be found that the organic electroluminescence devices of Examples 3 to 7, 12 and 13 have extended device life and extended device life when compared with those of Comparative Examples 1 to 8. Example Compounds B13, B20, B40, C25, C51, F46 and F53, including a substituent at β position of the naphthyl group, have a steric conformation close to plane for the naphthyl group and the substituent at β position, which results in stabilized radical state due to the delocalized conjugation around amine, thereby enhancing device life.

[0223] The organic electroluminescence device of Comparative Example 1 shows decreased device life when compared with those of Examples. Comparative Compound R1 has an amine group substituted at β position of naphthyl group via a linker similar to Example Compounds, but has two phenyl groups substituted in naphthyl group, which seems to result in largely distributed HOMO in naphthyl group and decreased electron density in amine group, thereby making it difficult to maintain the property of amine to extend device life.

[0224] The organic electroluminescence device of Comparative Example 2 uses an amine compound including a naphthyl group but not a phenylnaphthyl group, which results in low electric charge resistance, thereby decreasing device life and emission efficiency due to the insufficient quality of layers.

[0225] The organic electroluminescence devices of Comparative Examples 3 and 4 use Comparative Compounds R3 and R4 having an amine group substituted at β position of naphthyl group via a linker similar to Example Compounds, but having polycyclic aromatic groups connected to naphthyl group, contrary to Example Compounds having a phenyl group connected to naphthyl group, which seems to cause a strong molecular stacking and increased deposition temperature due to the polycyclic aromatic group, thereby resulting in easy thermal decomposition and decreased efficiency and device life, when compared with those of Examples.

[0226] The organic electroluminescence device of Comparative Example 6 uses Comparative Compound R6 having an amine group substituted at β position of naphthyl group via a linker similar to Example Compounds, but having a phenyl group with two substituents, which seems to cause a strong molecular stacking and increased deposition temperature, thereby resulting in easy thermal decomposition and decreased efficiency and device life, when compared with those of Examples.

[0227] The organic electroluminescence devices of Comparative Examples 5 and 7 shows especially decreased emission efficiency when compared with those of Examples. Comparative Compound R5 has a naphthyl group substituted with phenyl group which is substituted with dibenzofuran heterocycle, and Comparative Compound R7 is a diamine compound, both of which seem to disturb carrier balance.

[0228] The organic electroluminescence device of Comparative Example 8 shows decreased emission efficiency and

device life when compared with those of Examples. Comparative Compound R8 has a nitrogen atom substituted with both of 3-dibenzofuranyl and 9-phenanthryl, which seems to result in easy thermal decomposition. That is, Comparative Compound R8 has a nitrogen atom substituted with 9-phenanthryl which may greatly increase molecular stacking, and further substituted with 3-dibenzofuranyl which increases planarity of the whole molecule, thereby causing a strong molecular stacking and increased deposition temperature, which seems to result in easy thermal decomposition and decreased efficiency and device life.

[0229] The monoamine compound according to an embodiment of the inventive concept may be used as a material for a hole transport region of an organic electroluminescence device, thereby contributing to decrease of a driving voltage, increase of emission efficiency and extension of life for the organic electroluminescence device.

[0230] The organic electroluminescence device according to an embodiment of the inventive concept has high efficiency.

[0231] The monoamine compound according to an embodiment of the inventive concept may be used as a material for a hole transport region of an organic electroluminescence device, thereby enhancing efficiency and life of the organic electroluminescence device.

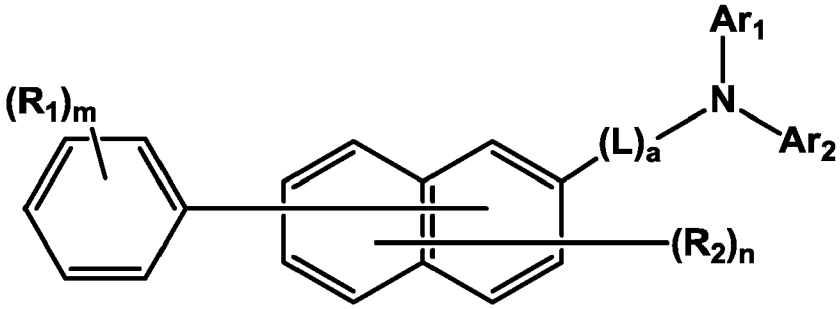
[0232] The monoamine compound according to an embodiment of the inventive concept may be used as a material for a hole transport region of an organic electroluminescence device, thereby decreasing a driving voltage of the organic electroluminescence device.

[0233] Although the embodiments of the present invention have been described referring to the attached drawings, it is understood that the present invention should not be limited to these embodiments but various changes and modifications can be made by one ordinary skilled in the art within the scope of the present invention as hereinafter claimed. It is also understood that the embodiments described above are merely descriptive, rather than limiting.

Claims

1. A monoamine compound represented by the following Formula 1:

[Formula 1]



wherein in Formula 1,

Ar_1 and Ar_2 are each independently a substituted or unsubstituted alkyl group having 1 to 10 carbon atoms, a substituted or unsubstituted cycloalkyl group having 3 to 20 carbon atoms for forming a ring, a substituted or unsubstituted aryl group having 6 to 30 carbon atoms for forming a ring, or a substituted or unsubstituted heteroaryl group having 2 to 30 carbon atoms for forming a ring,

L is a substituted or unsubstituted arylene group having 6 to 30 carbon atoms for forming a ring, or a substituted or unsubstituted heteroarylene group having 2 to 30 carbon atoms for forming a ring,

R_1 is a hydrogen atom, a deuterium atom, a halogen atom, a substituted or unsubstituted alkyl group having 1 to 20 carbon atoms, a substituted or unsubstituted cycloalkyl group having 3 to 20 carbon atoms for forming a ring, or a substituted or unsubstituted aryl group having 6 to 30 carbon atoms for forming a ring,

R_2 is a hydrogen atom, a deuterium atom, a halogen atom, a substituted or unsubstituted alkyl group having 1 to 20 carbon atoms, or a substituted or unsubstituted cycloalkyl group having 3 to 20 carbon atoms for forming a ring,

a is an integer of 0 to 3,

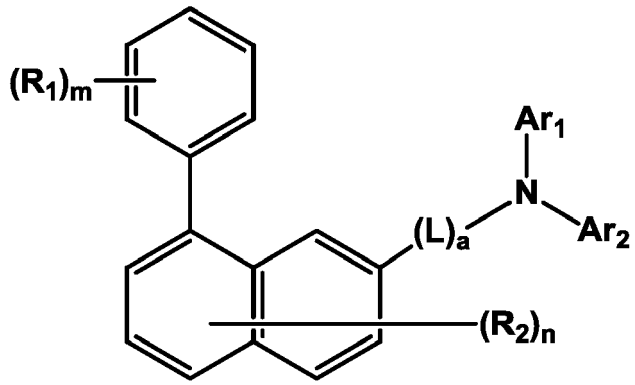
m is an integer of 0 or 1,

n is an integer of 0 to 6, and

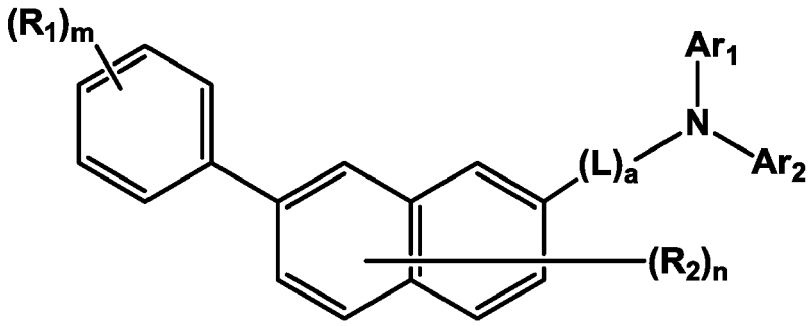
in case any one of Ar_1 and Ar_2 is 3-dibenzofuranyl, the other is not 9-phenanthryl.

2. A monoamine compound according to claim 1, wherein Formula 1 is represented by any one of the following Formulae 2 to 8:

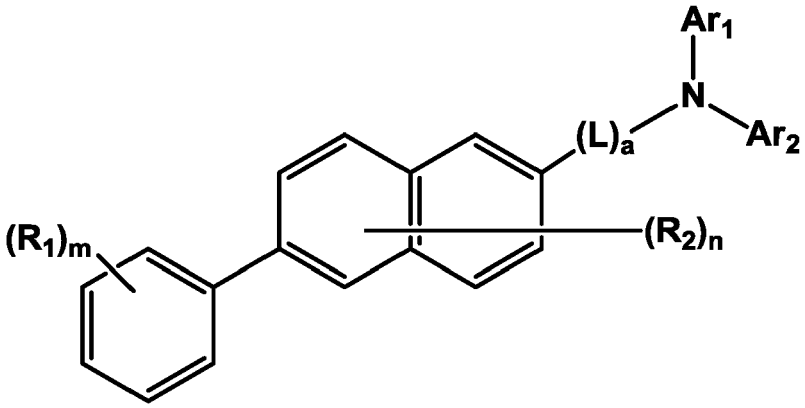
[Formula 2]



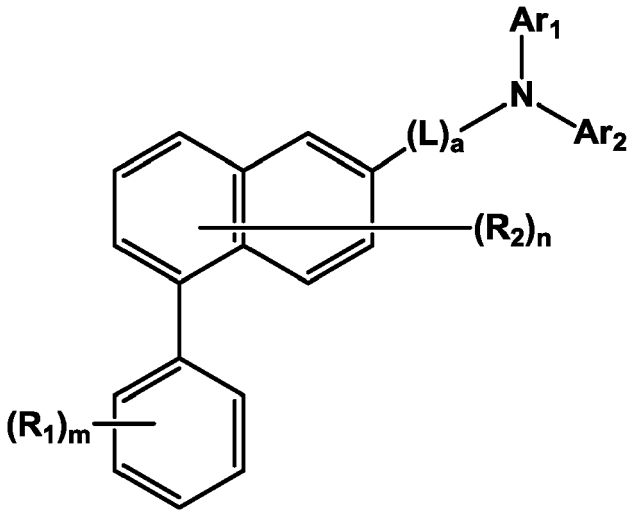
[Formula 3]



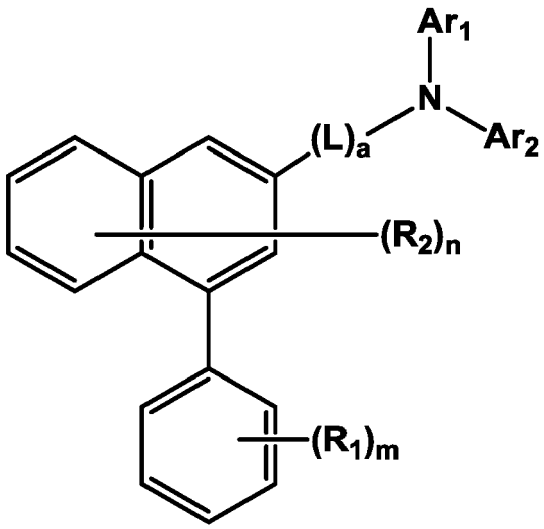
[Formula 4]



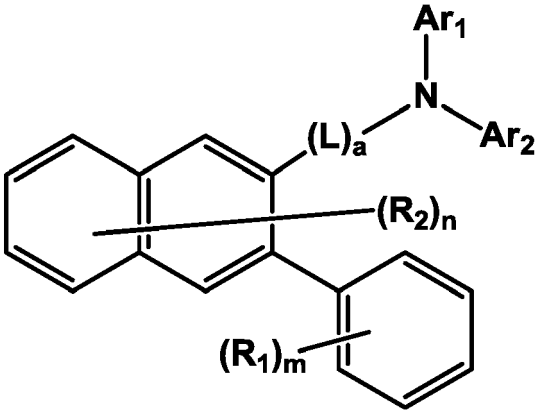
[Formula 5]



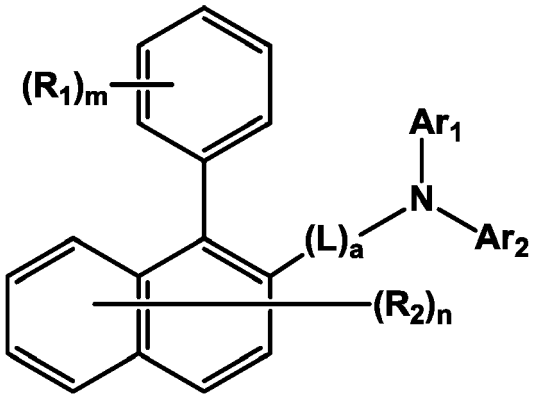
[Formula 6]



[Formula 7]



[Formula 8]



wherein in Formula 2 to 8,
Ar_1, Ar_2, L, R_1, R_2, a, m, and n are the same as defined in Formula 1.

3. A monoamine compound according to claim 1 or claim 2, wherein L is a substituted or unsubstituted arylene group having 6 to 12 carbon atoms for forming a ring.

4. A monoamine compound according to claim 3, wherein L is a substituted or unsubstituted phenylene group.

5. A monoamine compound according to any one of claims 1 to 4, wherein Ar_1 and Ar_2 are each independently a substituted or unsubstituted aryl group having 6 to 12 carbon atoms for forming a ring.

6. A monoamine compound according to claim 5, wherein Ar_1 and Ar_2 are each independently a substituted or unsubstituted phenyl group, a substituted or unsubstituted biphenyl group, a substituted or unsubstituted naphthylene group, or a substituted or unsubstituted fluorenyl group.

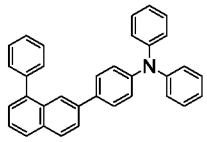
7. A monoamine compound according to any one of claims 1 to 4, wherein Ar_1 and Ar_2 are each independently a substituted or unsubstituted heteroaryl group having 5 to 12 carbon atoms for forming a ring.

8. A monoamine compound according to claim 7, wherein Ar_1 and Ar_2 are each independently a substituted or unsubstituted dibenzofuran group, a substituted or unsubstituted dibenzothiophene group, or a substituted or unsubstituted carbazole group.

9. A monoamine compound according to any one of claims 1 to 8, wherein R_2 is a hydrogen atom or a deuterium atom.

10. A monoamine compound according to claim 1, wherein the monoamine compound represented by Formula 1 is at least one selected from the group consisting of compounds represented in the following Compound Groups 1 to 7:

[Compound Group 1]



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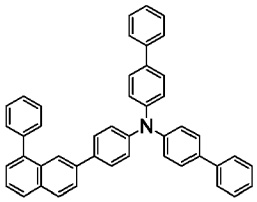

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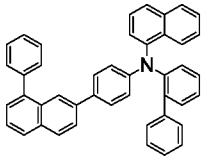

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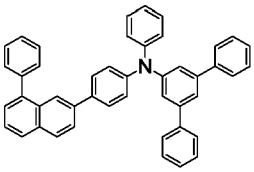

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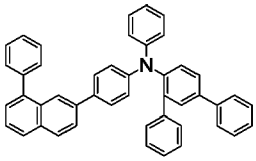

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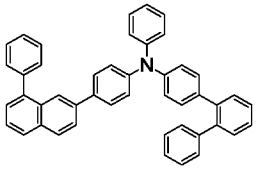

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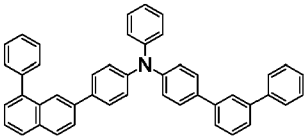

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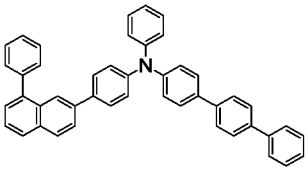

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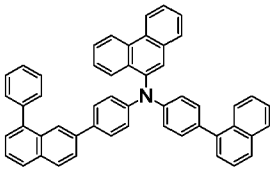

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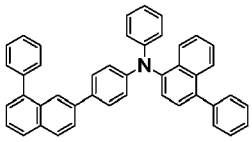

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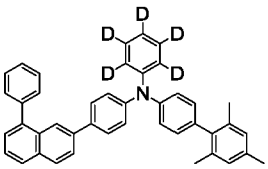

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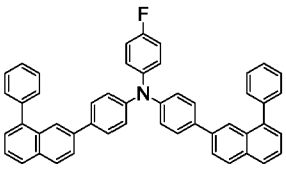

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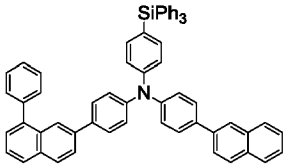

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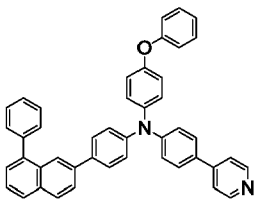

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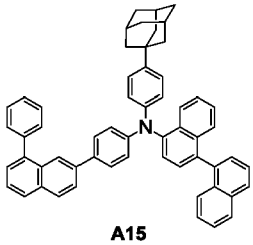

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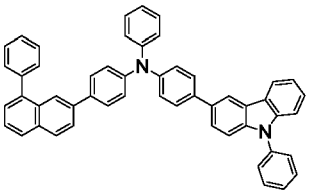

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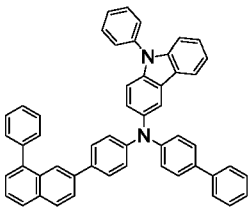

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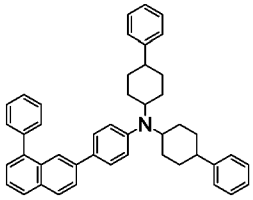

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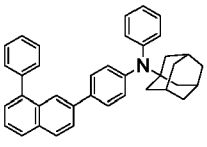

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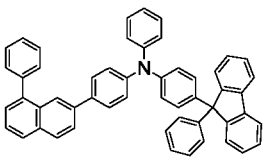

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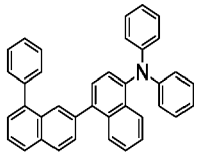

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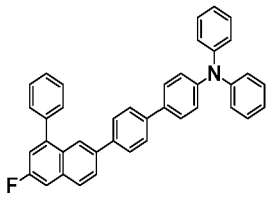

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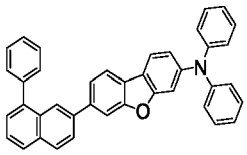

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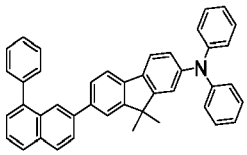

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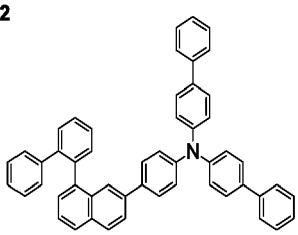

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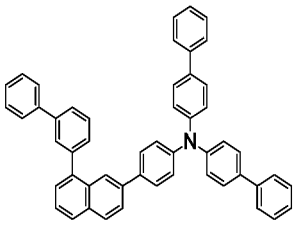

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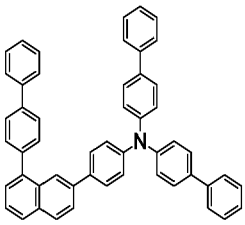

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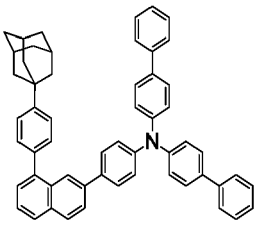

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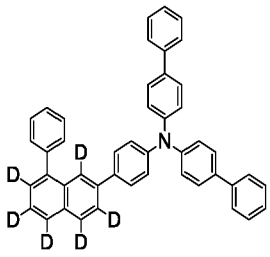

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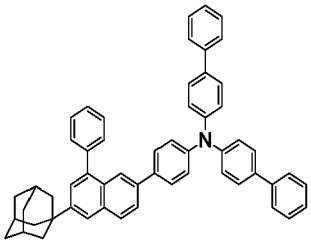

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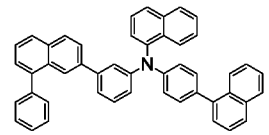

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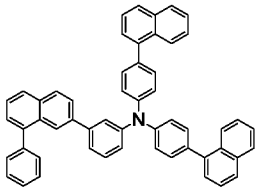

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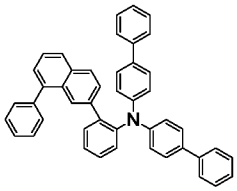

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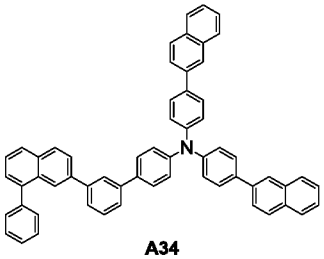

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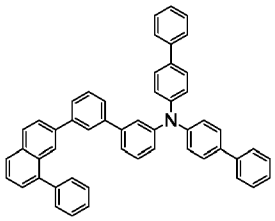

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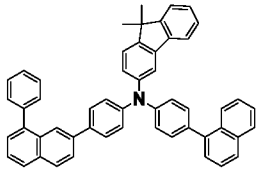

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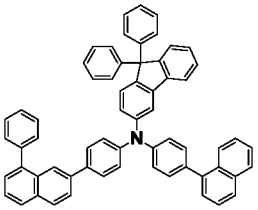

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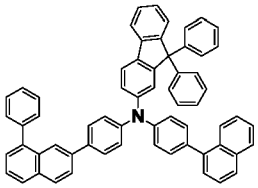

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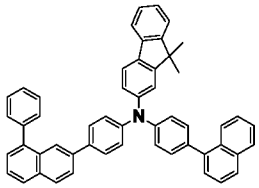

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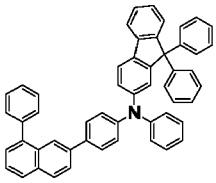

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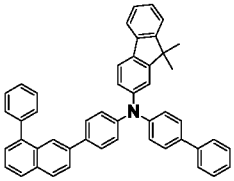

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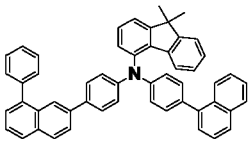

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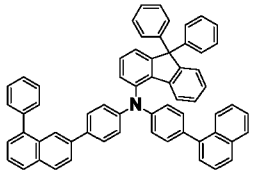

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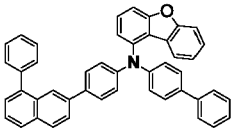

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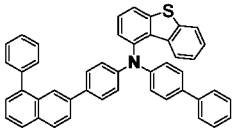

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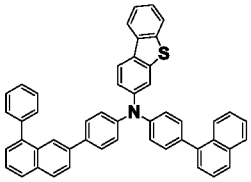

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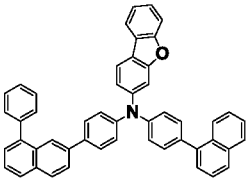

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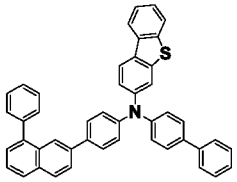

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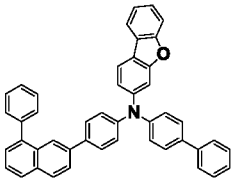

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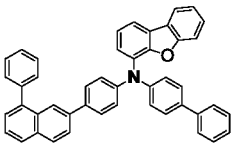

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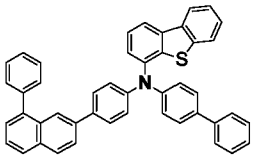

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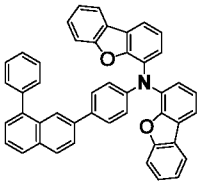

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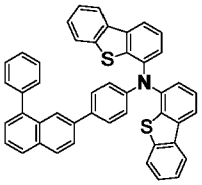

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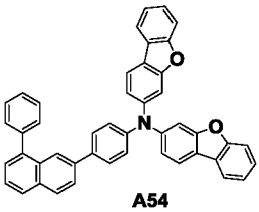

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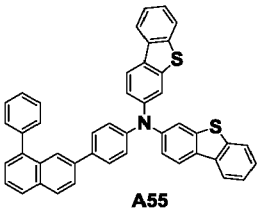

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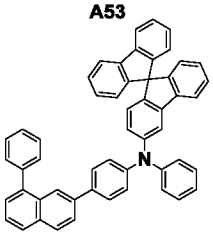

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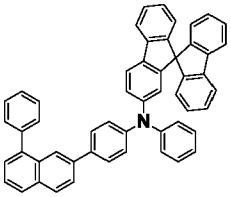

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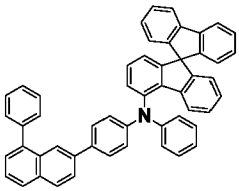

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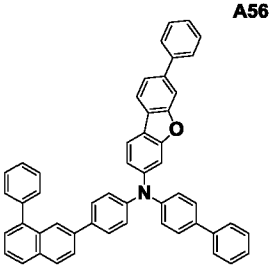

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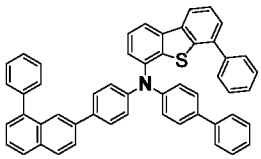
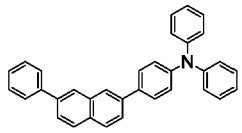


A60

[Compound Group 2]



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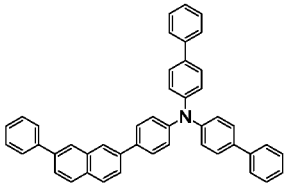

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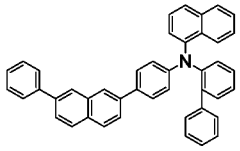

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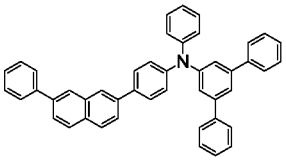

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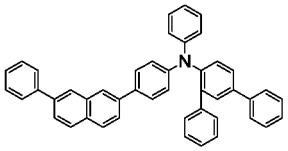

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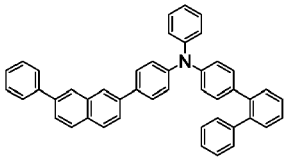

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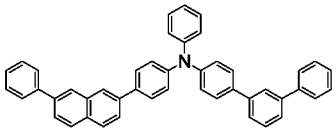

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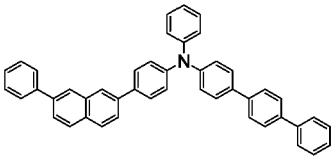

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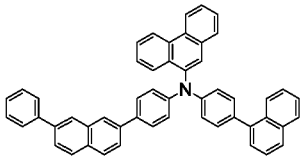

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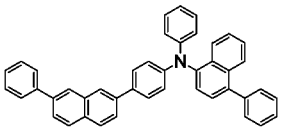

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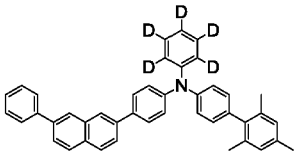

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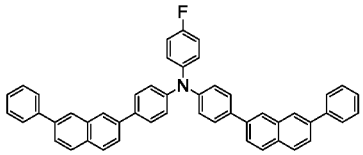

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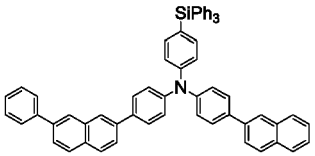

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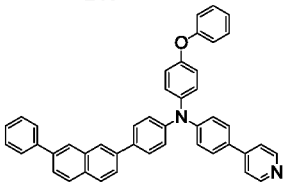

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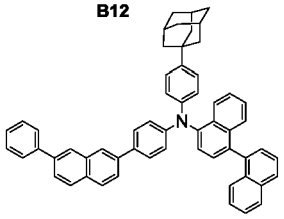

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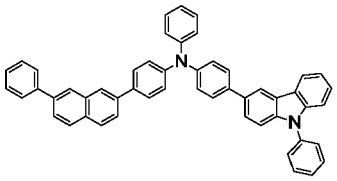

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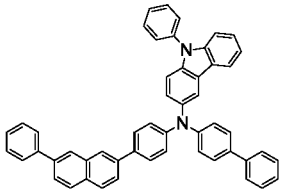

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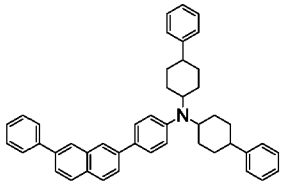

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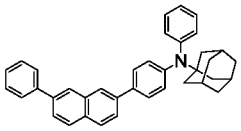

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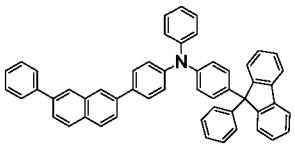

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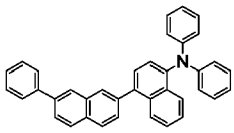

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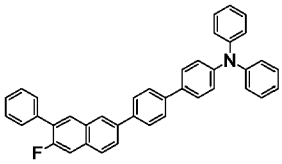

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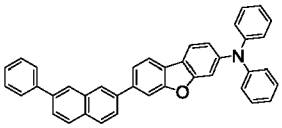

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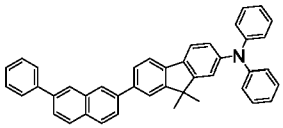

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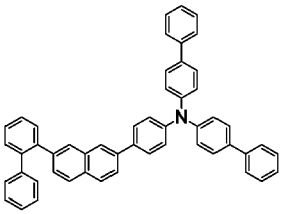

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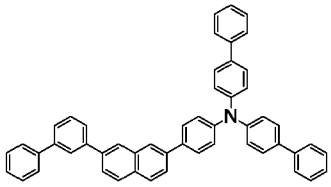

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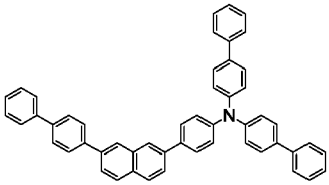

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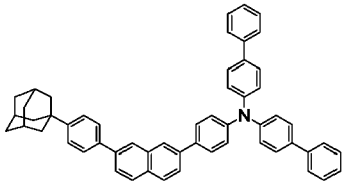

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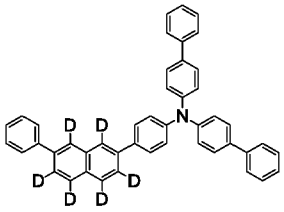

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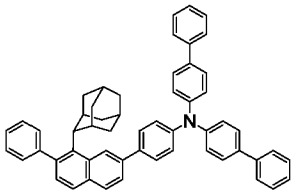

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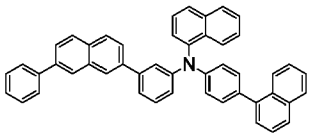

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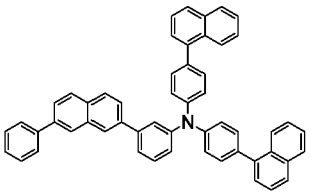

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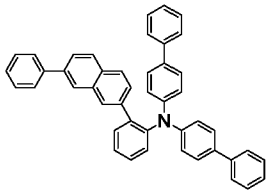

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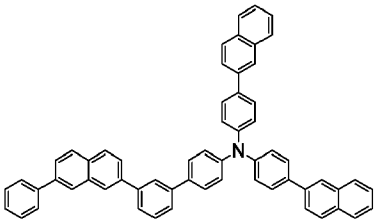

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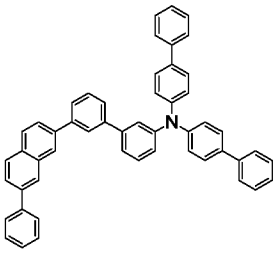

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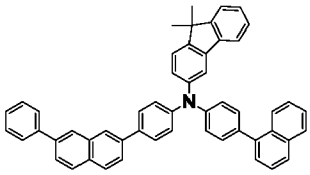

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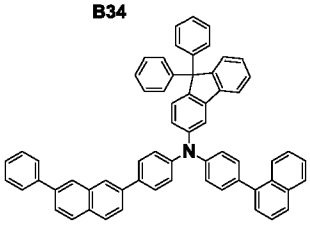

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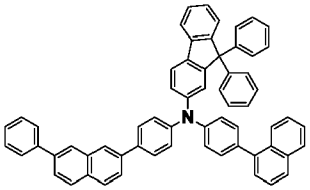

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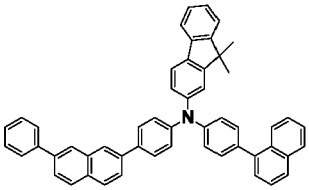

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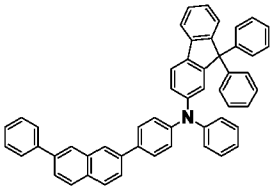

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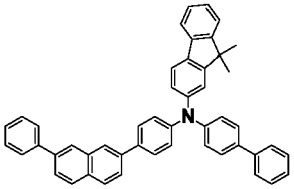

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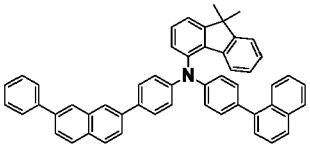

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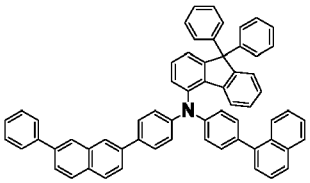
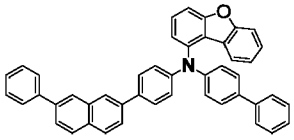


B43



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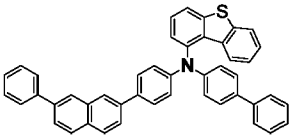

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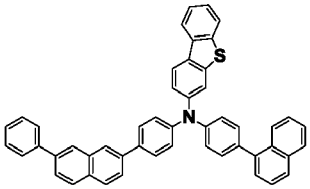

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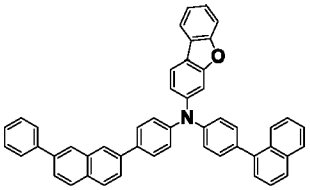

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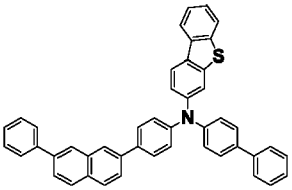

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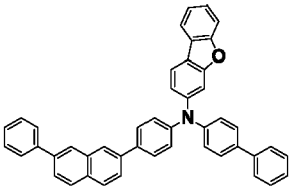

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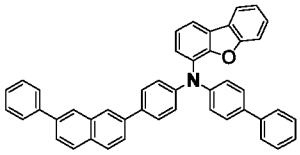

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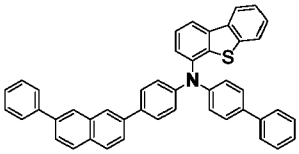

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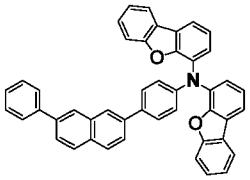

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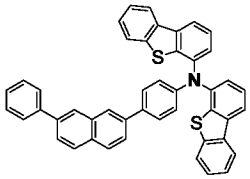

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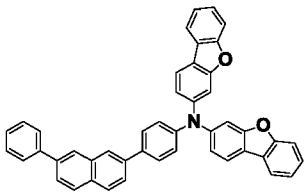

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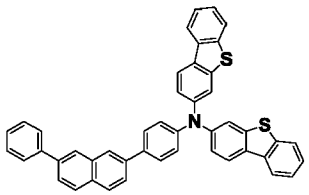

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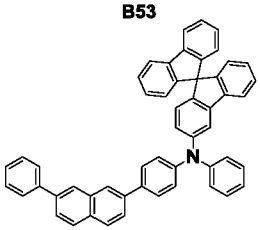

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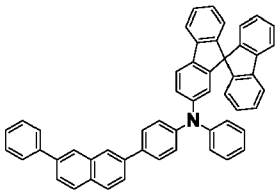

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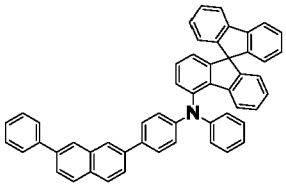

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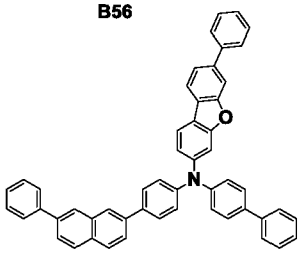

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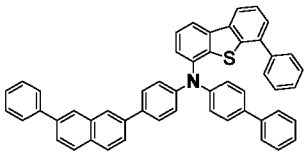
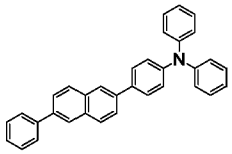


B60

[Compound Group 3]



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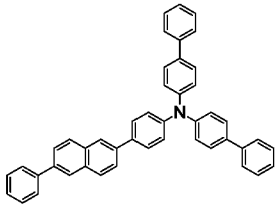

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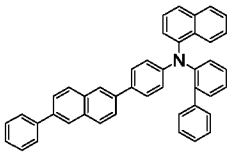

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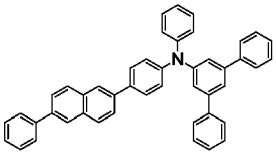

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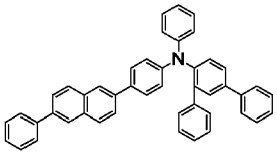

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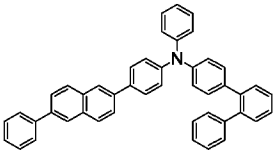

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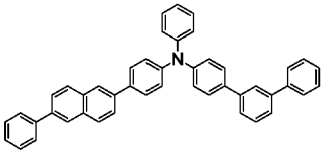

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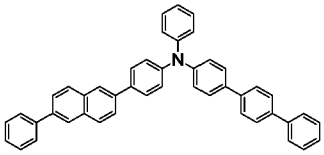

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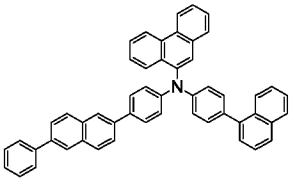

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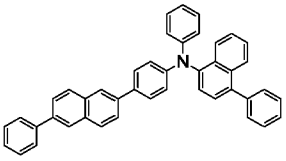

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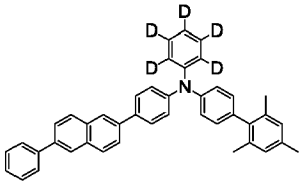

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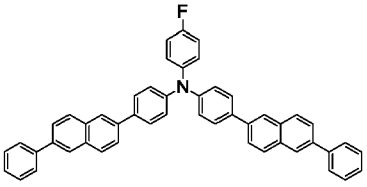

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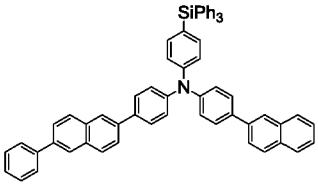

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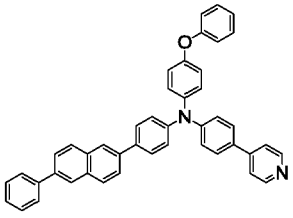

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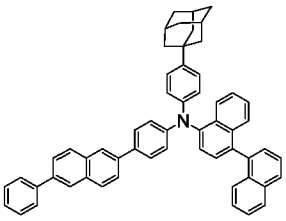

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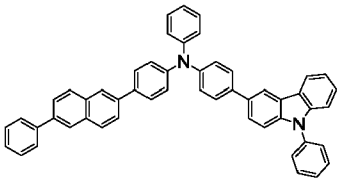

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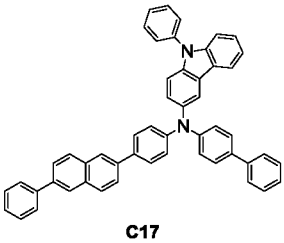

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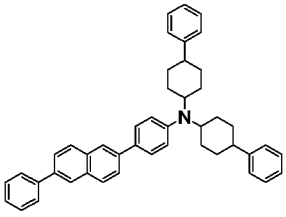

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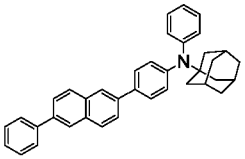

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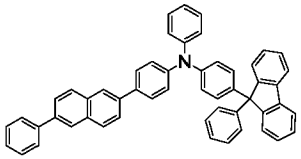

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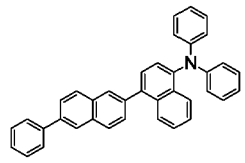

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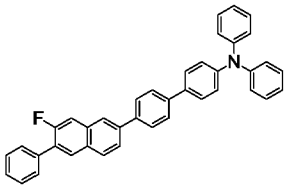

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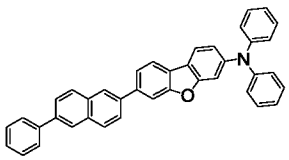

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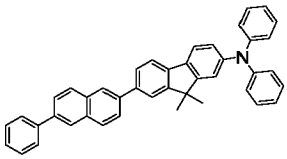

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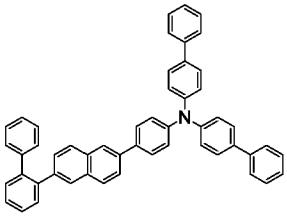

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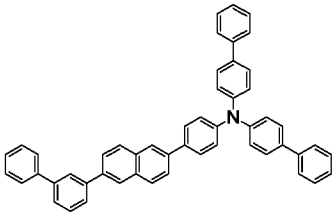

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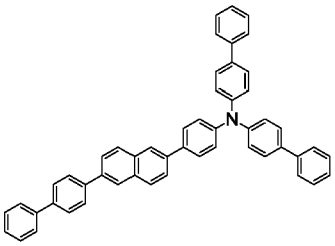

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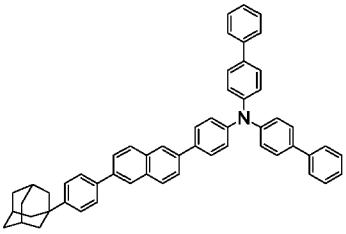

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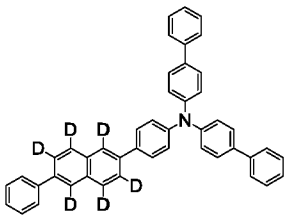

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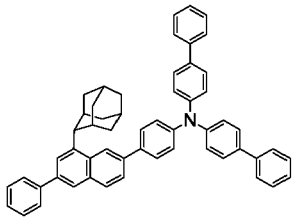

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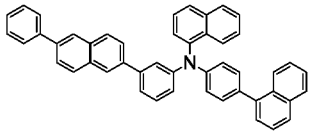

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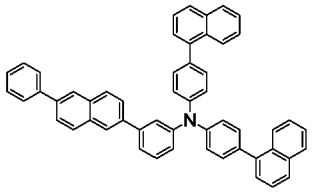

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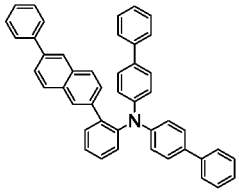

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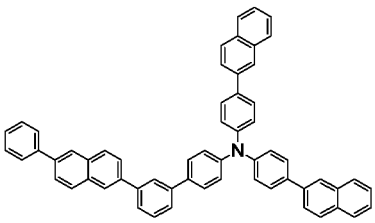

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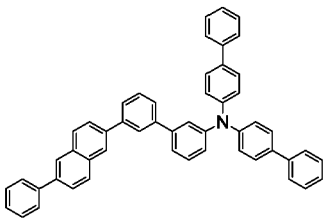

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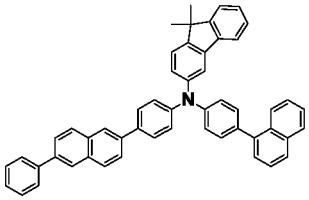

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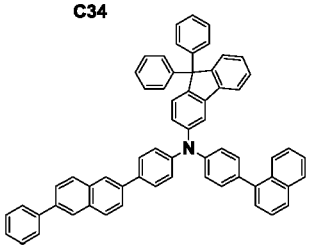

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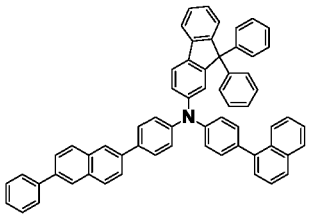
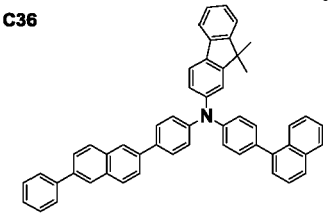


C38



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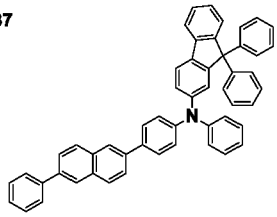

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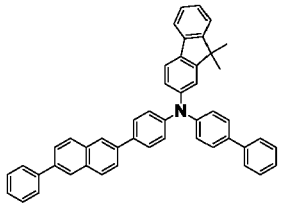

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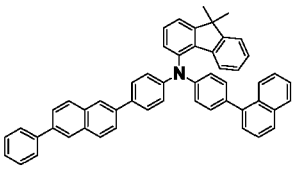
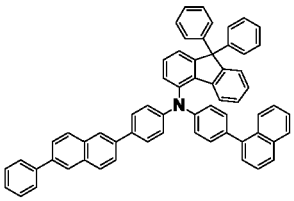
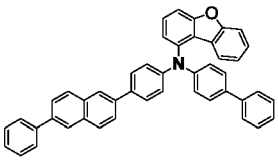


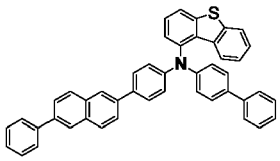
C42



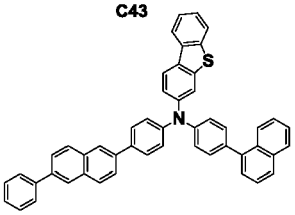
C43



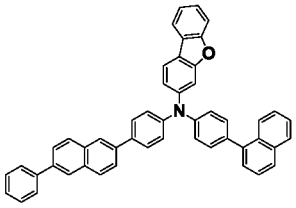
C44



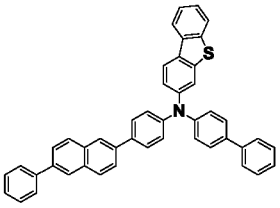
C45



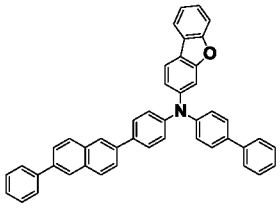
C46



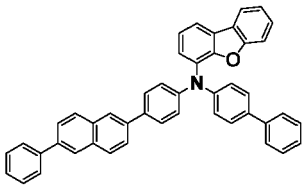
C47



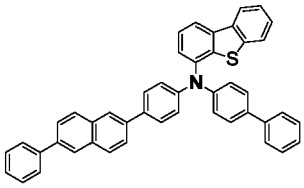
C48



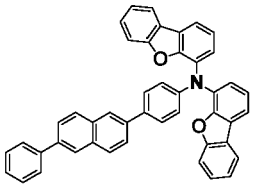
C49



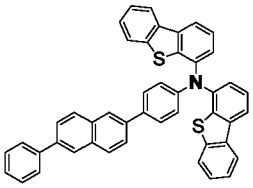
C50



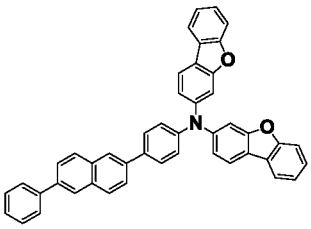
C51



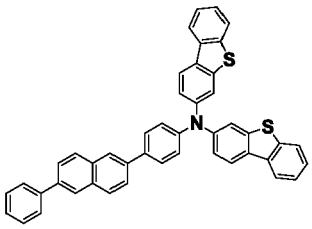
C52



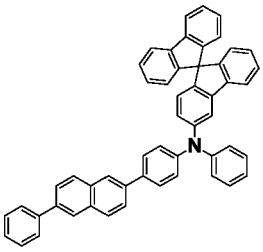
C53



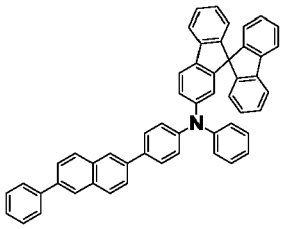
C54



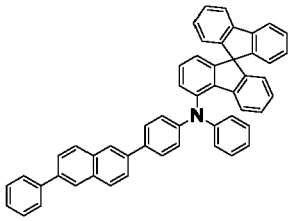
C55



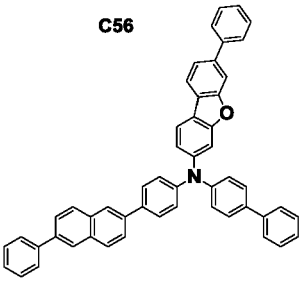
C56



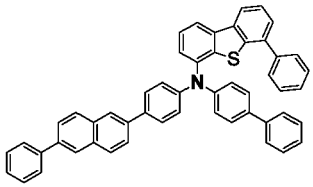
C57



C58

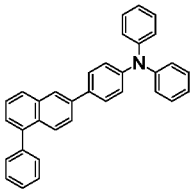


C59

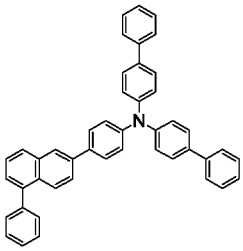


C60

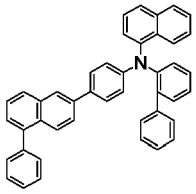
[Compound Group 4]



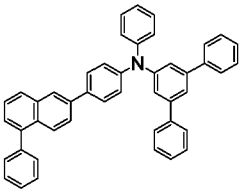
D1



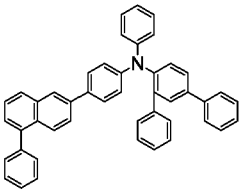
D2



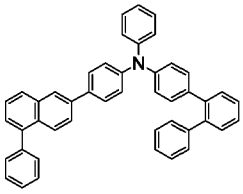
D3



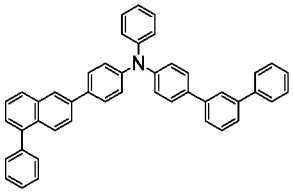
D4



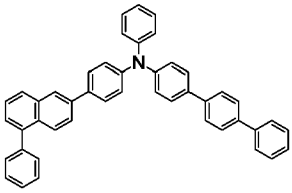
D5



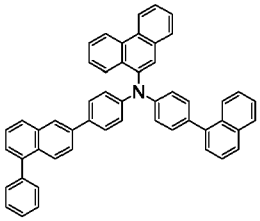
D6



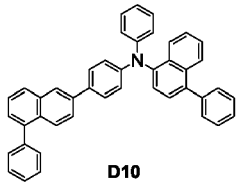
D7



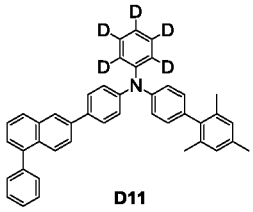
D8



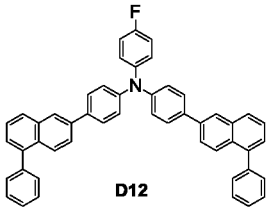
D9



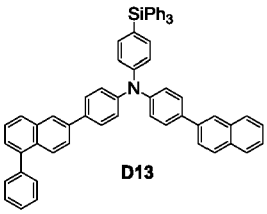
D10



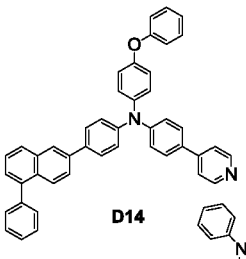
D11



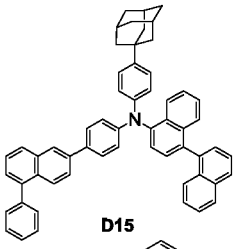
D12



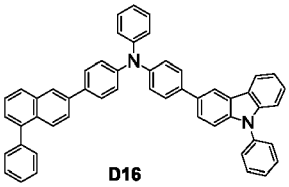
D13



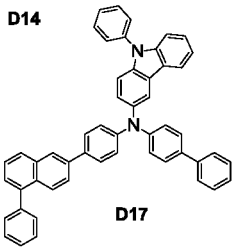
D14



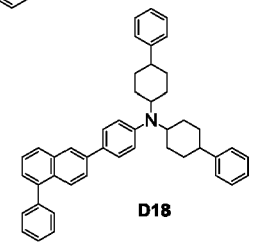
D15



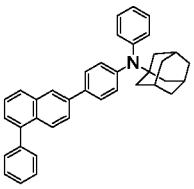
D16



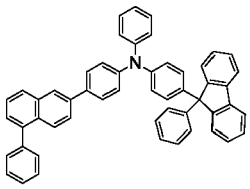
D17



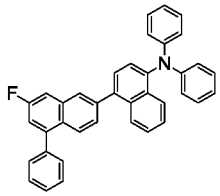
D18



D19



D20



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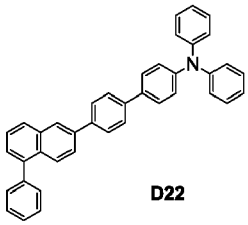
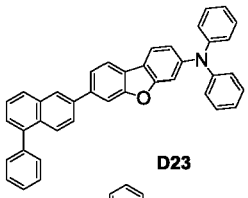


D22



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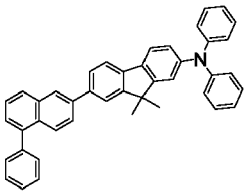

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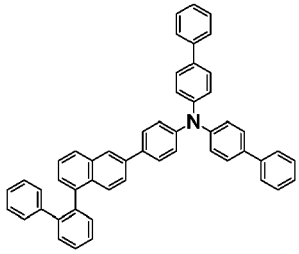

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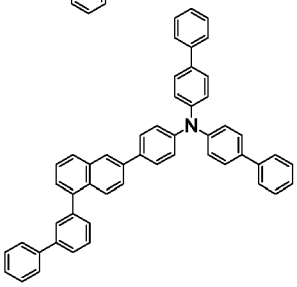
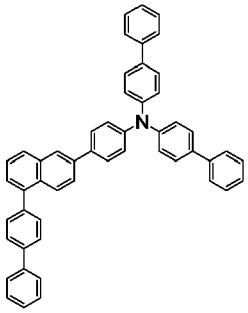
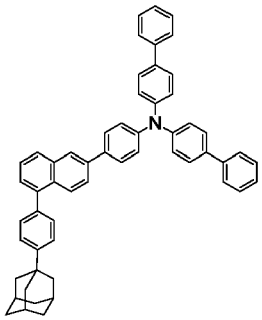


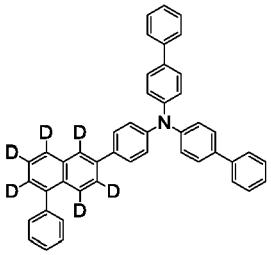
D26



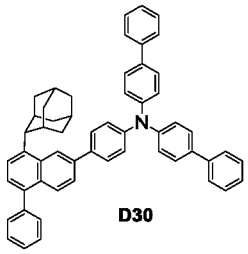
D27

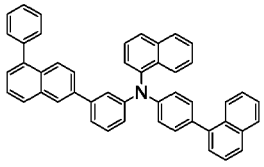


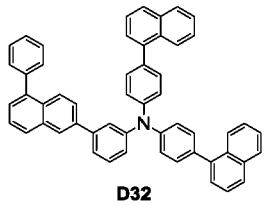
D28



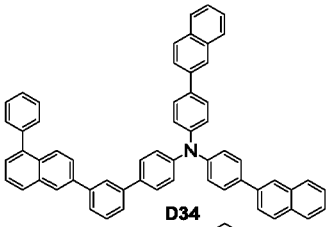
D29


D30


D31


D32


D33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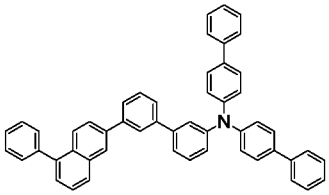
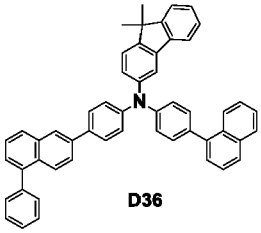
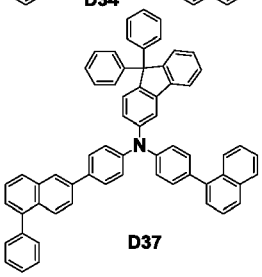
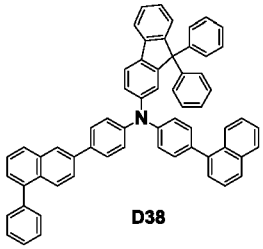
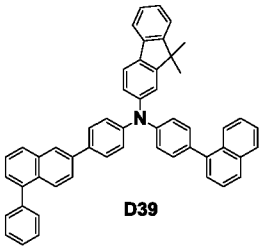
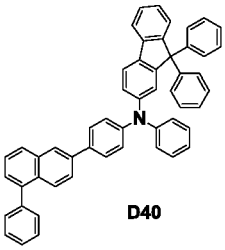

D35

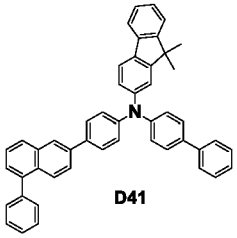

D36

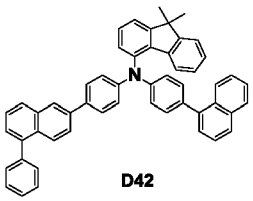

D37

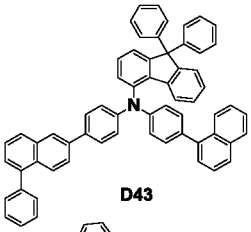

D38


D39


D40


D41


D42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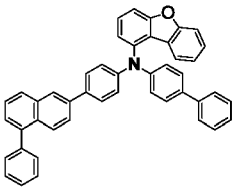
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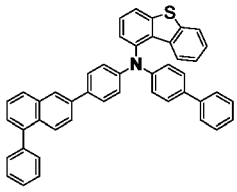
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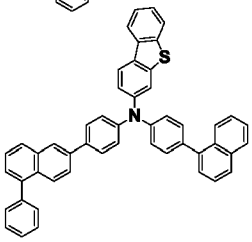
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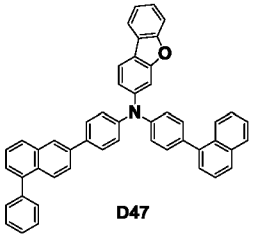
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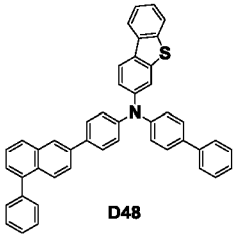
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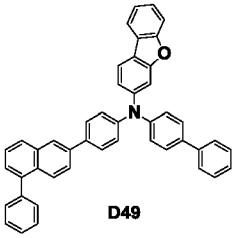
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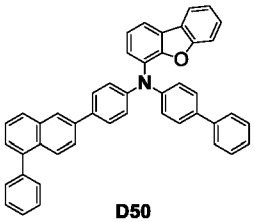
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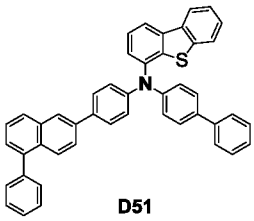
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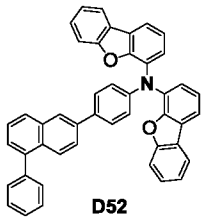
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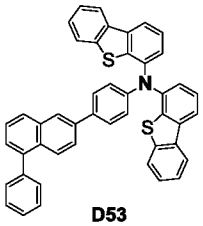
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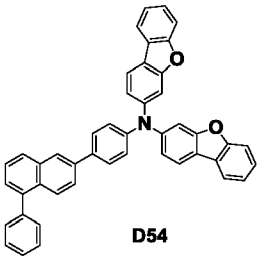
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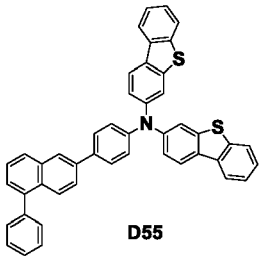
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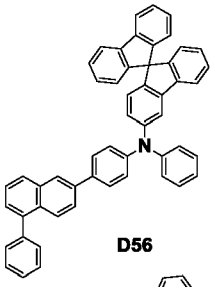
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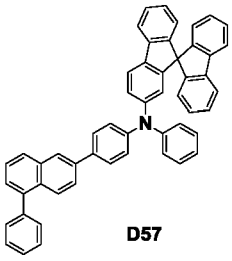
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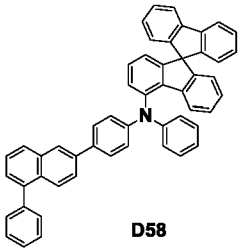
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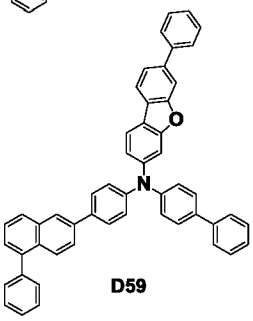
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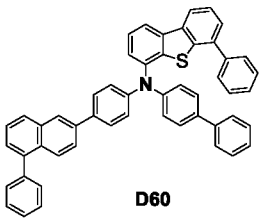
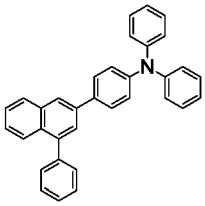
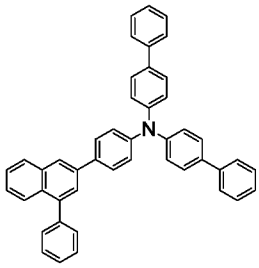

D60

[Compound Group 5]



E1



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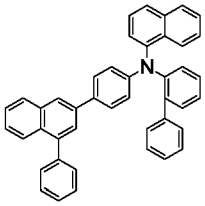

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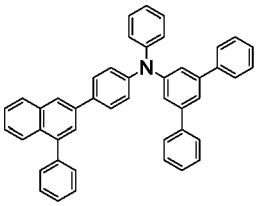

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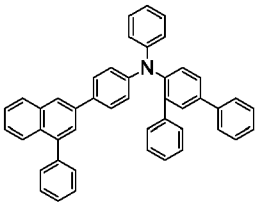

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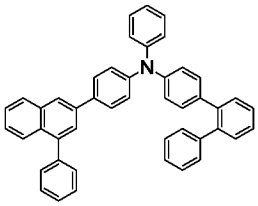

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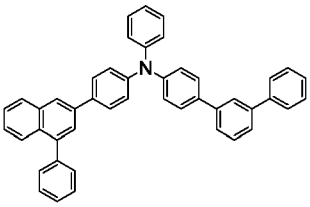

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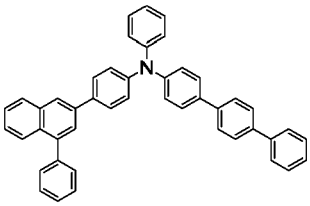

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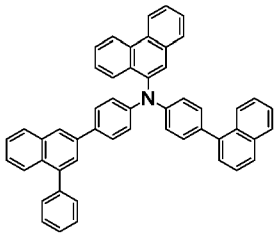

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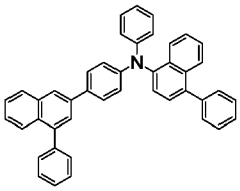

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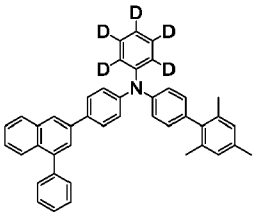

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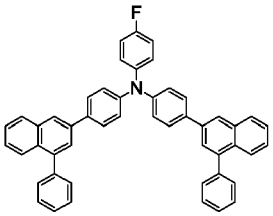

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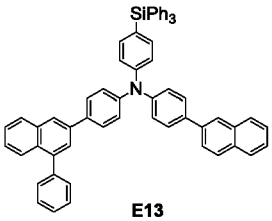

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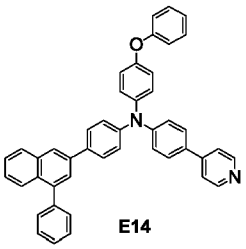

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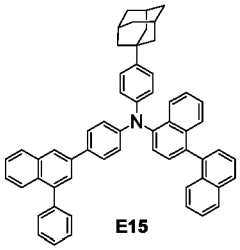

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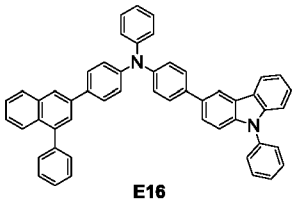

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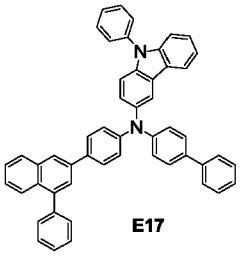

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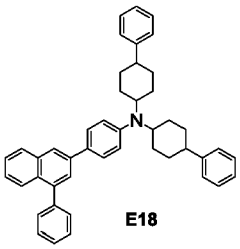

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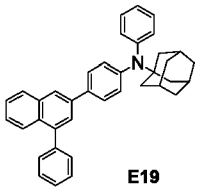

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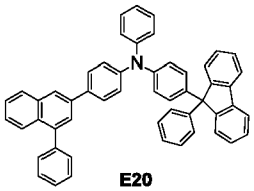

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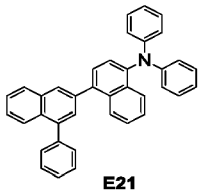
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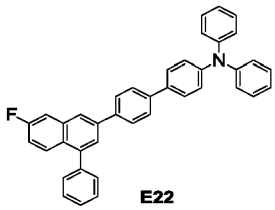
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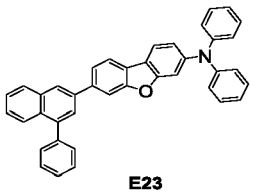
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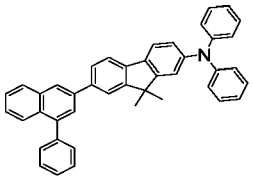
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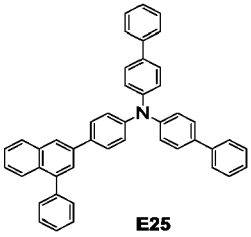
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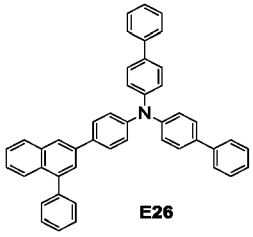
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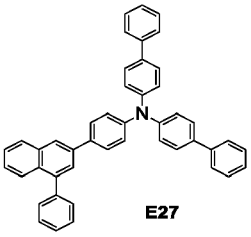
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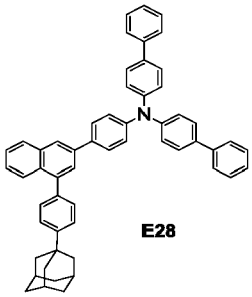
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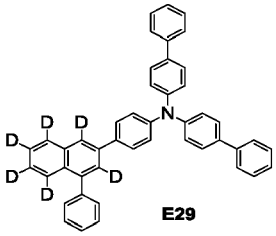
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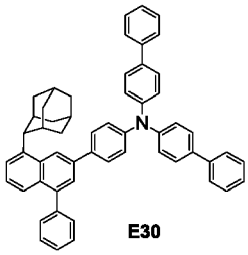

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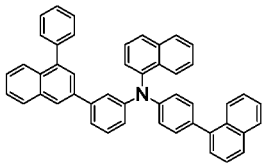

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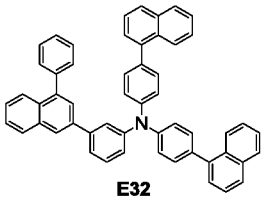

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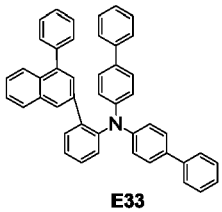

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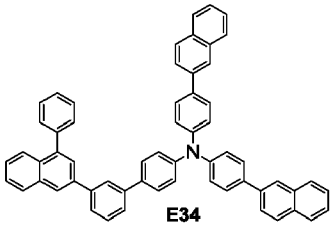

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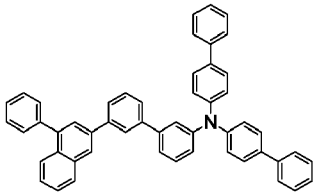

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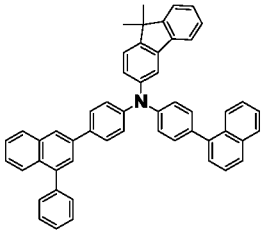

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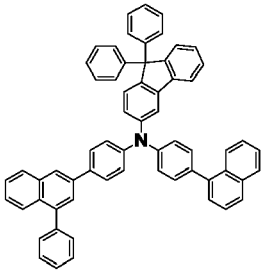

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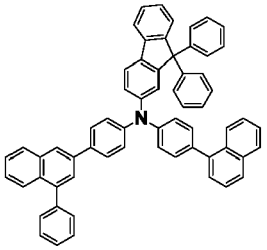

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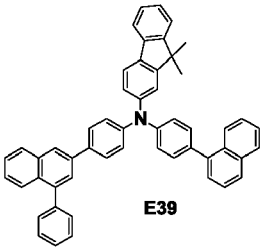

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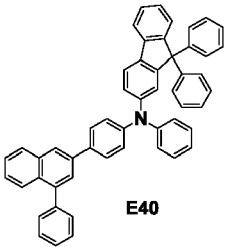
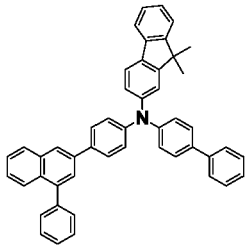
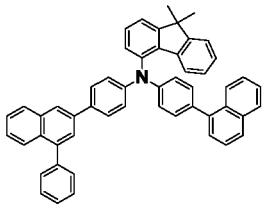


E40



E41



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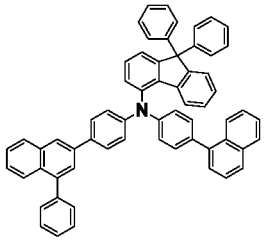

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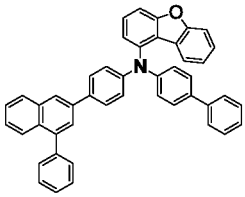

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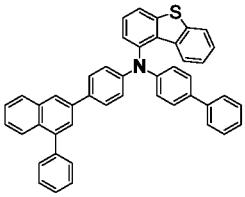

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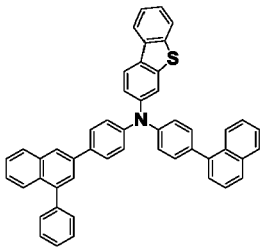

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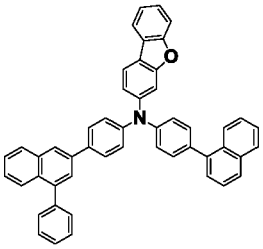

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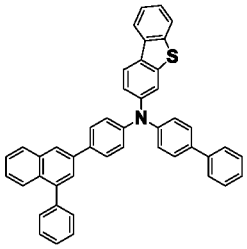

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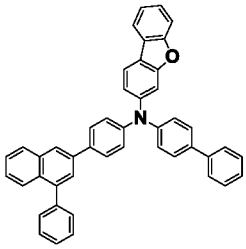

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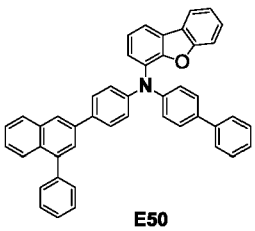

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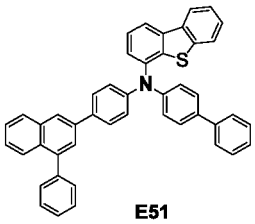

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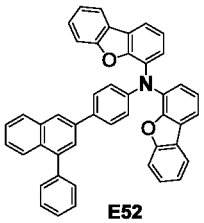

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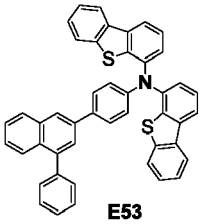

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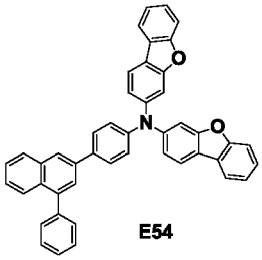

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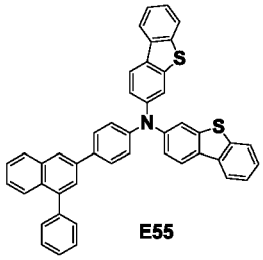

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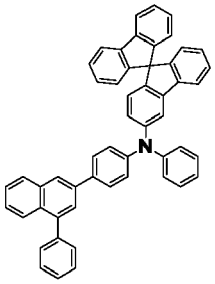

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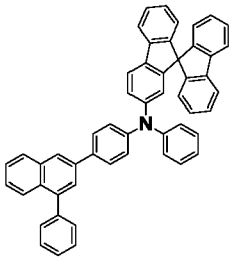

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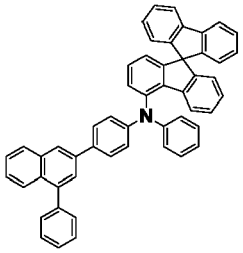

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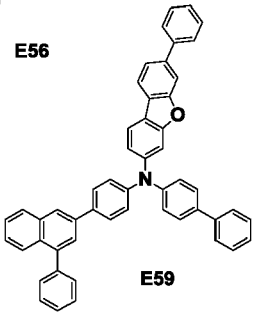

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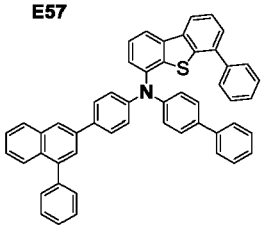
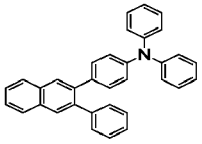


E60

[Compound Group 6]



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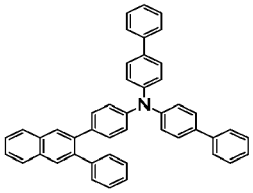

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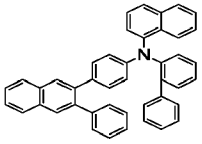

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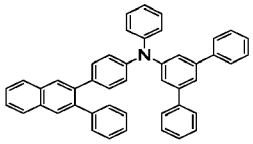

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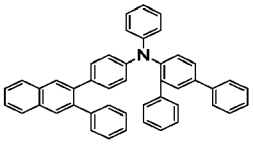

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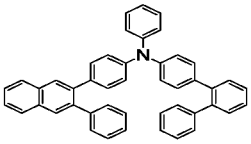

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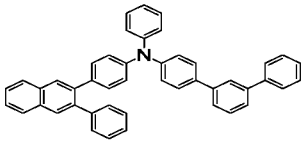

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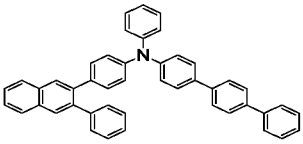

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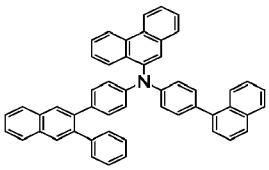

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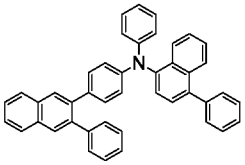

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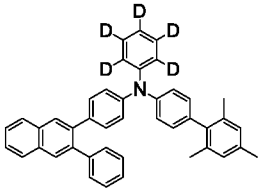

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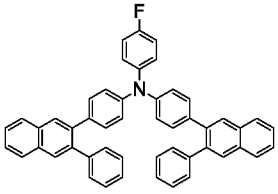

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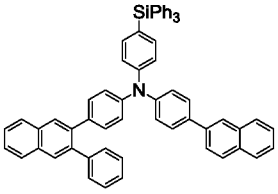

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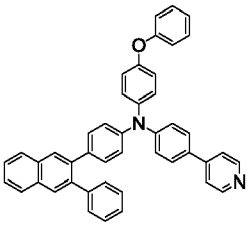

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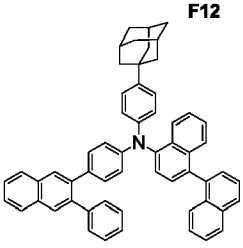

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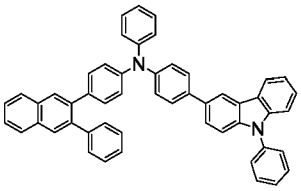

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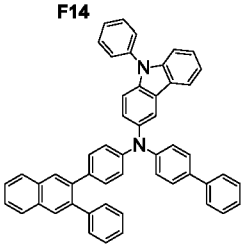

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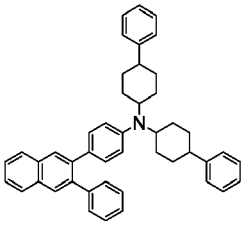

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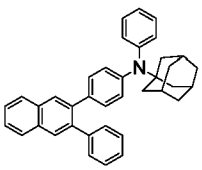

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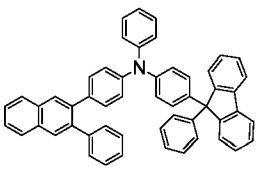

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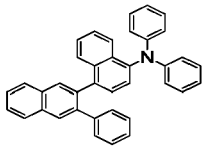

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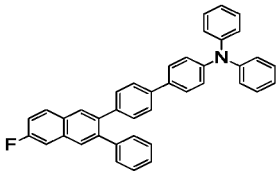

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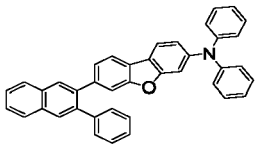

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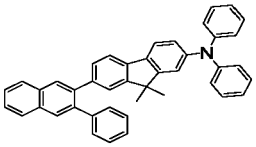

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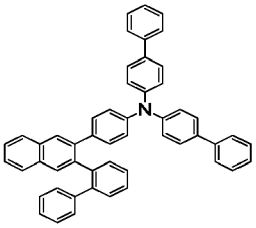

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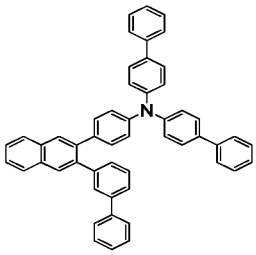

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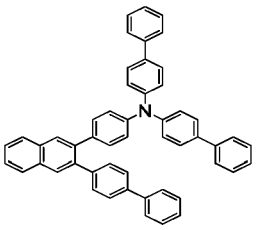

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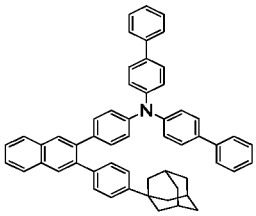

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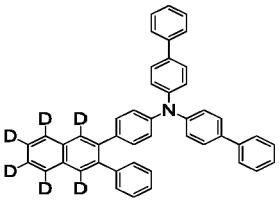

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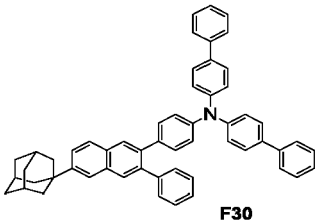

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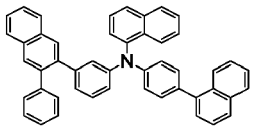

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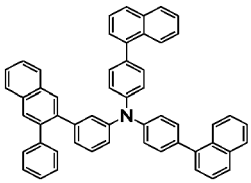

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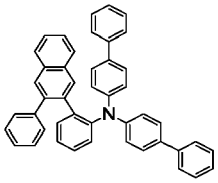

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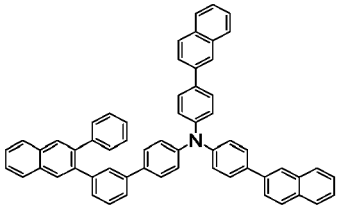

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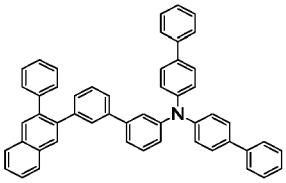

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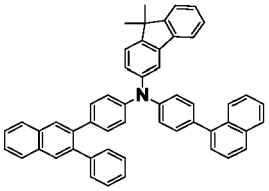

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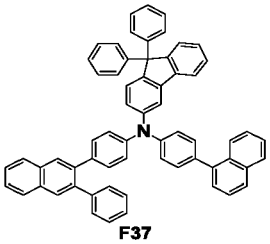

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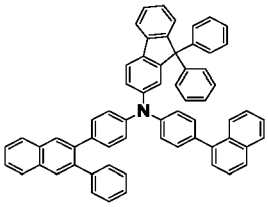

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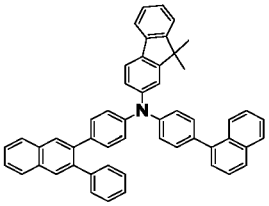

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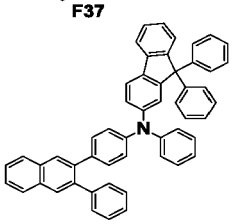

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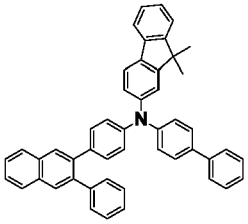

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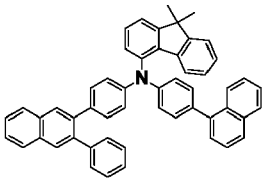

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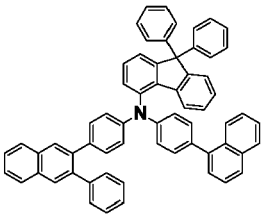

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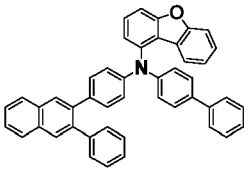

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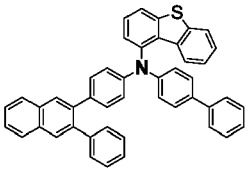

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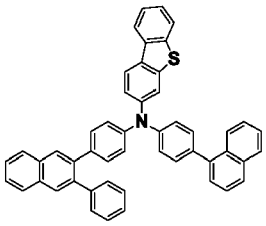

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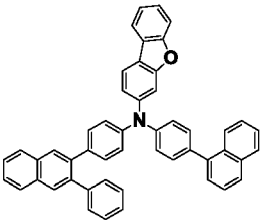

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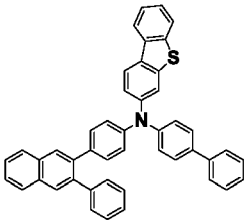

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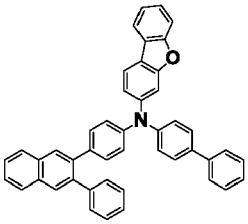

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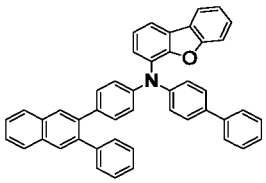

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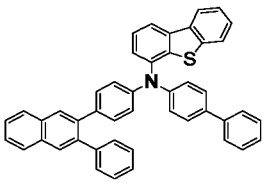

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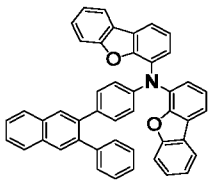

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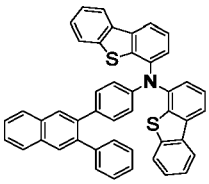

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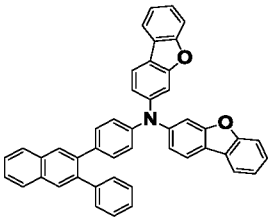

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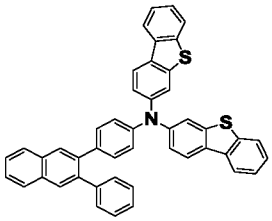

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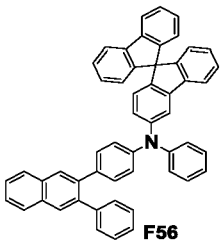

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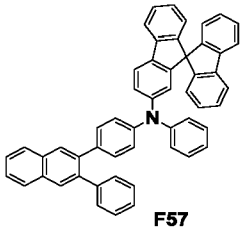

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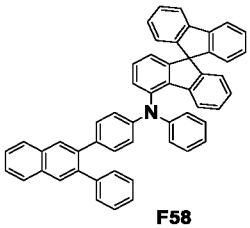

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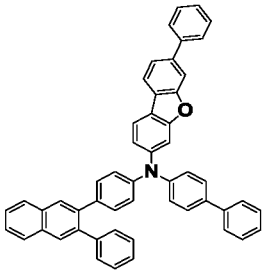

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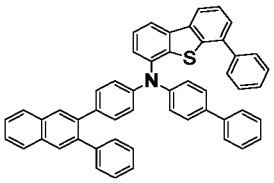
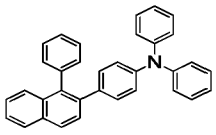
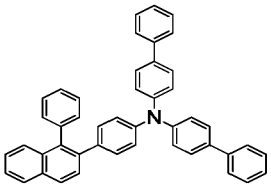


F60

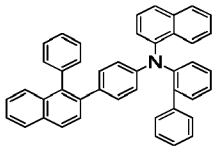
[Compound Group 7]



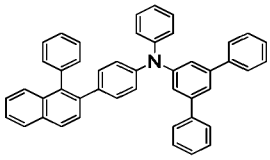
G1



G2



G3



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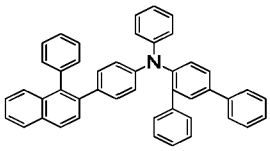

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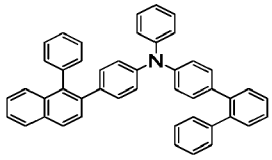

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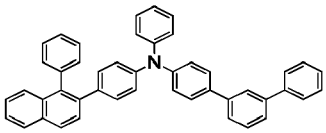

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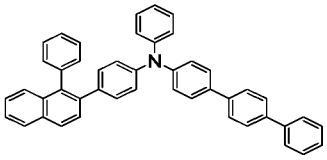

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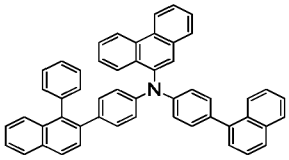

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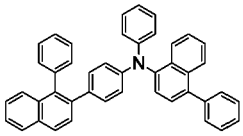

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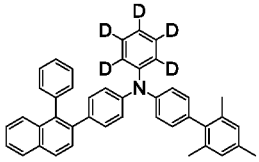

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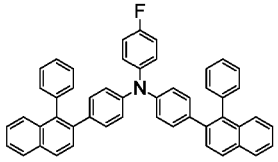

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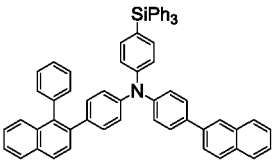

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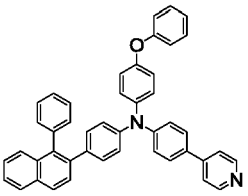

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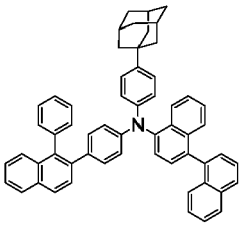

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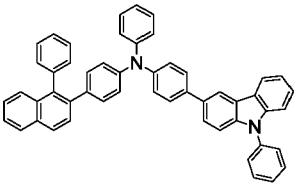

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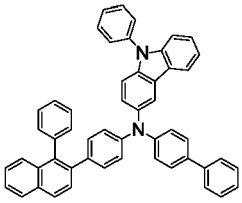

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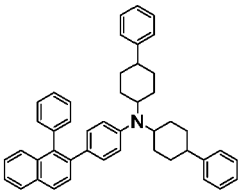

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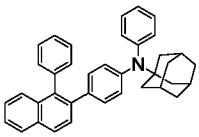

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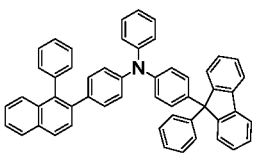

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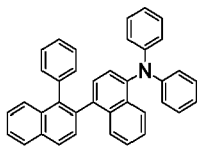

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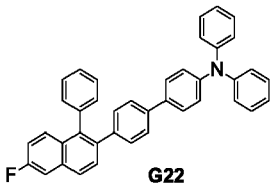

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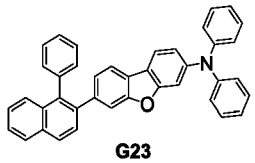

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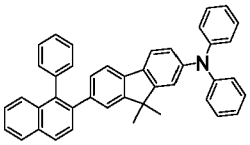

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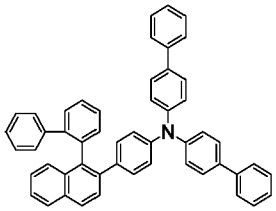

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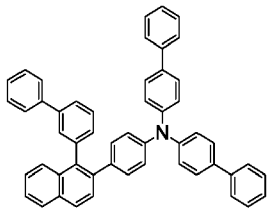

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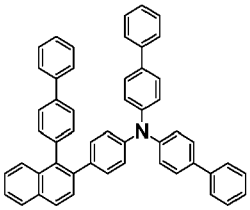

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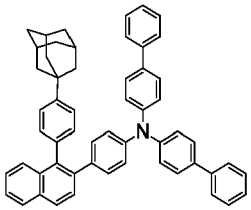

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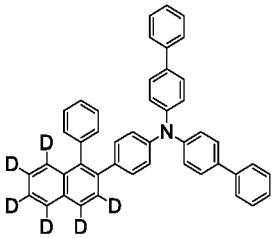

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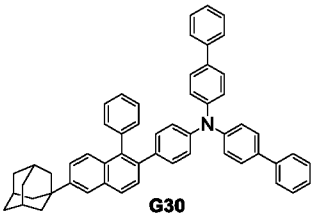

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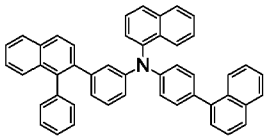

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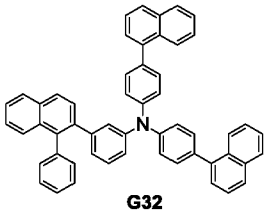

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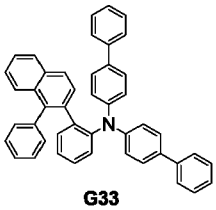

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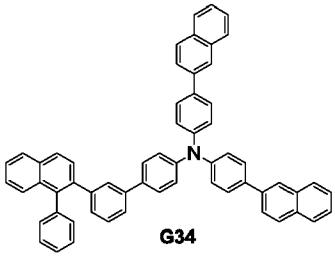

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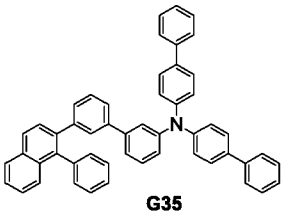
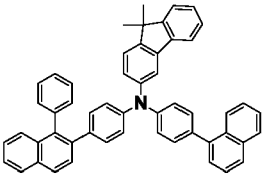
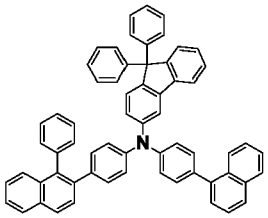


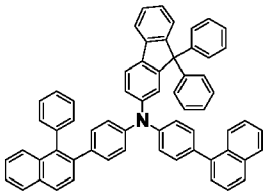
G35



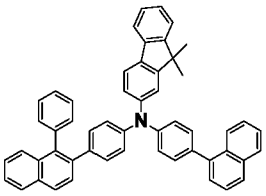
G36



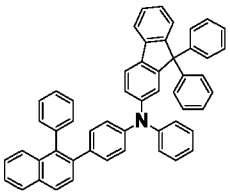
G37



G38



G39



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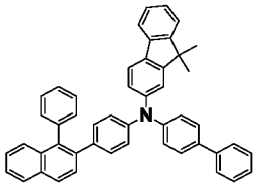

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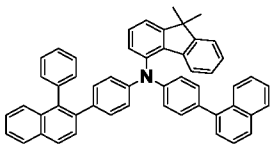

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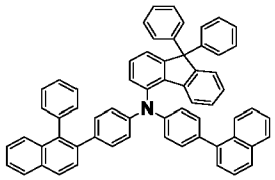

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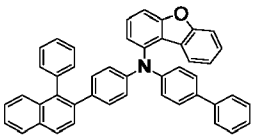

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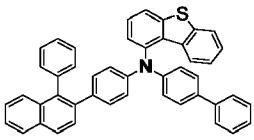

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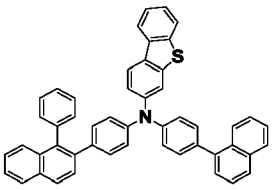

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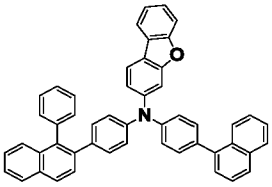

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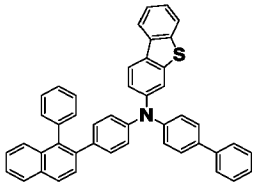

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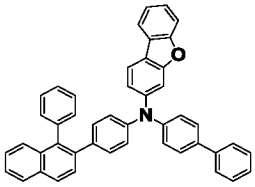

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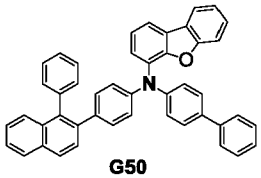

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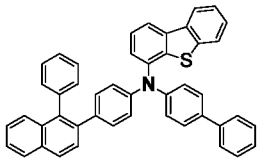

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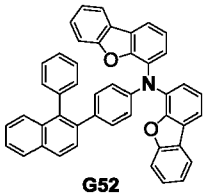

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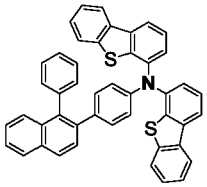

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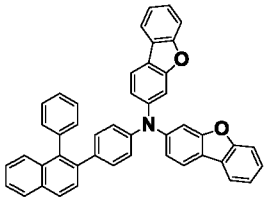

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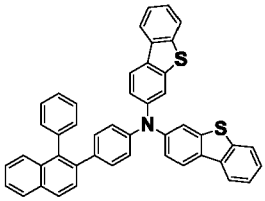

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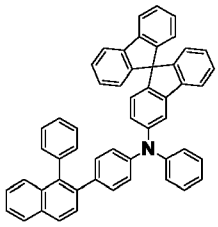

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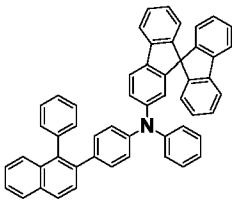

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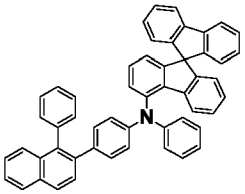
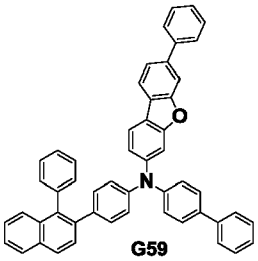


G58



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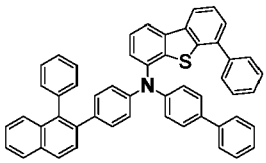

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11. An organic electroluminescence device, comprising:

a first electrode;
a hole transport region disposed on the first electrode;
an emission layer disposed on the hole transport region;
an electron transport region disposed on the emission layer; and
a second electrode disposed on the electron transport region,
wherein the hole transport region comprises a monoamine compound according to any one of claims 1 to 10.

12. An organic electroluminescence device according to claim 11, wherein the hole transport region has a multilayer structure having a plurality of layers, and a layer of the plurality of layers contacting with the emission layer comprises the monoamine compound according to any one of claims 1 to 10.

13. An organic electroluminescence device according to claim 11 or claim 12, wherein the hole transport region comprises:

a hole injection layer disposed on the first electrode;
a hole transport layer disposed on the hole injection layer; and
an electron blocking layer disposed on the hole transport layer; and
the electron blocking layer comprises the monoamine compound according to any one of claims 1 to 10.

FIG. 1

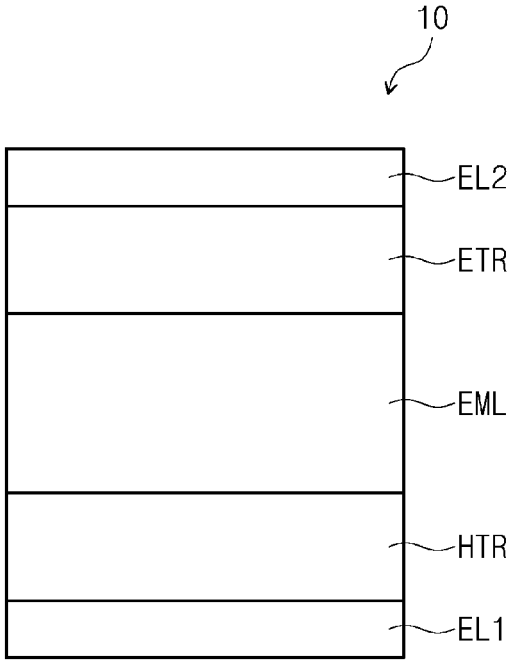


FIG. 2

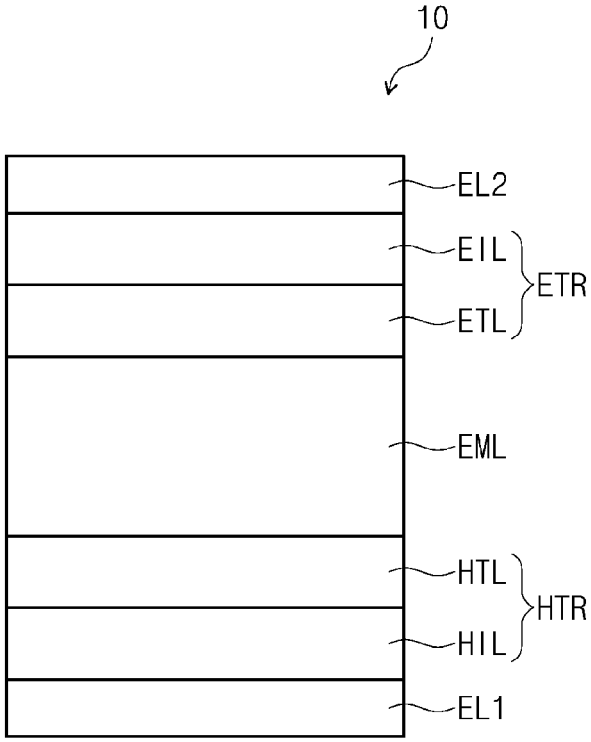
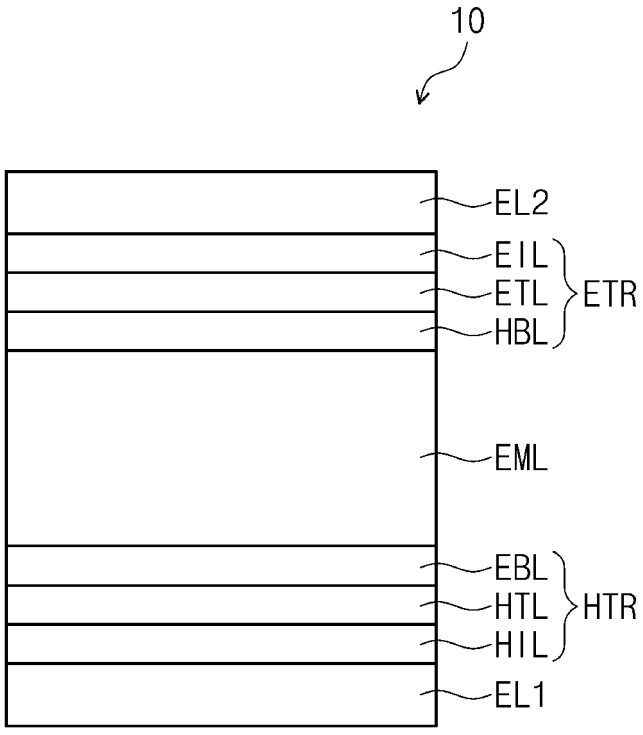


FIG. 3



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EUROPEAN SEARCH REPORT

Application Number
EP 19 15 3603

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	KR 2016 0054866 A (PNH TECH [KR]) 17 May 2016 (2016-05-17) * paragraph [0001] * * compounds 4, 9, 11-14, 17-20, 21, ..., 549, 550 * * examples 4, 9, 11-14, 17-20, 21, ... * * device examples 4, 9, 11-14, 17-20, 21, ... * * tables 1 and 2 * * claims 4,5 * -----	1-13	INV. H01L51/50 C09K11/06 B32B9/00 C07C211/54 C07D209/82 C07D333/76 C07D307/91 C07D407/12 C07D409/12
X	WO 2015/194791 A2 (DUK SAN NEOLUX CO LTD [KR]) 23 December 2015 (2015-12-23) * compounds P-12, P-14, P-18, P-40, P-42, P-81 * * examples II-12, II-14, II-18, II-40, II-42, II-81 * * claims 1, 6, 7 * -----	1-13	
X	KR 2015 0006374 A (LG CHEMICAL LTD [KR]) 16 January 2015 (2015-01-16) * compounds of formulae (1-a), (1-c), (1-d) and (1-f) * * compounds 1-a-4 to 1-a-7, 1-a-10 to 1-a-17 * * claim 9 * * compounds 1-c-4 to 1-c-7, 1-c-10 to 1-c-17 * * compounds 1-d-4 to 1-d-7, 1-d-10 to 1-d-17 * * compounds 1-f-4 to 1-f-7, 1-f-10 to 1-f-17 * ----- -/--	1-13	TECHNICAL FIELDS SEARCHED (IPC) C07D H01L C09K B32B C07C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	25 April 2019	Cortés Suárez, José

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EUROPEAN SEARCH REPORT

Application Number
EP 19 15 3603

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2011/031877 A1 (TAKADA ICHINORI [JP] ET AL) 10 February 2011 (2011-02-10) * page 27; example 2; compound (2)-1 * * page 30; example 4; compound (2)-18; comparative example 5; compound (5) * * claims 4, 5 *	1-13	
X	WO 2011/163610 A2 (UNIV RUTGERS [US]; UNIV NEW JERSEY MED [US] ET AL.) 29 December 2011 (2011-12-29) * examples 64, 66, 68, 77, 79, 81, 91, 92, 94, 96, 99 *	1-10	
A	US 2016/372665 A1 (TAKADA ICHINORI [JP]) 22 December 2016 (2016-12-22) * page 24; compounds 3, 17, 27 * * claim 5 *	1-13	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	25 April 2019	Cortés Suárez, José

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25-04-2019

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EPO FORM P0459

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

专利名称(译)	N-（4-（8-（苯基）萘-2-基）苯基）-n，n'-二（苯基）-胺衍生物和用于有机电致发光器件的相关化合物		
公开(公告)号	EP3518303A1	公开(公告)日	2019-07-31
申请号	EP2019153603	申请日	2019-01-24
[标]申请(专利权)人(译)	三星显示有限公司		
申请(专利权)人(译)	三星DISPLAY CO.，LTD.		
当前申请(专利权)人(译)	三星DISPLAY CO.，LTD.		
[标]发明人	MIYAKE HIDEO UENO MASATSUGU JIN XIULAN TAKADA ICHINORI UNO TAKUYA ITOI HIROAKI		
发明人	MIYAKE, HIDEO UENO, MASATSUGU JIN, XIULAN TAKADA, ICHINORI UNO, TAKUYA ITOI, HIROAKI		
IPC分类号	H01L51/50 C09K11/06 B32B9/00 C07C211/54 C07D209/82 C07D333/76 C07D307/91 C07D407/12 C07D409/12		
CPC分类号	C07C211/54 C07C211/57 C07C211/58 C07D213/38 C07D307/91 C07D333/76 C09K11/06 C09K2211/1007 C09K2211/1011 C09K2211/1029 C09K2211/1088 C09K2211/1092 H01L51/0052 H01L51/0056 H01L51/006 H01L51/0061 H01L51/0073 H01L51/0074 H01L51/5064 C07C211/56 C07C211/61 C07D209/82 C07D407/12 C07D409/12 H01L51/0072 H01L51/5056 H05B33/22 C07C211/60 C07C2602/26 C07C2603/16 C07C2603/26 C07C2603/74 C07C2603/97 H01L51/0058 H01L51/0067 H01L51/5012 H01L51/5072 H01L51/5096		
优先权	1020180009993 2018-01-26 KR 1020180146236 2018-11-23 KR		
外部链接	Espacenet		

摘要(译)

提供一种有机电致发光器件，包括第一电极，设置在第一电极上的空穴传输区域，设置在空穴传输区域上的发光层，设置在发光层上的电子传输区域，和设置在电子传输上的第二电极其中，空穴传输区域包括由式1表示的单胺化合物，例如， N-（4-（8-（苯基）萘-2-基）苯基）-N，N'-二（苯基）-胺衍生物或结构相关化合物，从而获得高发光效率。图。 1

FIG. 1