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(71) **Applicant** *(for all designated States except US)*: **ROHM AND HAAS ELECTRONIC MATERIALS KOREA LTD.** [KR/KR]; 736, Baekseok-dong, Cheonan-si, Chungcheongnam-do 331-980 (KR).

(72) **Inventors; and**

(75) **Inventors/Applicants** *(for US only)*: **KIM, Chi Sik** [KR/KR]; #105-1104, Taeyeong Desian Apt., Changjeon-dong, Mapo-gu, Seoul 121-789 (KR). **CHO, Young Jun** [KR/KR]; #101-1111, Samsung Apt., 15-1, Donam-dong, Seongbuk-gu, Seoul 136-060 (KR). **KWON, Hyuck Joo** [KR/KR]; #224-2001, Samsung Raemian 2 Cha, Jangan-dong, Dongdaemun-gu, Seoul 130-100 (KR). **KIM, Bong Ok** [KR/KR]; #101-1108, Hansol Apt., 4, Samseong-dong, Gangnam-gu, Seoul 135-090 (KR). **KIM, Sung Min** [KR/KR]; #EB-1003, Mokdong Trapalace, Mok 1-dong, Yangcheon-gu, Seoul 158-761 (KR).

(74) **Agents**: **KWON, Oh-Sig** et al.; 4F, Jooeunleaderstel, 921, Dunsan-dong, Seo-gu, Daejeon 302-120 (KR).

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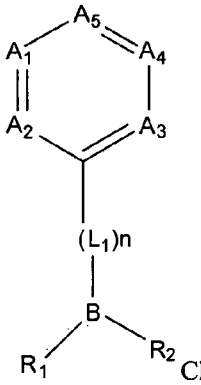
(54) **Title**: NOVEL ORGANIC ELECTROLUMINESCENT COMPOUNDS AND ORGANIC ELECTROLUMINESCENT DEVICE USING THE SAME



Chemical Formula 1

(57) **Abstract**: Organic electroluminescent compounds of Chemical Formula 1 : wherein the variables A_1, A_2, A_3, A_4, A_5, $(L_1)n$, R_1 and R_2 are as defined therein in the specification. These compounds exhibit high luminous efficiency and excellent life property of material are used in organic electroluminescent devices. An OLED having a very good operation life and improved consumption power is manufactured using these compounds.

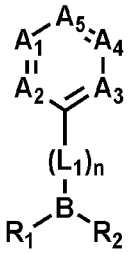
Description

Title of Invention: NOVEL ORGANIC ELECTROLUMINESCENT COMPOUNDS AND 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. More particularly, the organic electroluminescent compound is represented by Chemical Formula 1:

[2] [Chemical Formula 1]

[3] 

Background Art

[4] Among display devices, electroluminescent (EL) devices are advantageous in that they provide wide view angle, superior contrast and fast response rate as self-emissive display devices. In 1987, Eastman Kodak first developed an organic EL device using a low-molecular-weight aromatic diamine and aluminum complex as a substance for forming an electroluminescent layer [*Appl. Phys. Lett.* 51, 913, 1987].

[5] In an organic EL device, when a charge is applied to an organic layer formed between an electron injection electrode (cathode) and a hole injection electrode (anode), an electron and a hole are paired and exciton is generated. Light is emitted by using electroluminescence (phosphorescence or fluorescence) in a state that the exciton is inactivated. The organic EL device emits polarization of light at voltage of about 10V and high brightness of about 100~10,000cd/m^2. The organic EL device has a feature in that light is emitted in a spectrum ranging from blue color to red color by simply selecting a fluorescent material. The organic EL device is advantageous in that it can be formed on a flexible transparent substrate such as plastic, is operable with relatively low voltage (10 V or lower) as compared to plasma display panels or inorganic EL displays, consumes less power, and provides excellent color.

[6] In an organic EL device, the most important factor that determines its performance including luminescence efficiency and operation life is the electroluminescent material. Some requirements of the electroluminescent material include high electroluminescence quantum yield in solid state, high electron and hole mobility, resistance to de-

composition during vacuum deposition, ability to form uniform film and stability.

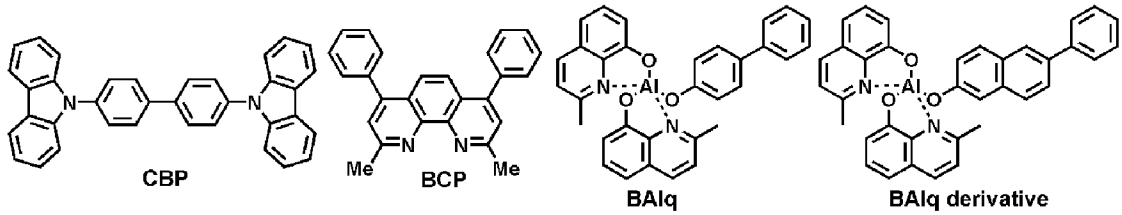
[7] Organic electroluminescent materials are generally classified into high-molecular materials and low-molecular materials. The low-molecular materials include metal complexes and thoroughly organic electroluminescent materials which do not contain metal, from the aspect of molecular structure. Such electroluminescent materials include chelate complexes such as tris(8-quinolinolato)aluminum complexes, coumarin derivatives, tetraphenylbutadiene derivatives, bis(styrylarylene) derivatives and oxadiazole derivatives. From those materials, it is reported that light emission of visible region from blue to red can be obtained.

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

[9] When the organic EL device is fabricated by doping technology, transferring energy from host molecule to dopant in an excited state does not achieve 100% and a host material as well as dopant emits light. In particular, since the host material emits light in a range of wavelength having larger visibility than the dopant in case of a red light emitting device, color purity is deteriorated due to dull light emission of the host material. If the technology is actually applied, it is required to increase luminescence life and improve durability.

[10] At present, CBP is most widely known as a host material for a phosphorescent material. High-efficiency OLEDs using a hole blocking layer comprising BCP, BAlq, etc. are reported. High-performance OLEDs using BAlq derivatives as a host were

reported by Pioneer (Japan) and others.

[11] 

[12] Although these materials provide good electroluminescence characteristics, they are disadvantageous in that degradation may occur during the high-temperature deposition process in vacuum because of low glass transition temperature and poor thermal stability. Since the power efficiency of an OLED is given by (π/voltage) current efficiency, the power efficiency is inversely proportional to the voltage. High power efficiency is required to reduce the power consumption of an OLED. Actually, OLEDs using phosphorescent materials provide much better current efficiency (cd/A) than those using fluorescent materials. However, when the existing materials such as BAlq, CBP, etc. are used as a host of the phosphorescent material, there is no significant advantage in power efficiency (lm/W) over the OLEDs using fluorescent materials because of high driving voltage.

[13] Further, the OLED devices do not have satisfactory operation life. Therefore, development of more stable, higher-performance host materials is required.

Disclosure of Invention

Technical Problem

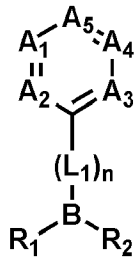
[14] Accordingly, an object of the present invention is to provide an organic electroluminescent compound having luminescence efficiency and device operation life improved over existing materials and having superior backbone with appropriate color coordinates in order to solve the aforesaid problems. Another object of the present invention is to provide a highly efficient and long life organic electroluminescent device employing the organic electroluminescent compound as an electroluminescent material.

Solution to Problem

[15] Provided are a novel organic electroluminescent compound represented by following Chemical Formula 1 and an organic electroluminescent device using the same. Since the organic electroluminescent compound according to the present invention exhibits good luminous efficiency and excellent life property compared to the existing host material, it may be used to manufacture OLED devices having very superior operation life and consuming less power due to improved power efficiency.

[16] [Chemical Formula 1]

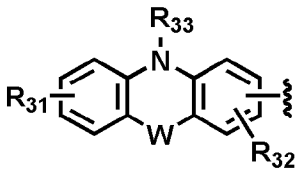
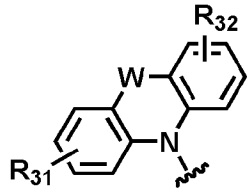
[17]



[18] wherein

[19] A_1 through A_5 independently represent CR or N;

[20] L_1 represents (C6-C30)arylene with or without substituent(s) or (C3-C30)heteroarylene with or without substituent(s);

[21] R, R_1 and R_2 independently represent hydrogen, deuterium, halogen, (C1-C30)alkyl with or without substituent(s), (C6-C30)aryl with or without substituent(s), substituted or unsubstituted (C6-C30)aryl fused with one or more (C3-C30)cycloalkyl(s) with or without substituent(s), (C3-C30)heteroaryl with or without substituent(s), 5- to 7-membered heterocycloalkyl with or without substituent(s), 5- to 7-membered heterocycloalkyl fused with one or more aromatic ring(s) with or without substituent(s), (C3-C30)cycloalkyl with or without substituent(s), (C3-C30)cycloalkyl fused with one or more aromatic ring(s) with or without substituent(s), cyano, nitro, $NR_{11}R_{12}$, $BR_{13}R_{14}$, $PR_{15}R_{16}$, $P(=O)R_{17}R_{18}$ [wherein R_{11} through R_{18} independently represent (C1-C30)alkyl with or without substituent(s), (C6-C30)aryl with or without substituent(s) or (C3-C30)heteroaryl with or without substituent(s)], $R_{19}R_{20}R_{21}Si$- [wherein R_{19} through R_{21} independently represent (C1-C30)alkyl with or without substituent(s), (C6-C30)aryl with or without substituent(s) or (C3-C30)heteroaryl with or without substituent(s)], (C6-C30)ar(C1-C30)alkyl with or without substituent(s), $R_{22}X$- [wherein X represents S or O, and R_{22} represents (C1-C30)alkyl with or without substituent(s), (C6-C30)aryl with or without substituent(s) or (C3-C30)heteroaryl with or without substituent(s)], (C2-C30)alkenyl with or without substituent(s), (C2-C30)alkynyl with or without substituent(s),  or  , or each of them may be linked to an adjacent substituent via substituted or unsubstituted (C3-C30)alkylene or substituted or unsubstituted (C3-C30)alkenylene with or without a fused ring to form an alicyclic ring, a mono- or

polycyclic aromatic ring or a mono- or polycyclic heteroaromatic ring;

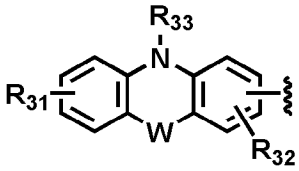
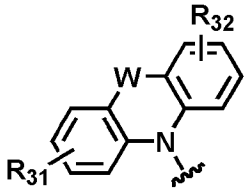
[22] W represents $-(CR_{41}R_{42})_m-$, $-(R_{41})C=C(R_{42})-$, $-N(R_{43})-$, -S-, -O-, $-Si(R_{44})(R_{45})-$, $-P(R_{46})-$, $-P(=O)(R_{47})-$, -C(=O)- or $-B(R_{48})-$;

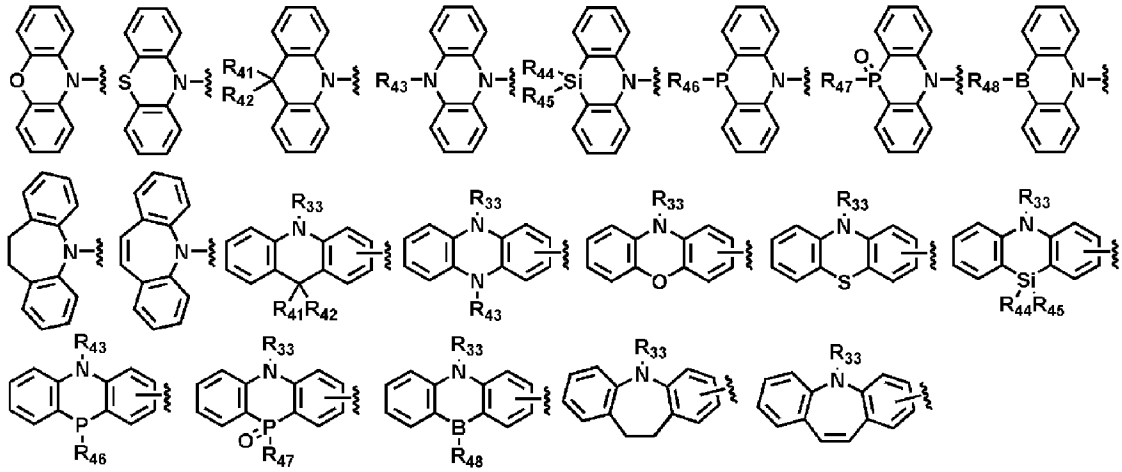
[23] R_{31} through R_{33} and R_{41} through R_{48} are the same as R;

[24] the heterocycloalkyl or heteroaryl may contain one or more heteroatom(s) selected from B, N, O, S, P(=O), Si and P;

[25] n represents an integer from 0 to 5; and

[26] m represents an integer 0, 1 or 2.

[27] To be specific, the  and  may be independently exemplified as following structures but are not limited thereto.

[28] 

[29] wherein

[30] each of R_{33} and R_{41} through R_{48} independently represents (C1-C30)alkyl with or without substituent(s), (C6-C30)aryl with or without substituent(s) or (C3-C30)heteroaryl with or without substituent(s), or the R_{41} through R_{48} may be linked to an adjacent substituent via substituted or unsubstituted (C3-C30)alkylene or substituted or unsubstituted (C3-C30)alkenylene with or without a fused ring to form an alicyclic ring, a mono- or polycyclic aromatic ring or a mono- or polycyclic heteroaromatic ring.

[31] In the present invention, "alkyl", "alkoxy" and other substituents containing "alkyl" moiety include both linear and branched species and "cycloalkyl" includes monocyclic hydrocarbons as well as polycyclic hydrocarbons such as adamantyl or (C7-C30)bicycloalkyl with or without substituent(s).

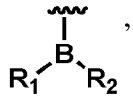
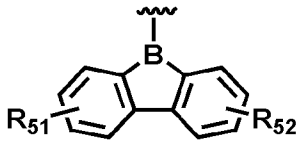
[32] In the present invention, "aryl" means an organic radical derived from an aromatic hydrocarbon by the removal of one hydrogen atom, and may include a 4- to

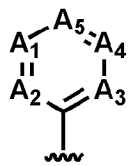
7-membered, particularly 5- or 6-membered, single ring or fused ring, including a plurality of aryls linked by single bond(s). Specific examples include phenyl, naphthyl, biphenyl, anthryl, indenyl, fluorenyl, phenanthryl, triphenylenyl, pyrenyl, perylenyl, chrysenyl, naphthacenyl, fluoranthenyl, etc., but are not limited thereto. The naphthyl includes 1-naphthyl and 2-naphthyl, the anthryl includes 1-anthryl, 2-anthryl and 9-anthryl, and the fluorenyl includes 1-fluorenyl, 2-fluorenyl, 3-fluorenyl, 4-fluorenyl and 9-fluorenyl. In the present invention, "heteroaryl" means an aryl group containing 1 to 4 heteroatom(s) selected from B, N, O, S, P(=O), Si and P as aromatic ring backbone atom(s), other remaining aromatic ring backbone atoms being carbon. It may be 5- or 6-membered monocyclic heteroaryl, polycyclic heteroaryl, or polycyclic heteroaryl resulting from condensation with a benzene ring, and may be partially saturated. Further, the heteroaryl includes more than one heteroaryls linked by single bond(s). The heteroaryl group includes a divalent aryl group wherein the heteroatom(s) in the ring may be oxidized or quaternized to form, for example, an N-oxide or a quaternary salt. Specific examples include monocyclic heteroaryl such as furyl, thiophenyl, pyrrolyl, imidazolyl, pyrazolyl, thiazolyl, thiadiazolyl, isothiazolyl, isoxazolyl, oxazolyl, oxadiazolyl, triazinyl, tetrazinyl, triazolyl, tetrazolyl, furazanyl, pyridyl, pyrazinyl, pyrimidinyl, pyridazinyl, etc., polycyclic heteroaryl such as benzofuranyl, benzothiophenyl, isobenzofuranyl, benzimidazolyl, benzothiazolyl, benzoisothiazolyl, benzoisoxazolyl, benzoxazolyl, isoindolyl, indolyl, indazolyl, benzothiadiazolyl, quinolyl, isoquinolyl, cinnolinyl, quinazolinyl, quinoxalinyl, carbazolyl, phenanthridinyl, benzodioxolyl, etc., an N-oxide thereof (e.g., pyridyl N-oxide, quinolyl N-oxide, etc.), a quaternary salt thereof, etc., but are not limited thereto.

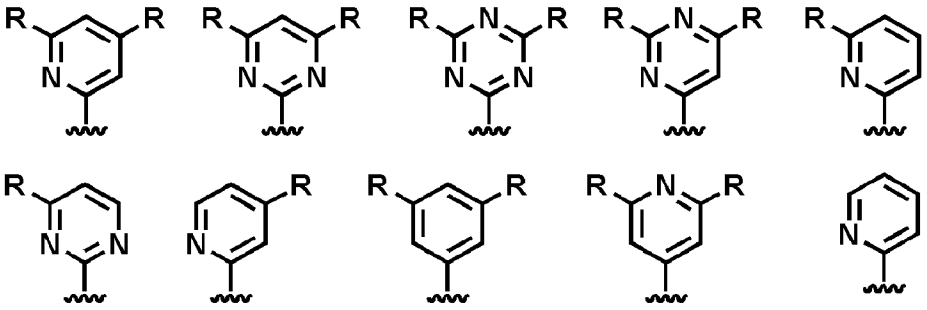
[33] In the present invention, the alkyl moiety of "(C1-C30)alkyl, tri(C1-C30)alkylsilyl, di(C1-C30)alkyl(C6-C30)arylsilyl, (C6-C30)ar(C1-C30)alkyl, (C1-C30)alkyloxy, (C1-C30)alkylthio", or the like may have 1 to 20 carbon atoms, more specifically 1 to 10 carbon atoms. The aryl moiety of "(C6-C30)aryl, di(C1-C30)alkyl(C6-C30)arylsilyl, tri(C6-C30)arylsilyl, (C6-C30)ar(C1-C30)alkyl, (C6-C30)aryloxy, (C6-C30)arylthio", or the like may have 6 to 20 carbon atoms, more specifically 6 to 12 carbon atoms. The heteroaryl of "(C3-C30)heteroaryl" may have 4 to 20 carbon atoms, more specifically 4 to 12 carbon atoms. The cycloalkyl of "(C3-C30)cycloalkyl" may have 3 to 20 carbon atoms, more specifically 3 to 7 carbon atoms. The alkenyl or alkynyl of "(C2-C30)alkenyl or alkynyl" may have 2 to 20 carbon atoms, more specifically 2 to 10 carbon atoms.

[34] And, in the present invention, the phrase "substituted or unsubstituted" or "with or without substituent(s)" means that each substituent of the L_1, R, R_1, R_2, R_{11} through R_{22}, R_{31} through R_{33} and R_{41} through R_{48} may be independently substituted with one or more substituent(s) selected from the group consisting of deuterium, halogen, (C1-C30)alkyl

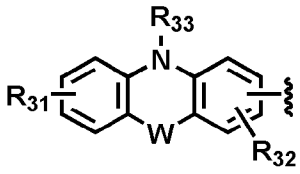
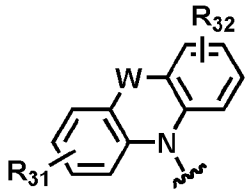
with or without halogen substituent(s), (C6-C30)aryl, (C3-C30)heteroaryl with or without (C6-C30)aryl substituent(s), 5- to 7-membered heterocycloalkyl, 5- to 7-membered heterocycloalkyl fused with one or more aromatic ring(s), (C3-C30)cycloalkyl, (C6-C30)cycloalkyl fused with one or more aromatic ring(s), $R^aR^bR^cSi$-[wherein R^a, R^b and R^c independently represent (C1-C30)alkyl or (C6-C30)aryl], (C2-C30)alkenyl, (C2-C30)alkynyl, cyano, carbazolyl, $-NR^dR^e$, $-BR^fR^g$, $-PR^hR^i$, $-P(=O)R^jR^k$[wherein R^d through R^k independently represent (C1-C30)alkyl, (C6-C30)aryl or (C3-C30)heteroaryl], (C6-C30)ar(C1-C30)alkyl, (C1-C30)alkyl(C6-C30)aryl, R^lX-[wherein X represents S or O, R^l represents (C1-C30)alkyl, (C6-C30)aryl or (C3-C30)heteroaryl], $R^mC(=O)$-[wherein R^m represents (C1-C30)alkyl, (C1-C30)alkoxy, (C6-C30)aryl or (C6-C30)aryloxy], $R^mC(=O)O$-[wherein R^m represents (C1-C30)alkyl, (C1-C30)alkoxy, (C6-C30)aryl or (C6-C30)aryloxy], carboxyl, nitro and hydroxyl, or may be linked to an adjacent substituent to form a ring.

[35] The R_1 and R_2 independently represent (C6-C30)aryl with or without substituent(s) or (C3-C30)heteroaryl with or without substituent(s), in  , R_1 and R_2 may be linked via alkylene or alkenylene with or without substituent(s) to form  [wherein R_{51} and R_{52} independently represent hydrogen, (C6-C30)aryl with or without substituent(s) or (C3-C30)heteroaryl with or without substituent(s)].

[36] The  is selected from the following structures but is not limited thereto.

[37] 

[38] R represents (C1-C30)alkyl with or without substituent(s), (C6-C30)aryl with or without substituent(s), (C3-C30)heteroaryl with or without substituent(s), $R_{22}X$-[wherein X represents S or O, and R_{22} represents (C1-C30)alkyl with or without sub-

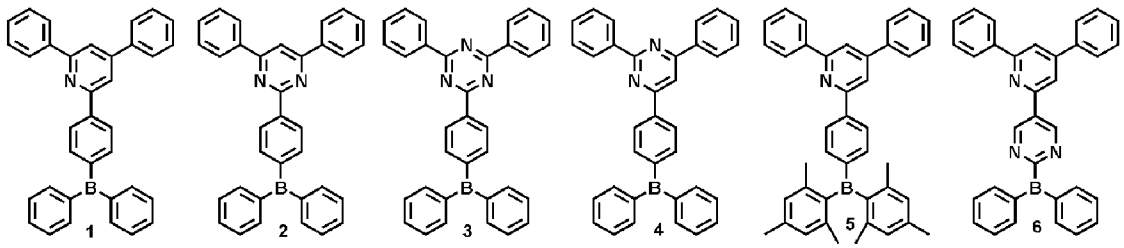
stituent(s), (C6-C30)aryl with or without substituent(s) or (C3-C30)heteroaryl with or without substituent(s)],  or  , and W and R_{31} through R_{33} are the same as defined in Chemical Formula 1, and R may be identical or different.

[39] L_1 represents phenylene, naphthylene, anthracenylene, fluorenylene, phenanthrylene, biphenylene, triphenylene, fluoranthenylene, chrysenylene, pyrenylene, perylenylene, pyridinylene, furylene, thiophenylene, selenophenylene, pyridinylene, pyrazinylene, pyridazinylene, quinolinylene or quinoxalinylene; and

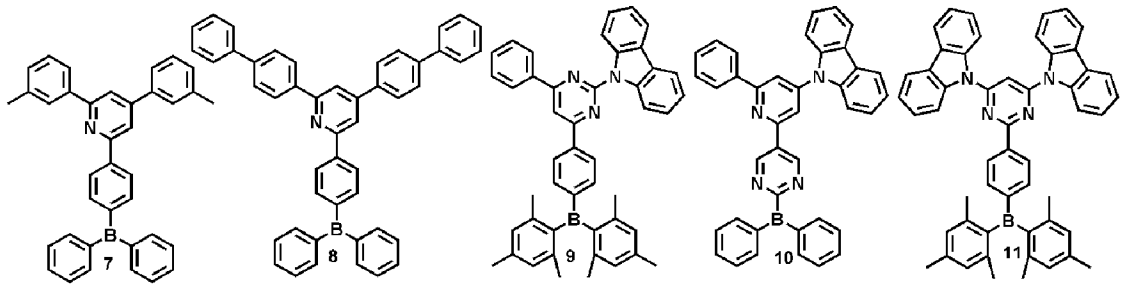
[40] R, R_1 and R_2 independently represent hydrogen, methyl, ethyl, n-propyl, i-propyl, n-butyl, i-butyl, t-butyl, pentyl, amyl, hexyl, heptyl, octyl, nonyl, decyl, trifluoromethyl, phenyl, phenyloxy, phenylthio, 1-naphthyl, 2-naphthyl, biphenyl, 1-phenanthryl, 2-phenanthryl, 3-phenanthryl, 4-phenanthryl, 9-phenanthryl, N-carbazolyl, N-phenyl-1-carbazolyl, N-phenyl-2-carbazolyl, N-phenyl-3-carbazolyl, N-phenyl-4-carbazolyl, 2-pyridyl, 3-pyridyl, 4-pyridyl, 2-quinolyl, 3-quinolyl, 4-quinolyl, 5-quinolyl, 6-quinolyl, 7-quinolyl, 8-quinolyl, 3-isoquinolyl, 1-isoquinolyl, 4-isoquinolyl, 5-isoquinolyl, 6-isoquinolyl, 7-isoquinolyl, 8-isoquinolyl, 9H-fluorene-2-yl, 9H-fluorene-3-yl, 9H-fluorene-4-yl, 9H-fluorene-1-yl, 2-pyrimidyl, 4-pyrimidyl, 5-pyrimidyl, 1,2,3-triazine-4-yl, 1,2,3-triazine-5-yl, 1,3,5-triazine-2-yl, N-dibenzocarbazolyl, N-7H-benzo[c]carbazolyl, N-phenyl-7H-benzo[c]carbazole-10-yl, N-phenyl-7H-benzo[c]carbazole-11-yl, N-phenyl-7H-benzo[c]carbazole-9-yl, N-phenyl-7H-benzo[c]carbazole-8-yl, 1-indolizinyl, 2-indolizinyl, 3-indolizinyl, 5-indolizinyl, 6-indolizinyl, 7-indolizinyl, 8-indolizinyl, 6-dibenzofuryl, 7-dibenzofuryl, 8-dibenzofuryl, 9-dibenzofuryl, 7-indole[2,3-c]isoquinolinyl or N-pyrido[2,3-b]indolyl, and the phenyl, naphthyl, biphenyl, phenanthryl, N-carbazolyl, pyridyl, quinolyl, isoquinolyl, fluorenyl, pyrimidyl, triazinyl, N-dibenzocarbazolyl, N-7H-benzo[c]carbazolyl, indolizinyl, dibenzofuryl, 7-indole[2,3-c]isoquinolinyl or N-pyrido[2,3-b]indolyl of R, R_1 and R_2 may be further substituted by one or more substituent(s) selected from methyl, phenyl, triphenylsilyl and trimethylsilyl.

[41] The organic electroluminescent compound according to the present invention may be exemplified by the following compounds, but are not limited thereto:

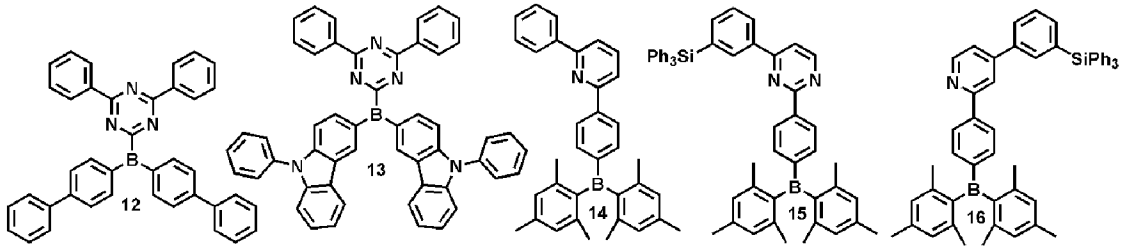
[42]



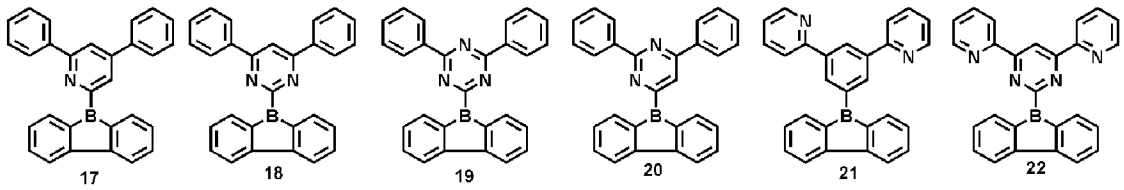
[43]



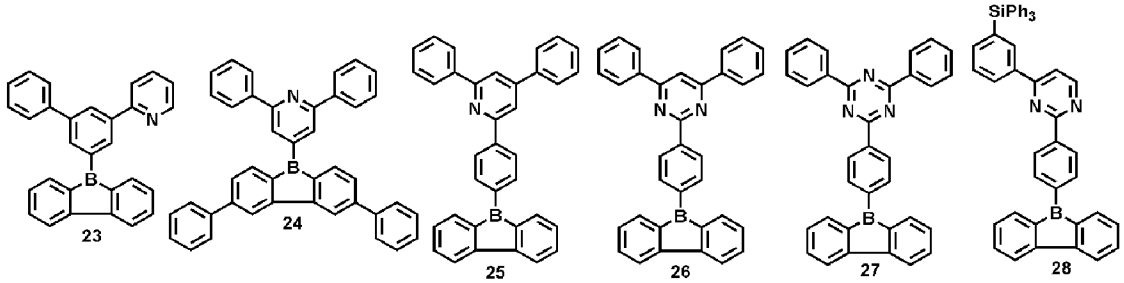
[44]



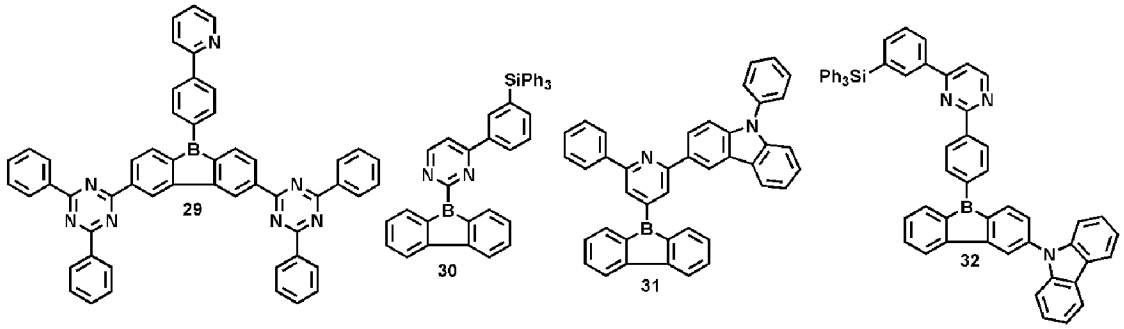
[45]



[46]

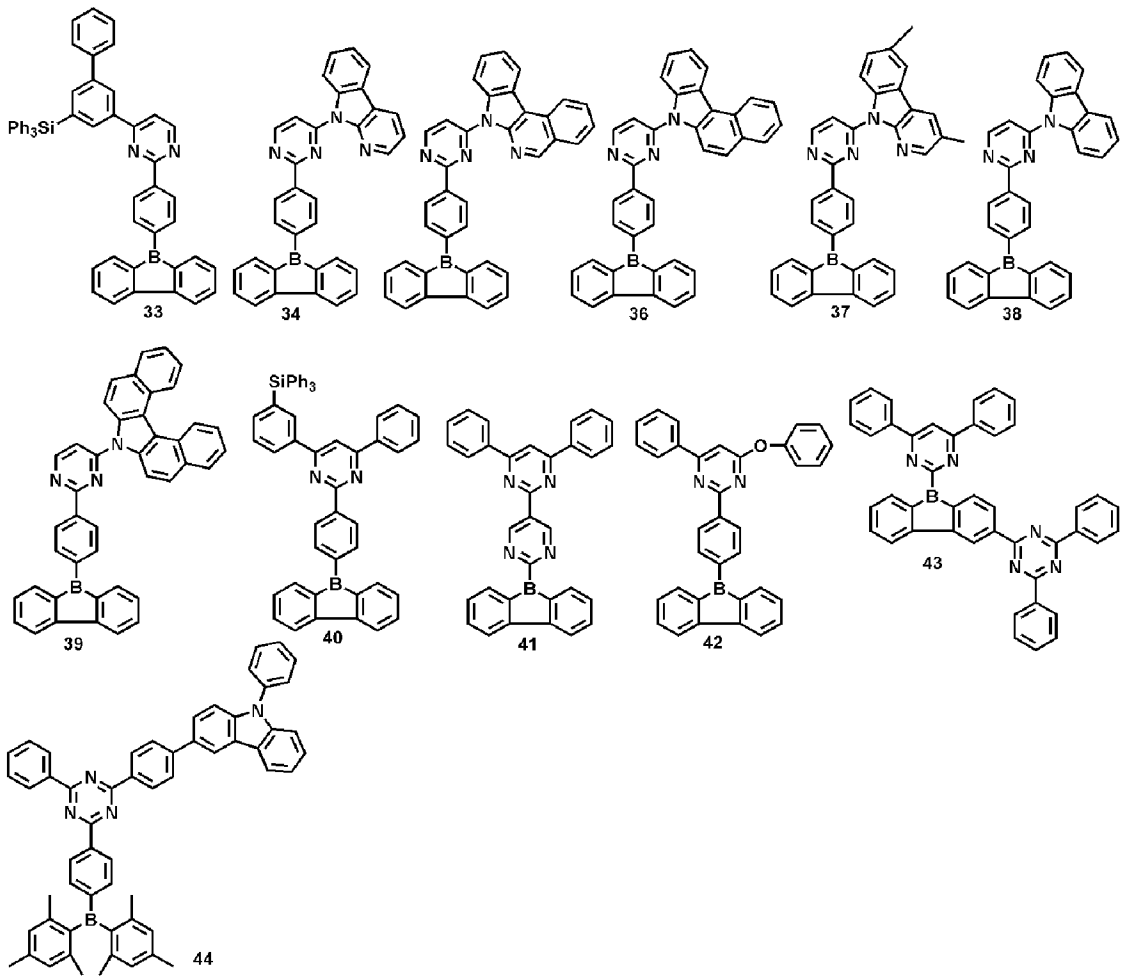


[47]



[48]

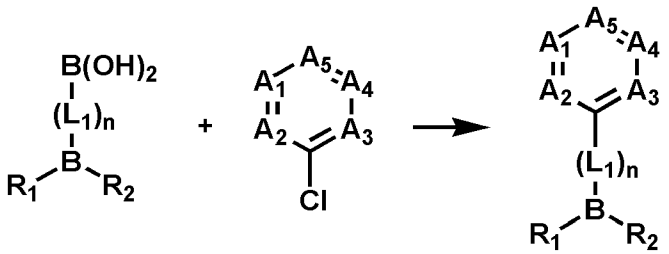
[49]



[50] The organic electroluminescent compound according to the present invention may be prepared by Scheme 1, without being limited thereto:

[51] [Scheme 1]

[52]



[53] wherein

[54] A_1 through A_5, L_1, R_1, R_2 and n are the same as defined in Chemical Formula 1.

[55] Provided is an organic electroluminescent device, which comprises a first electrode; a second electrode; and one or more organic layer(s) interposed between the first electrode and the second electrode, wherein the organic layer comprises one or more organic electroluminescent compound(s) represented by Chemical Formula 1. The organic layer may include one or more organic electroluminescent compounds of Chemical Formula 1 as an electroluminescent host and may include one or more

dopant(s). The dopant used in the organic electroluminescent device of the present invention is not particularly limited, but may be selected from the compounds represented by Chemical Formula 2:

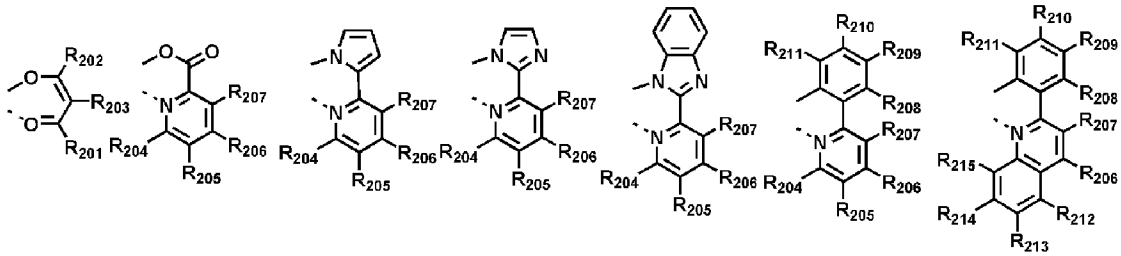
[56] [Chemical Formula 2]

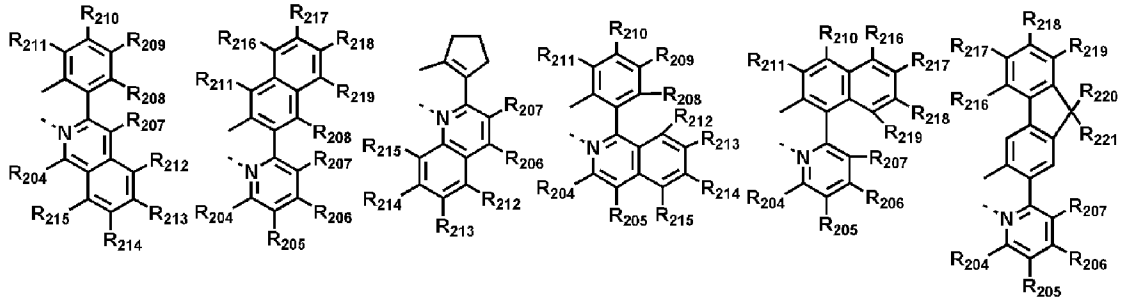
[57] $M^1L^{101}L^{102}L^{103}$

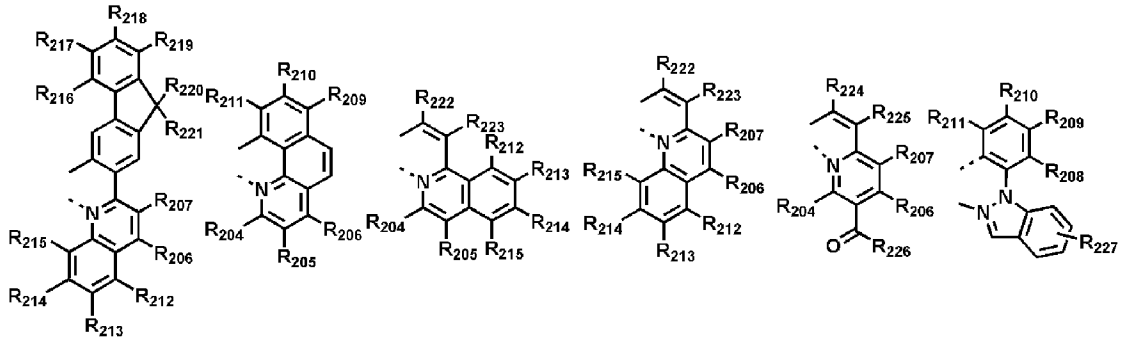
[58] wherein

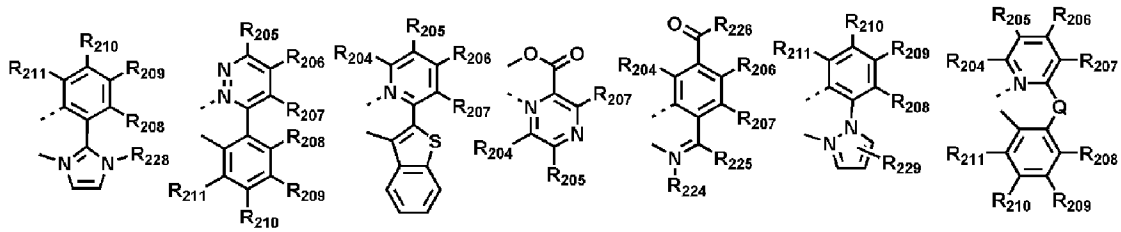
[59] M^1 is selected from the group consisting of Group 7, Group 8, Group 9, Group 10, Group 11, Group 13, Group 14, Group 15 and Group 16 metals; and

[60] ligands L^{101}, L^{102} and $L^{103}$are independently selected from the following structures:

[61] 

[62] 

[63] 

[64] 

[65] wherein

[66] R_{201} through R_{203} independently represent hydrogen, (C1-C30)alkyl with or without halogen substituent(s), (C6-C30)aryl with or without (C1-C30)alkyl substituent(s) or halogen;

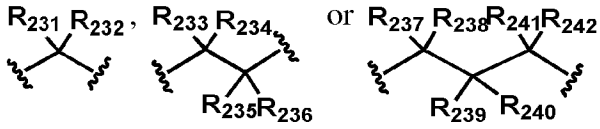
[67] R_{204} through R_{219} independently represent hydrogen, (C1-C30)alkyl with or without substituent(s), (C1-C30)alkoxy with or without substituent(s), (C3-C30)cycloalkyl with or without substituent(s), (C2-C30)alkenyl with or without substituent(s), (C6-C30)aryl with or without substituent(s), mono- or di-(C1-C30)alkylamino with or without substituent(s), mono- or di-(C6-C30)arylamino with or without substituent(s), SF_5, tri(C1-C30)alkylsilyl with or without substituent(s), di(C1-C30)alkyl(C6-C30)arylsilyl with or without substituent(s), tri(C6-C30)arylsilyl with or without substituent(s), cyano or halogen;

[68] R_{220} through R_{223} independently represent hydrogen, (C1-C30)alkyl with or without halogen substituent(s) or (C6-C30)aryl with or without (C1-C30)alkyl substituent(s);

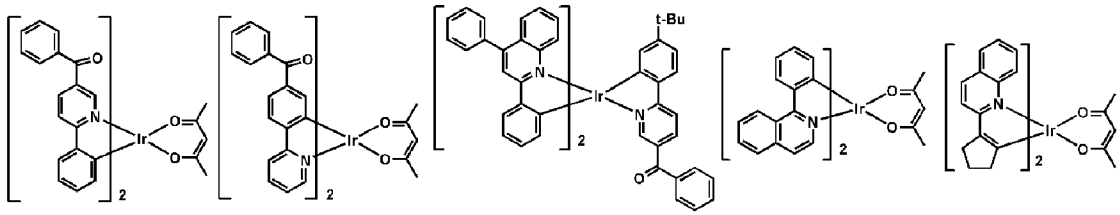
[69] R_{224} and R_{225} independently represent hydrogen, (C1-C30)alkyl with or without substituent(s), (C6-C30)aryl with or without substituent(s) or halogen, or R_{224} and R_{225} may be linked via (C3-C12)alkylene or (C3-C12)alkenylene with or without a fused ring to form an alicyclic ring or a mono- or polycyclic aromatic ring;

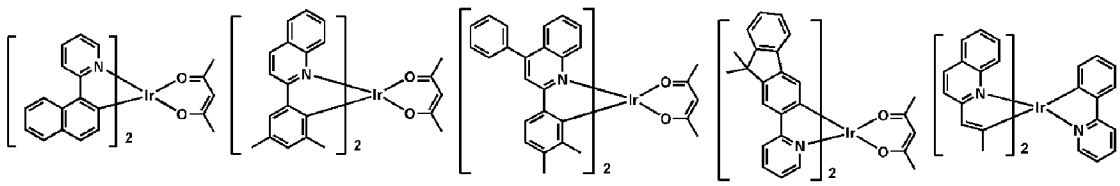
[70] R_{226} represents (C1-C30)alkyl with or without substituent(s), (C6-C30)aryl with or without substituent(s), (C5-C30)heteroaryl with or without substituent(s) or halogen;

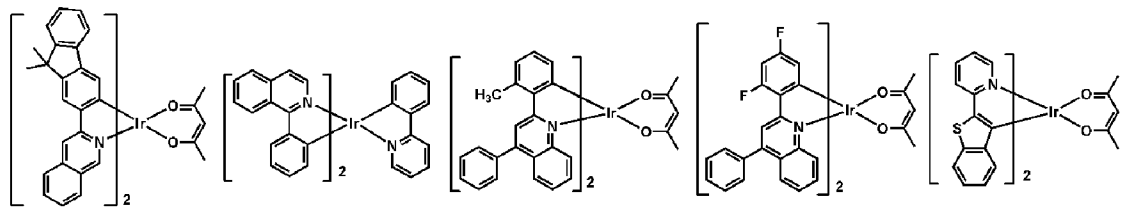
[71] R_{227} through R_{229} independently represent hydrogen, (C1-C30)alkyl with or without substituent(s), (C6-C30)aryl with or without substituent(s) or halogen; and

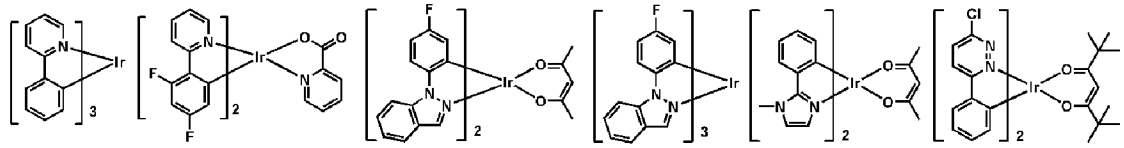
[72] Q represents  , wherein R_{231} through R_{242} independently represent hydrogen, (C1-C30)alkyl with or without halogen substituent(s), (C1-C30)alkoxy, halogen, (C6-C30)aryl with or without substituent(s), cyano or (C5-C30)cycloalkyl with or without substituent(s), each of them may be linked to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

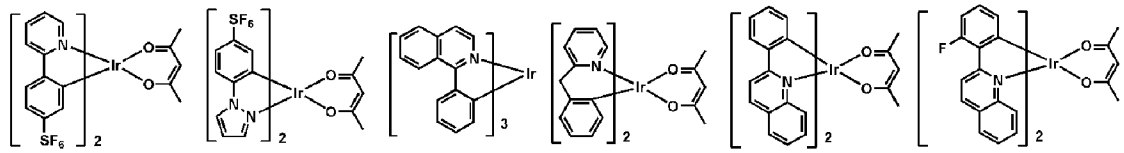
[73] The dopant compound represented by Chemical Formula 2 may be exemplified by the following compounds, but are not limited thereto:

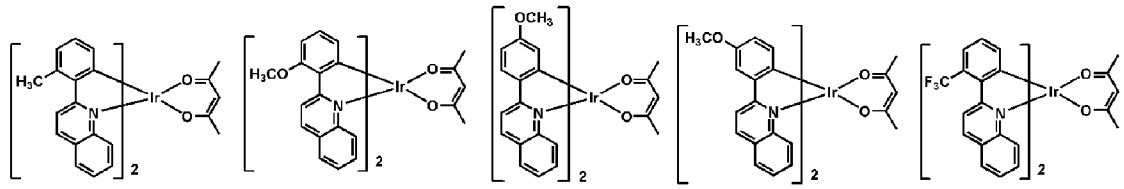
[74] 

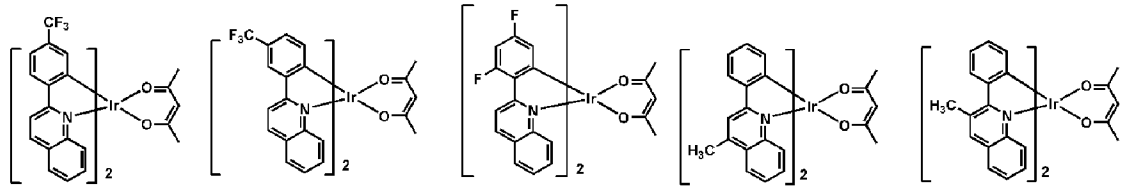
[75] 

[76] 

[77] 

[78] 

[79] 

[80] 

[81] In the organic electronic device of the present invention, the organic layer may further include, in addition to the organic electroluminescent compound represented by Chemical Formula 1, one or more compound(s) selected from the group consisting of arylamine compounds and styrylarylamine compounds, at the same time. The arylamine compounds or styrylarylamine compounds are exemplified in Korean Patent Application No. 10-2008-0123276, 10-2008-0107606 or 10-2008-0118428, but are not limited thereto.

[82] Further, in the organic electroluminescent device of the present invention, the organic layer may further include, in addition to the organic electroluminescent compound represented by Chemical Formula 1, one or more metal(s) selected from the group consisting of organic metals of Group 1, Group 2, 4th period and 5th period transition metals, lanthanide metals and d-transition elements or complex compounds. The organic layer may include an electroluminescent layer and a charge generating layer.

[83] Further, the organic layer may include, in addition to the organic electroluminescent compound, one or more organic electroluminescent layer(s) emitting blue, green or red light at the same time in order to embody a white-emitting organic electroluminescent device. The compound emitting blue, green or red light may be exemplified by the

compounds described in Korean Patent Application Nos. 10-2008-0123276, 10-2008-0107606 or 10-2008-0118428, but are not limited thereto.

[84] In the organic electroluminescent device of the present invention, a layer (hereinafter referred to as "surface layer" selected from a chalcogenide layer, a metal halide layer and a metal oxide layer may be placed on the inner surface of one or both electrode(s) among the pair of electrodes. More specifically, a chalcogenide (including oxide) layer of silicon or aluminum may be placed on the anode surface of the electroluminescent medium layer, and a metal halide layer or metal oxide layer may be placed on the cathode surface of the electroluminescent medium layer. An operation stability may be attained therefrom. The chalcogenide may be, for example, SiO_x ($1 = x = 2$), AlO_x ($1 = x = 1.5$), SiON, SiAlON, etc. The metal halide may be, for example, LiF, MgF_2, CaF_2, a rare earth metal fluoride, etc. The metal oxide may be, for example, Cs_2O, Li_2O, MgO, SrO, BaO, CaO, etc.

[85] In an organic electroluminescent device according to the present invention, it is also preferable to arrange on at least one surface of the pair of electrodes thus manufactured a mixed region of an electron transport compound and a reductive dopant, or a mixed region of a hole transport compound and an oxidative dopant. In that case, since the electron transport compound is reduced to an anion, injection and transport of electrons from the mixed region to an electroluminescent medium are facilitated. In addition, since the hole transport compound is oxidized to a cation, injection and transport of holes from the mixed region to an electroluminescent medium are facilitated. Preferable oxidative dopants include various Lewis acids and acceptor compounds. Preferable reductive dopants include alkali metals, alkali metal compounds, alkaline earth metals, rare-earth metals, and mixtures thereof. Further, a white-emitting electroluminescent device having two or more electroluminescent layers may be manufactured by employing a reductive dopant layer as acharge generating layer.

Advantageous Effects of Invention

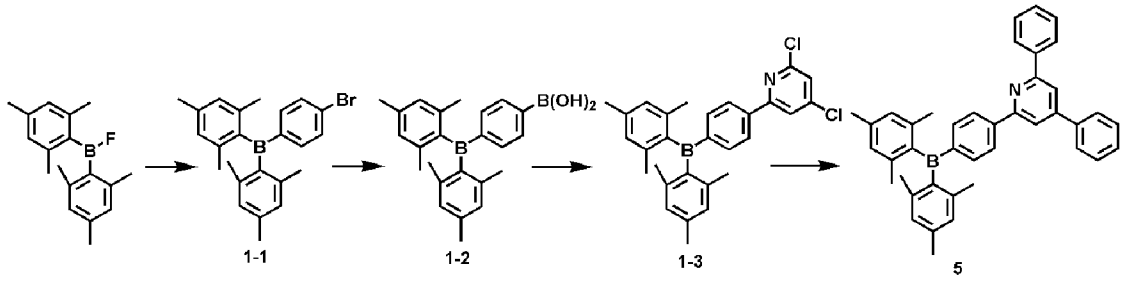
[86] Since the organic electroluminescent compound exhibits good luminous efficiency and excellent life property, it may be used to manufacture OLED devices having superior operation life and consuming less power due to improved power efficiency.

Mode for the Invention

[87] The present invention is further described with respect to organic electroluminescent compounds according to the present invention, processes for preparing the same, and luminescence properties of devices employing the same. However, the following examples are provided for illustrative purposes only and they are not intended to limit the scope of the present invention.

[88] [Preparation Example 1] Preparation of compound **5**

[89]



[90] Preparation of compound **1-1**

[91] 1,4-dibromobenzene (10.5g, 44.74mmol) was dissolved in THF (150ml) and n-buLi (17.89ml, 44.74mmol, 2.5M in Hexane) was slowly added thereto at -78℃. 1 hour later, dimesitylboron fluoride (10g) was dissolved in THF (50ml). After stirring the mixture for 10 hours, distilled water was added and a product was extracted with EA. Drying with magnesium sulfate and distillation under reduced pressure followed by column separation gave a compound **1-1** (12g, 29.61mmol, 79.44%).

[92] Preparation of compound **1-2**

[93] The compound **1-1** (12g, 29.61mmol) was dissolved in THF (100ml) and n-buLi (14.21ml, 35.53mmol, 2.5M in Hexane) was slowly added at -78℃. 1 hour later, trimethylborate (4.95ml, 44.42mmol) was added thereto and stirred for 10 hours. Distilled water was added and a product was extracted with EA. Drying with magnesium sulfate and distillation under reduced pressure followed by column separation gave a compound **1-2** (7g, 18.91mmol, 63.87%).

[94] Preparation of compound **1-3**

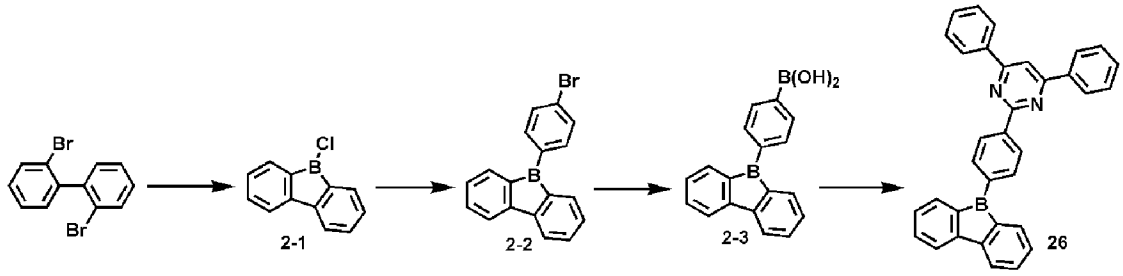
[95] The compound **1-2** (7g, 18.91mmol), 2,4,6-trichloropiridine (4.48ml, 24.58mmol), $Pd(PPh_3)_4$ (0.65g, 0.56mmol), K_2CO_3 (5.2g, 37.82mmol), distilled water 20ml, toluene (100ml) and ethanol (20ml) were added and stirred under reflux. 8 hours later, the mixture was cooled to room temperature and distilled water was added. After extracting with EA and drying with magnesium sulfate, distillation under reduced pressure followed by column separation gave a compound **1-3** (5g, 10.58mmol, 55.98%).

[96] Preparation of compound **5**

[97] compound **1-3** (5g, 10.58mmol), phenylboronic acid (3.22g, 26.46mmol), $Pd(PPh_3)_4$ (0.6g, 0.52mmol), 2M K_2CO_3 (10ml), toluene (70ml) and ethanol (20ml) were added and stirred under reflux. 14 hours later, the mixture was cooled to room temperature distilled water was added. After extracting with EA and drying with magnesium sulfate, distillation under reduced pressure followed by column separation gave a compound **5** (3.4g, 6.11mmol, 57.84%).

[98] [Preparation Example 2] Preparation of compound **26**

[99]



[100] Preparation of compound **2-1**

[101] 2,2'-dibromobiphenyl (15g, 48.07mmol) was dissolved in ethyl ether (500ml) and n-buLi (38.4ml, 96.15mmol, 2.5M in hexane) was slowly added at 0℃. The mixture was stirred for 2 hours and an organic solvent was distilled under reduced pressure. A solid was washed with hexane and mixed with hexane (400ml). The mixture was stirred and boron trichloride 48ml (48.07mmol, 1.0M in hexane) was slowly added thereto at 0℃. The mixture was stirred for 12 hours. The produced solid was filtered under reduced pressure and washed with hexane to give a compound **2-1** (3g, 15.11mmol, 31.46%).

[102] Preparation of compound **2-2**

[103] After 1,4-dibromobenzene (3.55g, 15.11mmol) was dissolved in THF (70ml), n-buLi (6.04ml, 15.11mmol, 2.5M in hexane) was slowly added thereto at -78℃. 1 hour later, the compound **2-1** (3g, 15.11mmol) was added thereto. After stirring the mixture for 12 hours and adding distilled water, a product was extracted with EA. Drying with magnesium sulfate and distillation under reduced pressure followed by column separation gave a compound **2-2** (4g, 12.53mmol, 82.98%).

[104] Preparation of compound **2-3**

[105] A compound **2-3** (2.3g, 8.10mmol, 64.65%) was given by combining the compound **2-2** (4g, 12.53mmol) according to the same method as preparation of the compound 1-2 in Preparation Example 1.

[106] Preparation of compound **26**

[107] The compound **2-3** (2.3g, 8.10mmol), 2-chloro-4,6-diphenylpirimidine (2.37g, 8.91mmol), $Pd(PPh_3)_4$ (0.28g, 2M K_2CO_3 8ml), toluene (50ml) and ethanol (20ml) were added and the mixture was stirred under reflux. 10 hours later, the mixture was cooled to room temperature and distilled water was added. The product was extracted with EA and dried with anhydrous $MgSO_4$. Distillation under reduced pressure followed by column separation gave a compound **26** (2.5g, 5.31mmol, 65.61%).

[108] Organic electroluminescent Compounds **1** to **44** were prepared according to Preparation Examples 1 and 2. Table 1 shows ^1H NMR and MS/FAB of the prepared organic electroluminescent compounds.

[109] Table 1

[Table 1]

[Table]

Comp.	^{1}H NMR($CDCl_3$, 200 MHz)	MS/FAB	
		found	calculated
1	δ = 7.41~7.54(14H, m), 7.75(4H, m), 7.84(2H, m), 8.2(2H, m), 8.3(4H, m)	471.40	471.22
2	δ = 7.41~7.51(12H, m), 7.75~7.81(12H, m), 8.23(1H, s)	472.39	472.21
3	δ = 7.41~7.51(12H, m), 7.75~7.81(8H, m), 8.28(4H, m)	473.37	473.21
4	δ = 7.41~7.51(12H, m), 7.75~7.81(10H, m), 8.23(1H, s), 8.28(2H, m)	472.39	472.21
5	δ = 2.34(18H, s), 6.91(4H, m), 7.41~7.54(8H, m), 7.84(2H, m), 8.2(2H, m), 8.3(4H, m)	555.56	555.31
6	δ = 7.41~7.54(14H, m), 7.75(4H, m), 8.26~8.3(3H, m), 8.56(1H, m), 9.93(2H, m)	473.37	473.21
7	δ = 2.34(6H, s), 7.19~7.25(2H, m), 7.33~7.45(9H, m), 7.75~7.84(7H, m), 8.11(1H, m), 8.2(2H, m), 8.3(3H, m)	499.45	499.25
8	δ = 7.25(4H, m), 7.41~7.52(16H, m), 7.75(4H, m), 7.84~7.88(4H, m), 8.2(2H, m), 8.3(2H, m), 8.81(2H, m)	623.59	623.28
9	δ = 2.34(18H, s), 6.91(4H, m), 7.25~7.33(3H, m), 7.41(1H, m), 7.5~7.51(3H, m), 7.63(1H, m), 7.79~7.81(6H, m), 7.94(1H, m), 8.12(1H, m), 8.55(1H, m), 8.63(1H, s)	645.64	645.33
10	δ = 7.11(1H, m), 7.25~7.33(3H, m), 7.41~7.54(11H, m), 7.63(1H, m), 7.75(4H, m), 7.94(1H, m), 8.12(1H, m), 8.3(2H, m), 8.55(1H, m), 9.93(2H, m)	562.47	562.23
11	δ = 2.34(18H, s), 6.91(4H, m), 7.16(1H, s), 7.25~7.33(6H, m), 7.5(2H, m), 7.63(2H, m), 7.79~7.81(4H, m), 7.94(2H, m), 8.12(2H, m), 8.55(2H, m)	734.74	734.36
12	δ = 7.41(4H, m), 7.51~7.52(12H, m), 7.79~7.81(8H, m), 8.28(4H, m)	549.47	549.24
13	δ = 7.25~7.33(3H, m), 7.41~7.51(15H, m), 7.58~7.63(6H, m), 7.94~7.98(4H, m), 8.12(1H, m), 8.28(4H, m), 8.55(1H, m)	727.66	727.29
14	δ = 2.34(18H, s), 6.86~6.91(6H, m), 7.44~7.47(2H, m),	479.46	479.28

	7.54(2H, m), 7.84(2H, m), 8.3(4H, m)		
15	δ = 2.34(18H, s), 6.91(4H, m), 7.37~7.46(13H, m), 7.55~7.61(5H, m), 7.76~7.81(5H, m), 7.89(1H, m), 8.54(1H, m)	738.84	738.36
16	δ = 2.34(18H, s), 6.91(4H, m), 7.37~7.46(13H, m), 7.55(3H, m), 7.61~7.62(2H, m), 7.76(1H, m), 7.84(2H, m), 8(1H, m), 8.3(2H, m), 8.44(1H, m), 8.6(1H, m)	737.85	737.36
17	δ = 7.11(1H, m), 7.41~7.54(12H, m), 7.79~7.81(4H, m), 8.3(2H, m), 8.6(1H, m)	393.29	393.17
18	δ = 7.41(4H, m), 7.51(6H, m), 7.79~7.81(8H, m), 8.63(1H, s)	394.27	394.16
19	δ = 7.41(4H, m), 7.51(6H, m), 7.79~7.81(4H, m), 8.28(4H, m)	395.26	395.16
20	δ = 7.32(1H, s), 7.41(4H, m), 7.51(6H, m), 7.79~7.81(6H, m), 8.28(2H, m)	394.27	394.16
21	δ = 7.00(2H, m), 7.26(2H, m), 7.41(2H, m), 7.51(4H, m), 7.79~7.81(4H, m), 8.19(2H, m), 8.5(2H, m), 8.9(1H, m)	394.27	394.16
22	δ = 7.36~7.41(4H, m), 7.51(2H, m), 7.79~7.85(6H, m), 8.4(2H, m), 8.59(2H, m), 10.55(1H, s)	396.25	396.15
23	δ = 7(1H, m), 7.26(1H, m), 7.41(3H, m), 7.51~7.52(7H, m), 7.68(1H, m), 7.79~7.81(4H, m), 8.13(1H, m), 8.39(1H, m), 8.5(1H, m)	393.29	393.17
24	δ = 7.05(2H, m), 7.41~7.54(16H, m), 7.75(2H, m), 7.87~7.88(4H, m), 8.3(4H, m)	545.48	545.23
25	δ = 7.41~7.54(12H, m), 7.79~7.84(6H, m), 8.2(2H, m), 8.3(4H, m)	469.38	469.20
26	δ = 7.41(4H, m), 7.51(6H, m), 7.79~7.81(12H, m), 8.23(1H, s)	470.37	470.20
27	δ = 7.41(4H, m), 7.51(6H, m), 7.79~7.81(8H, m), 8.28(4H, m)	471.36	471.19
28	δ = 7.37~7.46(22H, m), 7.76~7.81(9H, m), 7.89(1H, m), 8.29(1H, m)	652.66	652.25
29	δ = 7(1H, m), 7.26(1H, m), 7.41(4H, m), 7.51(9H, m), 7.75(2H, m), 7.84~7.88(6H, m), 8.28~8.3(10H, m), 8.5(1H,	779.69	779.30

	m)		
30	δ = 7.37~7.55(20H, m), 7.61(1H, m), 7.76~7.81(5H, m), 7.89(1H, m), 7.96(1H, m), 8.57(1H, m)	576.57	576.22
31	δ = 7.05(2H, m), 7.25(1H, m), 7.33(1H, m), 7.41~7.58(12H, m), 7.72(1H, m), 7.79~7.81(4H, m), 7.94(1H, m), 8.28~8.3(3H, m), 8.38(1H, m), 8.55(1H, m)	558.48	558.23
32	δ = 7.25(1H, m), 7.29(1H, m), 7.33(1H, m), 7.37(6H, m), 7.41(1H, m), 7.42(1H, m), 7.46~7.55(15H, m), 7.76~7.81(8H, m), 7.89~7.94(2H, m), 8.09~8.12(2H, m), 8.29(1H, m), 8.55(1H, m)	817.85	817.31
33	δ = 7.37~7.56(25H, m), 7.72(2H, m), 7.79~7.81(9H, m), 8.29(1H, m)	728.76	728.28
34	δ = 7.16(1H, m), 7.25(1H, m), 7.33~7.41(4H, m), 7.51(2H, m), 7.79~7.81(8H, m), 7.94(1H, m), 8.43(1H, m), 8.51~8.57(3H, m)	484.36	484.19
35	δ = 7.16(1H, m), 7.25(1H, m), 7.33(1H, m), 7.41~7.42(3H, m), 7.49~7.51(3H, m), 7.76~7.81(9H, m), 7.92~7.94(2H, m), 8.55~8.57(2H, m), 8.91(1H, m)	534.42	534.20
36	δ = 7.16(1H, m), 7.25(1H, m), 7.33(1H, m), 7.41(2H, m), 7.51(2H, m), 7.63~7.67(4H, m), 7.79~7.81(8H, m), 7.94(1H, m), 8.16(1H, m), 8.54~8.57(3H, m)	533.43	533.21
37	δ = 2.31(3H, s), 2.34(3H, s), 6.88(1H, m), 7.16(1H, m), 7.41(2H, m), 7.51(2H, m), 7.69(1H, m), 7.79~7.82(9H, m), 8.41(1H, m), 8.57(1H, m), 8.72(1H, m)	512.41	512.22
38	δ = 7.16(1H, m), 7.25~7.33(3H, m), 7.41(2H, m), 7.5~7.51(3H, m), 7.63(1H, m), 7.79~7.81(8H, m), 7.94(1H, m), 8.12(1H, m), 8.55~8.57(2H, m)	483.37	483.19
39	δ = 7.16(1H, m), 7.41(2H, m), 7.51(2H, m), 7.63~7.67(6H, m), 7.79~7.81(8H, m), 7.94~7.96(2H, m), 8.16(2H, m), 8.54~8.57(3H, m)	583.49	583.22
40	δ = 7.37~7.55(23H, m), 7.61(1H, m), 7.76~7.81(11H, m), 7.89(1H, m), 8.23(1H, s)	728.76	728.28
41	δ = 7.41(4H, m), 7.51(6H, m), 7.79~7.81(8H, m), 8.59(1H, s), 9.42(2H, m)	472.35	472.19
42	δ = 6.95~7.01(3H, m), 7.16(1H, s), 7.28(2H, m), 7.41(3H,	486.37	486.19

	m), 7.51(4H, m), 7.79~7.81(10H, m)		
43	δ = 7.41(5H, m), 7.51(9H, m), 7.75~7.81(7H, m), 7.87~7.88(2H, m), 8.28(4H, m), 8.63(1H, s)	625.53	625.24
44	δ = 2.34(18H, s), 6.91(4H, m), 7.25(3H, m), 7.33(1H, m), 7.41~7.51(6H, m), 7.58(2H, m), 7.69(1H, m), 7.77~7.87(8H, m), 7.94(1H, m), 8.28(2H, m), 8.55(1H, m)	798.82	798.39

[110] [Example 1] Manufacture of OLED device using the organic electroluminescent compound according to the present invention

[111] An OLED device was manufactured using the electroluminescent material according to the present invention. First, a transparent electrode ITO thin film (15 Ω/□) obtained from a glass for OLED (produced by Samsung Corning) was subjected to ultrasonic washing with trichloroethylene, acetone, ethanol and distilled water, sequentially, and stored in isopropanol before use.

[112] Then, an ITO substrate was equipped in a substrate folder of a vacuum vapor deposition apparatus, and 4,4',4"-tris(N,N-(2-naphthyl)-phenylamino)triphenylamine (2-TNATA) was placed in a cell of the vacuum vapor deposition apparatus, which was then ventilated up to 10^{-6} torr of vacuum in the chamber. Then, electric current was applied to the cell to evaporate 2-TNATA, thereby forming a hole injection layer having a thickness of 60 nm on the ITO substrate.

[113] Then, *N*,*N*'-bis(α-naphthyl)-*N*,*N*'-diphenyl-4,4'-diamine (NPB) was placed in another cell of the vacuum vapor deposition apparatus, and electric current was applied to the cell to evaporate NPB, thereby forming a hole transport layer having a thickness of 20 nm on the hole injection layer. After forming the hole injection layer and the hole transport layer, an electroluminescent layer was formed thereon as follows. A compound **9** was placed in a cell of a vacuum vapor deposition apparatus as host, and a compound $Ir(ppy)_3$[tris(2-phenylpyridine)iridium] was placed in another cell as a dopant. The two materials were evaporated at different rates such that an electroluminescent layer having a thickness of 30 nm was vapor-deposited on the hole transport layer at 4 to 10 wt%.

[114] Subsequently, tris(8-hydroxyquinoline)-aluminum(III) (Alq) was vapor-deposited with a thickness of 20 nm as an electron transport layer. Then, after vapor-depositing lithium quinolate (Liq) of a following structure with a thickness of 1 to 2 nm as an electron injection layer, an Al cathode having a thickness of 150 nm was formed using another vacuum vapor deposition apparatus to manufacture an OLED. Each compound used in the OLED was purified by vacuum sublimation at 10^{-6}torr.

[115] As a result, current of 4.2 mA/cm^2 with voltage of 6.3 V flows and it is confirmed that green light of 1450 cd/m^2 was emitted.

[116] [Example 2] Manufacture of OLED device using the organic electroluminescent compounds of the present invention

[117] An OLED device was manufactured according to the same method as Example 1 except that a compound **11** according to the present invention was used on the electro-luminescent layer as a host.

[118] As a result, current of 4.0 mA/cm^2 with voltage of 6.9 V flows and it is confirmed that green light of 1350 cd/m^2 was emitted.

[119] [Comparative Example 1] Electroluminescent properties of the OLED device using conventional electroluminescent material

[120] An OLED device was manufactured in the same manner as Examples 1 and 2 except that 4,4'-bis(carbazol-9-yl)biphenyl (CBP) instead of the compounds of the present invention was used as a host material in a cell of the vacuum vapor deposition apparatus and Bis(2-methyl-8-quinolinato)(*p*-phenyl-phenolato)aluminum(III) (BAlq) was used as the hole blocking layer.

[121] As a result, current of 3.8 mA/cm^2 with voltage of 7.5 V flows and it is confirmed that green light of 1000 cd/m^2 was emitted.

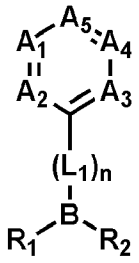
Industrial Applicability

[122] The organic electroluminescent compounds according to the present invention have excellent properties compared with the conventional material. In addition, the device using the organic electroluminescent compound according to the present invention as a host material for light emitting has excellent electroluminescent properties and drops driving voltage, thereby increasing power efficiency and reducing power consumption.

Claims

[Claim 1] An organic electroluminescent compound represented by Chemical Formula 1:

[Chemical Formula 1]

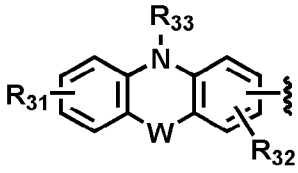


wherein

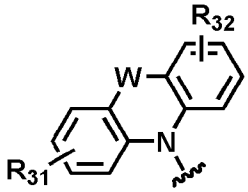
A_1 through A_5 independently represent CR or N;

L_1 represents (C6-C30)arylene with or without substituent(s) or (C3-C30)heteroarylene with or without substituent(s);

R, R_1 and R_2 independently represent hydrogen, deuterium, halogen, (C1-C30)alkyl with or without substituent(s), (C6-C30)aryl with or without substituent(s), substituted or unsubstituted (C6-C30)aryl fused with one or more (C3-C30)cycloalkyl(s) with or without substituent(s), (C3-C30)heteroaryl with or without substituent(s), 5- to 7-membered heterocycloalkyl with or without substituent(s), 5- to 7-membered heterocycloalkyl fused with one or more aromatic ring(s) with or without substituent(s), (C3-C30)cycloalkyl with or without substituent(s), (C3-C30)cycloalkyl fused with one or more aromatic ring(s) with or without substituent(s), cyano, nitro, $NR_{11}R_{12}$, $BR_{13}R_{14}$, $PR_{15}R_{16}$, $P(=O)R_{17}R_{18}$ [wherein R_{11} through R_{18} independently represent (C1-C30)alkyl with or without substituent(s), (C6-C30)aryl with or without substituent(s) or (C3-C30)heteroaryl with or without substituent(s)], $R_{19}R_{20}R_{21}Si$- [wherein R_{19} through R_{21} independently represent (C1-C30)alkyl with or without substituent(s), (C6-C30)aryl with or without substituent(s) or (C3-C30)heteroaryl with or without substituent(s)], (C6-C30)ar(C1-C30)alkyl with or without substituent(s), $R_{22}X$- [wherein X represents S or O, and R_{22} represents (C1-C30)alkyl with or without substituent(s), (C6-C30)aryl with or without substituent(s) or (C3-C30)heteroaryl with or without substituent(s)], (C2-C30)alkenyl with or without substituent(s), (C2-C30)alkynyl with or without sub-



or



, or each of them may be linked to an adjacent substituent via substituted or unsubstituted (C3-C30)alkylene or substituted or unsubstituted (C3-C30)alkenylene with or without a fused ring to form an alicyclic ring, a mono- or polycyclic aromatic ring or a mono- or polycyclic heteroaromatic ring;

W represents $-(CR_{41}R_{42})_m-$, $-(R_{41})C=C(R_{42})-$, $-N(R_{43})-$, -S-, -O-, $-Si(R_{44})(R_{45})-$, $-P(R_{46})-$, $-P(=O)(R_{47})-$, -C(=O)- or $-B(R_{48})-$;

R_{31} through R_{33} and R_{41} through R_{48} are the same as R;

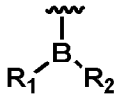
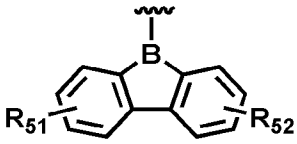
the heterocycloalkyl or heteroaryl may contain one or more heteroatom(s) selected from B, N, O, S, P(=O), Si and P;

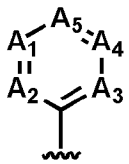
n represents an integer from 0 to 5; and

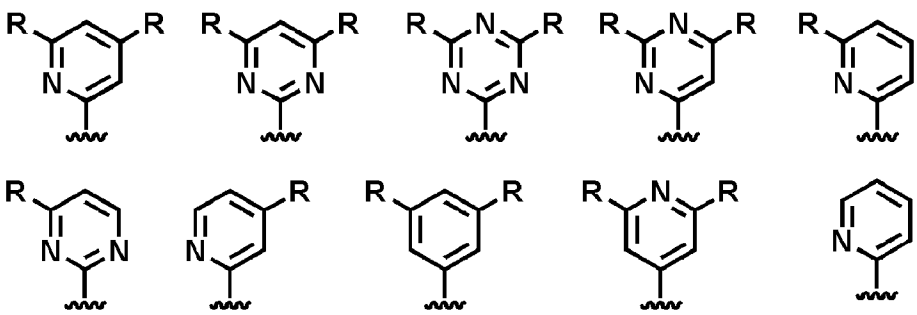
m represents an integer 0, 1 or 2.

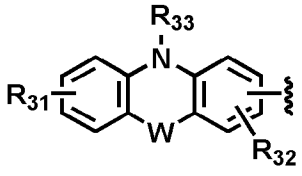
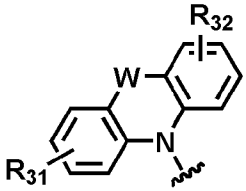
[Claim 2] The organic electroluminescent compound according to claim 1, wherein L_1, R, R_1, R_2, R_{11} through R_{22}, R_{31} through R_{33} and R_{41} through R_{48} may be further substituted by one or more substituent(s) selected from the group consisting of deuterium, halogen, (C1-C30)alkyl with or without halogen substituent(s), (C6-C30)aryl, (C3-C30)heteroaryl with or without (C6-C30)aryl substituent(s), 5- to 7-membered heterocycloalkyl, 5- to 7-membered heterocycloalkyl fused with one or more aromatic ring(s), (C3-C30)cycloalkyl, (C6-C30)cycloalkyl fused with one or more aromatic ring(s), $R^aR^bR^cSi$- [wherein R^a, R^b and R^c independently represent (C1-C30)alkyl or (C6-C30)aryl], (C2-C30)alkenyl, (C2-C30)alkynyl, cyano, carbazolyl, $-NR^dR^e$, $-BR^fR^g$, $-PR^hR^i$, $-P(=O)R^jR^k$ [wherein R^d through R^k independently represent (C1-C30)alkyl, (C6-C30)aryl or (C3-C30)heteroaryl], (C6-C30)ar(C1-C30)alkyl, (C1-C30)alkyl(C6-C30)aryl, R^lX- [wherein X represents S or O, and R^l represents (C1-C30)alkyl, (C6-C30)aryl or (C3-C30)heteroaryl], $R^mC(=O)$- [wherein R^m represents (C1-C30)alkyl, (C1-C30)alkoxy, (C6-C30)aryl or (C6-C30)aryloxy], $R^mC(=O)O$- [wherein R^m represents (C1-C30)alkyl, (C1-C30)alkoxy, (C6-C30)aryl or (C6-C30)aryloxy], carboxyl, nitro and hydroxyl, or each of them may be linked to an adjacent substituent to form a ring.

[Claim 3] The organic electroluminescent compound according to claim 1, wherein R_1 and R_2 independently represent (C6-C30)aryl with or

without substituent(s) or (C3-C30)heteroaryl with or without substituent(s), and in  , R_1 and R_2 may be linked via alkylene or alkenylene with or without substituent(s) to form  [wherein R_{51} and R_{52} independently represent hydrogen, (C6-C30)aryl with or without substituent(s) or (C3-C30)heteroaryl with or without substituent(s)].

[Claim 4] The organic electroluminescent compound according to claim 1, wherein  is selected from the following structures:



R represents (C1-C30)alkyl with or without substituent(s), (C6-C30)aryl with or without substituent(s), (C3-C30)heteroaryl with or without substituent(s), $R_{22}X$- [wherein X represents S or O, and R_{22} represents (C1-C30)alkyl with or without substituent(s), (C6-C30)aryl with or without substituent(s) or (C3-C30)heteroaryl with or without substituent(s)],  or  , and W and R_{31} through R_{33} are the same as defined in Chemical Formula 1, and R may be identical or different.

[Claim 5] The organic electroluminescent compound according to claim 1, wherein L_1 represents phenylene, naphthylene, anthracenylene, fluorenylene, phenanthrylene, biphenylene, triphenylene, fluoranthenylene, chrysenylene, pyrenylene, perylenylene, pyridinylene, furylene, thiophenylene, selenophenylene, pyridinylene, pyrazinylene, pyri-

dazinylene, quinolinylene or quinoxalinylene; and

R, R_1 and R_2 independently represent hydrogen, methyl, ethyl, n-propyl, i-propyl, n-butyl, i-butyl, t-butyl, pentyl, amyl, hexyl, heptyl, octyl, nonyl, decyl, trifluoromethyl, phenyl, phenyloxy, phenylthio, 1-naphthyl, 2-naphthyl, biphenyl, 1-phenanthryl, 2-phenanthryl, 3-phenanthryl, 4-phenanthryl, 9-phenanthryl, N-carbazolyl, N-phenyl-1-carbazolyl, N-phenyl-2-carbazolyl, N-phenyl-3-carbazolyl, N-phenyl-4-carbazolyl, 2-pyridyl, 3-pyridyl, 4-pyridyl, 2-quinolyl, 3-quinolyl, 4-quinolyl, 5-quinolyl, 6-quinolyl, 7-quinolyl, 8-quinolyl, 3-isoquinolyl, 1-isoquinolyl, 4-isoquinolyl, 5-isoquinolyl, 6-isoquinolyl, 7-isoquinolyl, 8-isoquinolyl, 9H-fluorene-2-yl, 9H-fluorene-3-yl, 9H-fluorene-4-yl, 9H-fluorene-1-yl, 2-pyrimidyl, 4-pyrimidyl, 5-pyrimidyl, 1,2,3-triazine-4-yl, 1,2,3-triazine-5-yl, 1,3,5-triazine-2-yl, N-dibenzocarbazolyl, N-7H-benzo[c]carbazolyl, N-phenyl-7H-benzo[c]carbazole-10-yl, N-phenyl-7H-benzo[c]carbazole-11-yl, N-phenyl-7H-benzo[c]carbazole-9-yl, N-phenyl-7H-benzo[c]carbazole-8-yl, 1-indolizinyl, 2-indolizinyl, 3-indolizinyl, 5-indolizinyl, 6-indolizinyl, 7-indolizinyl, 8-indolizinyl, 6-dibenzofuryl, 7-dibenzofuryl, 8-dibenzofuryl, 9-dibenzofuryl, 7-indole[2,3-c]isoquinolinyl or N-pyrido[2,3-b]indolyl, and the phenyl, naphthyl, biphenyl, phenanthryl, N-carbazolyl, pyridyl, quinolyl, isoquinolyl, fluorenyl, pyrimidyl, triazinyl, N-dibenzocarbazolyl, N-7H-benzo[c]carbazolyl, indolizinyl, dibenzofuryl, 7-indole[2,3-c]isoquinolinyl or N-pyrido[2,3-b]indolyl of R, R_1 and R_2 may be further substituted by one or more substituent(s) selected from methyl, phenyl, triphenylsilyl and trimethylsilyl.

[Claim 6] An organic electroluminescent device comprising the organic electroluminescent compound according to any of claims 1 to 5.

[Claim 7] The organic electroluminescent device according to claim 6, which comprises a first electrode; a second electrode; and one or more organic layer(s) interposed between the first electrode and the second electrode, wherein the organic layer comprises one or more organic electroluminescent compound(s) according to any of claims 1 to 5 and one or more dopant(s) represented by Chemical Formula 2:

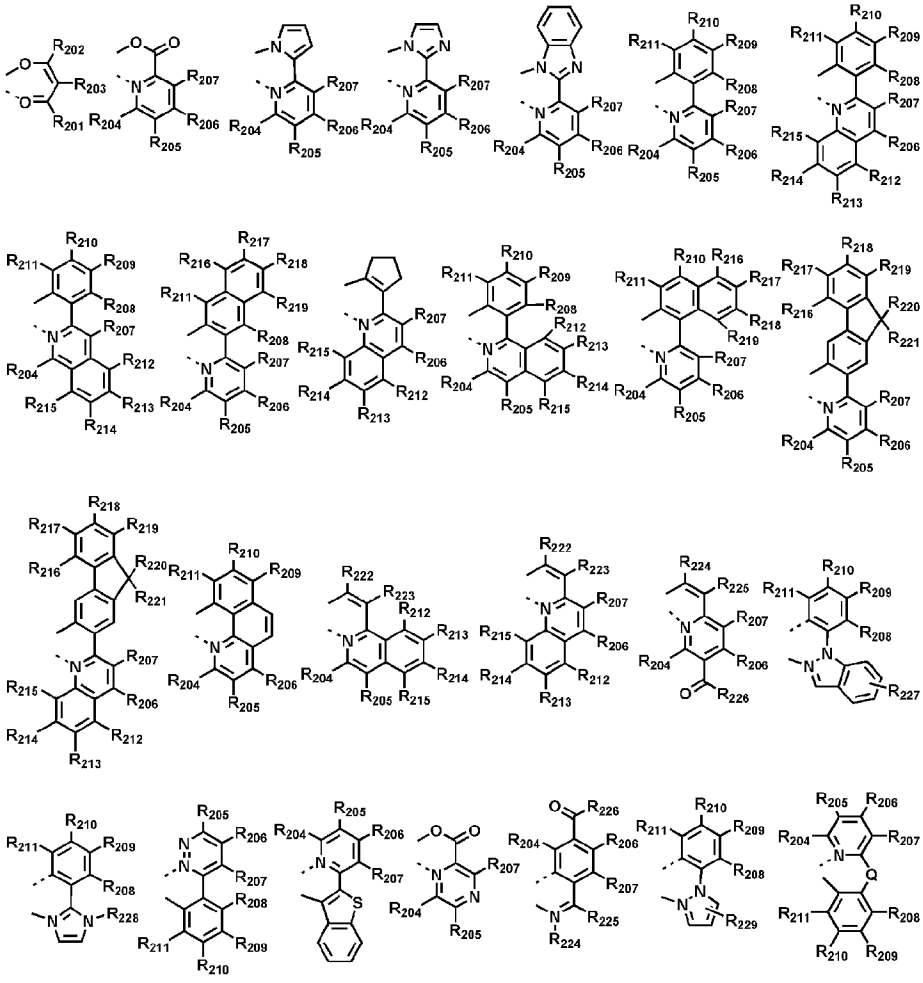
[Chemical Formula 2]

$M^1L^{101}L^{102}L^{103}$

wherein

M^1 is selected from the group consisting of Group 7, Group 8, Group 9, Group 10, Group 11, Group 13, Group 14, Group 15 and Group 16 metals; and

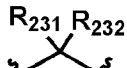
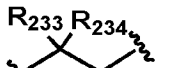
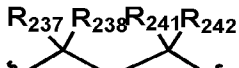
ligands L^{101}, L^{102} and $L^{103}$are independently selected from the following structures:



wherein

R_{201} through R_{203} independently represent hydrogen, (C1-C30)alkyl with or without halogen substituent(s), (C6-C30)aryl with or without (C1-C30)alkyl substituent(s) or halogen;

R_{204} through R_{219} independently represent hydrogen, (C1-C30)alkyl with or without substituent(s), (C1-C30)alkoxy with or without substituent(s), (C3-C30)cycloalkyl with or without substituent(s), (C2-C30)alkenyl with or without substituent(s), (C6-C30)aryl with or without substituent(s), mono- or di-(C1-C30)alkylamino with or without substituent(s), mono- or di-(C6-C30)arylamino with or without substituent(s), SF_5, tri(C1-C30)alkylsilyl with or without substituent(s), di(C1-C30)alkyl(C6-C30)arylsilyl with or without substituent(s),

tri(C6-C30)arylsilyl with or without substituent(s), cyano or halogen;
R_{220} through R_{223} independently represent hydrogen, (C1-C30)alkyl with or without halogen substituent(s) or (C6-C30)aryl with or without (C1-C30)alkyl substituent(s);
R_{224} and R_{225} independently represent hydrogen, (C1-C30)alkyl with or without substituent(s), (C6-C30)aryl with or without substituent(s) or halogen, or R_{224} and R_{225} may be linked via (C3-C12)alkylene or (C3-C12)alkenylene with or without a fused ring to form an alicyclic ring or a mono- or polycyclic aromatic ring;
R_{226} represents (C1-C30)alkyl with or without substituent(s), (C6-C30)aryl with or without substituent(s), (C5-C30)heteroaryl with or without substituent(s) or halogen;
R_{227} through R_{229} independently represent hydrogen, (C1-C30)alkyl with or without substituent(s), (C6-C30)aryl with or without substituent(s) or halogen; and
Q represents  ,  , or  , wherein R$_{231}$ through R_{242} independently represent hydrogen, (C1-C30)alkyl with or without halogen substituent(s), (C1-C30)alkoxy, halogen, (C6-C30)aryl with or without substituent(s), cyano or (C5-C30)cycloalkyl with or without substituent(s), each of them may be linked to an adjacent substituent via alkylene or alkenylene to form a spiro ring or a fused ring, or may be linked to R_{207} or R_{208} via alkylene or alkenylene to form a saturated or unsaturated fused ring.

[Claim 8] The organic electroluminescent device according to claim 7, wherein the organic layer further comprises one or more amine compound(s) selected from the group consisting of arylamine compounds and styrylarylamine compounds, or one or more metal(s) selected from the group consisting of organic metals of Group 1, Group 2, 4th period and 5th period transition metals, lanthanide metals and d-transition elements.

[Claim 9] The organic electroluminescent device according to claim 7, wherein the organic layer comprises an electroluminescent layer and a charge generating layer.

[Claim 10] The organic electroluminescent device according to claim 7, which is a white light-emitting electroluminescent device wherein the organic layer further comprises one or more organic electroluminescent layer(s) emitting blue, red or green light.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2010/006920

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

C09K 11/06 (2006.01) ***C07D 239/02*** (2006.01) ***H01L 27/32*** (2006.01)
C07D 213/00 (2006.01) ***C07D 251/02*** (2006.01) ***H01L 51/54*** (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: Registery and CAplus: Substructure Search based on Chemical Formula 1 and NOT SCREENS 2049 OR 2127 and Keywords luminence, oled, electroluminescence, light emit like terms and DEV/rl and Tem/rl, 46.156/RID OR 46.195/RID OR 46.492/RID and NOT fullerene/CNS, Biol/rl

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2009-246097 A (KONICA MINOLTA HOLDINGS INC) 22 October 2009 See abstract & CAS RN 1192173-84-4, RN 1192173-85-5, RN 1192174-19-8, RN 1192174-20-1, RN 1192174-54-1, RN 1192174-55-2	1-10
X	JP 2007-077033 A (JSR CORP) 29 March 2007 See Abstract and CAS RN 929900-21-0	1-10

[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
10 January 2011	13 JAN 2011
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. +61 2 6283 7999	Authorized officer **RICKY FUNG** AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No : +61 2 6222 3648

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2010/006920

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	'Xue J. et al "High efficiency deep-blue and white phosphorescent OLEDs" Organic Light Emitting Materials and Devices XIII (2009), Vol. 7415, pp 1-10 See whole doc. esp. Abstract and Fig 1 & CAS RN 929203-02-1	1-10
X	Sakuda, E. et al "Synthesis and Spectroscopic Properties of Platinum(II) Terpyridine Complexes Having an Arylborane Charge Transfer Unit" Inorganic Chemistry (2006), 45(26), 10670-10677 See whole doc. esp. Abstract & CAS RN 919990-71-9 and RN 919990-72-0	1-10
X	Zhou, G. et al "Manipulating charge-transfer character with electron-withdrawing main-group moieties for the color tuning of iridium electrophosphors Advanced Functional Materials (2008), 18(3), 499-511 See whole doc esp. abstract and CAS RN 790299-75-1	1-10

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2010/006920

This Annex lists the known "A" publication level 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 Cited in Search Report		Patent Family Member
JP	2009-246097	NONE
JP	2007-077033	NONE

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

END OF ANNEX