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(54) Title: NOVEL ORGANIC ELECTROLUMINESCENT COMPOUNDS AND ORGANIC ELECTROLUMINESCENT DEVICE COMPRISING THE SAME

(57) Abstract: The present invention relates to novel organic electroluminescent compounds and an organic electroluminescent device containing the same. The organic electroluminescent compounds according to the present invention can be used as a phosphorescent host material, a hole transport material, or a mixed host material; have a good hole transport ability; prevent crystallization in the production of the device; are suitable for forming a layer; and improve the current density of the device thereby reducing the driving voltage of the device.

WO 2013/151297 A1

Description

Title of Invention: NOVEL ORGANIC ELECTROLUMINESCENT COMPOUNDS AND ORGANIC ELECTROLUMINESCENT DEVICE COMPRISING THE SAME

Technical Field

[1] The present invention relates to novel organic electroluminescent compounds and organic electroluminescent device comprising the same.

Background Art

[2] An electroluminescent (EL) device is a self-light-emitting device with the advantage of providing a wider viewing angle, a greater contrast ratio, and a faster response time. An organic EL device was first developed by Eastman Kodak, by using small aromatic diamine molecules, and aluminum complexes as a material for forming a light-emitting layer [Appl. Phys. Lett. 51, 913, 1987].

[3] The most important factor determining luminous efficiency in an organic EL device is the light-emitting material. Until now, fluorescent materials have been widely used as light-emitting materials. However, in view of electroluminescent mechanisms, developing phosphorescent materials is one of the best methods to theoretically enhance luminous efficiency by four (4) times compared to fluorescent materials. Iridium(III) complexes have been widely known as phosphorescent materials, including bis(2-(2'-benzothienyl)-pyridinato-N,C3')iridium(acetylacetonate) ((acac)Ir(btp)$_2$), tris(2-phenylpyridine)iridium (Ir(ppy)$_3$) and bis(4,6-difluorophenylpyridinato-N,C2)picolinate iridium (Firpic) as red, green and blue materials, respectively.

[4] The light-emitting material may be used in the combination of a host material with a light-emitting material (dopant) to improve color purity, luminous efficiency, and stability. In a system of a light-emitting material (dopant)/host material, the selection of a host material is important, because the host material greatly influences the efficiency and capacity of a light-emitting device. Until now, 4,4'-N,N'-dicarbazol-biphenyl (CBP) is the most widely known phosphorescent host material. Further, Pioneer (Japan) et al., developed a high performance organic EL device by employing bathocuproine (BCP) and aluminum(III)bis(2-methyl-8-quinolinate)(4-phenylphenolate) (BAlq), which were used in a hole blocking layer, as host materials.

[5] Though these phosphorescent host materials provide good light-emitting characteristics, they have the following disadvantages: (1) Due to their low glass transition temperatures and poor thermal stability, their degradation may occur during a high-

temperature deposition process in a vacuum. (2) The power efficiency of an organic EL device is given by [(π/voltage) x current efficiency], and the power efficiency is inversely proportional to voltage. An organic EL device comprising phosphorescent host materials provides higher current efficiency (cd/A) and has a higher driving voltage than one comprising fluorescent host materials. Thus, the EL device using conventional phosphorescent materials has no advantage in terms of power efficiency (lm/W). (3) Further, the operating lifespan and luminous efficiency of the organic EL device are not satisfactory.

[6] Meanwhile, copper phthalocyanine (CuPc), 4,4'-bis[N-(l-naphthyl)-N-phenylamino]biphenyl (NPB), N,N'-diphenyl-N,N'-bis(3-methylphenyl)-(l,l'-biphenyl)-4,4'-diamine (TPD), 4,4',4"-tris(3-methylphenylphenylamino)triphenylamine (MTDATA), etc., have been used as hole injection and transport materials in the organic EL device. However, the organic EL device comprising the materials has low quantum efficiency and a short operating lifespan, because, when the organic EL device is driven at a high current, thermal stress is generated between an anode and a hole injection layer, thereby rapidly reducing the operating lifespan of the device. Further, holes greatly move in organic materials used in a hole injection layer, and thus the hole-electron charge balance is broken and quantum efficiency (cd/A) is reduced.

[7] International Publication No. WO 2009/148015 discloses compounds for an organic EL device, wherein a heteroaryl group including carbazole, dibenzofuran, and dibenzothiophene is directly bonded to the carbon atom in backbones of polycyclic compounds which are formed by fusing fluorene, carbazole, dibenzofuran, and dibenzothiophene with a heteroaryl group including indene, indole, benzofuran, and benzothiophene.

[8] Further, U. S. Patent Application Laying-Open No. US 201 1/0279020 A1 discloses compounds for an organic EL device, wherein two carbazoles are bonded to each other via a single bond between carbon atoms.

[9] However, organic EL devices comprising the compounds of the publications are not satisfactory in power efficiency, luminous efficiency, quantum efficiency, and operating lifespan.

Disclosure of Invention

Technical Problem

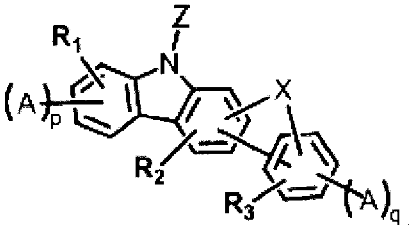
[10] The objective of the present invention is to provide an organic electroluminescent compound having high luminous efficiency, a long operating lifespan, and having proper color coordination; and an organic electroluminescent device having high efficiency and a long lifespan, comprising the organic electroluminescent compound in a

light-emitting layer or a hole transport layer.

Solution to Problem

[11] The present inventors found that the above objective can be achieved by a compound represented by the following formula 1:

[12]

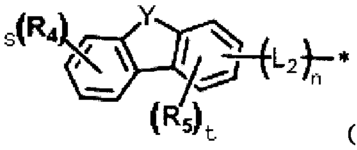


(1)

[13] wherein

[14] A is represented by the following formula 2:

[15]



(2);

[16] formula 2 is bonded to the compound of formula 1 via *;

[17] Z is represented by the following formula 3:

[18] $*-(L_1)_m-Ari$ (3);

[19] formula 3 is bonded to the compound of formula 1 via *;

[20] L_1 and L_2 each independently represent a single bond, a substituted or unsubstituted 5- to 30-membered heteroarylene group, or a substituted or unsubstituted (C6-C30)arylene group;

[21] X and Y each independently represent -0-, -S-, $-N(R_6)-$, $-C(R_7)(R_8)-$, or $-Si(R_9)(R_{10})-$;

[22] Ar_1 and Ri to R_5 each independently represent hydrogen, deuterium, a halogen, a substituted or unsubstituted (Cl-C30)alkyl group, a substituted or unsubstituted (C6-C30)aryl group, a substituted or unsubstituted 5- to 30-membered heteroaryl group, $-NR_{11}R_{12}$, or $-SiRi_3R_{14}R_{15}$; or are linked to an adjacent substituent(s) to form a mono- or polycyclic, 3- to 30-membered alicyclic or aromatic ring whose carbon atom(s) may be replaced with at least one hetero atom selected from nitrogen, oxygen and sulfur, proviso that when q is 1, Ri is not the group of formula 2, and when p is 1, R_3 is not the group of formula 2;

[23] R_6 to R_{15} each independently represent hydrogen, deuterium, a halogen, a substituted or unsubstituted (Cl-C30)alkyl group, a substituted or unsubstituted (C6-C30)aryl group, a substituted or unsubstituted 5- to 30-membered heteroaryl group; or are linked to an adjacent substituent(s) to form a mono- or polycyclic, 3- to 30-membered alicyclic or aromatic ring

[24] m and n each independently represent an integer of 0 to 2; where m is 2, each of L_1 is

the same or different, and n is 2, each of L_2 is the same or different;

[25] p and q each independently represent an integer of 0 or 1; where p+q = 1;

[26] s and t each independently represent an integer of 1 or 2; where s is 2, each of R_4 is the same or different, and t is 2, each of R_5 is the same or different; and

[27] the heteroaryl(ene) group contains at least one hetero atom selected from B, N, O, S, P(=0), Si and P.

Advantageous Effects of Invention

[28] The organic electroluminescent compounds according to the present invention have advantages in that they have high luminous efficiency and a long operating lifespan, and thus can produce an organic electroluminescent device having a long driving lifespan. Further, the organic electroluminescent compounds according to the present can be used as a phosphorescent host material, a hole transport material, or mixed host materials; have the superior ability of hole transport; prevent crystallization in the production of the device; are suitable for forming a layer; and improve the current density of the device thereby reducing driving voltage of the device.

Mode for the Invention

[29] Hereinafter, the present invention will be described in detail. However, the following description is intended to explain the invention, and is not meant in any way to restrict the scope of the invention.

[30] The present invention relates to an organic electroluminescent compound represented by formula 1 above, an organic electroluminescent material comprising the organic electroluminescent compound, and an organic electroluminescent device comprising the material.

[31] Herein, "(Cl-C30)alkyl(ene)" is meant to be a linear or branched alkyl(ene) having 1 to 30 carbon atoms, in which the number of carbon atoms is preferably 1 to 20, more preferably 1 to 10, and includes methyl, ethyl, n-propyl, isopropyl, n-butyl, isobutyl, tert-butyl, etc. "(C2-C30) alkenyl" is meant to be a linear or branched alkenyl having 2 to 30 carbon atoms, in which the number of carbon atoms is preferably 2 to 20, more preferably 2 to 10, and includes vinyl, 1-propenyl, 2-propenyl, 1-butenyl, 2-butenyl, 3-butenyl, 2-methylbut-2-enyl, etc. "(C2-C30)alkynyl" is a linear or branched alkynyl having 2 to 30 carbon atoms, in which the number of carbon atoms is preferably 2 to 20, more preferably 2 to 10, and includes ethynyl, 1-propynyl, 2-propynyl, 1-butynyl, 2-butynyl, 3-butynyl, l-methylpent-2-ynyl, etc. "(C3-C30)cycloalkyl" is a mono- or polycyclic hydrocarbon having 3 to 30 carbon atoms, in which the number of carbon atoms is preferably 3 to 20, more preferably 3 to 7, and includes cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, etc. "3- to 7-membered heterocycloalkyl" is a cycloalkyl having at least one heteroatom selected from B, N, O, S, P(=0), Si and P,

preferably O, S and N, and 3 to 7, preferably 5 to 7 ring backbone atoms, and includes tetrahydrofurane, pyrrolidine, thiolan, tetrahydropyran, etc. "(C6-C30)aryl(ene)" is a monocyclic or fused ring derived from an aromatic hydrocarbon having 6 to 30 carbon atoms, in which the number of carbon atoms is preferably 6 to 20, more preferably 6 to 15, and includes phenyl, biphenyl, terphenyl, naphthyl, fluorenyl, phenanthrenyl, anthracenyl, indenyl, triphenylenyl, pyrenyl, tetracenyl, perylenyl, chrysenyl, naphthacenyl, fluoranthenyl, etc. "5- to 30-membered heteroaryl(ene)" is an aryl group having at least one, preferably 1 to 4 heteroatom selected from the group consisting of B, N, O, S, P(=0), Si and P, and 5 to 30 ring backbone atoms; is a monocyclic ring, or a fused ring condensed with at least one benzene ring; has preferably 5 to 20, more preferably 5 to 15 ring backbone atoms; may be partially saturated; may be one formed by linking at least one heteroaryl or aryl group to a heteroaryl group via a single bond(s); and includes a monocyclic ring-type heteroaryl including furyl, thiophenyl, pyrrolyl, imidazolyl, pyrazolyl, thiazolyl, thiadiazolyl, isothiazolyl, isoxazolyl, oxazolyl, oxadiazolyl, triazinyl, tetrazinyl, triazolyl, tetrazolyl, furazanyl, pyridyl, pyrazinyl, pyrimidinyl, pyridazinyl, etc., and a fused ring-type heteroaryl including benzofuranyl, benzothiophenyl, isobenzofuranyl, dibenzofuranyl, dibenzothiophenyl, benzoimidazolyl, benzothiazolyl, benzoisothiazolyl, benzoisoxazolyl, benzoxazolyl, isoindolyl, indolyl, indazolyl, benzothiadiazolyl, quinolyl, isoquinolyl, cinnolinyl, quinazolinyl, quinoxalinyl, carbazolyl, phenoxazinyl, phenanthridinyl, benzodioxolyl, etc. Further, "halogen" includes F, CI, Br and I.

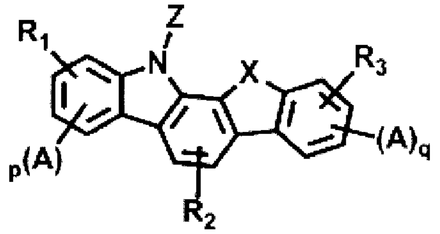
[32] Herein, "substituted" in the expression "substituted or unsubstituted" means that a hydrogen atom in a certain functional group is replaced with another atom or group, i.e., a substituent.

[33] Substituents of the substituted alkyl group, the substituted aryl(ene) group, and the substituted heteroaryl(ene) group in L_1, L_2, Ar_1, and Ri to R_{15} groups of formulae 1 to 3, each independently are at least one selected from the group consisting of deuterium; a halogen; a cyano group; a carboxyl group; a nitro group; a hydroxyl group; a (Cl-C30)alkyl group; a halo(Cl-C30)alkyl group; a (C6-C30)aryl group; a 5- to 30-membered heteroaryl group; a 5- to 30-membered heteroaryl group substituted with a (C6-C30)aryl; a (C6-C30)aryl group substituted with a 5- to 30-membered heteroaryl; a (C3-C30)cycloalkyl group; a 3- to 7-membered heterocycloalkyl group; a tri(Cl-C30)alkylsilyl group; a tri(C6-C30)arylsilyl group; a di(Cl-C30)alkyl(C6-C30)arylsilyl group; a (Cl-C30)alkyldi(C6-C30)arylsilyl group; a (C2-C30)alkenyl group; a (C2-C30)alkynyl group; a mono- or di(Cl-C30)alkylamino group; a mono- or di(C6-C30)arylamino group; a (Cl-C30)alkyl(C6-C30)arylamino group; a di(C6-C30)arylboronyl group; a di(Cl-C30)alkylboronyl group; a (Cl-C30)alkyl(C6-C30)arylboronyl group; a (C6-C30)aryl(Cl-C30)alkyl group; and a

(Cl-C30)alkyl(C6-C30)aryl group.

[34] The compound of formula 1 according to the present invention is selected from the group consisting of the following formulae 4 to 9:

[35]



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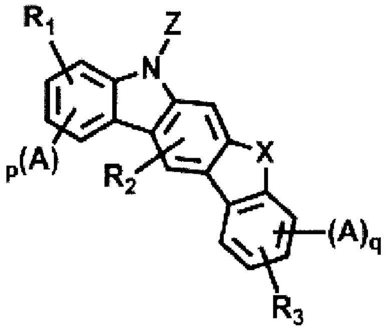

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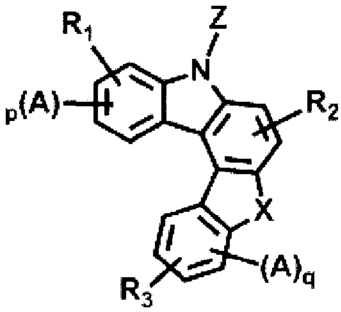
[36]



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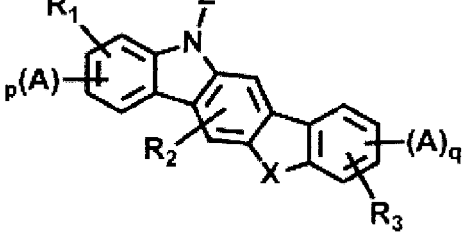

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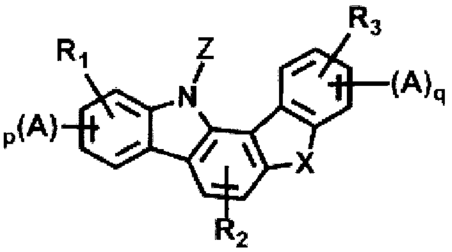
[37]



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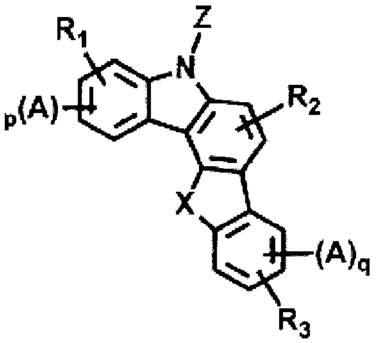


(9)

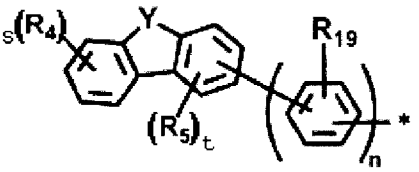
[38] wherein

[39] A, Z, X, R_1 to R_3, p, and q are as defined in formula 1.

[40] The substituents in the above formulae are specifically defined in the below.

[41] A is preferably represented by the following formula 10:

[42]



(10)

[43] wherein

[44] formula 10 is bonded to the compounds of formulae 1 and 4 to 9 via *;

[45] Y, R_4, R_5, n, s and t are as defined in claim 1;

[46] R_{19} each independently represents hydrogen, deuterium, a halogen, a substituted or unsubstituted (Cl-C30)alkyl group, a substituted or unsubstituted (C6-C30)aryl group, or a substituted or unsubstituted 5- to 30-membered heteroaryl group, preferably hydrogen or an unsubstituted (Cl-C30)alkyl group; or are linked to an adjacent substituent(s) to form a mono- or polycyclic, 3- to 30-membered alicyclic or aromatic ring whose carbon atom(s) may be replaced with at least one hetero atom selected from nitrogen, oxygen and sulfur; and

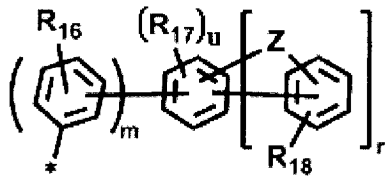
[47] the heteroaryl group contains at least one hetero atom selected from B, N, O, S, P(=0), Si and P.

[48] X preferably represents -0-, -S-, or -C(R_7)(R_8)-.

[49] Y preferably represents -0-, -S-, or -N(R_6)-; more preferably, -N(R_6)-.

[50] Z preferably represents formula 3, wherein Ar_1 represents a substituted or unsubstituted (Cl-C30)alkyl group, a substituted or unsubstituted (C6-C30)aryl group, a substituted or unsubstituted 5- to 30-membered heteroaryl group, -NRnRi$_2$, or -S1$R_{13}R_{14}R_{15}$. More preferably, Z represents formula 3, wherein L_1 represents a single bond, or a substituted or unsubstituted (C6-C30)arylene group, and Ari represents an unsubstituted (Cl-ClO)alkyl group, a (C6-C20)aryl group unsubstituted or substituted with a (Cl-ClO)alkyl, a 5- to 20-membered heteroaryl group unsubstituted or substituted with a (Cl-ClO)alkyl, or -NRnRi$_2$.

[51] More preferably, Z represents the following formula 11:

[52] 

(11)

[53] wherein

[54] formula 11 is bonded to the compounds of formulae 1 and 4 to 9 via *;

[55] Z represents -0-, -S-, -N(R_{20})-, -C(R_{21})(R_{22})-, or -Si(R_{23})(R_{24})-;

[56] R_{16} to R_{18} each independently represent hydrogen, deuterium, a halogen, a substituted or unsubstituted (Cl-C30)alkyl group, a substituted or unsubstituted (C6-C30)aryl group, a substituted or unsubstituted 5- to 30-membered heteroaryl group, -$NR_{25}R_{26}$, or -Si$R_{27}R_{28}R_{29}$; preferably hydrogen or an unsubstituted (Cl-C30)alkyl group; or are linked to an adjacent substituent(s) to form a mono- or polycyclic, 3- to 30-membered alicyclic or aromatic ring whose carbon atom(s) may be replaced with at least one hetero atom selected from nitrogen, oxygen and sulfur;

[57] R_{20} to R_{29} each independently represent hydrogen, deuterium, a halogen, a substituted or unsubstituted (Cl-C30)alkyl group, a substituted or unsubstituted (C6-C30)aryl group, or a substituted or unsubstituted 5- to 30-membered heteroaryl group;

preferably hydrogen, an unsubstituted (Cl-C30)alkyl group, or an unsubstituted (C6-C30)aryl group; or are linked to an adjacent substituent(s) to form a mono- or polycyclic, 3- to 30-membered alicyclic or aromatic ring;

[58] m represents an integer of 0 to 2, preferably 0 or 1;

[59] r represents an integer of 0 or 1, preferably 0;

[60] u represents an integer of 1 to 3; where u is 2 or more, each of R_{17} is the same or different; and

[61] the heteroaryl group contains at least one hetero atom selected from B, N, O, S, P(=0), Si and P.

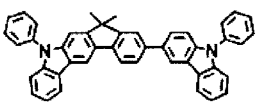
[62] Preferably, R_i to R_5 each independently represent hydrogen, deuterium, a halogen, a substituted or unsubstituted (Cl-C30)alkyl group, a substituted or unsubstituted (C6-C30)aryl group, a substituted or unsubstituted 5- to 30-membered heteroaryl group, $-NR_{11}R_{12}$, or $-SiRi_{3}R_{14}R_{15}$; or are linked to an adjacent substituent(s) to form a monocyclic, 3- to 30-membered aromatic hydrocarbon ring. More preferably, R_1 to R_5 each independently represent hydrogen; an unsubstituted (Cl-ClO)alkyl group; a (C6-C20)aryl group unsubstituted or substituted with a (Cl-ClO)alky or (C6-C20)aryl group; a 5- to 20-membered heteroaryl group unsubstituted or substituted with a (Cl-ClO)alky or (C6-C20)aryl group; or $-NRnRi_{2}$; or are linked to an adjacent substituent(s) to form a monocyclic, 3- to 30-membered aromatic hydrocarbon ring. Still more preferably, R_1 to R_5 each independently represent hydrogen.

[63] Preferably, R_6 to R_{10} each independently represent a substituted or unsubstituted (Cl-C30)alkyl group, a substituted or unsubstituted (C6-C30)aryl group, or a substituted or unsubstituted 5- to 30-membered heteroaryl group.

[64] Preferably, R_{11} to R_{15} each independently represent hydrogen; an unsubstituted (Cl-C30)alkyl group; or a (C6-C30)aryl group unsubstituted or substituted with a (Cl-C30)alkyl or a (C6-C30)aryl.

[65] The organic electroluminescent compounds of the present invention include the following compounds:

[66]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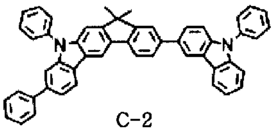
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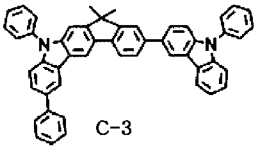
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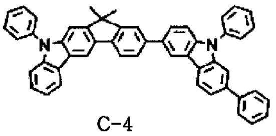
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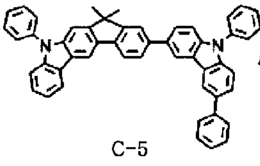
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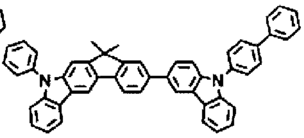
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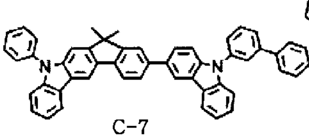
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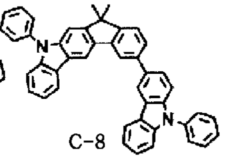
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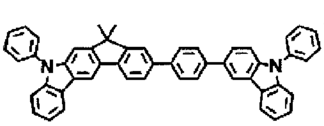

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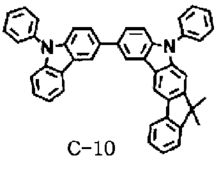

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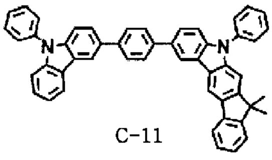

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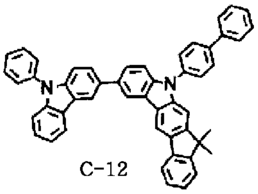

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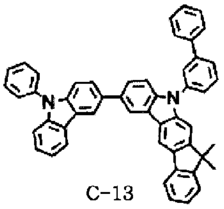

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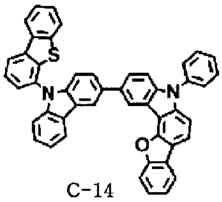

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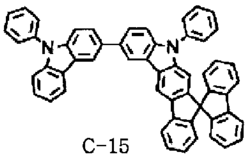

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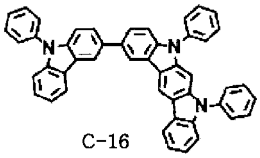

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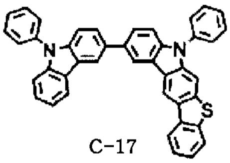

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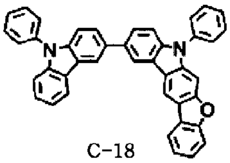

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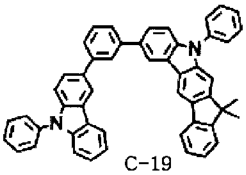

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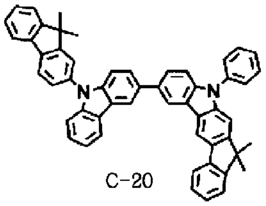

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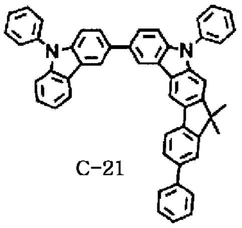

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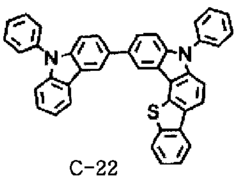

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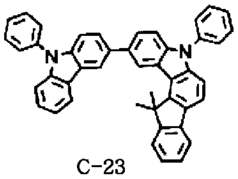

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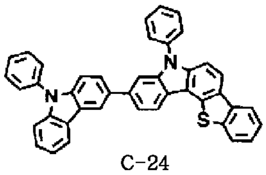

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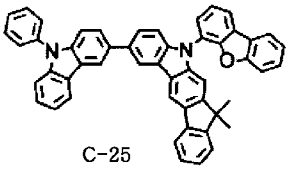

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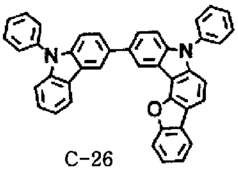

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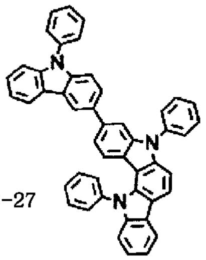

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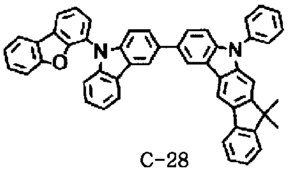

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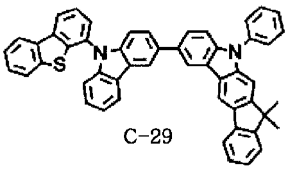

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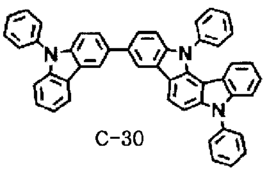

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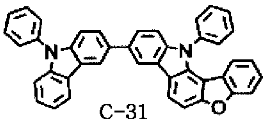

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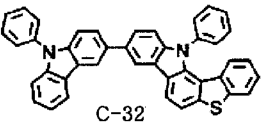

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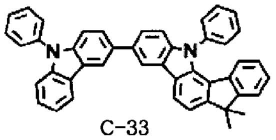

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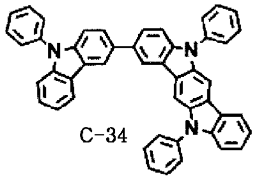

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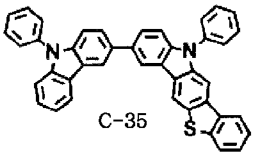

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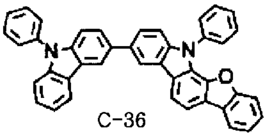

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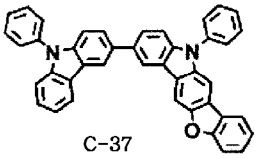
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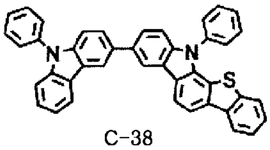
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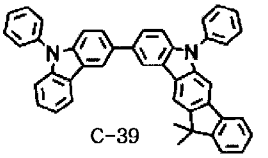
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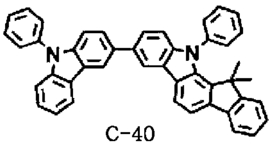
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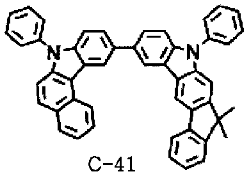
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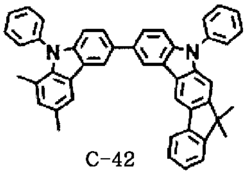
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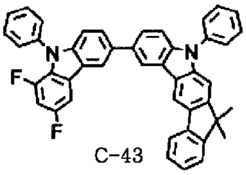
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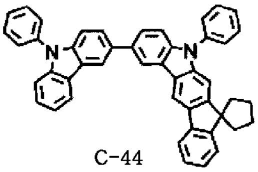
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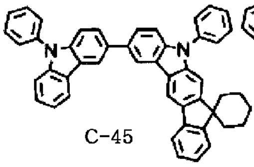
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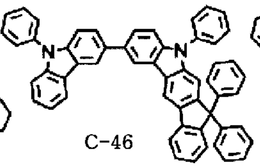
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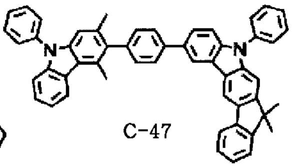
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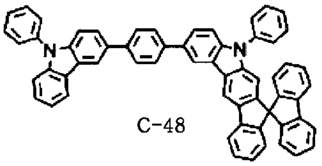
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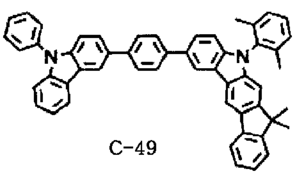
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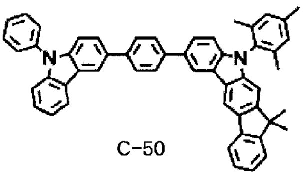
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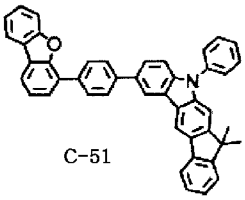
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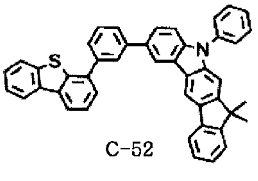
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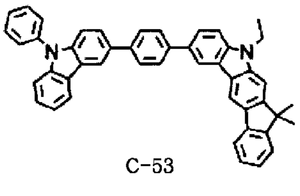
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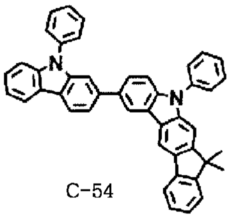
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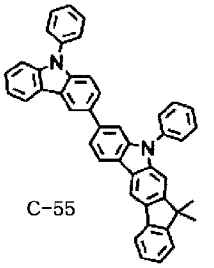
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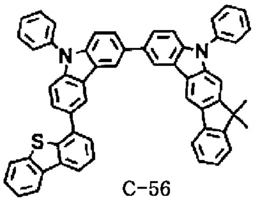
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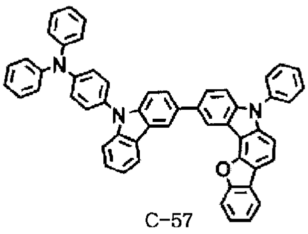
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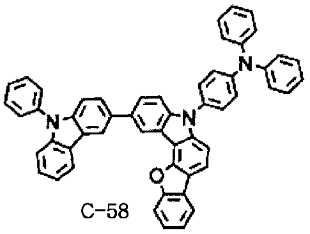
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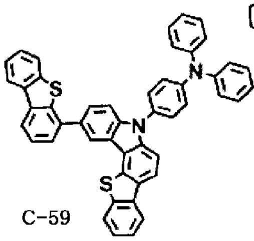
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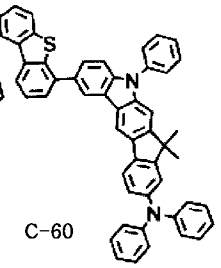
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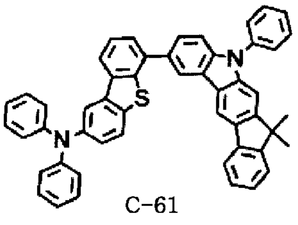
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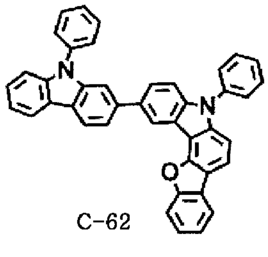
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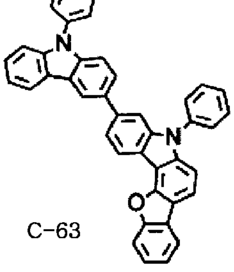
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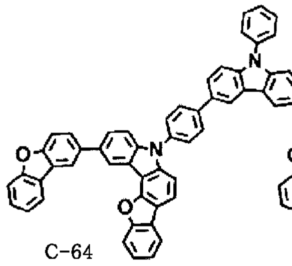
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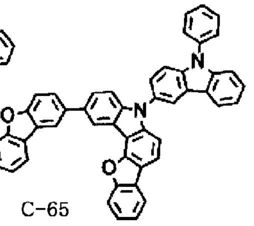
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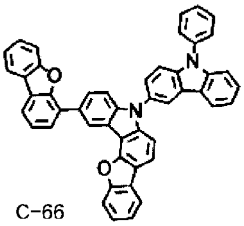
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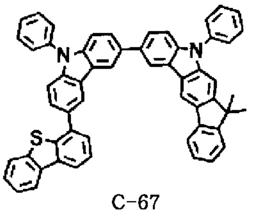
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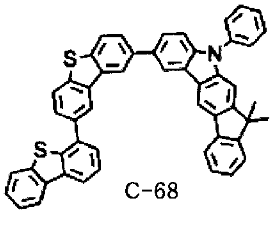
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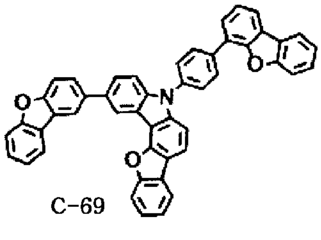
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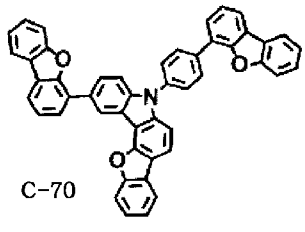
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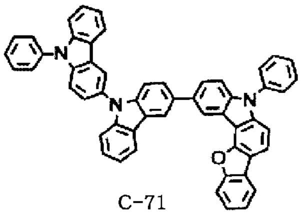
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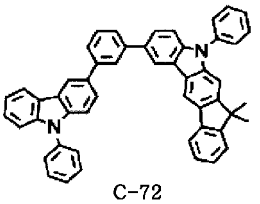
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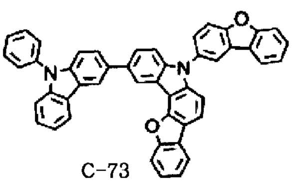
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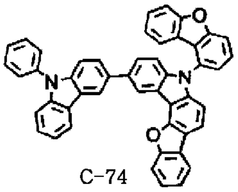
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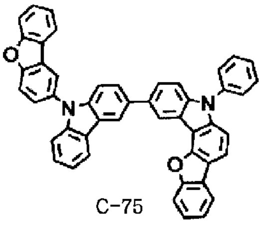
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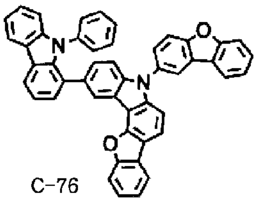
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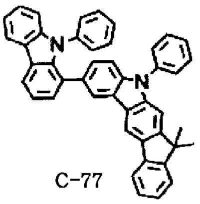
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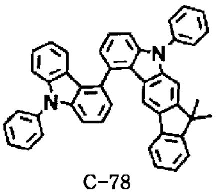
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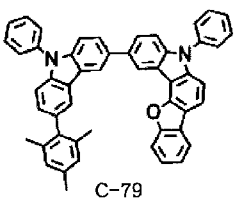
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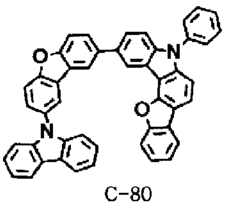
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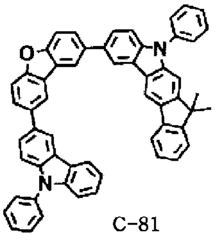
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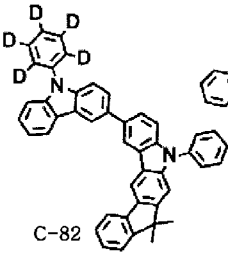
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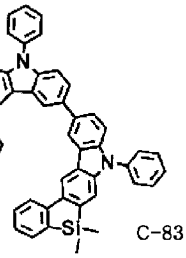
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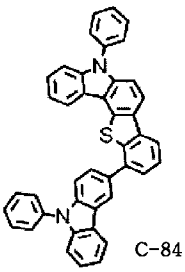
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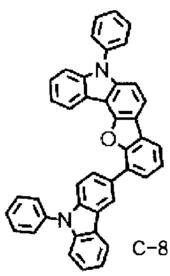
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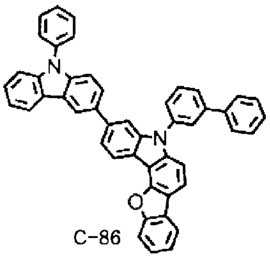
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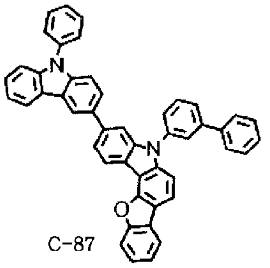
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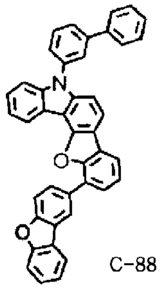
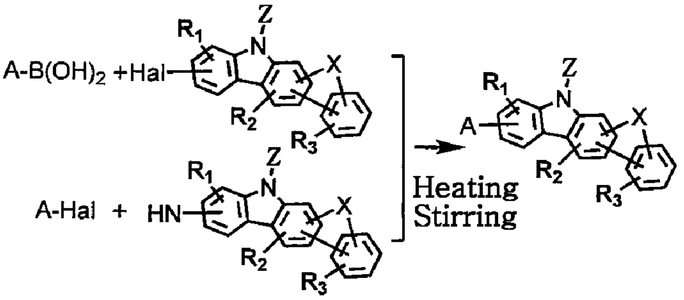

C-88

[88] The organic electroluminescent compounds according to the present invention can be

prepared according to the methods known in the art, for example, following reaction schemes 1 and 2.

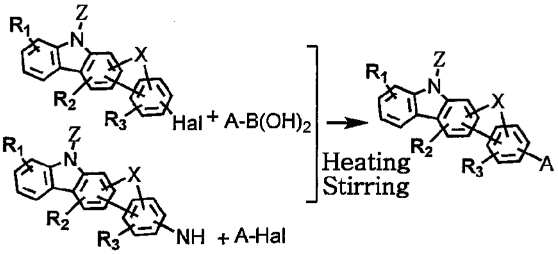
[89] [Reaction Scheme 1]

[90]



[91] [Reaction Scheme 2]

[92]



[93] wherein A, Z, X, and R_1 to R_3 are as defined in formula 1 above, and Hal represents a halogen.

[94] The present invention further provides an organic electroluminescent material comprising the organic electroluminescent compound of formula 1, and an organic electroluminescent device comprising the material. The material can be comprised of the organic electroluminescent compound according to the present invention alone, or can further include conventional materials generally used in organic electroluminescent materials. The organic electroluminescent device may comprise a first electrode, a second electrode, and at least one organic layer between the first and second electrodes, wherein the organic layer comprises at least one compound of formula 1 according to the present invention.

[95] One of the first electrodes and the second electrodes can be an anode and the other can be a cathode. The organic layer further comprises a light-emitting layer, and at least one layer selected from the group consisting of a hole injection layer, a hole transport layer, an electron transport layer, an electron injection layer, an interlayer, and a hole blocking layer.

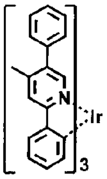
[96] The organic electroluminescent compound of formula 1 of the present invention can be included in at least one of the light-emitting layers and hole transport layers. When used in the hole transport layer, the organic electroluminescent compounds of formula 1 of the present invention can be included as a hole transport material. When used in the light-emitting layer, the organic electroluminescent compounds of formula 1 of the

present invention can be included as a host material. Preferably, the light-emitting layer may comprise at least one dopant. If necessary, other compounds in addition to the organic electroluminescent compound of formula 1 of the present invention may be further included as a second host material.

[97] The dopants are preferably one or more phosphorescent dopants. The phosphorescent dopant material applied to the organic electroluminescent device of the present invention is not specifically limited, but preferably may be selected from complex compounds of iridium (Ir), osmium (Os), copper (Cu), and platinum (Pt), more preferably ortho metallated complex compounds of iridium (Ir), osmium (Os), copper (Cu), and platinum (Pt), and even more preferably ortho metallated iridium complex compounds.

[98] The phosphorescent dopants specifically include the following:

[99]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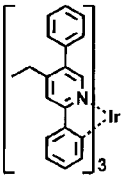
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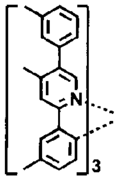
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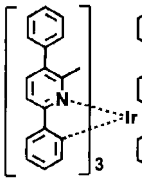
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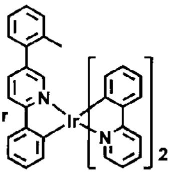
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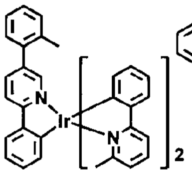
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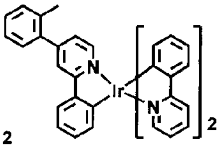
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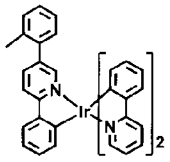
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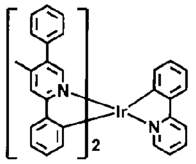
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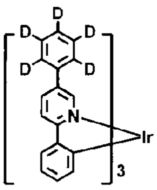
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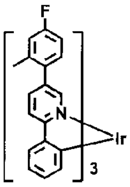
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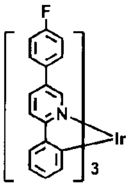
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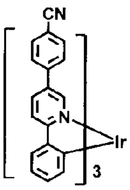
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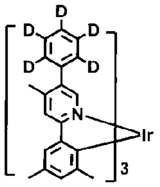
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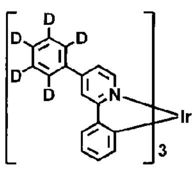
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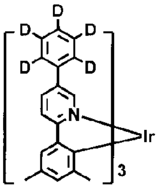
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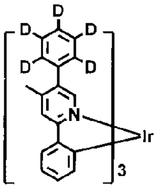
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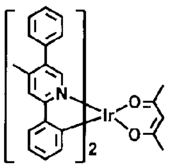
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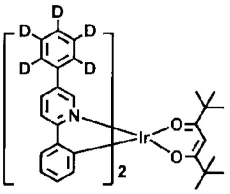
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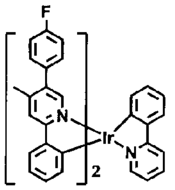
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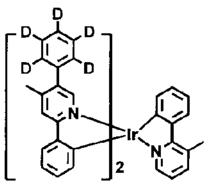
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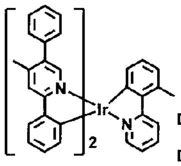
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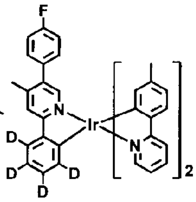
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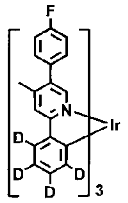
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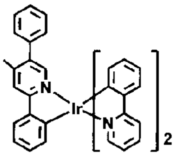
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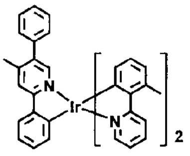
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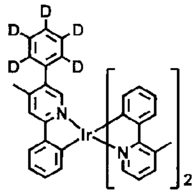
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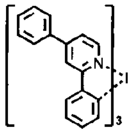
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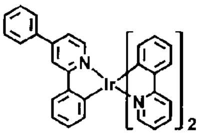
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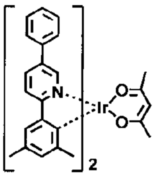
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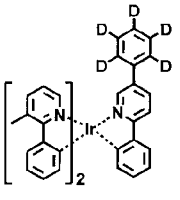
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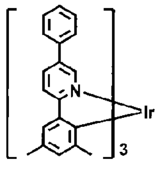
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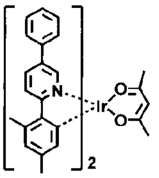
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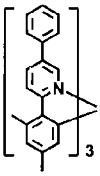
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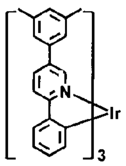
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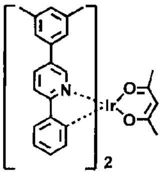
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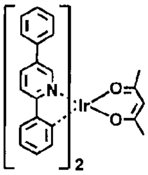
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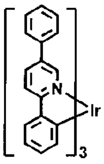
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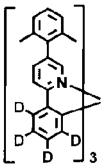
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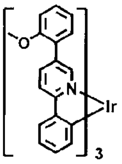
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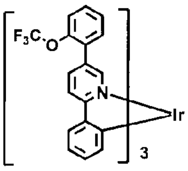
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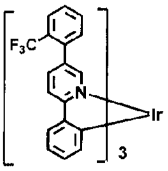
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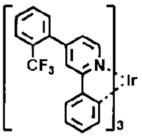
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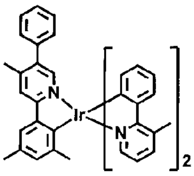
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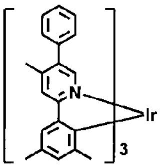
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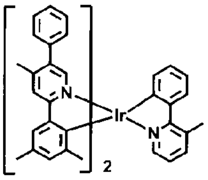
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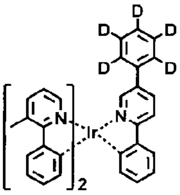
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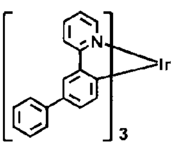
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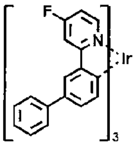
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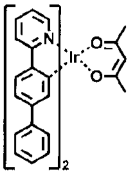
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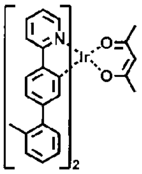
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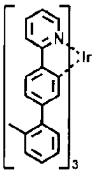
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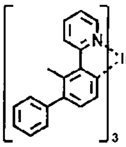
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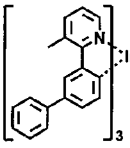
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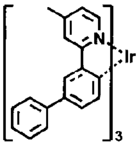
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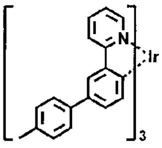
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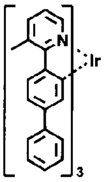
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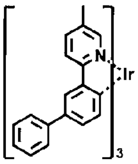
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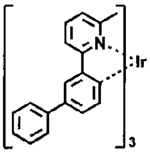
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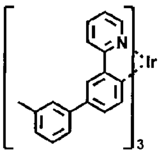
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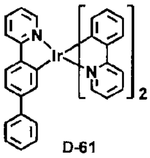
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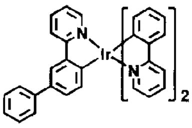
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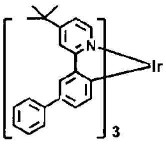
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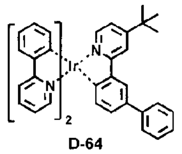
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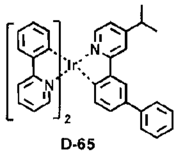
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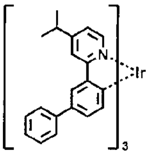
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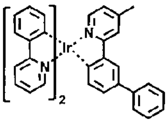
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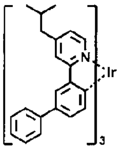
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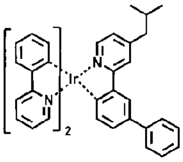
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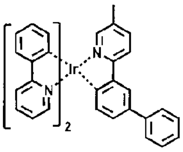
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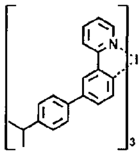
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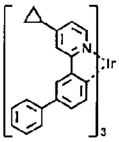
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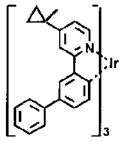

D-73

[110] The present invention further provides the material for the organic electroluminescent device. The material comprises a first host material and a second host material; and the first host material may comprise the organic electroluminescent compounds of the present invention. The first host material and the second host material may be in the range of 1:99 to 99:1 in a weight ratio.

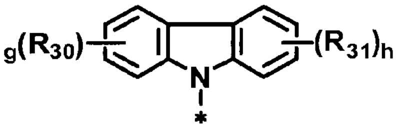
[111] The second host material can be any of the known phosphorescent hosts, preferably phosphorescent hosts selected from the following formulae 12 and 13:

[112] $(Cz-L_3)_e-M$ (12)

[113] $(Cz)_f-L_3-M$ (i 3)

[114] wherein

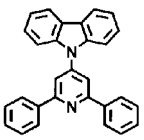
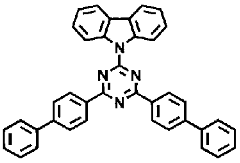
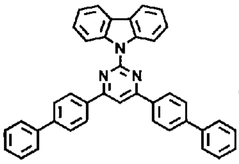
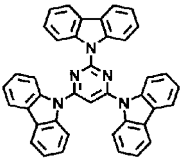
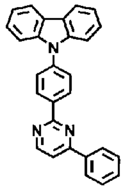
[115] Cz represents the following structure:

[116] 
;

[117] R_{30} and R_{31} each independently represent hydrogen, deuterium, a halogen, a substituted or unsubstituted (Cl-C30)alkyl group, a substituted or unsubstituted (C6-C30)aryl group, a substituted or unsubstituted 5- or 30-membered heteroaryl group, or $R_{32}R_{33}R_{34}S1$-; R_{32} to R_{34} each independently represent a substituted or unsubstituted (Cl-C30)alkyl group, or a substituted or unsubstituted (C6-C30)aryl group; each of R_{30} or each of R_{31} are the same or different; L_3 represents a chemical bond, a substituted or unsubstituted (C6-C30)arylene group, or a substituted or unsubstituted 5- or 30-membered heteroarylene group; M represents a substituted or unsubstituted (C6-C30)aryl group, or a substituted or unsubstituted 5- or 30-membered heteroaryl group; e to h each independently represent an integer of 0 to 4.

[118] Specifically, the second host material includes the following (TPS means a triphenylsilane group):

[119]

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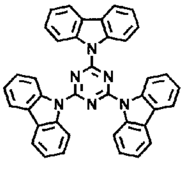
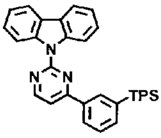
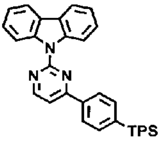
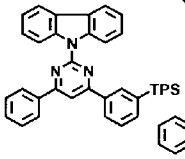
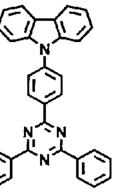
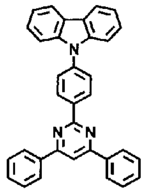

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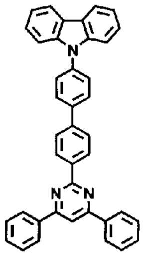
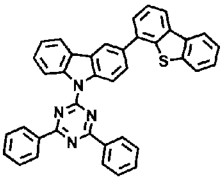
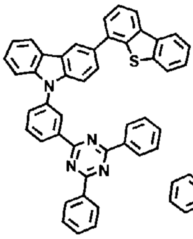
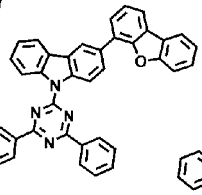
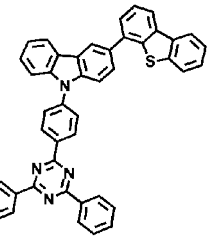

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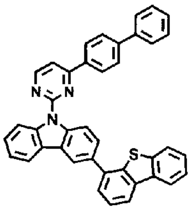
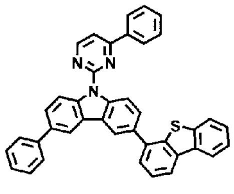
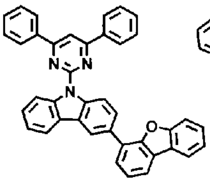
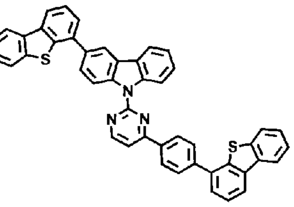

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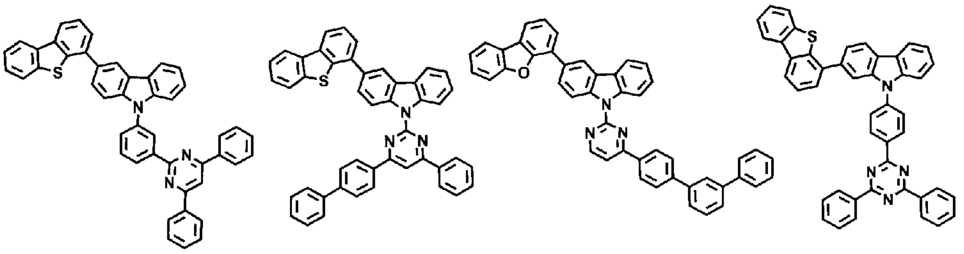

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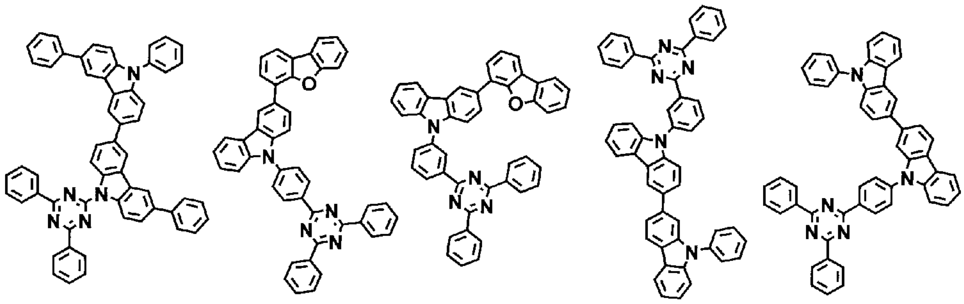

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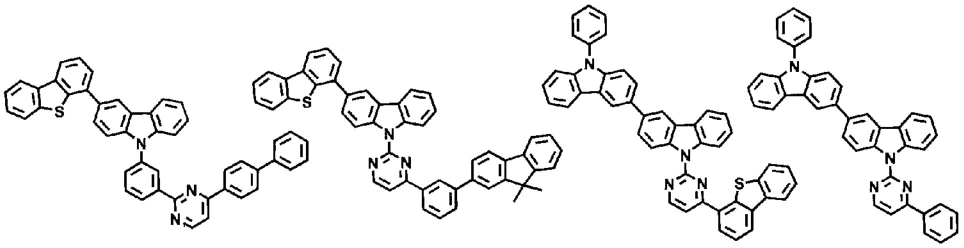

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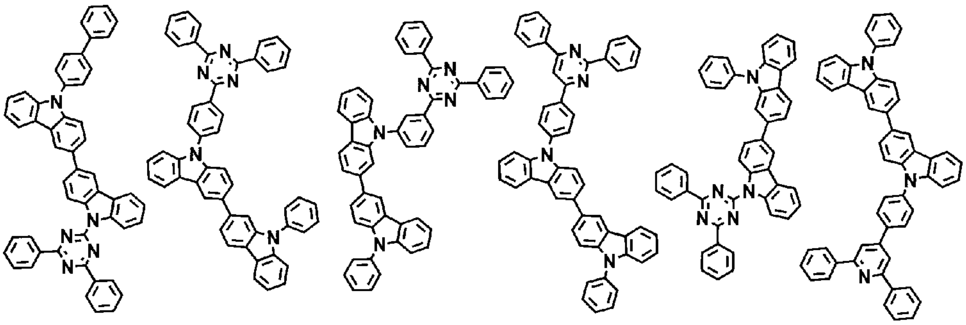

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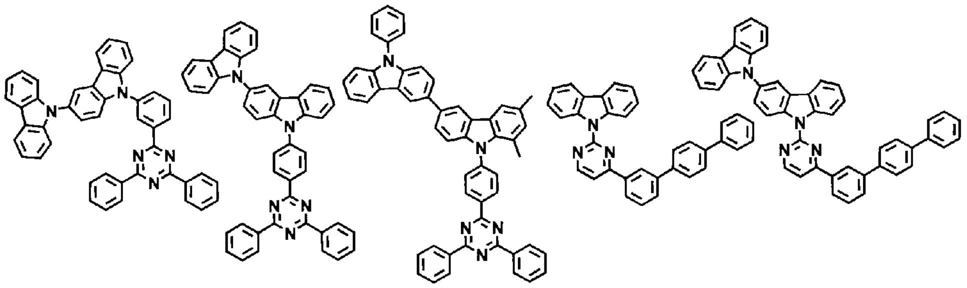

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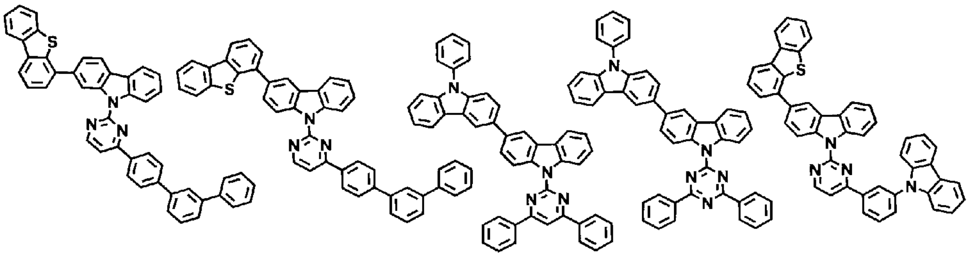

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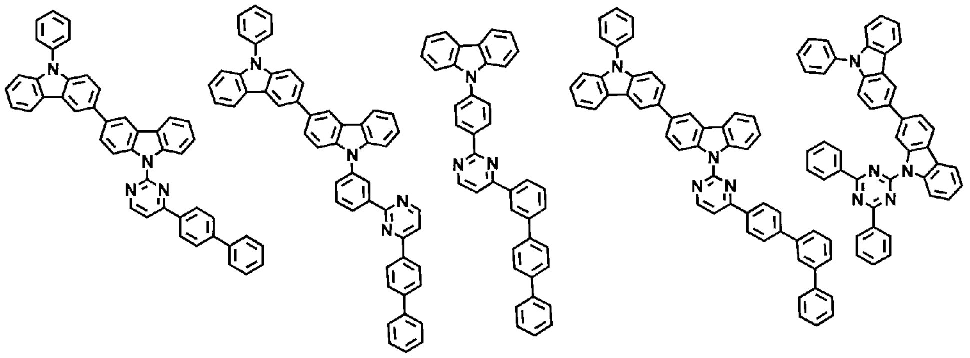

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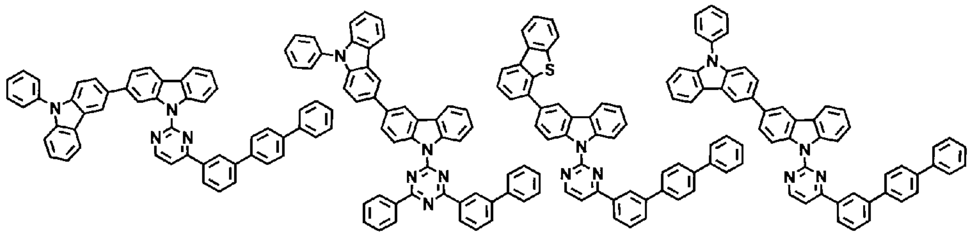

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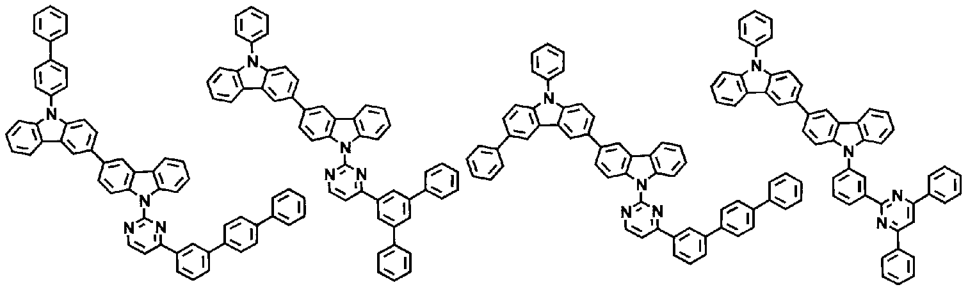

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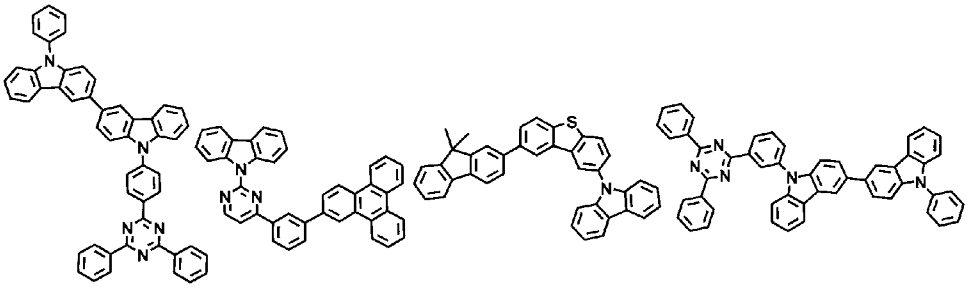


[133] The organic electroluminescent device of the present invention may comprise a first electrode, a second electrode, and at least one organic layer between the first and second electrodes, wherein the organic layer comprises a light-emitting layer, the light-emitting layer comprises the organic electroluminescent material of the present invention and phosphorescent dopants, and the organic electroluminescent material is

preferably used as a host material in the light-emitting layer.

[134] The organic electroluminescent device according to the present invention may further comprise, in addition to the organic electroluminescent compounds represented by formula 1, at least one compound selected from the group consisting of arylamine-based compounds and styrylarylamine-based compounds in the organic layer.

[135] In the organic electroluminescent device according to the present invention, the organic layer may further comprise, in addition to the organic electroluminescent compounds represented by formula 1, at least one metal selected from the group consisting of metals of Group 1, metals of Group 2, transition metals of the 4th period, transition metals of the 5th period, lanthanides, and organic metals of d-transition elements of the Periodic Table, or at least one complex compound comprising the metal.

[136] In addition, the organic electroluminescent device of the present invention may emit white light by further comprising at least one light-emitting layer which comprises a blue electroluminescent compound, a red electroluminescent compound, or a green electroluminescent compound, besides the organic electroluminescent compound according to the present invention; and may further include a yellow or orange light-emitting layer, if necessary.

[137] Preferably, in the organic electroluminescent device according to the present invention, at least one layer (hereinafter, "a surface layer") selected from a chalcogenide layer, a metal halide layer and a metal oxide layer may be placed on an inner surface(s) of one or both electrode(s). Specifically, it is preferred that a chalcogenide(includes oxides) layer of silicon or aluminum is placed on an anode surface of an electroluminescent medium layer, and a metal halide layer or metal oxide layer is placed on a cathode surface of an electroluminescent medium layer. The surface layer provides operating stability for the organic electroluminescent device. Preferably, the chalcogenide includes SiO_x ($1 \leq X<2$), $A10_X$($1 \leq X<1.5$), SiON, SiAlON, etc.; the metal halide includes LiF, MgF_2, CaF_2, a rare earth metal fluoride, etc.; and the metal oxide includes Cs_20 , Li_20 , MgO, SrO, BaO, CaO, etc.

[138] Preferably, in the organic electroluminescent device according to the present invention, a mixed region of an electron transport compound and an reductive dopant, or a mixed region of a hole transport compound and an oxidative dopant may be placed on at least one surface of a pair of electrodes. In this case, the electron transport compound is reduced to an anion, and thus it becomes easier to inject and transport electrons from the mixed region to an electroluminescent medium. Further, the hole transport compound is oxidized to a cation, and thus it becomes easier to inject and transport holes from the mixed region to the electroluminescent medium. Preferably, the oxidative dopant includes various Lewis acids and acceptor compounds; and the

reductive dopant includes alkali metals, alkali metal compounds, alkaline earth metals, rare-earth metals, and mixtures thereof. A reductive dopant layer may be employed as a charge generating layer to prepare an electroluminescent device having two or more electroluminescent layers and emitting white light.

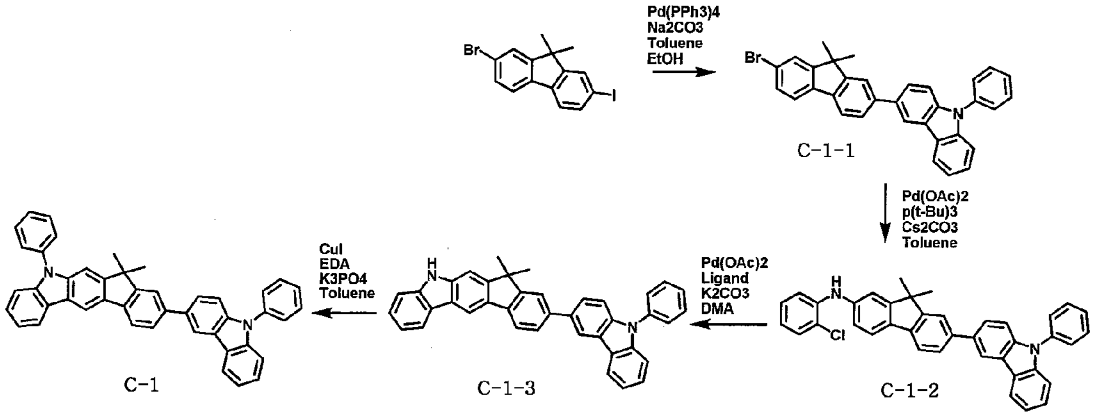
[139] In order to form each layer constituting the organic electroluminescent device according to the present invention, dry film-forming methods, such as vacuum evaporation, sputtering, plasma, ion plating methods, etc., or wet film-forming methods, such as spin coating, dip coating, flow coating methods, etc., can be used.

[140] When using a wet film-forming method, a thin film is formed by dissolving or dispersing the material constituting each layer in suitable solvents, such as ethanol, chloroform, tetrahydrofuran, dioxane, etc. The solvents are not specifically limited as long as the material constituting each layer is soluble or dispersible in the solvents, which do not cause any problems in forming a layer.

[141] Hereinafter, the organic electroluminescent compound of the present invention, the preparation method of the compound, and the luminescent properties of the device comprising the compound will be explained in detail with reference to the following examples:

[142] Example 1: Preparation of compound C-1

[143]



[144] Preparation of compound C-l-1

[145] After adding 2-bromo-7-iodo-9,9-dimethyl-9H-fluorene (25.0 g, 62.6 mmol), 9-phenyl-9H-carbazole-3-yl boronic acid (16.3 g, 56.9 mmol), tetrakis(triphenylphosphine)palladium(0) [Pd(PPh$_3$)$_4$] (3.6 g, 3.1 mmol), and Na$_2$C0$_3$ (19.9 g, 216.0 mmol) to a flask and dissolving the reaction mixture by adding toluene (400.0 ml), ethanol (EtOH) (100.0 ml), and distilled water (100.0 ml), the reaction mixture was stirred for 3 hours at 120°C. After reaction, the reaction was completed by slowly adding distilled water, the organic layer was extracted with ethylene acetate (EA). The obtained organic layer was dried with MgS0$_4$ to remove the remaining moisture, and was separated through column chromatography to obtain compound C-

1-1 (27.5 g, 53.5 mmol, Yield: 84 %).

[146] Preparation of compound C-l-2

[147] After adding compound C-l-1 (27.5 g, 53.5 mmol), 2-chloroaniline (11.2 ml, 106.9 mmol), palladium acetate (480.0 mg, 2.13 mmol), $P(t\text{-}Bu)_3$ (tri-t-butylphosphine) (1.0 ml, 6.2 mmol), and potassium-tert-butoxide (15.0 g, 133.6 mmol) to a flask and dissolving the reaction mixture by adding toluene (148.0 ml), the reaction mixture was refluxed for 24 hours at 120°C. After completing the reaction, the organic layer was extracted with EA. The obtained organic layer was dried with $MgS0_4$ to remove the remaining moisture, and was separated through column chromatography to obtain compound C-l-2 (14.5 g, 25.8 mmol, Yield: 48 %).

[148] Preparation of compound C-l-3

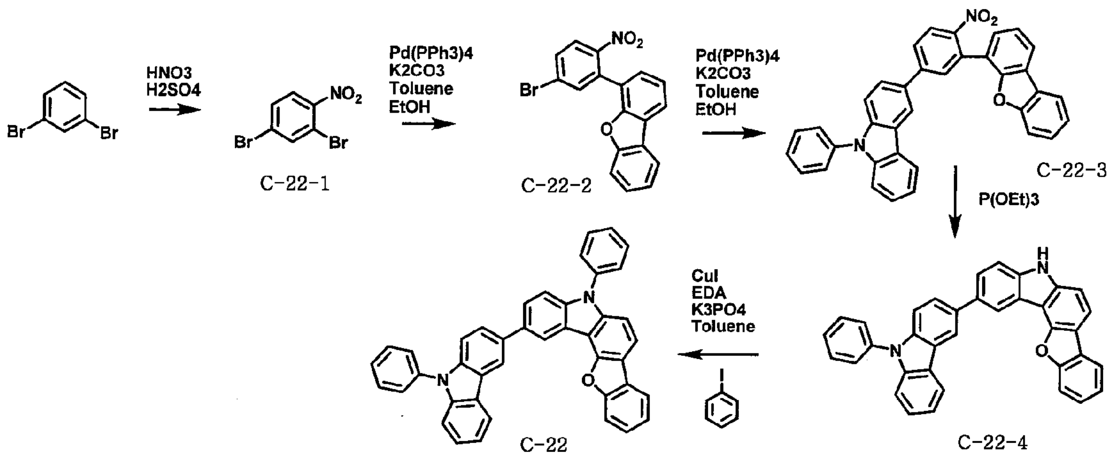
[149] After adding compound C-l-2 (14.5 g, 25.8 mmol), palladium acetate (290.0 mg, 1.29 mmol), tri-t-butylphosphonium tetrafluoroborate (0.75 g, 2.58 mmol), and K_2C0_3 (10.7 g, 77.5 mmol) to a flask and dissolving the reaction mixture by adding dimethylacetamide (DMA) (143.0 ml), the reaction mixture was refluxed for 24 hours at 180°C. After completing the reaction, the organic layer was extracted with EA. The obtained organic layer was dried with $MgS0_4$ to remove the remaining moisture, and was separated through column chromatography to obtain compound C-l-3 (10.9 g, 20.7 mmol, Yield: 66 %).

[150] Preparation of compound C-1

[151] After adding compound C-l-3 (9.9 g, 18.8 mmol), iodobenzene (3.2 ml, 28.3 mmol), Cul (1.8 g, 9.4 mmol), ethylenediamine (1.26 ml, 18.8 mmol) and K_3P0_4 (12.2 g, 56.6 mmol) to a flask and dissolving the reaction mixture by adding toluene (100.0 ml), the reaction mixture was refluxed for 24 hours at 120°C. After completing the reaction, the organic layer was extracted with EA. The obtained organic layer was dried with $MgSO_4$ to remove the remaining moisture, and was separated through column chromatography to obtain compound C-l (6.2 g, 10.3 mmol, Yield: 55 %).

[152] Example 2: Preparation of compound C-22

[153]



[154] Preparation of compound C-22- 1

[155] 1,3-dibromobenzene and sulfuric acid (250.0 ml) were added to a flask and the reaction mixture was cooled to an internal temperature of 0°C. Nitric acid (28.6 ml) was slowly added to the flask and the reaction mixture was stirred for 30 minute. After completing the reaction, the reaction mixture was added to ice water, and the obtained solid was filtered and rinsed with water. The solid was rinsed with NaOH to make a neutral solid. The solid was separated through column chromatography to obtain compound C-22-1 (60.0 g, 213.5 mmol, Yield: 50 %).

[156] Preparation of compound C-22-2

[157] After adding compound C-22-1 (60.0 g, 213.5 mmol), dibenzo[b,d]thiophene-4-yl boronic acid (40.6 g, 177.9 mmol), $Pd(PPh_3)_4$ (8.2 g, 7.1 mmol), and Na_2C0_3 (56.6 g, 534.0 mmol) to a flask and dissolving the reaction mixture by adding toluene (520.0 ml), EtOH (260.0 ml), and distilled water (260.0 ml), the reaction mixture was stirred for 3 hours at 120°C. After reaction, the reaction was completed by slowly adding distilled water, the organic layer was extracted with EA. The obtained organic layer was dried with $MgS0_4$ to remove the remaining moisture, and was separated through column chromatography to obtain compound C-22-2 (42.0 g, 109.0 mmol, Yield: 51 %).

[158] Preparation of compound C-22-3

[159] After adding compound C-22-2 (10.5 g, 29.8 mmol), 9-phenyl-9H-carbazole-3-yl boronic acid (10.3 g, 35.8 mmol), $Pd(PPh_3)_4$ (1.4 g, 1.2 mmol), and K_2C0_3 (12.3 g, 89.4 mmol) to a flask and dissolving the reaction mixture by adding toluene (100.0 ml), EtOH (45.0 ml), and distilled water (45.0 ml), the reaction mixture was stirred for 3 hours at 120°C. After reaction, the reaction was completed by slowly adding distilled water, the organic layer was extracted with EA. The obtained organic layer was dried with $MgS0_4$ to remove the remaining moisture, and was separated through column chromatography to obtain compound C-22-3 (8.5 g, 16.5 mmol, Yield: 55 %).

[160] Preparation of compound C-22-4

[161] After adding compound C-22-3 (42.0 g, 109.0 mmol) to a flask and dissolving the reaction mixture by adding triethylphosphite (250.0 ml) and 1,2-dichlorobenzene (200.0 ml), the reaction mixture was stirred for 24 hours at 150°C. After completing the reaction, the remaining solvents were removed by a distillation apparatus, and the obtained organic layer was separated through column chromatography to obtain compound C-22-4 (10.5 g, 29.8 mmol, Yield: 27 %).

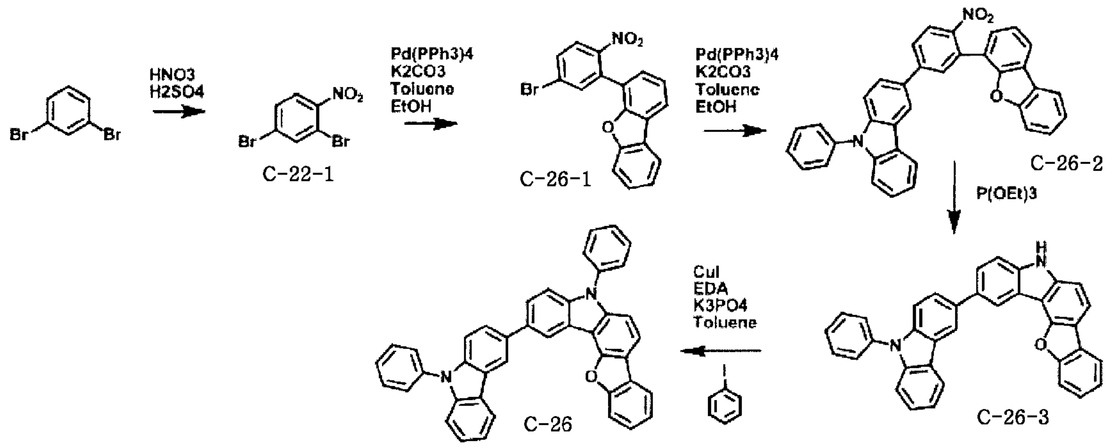
[162] Preparation of compound C-22

[163] After adding compound C-22-4 (8.5 g, 16.5 mmol), iodobenzene (3.7 ml, 33.0 mmol), Cul (1.6 g, 8.2 mmol), ethylenediamine (1.1 ml, 16.5 mmol) and K_3P0_4 (10.5 g, 49.5 mmol) to a flask and dissolving the reaction mixture by adding toluene (100.0

ml), the reaction mixture was refluxed for 24 hours at 120°C. After completing the reaction, the organic layer was extracted with EA. The obtained organic layer was dried with $MgSO_4$ to remove the remaining moisture, and was separated through column chromatography to obtain compound C-22 (4.5 g, 7.6 mmol, Yield: 46 %).

[164] Example 3: Preparation of compound C-26

[165]



[166] Preparation of compound C-26-1

[167] After adding compound C-22-1 (60.0 g, 213.5 mmol), dibenzo[b,d]furan-4-yl boronic acid (37.7 g, 177.9 mmol), $Pd(PPh_3)_4$ (10.2 g, 8.8 mmol), and Na_2CO_3 (56.6 g, 534.0 mmol) to a flask and dissolving the reaction mixture by adding toluene (520.0 ml), EtOH (260.0 ml), and distilled water (260.0 ml), the reaction mixture was stirred for 3 hours at 120°C. After reaction, the reaction was completed by slowly adding distilled water, the organic layer was extracted with EA. The obtained organic layer was dried with $MgSO_4$ to remove the remaining moisture, and was separated through column chromatography to obtain compound C-26-1 (42.0 g, 114.0 mmol, Yield: 54 %).

[168] Preparation of compound C-26-2

[169] After adding compound C-26-1 (10.0 g, 29.7 mmol), 9-phenyl-9H-carbazole-3-yl boronic acid (10.2 g, 35.7 mmol), $Pd(PPh_3)_4$ (1.4 g, 1.2 mmol), and K_2CO_3 (12.3 g, 89.4 mmol) to a flask and dissolving the reaction mixture by adding toluene (100.0 ml), EtOH (45.0 ml), and distilled water (45.0 ml), the reaction mixture was stirred for 3 hours at 120°C. After reaction, the reaction was completed by slowly adding distilled water, the organic layer was extracted with EA. The obtained organic layer was dried with $MgSO_4$ to remove the remaining moisture, and was separated through column chromatography to obtain compound C-26-2 (8.0 g, 16.0 mmol, Yield: 54 %).

[170] Preparation of compound C-26-3

[171] After adding compound C-26-2 (42.0 g, 114.0 mmol) to a flask and dissolving the reaction mixture by adding triethylphosphite (250.0 ml) and 1,2-dichlorobenzene (200.0 ml), the reaction mixture was stirred for 24 hours at 150°C. After completing

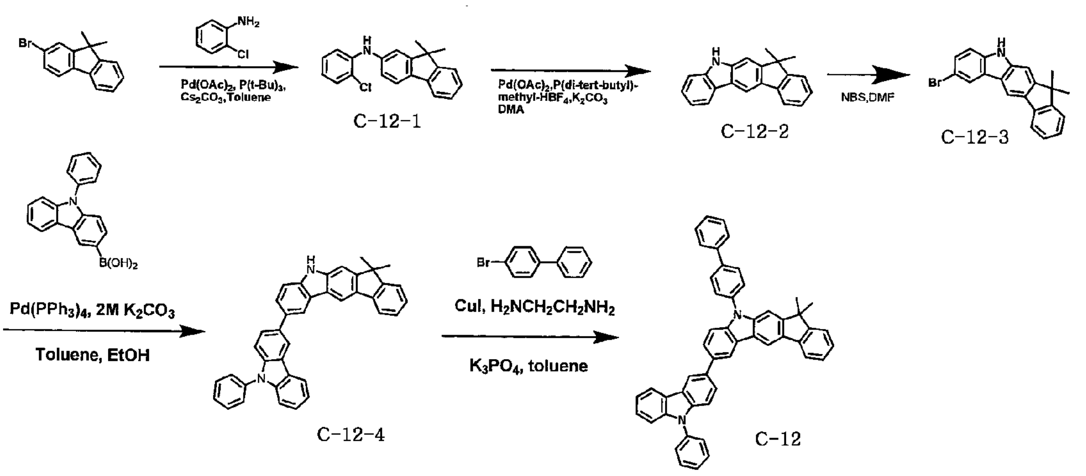
the reaction, the remaining solvents were removed by a distillation apparatus, and the obtained organic layer was separated through column chromatography to obtain compound C-26-3 (10.5 g, 29.7 mmol, Yield: 26 %).

[172] Preparation of compound C-26

[173] After adding compound C-26-3 (8.0 g, 16.0 mmol), iodobenzene (3.6 ml, 32.0 mmol), Cul (1.5 g, 8.0 mmol), ethylenediamine (1.1 ml, 16.0 mmol) and K_3P0_4 (10.2 g, 48.1 mmol) to a flask and dissolving the reaction mixture by adding toluene (100.0 ml), the reaction mixture was refluxed for 24 hours at 120°C. After completing the reaction, the organic layer was extracted EA and was dried with $MgS0_4$ to remove the remaining moisture. The obtained organic layer was separated through column chromatography to obtain compound C-26 (4.5 g, 7.8 mmol, Yield: 49 %).

[174] Example 4: Preparation of compound C-12

[175]



[176] Preparation of compound C-12-1

[177] Toluene (600.0 ml) was added to 2-bromo-9,9-dimethylfluorene (56.0 g, 0.20 mol), 2-chloroaniline (31.0 g, 0.24 mol), palladium acetate (1.5 g, 0.001 mol), P(t-Bu)$_3$ (4.0 ml, 0.021 mol), and Cs_2C0_3 (143.0 g, 0.439 mol). The mixture was stirred for 12 hours at 120°C. After completing the reaction, the mixture was rinsed with distilled water and the organic layer was extracted with EA. After drying the obtained organic layer with $MgS0_4$, the remaining solvents were removed by using a rotary evaporator. The obtained organic layer was purified through column chromatography to obtain compound C-12-1 (65.0 g, Yield: 92 %).

[178] Preparation of compound C-12-2

[179] DMA (1000.0 ml) was added to compound C-12-1 (65.0 g, 0.20 mol), palladium acetate (2.3 g, 0.01 mol), di-tert-butyl(methyl)phosphonium tetrafluoroborate (5.9 g, 0.02 mol), and Na_2C0_3 (64.0 g, 0.60 mol). The mixture was stirred for 16 hours at 190°C. After completing the reaction, the mixture was rinsed with distilled water and the organic layer was extracted with EA. After drying the obtained organic layer with

$MgSO_4$, the remaining solvents were removed by using a rotary evaporator. The obtained organic layer was purified through column chromatography to obtain compound C-12-2 (31.0 g, Yield: 54 %).

[180] Preparation of compound C-12-3

[181] Compound C-12-2 (10.0 g, 0.035 mol) and dimethylformamide (DMF) (500.0 ml) were added to a two-neck round bottom flask (2L) and the reaction mixture was stirred for 10 minutes at 0°C. After adding N-bromosuccinic imide (NBS) (6.0 g, 0.03 mol) to DMF (350.0 ml), the solution was slowly added to the flask, and the mixture was stirred for 6 hours at 0°C. After completing the reaction, the mixture was neutralized by adding distilled water, and the organic layer was extracted with EA. After drying the obtained organic layer with $MgSO_4$, the remaining solvents were removed by using a rotary evaporator. The obtained organic layer was purified through column chromatography with EA as a developing solvent to obtain compound C-12-3 (10.0 g, Yield: 78 %).

[182] Preparation of compound C-12-4

[183] Compound C-12-3 (11.2 g, 31.0 mmol), 9-phenylcarbazole-3-boronic acid (11.0 g, 35.7 mmol), $Pd(PPh_3)_4$ (1.8 g, 1.6 mmol), K_2CO_3 (11.0 g, 78.0 mmol), toluene (120.0 ml), ethanol (40.0 ml), and distilled water (40.0 ml) to a round bottom flask (500 ml). The reaction mixture was stirred for 12 hours at 120°C. After completing the reaction, the mixture was rinsed with distilled water, and the organic layer was extracted with EA. After drying the obtained organic layer with $MgSO_4$, the remaining solvents were removed by using a rotary evaporator. The obtained organic layer was purified through column chromatography to obtain compound C-12-4 (13.6 g, Yield: 84 %).

[184] Preparation of compound C-12

[185] After adding compound C-12-4 (6.0 g, 11.4 mmol), 4-bromobiphenyl (2.9 g, 12.5 mmol), CuI (1.0 g, 5.7 mmol), ethylenediamine (1.5 ml, 23.0 mmol), K_3PO_4 (6.0 g, 29.0 mmol), and toluene (60.0 ml) to a round bottom flask (250 ml), the reaction mixture was heated to 120°C and was stirred for 12 hours. After completing the reaction, the mixture was rinsed with distilled water, and the organic layer was extracted with EA. After drying the obtained organic layer with $MgSO_4$, the remaining solvents were removed by using a rotary evaporator. The obtained organic layer was purified through column chromatography to obtain compound C-12 (5.0 g, Yield: 65 %).

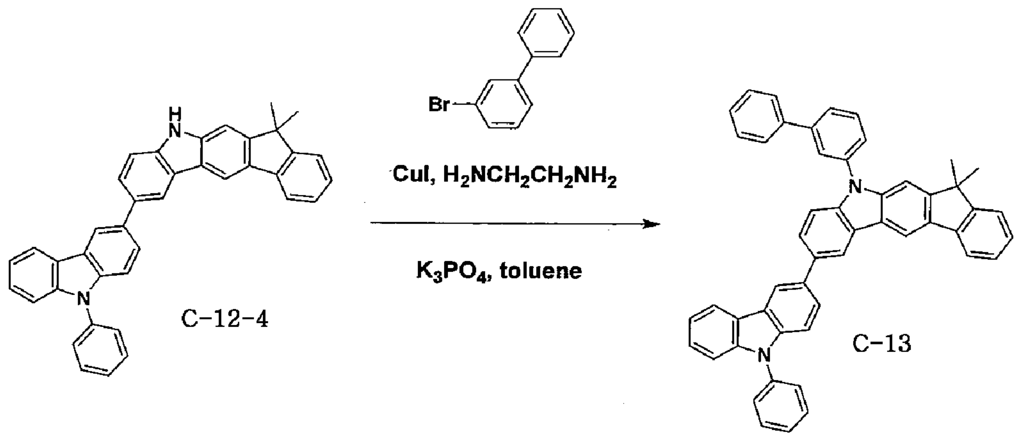
[186] Example 5: Preparation of compound C-10

[187] After adding compound C-12-4 (8.8 g, 16.7 mmol), iodobenzene (2.8 ml, 25.1 mmol), CuI (1.6 g, 8.3 mmol), ethylenediamine (1.1 ml, 16.7 mmol) and K_3PO_4 (11.0 g, 50.3 mmol) to a flask and dissolving the reaction mixture by adding toluene (100.0 ml), the reaction mixture was stirred for 24 hours at 120°C. After completing the

reaction, the organic layer was extracted EA and was dried with MgS0$_4$ to remove the remaining moisture. The obtained organic layer was separated through column chromatography to obtain compound C-10 (6.0 g, 9.9 mmol, Yield: 60 %).

[188] Example 6: Preparation of compound C-13

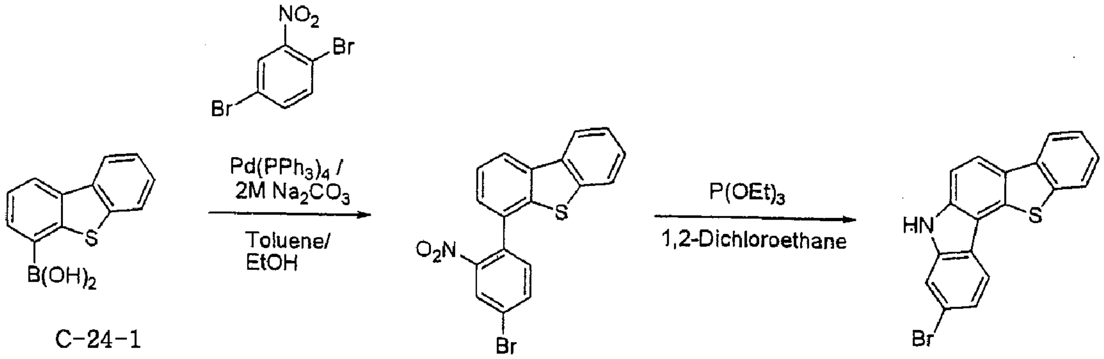
[189]



[190] After adding compound C-12-4 (7.0 g, 13.3 mmol), 3-bromobiphenyl (3.1 g, 13.3 mmol), Cul (1.3 g, 6.7 mmol), ethylenediamine (2.0 ml, 26.6 mmol), K$_3$P0$_4$ (7.0 g, 33.0 mmol), and toluene (70.0 ml) to a round bottom flask (250 ml), the reaction mixture was heated to 120°C and was stirred for 12 hours. After completing the reaction, the mixture was rinsed with distilled water, and the organic layer was extracted with EA. After drying the obtained organic layer with MgS0$_4$, the remaining solvents were removed by using a rotary evaporator. The obtained organic layer was purified through column chromatography to obtain compound C-13 (6.4 g, Yield: 71 %).

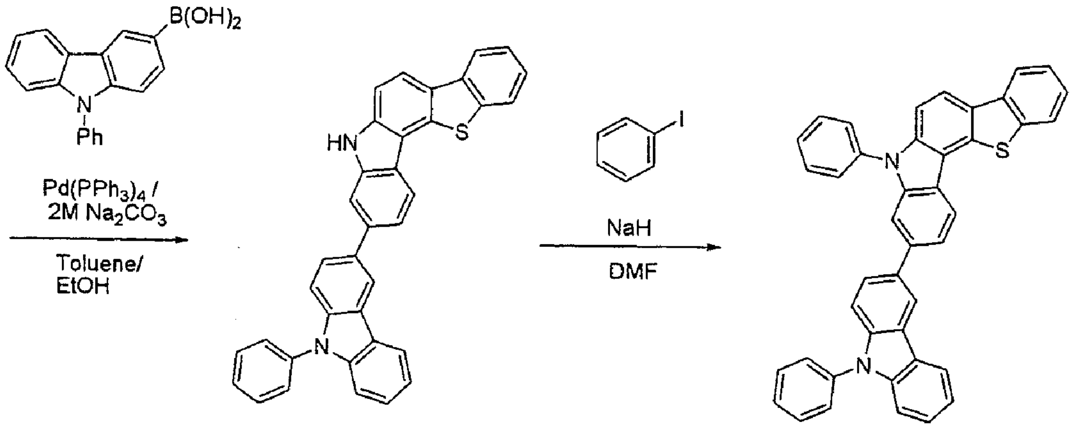
[191] Example 7: Preparation of compound C-24

[192]



C-24-2 C-24-3

[193]



C-24-4

C-24

[194] Preparation of compound C-24-2

[195] Compound C-24-1 (29.0 g, 128.0 mmol), $Pd(PPh_3)_4$ (4.9 g, 4.3 mmol), Na_2C0_3 (28.0 g, 267.0 mmol), toluene (450.0 ml), ethanol (150.0 ml), and distilled water (150.0 ml) were added to a round bottom flask (2L) and the reaction mixture was stirred for 1.5 hours at 120°C. The reaction mixture was extracted with EA/distilled water, and the obtained organic layer was dried with $MgS0_4$ to remove the remaining moisture and was distilled under the reduced pressure. The crude product was purified through column chromatography with methylene chloride (MC) and hexane as developing solvents to obtain compound C-24-2 as a yellow solid (34.0 g, Yield: 70 %).

[196] Preparation of compound C-24-3

[197] Compound C-24-2 (34.0 g, 88.5 mmol), $P(OEt)_3$ (250.0 ml), and 1,2-dichlorobenzene (250.0 ml) were added to a round bottom flask (2L) and the reaction mixture was stirred for 3.5 hours at 150°C. The reaction mixture was separated by distillation and was extracted with EA/distilled water. The obtained organic layer was dried with $MgS0_4$ to remove the remaining moisture and was distilled under the reduced pressure. The crude product was purified through column chromatography with MC and hexane as developing solvents to obtain compound C-24-3 as a white solid (14.6 g, Yield: 47 %).

[198] Preparation of compound C-24-4

[199] Compound C-24-3 (6.0 g, 17.0 mmol), 9-phenyl-9H-carbazole-3-yl boronic acid (6.4 g, 22.0 mmol), $Pd(PPh_3)_4$ (984.0 mg, 0.85 mmol), K_2C0_3 (5.9 g, 43.0 mmol), toluene (80.0 ml), ethanol (20.0 ml), and distilled water (20.0 ml) were added to a round bottom flask (500 ml) and the reaction mixture was stirred for 4 hours at 120°C. The reaction mixture was extracted with EA/distilled water. The obtained organic layer was dried with $MgS0_4$ to remove the remaining moisture and was distilled under the

reduced pressure. The crude product was filtered on silica with chloroform to obtain compound C-24-4 as a white solid (5.0 g, Yield: 57 %).

[200] Preparation of compound C-24

[201] Compound C-24-4 (4.4 g, 8.5 mmol), iodobenzene (4.36 g, 21.4 mmol), Cul (814.0 mg, 4.3 mmol), K_3P0_4 (5.4 g, 25.6 mmol), ethylenediamine (1.2 ml, 17.0 mmol), and toluene (45.0 ml) were added to a round bottom flask (250 ml) and the reaction mixture was stirred for 6 hours at 120°C. The reaction mixture was extracted with EA/ distilled water. The obtained organic layer was dried with $MgS0_4$ to remove the remaining moisture and was distilled under the reduced pressure. The crude product was purified through column chromatography with MC and hexane as developing solvents and was recrystallized with DMF to obtain compound C-24 as a white solid (1.0 g, Yield: 20 %).

[202] Example 8: Preparation of compound C-11

[203] 3-(4-bromophenyl)-9-phenyl-9H-carbazole (3.2 g, 8.0 mmol), 7,7-dimethyl-5-phenyl-5,7-dihydroindeno[2,l-b]carbazole-2-yl boronic acid (3.9 g, 11.0 mmol), $Pd(PPh_3)_4$ (464.0 mg, 0.40 mmol), K_2C0_3 (3.3 g, 243.0 mmol), toluene (24.0 ml), ethanol (12.0 ml), and distilled water (12.0 ml) were added to a round bottom flask (500 ml) and the reaction mixture was stirred for 4 hours at 120°C. The reaction mixture was extracted with EA/distilled water. The obtained organic layer was dried with $MgS0_4$ to remove the remaining moisture and was distilled under the reduced pressure. The crude product was filtered on silica with chloroform to obtain compound C-11 as a white solid (2.2 g, Yield: 41 %).

[204] The physical properties of the compounds of the present invention, which were prepared in Examples 1 to 8, are provided in the table 1 below:

[205] Table 1

[206]

Compound Nos.	Yield(%)	MS/EIMS		UV(nm)	PL(nm)	mp(℃)
		Found	Calculated			
C-1	**55%**	**599.61**	**600.75**	**344nm**	**387nm**	**265**
C-10	**60%**	**599.74**	**600.75**	**342nm**	**406nm**	**176**
C-11	**41%**	**676.32**	**676.84**	**394nm**	**322nm**	**270**
C-12	**65%**	**676.65**	**676.84**	**322nm**	**409nm**	**319**
C-13	**70%**	**676.92.**	**676.84**	**308nm**	**407nm**	**194**
C-22	**46%**	**589.97**	**590.73**	**334nm**	**389nm**	**226**
C-24	**20%**	**589.51**	**590.73**	**308nm**	**393nm**	**229**
C-26	**48%**	**573.95**	**574.67**	**356nm**	**386nm**	**203**

[207] Device Example 1: Production of an PLED device using the

[208] organic electroluminescent compound according to the present invention

[209] An OLED device was produced using the organic electroluminescent compound according to the present invention. A transparent electrode indium tin oxide (ITO) thin

film (15 Ω/sq) on a glass substrate for an organic light-emitting diode (OLED) device (Samsung Corning, Republic of Korea) was subjected to an ultrasonic washing with trichloroethylene, acetone, ethanol, and distilled water, sequentially, and then was stored in isopropanol. Then, the ITO substrate was mounted on a substrate holder of a vacuum vapor depositing apparatus. N^1,$N^{1'}$-([l,l'-biphenyl]-4,4'-diyl)bis(N^1-(naphthalene- l-yl)-N^4,N^4-diphenylbenzene-l,4-diamine) was introduced into a cell of the vacuum vapor depositing apparatus, and then the pressure in the chamber of the apparatus was controlled to IO^6 torr. Thereafter, an electric current was applied to the cell to evaporate the above introduced material, thereby forming a hole injection layer having a thickness of 60 nm on the ITO substrate. Then, compound C-l according to the present invention was introduced into another cell of the vacuum vapor depositing apparatus, and was evaporated by applying electric current to the cell, thereby forming a hole transport layer having a thickness of 20 nm on the hole injection layer. Thereafter, 9-(3-(4,6-diphenyl-l,3,5-triazine-2-yl)phenyl)-9'-phenyl-9H,9H'-3,3'-bicarbazole as a host was introduced into one cell of the vacuum vapor depositing apparatus, and tris(4-methyl-2,5-diphenylpyridine)iridium (D-5) as a dopant was introduced into another cell. The two materials were evaporated at different rates and deposited in a doping amount of 15 wt% of the dopant, based on the total weight of the host and dopant, to form a light-emitting layer having a thickness of 30 nm on the hole transport layer. Then, 2-(4-(9,10-di(naphthalene-2-yl)anthracen-2-yl)phenyl)-l-phenyl-lH-benzo[<i]imidazole was introduced into one cell and lithium quinolate (Liq) was introduced into another cell. The two materials were evaporated at the same rate and were respectively deposited in a doping amount of 50 wt% to form an electron transport layer having a thickness of 30nm on the light-emitting layer. Then, after depositing lithium quinolate as an electron injection layer having a thickness of 2 nm on the electron transport layer, an Al cathode having a thickness of 150 nm was deposited by another vacuum vapor deposition apparatus on the electron injection layer. Thus, an OLED device was produced. All the materials used for producing the OLED device were purified by vacuum sublimation at IO^6 torr prior to use.

[210] The produced OLED device showed green emission having a luminance of 5050 cd/m^2 and a current density of 12.5 mA/cm^2.

[211] Device Example 2: Production of an OLED device using the

[212] organic electroluminescent compound according to the present invention

[213] An OLED device was produced in the same manner as in Device Example 1, except for using compound **C-10** as the hole transport layer, 9-phenyl-10-(4-phenylnaphthalene-l-yl)anthracene as a host, and

(E)-9,9-dimethyl-7-(4-(naphthalene-2-yl(phenyl)amino)styryl)-N,N-diphenyl-9H-fluorene-2-amine as a dopant.

[214] The produced OLED device showed blue emission having a luminance of 2050 cd/m^2 and a current density of 28.5 mA/cm^2.

[215]

[216] Device Example 3: Production of an OLED device using the

[217] organic electroluminescent compound according to the present invention

[218] An OLED device was produced in the same manner as in Device Example 1, except for using compound **C-ll** as the hole transport layer.

[219] The produced OLED device showed green emission having a luminance of 4000 cd/m^2 and a current density of 7.4 mA/cm^2.

[220]

[221] Device Example 4: Production of an OLED device using the

[222] organic electroluminescent compound according to the present invention

[223] An OLED device was produced in the same manner as in Device Example 1, except for using compound **C-12** as the hole transport layer.

[224] The produced OLED device showed green emission having a luminance of 7000 cd/m^2 and a current density of 13.5 mA/cm^2.

[225]

[226] Device Example 5: Production of an OLED device using the

[227] organic electroluminescent compound according to the present invention

[228] An OLED device was produced in the same manner as in Device Example 1, except for using compound **C-22** as the hole transport layer.

[229] The produced OLED device showed blue emission having a luminance of 3000 cd/m^2 and a current density of 41.1 mA/cm^2.

[230]

[231] Device Example 6: Production of an OLED device using the

[232] organic electroluminescent compound according to the present invention

[233] An OLED device was produced in the same manner as in Device Example 1, except for using compound **C-26** as the hole transport layer.

[234] The produced OLED device showed green emission having a luminance of 2000 cd/m^2 and a current density of 3.7 mA/cm^2.

[235]

[236] Device Example 7: Production of an OLED device using the

[237] organic electroluminescent compound according to the present invention

[238] An OLED device was produced in the same manner as in Device Example 1, except for using compound **C-24** as the hole transport layer.

[239] The produced OLED device showed green emission having a luminance of 2000 cd/

m^2 and a current density of 5.5 mA/cm^2.

[240]

[241] Device Example 8: Production of an PLED device using the

[242] organic electroluminescent compound according to the present invention

[243] An OLED device was produced in the same manner as in Device Example 1, except for using compound **C-13** as the hole transport layer.

[244] The produced OLED device showed green emission having a luminance of 5520 cd/m^2 and a current density of 10.5 mA/cm^2.

[245]

[246] Comparative Example 1: Production of an OLED device using

[247] conventional electroluminescent compounds

[248] An OLED device was produced in the same manner as in Device Example 1, except that a hole transport layer having a thickness of 20 nm was deposited by using N,N'-di(4-biphenyl)-N,N'-di(4-biphenyl)-4,4' -diaminobiphenyl, a light-emitting layer having a thickness of 30 nm was deposited on the hole transport layer by using 4,4' -N,N'-dicarbazole-biphenyl as a host and tris(2-phenylpyridine)iridium (D-4) as a dopant, and a hole blocking layer having a thickness of 10 nm was deposited by using bis(2-methyl-8-quinolinato) (4-phenylphenolato) aluminum(III).

[249] The produced OLED device showed green emission having a luminance of 4080 cd/m^2 and a current density of 12.0 mA/cm^2.

[250]

[251] Comparative Example 2: Production of an OLED device using

[252] conventional electroluminescent compounds

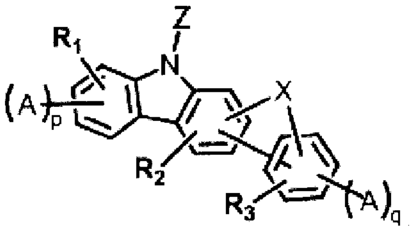
[253] An OLED device was produced in the same manner as in Device Example 1, except that a hole transport layer having a thickness of 20 nm was deposited by using N,N'-di(4-biphenyl)-N,N'-di(4-biphenyl)-4,4' -diaminobiphenyl, a light-emitting layer having a thickness of 30 nm was deposited on the hole transport layer by using 9-phenyl-10-(4-phenylnaphthalene-l-yl)anthracene as a host and (E)-9,9-dimethyl-7-(4-(naphthalene-2-yl(phenyl)amino)styryl)-N,N-diphenyl-9H-fluorene-2-amine as a dopant.

[254] The produced OLED device showed blue emission having a luminance of 1010 cd/m^2 and a current density of 16.8 mA/cm^2.

[255] The organic electroluminescent compounds of the present invention have luminous characteristics superior to the conventional materials.

Claims

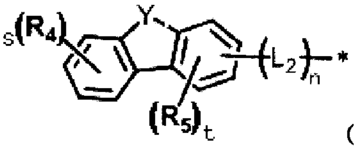
[Claim 1] An organic electroluminescent compound represented by the following formula 1:



(1)

wherein

A is represented by the following formula 2:



(2);

formula 2 is bonded to the compound of formula 1 via *;

Z is represented by the following formula 3:

$*-(L_1)_m-Ar_1$ (3);

formula 3 is bonded to the compound of formula 1 via *;

L$_1$ and **L**$_2$ each independently represent a single bond, a substituted or unsubstituted 5- to 30-membered heteroarylene group, or a substituted or unsubstituted (C6-C30)arylene group;

X and Y each independently represent -0-, -S-, -N(R_6)-, -C(R_7)(R_8)-, or -Si(R_9)(R_{1_0})-;

Ar$_1$ and **Ri** to R_5 each independently represent hydrogen, deuterium, a halogen, a substituted or unsubstituted (Cl-C30)alkyl group, a substituted or unsubstituted (C6-C30)aryl group, a substituted or unsubstituted 5- to 30-membered heteroaryl group, **-NRnRi** $_2$, or **-SiRi**$_3$**R**$_{14}$**R**$_{15}$**;** or are linked to an adjacent substituent(s) to form a mono- or polycyclic, 3- to 30-membered alicyclic or aromatic ring whose carbon atom(s) may be replaced with at least one hetero atom selected from nitrogen, oxygen and sulfur, proviso that where q is 1, **Ri** is not the group of formula 2, and p is 1, R_3 is not the group of formula 2;

R_6 to R_{15} each independently represent hydrogen, deuterium, a halogen, a substituted or unsubstituted (Cl-C30)alkyl group, a substituted or unsubstituted (C6-C30)aryl group, or a substituted or unsubstituted 5- to 30-membered heteroaryl group; or are linked to an adjacent substituent(s) to form a mono- or polycyclic, 3- to 30-membered alicyclic or aromatic ring;

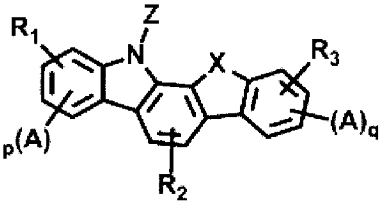
m and n each independently represent an integer of 0 to 2; where m is 2, each of L_1 is the same or different, and n is 2, each of L_2 is the same or different;

p and q each independently represent an integer of 0 or 1; where p+q = 1;

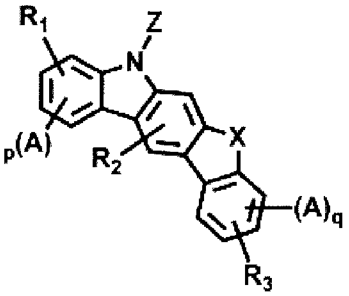
s and t each independently represent an integer of 1 or 2; where s is 2, each of R_4 is the same or different, and t is 2, each of R_5 is the same or different; and

the heteroaryl(ene) group contains at least one hetero atom selected from B, N, O, S, P(=0), Si and P.

[Claim 2] The organic electroluminescent compound according to claim 1, wherein the compound is one selected from the group consisting of the following formulae 4 to 9:



(4)



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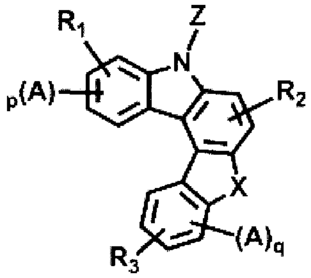

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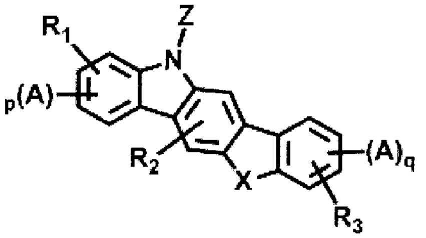

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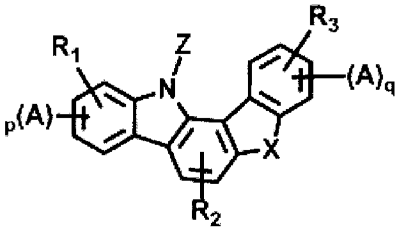

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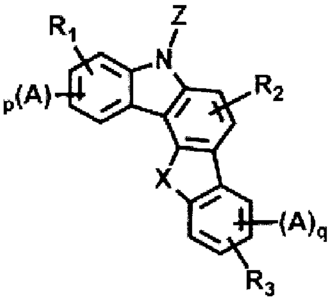


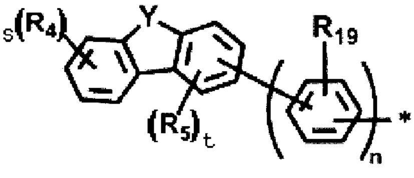
(9)

wherein

A, Z, X, R_1 to R_3, p and q are as defined in claim 1.

[Claim 3] The organic electroluminescent compound according to claim 1, wherein the substituents of the substituted alkyl group, the substituted aryl(ene) group, and the substituted heteroaryl(ene) group in L_1, L_2, Ar_1, and Ri to R_{15} each independently are at least one selected from the group consisting of deuterium; a halogen; a cyano group; a carboxyl group; a nitro group; a hydroxyl group; a (Cl-C30)alkyl group; a halo(Cl-C30)alkyl group; a (C6-C30)aryl group; a 5- to 30-membered heteroaryl group; a 5- to 30-membered heteroaryl group substituted with a (C6-C30)aryl; a (C6-C30)aryl group substituted with a 5- to 30-membered heteroaryl; a (C3-C30)cycloalkyl group; a 3- to 7-membered heterocycloalkyl group; a tri(Cl-C30)alkylsilyl group; a tri(C6-C30)arylsilyl group; a di(Cl-C30)alkyl(C6-C30)arylsilyl group; a (Cl-C30)alkyldi(C6-C30)arylsilyl group; a (C2-C30)alkenyl group; a (C2-C30)alkynyl group; a mono- or di(Cl-C30)alkylamino group; a mono- or di(C6-C30)arylamino group; a (Cl-C30)alkyl(C6-C30)arylamino group; a di(C6-C30)arylboronyl group; a di(Cl-C30)alkylboronyl group; a (Cl-C30)alkyl(C6-C30)arylboronyl group; a (C6-C30)aryl(Cl-C30)alkyl group; and a (Cl-C30)alkyl(C6-C30)aryl group.

[Claim 4] The organic electroluminescent compound according to claim 2, wherein A is represented by the following formula 10:



(10)

wherein

formula 10 is bonded to the compounds of formulae 1 and 4 to 9 via *;

Y, R_4, R_5, n, s and t are as defined in claim 1;

R_{19} represents hydrogen, deuterium, a halogen, a substituted or unsubstituted (Cl-C30)alkyl group, a substituted or unsubstituted (C6-C30)aryl group, or a substituted or unsubstituted 5- to 30-membered heteroaryl group; or are linked to an adjacent substituent(s) to form a mono- or polycyclic, 3- to 30-membered alicyclic or aromatic ring whose carbon atom(s) may be replaced with at least one hetero atom selected from nitrogen, oxygen and sulfur; and

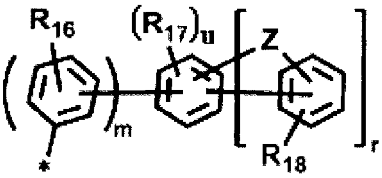
the heteroaryl group contains at least one hetero atom selected from B, N, O, S, P(=0), Si and P.

[Claim 5] The organic electroluminescent compound according to claim 2, wherein X represents -0-, -S, or -C(R_7)(R_8)-, in which R_7 and R_8 are as defined in claim 1.

[Claim 6] The organic electroluminescent compound according to claim 2, wherein Y represents -0-, -S, or -N(R_6)-, in which R_6 is as defined in claim 1.

[Claim 7] The organic electroluminescent compound according to claim 2, wherein Z is represented by formula 3, wherein Ar_1 represents a substituted or unsubstituted (Cl-C30)alkyl group, a substituted or unsubstituted (C6-C30)aryl group, a substituted or unsubstituted 5- to 30-membered heteroaryl group, -NRnRi $_2$ or -SiRi$_3$$R_{14}$$R_{15}$, in which R_{11} to R_{15} are as defined in claim 1.

[Claim 8] The organic electroluminescent compound according to claim 7, wherein Z is represented by the following formula 11:



(11)

wherein

formula 11 is bonded to the compounds of formulae 1 and 4 to 9 via *;

Z represents -0-, -S-, -N(R_{20})-, -C(R_{21})(R_{22})-, or -Si(R_{23})(R_{24})-;

R_{16} to R_{18} each independently represent hydrogen, deuterium, a halogen, a substituted or unsubstituted (Cl-C30)alkyl group, a substituted or unsubstituted (C6-C30)aryl group, a substituted or unsubstituted 5- to 30-membered heteroaryl group, -N$R_{25}$$R_{26}$ or -Si$R_{27}$$R_{28}$$R_{29}$; or are linked to an adjacent substituent(s) to form a mono- or polycyclic, 3- to 30-membered alicyclic or aromatic ring whose carbon atom(s) may be replaced with at least one hetero atom selected from nitrogen, oxygen and sulfur;

R_{20} to R_{29} each independently represent hydrogen, deuterium, a halogen, a substituted or unsubstituted (Cl-C30)alkyl group, a substituted or unsubstituted (C6-C30)aryl group, or a substituted or unsubstituted 5- to 30-membered heteroaryl group; or are linked to an adjacent substituent(s) to form a mono- or polycyclic, 3- to 30-membered alicyclic or aromatic ring;

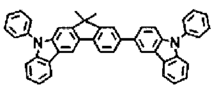
m represents an integer of 0 to 2;

r represents an integer of 0 or 1;

u represents an integer of 1 to 3; where u is 2 or more, each of R_{17} is the same or different; and

the heteroaryl group contains at least one hetero atom selected from B, N, O, S, P(=0), Si and P.

[Claim 9] The organic electroluminescent compound according to claim 1, wherein the compound represented by formula 1 is selected from the group consisting of: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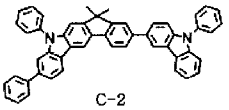
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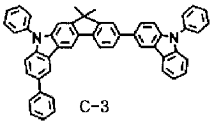
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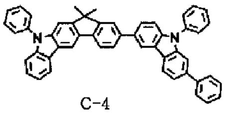
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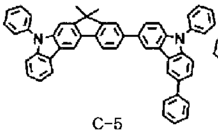
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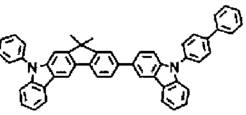
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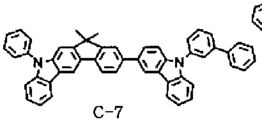
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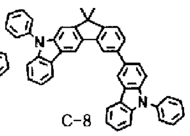
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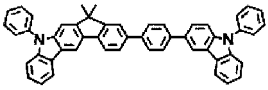
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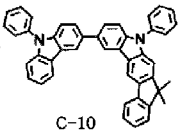
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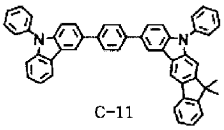
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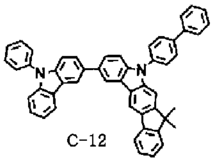
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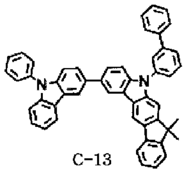
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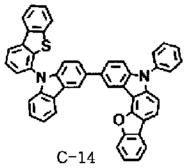
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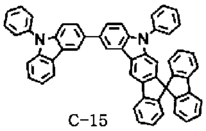
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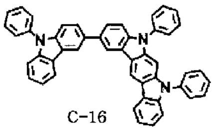
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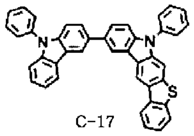
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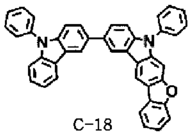
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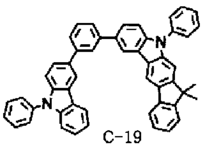
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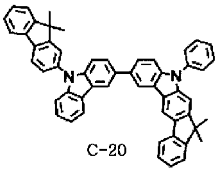
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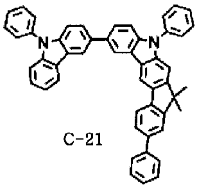
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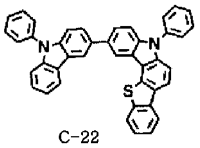
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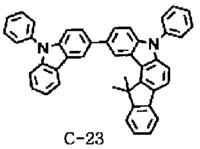
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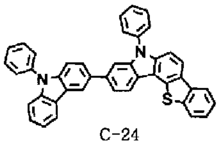
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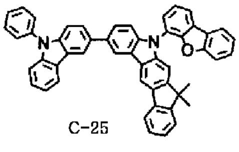
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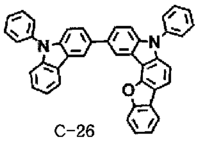
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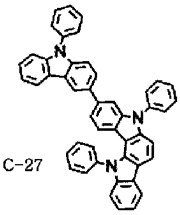
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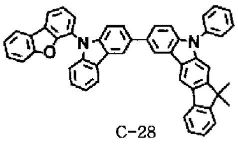
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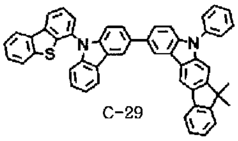
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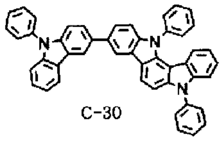
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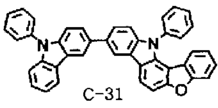
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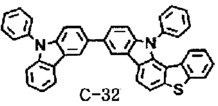
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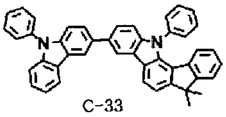
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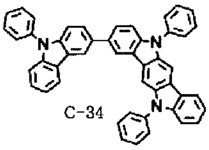
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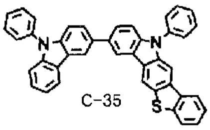
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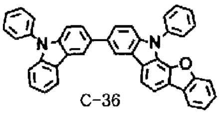
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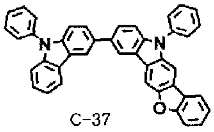
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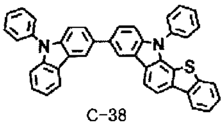
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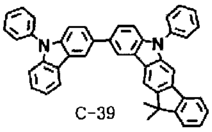
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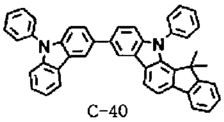
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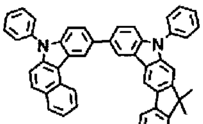
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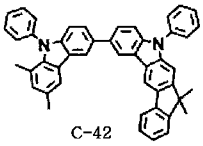
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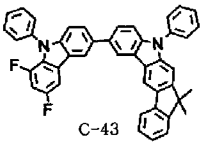
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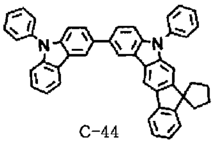
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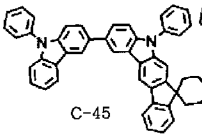
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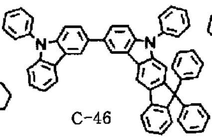
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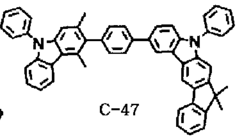
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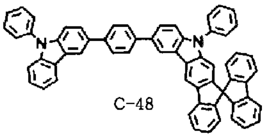
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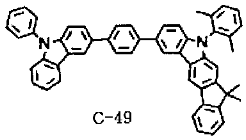
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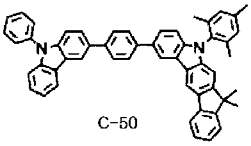
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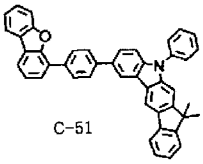
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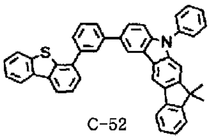
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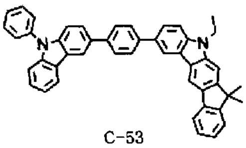
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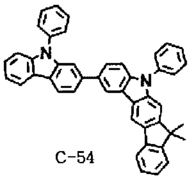
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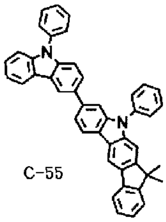
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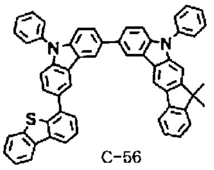
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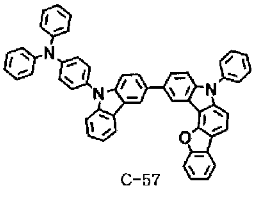
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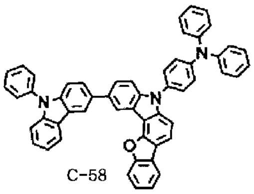
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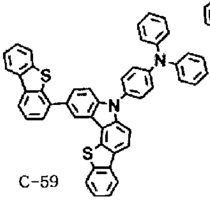
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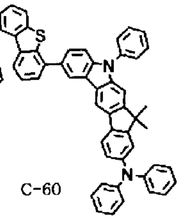
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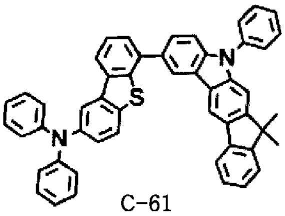
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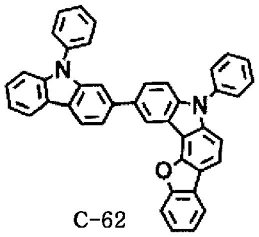
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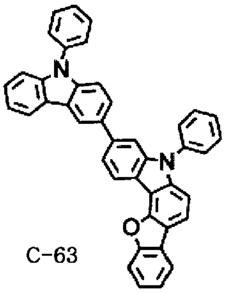
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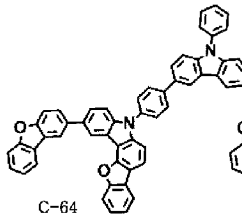
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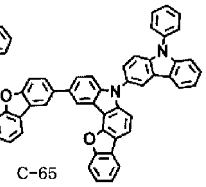
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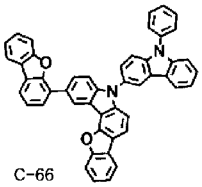
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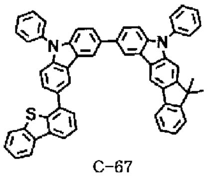
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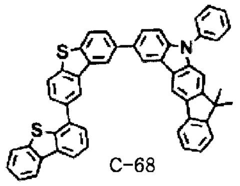
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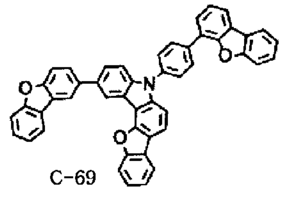
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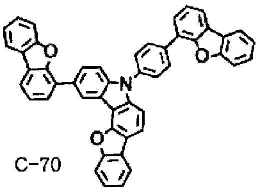
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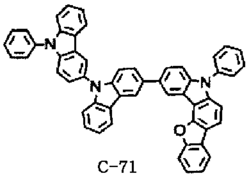
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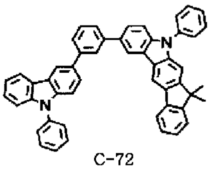
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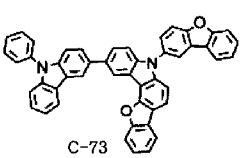
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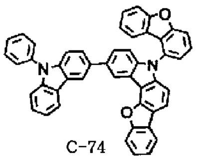
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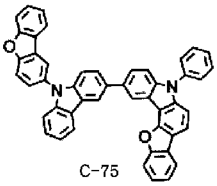
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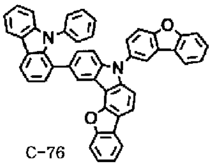
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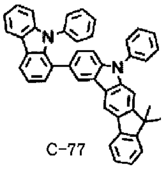
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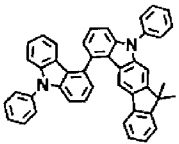
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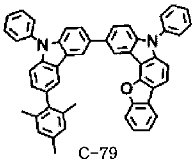
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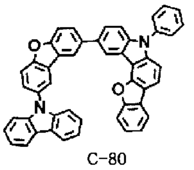
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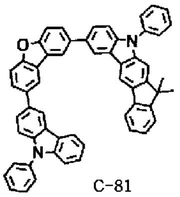
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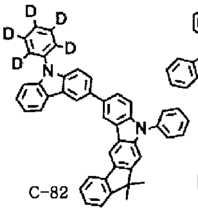
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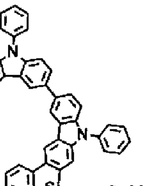
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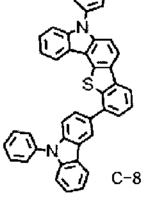
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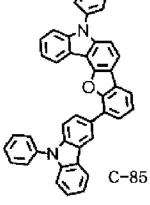
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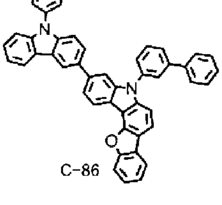
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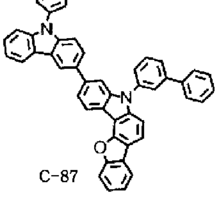
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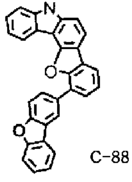
C-88

[Claim 10] An organic electroluminescent device comprising the compound according to claim 1.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2013/002713

A. CLASSIFICATION OF SUBJECT MATTER

C09K 11/06 (2006.01) ***C07D 403/04 (2006.01)*** ***C07D 403/10 (2006.01)*** ***C07D 405/10 (2006.01)*** ***C07D 405/14 (2006.01)***
C07D 409/04 (2006.01) ***C07D 409/10 (2006.01)*** ***C07D 409/14 (2006.01)*** ***C07D 411/04 (2006.01)*** ***C07D 413/04 (2006.01)***
C07D 413/14 (2006.01) ***C07D 417/04 (2006.01)*** ***C07F 7/10 (2006.01)*** ***H01L 27/32 (2006.01)*** ***H01L 51/54 (2006.01)***
H05B 33/14 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

STN: Chemical Abstracts Registry and CAplus - structure search based on compounds of Formula (1).

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	

☒ Further documents are listed in the continuation of Box C ☒ See patent family annex

*	Special categories of cited documents:		
"A"	document defining the general state of the art which is not considered to be of particular relevance	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E"	earlier application or patent but published on or after the international filing date	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"0"	document referring to an oral disclosure, use, exhibition or other means	"&"	document member of the same patent family
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 26 July 2013	Date of mailing of the international search report 26 July 2013

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Authorised officer

Tina Bryant
AUSTRALIAN PATENT OFFICE
(ISO 9001 Quality Certified Service)
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INTERNATIONAL SEARCH REPORT C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		International application No. **PCT7KR2013/002713**
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2012-028548 A (KONICA MINOLTA HOLDINGS INC.) 09 February 2012 Pages 15, 16, 22, 25, 28, 30, 31, 36 and 41 Compounds 32, 40, 71, 75, 91, 107, 110, 122, 128, 155 and 180, Claims 1, 5-7.	1-8, 10
X	WO 2012/015274 A2 (ROHM AND HAAS ELECTRONIC MATERIALS KOREA LTD.) 02 February 2012 Page 19 Compounds 60 and 61, Claims 7-10.	1-7, 10
X	WO 2012/014500 Al (HODOGAYA CHEMICAL CO., LTD) 02 February 2012 Pages 26, 32-36, 39-41, 53, 54, 68-78 Compounds 5, 22-32, 38-41, 43, 70, 71, 80, 91 and 102-123, Claim 12.	1-10
X	WO 2011/149283 A2 (DUKSAN HIGH METAL CO., LTD.) 01 December 2011 Page 10 Compounds 3-34 and 3-35, Claim 4, Abstract.	1, 2, 4, 5, 7, 8, 10
X	WO 2011/136520 Al (ROHM AND HAAS ELECTRONIC MATERIALS KOREA LTD.) 03 November 2011 Pages 6-8 Compounds 1-19, Page 8 Paragraph [40], Claims 1, 5-9.	1-10
X	US 2012/0068170 Al (PFLUMM et al.) 22 March 2012 Page 1 Paragraph [0001], page 42 first-third compounds in second column, page 47 first compound in first column, page 52 last compound in second column, page 53 first and second compounds in first column, page 109 Compound H7, Examples 33, 40 and 42, Claims 17, 21-24, 28 and 29.	1-10
X	WO 2010/114263 A2 (DOW ADVANCED DISPLAY MATERIALS, LTD.) 07 October 2010 Page 17 Compound 199, Claim 3.	1-3, 7, 8, 10
X	US 2008/0124455 Al (SHIN et al.) 29 May 2008 Page 7 Compound of Formula 16, Claim 14.	1, 2, 4, 5, 7, 8, 10
E	WO 2013/081315 Al (DUKSAN HIGH METAL CO., LTD.) 06 June 2013 Pages 18-19 Compounds 1-88, 1-99, 1-124 and 1-135, page 73 Compound 2-(9-(4,6-diphenylpyrinhdin-2-yl)-9H-carbazol-3-yl)-5-phenyl-5H-benzo[4,5]thieno[3,2-c]carbazole, page 74 Compound l l-(9-(4,6-diphenyl-l,3,5-triazin-2-yl)-9H-carbazol-3-yl)-8-phenyl-8H-benzo[4,5]thieno[2,3-c]carbazole, Claims 5 and 6.	1-8, 10
E	WO 2013/081416 Al (ROHM AND HAAS ELECTRONIC MATERIALS KOREA LTD.) 06 June 2013 Pages 8-10 Compounds C-14, C-19, C-36, C-37, C-73, C-89 and C-98, Claims 4 and 5.	1-8, 10
E	WO 2013/073896 Al (ROHM AND HAAS ELECTRONIC MATERIALS KOREA LTD.) 23 May 2013 Pages 9-10 Compounds C-10, C-26, C-30, C-39, C-45, C-52 and C-53, Claims 5 and 6.	1-8, 10
E	US 2013/0113367 Al (JUNG et al.) 09 May 2013 Page 1 Paragraph [0008], Page 21 Compound 67, Claim 18.	1, 2, 4, 5, 7, 10
E	WO 2013/056776 Al (MERCK PATENT GMBH) 25 April 2013 Page 28 Compounds 125 and 127, page 52 Compounds B17 and B19, page 66 Compound BICl, Claims 14 and 15.	1, 2, 4-8, 10
	WO 2013/041176 Al (MERCK PATENT GMBH) 28 March 2013	

INTERNATIONAL SEARCH REPORT C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT	International application No. **PCT/KR2013/002713**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	Pages 20-25 Compounds 42-49, 51, 53-55, 57-59, 61-65, 68, 73, 75, 83, 86, 101, 110; page 42 Compounds B28 and B29; page 43 Compound B30; page 51 compound BIC, Claims 16-18.	1-8, 10
P,X	WO 2012/136295 A1 (MERCK PATENT GMBH) 11 October 2012 Page 22 Table fifth row 1st and 2nd compounds, page 22 Table sixth row 2nd compound, page 23 Table 3rd row 3rd compound, page 23 Table 4th row 1st and 3rd compounds, page 23 Table sixth row 1st compound, page 42 Compound Cbz2, page 43 Compounds IC4 and Cbz3, Claim 1.	1-10
P,X	KR 10-2012-078301 A (CHEIL INDUSTRIES INC.) 10 July 2012 Pages 12, 13 and 17-19 Compounds B-3, B-4, B-14, B-15, D-l, D-2, D-4 - D-8, E-l - E-6, Claims 9 and 11.	1-8, 10
P,X	WO 2012/069121 A1 (MERCK PATENT GMBH) 31 May 2012 Pages 18, 20, 49, 50 Compounds 33, 70 and 71, Example 6 Compound 21 and Example 7 Compounds 23 and 24, Claim 14.	1-8, 10
P,X	WO 2012/067425 A1 (ROHM AND HAAS ELECTRONIC MATERIAL SKOREA LTD.) 24 May 2012 Pages 7-18 Compounds 1-111, Claims 5 and 6.	1-8, 10
P,X	US 2012/0097932 A1 (KIM et al.) 26 April 2012 Pages 12, 13, 16-19 Compounds 7, 10, 13, 14, 16, 37, 38, 43, 45, 47, 48 and 54-57, Claims 11-20.	1-8, 10
P,X	WO 2012/050371 A1 (ROHM AND HAAS ELECTRONIC MATERIALS KOREA LTD.) 19 April 2012 Page 30 last compound in 5th row, page 31 all compound 1st row, page 31 first compound 2nd row, page 31 middle and last compounds 4th row, page 31 all compounds 5th row, page 32 middle and last compounds 2nd row, page 32 all compounds in the 3rd, 4th and 5th row, page 33 all compounds on page, page 34 all compounds in the 1st, 2nd, 3rd and 4th row, page 34 first and middle compounds in 5th row, Claims 8-10.	1-8, 10

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/KR2013/002713**

This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document/s Cited in Search Report		**Patent Family Member/s**	
Publication Number	**Publication Date**	**Publication Number**	**Publication Date**
JP 2012-028548 A	09 Feb 2012	None	
WO 2012/015274 A2	02 Feb 2012	EP 2599851 A2	05 Jun 2013
		KR 20120012431 A	09 Feb 2012
		TW 201300501 A	01 Jan 2013
		WO 2012015274 A2	02 Feb 2012
WO 2012/014500 A1	02 Feb 2012	EP 2599773 A1	05 Jun 2013
		TW 201226392 A	01 Jul 2012
		US 2013126856 A1	23 May 2013
		WO 2012014500 A1	02 Feb 2012
WO 2011/149283 A2	01 Dec 2011	None	
WO 2011/136520 A1	03 Nov 2011	None	
US 2012/0068170 A1	22 Mar 2012	None	
WO 2010/114263 A2	07 Oct 2010	None	
US 2008/0124455 A1	29 May 2008	None	
WO 2013/081315 A1	06 Jun 2013	None	
WO 2013/081416 A1	06 Jun 2013	None	
WO 2013/073896 A1	23 May 2013	WO 2013073896 A1	23 May 2013
US 2013/0113367 A1	09 May 2013	KR 20130049275 A	14 May 2013
		US 2013113367 A1	09 May 2013
WO 2013/056776 A1	25 Apr 2013	None	
WO 2013/041176 A1	28 Mar 2013	None	
WO 2012/136295 A1	11 Oct 2012	None	
KR 10-2012-078301 A	10 Jul 2012	None	
WO 2012/069121 A1	31 May 2012	None	
WO 2012/067425 A1	24 May 2012	TW 201229202 A	16 Jul 2012

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/KR2013/002713**

This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document/s Cited in Search Report		**Patent Family Member/s**	
Publication Number	**Publication Date**	**Publication Number**	**Publication Date**
		WO 2012067425 A1	24 May 2012
US 2012/0097932 A1	26 Apr 2012	US 2012097932 A1	26 Apr 2012
WO 2012/050371 A1	19 Apr 2012	TW 201221619 A	01 Jun 2012
		WO 2012050371 A1	19 Apr 2012

End of Annex

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

专利名称(译)	新型有机电致发光化合物和包含该化合物的有机电致发光装置		
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摘要(译)

本发明涉及新型有机电致发光化合物和含有该化合物的有机电致发光器件。根据本发明的有机电致发光化合物可用作磷光主体材料，空穴传输材料或混合主体材料;具有良好的空穴传输能力;防止在装置的生产中结晶;适合形成一层;并改善器件的电流密度，从而降低器件的驱动电压。