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(54) Title: A NOVEL ORGANIC ELECTROLUMINESCENCE COMPOUND AND AN ORGANIC ELECTROLUMINESCENCE DEVICE CONTAINING THE SAME

(57) Abstract: The present invention relates to a novel organic electroluminescent compound and an organic electroluminescent device comprising the same. The organic electroluminescent compound according to the present invention has superior luminous efficiency, and can provide an organic electroluminescent device having improved power efficiency by reducing the driving voltage of the device.



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Description

Title of Invention: A NOVEL ORGANIC ELECTROLUMINESCENCE COMPOUND AND AN ORGANIC ELECTROLUMINESCENCE DEVICE CONTAINING THE SAME

Technical Field

- [1] The present invention relates to a novel organic electroluminescent compound and an organic electroluminescent device containing 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. In this regard, 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)picolate iridium [Firpic] as red, green and blue materials, respectively.
- [4] In order to improve color purity, luminous efficiency, and stability, a host material mixed with a light-emitting material (dopant) can be used as a light-emitting material. When using such a light-emitting material (dopant)/a host material system, choosing the host material is important, since the host material has a large influence in efficiency and performance of a light-emitting device. Generally, 4,4'-N,N'-dicarbazole-biphenyl (CBP) is the most widely known phosphorescent light-emitting host material. Lately, Pioneer (Japan) et al., developed a high performance organic EL device employing a Bathocuproine (BCP) and aluminum(III) bis(2-methyl-8-quinolinato)(4-phenylphenolate) (BAIq), etc., as a host material, which were used as a hole blocking material.

- [5] Although these phosphorescent host materials have some advantages in view of light-emitting characteristics, they have the following disadvantages: (1) Due to their low glass transition temperature and poor thermal stability, they may be degraded during a high-temperature deposition process in a vacuum. (2) The power efficiency of an organic EL device is given by $[(\pi/\text{voltage}) \times \text{current efficiency}]$, and power efficiency is inversely proportional to voltage. An organic EL device comprising phosphorescent host materials provides a higher current efficiency (cd/A) than one comprising fluorescent materials. However, it has a higher driving voltage, and thus, there is no substantial merit in terms of power efficiency (lm/W). (3) Further, when the phosphorescent host materials are used in an OLED device, the operating lifespan of the device is unsatisfactory, and luminous efficiency still needs improvement.
- [6] Meanwhile, copper phthalocyanine(CuPc), 4,4'-bis[N-(1-naphthyl)-N-phenylamino]biphenyl(NPB), N,N'-diphenyl-N,N'-bis(3-methylphenyl)-(1,1'-biphenyl)-4,4'-diamine(TPD), 4,4',4''-tris(3-methylphenylphenylamino)triphenylamine(MTDATA), etc., were used as a hole injection and transport material in an organic EL device. However, such materials have problems with decreasing quantum efficiency and the lifespan of an organic EL device, because when the organic EL device is operated at high current, thermal stress occurs between an anode and a hole injection layer, which reduces the lifespan of the device. Further, since organic materials used in a hole injection layer have high motility of holes, hole-electron charge balance is lost and quantum efficiency (cd/A) is reduced.
- [7] Korean Patent Appln. Laying-Open No. 2009-0035729 A discloses amine compounds containing carbazole for an organic electroluminescence device. Further, Korean Patent Appln. Laying-Open No. 2011-0129766 A discloses amine compounds containing fused carbazole for an organic electroluminescence device. However, the organic EL devices comprising the compounds disclosed in the reference are still unsatisfactory in view of power efficiency, luminous efficiency, quantum efficiency, and lifespan, etc.

Disclosure of Invention

Technical Problem

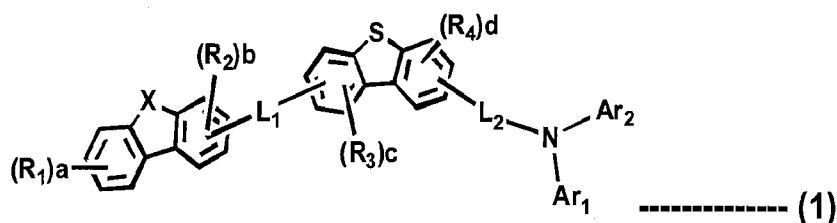
- [8] The objective of the present invention is to provide an organic electroluminescent compound having high luminous efficiency and superior lifespan over conventional materials, and to provide an organic electroluminescent device having high efficiency and long lifespan.

Solution to Problem

- [9] The present inventors found that the objective above is achievable by a compound

represented by the following formula 1:

[10]



[11]

wherein

[12]

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

[13]

Ar_1 and Ar_2 each independently represent a substituted or unsubstituted (C6-C30)aryl group, or a substituted or unsubstituted 5- to 30-membered heteroaryl group;

[14]

X represents oxygen atom, sulfur atom, or $-CR_5R_6-$;

[15]

R_1 to R_6 each independently represent hydrogen, deuterium, a halogen, a cyano group, a carboxyl group, a nitro group, a hydroxyl group, a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C2-C30)alkenyl group, a substituted or unsubstituted (C2-C30)alkynyl group, a substituted or unsubstituted (C1-C30)alkoxy group, a substituted or unsubstituted (C3-C30)cycloalkyl group, a substituted or unsubstituted (C3-C30)cycloalkenyl group, a substituted or unsubstituted 3- to 7-membered heterocycloalkyl group, a substituted or unsubstituted (C6-C30)aryl group, a (C6-C30)aryl group fused with a (C3-C30)cycloalkyl group, or a substituted or unsubstituted 5- to 30-membered heteroaryl group, $-NR_{11}R_{12}$, $-SiR_{13}R_{14}R_{15}$, $-SR_{16}$, $-OR_{17}$, $-COR_{18}$ or $-B(OR_{19})(OR_{20})$; 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 by at least one heteroatom selected from nitrogen, oxygen and sulfur;

[16]

R_{11} to R_{20} each independently represent hydrogen, deuterium, a halogen, a cyano group, a carboxyl group, a nitro group, a hydroxyl group, a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C2-C30)alkenyl group, a substituted or unsubstituted (C2-C30)alkynyl group, a substituted or unsubstituted (C1-C30)alkoxy group, a substituted or unsubstituted (C3-C30)cycloalkyl group, a substituted or unsubstituted (C3-C30)cycloalkenyl group, a substituted or unsubstituted 3- to 7-membered heterocycloalkyl 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 by at least one heteroatom selected from nitrogen, oxygen and sulfur;

- [17] a represents an integer of 1 to 4; where a is an integer of 2 or more, each of R₁ is the same or different;
- [18] b to d each independently represent an integer of 1 to 3; where b, c or d is an integer of 2 or more, each of R₂, each of R₃, and each of R₄ is the same or different;
- [19] the heteraryl(ene) group contains at least one hetero atom selected from B, N, O, S, P(=O), Si and P; and
- [20] the heterocycloalkyl group contains at least one hetero atom selected from O, S and N.

Advantageous Effects of Invention

- [21] The organic electroluminescent compound according to the present invention has high luminous efficiency and superior lifespan characteristics of material, and thus can provide an organic electroluminescent device, which is excellent in operational lifespan of the device. Further, the organic electroluminescent compound according to the present invention can reduce driving voltage and improve power efficiency of an organic electroluminescent device at the same time.

Mode for the Invention

- [22] 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.
- [23] 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.
- [24] Hereinafter, the organic electroluminescent compound represented by the above formula 1 will be described in detail.
- [25] In formula 1, above, L₁ and L₂ each independently represent a single bond, a substituted or unsubstituted (C6-C30)arylene group, or a substituted or unsubstituted 5- to 30-membered heteroarylene group; preferably a single bond, a substituted or unsubstituted (C6-C20)arylene group, or a substituted or unsubstituted 5- to 15-membered heteroarylene group; more preferably a single bond; a (C6-C20)arylene group unsubstituted or substituted with a (C1-C6)alkyl group, a (C1-C15)aryl group or a di(C6-C15)arylamino group; or an unsubstituted 5- to 10-membered heteroarylene group.
- [26] In formula 1, above, Ar₁ and Ar₂ each independently represent a substituted or unsubstituted (C6-C30)aryl group, or a substituted or unsubstituted 5- to 30-membered heteroaryl group; preferably a substituted or unsubstituted (C6-C15)aryl group, or a substituted or unsubstituted 5- to 15-membered heteroaryl group; more preferably a (C6-C15)aryl group unsubstituted or substituted with a (C1-C6)alkyl group, a

(C6-C15)aryl group, a di(C6-C15)arylamino group, or a (C6-C15)aryl(5- to 10-membered) heteroarylamino group; or a 5- to 10-membered heteroaryl group unsubstituted or substituted with a (C6-C15)aryl group or a di(C6-C15)arylamino group.

[27] In formula 1, above, X represents oxygen atom, sulfur atom, or -CR₅R₆;

[28] In formula 1, above, R₁ to R₆ each independently represent hydrogen, deuterium, a halogen, a cyano group, a carboxyl group, a nitro group, a hydroxyl group, a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C2-C30)alkenyl group, a substituted or unsubstituted (C2-C30)alkynyl group, a substituted or unsubstituted (C1-C30)alkoxy group, a substituted or unsubstituted (C3-C30)cycloalkyl group, a substituted or unsubstituted (C3-C30)cycloalkenyl group, a substituted or unsubstituted 3- to 7-membered heterocycloalkyl group, a substituted or unsubstituted (C6-C30)aryl group, a (C6-C30)aryl group fused with a (C3-C30)cycloalkyl group, or a substituted or unsubstituted 5- to 30-membered heteroaryl group, -NR₁₁R₁₂, -SiR₁₃R₁₄R₁₅, -SR₁₆, -OR₁₇, -COR₁₈ or -B(OR₁₉)(OR₂₀); 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 by at least one heteroatom selected from nitrogen, oxygen and sulfur; preferably hydrogen, a halogen, a substituted or unsubstituted (C1-C15)alkyl group, a substituted or unsubstituted (C6-C15)aryl group, a (C6-C15)aryl group fused with a (C3-C20)cycloalkyl group, a substituted or unsubstituted 5- to 15-membered heteroaryl group, -NR₁₁R₁₂, or -SiR₁₃R₁₄R₁₅; more preferably hydrogen; a halogen; an unsubstituted (C1-C6)alkyl group; a (C6-C15)aryl group unsubstituted or substituted with a (C1-C6)alkyl group or a (C6-C15)aryl group; a (C6-C15)aryl group fused with a (C3-C7)cycloalkyl group; an unsubstituted 5- to 15-membered heteroaryl group; or -NR₁₁R₁₂;

[29] R₁₁ to R₁₂ each independently represent preferably a substituted or unsubstituted (C6-C15)aryl group, or a substituted or unsubstituted 5- to 15-membered heteroaryl group; more preferably an unsubstituted (C6-C15)aryl group; and R₁₃ to R₁₅ each independently represent preferably a substituted or unsubstituted (C1-C10)alkyl group, or a substituted or unsubstituted (C6-C15)aryl group.

[30] According to an embodiment of the present invention in formula 1, above, L₁ and L₂ each independently represent a single bond, a substituted or unsubstituted (C6-C20)arylene group, or a substituted or unsubstituted 5- to 15-membered heteroarylene group; Ar₁ and Ar₂ each independently represent a substituted or unsubstituted (C6-C15)aryl group, or a substituted or unsubstituted 5- to 15-membered heteroaryl group; R₁ to R₆ each independently represent hydrogen, a halogen, a substituted or unsubstituted (C1-C15)alkyl group, a substituted or unsubstituted (C6-C15)aryl group, a (C6-C15)aryl group fused with a (C3-C20)cycloalkyl group, or a substituted or unsubstituted 5- to 15-membered heteroaryl group, -NR₁₁R₁₂ or -SiR₁₃R₁₄R₁₅;

₁₄R₁₅; wherein R₁₁ and R₁₂ each independently represent a substituted or unsubstituted (C6-C15)aryl group, or a substituted or unsubstituted 5- to 15-membered heteroaryl group; and R₁₃ to R₁₅ each independently represent a substituted or unsubstituted (C1-C10)alkyl group, or a substituted or unsubstituted (C6-C15)aryl group.

[31] According to another embodiment of the present invention in formula 1, above, L₁ and L₂ each independently represent a single bond; a (C6-C20)arylene group unsubstituted or substituted with a (C1-C6)alkyl group, a (C6-C15)aryl group, or a di(C6-C15)arylamino group; or an unsubstituted 5- to 10-membered heteroarylene group; Ar₁ and Ar₂ each independently represent a (C6-C15)aryl group unsubstituted or substituted with a (C1-C6)alkyl group, a (C6-C15)aryl group, a di(C6-C15)arylamino group, or a (C6-C15)aryl (5- to 10-membered) heteroarylamino group; or a 5- to 10-membered heteroaryl group unsubstituted or substituted with a (C6-C15)aryl group or a di(C6-C15)arylamino group; R₁ to R₆ each independently represent hydrogen; a halogen; an unsubstituted (C1-C6)alkyl group; a (C6-C15)aryl group unsubstituted or substituted with a (C1-C6)alkyl group or a (C6-C15)aryl group; a (C6-C15)aryl group fused with a (C3-C7)cycloalkyl group; an unsubstituted 5- to 15-membered heteroaryl group; or -NR₁₁R₁₂; wherein R₁₁ and R₁₂ each independently represent an unsubstituted (C6-C15)aryl group.

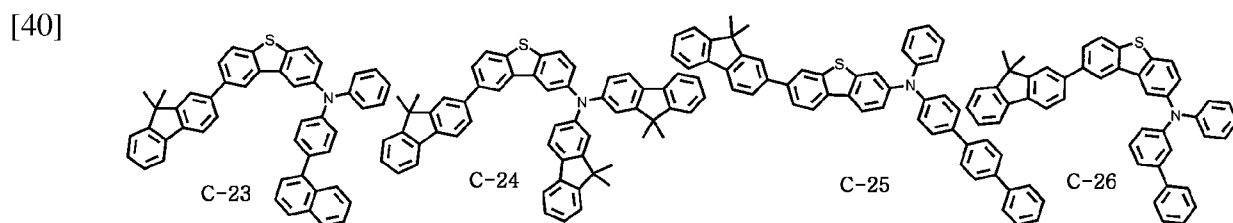
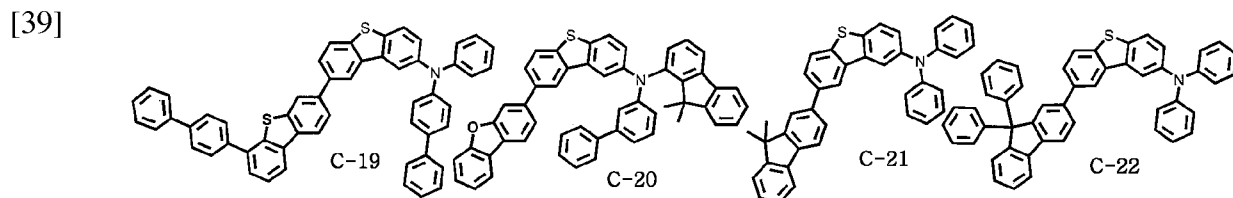
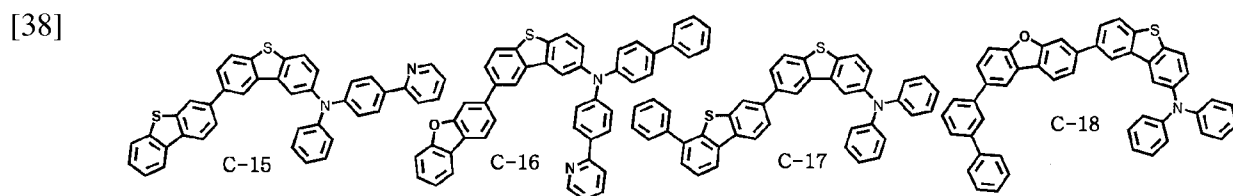
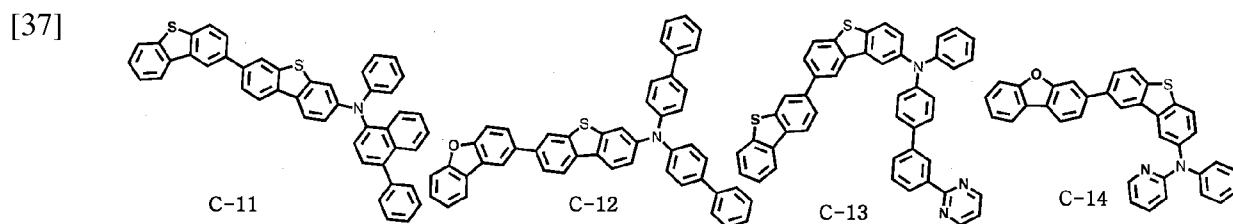
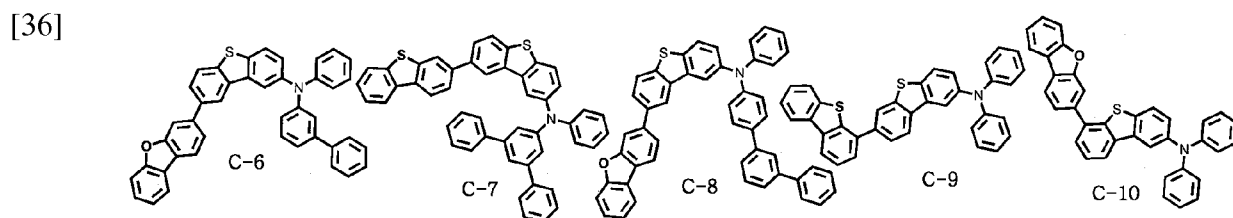
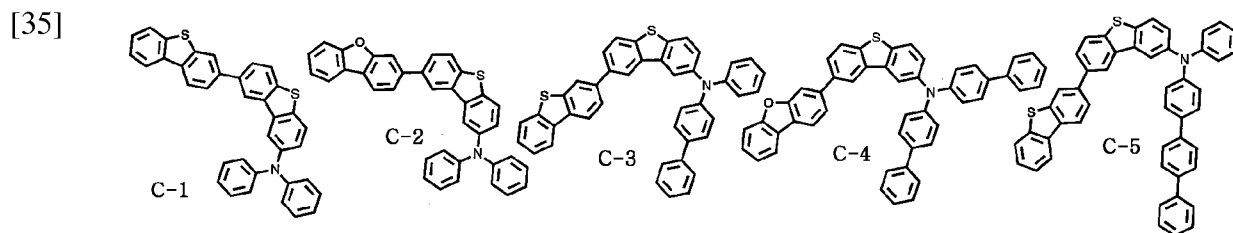
[32] Herein, “(C1-C30)alkyl” is meant to be a linear or branched alkyl having 1 to 30 carbon atoms, in which the number of carbon atoms is preferably 1 to 15; more preferably 1 to 6; and includes methyl, ethyl, n-propyl, isopropyl, n-butyl, isobutyl and tert-butyl, etc.; “(C2-C30)alkenyl” is meant to 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-butyne, 2-butyne, 3-butyne, 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.; “3- 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 3 to 7 ring backbone atoms; and includes tetrahydrofuran, 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(=O), 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 15; more preferably 5 to 10 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, Cl, Br and I.

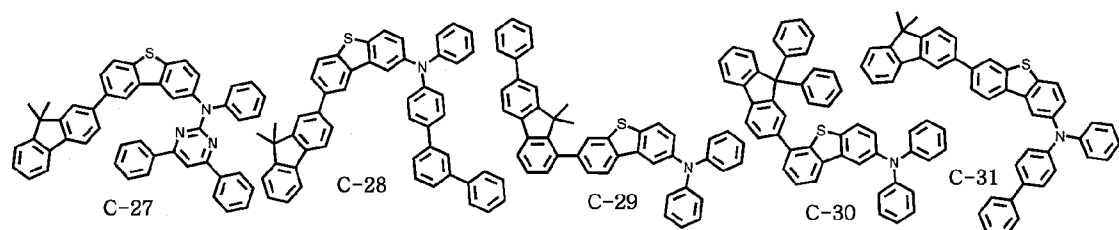
- [33] Herein, “substituted” in the expression “substituted or unsubstituted” means that a hydrogen atom in a certain functional group is replaced with another atom or group, i.e., a substituent. In formula 1, above, substituents of the substituted (C1-C30)alkyl group, the substituted (C2-C30)alkenyl group, the substituted (C2-C30)alkynyl group, the substituted (C1-C30)alkoxy group, the substituted (C3-C30)cycloalkyl group, the substituted (C3-C30)cycloalkyl group, the substituted 3- to 7-membered heterocycloalkyl group, the substituted (C6-C30)aryl(ene) group, or the substituted 5- to 30-membered heteroaryl(ene) group 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 (C1-C30)alkyl group, a halo(C1-C30)alkyl group, a (C2-C30)alkenyl group, a (C2-C30)alkynyl group, a (C1-C30)alkoxy group, a (C1-C30)alkylthio group, a (C3-C30)cycloalkyl group, a (C3-C30)cycloalkenyl group, a 3- to 7-membered heterocycloalkyl group, a (C6-C30)aryloxy group, a (C6-C30)arylthio group, a 5- to 30-membered heteroaryl group unsubstituted or substituted with a (C6-C30)aryl group, a (C6-C30)aryl group unsubstituted or substituted with a 5- 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, an amino group, a mono- or di-(C1-C30)alkylamino group, a mono- or di-(C6-C30)arylamino group, a (C1-C30)alkyl(C6-C30)arylamino group, a (C1-C30)alkylcarbonyl group, (C1-C30)alkoxycarbonyl group, (C6-C30)arylcarbonyl 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, and a

(C1-C30)alkyl(C6-C30)aryl group; preferably each independently are at least one selected from the group consisting of a (C1-C6)alkyl group, a (C6-C15)aryl group, a di(C6-C15)arylamino group, and a (C6-C15)aryl(5- to 10-membered)heteroarylamino group.

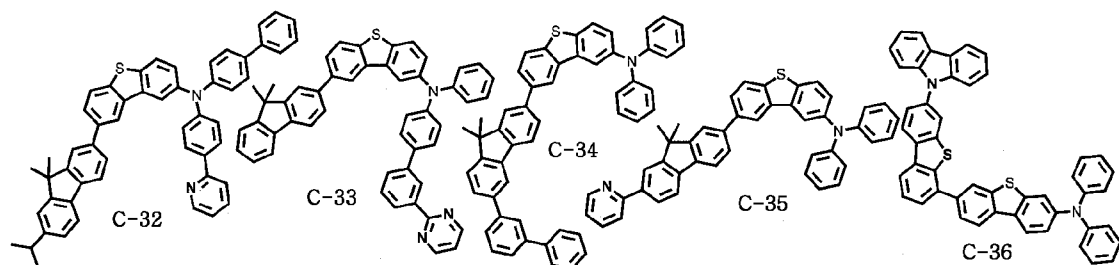
[34] The representative organic electroluminescent compounds of the present invention include the following compounds:



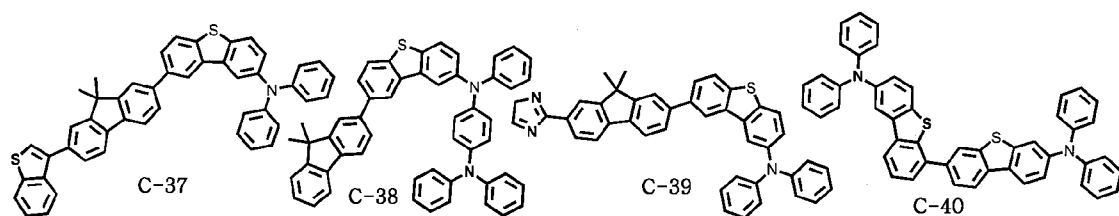
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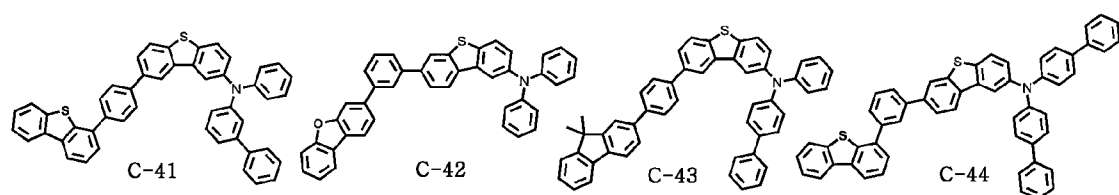
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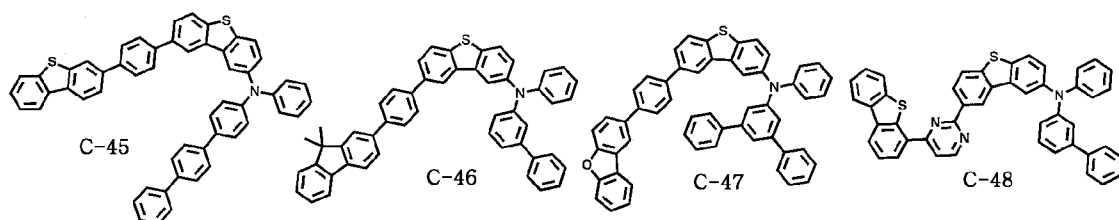
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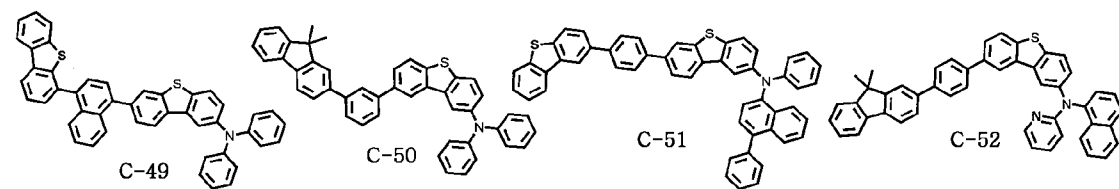
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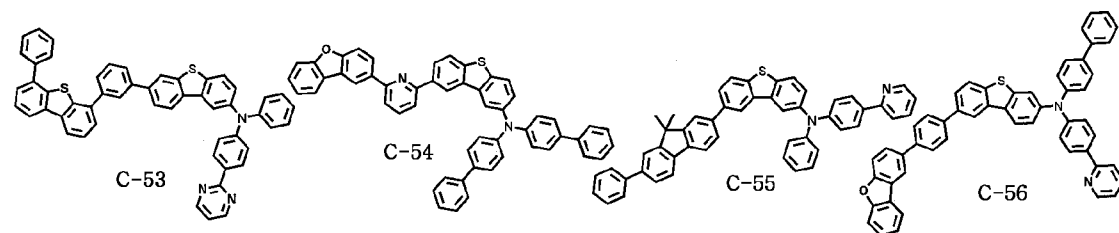
[45]



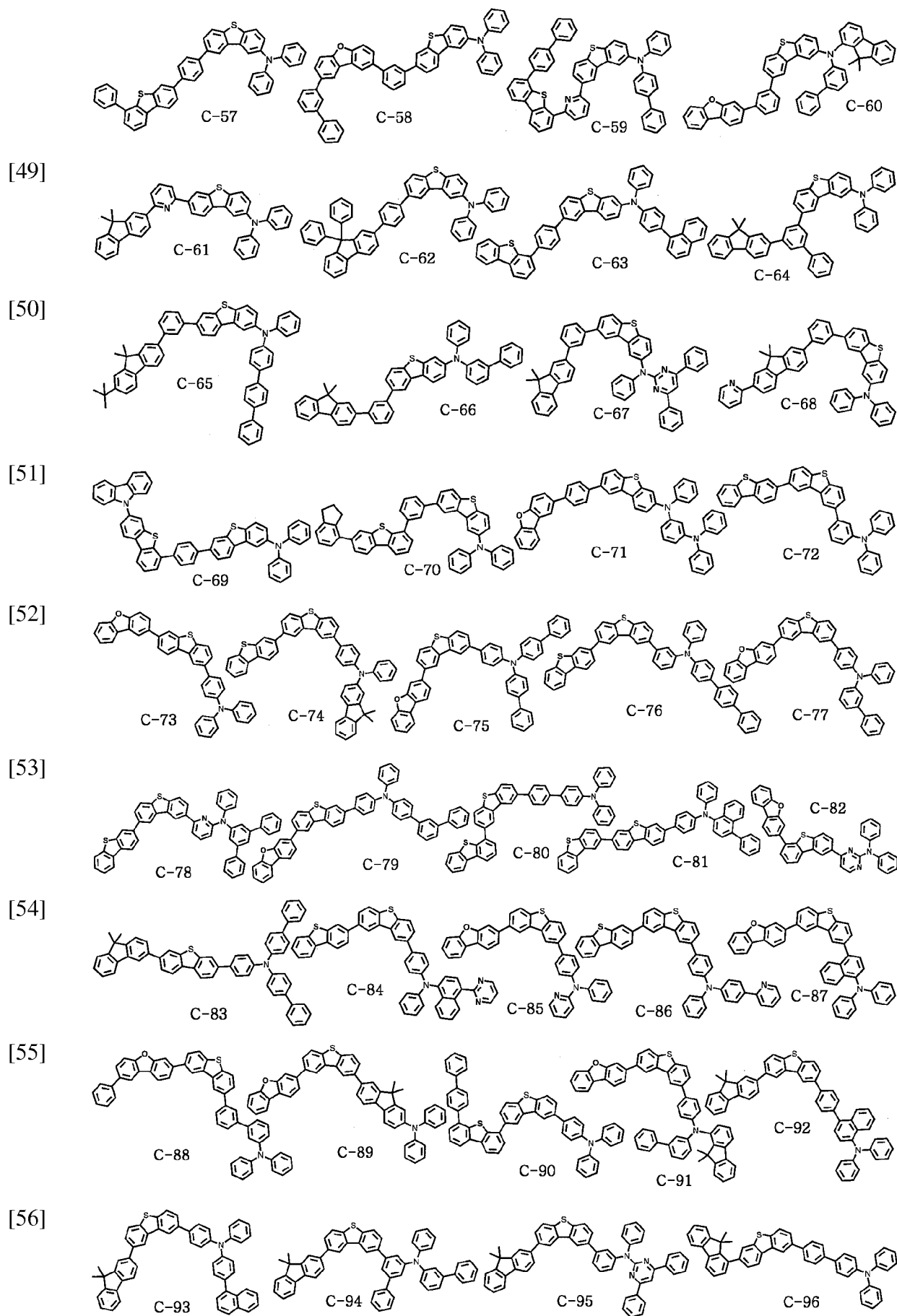
[46]

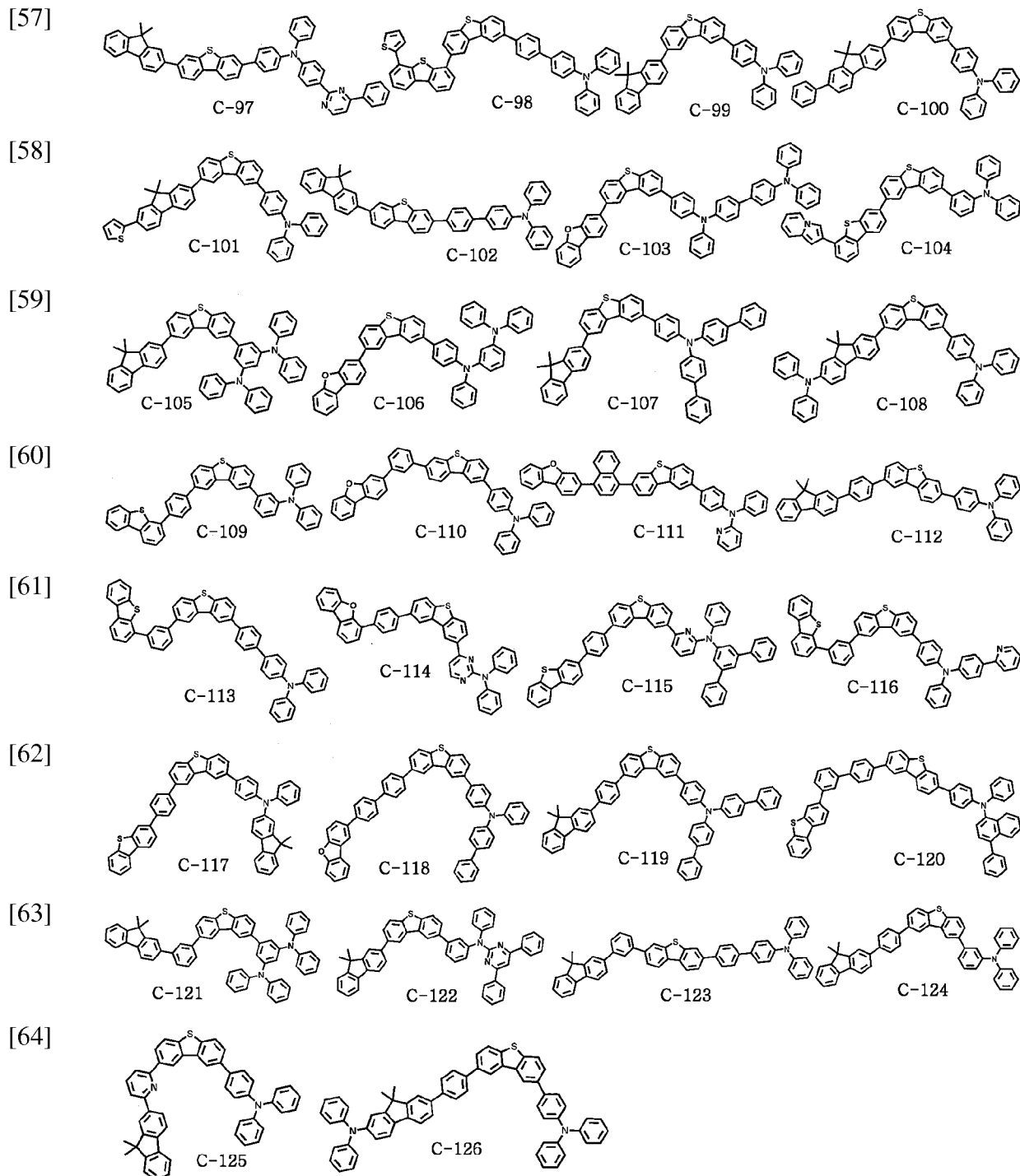


[47]



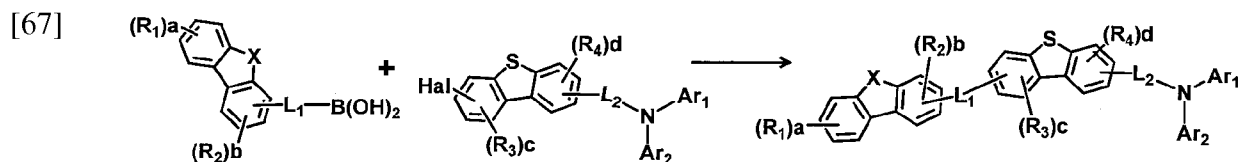
[48]





[65] The organic electroluminescent compounds of the present invention can be prepared according to reactions well-known in the art, for example, the following reaction schemes:

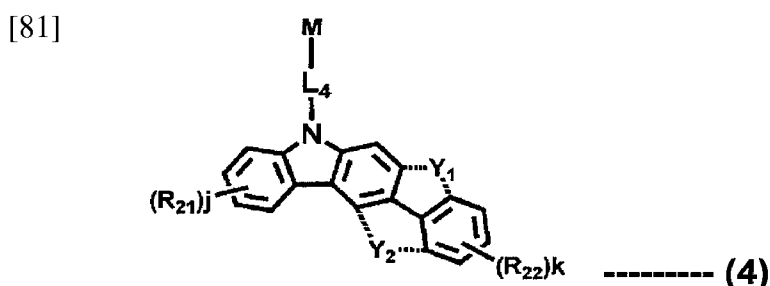
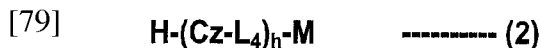
[66] [Reaction Scheme 1]



- [68] Wherein, in Reaction Scheme 1, X, L₁, L₂, Ar₁, Ar₂, R₁ to R₄, a, b, c and d are as defined in formula 1 above, and Hal represents a halogen atom.
- [69] The reaction of Reaction Scheme 1 is performed under aromatic hydrocarbons or ordinary polar organic solvents (for example, benzene, toluene, xylene, tetrahydrofuran, dioxane, or mixture thereof), preferably toluene. Additionally, the reaction is performed under alkali metal hydroxides or carbonate (for example, NaOH, KOH, Na₂CO₃, K₂CO₃, Cs₂CO₃, etc.), preferably aqueous K₂CO₃ solution.
- [70] Generally, the reaction temperature is selected in the range of 40 to 180°C under reflux, and the reaction time is selected in the range of 1 to 80 hours, preferably 2 to 24 hours.
- [71] According to preferred embodiment of the present invention, Pt based catalysts, especially (Ph₃P)₄Pd or derivatives thereof, is used in the reaction as an ordinary catalyst for coupling reaction or polycondensation reaction. The catalyst is added in the form of solution or suspension.
- [72] Further, the obtained compound according to the present invention in the reaction can be separated through a method well-known in the art. For example, the reaction mixture is extracted with ethyl acetate(EA)/ H₂O, and dried with MgSO₄. The resulting product is then distilled under reduced pressure and separated through column chromatography to obtain the compound according to the present invention.
- [73] The present invention provides an organic electroluminescent material comprising the organic electroluminescent compound of formula 1, and an organic electroluminescent device comprising the material.
- [74] The above material can be comprised of the organic electroluminescent compound according to the present invention alone, or can further include conventional materials generally contained in organic electroluminescent materials.
- [75] Said organic electroluminescent device comprises a first electrode, a second electrode, and at least one organic layer between said first and second electrodes. Said organic layer may comprise at least one organic electroluminescent compound of formula 1 according to the present invention.
- [76] One of the first and second electrodes 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.
- [77] The organic electroluminescent compound of formula 1 according to the present invention can be comprised of in at least one of the light-emitting layer and the hole transport layer. Where used in the hole transport layer, the compound of formula 1 according to the present invention can be comprised as a hole transport material.

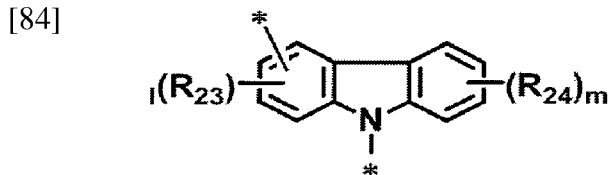
Where used in the light-emitting layer, the compound of formula 1 according to the present invention can be comprised as a host material; preferably, the light-emitting layer can further comprise at least one dopant; and, if needed, another compound as a second host material in addition to the organic electroluminescent compound of formula 1 according to the present invention.

[78] The second host material can be from any of the known phosphorescent hosts. Specifically, the phosphorescent host selected from the group consisting of the compounds of formulas 2 to 4 below is preferable in view of luminous efficiency.



[82] wherein

[83] Cz represents the following structure;

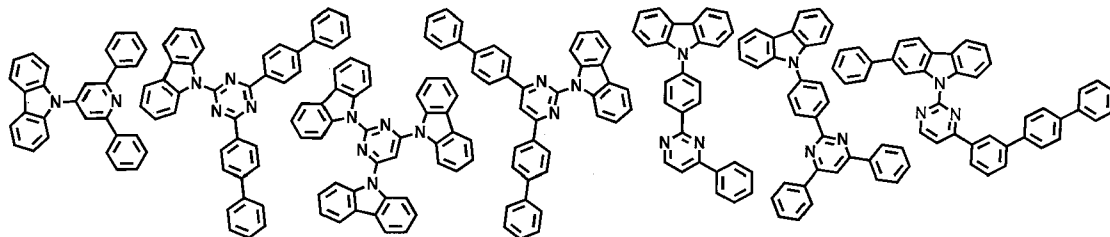


[85] R_{21} to R_{24} each independently represent hydrogen, deuterium, a halogen, a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C6-C30)aryl group, a substituted or unsubstituted 5- to 30-membered heteroaryl group, or $R_{25}R_{26}R_{27}$ Si-; R_{25} to R_{27} each independently represent a substituted or unsubstituted (C1-C30)alkyl group, or a substituted or unsubstituted (C6-C30)aryl group; 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; M represents a substituted or unsubstituted (C6-C30)aryl group, or a substituted or unsubstituted 5- to 30-membered heteroaryl group; Y_1 and Y_2 each independently represent -O-, -S-, -N(R_{31})- or -C(R_{32})(R_{33})-, provided that Y_1 and Y_2 do not simultaneously exist; 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; h and i each independently represent an integer of 1 to 3; j, k, l and m each independently represent

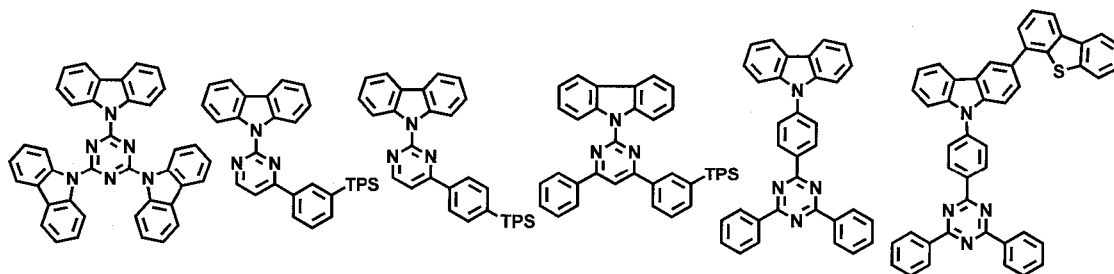
an integer of 0 to 4; and where h, i, j, k, l or m is an integer of 2 or more, each of (Cz-L₄), each of (Cz), each of R₂₁, each of R₂₂, each of R₂₃ or each of R₂₄ is the same or different.

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

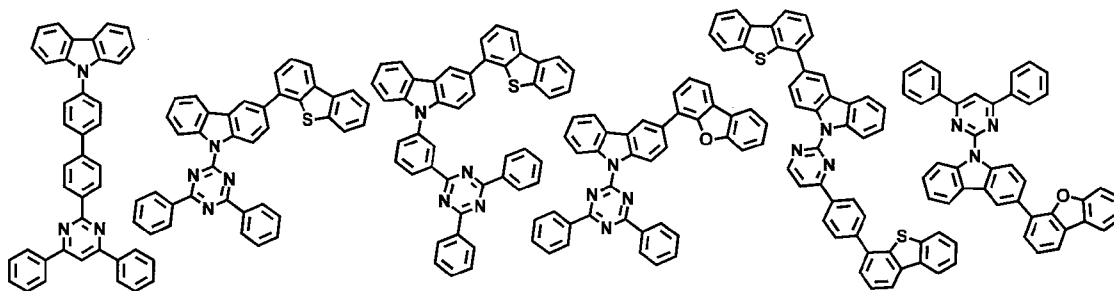
[87]



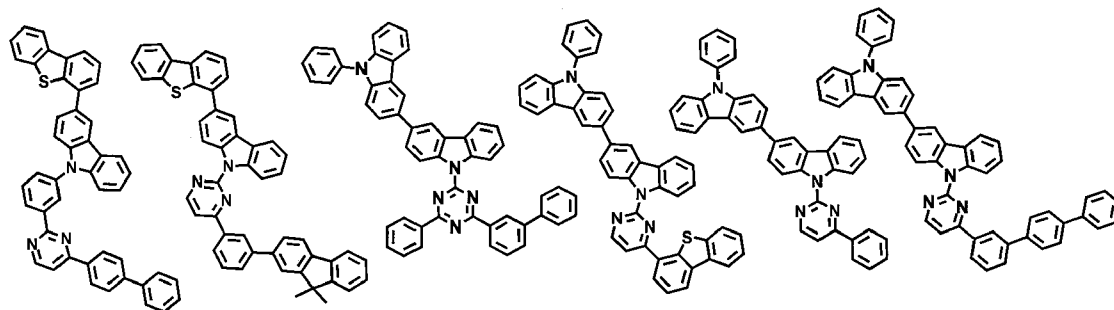
[88]



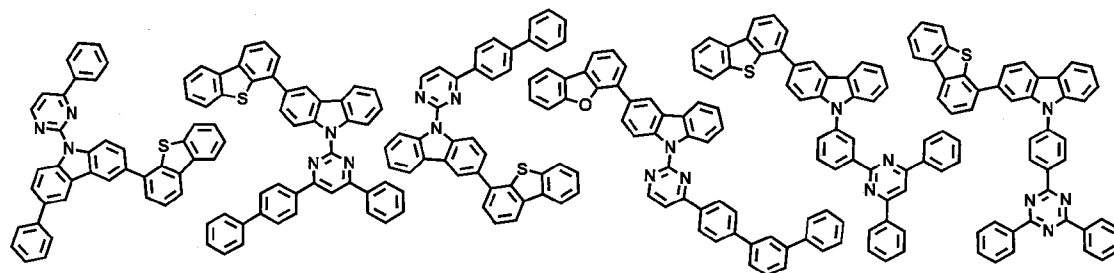
[89]



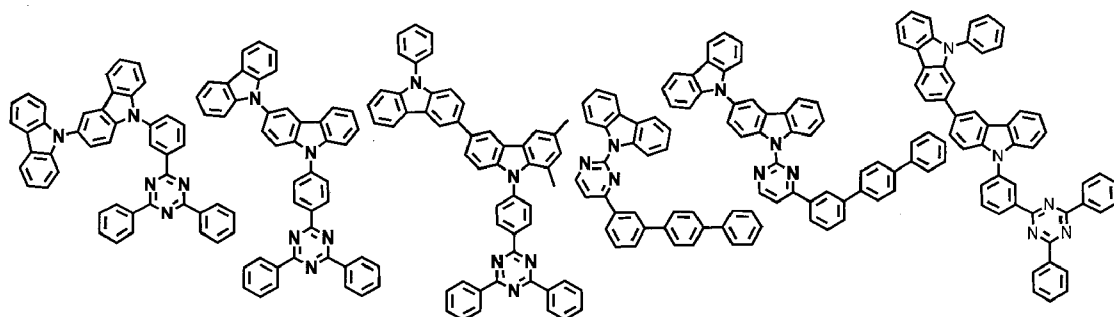
[90]



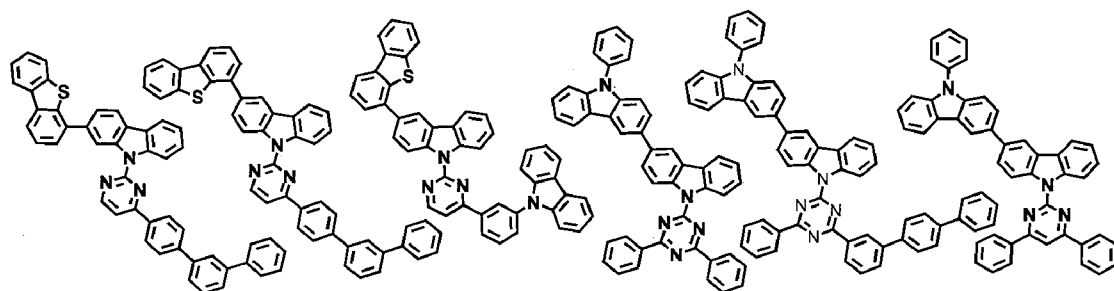
[91]



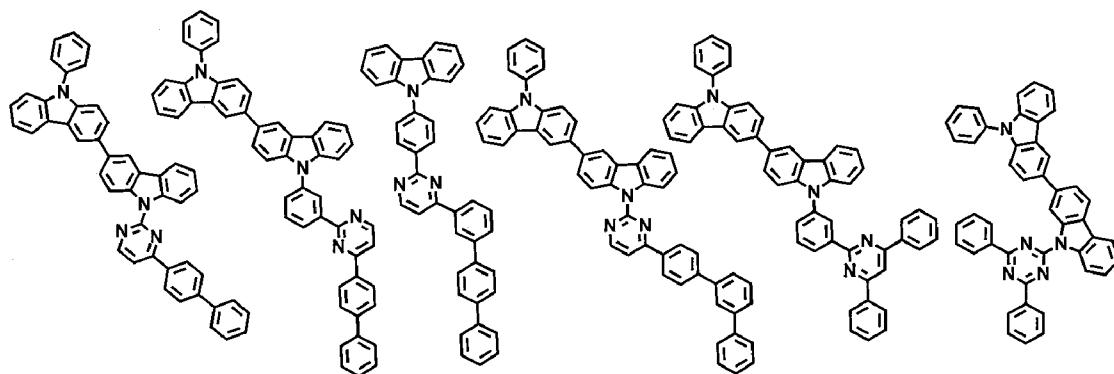
[92]



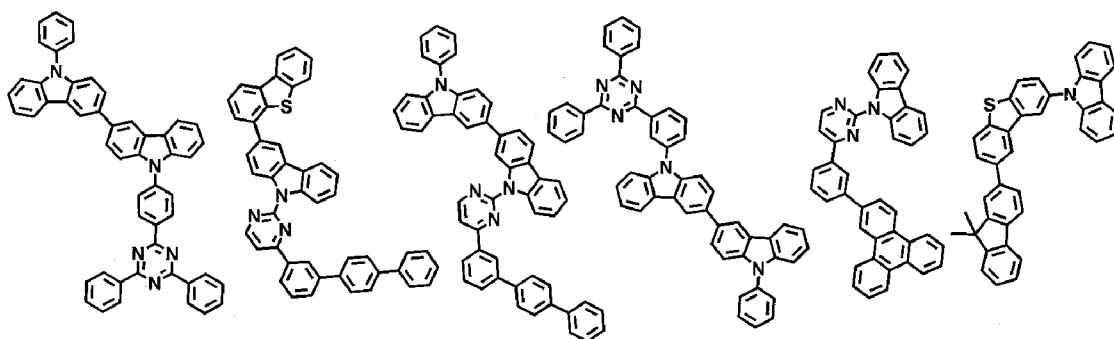
[93]



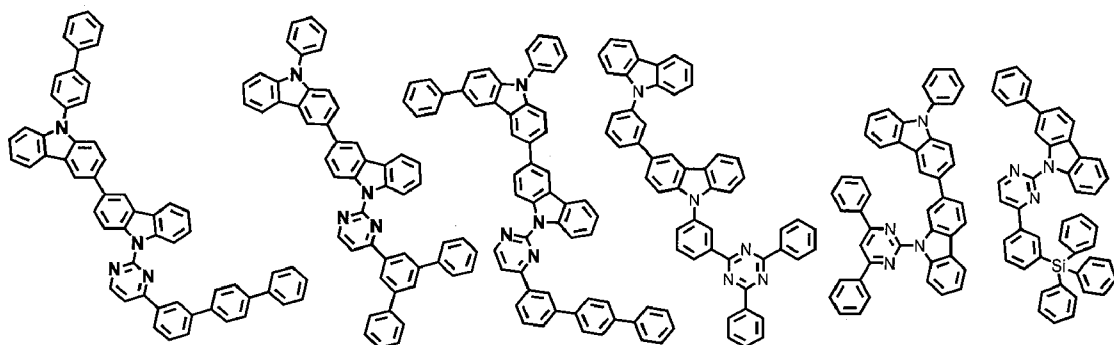
[94]



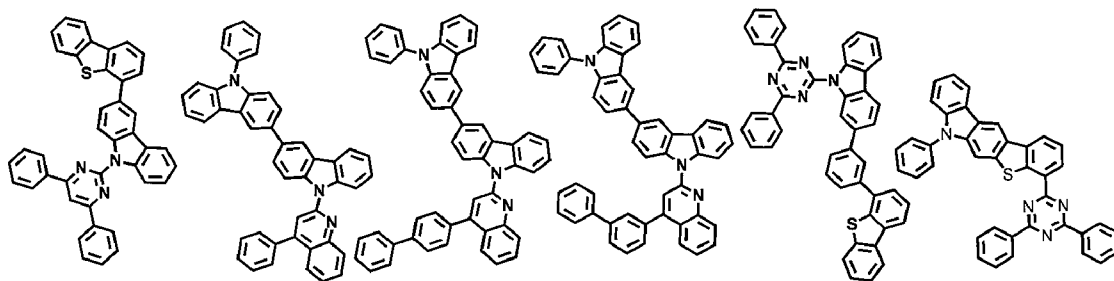
[95]



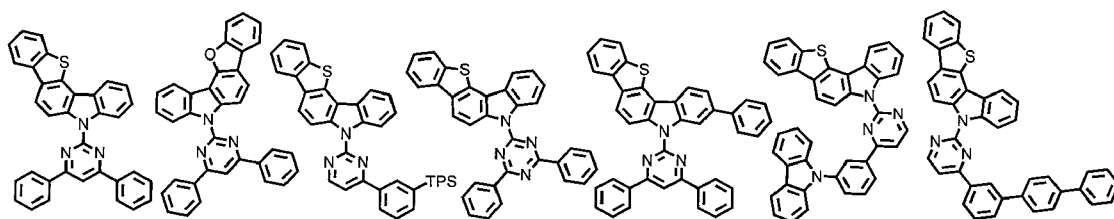
[96]



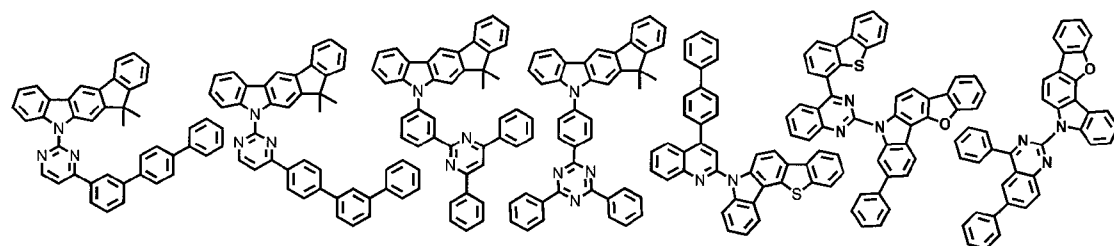
[97]



[98]



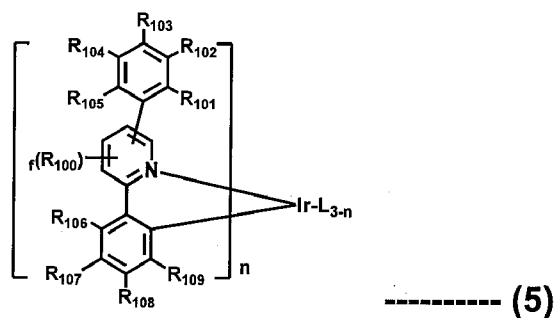
[99]



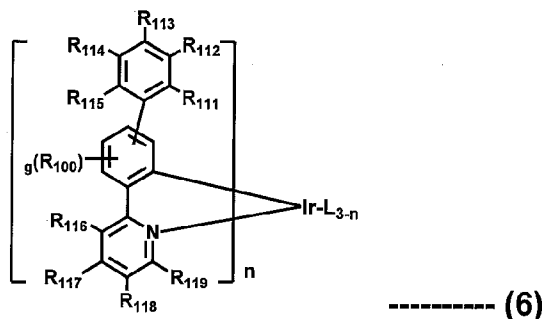
[100] According to the present invention, the dopant used in the manufacture of the organic electroluminescent device is preferably one or more phosphorescent dopants. The phosphorescent dopant material applied to the electroluminescent device according to the present invention is not limited, but preferably may be selected from complex compounds of iridium(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.

[101] According to the present invention, the phosphorescent dopant comprised in the organic electroluminescent device may be selected from compounds represented by the following formulas 5 to 7.

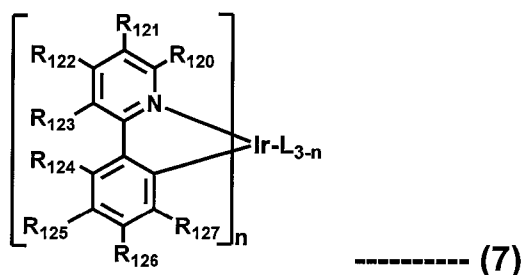
[102]



[103]



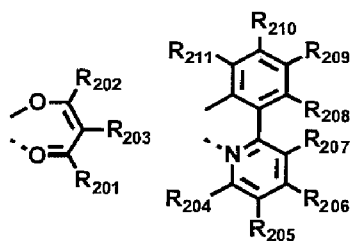
[104]



[105]

wherein L is selected from the following structures:

[106]



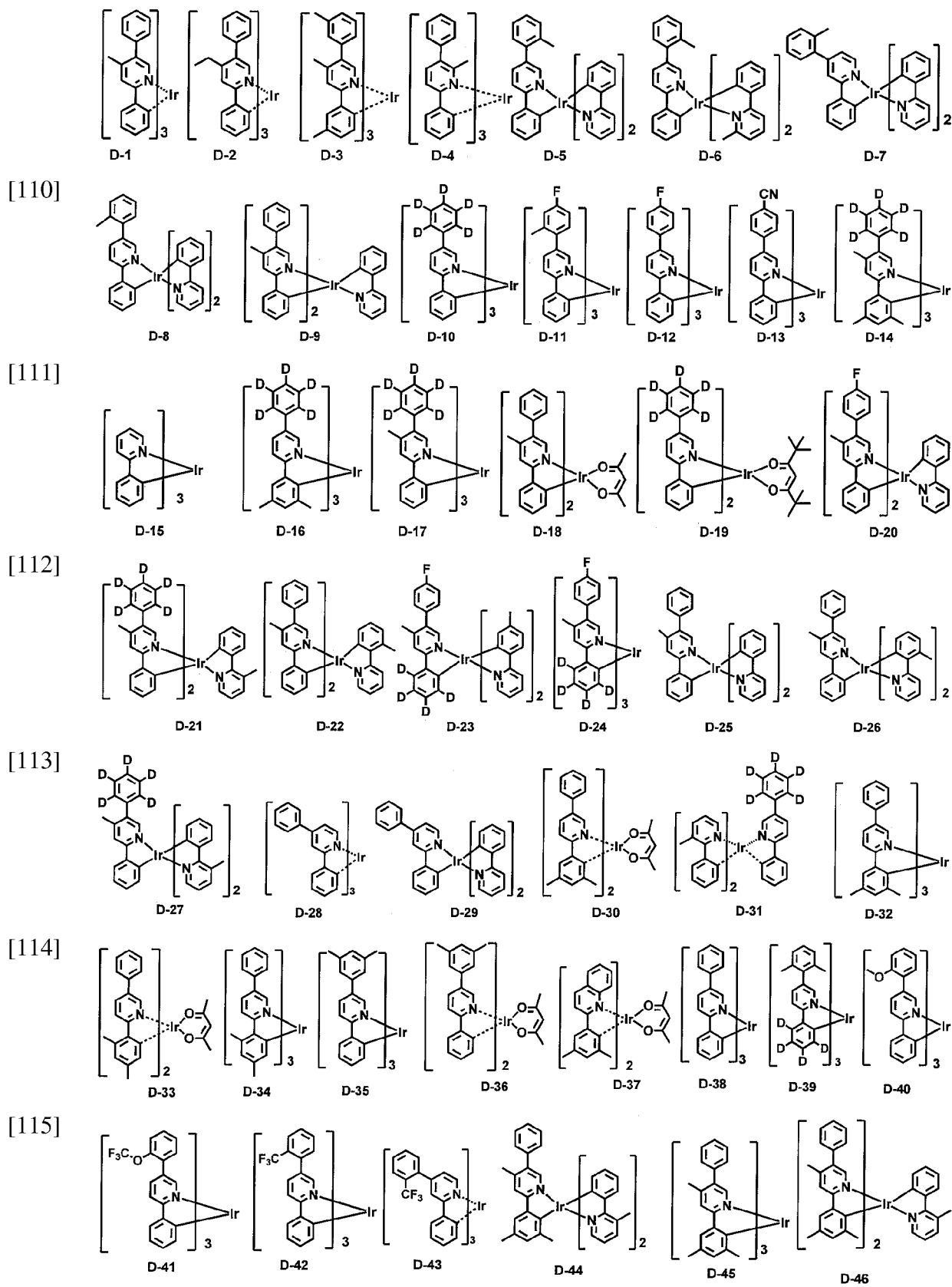
[107]

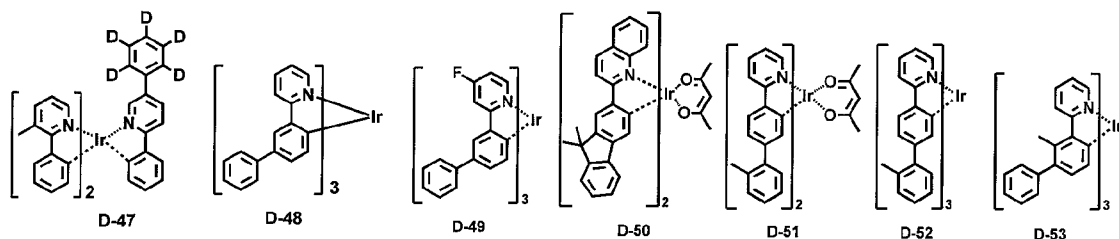
R_{100} represents hydrogen, or a substituted or unsubstituted (C1-C30)alkyl group; R_{101} to R_{109} , and R_{111} to R_{123} each independently represent hydrogen, deuterium, a halogen, a (C1-C30)alkyl group unsubstituted or substituted with halogen(s), a cyano group, a substituted or unsubstituted (C1-C30)alkoxy group, or a substituted or unsubstituted (C3-C30)cycloalkyl group; or R_{120} to R_{123} are linked to an adjacent substituent(s) to form a mono- or polycyclic 3- to 30-membered alicyclic or aromatic 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 an adjacent substituent(s) to form a mono- or polycyclic 3- to 30-membered alicyclic or aromatic 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); 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.

[108]

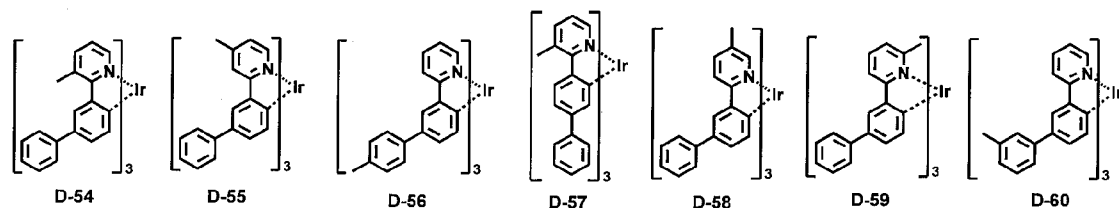
Specifically, the phosphorescent dopant may be selected from compounds represented by the following compounds:

[109]

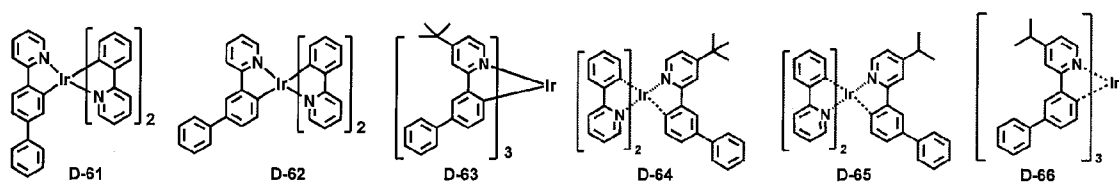




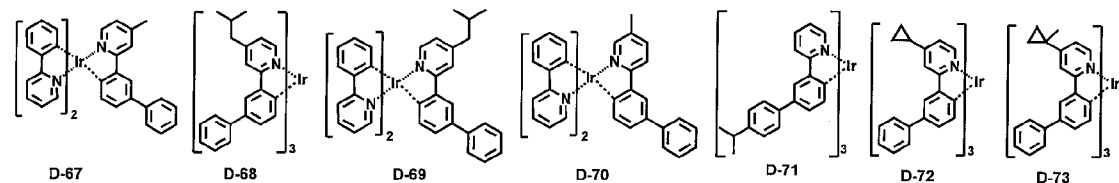
[117]



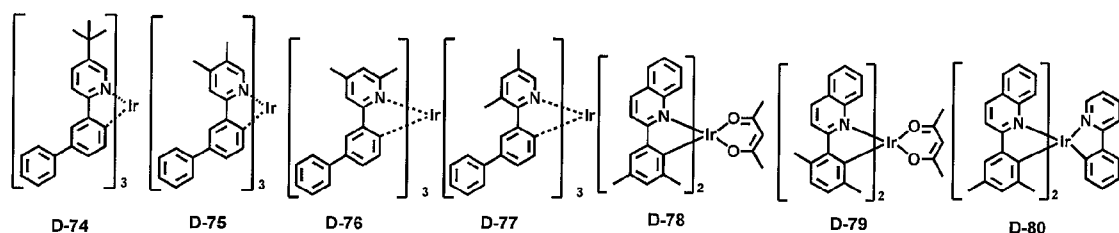
[118]



[119]



[120]



[121] 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 first host material to the second host material can be in the range of 1:99 to 99:1.

[122] 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.

[123] 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.

- [124] 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.
- [125] 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.
- [126] 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.
- [127] 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.

[128] In order to form each layer 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, dip coating, and flow coating methods can be used.

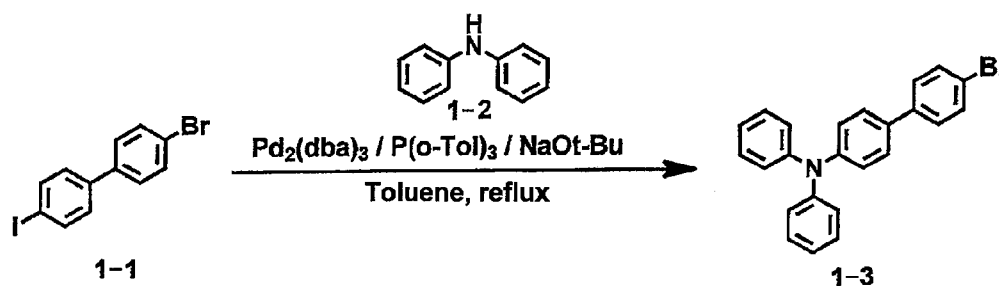
[129] When applying a wet film-forming method, a thin film can be formed by dissolving or diffusing materials which will form each layer, into any suitable solvent such as ethanol, chloroform, tetrahydrofuran, dioxane, etc. The solvent can be any solvent which the materials can dissolve or diffuse, unless the solvent has problems in film formation properties.

[130] Hereinafter, the representative 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, but not limited thereto:

[131] Example 1: Preparation of compound C-80

[132] Preparation of compound 1-3

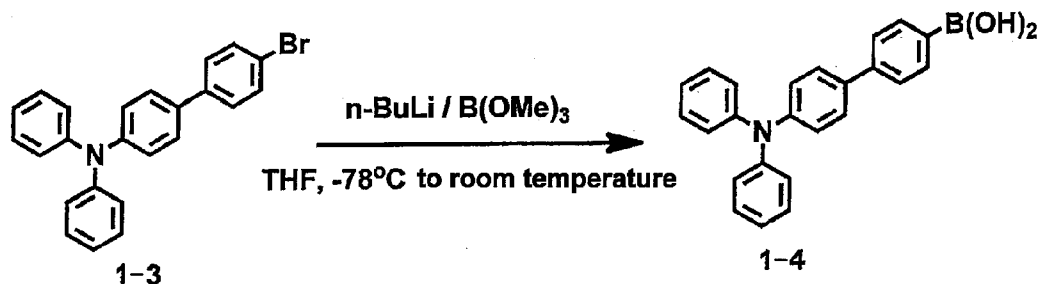
[133]



[134] After dissolving compound 1-1, 63g (0.177mol), compound 1-2, 30g (0.177mol), sodium tert-butoxide (NaOt-Bu) 26g (0.266mol) and tri(o-tolyl)phosphine ($\text{P}(\text{o-Tol})_3$) 4.3g (0.014mol) in toluene 1.7L, tris(dibenzylideneacetone)dipalladium(0) ($\text{Pd}_2(\text{dba})_3$) 3.2g (0.004mol) was added. The mixture was stirred for 3 hours at 120°C . The reactant was cooled to room temperature, and extracted with ethyl acetate 1L. The obtained organic layer was washed with distilled water 400mL. The organic solvent was removed under reduced pressure. The obtained solid was washed with methanol and dried after filtration. The resulting product was separated through silica gel column chromatography and recrystallization to obtain compound 1-3, 41g (58%).

[135] Preparation of compound 1-4

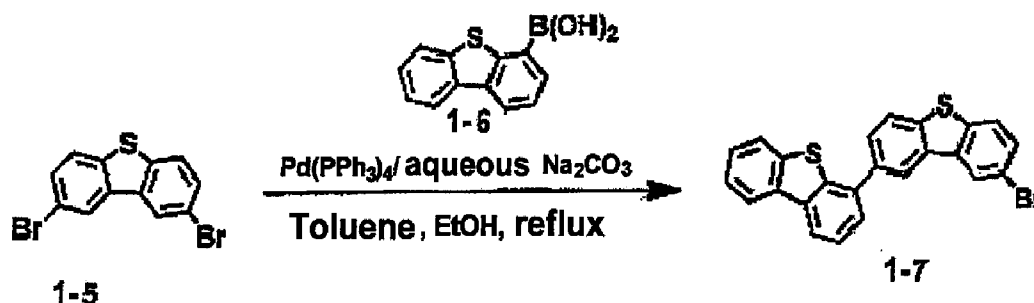
[136]



[137] After dissolving compound 1-3, 10g(25mmol) in tetrahydrofuran(THF) 150mL, n-BuLi (2.5M, in hexane) 15mL(37.50mol) was added at -78°C. The mixture was stirred for 1 hour at -78°C, and trimethoxyborane(B(OMe)₃) compound 4.2mL(37.50mol) was added. The total reactant was stirred for 2 hours, and the reaction was terminated with NH₄Cl 100mL. After extracting with ethyl acetate 200mL, the obtained organic layer was washed with distilled water 100mL. The organic layer was dried with MgSO₄ and the organic solvent was removed under reduced pressure. The obtained solid was separated through recrystallization to obtain compound 1-4, 5.4g(59%).

[138] Preparation of compound 1-7

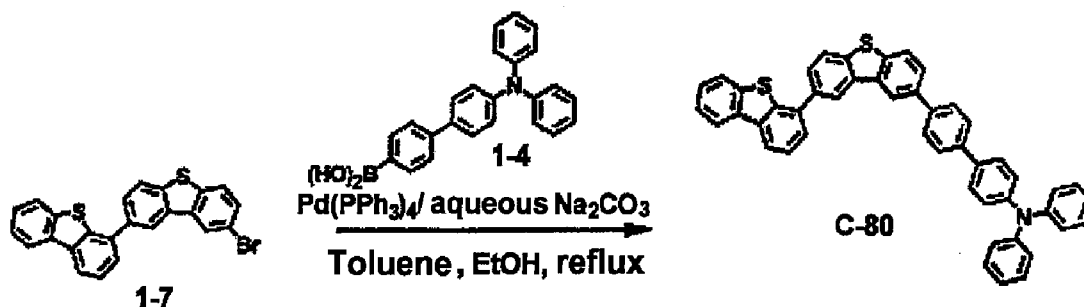
[139]



[140] After dissolving compound 1-5, 6.7g(19.60mmol), compound 1-6, 4.1g(17.82mmol) and Na₂CO₃ 4.7g(44.55mol) in mixed solution of toluene 90mL, ethanol 20mL and distilled water 20mL, tetrakis(triphenylphosphine) palladium 0.6g(0.53mmol) was added. The mixture was stirred under reflux for 5 hours at 120°C. The reactant was cooled to room temperature and extracted with ethyl acetate 200mL. The obtained organic layer was washed with distilled water 100mL. The organic solvent was removed under reduced pressure. The obtained solid was washed with methanol and dried after filtration. The resulting product was separated through silica gel column chromatography and recrystallization to obtain compound 1-7, 3.7g (47%).

[141] Preparation of compound C-80

[142]



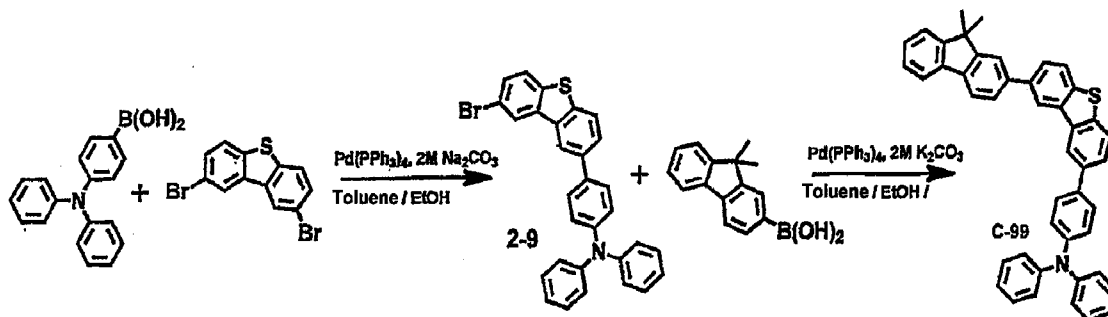
[143] After dissolving compound 1-7, 3.7g(8.30mmol), compound 1-4, 3.3g(9.10mmol) and Na₂CO₃ 2.2g(20.80mmol) in a mixed solution of toluene 44mL, ethanol 11mL and distilled water 11mL, tetrakis(triphenylphosphine) palladium 0.5g(0.4mmol) was added. The mixture was stirred under reflux for 5 hours at 120°C. The reactant was cooled to room temperature, and extracted with ethyl acetate 200mL. The obtained organic layer

was washed with distilled water 100mL. The organic solvent was removed under reduced pressure. The obtained solid was washed with methanol and dried after filtration. The resulting product was separated through silica gel column chromatography and recrystallization to obtain compound **C-80**, 1.8g(32%).

[144] MS/EIMS: found 685.90; calculated 685.19, melting point(Mp): 211°C

[145] Example 2: Preparation of compound C-99

[146]



[147] Preparation of compound 2-9

[148] After introducing 4-(diphenylamino)phenylboronic acid 15g(52mmol), 2,8-dibromobenzo[b,d]thiophene 103.8g(103.8mmol), tetrakis(triphenylphosphine)palladium(0) [Pd(PPh₃)₄] 3g(2.6mmol) and Na₂CO₃ 14g(130mmol) into a round flask, toluene 250mL, EtOH 50mL and H₂O 50mL were added. The reaction mixture was stirred for 2 hours at 100°C. The reactant was extracted with ethyl acetate(EA)/H₂O, dried with MgSO₄, and distilled under reduced pressure. The resulting product was separated through column chromatography to obtain compound 2-9, 13g(58%).

[149] Preparation of compound C-99

[150] After introducing compound 2-9, 6g(13.9mmol), 9,9-dimethyl-9H-fluoren-2-ylboronic acid 4g(16.7mmol), Pd(PPh₃)₄ 0.8g(0.7mmol) and K₂CO₃ 4.8g(35mmol) into a round flask, toluene 45mL, EtOH 15mL and H₂O 15mL were added. The reaction mixture was stirred for 2 hours at 120°C. The reactant was extracted with EA/H₂O, dried with MgSO₄, and distilled under reduced pressure. The resulting product was separated through column chromatography to obtain compound **C-99**, 3.9g(45%).

[151] MS/EIMS: found 619.8; calculated 619.23, melting point(Mp): 198°C

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

[153] An OLED device using the organic electroluminescent compound according to the present invention was produced as follows.

[154] First, 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) 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. N¹,N^{1'}-([1,1'-biphenyl]-4,4'-diyl)bis(N¹-(naphthalen-1-yl)-N⁴,N^{4'}-diphenylbenzen-1,4-diamine) was introduced into a cell of said vacuum vapor depositing apparatus, and then the pressure in the chamber of said 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, compound **C-99** was introduced into another cell of said vacuum vapor depositing apparatus, and was evaporated by applying an electric current to the cell, thereby forming a hole transport layer having a thickness of 20 nm on the hole injection layer. After the hole injection layer and the hole transport layer were formed as above, a light-emitting layer was deposited on said layers as follows.

- [155] 5-(4-([1,1':4',1''-terphenyl]-3-yl)pyrimidine-2-yl)-5H-benzo[4,5]thieno[3,2-c]carbazole was introduced into one cell of the vacuum vapor depositing apparatus, as a host material, and compound D-1 was introduced into another cell as a dopant material, and the two materials were evaporated at different rates, and deposited in a doping amount of 15 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, in order to form an electron transport layer on the formed light-emitting layer, 2-(4-(9,10-di(naphthalen-2-yl)anthracen-2-yl)phenyl)-1-phenyl-1H-benzo[d]imidazole was introduced into a cell, and lithium quinolate was introduced into another cell, and the two materials were evaporated at the same rate to deposit in a doping amount of 50 wt%, respectively. Thus, an electron transport layer having a thickness of 30 nm was formed on the light-emitting layer. Then, in order to form an electron injection layer, after depositing lithium quinolate in a thickness of 2 nm, an Al cathode having a thickness of 150 nm was deposited by another vacuum vapor deposition apparatus. Thus, an OLED device was produced. All the materials used for producing the OLED device were purified by vacuum sublimation at 10⁻⁶ torr prior to use.

- [156] As a result, the produced OLED device showed a green emission having a luminance of 8020 cd/m² and a current density of 19.2 mA/cm².

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

- [158] An OLED device was produced in the same manner as that of Device Example 1, except that compound C-80 was deposited as the hole transport layer having a thickness of 20 nm; and 9-(4-([1,1':3',1''-terphenyl]-4-yl)pyrimidine-2-yl)-3-(dibenzo[b,d]thiophen-4-yl)-9H-carbazole was introduced into one cell of the vacuum vapor depositing apparatus; compound D-25 was introduced into another cell as a dopant material; and the two

materials were evaporated at different rates, and deposited in a doping amount of 15 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.

[159] As a result, the produced OLED device showed a green emission having a luminance of 2630 cd/m² and a current density of 6.4 mA/cm².

[160] Comparative Example 1: Production of an OLED device using conventional
[161] electroluminescent compounds

[162] An OLED device was produced in the same manner as in Device Example 1, except that N,N'-di(4-biphenyl)-N,N'-di(4-biphenyl)-4,4'-diaminobiphenyl was deposited as a hole transport layer having a thickness of 20 nm; 4,4'-N,N'-dicarbazole-biphenyl was used as a host material, and compound D-15 was used as a dopant material; a light-emitting layer having a thickness of 30 nm was deposited on the hole transport layer; and a hole blocking layer having a thickness of 10 nm was deposited by using aluminium(III) bis(2-methyl-8-quinolinato)4-phenylphenolate.

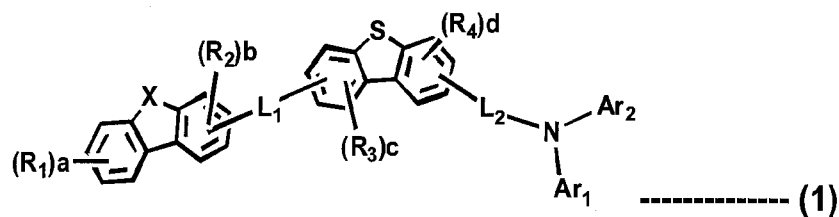
[163] As a result, the produced OLED device showed a green emission having a luminance of 3350 cd/m² and a current density of 9.7 mA/cm².

[164] It is confirmed that the organic electroluminescent compounds according to the present invention have high luminous efficiency, compared with conventional materials. Further, the organic electroluminescent device using the organic electroluminescent compounds according to the present invention has superior luminous efficiency and power efficiency.

Claims

[Claim 1]

An organic electroluminescent compound represented by the following formula 1:



wherein

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

Ar_1 and Ar_2 each independently represent a substituted or unsubstituted (C6-C30)aryl group, or a substituted or unsubstituted 5- to 30-membered heteroaryl group;

X represents oxygen atom, sulfur atom, or $-CR_5R_6-$;

R_1 to R_6 each independently represent hydrogen, deuterium, a halogen, a cyano group, a carboxyl group, a nitro group, a hydroxyl group, a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C2-C30)alkenyl group, a substituted or unsubstituted (C2-C30)alkynyl group, a substituted or unsubstituted (C1-C30)alkoxy group, a substituted or unsubstituted (C3-C30)cycloalkyl group, a substituted or unsubstituted (C3-C30)cycloalkenyl group, a substituted or unsubstituted 3- to 7-membered heterocycloalkyl group, a substituted or unsubstituted (C6-C30)aryl group, a (C6-C30)aryl group fused with a (C3-C30)cycloalkyl group, or a substituted or unsubstituted 5- to 30-membered heteroaryl group, $-NR_{11}R_{12}$, $-SiR_{13}R_{14}R_{15}$, $-SR_{16}$, $-OR_{17}$, $-COR_{18}$ or $-B(OR_{19})(OR_{20})$; 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 by at least one heteroatom selected from nitrogen, oxygen and sulfur;

R_{11} to R_{20} each independently represent hydrogen, deuterium, a halogen, a cyano group, a carboxyl group, a nitro group, a hydroxyl group, a substituted or unsubstituted (C1-C30)alkyl group, a substituted or unsubstituted (C2-C30)alkenyl group, a substituted or unsubstituted (C2-C30)alkynyl group, a substituted or unsubstituted (C1-C30)alkoxy group, a substituted or unsubstituted (C3-C30)cycloalkyl group, a sub-

stituted or unsubstituted (C3-C30)cycloalkenyl group, a substituted or unsubstituted 3- to 7-membered heterocycloalkyl 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 by at least one heteroatom selected from nitrogen, oxygen and sulfur;

a represents an integer of 1 to 4; where a is an integer of 2 or more, each of R₁ is the same or different;

b to d each independently represent an integer of 1 to 3; where b, c or d is an integer of 2 or more, each of R₂, each of R₃, and each of R₄ is the same or different;

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

the heterocycloalkyl group contains at least one hetero atom selected from O, S and N.

[Claim 2]

The organic electroluminescent compound according to claim 1, wherein the substituents of the substituted (C1-C30)alkyl group, the substituted (C2-C30)alkenyl group, the substituted (C2-C30)alkynyl group, the substituted (C1-C30)alkoxy group, the substituted (C3-C30)cycloalkyl group, the substituted (C3-C30)cycloalkenyl group, the substituted 3- to 7-membered heterocycloalkyl group, the substituted aryl(ene) group, and the substituted 5- to 30-membered heteroaryl(ene) group in L₁, L₂, Ar₁, Ar₂, R₁ to R₆, and R₁₁ to R₂₀ 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 (C1-C30)alkyl group, a halo(C1-C30)alkyl group, a (C2-C30)alkenyl group, a (C2-C30)alkynyl group, a (C1-C30)alkoxy group, a (C1-C30)alkylthio group, a (C3-C30)cycloalkyl group, a (C3-C30)cycloalkenyl group, a 3- to 7-membered heterocycloalkyl group, a (C6-C30)aryloxy group, a (C6-C30)arylthio group, a 5- to 30-membered heteroaryl group unsubstituted or substituted with a (C6-C30)aryl group, a (C6-C30)aryl group unsubstituted or substituted with a 5- 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, an amino group, a mono- or di-(C1-C30)alkylamino group, a mono- or di-(C6-C30)arylamino

group, a (C1-C30)alkyl(C6-C30)arylamino group, a (C1-C30)alkylcarbonyl group, (C1-C30)alkoxycarbonyl group, (C6-C30)arylcarbonyl 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, and a (C1-C30)alkyl(C6-C30)aryl group.

[Claim 3]

The organic electroluminescent compound according to claim 1, wherein L_1 and L_2 each independently represent a single bond, a substituted or unsubstituted (C6-C20)arylene group, or a substituted or unsubstituted 5- to 15-membered heteroarylene group; Ar_1 and Ar_2 each independently represent a substituted or unsubstituted (C6-C15)aryl group, or a substituted or unsubstituted 5- to 15-membered heteroaryl group; R_1 to R_6 each independently represent hydrogen, a halogen, a substituted or unsubstituted (C1-C15)alkyl group, a substituted or unsubstituted (C6-C15)aryl group, a (C6-C15)aryl group fused with a (C3-C20)cycloalkyl group, or a substituted or unsubstituted 5- to 15-membered heteroaryl group, $-NR_{11}R_{12}$ or $-SiR_{13}R_{14}R_{15}$; wherein R_{11} and R_{12} each independently represent a substituted or unsubstituted (C6-C15)aryl group, or a substituted or unsubstituted 5- to 15-membered heteroaryl group; and R_{13} to R_{15} each independently represent a substituted or unsubstituted (C1-C10)alkyl group, or a substituted or unsubstituted (C6-C15)aryl group.

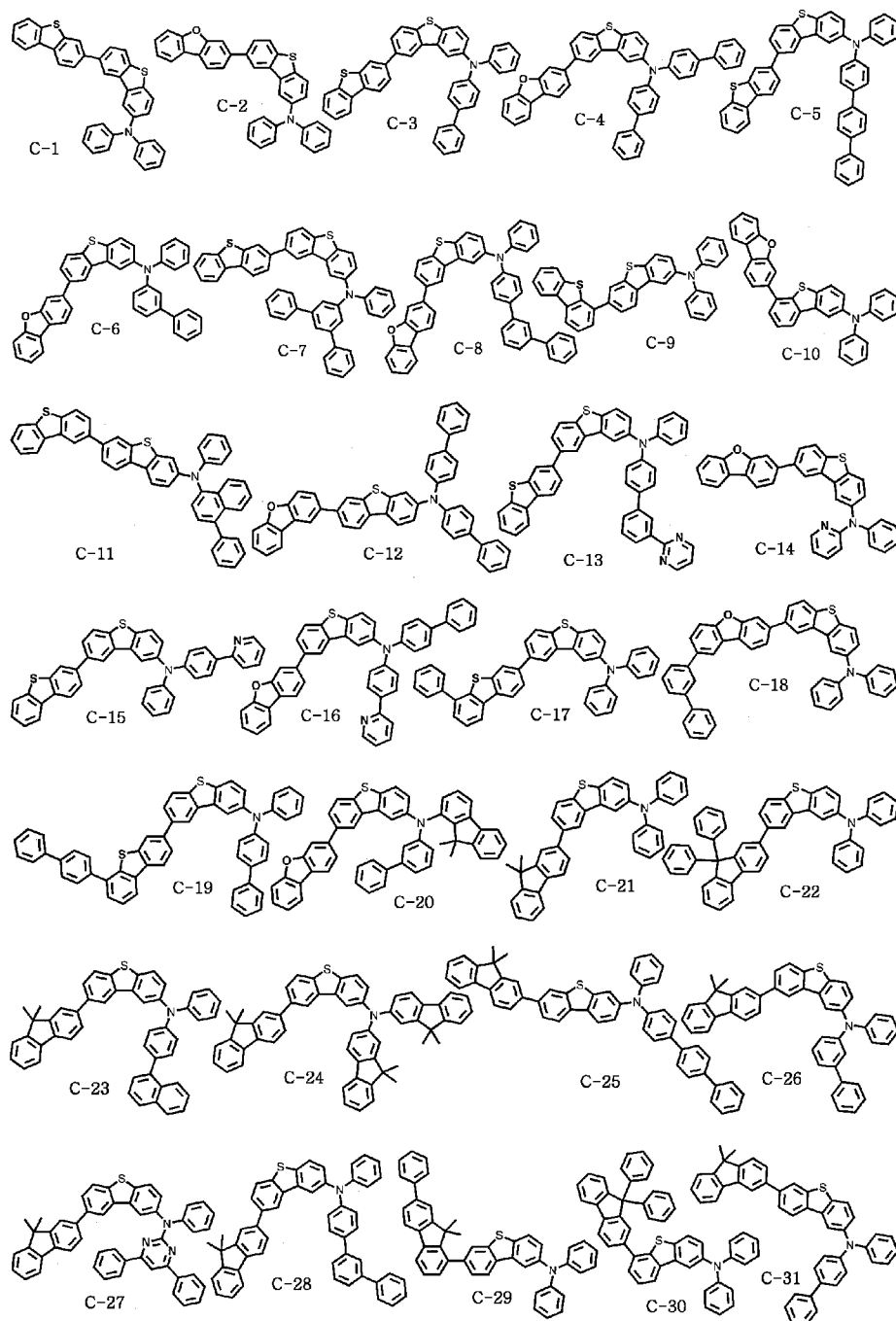
[Claim 4]

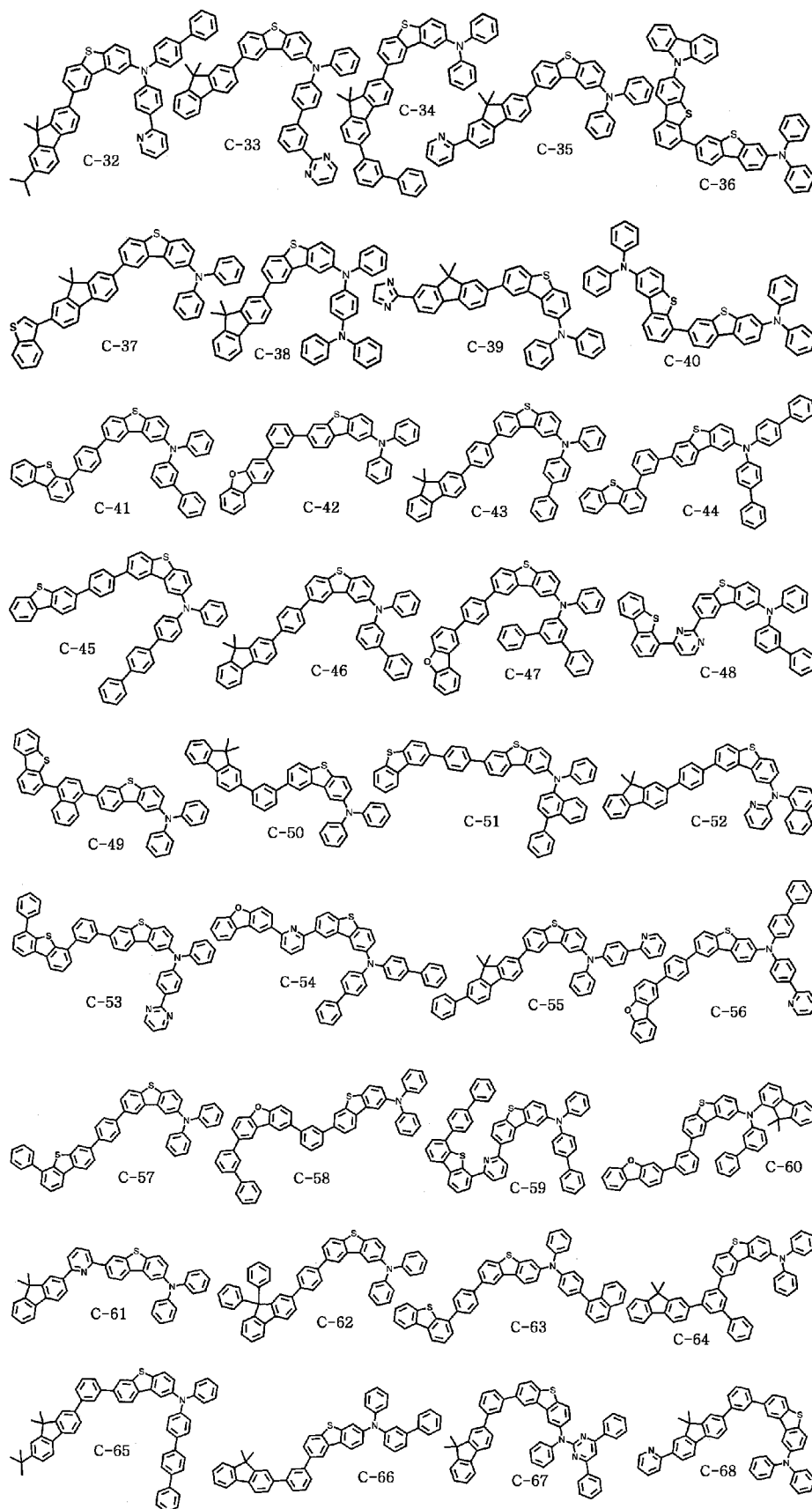
The organic electroluminescent compound according to claim 1, wherein L_1 and L_2 each independently represent a single bond; a (C6-C20)arylene group unsubstituted or substituted with a (C1-C6)alkyl group, a (C6-C15)aryl group, or a di(C6-C15)arylamino group; or an unsubstituted 5- to 10-membered heteroarylene group; Ar_1 and Ar_2 each independently represent a (C6-C15)aryl group unsubstituted or substituted with a (C1-C6)alkyl group, a (C6-C15)aryl group, a di(C6-C15)arylamino group, or a (C6-C15)aryl(5- to 10-membered) heteroarylamino group; or a 5- to 10-membered heteroaryl group unsubstituted or substituted with a (C6-C15)aryl group or a di(C6-C15)arylamino group; R_1 to R_6 each independently represent hydrogen; a halogen; an unsubstituted (C1-C6)alkyl group; a (C6-C15)aryl group unsubstituted or substituted with a (C1-C6)alkyl group or a (C6-C15)aryl group; a (C6-C15)aryl group fused with a (C3-C7)cycloalkyl group; an unsub-

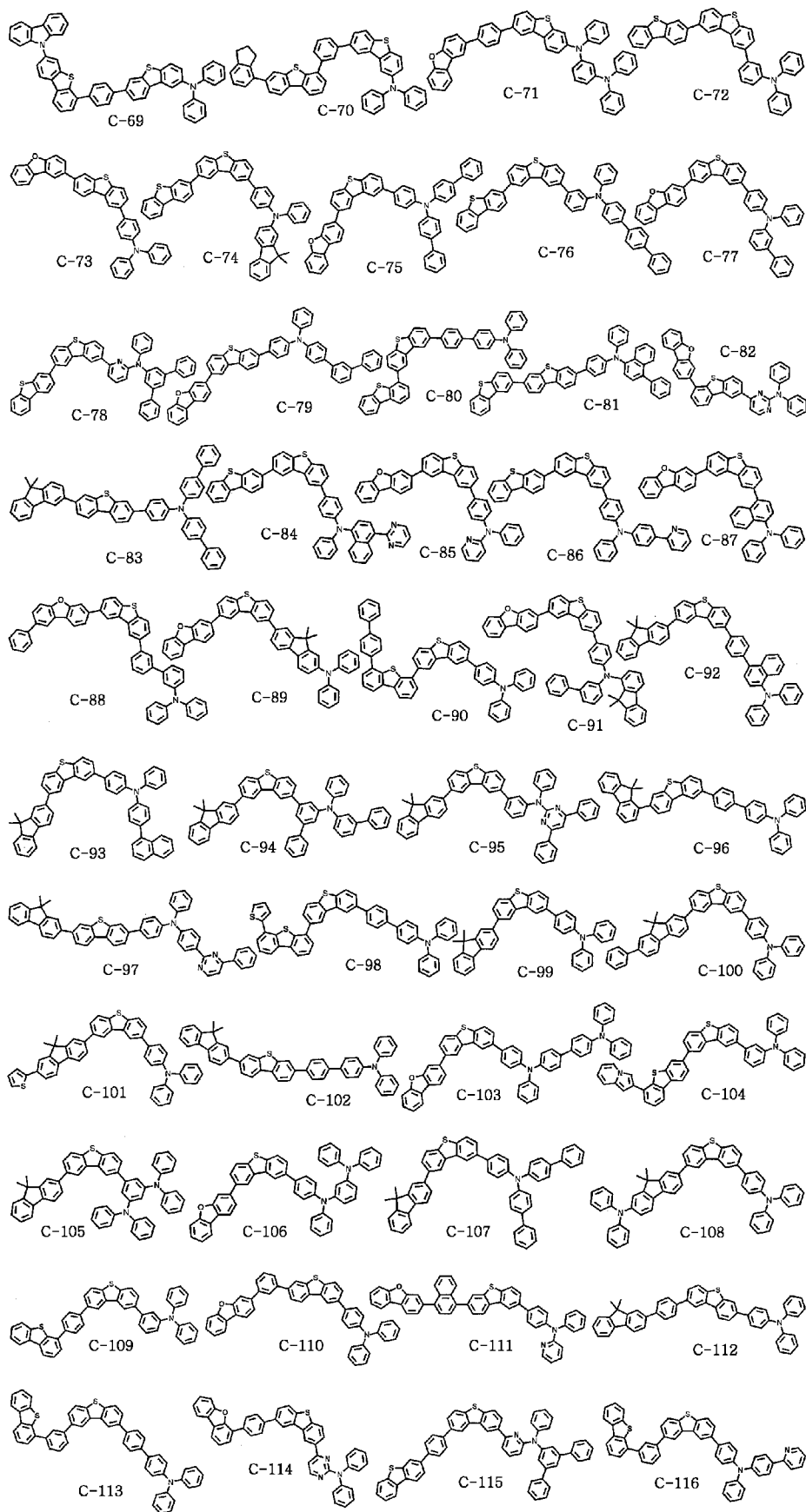
stituted 5- to 15-membered heteroaryl group; or $-NR_{11}R_{12}$; wherein R_{11} and R_{12} each independently represent an unsubstituted (C6-C15)aryl group.

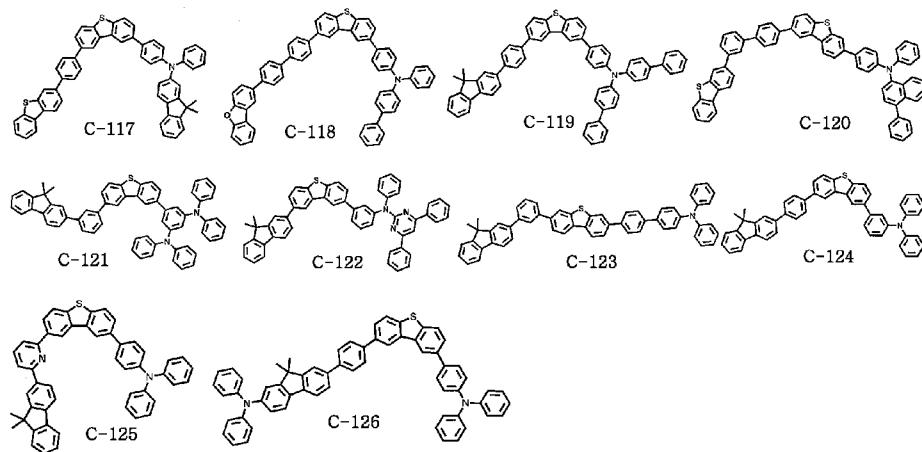
[Claim 5]

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









[Claim 6]

An organic electroluminescent device comprising the organic electroluminescent compound according to claim 1.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2013/008206

A. CLASSIFICATION OF SUBJECT MATTER

C09K 11/06 (2006.01) C07D 333/76 (2006.01) C07D 409/04 (2006.01) C07D 409/10 (2006.01) H01L 51/50 (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: CAPlus, Registry: Substructure search of Chemical Formula 1; Keywords based on electroluminescent, OLED, light, emit, dibenzo, diaryl, amine

Patentscope: Electroluminescent, Rohm and Haas

Espacenet: Electroluminescent, Rohm and Haas

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

* "A"	Special categories of cited documents: 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
"O"	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
29 November 2013

Date of mailing of the international search report
02 December 2013

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INTERNATIONAL SEARCH REPORT		International application No.
C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		PCT/KR2013/008206
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2003171366 A (MITSUI CHEMICALS INC.) 20 June 2003 Abstract; Chemical Abstracts Accession No. 2003:470479 & CAS Registry File RN 545401-98-7 and RN 545402-01-5	1-6
A	WO 2012/015265 A1 (ROHM AND HAAS ELECTRONIC MATERIALS KOREA LTD) 02 February 2012 Abstract; Claim 1; Compound 27, page 8	1-6
A	WO 2012/011756 A1 (ROHM AND HAAS ELECTRONIC MATERIALS KOREA LTD) 26 January 2012 Abstract; Claim 1; Compound 30, page 7	1-6

Form PCT/ISA/210 (fifth sheet) (July 2009)

INTERNATIONAL SEARCH REPORT Information on patent family members		International application No. PCT/KR2013/008206	
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 2003171366 A	20 Jun 2003	JP 4276398 B2	10 Jun 2009
WO 2012/015265 A1	02 Feb 2012	JP 2013539205 A	17 Oct 2013
		KR 20120011445 A	08 Feb 2012
		TW 201213501 A	01 Apr 2012
		WO 2012015265 A1	02 Feb 2012
WO 2012/011756 A1	26 Jan 2012	JP 2013538793 A	17 Oct 2013
		KR 20120009761 A	02 Feb 2012
		TW 201300499 A	01 Jan 2013
		WO 2012011756 A1	26 Jan 2012
End of Annex			
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001. Form PCT/ISA/210 (Family Annex)(July 2009)			