(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
23 May 2013 (23.05.2013)

WIPO | PCT

(10) International Publication Number
WO 2013/073874 A1

(51) **International Patent Classification**:
C07D 401/04 (2006.01) *C07D 401/14* (2006.01)
C07D 401/08 (2006.01) *C07D 407/14* (2006.01)
C07D 401/10 (2006.01) *C07D 409/14* (2006.01)
C07D 401/12 (2006.01)

(21) **International Application Number**:
PCT/KR2012/009686

(22) **International Filing Date**:
15 November 2012 (15.11.2012)

(25) **Filing Language**: English

(26) **Publication Language**: English

(30) **Priority Data**:
10-2011-0120827
18 November 2011 (18.11.2011) KR

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(81) **Designated States** *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

WO 2013/073874 A1

(54) **Title**: NOVEL ORGANIC ELECTROLUMINESCENT COMPOUNDS AND AN ORGANIC ELECTROLUMINESCENT DEVICE USING THE SAME

(57) **Abstract**: The present invention relates to a novel organic electroluminescent compound and an organic electroluminescent device containing the same. The organic electroluminescent compound according to the present invention has an advantage of manufacturing an OLED device having long operating lifespan due to its excellent lifespan characteristics, lower driving voltages, high luminous efficiency, and reduced power consumption induced by improved power efficiency.

Description

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

Technical Field

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

Background Art

[2] An electroluminescent (EL) device is a self-light-emitting device which has advantages over other types of display devices in that it provides 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 materials 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 a light-emitting material. However, in view of electroluminescent mechanisms, since phosphorescent light-emitting materials theoretically enhance the luminous efficiency by four (4) times compared to fluorescent light-emitting materials, development of phosphorescent light-emitting materials are widely being researched. Iridium(III) complexes have been widely known as phosphorescent materials, including bis(2-(2'-benzothienyl)-pyridinato-N,C-3')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] Until now, 4,4'-N,N'-dicarbazol-biphenyl (CBP) was the most widely known host material for phosphorescent substances. Further, an organic EL device using bathocuproine (BCP) and aluminum(III)bis(2-methyl-8-quinolinate)(4-phenylphenolate) (BAlq) for a hole blocking layer is also known, and Pioneer (Japan) et al. developed a high performance organic EL device employing a derivative of BAlq as a host material.

[5] Though these materials provide good light-emitting characteristics, they have the following disadvantages. Due to their low glass transition temperature and poor thermal stability, degradation may occur during a high-temperature deposition process in a vacuum. The power efficiency of an organic EL device is given by [(π/voltage) × current efficiency], and power efficiency is inversely proportional to voltage, and thus

in order to lower power consumption, power efficiency should be raised. Although an organic EL device comprising phosphorescent materials provides a much higher current efficiency (cd/A) than one comprising fluorescent materials, an organic EL device using conventional phosphorescent materials such as BAlq or CBP has a higher driving voltage than those using fluorescent materials. Thus, the EL device using conventional phosphorescent materials has less advantage in terms of power efficiency (lm/W). Further, the operating lifespan of the organic EL device is short.

[6] International Patent Publication No. WO 2006/049013 discloses compounds for organic electroluminescent device having a carbazole backbone structure wherein the nitrogen atom of the carbazole is bonded to a heteroaryl group containing nitrogen through an aryl group, etc.

[7] However, it does not disclose a compound having a benzocarbazole backbone structure wherein the nitrogen atom of the benzocarbazole is bonded, directly or through an aryl group, to a heteroaryl group substituted with an aryl group, etc.

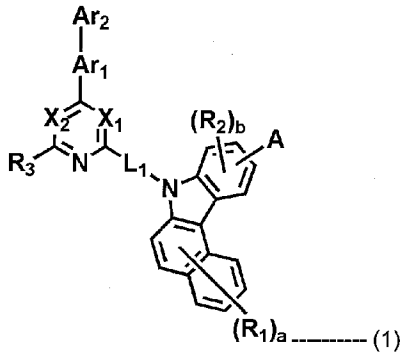
Disclosure of Invention

Technical Problem

[8] The objective of the present invention is to provide an organic electroluminescent compound imparting high luminous efficiency and a long operating lifespan to a device, and having proper color coordination; and an organic electroluminescent device having high efficiency and a long lifespan, using the compound as a light-emitting material.

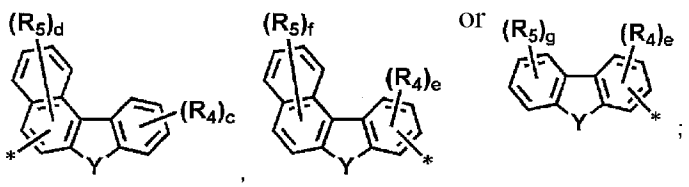
Solution to Problem

[9] The present inventors found that the objective above is achievable by a compound represented by the following formula 1:

[10] 

(1)

[11] wherein

[12] A represents 

;

[13] L_1 represents a single bond, a substituted or unsubstituted 3- to 30-membered heteroarylene group, a substituted or unsubstituted (C6-C30)arylene group, or a substituted or unsubstituted (C3-C30)cycloalkylene group;

[14] X_1 and X_2 each independently represent CR_6 or N;

[15] Y represents -O-, -S-, $-CR_{11}R_{12}-$, $-SiR_{11}R_{12}-$, or $-NR_{13}-$;

[16] Ar_1 represents a single bond, a substituted or unsubstituted 3- to 30-membered heteroarylene group, a substituted or unsubstituted (C6-C30)arylene group, or a substituted or unsubstituted (C1-C30)alkylene group;

[17] Ar_2 represents hydrogen, deuterium, a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C6-C30)aryl group, or a substituted or unsubstituted 3- to 30-membered heteroaryl group;

[18] R_1 to R_6 each independently represent hydrogen, deuterium, a halogen, a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C6-C30)aryl group, a substituted or unsubstituted 3- to 30-membered heteroaryl group, a substituted or unsubstituted (C3-C30)cycloalkyl group, a substituted or unsubstituted 5- to 7-membered heterocycloalkyl group, a substituted or unsubstituted (C6-C30)aryl(C1-C30)alkyl group, a substituted or unsubstituted (C6-C30)aryl group fused with at least one substituted or unsubstituted (C3-C30)cycloalkyl, a substituted or unsubstituted 5- to 7-membered heterocycloalkyl group fused with at least one substituted or unsubstituted aromatic ring, a substituted or unsubstituted (C3-C30)cycloalkyl group fused with at least one substituted or unsubstituted aromatic ring, $-NR_{14}R_{15}$, $-SiR_{16}R_{17}R_{18}$, $-SR_{19}$, $-OR_{20}$, a (C2-C30)alkenyl group, a (C2-C30)alkynyl group, a cyano group or a nitro group;

[19] R_{11} to R_{13} each independently represent a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C6-C30)aryl group, or a substituted or unsubstituted 3- to 30-membered heteroaryl group;

[20] R_{14} to R_{20} each independently represent hydrogen, deuterium, a halogen, a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C6-C30)aryl group, or a substituted or unsubstituted 3- to 30-membered heteroaryl group; or are linked to an adjacent substituent(s) to form a 3- to 30-membered mono- or polycyclic, alicyclic or aromatic ring whose carbon atom(s) may be replaced with at least one hetero atom selected from nitrogen, oxygen and sulfur;

[21] a and f each independently represent an integer of 1 to 6; where a or f is an integer of 2 or more, each of R_1, or each of R_5 is the same or different;

[22] b and e each independently represent an integer of 1 to 3; where b or e is an integer of 2 or more, each of R_2, or each of R_4 is the same or different;

[23] c and g each independently represent an integer of 1 to 4; where c or g is an integer of 2 or more, each of R_4, or each of R_5 is the same or different;

[24] d represents an integer of 1 to 5; where d is an integer of 2 or more, each of R_5 is the same or different; and

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

Advantageous Effects of Invention

[26] The present invention makes it possible to manufacture a device free from crystallization since the compounds used in the organic electronic material are highly efficient in transporting electrons. Further, the compounds have good layer formability and improve the current characteristic of the device. Therefore, they can produce an organic electroluminescent device having lowered driving voltages and enhanced power efficiency.

Mode for the Invention

[27] 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.

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

[29] Hereinafter, the organic electroluminescent compound represented by the above formula 1 will be described in detail.

[30] Herein, "(C1-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 10; more preferably 1 to 6; and includes methyl, ethyl, n-propyl, isopropyl, n-butyl, isobutyl and 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 and 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, 1-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.; "5- to 7-membered heterocycloalkyl" is a cycloalkyl having at least one heteroatom selected from B, N, O, S, P(=O), Si and P; preferably O, S and N, and 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 hy-

drocarbon having 6 to 30 carbon atoms, in which the number of carbon atoms is preferably 6 to 20; more preferably 6 to 12; and includes phenyl, biphenyl, terphenyl, naphthyl, binaphtyl, phenylnaphtyl, naphtylphenyl, fluorenyl, phenylfluorenyl, benzofluorenyl, dibenzofluorenyl, phenanthrenyl, phenylphenanthrenyl, anthracenyl, indenyl, triphenylenyl, pyrenyl, tetracenyl, perylenyl, chrysenyl, naphthacenyl, fluoranthenyl, dihydroacenaphthyl, etc.; "3- 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(=O), Si and P, and 3 to 30 ring backbone atoms; is a monocyclic ring, or a fused ring condensed with at least one benzene ring; has preferably 3 to 20; more preferably 3 to 12 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, benzocarbazolyl, dibenzocarbazolyl, phenoxazinyl, phenanthridinyl, benzodioxolyl, etc. Further, "Halogen" includes F, Cl, Br and I.

[31] 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.

[32] Substituents of the substituted alkyl(ene) group, the substituted aryl(ene) group, the substituted heteroaryl(ene) group, the substituted cycloalkyl(ene) group and the substituted heterocycloalkyl group in L_1, Ar_1, Ar_2, R_1 to R_6 and R_{11} to R_{20} groups of formula 1, each independently are at least one selected from the group consisting of deuterium; a halogen; a (C1-C30)alkyl group substituted or unsubstituted with a halogen; a (C6-C30)aryl group; a 3- to 30-membered heteroaryl group substituted or unsubstituted with a (C6-C30)aryl; a (C3-C30)cycloalkyl group; a 5- to 7-membered heterocycloalkyl group; a tri(C1-C30)alkylsilyl group; a tri(C6-C30)arylsilyl group; a di(C1-C30)alkyl(C6-C30)arylsilyl group; a (C1-C30)alkyldi(C6-C30)arylsilyl group; a (C2-C30)alkenyl group; a (C2-C30)alkynyl group; a cyano group; an N-carbazolyl group; a di(C1-C30)alkylamino group; a di(C6-C30)arylamino group; a (C1-C30)alkyl(C6-C30)arylamino group; a di(C6-C30)arylboronyl group; a di(C1-C30)alkylboronyl group; a (C1-C30)alkyl(C6-C30)arylboronyl group; a (C6-C30)aryl(C1-C30)alkyl group; a (C1-C30)alkyl(C6-C30)aryl group; a carboxyl

group; a nitro group; and a hydroxyl group, preferably each independently are at least one selected from the group consisting of deuterium, a halogen, a (C1-C6)alkyl group, a (C6-C12)aryl group, a di(C1-C6)alkyl(C6-C12)arylsilyl group and a (C1-C6)alkyldi(C6-C12)arylsilyl group.

[33] More specifically,

[34] L_1 represents a single bond, a 3- to 30-membered heteroarylene group or a (C6-C30)arylene group;

[35] X_1 and X_2 each independently represent CR_6 or N;

[36] Y represents -O-, -S-, $-CR_{11}R_{12}-$, $-SiR_{11}R_{12}-$ or $-NR_{13}-$;

[37] Ar_1 represents a single bond or a (C6-C30)arylene group;

[38] Ar_2 represents hydrogen, deuterium, a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C6-C30)aryl group, or a substituted or unsubstituted 3- to 30-membered heteroaryl group, 1,2-dihydroacenaphtyl group, a substituted or unsubstituted N-carbazolyl group, a substituted or unsubstituted N-benzocarbazolyl group, or a substituted or unsubstituted N-dibenzocarbazolyl group;

[39] R_1 to R_6 each independently represent hydrogen, deuterium, a halogen, a (C1-C30)alkyl group, a (C6-C30)aryl group, a 3- to 30-membered heteroaryl group, or an N-carbazolyl group;

[40] R_{11} to R_{13} each independently represent a (C1-C30)alkyl group, a (C6-C30)aryl group, or a 3- to 30-membered heteroaryl group; and

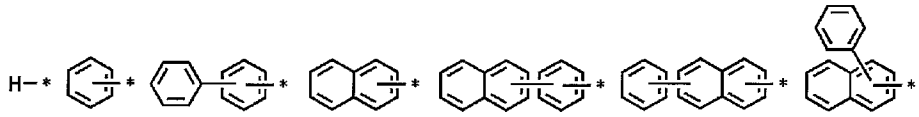
[41] the heteroarylene and arylene groups in L_1, the arylene group in Ar_1, the alkyl, aryl, heteroaryl, N-carbazolyl, N-benzocarbazolyl and N-dibenzocarbazolyl groups in Ar_2, the alkyl, aryl, heteroaryl and N-carbazolyl groups in R_1 to R_6, and the alkyl, aryl and heteroaryl groups in R_{11} to R_{13} each independently can be substituted with at least one selected from the group consisting of deuterium; a halogen; a (C1-C30)alkyl group substituted or unsubstituted with a halogen; a (C6-C30)aryl group; a 3- to 30-membered heteroaryl group; a tri(C1-C30)alkylsilyl group; a tri(C6-C30)arylsilyl group; a di(C1-C30)alkyl(C6-C30)arylsilyl group; a (C1-C30)alkyldi(C6-C30)arylsilyl group; a cyano group; an N-carbazolyl group; a (C6-C30)aryl(C1-C30)alkyl group; a (C1-C30)alkyl(C6-C30)aryl group; a carboxyl group; a nitro group; and a hydroxyl group.

[42] In formula 1, above, L_1 is preferably selected from the group consisting of a single bond, phenylene, naphtylene, biphenylene, terphenylene, anthrylene, andenylene, fluorenylene, phenantrylene, triphenylenylene, pyrenylene, perylenylene, crysenylene, naphthacenylene, fluoranthenylene, phenylene-naphthylene, furylene, thiophenylene, pyrrolylene, imidazolylene, pyrazolylene, thiazolylene, thiadiazolylene, isothiazolylene, isoxazolylene, oxazolylene, oxadiazolylene, triazinylene, tetrazinylene, triazolylene, furazanylene, pyridylene, pyrazinylene, pyrimidinylene, pyridazinylene, ben-

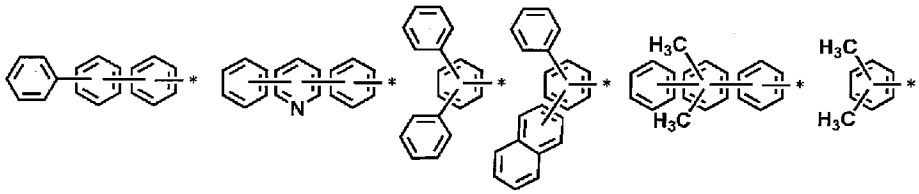
zofuranylene, benzothiophenylene, isobenzofuranylene, benzoimidazolylene, benzothiazolylene, benzoisothiazolylene, benzoisoxazolylene, benzoxazolylene, isoindolylene, indolylene, indazolylene, benzothiadiazolylene, quinolylene, isoquinolylene, cinnolinylene, quinazolinylene, quinoxalinylene, carbazolylene, phenanthridinylene, benzodioxolylene, dibenzofuranylene, and dibenzothiophenylene.

[43] In formula 1, above, the moiety, Ar_2-Ar_1-* is selected from the following structures:

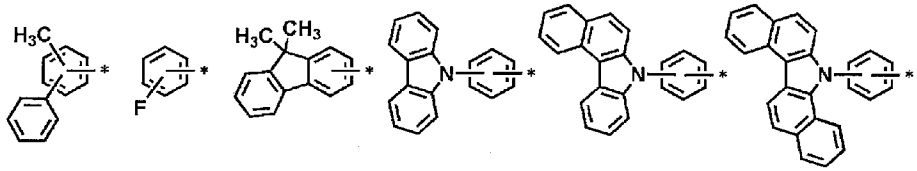
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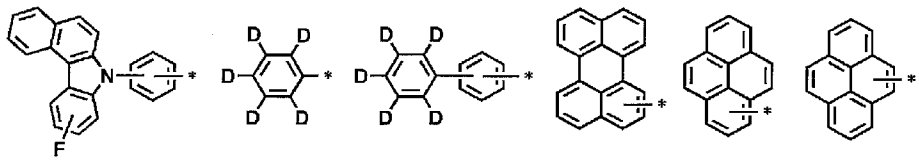
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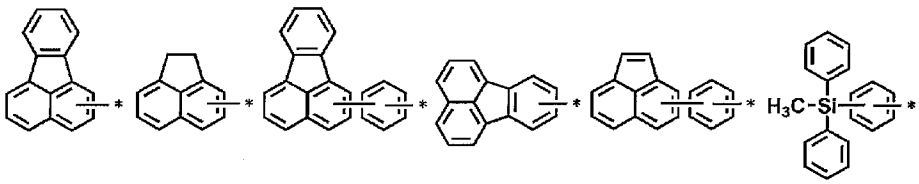
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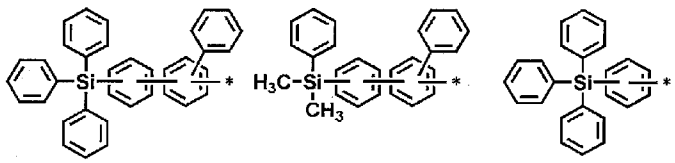
[47]



[48]



[49]



[50] In formula 1, above, L_1 is a single bond, a substituted or unsubstituted 3- to 30-membered heteroarylene group, a substituted or unsubstituted (C6-C30)arylene group, or a substituted or unsubstituted (C3-C30)cycloalkylene group, preferably a single bond or a substituted or unsubstituted (C6-C30)arylene group, more preferably a single bond, or a (C6-C20)arylene group substituted or unsubstituted with a (C1-C6)alkyl group.

[51] X_1 and X_2 are each independently CR_6 or N.

[52] Y represents -O-, -S-, -$CR_{11}R_{12}$-, -$SiR_{11}R_{12}$- or -NR_{13}-.

[53] Ar_1 is a single bond, a substituted or unsubstituted 3- to 30-membered heteroarylene group, a substituted or unsubstituted (C6-C30)arylene group, or a substituted or unsubstituted (C1-C30)alkylene group, preferably a single bond or a substituted or unsubstituted (C6-C20)arylene group, more preferably a single bond or (C6-C12)arylene group substituted or unsubstituted with a (C6-C12)aryl group.

[54] Ar_2 is hydrogen, deuterium, a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C6-C30)aryl group, or a substituted or unsubstituted 3- to 30-membered heteroaryl group, preferably hydrogen, a substituted or unsubstituted (C6-C30)aryl group, or a substituted or unsubstituted 3- to 30-membered heteroaryl group, more preferably hydrogen, a (C6-C20)aryl group substituted or unsubstituted with deuterium, a halogen, a (C1-C6)alkyl group, di(C1-C6)alkyl(C6-C12)arylsilyl group, or (C1-C6)alkyldi(C6-C12)arylsilyl group, or a 3- to 30-membered heteroaryl group substituted or unsubstituted with a halogen.

[55] R_1 to R_6 each independently are hydrogen, deuterium, a halogen, a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C6-C30)aryl group, a substituted or unsubstituted 3- to 30-membered heteroaryl group, a substituted or unsubstituted (C3-C30)cycloalkyl group, a substituted or unsubstituted 5- to 7-membered heterocycloalkyl group, a substituted or unsubstituted (C6-C30)aryl(C1-C30)alkyl group, a substituted or unsubstituted (C6-C30)aryl group fused with at least one substituted or unsubstituted (C3-C30)cycloalkyl, a substituted or unsubstituted 5- to 7-membered heterocycloalkyl group fused with at least one substituted or unsubstituted aromatic ring, a substituted or unsubstituted (C3-C30)cycloalkyl group fused with at least one substituted or unsubstituted aromatic ring, -$NR_{14}R_{15}$, -$SiR_{16}R_{17}R_{18}$, -SR_{19}, -OR_{20}, a (C2-C30)alkenyl group, a (C2-C30)alkynyl group, a cyano group or a nitro group, preferably hydrogen or a substituted or unsubstituted (C6-C30)aryl group, more preferably hydrogen or a (C6-C12)aryl group substituted or unsubstituted with a (C1-C6)alkyl group or a tri(C6-C12)arylsilyl group.

[56] R_{11} to R_{13} each independently are a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C6-C30)aryl group, or a substituted or unsubstituted 3- to 30-membered heteroaryl group, preferably an unsubstituted (C1-C10)alkyl group, or a substituted or unsubstituted (C6-C30)aryl group, more preferably an unsubstituted (C1-C6)alkyl group, or a (C6-C20)aryl group substituted or unsubstituted with a (C1-C6)alkyl group.

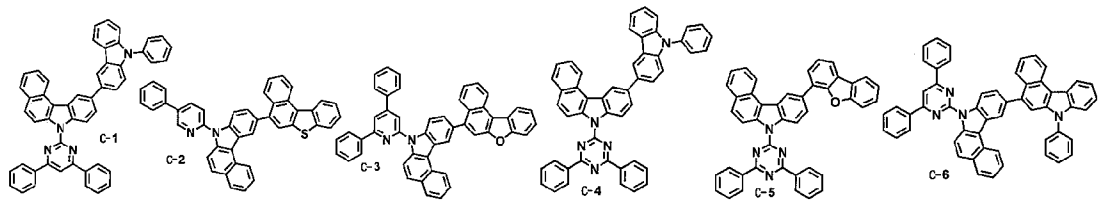
[57] According to an embodiment of the present invention, in formula 1, above, L_1 is a single bond or a substituted or unsubstituted (C6-C30)arylene group; X_1 and X_2 are each independently CR_6 or N; Y represents -O-, -S-, -$CR_{11}R_{12}$-, -$SiR_{11}R_{12}$- or -NR_{13}-; Ar_1 is a single bond or a substituted or unsubstituted (C6-C20)arylene group; Ar_2 is a

hydrogen, a substituted or unsubstituted (C6-C30)aryl group, or a substituted or unsubstituted 3- to 30-membered heteroaryl group; R_1 to R_6 each independently are hydrogen or a substituted or unsubstituted (C6-C30)aryl group; R_{11} to R_{13} each independently are an unsubstituted (C1-C10)alkyl group, or a substituted or unsubstituted (C6-C30)aryl group.

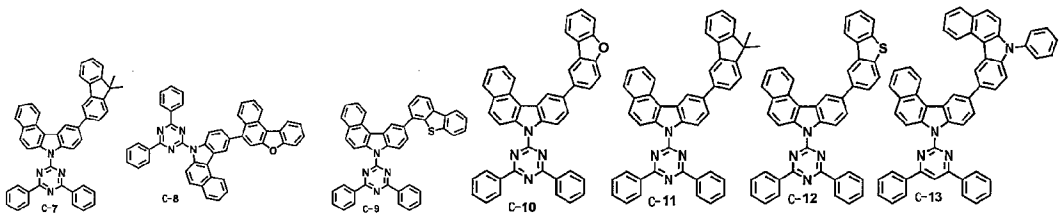
[58] According to another embodiment of the present invention, in formula 1, above, L_1 is a single bond, or a (C6-C20)arylene group substituted or unsubstituted with a (C1-C6)alkyl group; X_1 and X_2 are each independently CR_6 or N; Y represents -O-, -S-, $-CR_{11}R_{12}$-, $-SiR_{11}R_{12}$- or $-NR_{13}$-; Ar_1 is a single bond or (C6-C12)arylene group substituted or unsubstituted with a (C6-C12)aryl group; Ar_2 is hydrogen, a (C6-C20)aryl group substituted or unsubstituted with deuterium, a halogen, a (C1-C6)alkyl group, di(C1-C6)alkyl(C6-C12)arylsilyl group, or (C1-C6)alkyldi(C6-C12)arylsilyl group, or a 3- to 20-membered heteroaryl group substituted or unsubstituted with a halogen; R_1 to R_6 each independently are hydrogen or a (C6-C12)aryl group substituted or unsubstituted with a (C1-C6)alkyl group or a tri(C6-C12)arylsilyl group; R_{11} to R_{13} each independently are an unsubstituted (C1-C6)alkyl group, or a (C6-C20)aryl group substituted or unsubstituted with a (C1-C6)alkyl group.

[59] The representative compounds of the present invention include the following compounds:

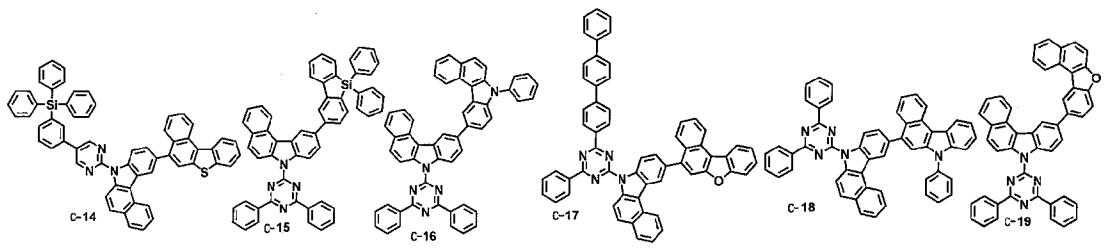
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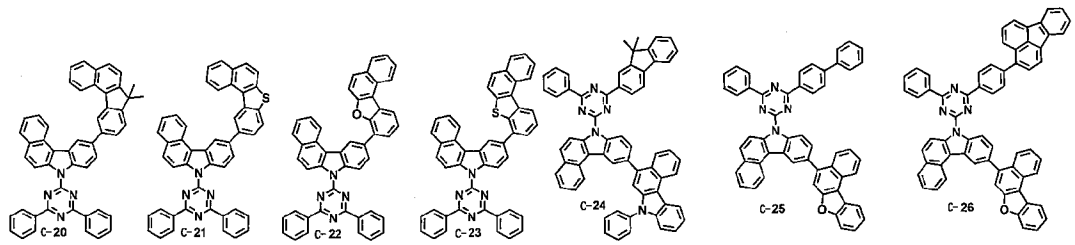
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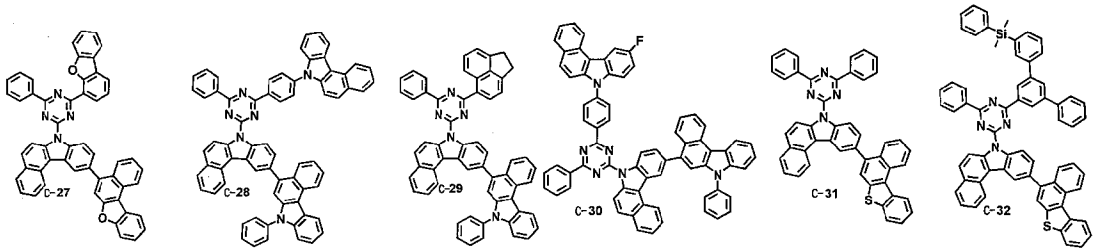
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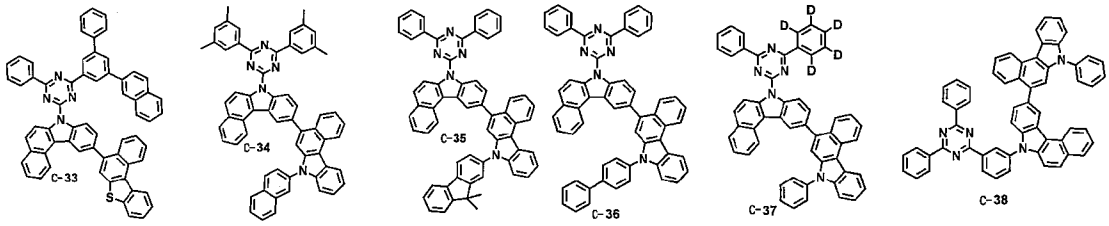
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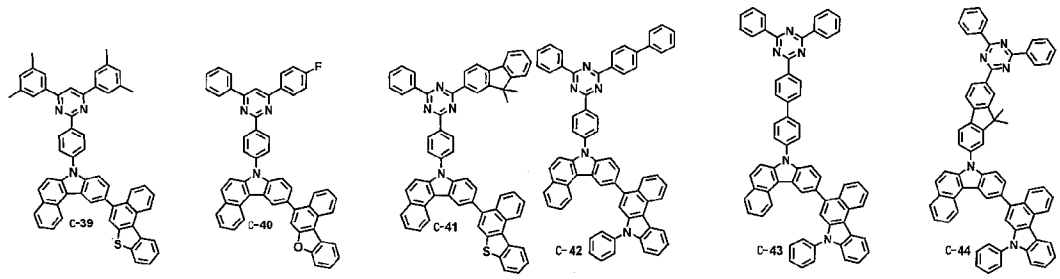
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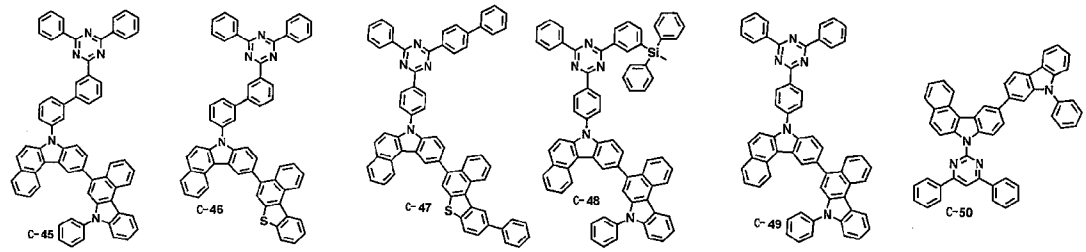
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[66]



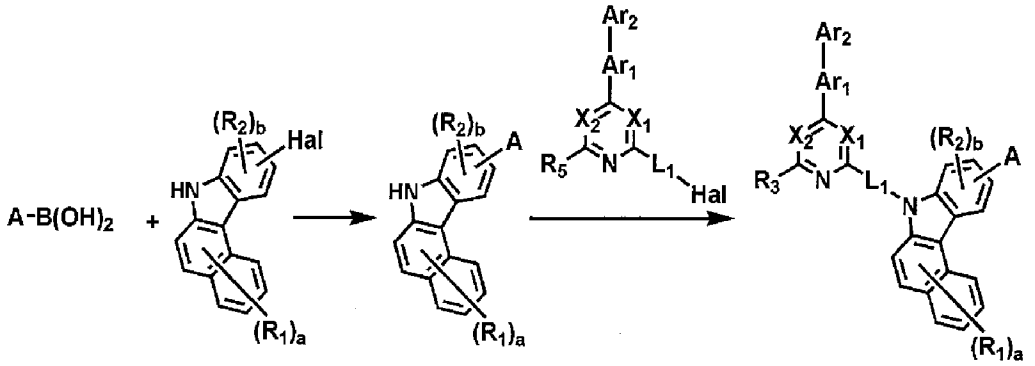
[67]



[68] The organic electroluminescent compounds according to the present invention can be prepared according to the following reaction scheme.

[69] [Reaction Scheme 1]

[70]



[71] wherein A, X_1, X_2, Ar_1, Ar_2, L_1, R_1 to R_5, Y, a and b are as defined in formula 1 above, and Hal represents a halogen.

[72] In addition, the present invention provides an organic electroluminescent material comprising the organic electroluminescent compound of formula 1, and an organic electroluminescent device comprising the material.

[73] The above 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.

[74] The organic electroluminescent device comprises a first electrode, a second electrode, and at least one organic layer between the first and second electrodes. The organic layer comprises at least one compound of formula 1 according to the present invention. Further, the organic layer comprises a light-emitting layer in which the compound of formula 1 is comprised as a host material.

[75] One of the first electrode and the second electrode is an anode, and the other is a cathode. The organic layer 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, a hole blocking layer and an electron blocking layer.

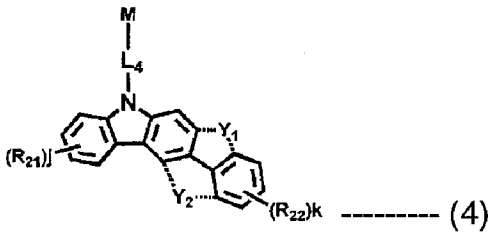
[76] The organic electroluminescent compound according to the present invention can be comprised of in the light-emitting layer. Where used in the light-emitting layer, the organic electroluminescent compound according to the present invention can be comprised as a host material.

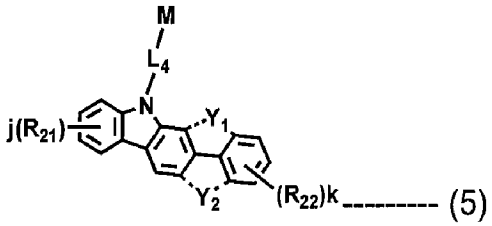
[77] The light-emitting layer can further comprise at least one dopant, and, if needed, another compound as a second host material in addition to the organic electroluminescent compound according to the present invention.

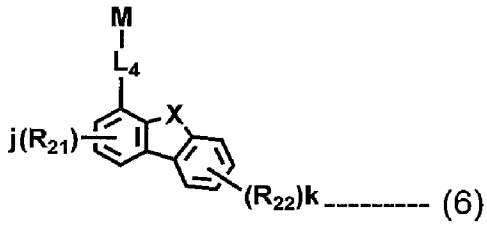
[78] The second host material can be from any of the known phosphorescent dopants. Specifically, the phosphorescent dopant selected from the group consisting of the compounds of formula 2 to 6 below is preferable in view of luminous efficiency.

[79] $H\text{-}(Cz\text{-}L_4)_h\text{-}M$ --------- (2)

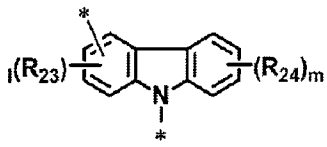
[80] $H\text{-}(Cz)_i\text{-}L_4\text{-}M$ --------- (3)

[81]  --------- (4)

[82]  --------- (5)

[83]  --------- (6)

[84] Wherein

[85] Cz represents  ;

[86] X represents O or S;

[87] R_{21} to R_{24} each independently represent hydrogen, deuterium, a halogen, a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C6-C30)aryl group, a substituted or unsubstituted 5- to 30-membered heteroaryl group, or $R_{25}R_{26}R_{27}Si$-;

[88] R_{25} to R_{27} each independently represent a substituted or unsubstituted (C1-C30)alkyl group, or a substituted or unsubstituted (C6-C30)aryl group;

[89] L_4 represents a single bond, a substituted or unsubstituted (C6-C30)arylene group, or a substituted or unsubstituted 5- to 30-membered heteroarylene group;

[90] M represents a substituted or unsubstituted (C6-C30)aryl group, or a substituted or unsubstituted 5- to 30-membered heteroaryl group;

[91] Y_1 and Y_2 represent -O-, -S-, $-N(R_{31})$- or $-C(R_{32})(R_{33})$-, and Y_1 and Y_2 cannot exist simultaneously;

[92] R_{31} to R_{33} each independently represent a substituted or unsubstituted (C1-C30)alkyl

group, a substituted or unsubstituted (C6-C30)aryl group, or a substituted or unsubstituted 5- to 30-membered heteroaryl group, and R_{32} and R_{33} are the same or different;

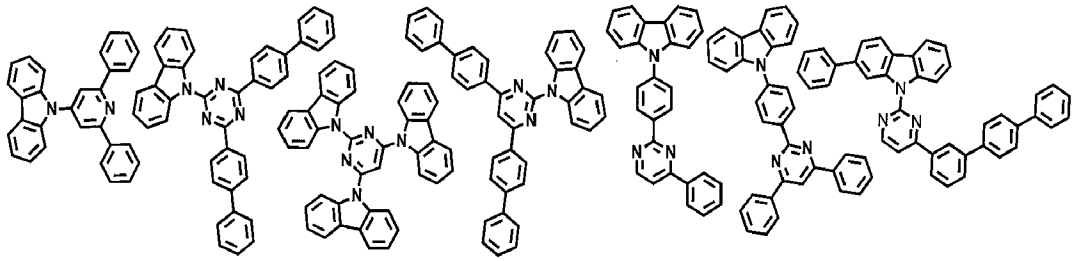
[93] h and i each independently represent an integer of 1 to 3;

[94] j, k, l, and m each independently represent an integer of 0 to 4; and

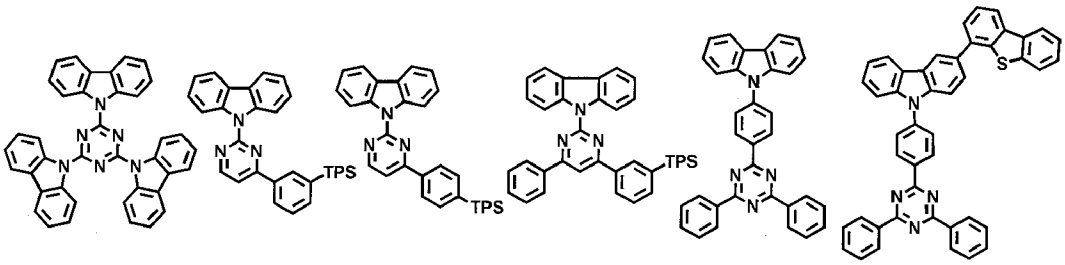
[95] where h, i, j, k, l, or m is an integer of 2 or more, each of (Cz-L_4), each of (Cz), each of R_{21}, each of R_{22}, each of R_{23} or each of R_{24} is the same or different.

[96] Specifically, preferable examples of the second host material are as follows:

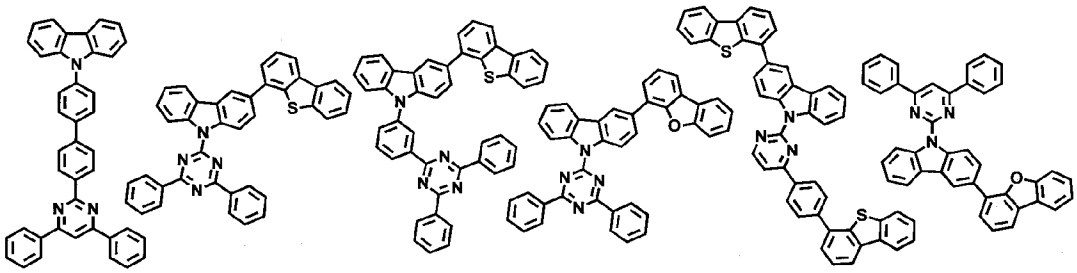
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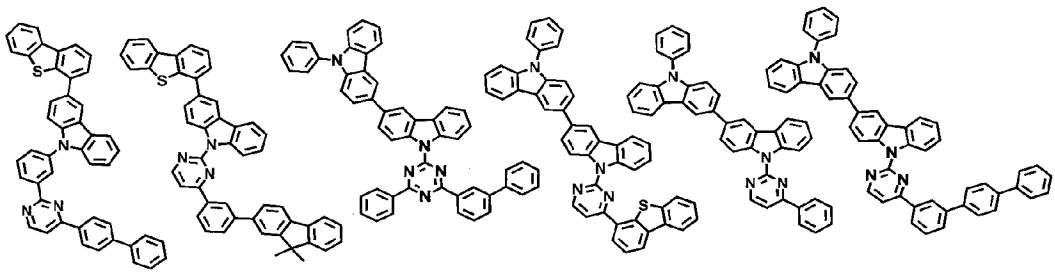
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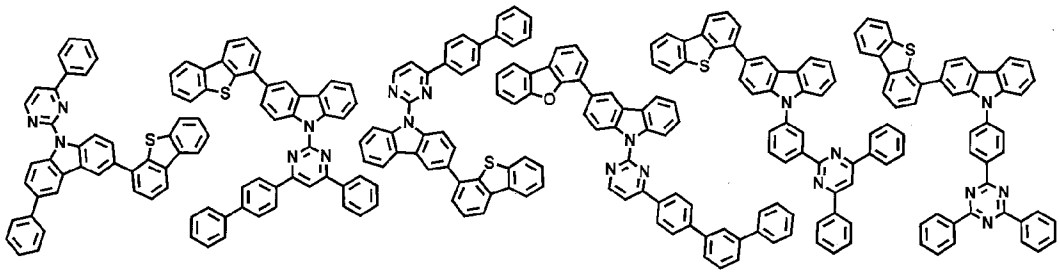
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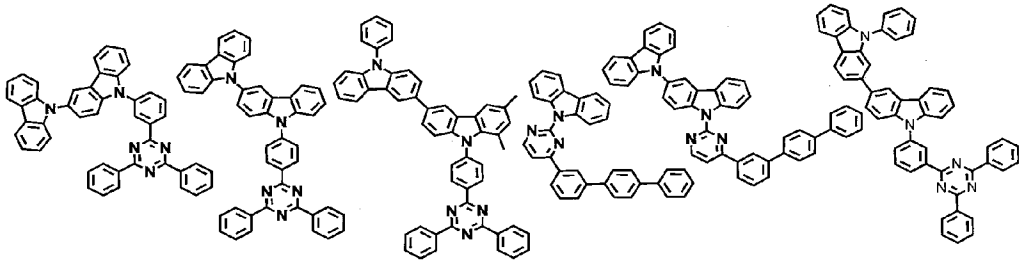
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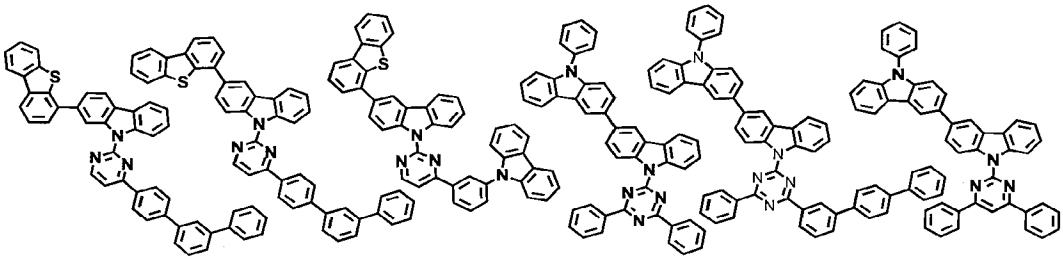
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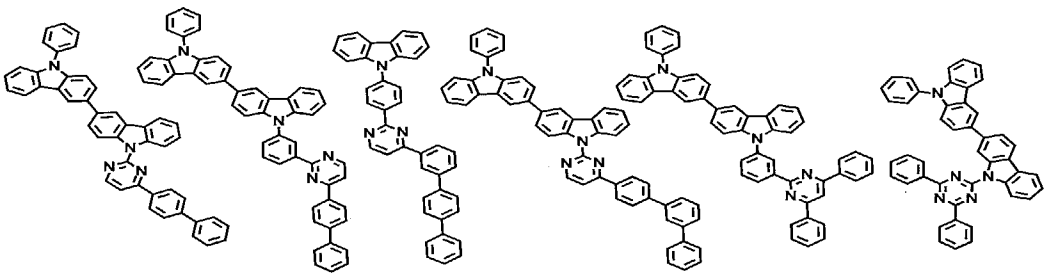
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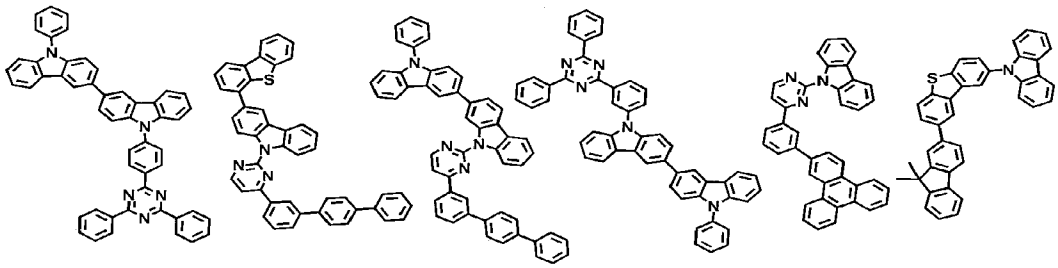
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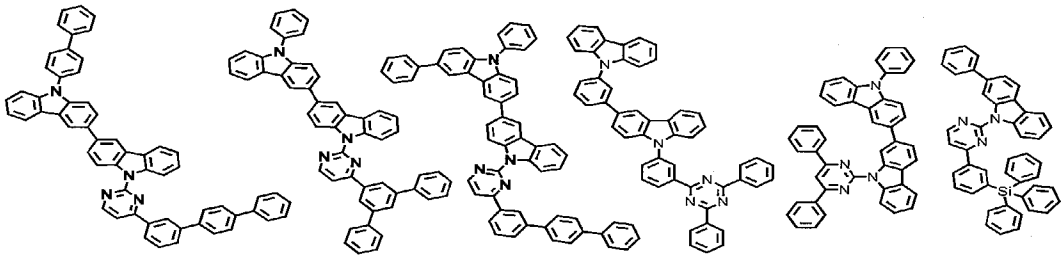
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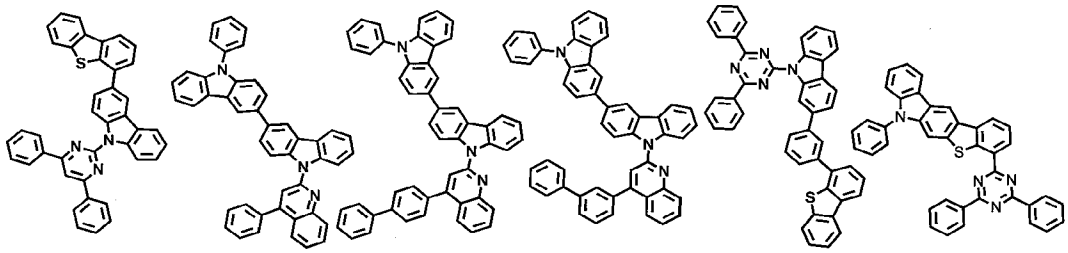
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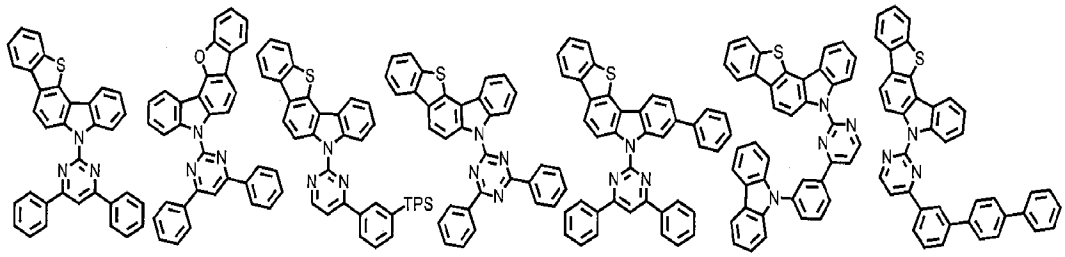
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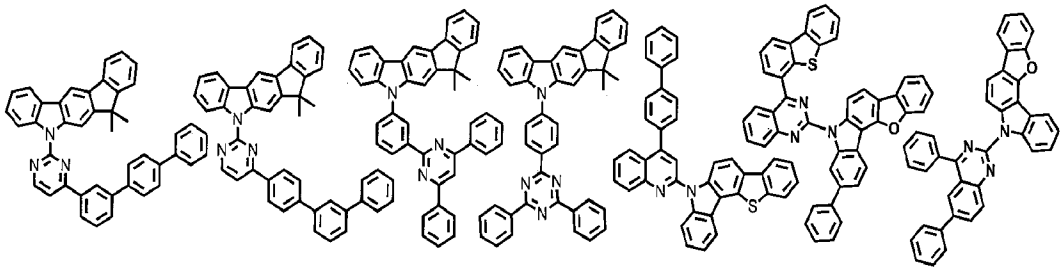
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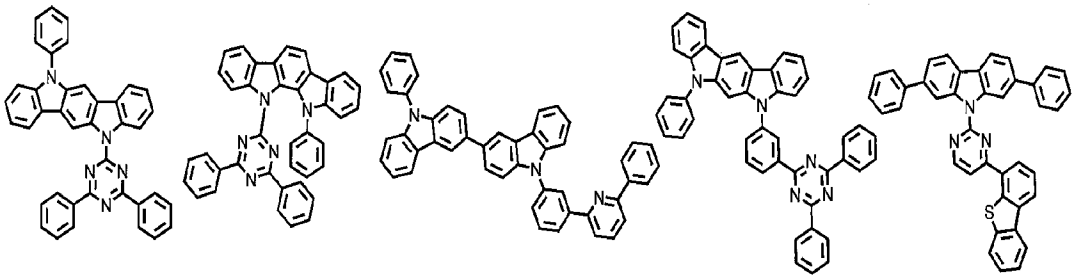
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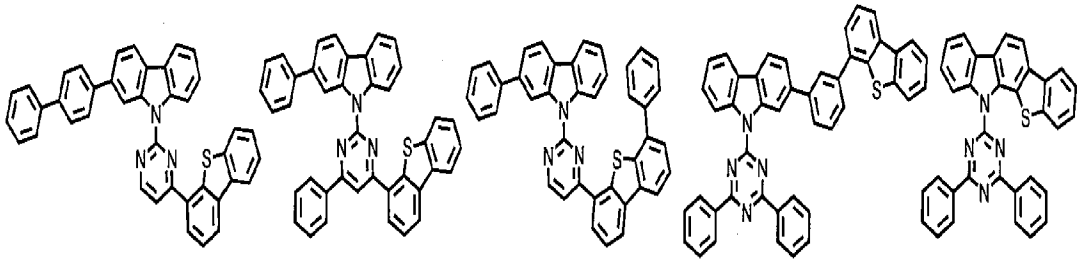
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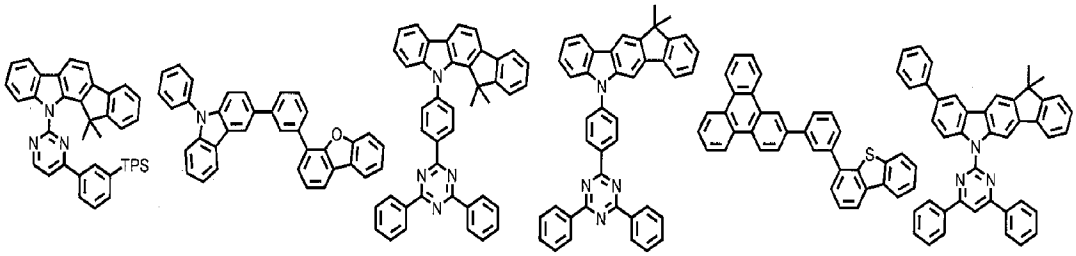
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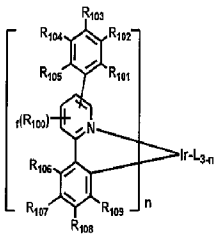


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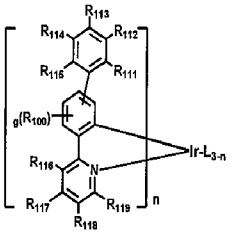


[113] According to the present invention, the dopant used in the manufacture of the organic electroluminescent device is preferably one or more phosphorescent dopants. The phosphorescent dopant material applied to the electroluminescent device according to the present invention is not limited, but preferably may be selected from complex compounds of iridium, osmium, copper and platinum; more preferably ortho-metallated complex compounds of iridium, osmium, copper and platinum; and even more preferably ortho-metallated iridium complex compounds.

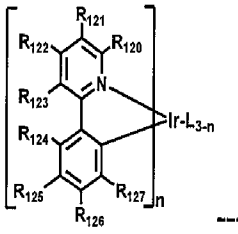
[114] According to the present invention, the dopant comprised in the organic electroluminescent device may be selected from compounds represented by the following formulas 7 to 9.

[115] 

---------(7)

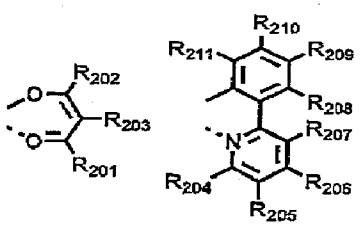
[116] 

---------(8)

[117] 

----------(9)

[118] wherein L is selected from the following structures:

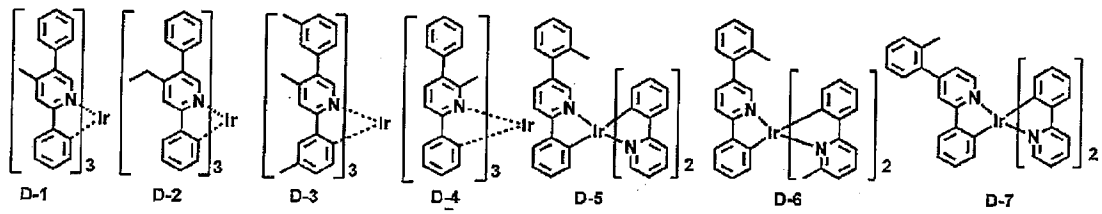
[119] 

[120] R_{100} represents hydrogen, a substituted or unsubstituted (C1-C30)alkyl group, or a substituted or unsubstituted (C3-C30)cycloalkyl group; R_{101} to R_{109}, and R_{111} to R_{123} each independently represent hydrogen, deuterium, a halogen, a (C1-C30)alkyl group unsubstituted or substituted with halogen(s), a substituted or unsubstituted

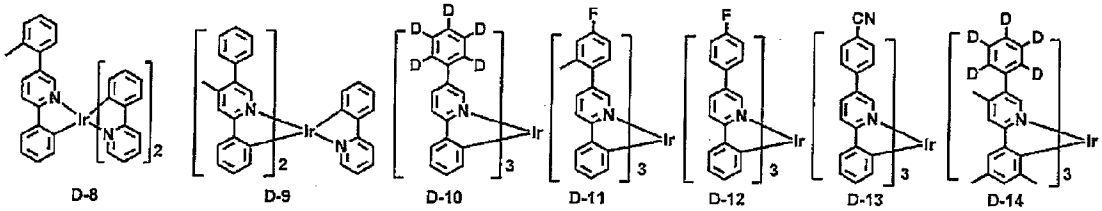
(C3-C30)cycloalkyl group, a cyano group, or a substituted or unsubstituted (C1-C30)alkoxy group; R_{120} to R_{123} are linked to an adjacent substituent to form a fused ring, e.g. quinoline; R_{124} to R_{127} each independently represent hydrogen, deuterium, a halogen, a substituted or unsubstituted (C1-C30)alkyl group, or a substituted or unsubstituted (C6-C30)aryl group; where R_{124} to R_{127} are aryl groups, adjacent substituents may be linked to each other to form a fused ring, e.g. fluorene; R_{201} to R_{211} each independently represent hydrogen, deuterium, a halogen, a (C1-C30)alkyl group unsubstituted or substituted with halogen(s), or a substituted or unsubstituted (C3-C30)cycloalkyl group; f and g each independently represent an integer of 1 to 3; where f or g is an integer of 2 or more, each of R_{100} is the same or different; and n is an integer of 1 to 3.

[121] Specifically, the phosphorescent dopant may be selected from compounds represented by the following compounds:

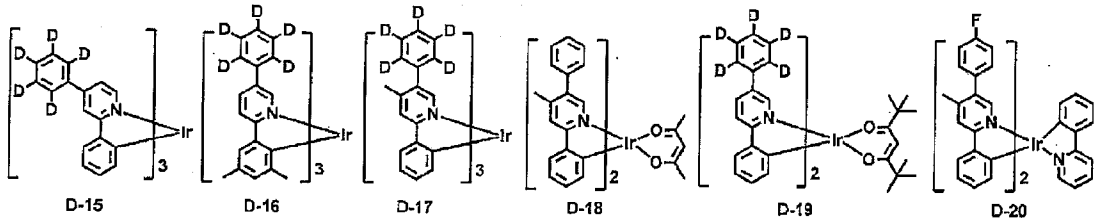
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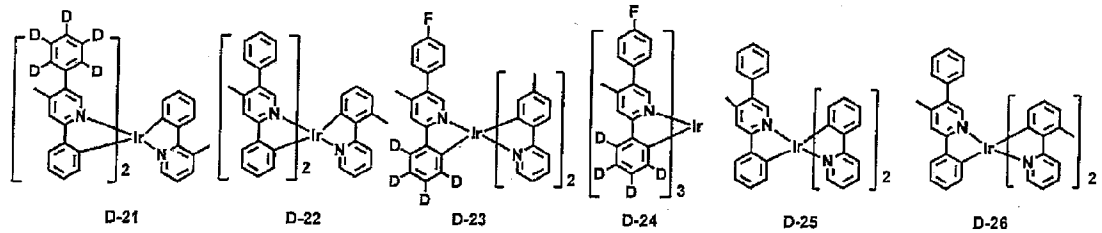
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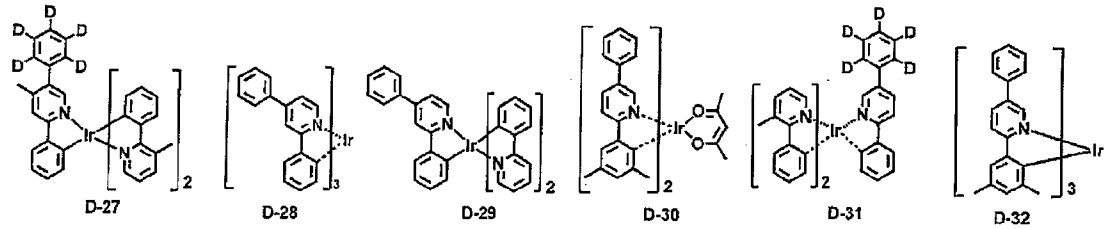
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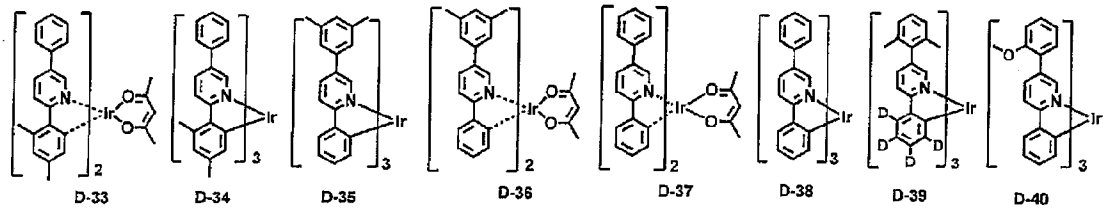
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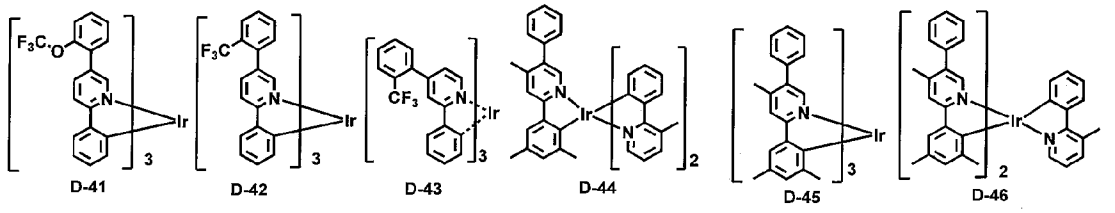
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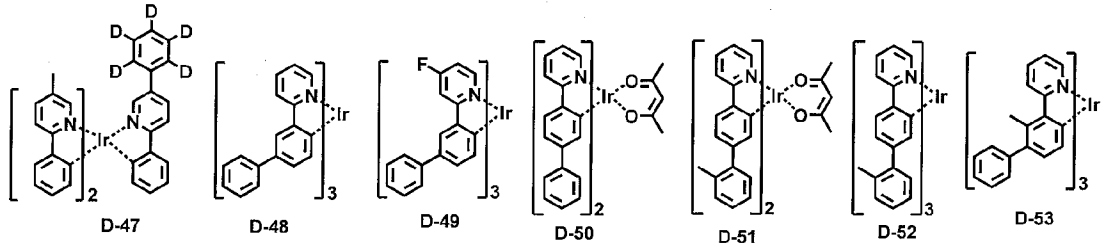
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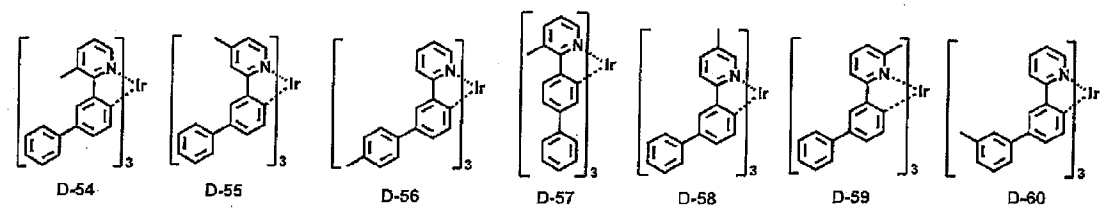
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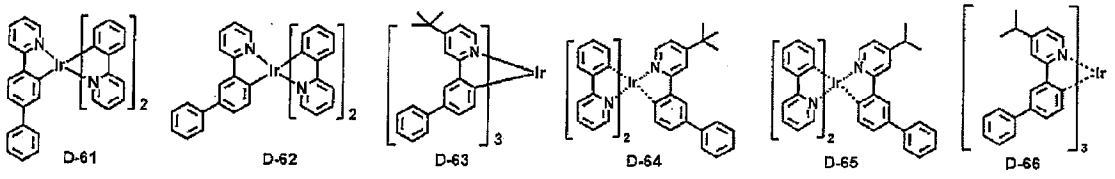
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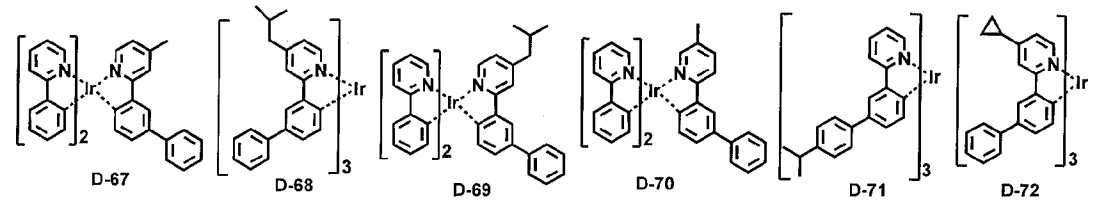
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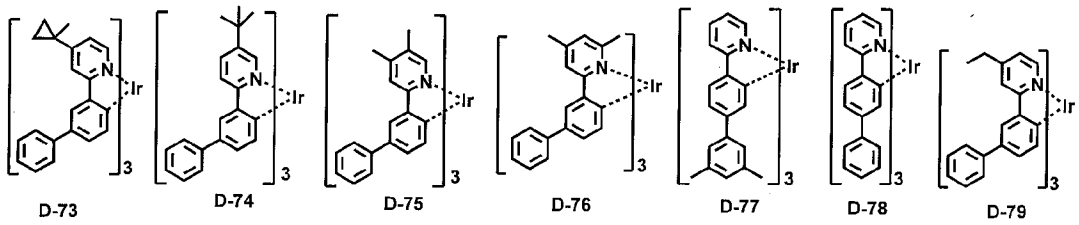
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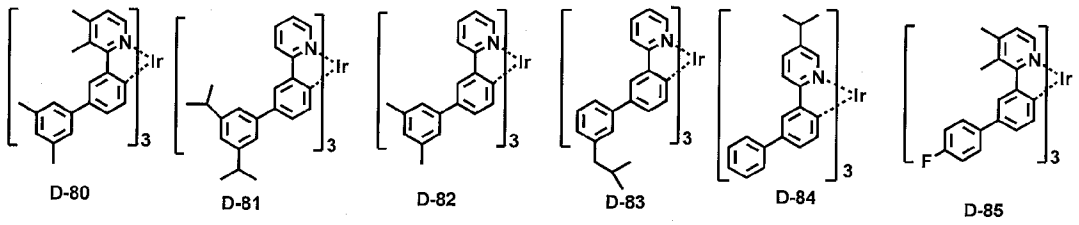
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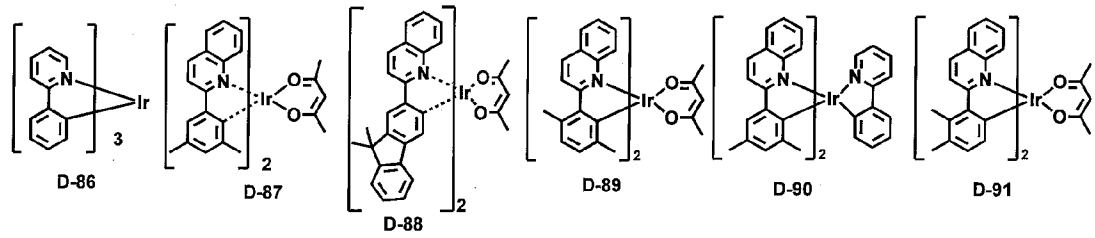
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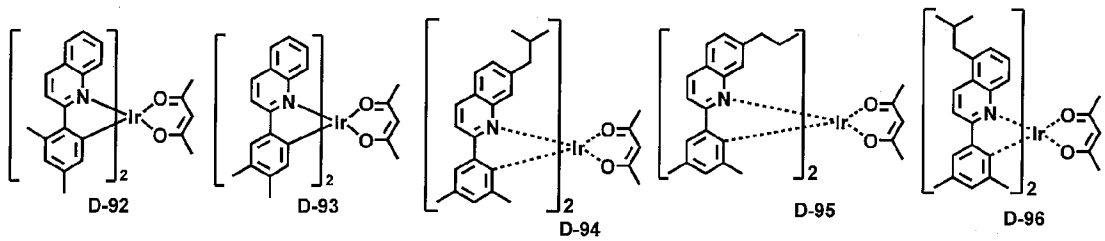
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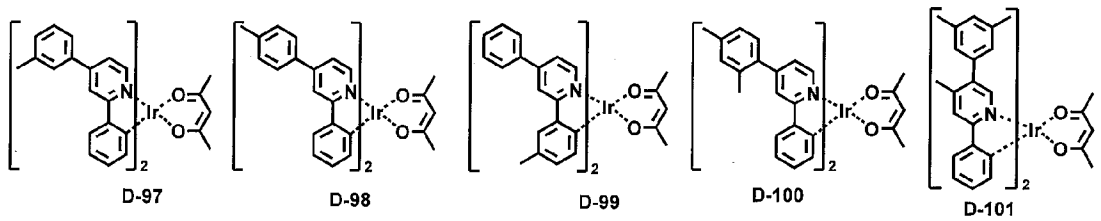
[135]



[136]



[137]



[138] The present invention further provides a material for an organic electroluminescent device. The material comprises a first host material and a second host material, wherein the compound according to the present invention can be comprised as a first host material, wherein the ratio of the organic electroluminescent compound according to the present invention (a first host material) to the second host material can be in the range of 1:99 to 99:1.

[139] Further, the organic electroluminescent device comprises a first electrode, a second electrode, and at least one organic layer between the first and second electrodes. The organic layer comprises a light-emitting layer, wherein the light-emitting layer comprises the material for the organic electroluminescent device according to the present invention and a phosphorescent dopant material, and the material for the

organic electroluminescent device according to the present invention is used as a host material.

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

[141] In the organic electroluminescent device according to the present invention, the organic layer may further comprise 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. The organic layer may comprise a light-emitting layer and a charge generating layer.

[142] In addition, the organic electroluminescent device 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 compound according to the present invention. Additionally, if needed, it further comprises a yellow or orange light-emitting layer.

[143] According to the present invention, at least one layer (hereinafter, "a surface layer") of the organic electroluminescent device preferably 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, a chalcogenide(includes oxides) layer of silicon or aluminum is preferably placed on an anode surface of an electroluminescent medium layer, and a metal halide layer or a metal oxide layer is placed on a cathode surface of an electroluminescent medium layer. Such a surface layer provides operation stability for the organic electroluminescent device. Preferably, the chalcogenide includes $SiO_X(1\leq X\leq 2)$, $AlO_X(1\leq X\leq 1.5)$, SiON, SiAlON, etc.; the metal halide includes LiF, MgF_2, CaF_2, a rare earth metal fluoride, etc.; and the metal oxide includes Cs_2O, Li_2O, MgO, SrO, BaO, CaO, etc.

[144] 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.

[145] As for the formation of the layers of the organic electroluminescent device according to the present invention, dry film-forming methods such as vacuum evaporation, sputtering, plasma and ion plating methods, or wet film-forming methods such as spin coating, dipping and flow coating methods can be used.

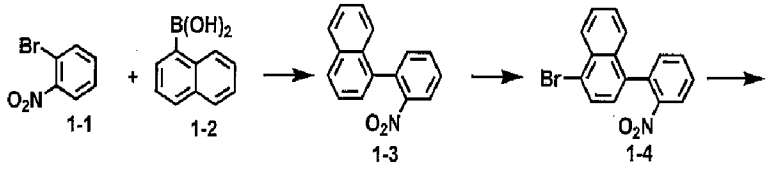
[146] When applying a wet film-forming method, a thin film is formed by dissolving or diffusing materials forming each layer into any suitable solvent such as ethanol, chloroform, tetrahydrofuran, dioxane, etc.

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

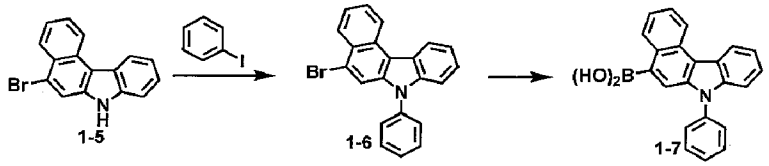
[148]

[149] Example 1: Preparation of compound **C-18**

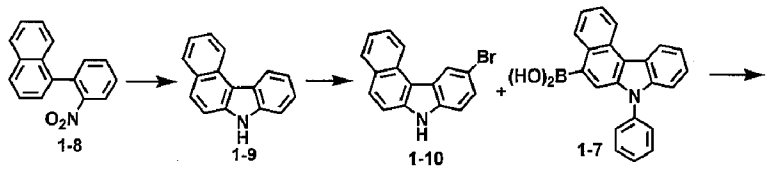
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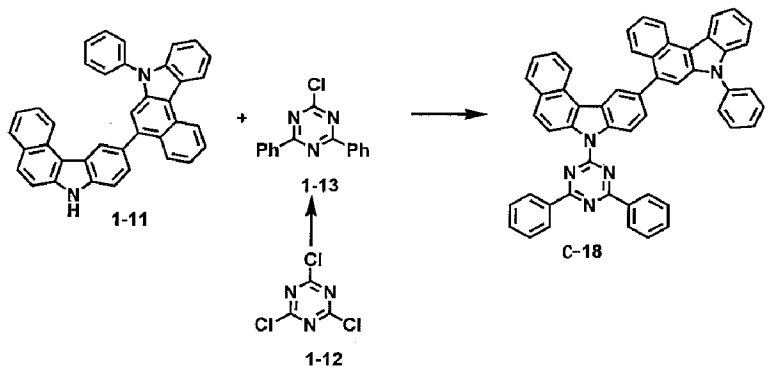
[151]



[152]



[153]



[154] Preparation of compound 1-3

[155] After dissolving compound 1-1 (50.7 g, 251 mmol), compound 1-2 (43.2 g, 251 mmol), $Pd(PPh_3)_4$ (11 g, 10 mmol) and K_2CO_3 (84.2 g, 609 mmol) in toluene (1 L)/EtOH (200 mL)/distilled water(200 mL), the reaction mixture was stirred for 2 hours at 90°C. The organic layer was distillated under reduced pressure, and then triturated with MeOH. The obtained solid was silica-filtered by dissolving in methylene chloride (MC), and then triturated with MC and hexane to obtain compound 1-3 (50 g, 80 %).

[156] Preparation of compound 1-4

[157] Compound 1-3 (20 g, 80.24 mmol) was dissolved in CCl_4 (20 mL). After putting Br_2 (4.1 g, 80.24 mmol), the reaction mixture was stirred for a day at room temperature. After terminating the reaction, the reaction mixture was extracted with ethyl acetate (EA), and the obtained organic layer was concentrated. The organic layer was purified by a silica column to obtain compound 1-4 (25.6 g, 97 %).

[158] Preparation of compound 1-5

[159] After dissolving compound 1-4 (25.6 g, 78 mmol) in $P(OEt)_3$ (200 mL) and 1,2-dichlorobenzene (150 mL), the reaction mixture was stirred for a day at 150°C. After terminating the reaction, the reaction mixture was concentrated under reduced pressure, and extracted with EA. The obtained organic layer was concentrated, and purified by a silica column to obtain compound 1-5 (12 g, 52 %).

[160] Preparation of compound 1-6

[161] After dissolving compound 1-5 (12 g, 41 mmol), iodobenzene (9.2 mL, 82 mmol), CuI (3.9 g, 20.5 mmol), ethylenediamine (EDA) (1.4 mL, 20.5 mmol) and Cs_2CO_3 (40 g, 123 mmol) in toluene (250 mL), the reaction mixture was stirred under reflux for a day. After extracting with EA, the reaction mixture was distilled under reduced pressure, and was purified by a column chromatography with MC/Hexane to obtain compound 1-6 (14 g, 93 %).

[162] Preparation of compound 1-7

[163] After dissolving compound 1-6 (14 g, 37.6 mmol) in tetrahydrofuran (THF) (140 mL) and adding 2.5 M n-BuLi (18 mL, 45.1 mmol) in hexane at -78°C, the reaction mixture was stirred for one hour. The reaction mixture was then stirred for 2 hours while slowly adding $B(OMe)_3$ (13 mL, 56.4 mmol). After quenching by adding 2 M HCl, the reaction mixture was extracted with distilled water and EA. After recrystallizing using MC and hexane, compound 1-7 (6 g, 47 %) was obtained.

[164] Preparation of compound 1-9

[165] After dissolving compound 1-8 (20 g, 80.2 mmol) in $P(OEt)_3$ (200 mL) and 1,2-dichlorobenzene (200 mL), the reaction mixture was stirred for one hour at 150°C. After terminating the reaction, the reaction mixture was concentrated under reduced pressure, and extracted with EA. The obtained organic layer was concentrated, and

purified by a silica column to obtain compound 1-9 (8.7 g, 50 %).

[166] Preparation of compound 1-10

[167] After dissolving compound 1-9 (8.7 g, 40.1 mmol) in dimethylformamide (DMF) (50 mL), and adding N-bromosuccinimide (NBS) (4.7 g, 40.1 mmol), the reaction mixture was stirred for a day at room temperature. After terminating the reaction, the reaction mixture was extracted with EA, and the organic layer was concentrated. The resulting product was purified by a silica column to give compound 1-10 (9.5 g, 80 %).

[168] Preparation of compound 1-11

[169] After dissolving compound 1-7 (6 g, 17.8 mmol), compound 1-10 (4.4 g, 14.9 mmol), K_2CO_3 (6.2 g, 44.7 mmol) and $Pd(PPh_3)_4$ (860 mg, 0.75 mmol) in toluene (100 mL)/EtOH(20 mL)/purified water (20 mL), the reaction mixture was stirred for 3 hours at 95°C. After terminating the reaction, the reaction mixture was cooled to room temperature, and left standing to remove the water layer. After concentrating, the oil layer was triturated with MC and filtered to obtain compound 1-11 (7 g, 92 %).

[170] Preparation of compound 1-13

[171] After dissolving compound 1-12 (36 g, 195 mmol) in THF (360 mL), the reaction mixture was cooled to 0°C, and PhMgBr (160 mL) was added slowly. While increasing the temperature to room temperature, the reaction mixture was stirred for 2 hours. After terminating the reaction by adding distilled water, the organic layer was extracted with EA, dried using magnesium sulfate, and recrystallized with MC/MeOH to obtain compound 1-13 (12 g, 72 %).

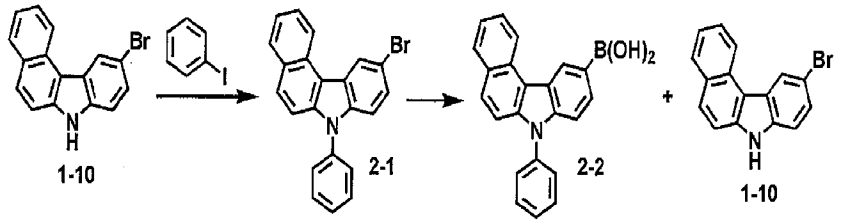
[172] Preparation of compound C-18

[173] After suspending compound 1-11 (800 mg, 1.6 mmol) and compound 1-13 (508 mg, 1.9 mmol) in DMF (1 mL), 60 % NaH (83 g, 2 mmol) was added at room temperature. The reaction mixture was stirred for 12 hours. After adding purified water, the reaction mixture was filtered under reduced pressure. The obtained solid was triturated with MeOH/EA, dissolved in MC, silica-filtered, and triturated with MC/n-hexane to obtain compound C-18 (1 g, 83.3 %).

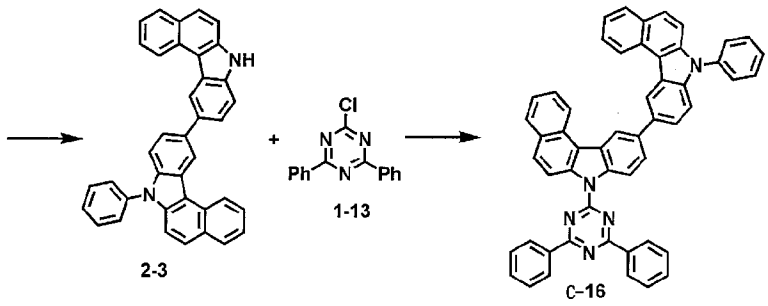
[174] MS/FAB found 739.86; calculated 739.27

[175]

[176] Example 2: Preparation of compound **C-16**

[177] 

[178]



[179] Preparation of compound 2-1

[180] Using compound 1-10 (7.5 g, 25.3 mmol) and iodobenzene (7.5 mL, 51 mmol), compound 2-1 (7.9 g, 84 %) was obtained in the same manner as compound 1-6 of Example 1.

[181] Preparation of compound 2-2

[182] Using compound 2-1 (7.5 g, 79 mmol) and $B(Oi\text{-}Pr)_3$ (6.8 mL, 119 mmol), compound 2-2 (5 g, 75 %) was obtained in the same manner as compound 1-7 of Example 1.

[183] Preparation of compound 2-3

[184] Using compound 2-1 (8 g, 27 mmol) and compound 2-2 (10.9 g, 32.4 mmol), compound 2-3 (11.5 g, 87 %) was obtained in the same manner as compound 1-11 of Example 1.

[185] Preparation of compound C-16

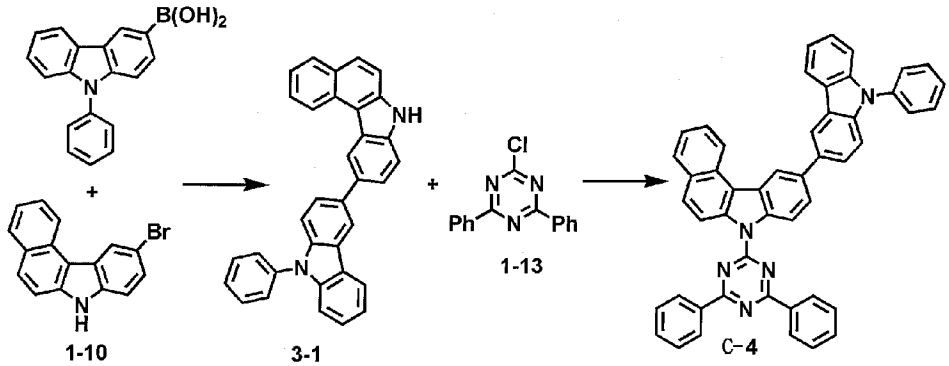
[186] Using compound 2-3 (2.9 g, 5.7 mmol) and compound 1-13 (1.7 g, 6.3 mmol), compound C-16 (11.5 g, 87 %) was obtained in the same manner as compound C-18 of Example 1.

[187] MS/FAB found 739.86; calculated 739.27

[188]

[189] Example 3: Preparation of compound **C-4**

[190]



[191] Preparation of compound 3-1

[192] Using 9-phenylcarbazolyl-3-boronic acid (9.3 g, 32.4 mmol) and compound 1-10 (4.3 g, 27 mmol), compound 3-1 (9.7 g, 78 %) was obtained in the same manner as compound 1-11 of Example 1.

[193] Preparation of compound C-4

[194] Using compound 3-1 (2.3 g, 5 mmol) and compound 1-13 (1.5 g, 5.5 mmol), compound C-4 (2.5 g, 72 %) was obtained in the same manner as compound C-18 of Example 1.

[195] MS/FAB found 689.80; calculated 689.26

[196]

[197] Device Example 1: Production of an OLED device using the compound according to the present invention

[198] An OLED device was produced using the 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. $N^1,N^{1'}$-([1,1'-biphenyl]-4,4'-diyl)bis(N^1-(naphthalen-1-yl)-N^4,N^4-diphenylbenzene-1,4-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 10^{-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, N,N'-di(4-biphenyl)-N,N'-di(4-biphenyl)-4,4'-diaminobiphenyl was introduced into another cell of the vacuum vapor depositing apparatus, and was evaporated by applying a electric current to the cell, thereby forming a hole transport layer having a thickness of 20 nm on the hole injection layer. Thereafter, compound **C-18** was introduced into one cell of the vacuum vapor depositing apparatus, as a host material, and compound **D-88** was introduced into another cell as a dopant. The two materials were evaporated at different rates and deposited in a doping amount of 4 wt% based on the total amount 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(naphthalen-2-yl)anthracen-2-yl)phenyl)-1-phenyl-1H-benzo[*d*]imidazole was introduced into one cell and lithium quinolate was introduced into another cell. The two materials were evaporated at the same rate and deposited in a doping amount of 50 wt% to form an electron transport layer having a thickness of 30 nm 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 material used for producing the OLED device were purified by vacuum sublimation at 10^{-6} torr

prior to use.

[199] The produced OLED device showed a red emission having a luminance of 1,040 cd/m^2 and a current density of 15.7 mA/cm^2 at a driving voltage of 3.5 V. Further, it took a minimum of 35 hours to reduce luminance by 90 % at a luminance of 5,000 nit.

[200] Device Example 2: Production of an OLED device using the compound according to the present invention

[201] An OLED device was produced in the same manner as that of Device Example 1, except that compound **C-4** was used in a host and compound **D-87** was used in a dopant as the light-emitting material.

[202] As a result, the produced OLED device showed a red emission having a luminance of 1,020 cd/m^2 and a current density of 7.8 mA/cm^2 at a driving voltage of 3.8 V. Further, it took a minimum of 40 hours to reduce luminance by 90 % at a luminance of 5,000 nit.

[203] Device Example 3: Production of an OLED device using the compound according to the present invention

[204] An OLED device was produced in the same manner as that of Device Example 1, except that compound **C-16** was used in a host and compound **D-88** was used in a dopant as the light-emitting material.

[205] As a result, the produced OLED device showed a red emission having a luminance of 1,010 cd/m^2 and a current density of 12.5 mA/cm^2 at a driving voltage of 4.0 V. Further, it took a minimum of 40 hours to reduce luminance by 90 % at a luminance of 5,000 nit.

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

[207] electroluminescent compounds

[208] An OLED device was produced in the same manner as that of Device Example 1, except that as a light-emitting material 4,4'-N,N'-dicarbazol-biphenyl was used as a host material and compound **D-88** was used as a dopant; a light-emitting layer having a thickness of 30 nm was deposited on a hole transport layer; and a hole blocking layer having a thickness of 10 nm was deposited by using aluminum(III) bis(2-methyl-8-quinolinato)4-phenylphenolate.

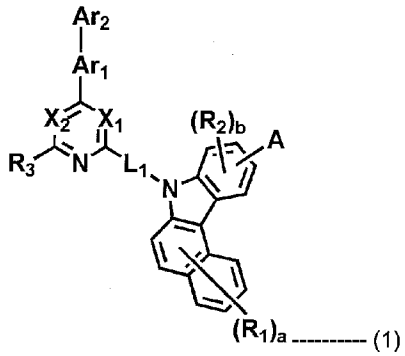
[209] As a result, the produced OLED device showed a red emission having a luminance of 1,000 cd/m^2 and a current density of 20.0 mA/cm^2 at a driving voltage of 8.2 V. Further, it took a minimum of 10 hours to reduce luminance by 90 % at a luminance of 5,000 nit.

[210] The present invention makes it possible to manufacture a device free from crystallization since the compounds used in the organic electronic material are highly efficient in transporting electrons. Further, the organic electroluminescent compound according to the present invention has good layer formability and an advantage of

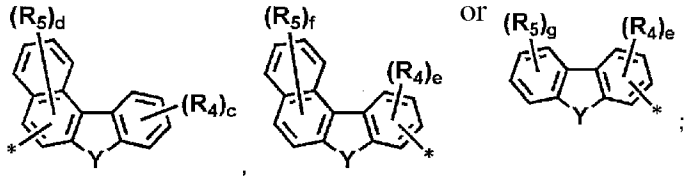
manufacturing an OLED device having long operating lifespan due to its excellent lifespan characteristics, lower driving voltages, high luminous efficiency, and reduced power consumption induced by improved power efficiency.

Claims

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



wherein

A represents ;

L_1 represents a single bond, a substituted or unsubstituted 3- to 30-membered heteroarylene group, a substituted or unsubstituted (C6-C30)arylene group, or a substituted or unsubstituted (C3-C30)cycloalkylene group;

X_1 and X_2 each independently represent CR_6 or N;

Y represents -O-, -S-, $-CR_{11}R_{12}-$, $-SiR_{11}R_{12}-$, or $-NR_{13}-$;

Ar_1 represents a single bond, a substituted or unsubstituted 3- to 30-membered heteroarylene group, a substituted or unsubstituted (C6-C30)arylene group, or a substituted or unsubstituted (C1-C30)alkylene group;

Ar_2 represents hydrogen, deuterium, a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C6-C30)aryl group, or a substituted or unsubstituted 3- to 30-membered heteroaryl group;

R_1 to R_6 each independently represent hydrogen, deuterium, a halogen, a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C6-C30)aryl group, a substituted or unsubstituted 3- to 30-membered heteroaryl group, a substituted or unsubstituted (C3-C30)cycloalkyl group, a substituted or unsubstituted 5- to 7-membered heterocycloalkyl group, a substituted or unsubstituted (C6-C30)aryl(C1-C30)alkyl group, a substituted or unsubstituted

(C6-C30)aryl group fused with at least one substituted or unsubstituted (C3-C30)cycloalkyl, a substituted or unsubstituted 5-to 7-membered heterocycloalkyl group fused with at least one substituted or unsubstituted aromatic ring, a substituted or unsubstituted (C3-C30)cycloalkyl group fused with at least one substituted or unsubstituted aromatic ring, $-NR_{14}R_{15}$, $-SiR_{16}R_{17}R_{18}$, $-SR_{19}$, $-OR_{20}$, a (C2-C30)alkenyl group, a (C2-C30)alkynyl group, a cyano group or a nitro group;

R_{11} to R_{13} each independently represent a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C6-C30)aryl group, or a substituted or unsubstituted 3- to 30-membered heteroaryl group;

R_{14} to R_{20} each independently represent hydrogen, deuterium, a halogen, a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C6-C30)aryl group, or a substituted or unsubstituted 3- to 30-membered heteroaryl group; or are linked to an adjacent substituent(s) to form a 3- to 30-membered mono- or polycyclic, alicyclic or aromatic ring whose carbon atom(s) may be replaced with at least one hetero atom selected from nitrogen, oxygen and sulfur;

a and f each independently represent an integer of 1 to 6; where a or f is an integer of 2 or more, each of R_1, or each of R_5 is the same or different;

b and e each independently represent an integer of 1 to 3; where b or e is an integer of 2 or more, each of R_2, or each of R_4 is the same or different;

c and g each independently represent an integer of 1 to 4; where c or g is an integer of 2 or more, each of R_4, or each of R_5 is the same or different;

d represents an integer of 1 to 5; where d is an integer of 2 or more, each of R_5 is the same or different; and

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

[Claim 2] The organic eletroluinescence compound according to claim 1, wherein the substituents of the substituted groups in L_1, Ar_1, Ar_2, R_1 to R_6 and R_{11} to R_{20} groups each independently are at least one selected from the group consisting of deuterium; a halogen; a (C1-C30)alkyl group substituted or unsubstituted with a halogen; a (C6-C30)aryl group; a 3- to

30-membered heteroaryl group substituted or unsubstituted with a (C6-C30)aryl; a (C3-C30)cycloalkyl group; a 5- to 7-membered hetero-cycloalkyl group; a tri(C1-C30)alkylsilyl group; a tri(C6-C30)arylsilyl group; a di(C1-C30)alkyl(C6-C30)arylsilyl group; a (C1-C30)alkyldi(C6-C30)arylsilyl group; a (C2-C30)alkenyl group; a (C2-C30)alkynyl group; a cyano group; an N-carbazolyl group; a di(C1-C30)alkylamino group; a di(C6-C30)arylamino group; a (C1-C30)alkyl(C6-C30)arylamino group; a di(C6-C30)arylboronyl group; a di(C1-C30)alkylboronyl group; a (C1-C30)alkyl(C6-C30)arylboronyl group; a (C6-C30)aryl(C1-C30)alkyl group; a (C1-C30)alkyl(C6-C30)aryl group; a carboxyl group; a nitro group; and a hydroxyl group.

[Claim 3] The organic electroluminescent compound according to claim 1, wherein

L_1 represents a single bond, a 3- to 30-membered heteroarylene group or a (C6-C30)arylene group;

X_1 and X_2 each independently represent CR_6 or N;

Y represents -O-, -S-, $-CR_{11}R_{12}-$, $-SiR_{11}R_{12}-$, or $-NR_{13}-$;

Ar_1 represents a single bond or a (C6-C30)arylene group;

Ar_2 represents hydrogen, deuterium, a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C6-C30)aryl group, or a substituted or unsubstituted 3- to 30-membered heteroaryl group, 1,2-dihydroacenaphtyl group, a substituted or unsubstituted N-carbazolyl group, a substituted or unsubstituted N-benzocarbazolyl group, or a substituted or unsubstituted N-dibenzocarbazolyl group;

R_1 to R_6 each independently represent hydrogen, deuterium, a halogen, a (C1-C30)alkyl group, a (C6-C30)aryl group, a 3- to 30-membered heteroaryl group, or an N-carbazolyl group;

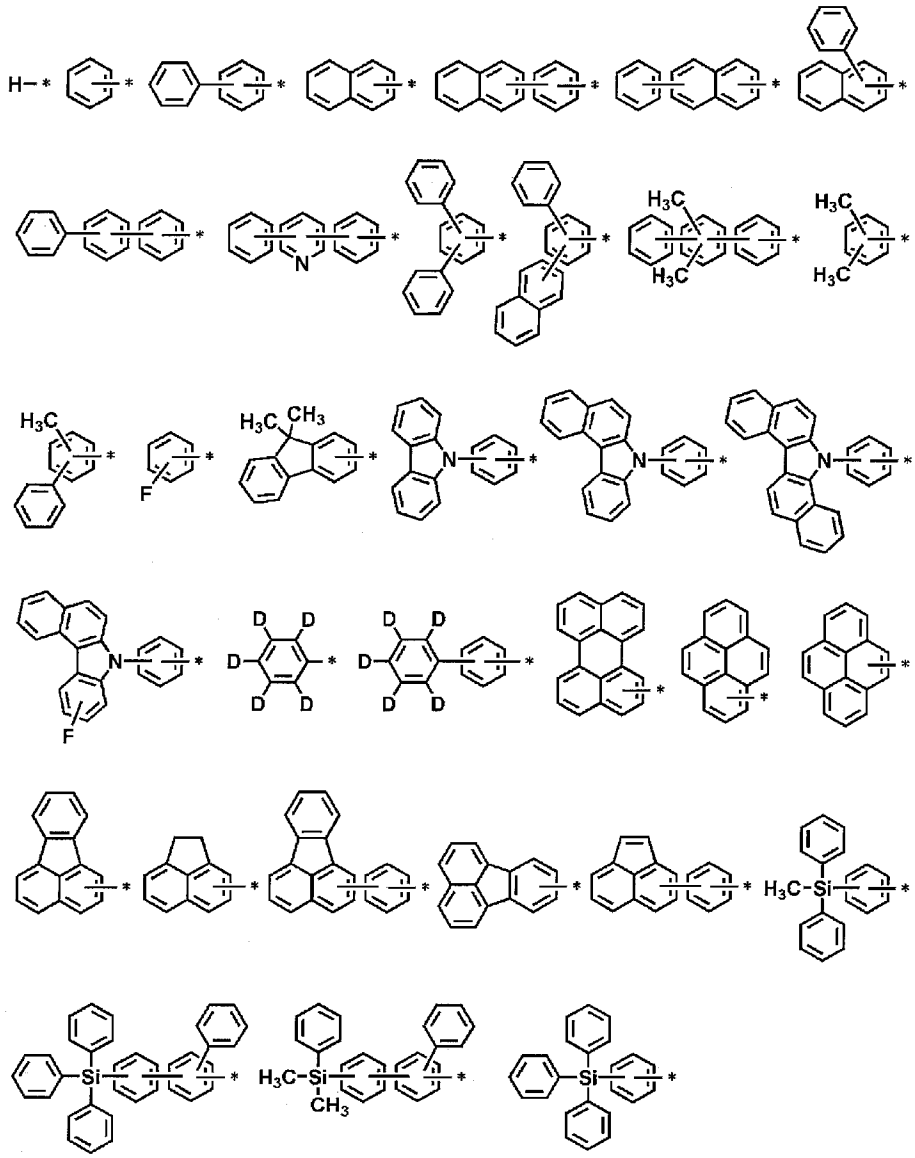
R_{11} to R_{13} each independently represent a (C1-C30)alkyl group, a (C6-C30)aryl group, or a 3- to 30-membered heteroaryl group; and

the heteroarylene and arylene groups in L_1, the arylene group in Ar_1, the alkyl, aryl, heteroaryl, N-carbazolyl, N-benzocarbazolyl and N-dibenzocarbazolyl groups in Ar_2, the alkyl, aryl, heteroaryl and N-carbazolyl groups in R_1 to R_6, and the alkyl, aryl and heteroaryl groups in R_{11} to R_{13} each independently can be substituted with at least one selected from the group consisting of deuterium; a halogen; a (C1-C30)alkyl group substituted or unsubstituted with a halogen; a (C6-C30)aryl group; a 3- to 30-membered heteroaryl group; a

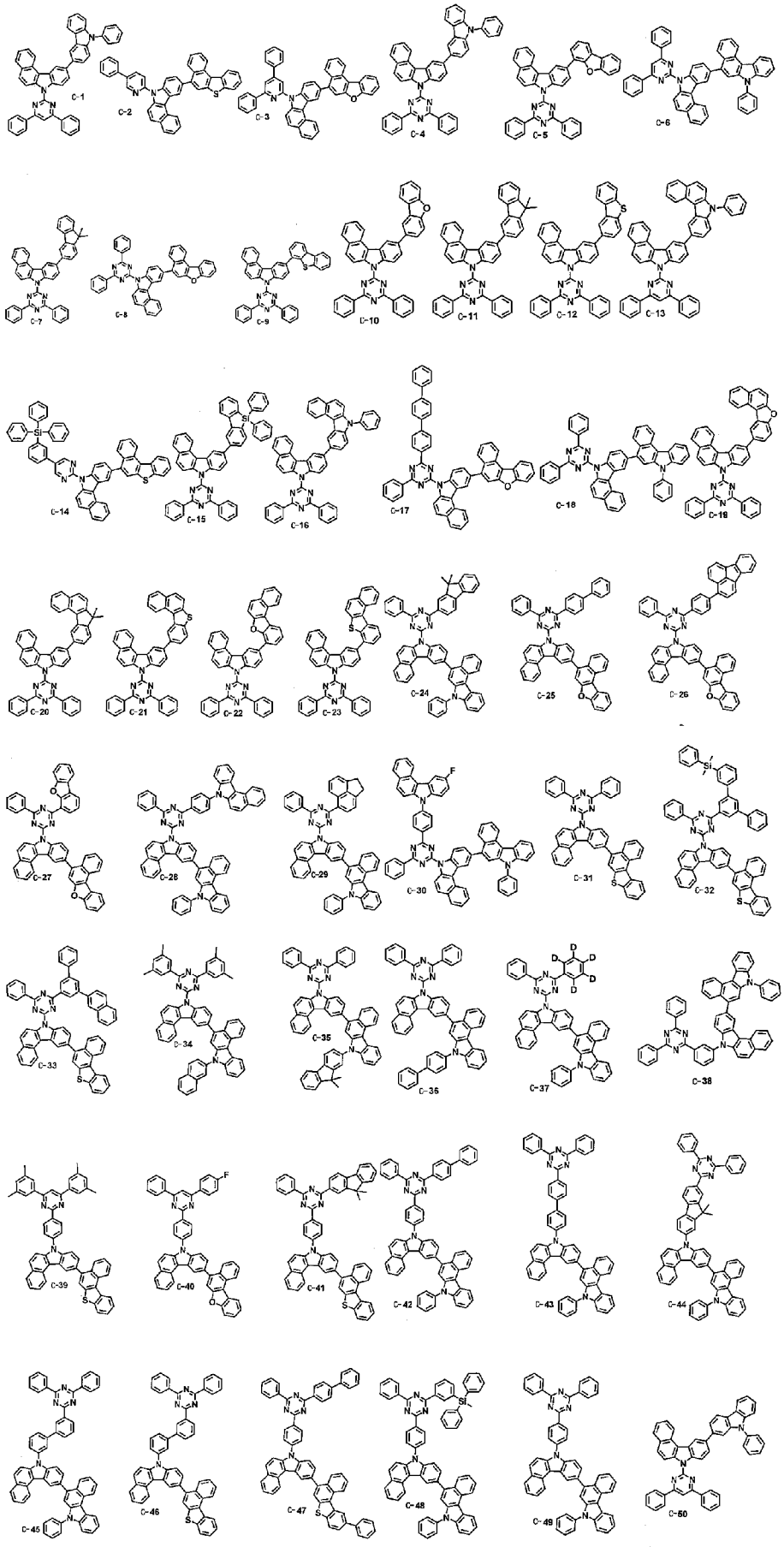
tri(C1-C30)alkylsilyl group; a tri(C6-C30)arylsilyl group; a di(C1-C30)alkyl(C6-C30)arylsilyl group; a (C1-C30)alkyldi(C6-C30)arylsilyl group; a cyano group; an N-carbazolyl group; a (C6-C30)aryl(C1-C30)alkyl group; a (C1-C30)alkyl(C6-C30)aryl group; a carboxyl group; a nitro group; and a hydroxyl group.

[Claim 4] The organic electroluminescent compound according to claim 1, wherein

the moiety, Ar_2-Ar_1-* in formula 1 is selected from the following structures:



[Claim 5] The organic electroluminescent compound according to claim 1, wherein the compound represented by formula 1 is selected from the group consisting of:


C-1
C-2
C-3
C-4
C-5
C-6
C-7
C-8
C-9
C-10
C-11
C-12
C-13
C-14
C-15
C-16
C-17
C-18
C-19
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C-30
C-31
C-32
C-33
C-34
C-35
C-36
C-37
C-38
C-39
C-40
C-41
C-42
C-43
C-44
C-45
C-46
C-47
C-48
C-49
C-50

[Claim 6] An organic electroluminescent device comprising the organic electroluminescent compound according to claim 1.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2012/009686

A. CLASSIFICATION OF SUBJECT MATTER

C07D 401/04 (2006.01) ***C07D 401/08 (2006.01)*** ***C07D 401/10 (2006.01)*** ***C07D 401/12 (2006.01)*** ***C07D 401/14 (2006.01)*** ***C07D 407/14 (2006.01)*** ***C07D 409/14 (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)

Chemical Abstracts, Registry

Structure search based on claim 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	

[X] Further documents are listed in the continuation of Box C [X] 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

"E" earlier application or patent but published on or after the international filing date

"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)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"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

"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

"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

"&" document member of the same patent family

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

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INTERNATIONAL SEARCH REPORT C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		International application No. **PCT/KR2012/009686**
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2011/019156 A1 (ROHM AND HAAS ELECTRONIC MATERIALS KOREA LTD) 17 February 2011 pages 7, 8: compounds 18, 21-25, 28-34	1-4, 6
E	WO 2013/012298 A1 (ROHM AND HAAS ELECTRONIC MATERIALS KOREA LTD) 24 January 2013 claim 5: compounds 15, 26, 31, 37, 51, 55, 60, 66 and 77	1-4, 6

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/KR2012/009686**

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 2011/019156 A1	17 Feb 2011	CN 102918134 A	06 Feb 2013
		KR 20110015836 A	17 Feb 2011
		TW 201120186 A	16 Jun 2011
		US 2012235123 A1	20 Sep 2012
		WO 2011019156 A1	17 Feb 2011
WO 2013/012298 A1	24 Jan 2013	KR 20130011955 A	30 Jan 2013
		WO 2013012298 A1	24 Jan 2013

End of Annex

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