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

(57) **Abstract**: Provided are novel organic electroluminescent compounds and an organic electroluminescent device using the same. Since the organic electroluminescent compound 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.

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, to novel organic electroluminescent compounds used as an electroluminescent material and an organic electroluminescent device using the same as host.

Background Art

[2] An organic EL device is a device wherein, when charge is applied to an organic film formed between an electron injection electrode (cathode) and a hole injection electrode (anode), an electron and a hole form a pair and then become extinct with emitting light. A device can be formed on a transparent flexible substrate such as plastics. The device can be operated at a lower voltage (not more than 10 V) with relatively lower power consumption but excellent color purity, as compared to a plasma display panel or an inorganic EL display. Since the organic electroluminescent (EL) devices can develop three colors (green, blue and red), they have been focused as full colored display devices for next generation.

[3] In an organic light-emitting diode (OLED), the most important factor that determines its performance including luminescence efficiency and operation life is the electroluminescent material. In functional aspect, the electroluminescent materials may be divided into host materials and dopant materials. In general, an electroluminescent layer prepared by doping a dopant in a host is known to provide superior EL property. Recently, development of an organic EL device having high efficiency and long operation life is becoming an imminent task. Especially, considering the level of EL performance required for medium-to-large sized OLED panels, development of materials which are much superior to existing electroluminescent materials is urgently needed.

Disclosure of Invention

Technical Problem

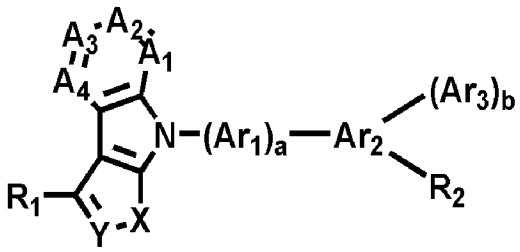
[4] Accordingly, an object of the present invention is to provide an organic electroluminescent compound having luminescence efficiency and device operation life improved over existing materials and having superior backbone with appropriate color coordinates in order to solve the aforesaid problems.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

invention is to provide an organic electroluminescent device employing the organic electroluminescent compound as an electroluminescent material.

Solution to Problem

[5] In one general aspect, the present invention provides an organic electroluminescent compound represented by Chemical Formula 1 and an organic electroluminescent device using the same. With superior luminescence efficiency and excellent life property, the organic electroluminescent compound according to the present invention may be used to manufacture an OLED device having very superior operation life.

[6] [Chemical Formula 1]

[7] 

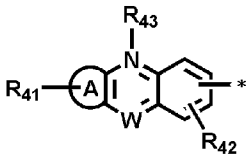
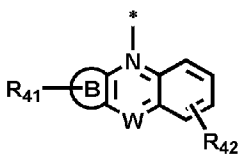
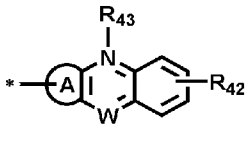
[8] wherein

[9] A_1 through A_4 independently represent CR_3 or N;

[10] X represents $-N(R_{10})-$, -S-, -O- or $-Si(R_{11})(R_{12})-$;

[11] Y represents CR_4 or N;

[12] Ar_1 and Ar_2 independently represent (C6-C30)arylene with or without substituent(s) or (C3-C30)heteroarylene with or without substituent(s), and Ar_3 represents (C6-C30)aryl with or without substituent(s) or (C3-C30)heteroaryl with or without substituent(s);

[13] R_1 through R_4 and R_{10} through R_{12} 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, $NR_{21}R_{22}$, $BR_{23}R_{24}$, $PR_{25}R_{26}$, $P(=O)R_{27}R_{28}$, $R_{29}R_{30}R_{31}Si-$, $R_{32}Z-$, (C6-C30)ar(C1-C30)alkyl 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 (C3-C30)alkylene or (C3-C30)alkenylene with or

without a fused ring to form an alicylic ring, a mono- or polycyclic aromatic ring or a mono- or polycyclic heteroaromatic ring;

[14] A ring and B ring independently represent (C5-C30)cycloalkyl with or without substituent(s), (C6-C30)aryl with or without substituent(s),(C6-C30)heteroaryl with or without substituent(s);

[15] R_{21} through R_{32} 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);

[16] z represents S or O;

[17] W represents $-(CR_{51}R_{52})_{m}-$, $-(R_{51})C=C(R_{52})-$, $-N(R_{53})-$, -S-, -O-, $-Si(R_{54})(R_{55})-$, $-P(R_{56})-$, $-P(=O)(R_{57})-$, -C(=O)- or $-B(R_{58})-$;

[18] R_{41} through R_{43} and R_{51} through R_{58} are the same as R_1 through R_3;

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

[20] m represents an integer from 0 to 2; and

[21] a and b independently represent an integer from 0 to 4; and they may be identical or different when a and b are larger than 2.

[22] In the present invention, "alkyl", "alkoxy" and other substituents containing "alkyl" moiety include both linear and branched species. In the present invention, the cycloalkyl includes hydrocarbon such as adamantyl or bicycloalkyl of a polycyclic ring as well as a monocyclic ring. Also, * marked in the chemical structure of the present invention means a portion linked inside the structure.

[23] 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 chemical 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 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 chemical bond(s). The heteroaryl 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.

[24] Specific examples include heteroaryl such as furyl, thiophenyl, pyrrolyl, imidazolyl, pyrazolyl, thiazolyl, thiadiazolyl, isothiazolyl, isoxazolyl, oxazolyl, oxadiazolyl, triazinyl, tetrazinyl, phenazinyl, phenothiazinyl, phenoxazinyl, triazolyl, tetrazolyl, furazanyl, pyridyl, pyrazinyl, pyrimidinyl, pyridazinyl, etc., polycyclic heteroaryl such as benzofuranyl, benzothiophenyl, dibenzofuranyl, dibenzothiophenyl, isobenzofuranyl, benzimidazolyl, benzothiazolyl, benzoisothiazolyl, benzoisoxazolyl, benzoxazolyl, isoindolyl, indolyl, indazolyl, benzothiadiazolyl, quinolyl, isoquinolyl, cinnolinyl, quinazolinyl, quinoxalinyl, carbazolyl, carborinyl, 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.

[25] The '(C1-C30)alkyl' groups described herein may include (C1-C20)alkyl or (C1-C10)alkyl and the '(C6-C30)aryl' groups include (C6-C20)aryl or (C6-C12)aryl. The '(C3-C30)heteroaryl' groups include (C3-C20)heteroaryl or (C3-C12)heteroaryl and the '(C3-C30)cycloalkyl' groups include (C3-C20)cycloalkyl or (C3-C7)cycloalkyl. The '(C2-C30)alkenyl or alkynyl' group include (C2-C20)alkenyl or alkynyl, (C2-C10)alkenyl or alkynyl.

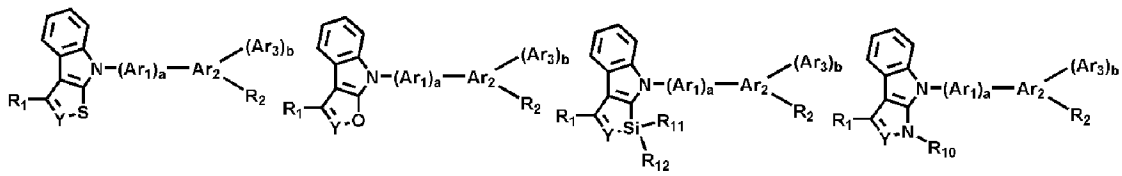
[26] In the term 'substituted or unsubstituted (or with or without) substituent(s)' described herein, the term 'substituted' means being further substituted by an unsubstituted substituent. The substituent further substituted by the Ar_1 andAr_3, R_1 through R_4, R_{10} through R_{12}, R_{21} through R_{32}, R_{41} through R_{43} and R_{51} through R_{58} 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, (C6-C30)aryl with or without (C6-C30)aryl substituent(s), (C6-C30)aryl with or without (C6-C30)heteroaryl substituent(s), (C3-C30)heteroaryl with or without (C6-C30)aryl substituent(s), (C3-C30)heteroaryl, 5- to 7-membered heterocycloalkyl, 5- to 7-membered heterocycloalkyl fused with one or more aromatic ring(s), (C3-C30)cycloalkyl, (C3-C30)cycloalkyl fused with one or more aromatic ring(s), $NR_{61}R_{62}$, $BR_{63}R_{64}$, $PR_{65}R_{66}$, $P(=O)R_{67}R_{68}$, $R_{69}R_{70}R_{71}Si$-, $R_{72}Z$-, $R_{73}C(=O)$-, $R_{74}C(=O)O$-, (C2-C30)alkenyl, (C2-C30)alkynyl, cyano, carbazolyl, (C6-C30)ar(C1-C30)alkyl, (C1-C30)alkyl(C6-C30)aryl, carboxyl, nitro and hydroxyl, or may be linked to an adjacent substituent to form a ring;

[27] R_{61} through R_{72} independently represent (C1-C30)alkyl, (C6-C30)aryl or (C3-C30)heteroaryl;

[28] Z represents S or O; and

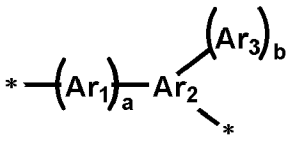
[29] R_{73} and R_{74} independently represent (C1-C30)alkyl, (C1-C30)alkoxy, (C6-C30)aryl or (C6-C30)aryloxy.

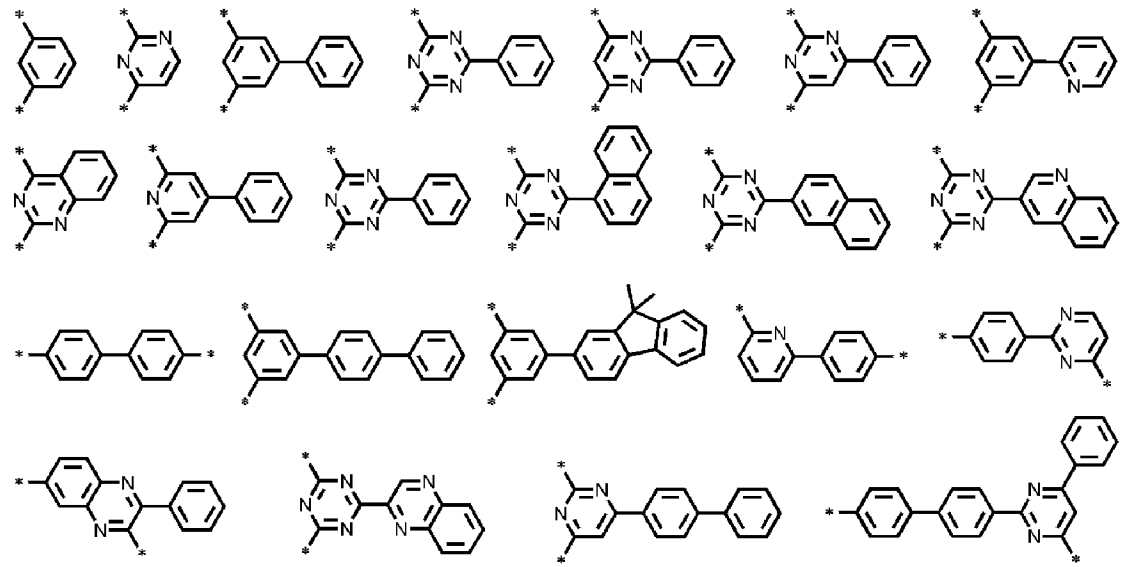
[30] More specifically, organic electroluminescent compound according to the present invention is selected from the following compounds, but is not limited thereto

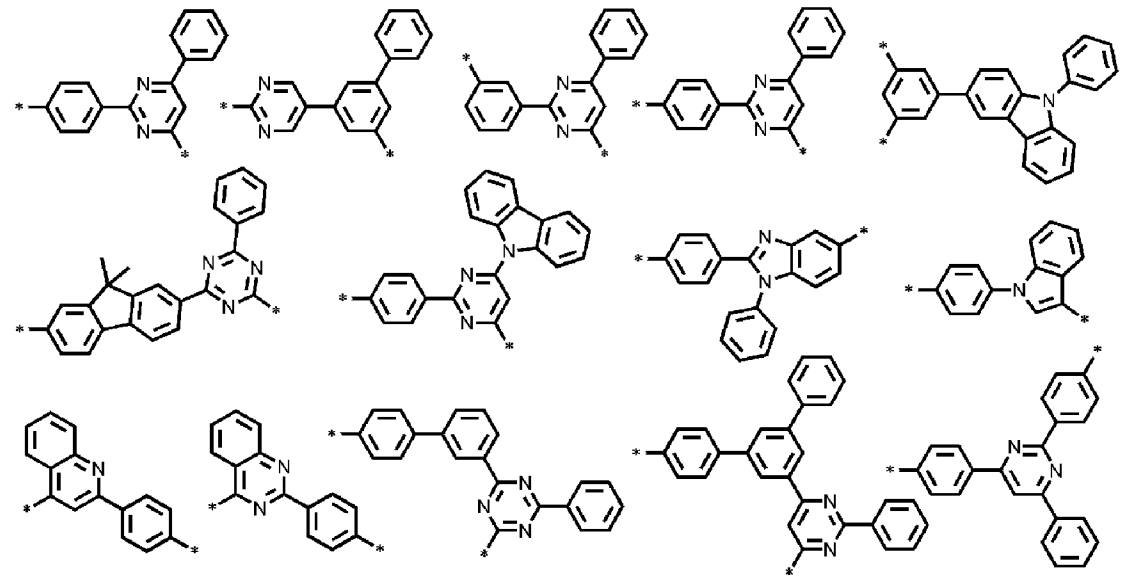
[31] 

[32] wherein

[33] Ar_1 throughAr_3, Y, R_1,R_2, R_{10} throughR_{12}, a and b are the same as defined in Chemical Formula 1 of claim 1.

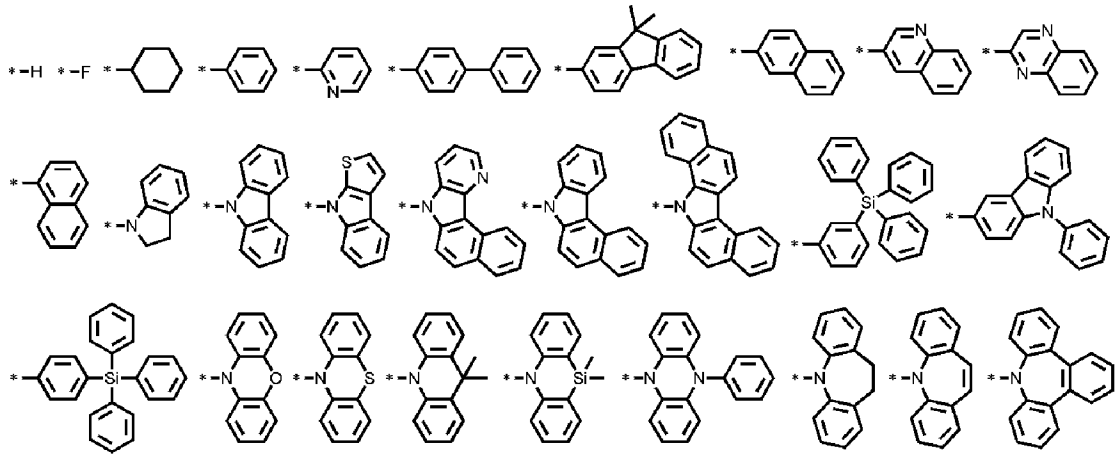
[34] The  is selected from the following structures but are not limited thereto.

[35] 

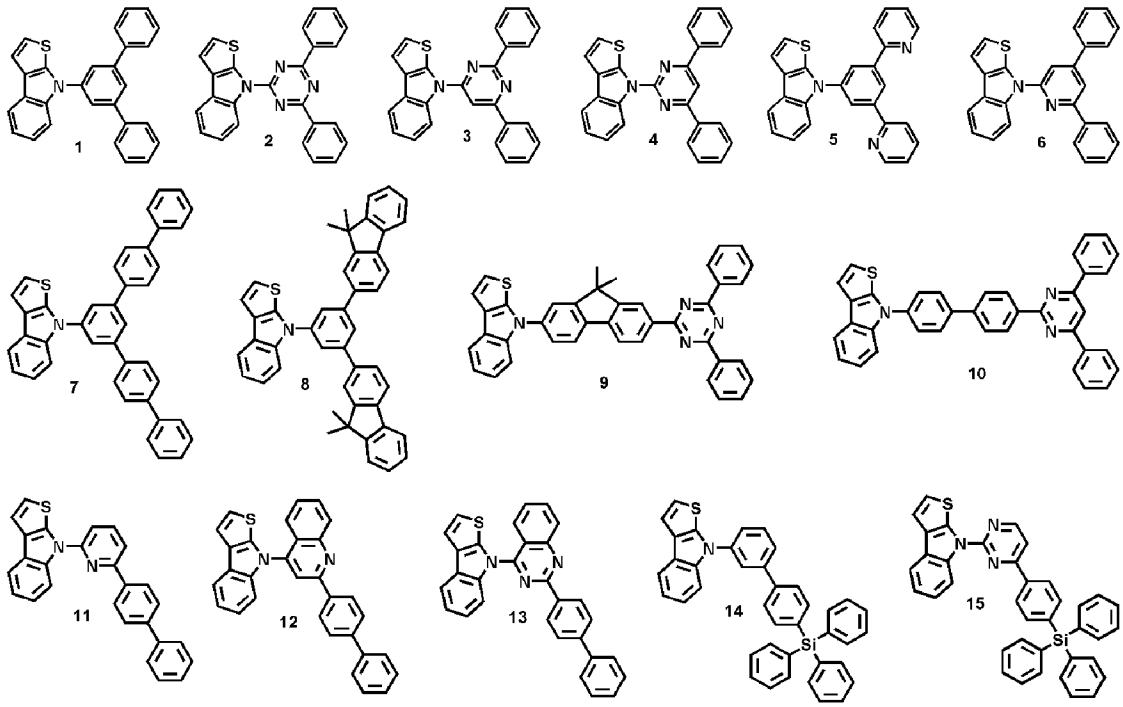
[36] 

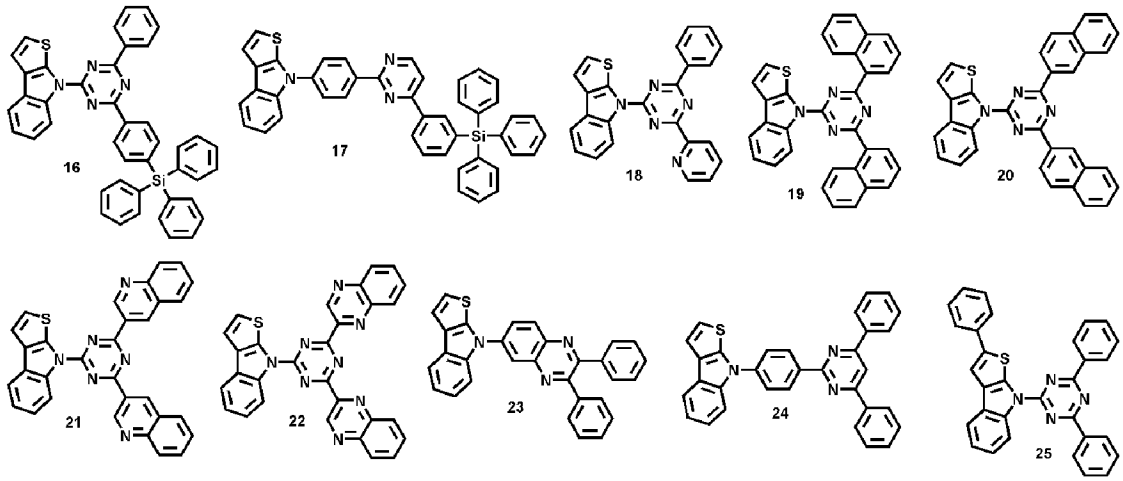
[37] Also, the R_1 and R_2 are independently selected from the following structures, but are

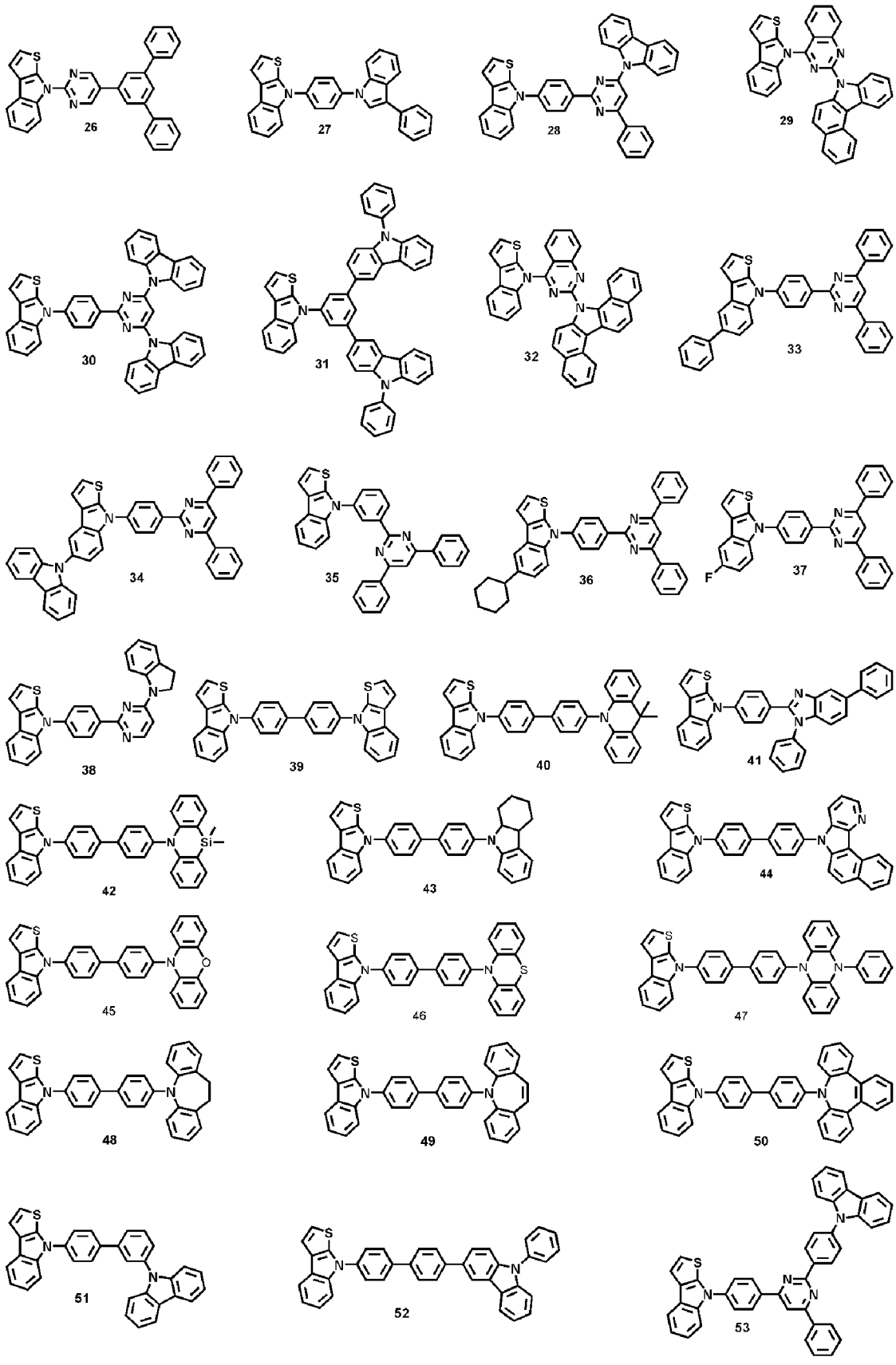
not limited thereto.

[38] 

[39] The organic electroluminescent compound may be exemplified as the following compounds but the present invention is not limited by the compounds.

[40] 

[41] 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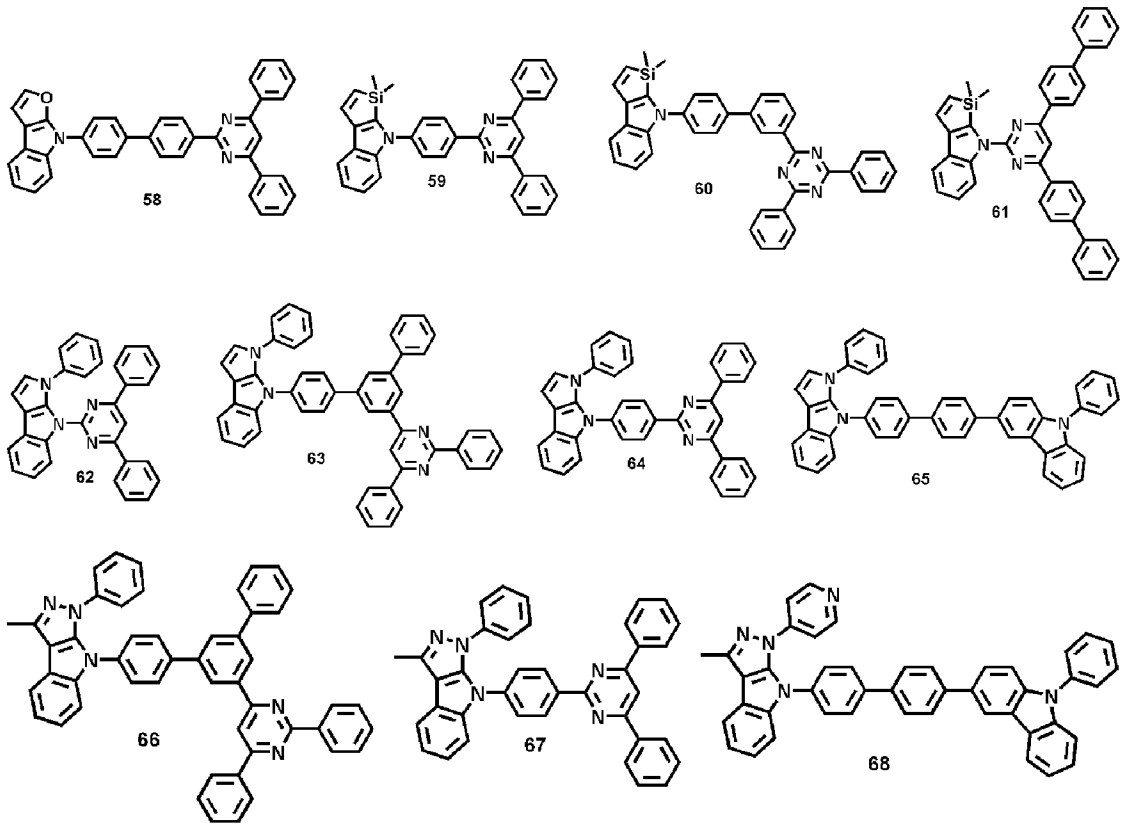
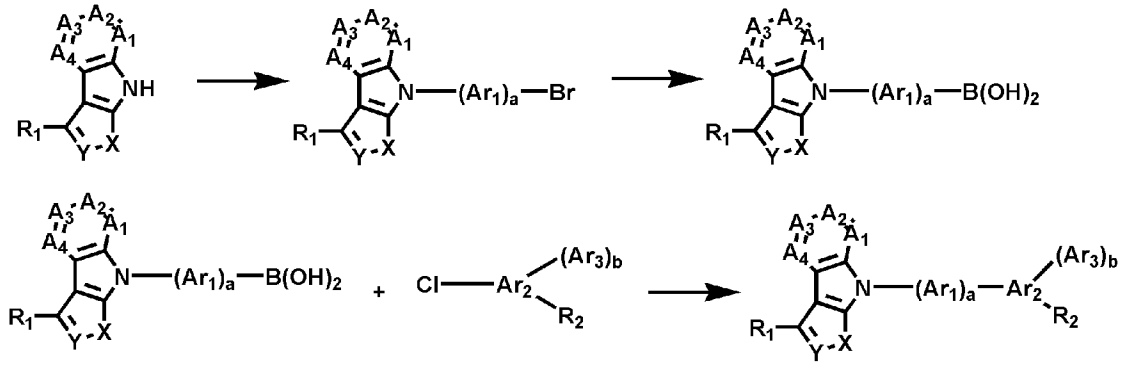


[43] The organic electroluminescent compound according to the present invention may be prepared as shown in following Scheme 1.

[44] [Scheme 1]

[45] 

[46] Wherein

[47] A_1 through A_4, X, Y, Ar_1 through Ar_3, R_1, R_2, a and b are the same as defined in the Chemical Formula 1.

[48] 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 comprises an electroluminescent layer, which includes one or more dopants with one or more organic electroluminescent compounds of Chemical Formula

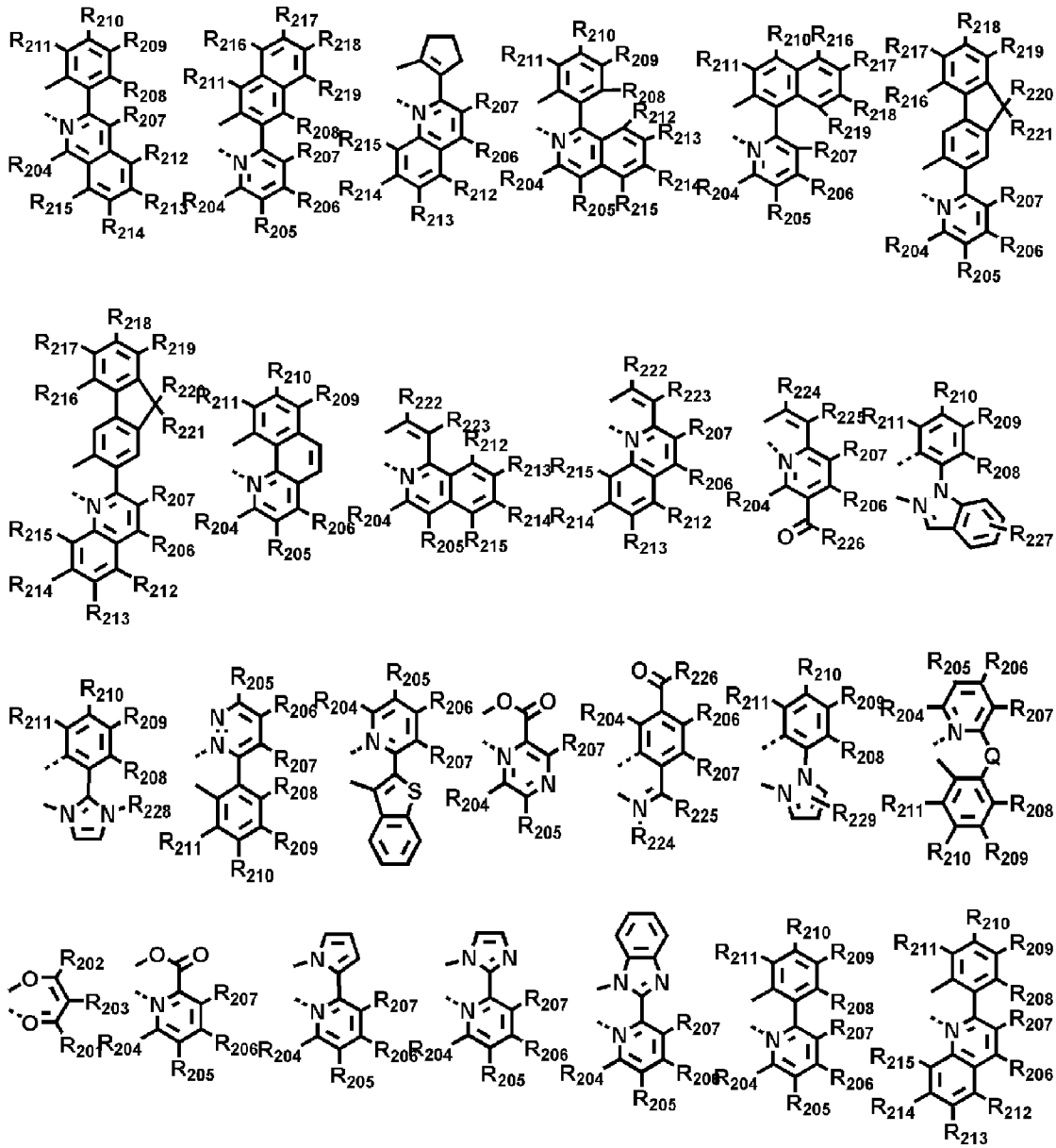
1 as a host. The dopant used in the organic electroluminescent device of the present invention is not particularly limited, but may be selected from the compounds represented by Chemical Formula 2.

[49] [Chemical Formula 2]

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

[51] Wherein

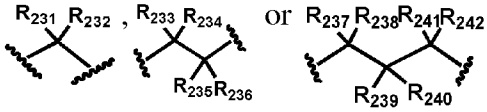
[52] M^1 is selected from the group consisting of Group 7, Group 8, Group 9, Group 10, Group 11, Group 13, Group 14, Group 15 and Group 16 metals, and ligands L^{101}, L^{102} and $L^{103}$are independently selected from the following structures:

[53] 

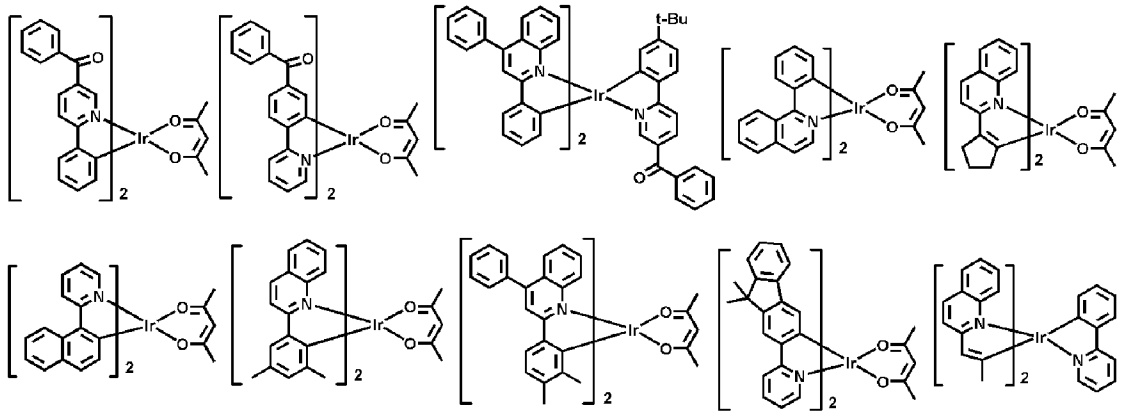
[54] wherein

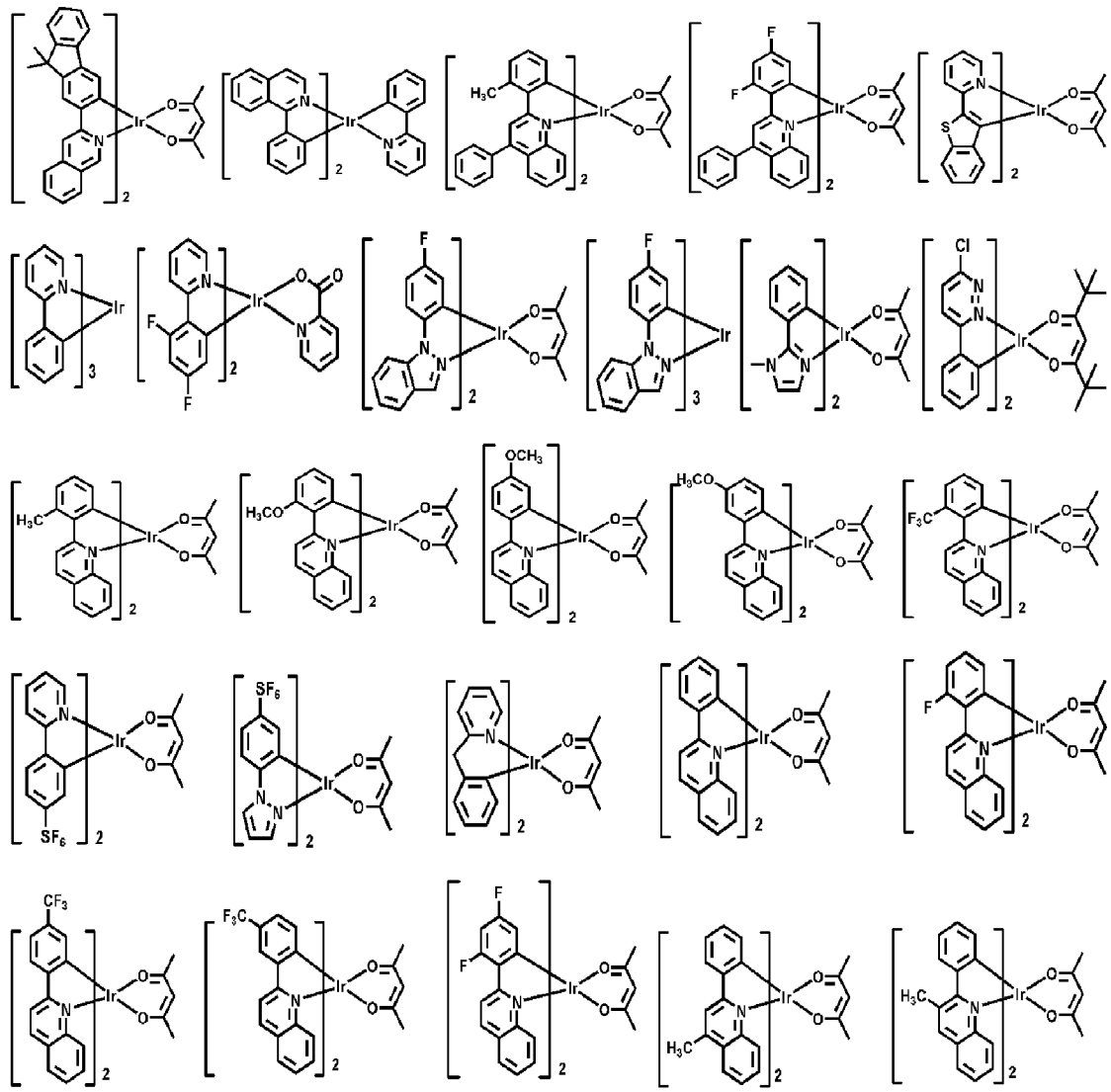
[55] R_{201} through R_{203} independently represent hydrogen, (C1-C30)alkyl with or without halogen substituent(s), (C6-C30)aryl with or without (C1-C30)alkyl substituent(s) or

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, deuterium, (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, deuterium, (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, deuterium, (C1-C30)alkyl with or without substituent(s), (C6-C30)aryl with or without substituent(s) or halogen; and

[56] Q represents  , wherein R_{231} through R_{242} independently represent hydrogen, deuterium, (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), or 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.

[57] The dopant compounds of the Chemical Formula 2 may be exemplified by the compounds having following structures but are not limited thereto.



[58] 

[59] 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.

[60] 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 compound(s). The organic layer may include an electroluminescent layer and a charge generating layer.

[61] Further, the organic layer may include, in addition to the organic electroluminescent

compound of Chemical Formula 1, 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 No. 10-2008-0123276, 10-2008-0107606 or 10-2008-0118428, but are not limited thereto.

[62] 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 metal 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. Operation stability may be attained therefrom.

[63] The chalcogenide may be, for example, SiO_x ($1 \leq x \geq 2$), AlOx ($1 \leq x \geq 1.5$), 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.

[64] In the 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 a charge generating layer.

Advantageous Effects of Invention

[65] Since the organic electroluminescent compound according to the present invention exhibits good luminous efficiency and excellent life property, it may be used to manufacture OLED devices having very superior operation life.

Mode for the Invention

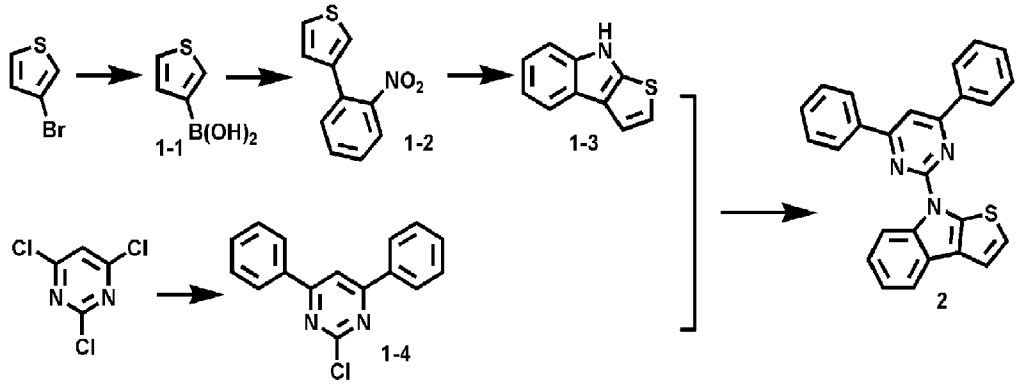
[66] The present invention is further described with respect to organic electroluminescent compounds according to the present invention, processes for preparing the same, and

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.

[67] [Preparation Example 1]

[68] Preparation of Compound 2

[69]



[70] Preparation of Compound 1-1

[71] After 3-bormothiophene (50 g, 306 mmol) was dissolved in THF (300 mL) and toluen (1,200 mL), the mixture was cooled to -78 ℃, and n-BuLi (150 mL, 2.5M in hexane, 367 mmol) was added thereto. After stirring the mixture for 1 hour, triiso-propylborate (112 mL, 490 mmol) was added while maintaining temperature at -78 ℃. The mixture was stirred for 10 minutes. Upon completion of the reaction, H_2O was added and the mixture was extracted with EA/H_2O. After removing moisture with $MgSO_4$ and performing distillation under reduced pressure, Compound 1-1 (24 g, 60%) was obtained by column (methylene chloride (MC)/Hexane) separation.

[72] Preparation of Compound 1-2

[73] After Compound 1-1 (20.6 g, 161 mmol), 2-bromonitrobenzene (25 g, 124 mmol), Pd_2dba_3 (1.1 g, 1.2 mmol),X-phos (2.4 g, 5 mmol), and K_3PO_4 (79 g, 370 mmol) were dissolved in 1,4-dioxane (300 mL), the mixture was stirred under reflux for one day. Upon completion of the reaction, the mixture was cooled at room temperature and extracted with EA/H_2O. After removing moisture with $MgSO_4$ and performing distillation under reduced pressure, Compound 1-2 (23.5 g, 92%) was obtained by column(MC/Hexane) separation.

[74] Preparation of Compound 1-3

[75] After Compound 1-2 (22.5 g, 110 mmol) was dissolved in $P(OEt)_3$ (500 mL) and was stirred under reflux for 4 hours, $P(OEt)_3$ was removed by distillation to give a red liquid. Compound 1-3 (6 g, 31%) was obtained by performing column(EA/Hexane) separation on the red liquid.

[76] Preparation of Compound 1-4

[77] 2,4,6-trichloropyrimidine (10 g, 54.51 mmol), phenylboronic acid (16.6 g, 136,29

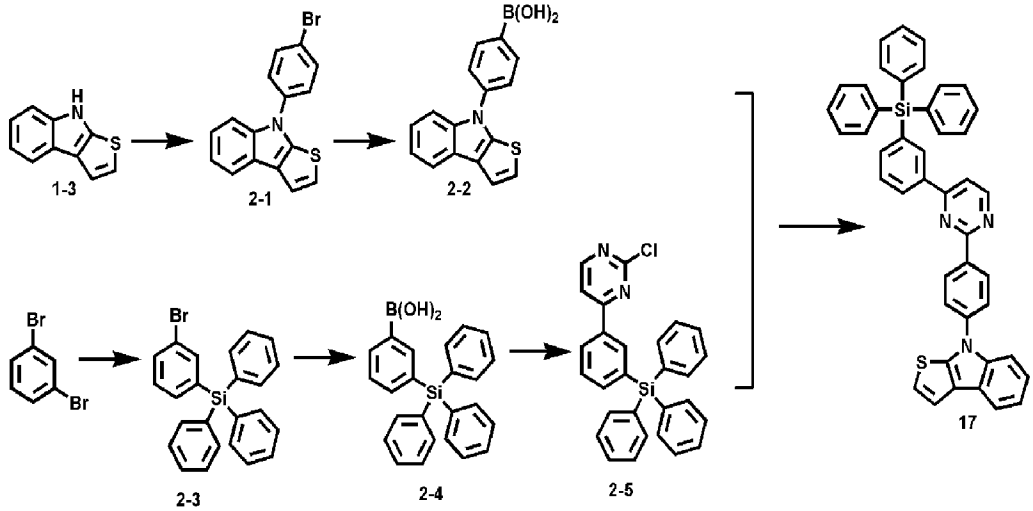
mmol), $Pd(PPh_3)_4$ (3.15 g, 2.72 mmol), 2M K_2CO_3 (50 mL), toluen (100 mL) and ethanol (30 mL) were stirred under reflux. 4 hours later, the mixture was cooled to room temperature and extracted with EA after adding distilled water. After drying with $MgSO_4$ and distillation under reduced pressure, Compound 1-4 (7 g, 48.%) was obtained by column separation.

[78] Preparation of Compound 2

[79] NaH (1.57 g, 39.36 mmol, 60% in mineral oil) was added to DMF (70 mL), and Compound 1-4 (7 g, 26.24 mmol) was dissolved in DMF (60 mL). 1 hour later, Compound 1-3 (3.8 g, 21.87 mmol) was dissolved in DMF (70 mL). After stirring the mixture for 10 hours, distilled water was added and the mixture was extracted with EA. After drying with $MgSO_4$ and distillation under reduced pressure, Compound 2 (7 g, 56%) was obtained by column separation.

[80] [Preparation Example 2] Preparation of Compound 17

[81]



[82] Preparation of Compound 2-1

[83] After Compound 1-3 (5.3 g, 30.6mmol), 4-iodobromobenzene (17.3 g, 61 mmol), Cu (2.9 g, 46mmol), 18-crown-6 (0.8 g, 3 mmol) and K_2CO_3 (12 g, 72 mmol) were dissolved in 1,2-dichlorobenzene (350 mL), the mixture was stirred under reflux for one day. Upon completion of the reaction, Cu and base were removed using cellite and the solution was extracted with EA/H_2O. After drying with $MgSO_4$ and distillation under reduced pressure, Compound 2-1 (5 g, 50%) was obtained by column(MC/Hexane) separation.

[84] Preparation of Compound 2-2

[85] After Compound 2-1 (4 g, 12 mmol) was dissolved in THF (60 mL), the mixture was cooled to -78 ℃, and n-BuLi (5.8 mL, 2.5M in hexane, 14.4 mmol) was slowly added thereto. After stirring the mixture for 1 hour, triisopropylborate (4 mL, 19.2 mmol) was added. After slowly increasing temperature, the mixture was stirred at room temperature for one day. Upon completion of the reaction, 2M HCl was added and the

mixture was extracted with EA/H_2O. After removing moisture with $MgSO_4$ and performing distillation under reduced pressure, Compound 2-2 (2.1 g, 60%) was obtained by column(MC/Hexane) separation.

[86] Preparation of Compound 2-3

[87] After 1,3-dibromobenzene (11.2 g, 47 mmol) was dissolved in THF (200 mL), the mixture was cooled to -78 ℃. After slowly adding n-BuLi (19 mL, 2.5M in hexane, 70.5 mmol), the mixture was stirred for 1 hour. Solution that TPS-Cl (20 g, 56.8 mmol) was dissolved in THF (25 mL) was slowly added. After slowly increasing temperature, the mixture was stirred at room temperature for one day. Upon completion of the reaction, H_2O was added and the mixture was extracted with EA/H_2O. After removing moisture with $MgSO_4$ and performing distillation under reduced pressure, Compound 2-3 (17 g, 87%) was obtained by column(MC/Hexane) separation.

[88] Preparation of Compound 2-4

[89] After Compound 2-3 (17.3 g, 41.8 mmol) was dissolved in THF (200 mL), the mixture was cooled to -78 ℃. After slowly adding n-BuLi (20 mL, 2.5M in hexane, 50 mmol), the mixture was stirred for 1 hour. Trimethyl borate (7 mL, 67 mmol) was slowly added thereto and temperature was slowly increased. The mixture was stirred at room temperature for one day. Upon completion of the reaction, 2M HCl was added and the mixture was extracted with EA/H_2O. After removing moisture with $MgSO_4$ and performing distillation under reduced pressure, Compound 2-4 (10.5 g, 66%) was obtained by column(MC/Hexane) separation.

[90] Preparation of Compound 2-5

[91] After Compound 2-4 (5 g, 13 mmol), 2,4-dichloropyrimidine (1.8 g, 12 mmol), $Pd(PPh_3)_4$ (0.7 g, 0.6 mmol) and Na_2CO_3 (2.5 g, 24 mmol) were dissolved in toluen (90 mL), EtOH (30 mL), and H_2O (12 mL), the mixture was stirred at 80 ℃ for 1.5 hours. Upon completion of the reaction, the mixture was extracted with EA/H_2O. After removing moisture with $MgSO_4$ and performing distillation under reduced pressure, Compound 2-5 (5 g, 93%) was obtained by column (MC/Hexane) separation.

[92] Preparation of Compound 17

[93] After Compound 2-2 (2 g, 6.8 mmol), Compound 2-5 (2.8 g, 6.2 mmol), $Pd(PPh_3)_4$ (0.3 g, 0.3 mmol) and Na_2CO_3 (1.4 g, 12.5 mmol) were dissolved in toluen (50 mL), EtOH (15 mL), and H_2O (6 mL), the mixture was stirred at 100 ℃ for one day. Upon completion of the reaction, the mixture was extracted with EA/H_2O. After removing moisture with $MgSO_4$ and performing distillation under reduced pressure, Compound 17 (2 g, 60%) was obtained by column(MC/Hexane) separation.

[94] Compounds 1 to 68 were prepared according to the procedure of Preparation Examples 1 and 2. ^1H NMR and MS/FAB data of thus prepared organic electroluminescent compounds are given in Tables 1 to 8.

[95] Table 1

[Table 1]

	^{1}H NMR($CDCl_3$, 200 MHz)	MS/FAB	
compound		found	calculated
1	δ = 6.96(1H, m), 7.2~7.25(2H, m), 7.33(1H, m), 7.41(2H, m), 7.51~7.52(8H, m), 7.88(1H, m), 7.94(1H, m), 8.05(2H, m), 8.55(1H, m)	401.52	401.12
2	δ = 6.96(1H, m), 7.2~7.25(2H, m), 7.33(1H, m), 7.41(2H, m), 7.51(4H, m), 7.94(1H, m), 8.28(4H, m), 8.55(1H, m)	404.49	404.11
3	δ = 6.96(1H, m), 7.2~7.25(2H, m), 7.32(1H, s), 7.33(1H, m), 7.41(2H, m), 7.51(4H, m), 7.79(2H, m), 7.94(1H, m), 8.28(2H, m), 8.55(1H, m)	403.50	403.11
4	δ = 6.96(1H, m), 7.2~7.25(2H, m), 7.33(1H, m), 7.41(2H, m), 7.51(4H, m), 7.79(4H, m), 7.94(1H, m), 8.55(1H, m), 8.63(1H, s), (H,)	403.50	403.11
5	δ = 6.96~7(3H, m), 7.2~7.26(4H, m), 7.33(1H, m), 7.51(2H, m), 7.94(1H, m), 8.5~8.55(3H, m), 8.62(2H, m), 8.9(1H, m)	403.50	403.11
6	δ = 6.96(1H, m), 7.11(1H, m), 7.2~7.25(2H, m), 7.33(1H, m), 7.41~7.54(8H, m), 7.94(1H, m), 8.3(2H, m), 8.55~8.6(2H, m)	402.51	402.12
7	δ = 6.96(1H, m), 7.2~7.25(10H, m), 7.33(1H, m), 7.41(2H, m), 7.51~7.52(8H, m), 7.88(1H, m), 7.94(1H, m), 8.05(2H, m), 8.55(1H, m)	553.71	553.19
8	δ = 1.72(12H, s), 6.96(1H, m), 7.2~7.38(7H, m), 7.55(2H, m), 7.63(2H, m), 7.77(2H, m), 7.87~7.94(6H, m), 8.05(2H, m), 8.55(1H, m)	633.84	633.25
9	δ = 1.72(6H, s), 6.96(1H, m), 7.17~7.25(3H, m), 7.33~7.34(2H, m), 7.41(2H, m), 7.51~7.56(5H, m), 7.63(1H, m), 7.87~7.94(3H, m), 8.28(4H, m), 8.55(1H, m)	596.74	596.20
10	δ = 6.96(1H, m), 7.2~7.25(4H, m), 7.33(1H, m), 7.41(2H, m), 7.51(4H, m), 7.68(2H, m), 7.79~7.85(8H, m), 7.94(1H, m), 8.23(1H, s), 8.55(1H, m)	555.69	555.18

[96] Table 2

[Table 2]

	^{1}H NMR($CDCl_3$, 200 MHz)	MS/FAB	
compound		found	calculated
11	δ = 6.96(1H, m), 7.2~7.26(3H, m), 7.33~7.41(3H, m), 7.5~7.52(5H, m), 7.88(2H, m), 7.94(1H, m), 8.55(1H, m), 8.81(2H, m)	402.51	402.12
12	δ = 6.96(1H, m), 7.2~7.25(2H, m), 7.33(1H, m), 7.41(1H, m), 7.51~7.52(4H, m), 7.6(1H, m), 7.62(1H, s), 7.78(1H, m), 7.88(2H, m), 7.94~7.98(2H, m), 8.22(1H, m), 8.55(1H, m), 8.81(2H, m)	452.57	452.13
13	δ = 6.96(1H, m), 7.2~7.25(4H, m), 7.33(1H, m), 7.41(1H, m), 7.51~7.52(4H, m), 7.8~7.85(3H, m), 7.94(1H, m), 8.05~8.06(2H, m), 8.16(1H, m), 8.55(1H, m)	453.56	453.13
14	δ = 6.96(1H, m), 7.2~7.25(2H, m), 7.33~7.37(7H, m), 7.46~7.55(14H, m), 7.89~7.94(3H, m), 8.09(1H, m), 8.55(1H, m)	583.82	583.18
15	δ = 6.96(1H, m), 7.2~7.25(2H, m), 7.33~7.37(7H, m), 7.46~7.55(11H, m), 7.89~7.96(4H, m), 8.55~8.57(2H, m)	585.79	585.17
16	δ = 6.96(1H, m), 7.2~7.25(2H, m), 7.33~7.55(21H, m), 7.89~7.94(3H, m), 8.28(2H, m), 8.55(1H, m)	662.88	662.20
17	δ = 6.96(1H, m), 7.2~7.25(2H, m), 7.33~7.46(14H, m), 7.55~7.61(5H, m), 7.68(2H, m), 7.76~7.79(3H, m), 7.89~7.94(2H, m), 8.29(1H, m), 8.55(1H, m)	661.89	661.20
18	δ = 6.96(1H, m), 7.2~7.25(2H, m), 7.33~7.41(3H, m), 7.51(2H, m), 7.85(1H, m), 7.94(1H, m), 8.28(2H, m), 8.38(1H, m), 8.55~8.59(2H, m)	405.47	405.10
19	δ = 6.96(1H, m), 7.2~7.25(2H, m), 7.33(1H, m), 7.55(4H, m), 7.61(2H, m), 7.94~7.95(3H, m), 8.04~8.08(4H, m), 8.55(3H, m)	504.60	504.14
20	δ = 6.96(1H, m), 7.2~7.25(2H, m), 7.33(1H, m), 7.59(4H, m), 7.92~8(7H, m), 8.49(2H, m), 8.55(1H, m), 9.09(2H, m)	504.60	504.14

[97]

[98] Table 3

[Table 3]

	^{1}H NMR($CDCl_3$, 200 MHz)	MS/FAB	
compound		found	calculated
21	δ = 6.96(1H, m), 7.2~7.25(2H, m), 7.33(1H, m), 7.6(2H, m), 7.78(2H, m), 7.94~7.98(3H, m), 8.06(2H, m), 8.22(2H, m), 8.55~8.57(3H, m)	506.58	506.13
22	δ = 6.96(1H, m), 7.2~7.25(2H, m), 7.33(1H, m), 7.67(4H, m), 7.8(4H, m), 7.94(1H, m), 8.55(1H, m), 8.7(2H, s), (H,)	508.56	508.12
23	δ = 6.96(1H, m), 7.2~7.33(4H, m), 7.41~7.51(10H, m), 7.67(1H, m), 7.94(1H, m), 8.06(1H, m), 8.55(1H, m)	453.56	453.13
24	δ = 6.96(1H, m), 7.2~7.25(2H, m), 7.33(1H, m), 7.41(2H, m), 7.51(4H, m), 7.68(2H, m), 7.79(6H, m), 7.94(1H, m), 8.23(1H, s), 8.55(1H, m)	479.59	479.15
25	δ = 7.25(2H, s), 7.25(0H, m), 7.33(1H, m), 7.41(3H, m), 7.51(6H, m), 7.79(2H, m), 7.94(1H, m), 8.28(4H, m), 8.55(1H, m)	480.58	480.14
26	δ = 6.96(1H, m), 7.2~7.25(2H, m), 7.33(1H, m), 7.41(2H, m), 7.51~7.52(8H, m), 7.66(3H, m), 7.94(1H, m), 8.55(1H, m), 9.42(2H, m)	479.59	479.15
27	δ = 6.96(1H, m), 7.2~7.25(2H, m), 7.33(1H, m), 7.36(1H, s), 7.41~7.42(3H, m), 7.51~7.52(4H, m), 7.62(4H, m), 7.71(1H, m), 7.94(1H, m), 8.17(1H, m), 8.55(1H, m)	440.56	440.13
28	δ = 6.96(1H, m), 7.2~7.29(4H, m), 7.32(1H, s), 7.33(2H, m), 7.41(1H, m), 7.5~7.51(3H, m), 7.63~7.68(3H, m), 7.79(4H, m), 7.94(2H, m), 8.12(1H, m), 8.55(2H, m)	568.69	568.17
29	δ = 6.96(1H, m), 7.2~7.25(3H, m), 7.33(2H, m), 7.63~7.67(4H, m), 7.8(1H, m), 7.94(2H, m), 8.05~8.06(2H, m), 8.16(2H, m), 8.54~8.55(3H, m)	516.61	516,.14

[99]

[100]

[101] Table 4

[Table 4]

	^{1}H NMR($CDCl_3$, 200 MHz)	MS/FAB	
compound		found	calculated
30	δ = 6.96(1H, m), 7.16(1H, s), 7.2~7.33(9H, m), 7.5(2H, m), 7.63~7.68(4H, m), 7.79(2H, m), 7.94(3H, m), 8.12(2H, m), 8.55(3H, m)	657.78	657.20
31	δ = 6.96(1H, m), 7.2~7.33(6H, m), 7.45~7.5(7H, m), 7.58~7.63(5H, m), 7.69(1H, m), 7.77(2H, m), 7.87~7.88(2H, m), 7.94~8.05(5H, m), 8.12(1H, m), 8.18(1H, m), 8.55(2H, m)	731.90	731.24
32	δ = 6.96(1H, m), 7.2~7.25(2H, m), 7.33(1H, m), 7.57(1H, m), 7.67(4H, m), 7.8(1H, m), 7.94~7.96(3H, m), 8.05~8.16(6H, m), 8.51~8.55(3H, m)	566.67	566.16
33	δ = 6.96(1H, m), 7.2(1H, m), 7.41(3H, m), 7.51~7.52(8H, m), 7.68(2H, m), 7.77~7.79(7H, m), 8(1H, m), 8.18(1H, m), 8.23(1H, s), (H,)	555.69	555.18
34	δ = 6.96(1H, m), 7.2~7.33(4H, m), 7.41(2H, m), 7.5~7.51(5H, m), 7.62~7.68(4H, m), 7.79(6H, m), 7.94~7.98(3H, m), 8.12(1H, m), 8.23(1H, s), 8.55(1H, m)	644.78	644.20
35	δ = 6.96(1H, m), 7.2~7.25(2H, m), 7.33(1H, m), 7.41~7.51(8H, m), 7.79(4H, m), 7.94(1H, m), 8.09(1H, m), 8.23(1H, s), 8.28(1H, m), 8.55(1H, m)	479.59	479.15
36	δ = 1.48(6H, m), 1.73(4H, m), 2.72(1H, m), 6.95~6.96(2H, m), 7.2(1H, m), 7.41(2H, m), 7.51(4H, m), 7.68(2H, m), 7.79(6H, m), 7.86(1H, m), 8.23(1H, s), 8.79(1H, m)	561.74	561.22
37	δ = 6.96(1H, m), 7.06(1H, m), 7.2(1H, m), 7.41(2H, m), 7.51(4H, m), 7.68(2H, m), 7.79(6H, m), 7.92(1H, m), 8.22(1H, m), 8.23(1H, s), (H,)	497.58	497.14

[102]

[103]

[104]

[105] Table 5

[Table 5]

	^{1}H NMR($CDCl_3$, 200 MHz)	MS/FAB	
compound		found	calculated
38	δ = 3.05(2H, m), 4.14(2H, m), 6.06(1H, m), 6.55(1H, m), 6.72(1H, m), 6.96(1H, m), 7.05~7.07(2H, m), 7.2~7.25(2H, m), 7.33(1H, m), 7.68(2H, m), 7.79~7.83(3H, m), 7.94(1H, m), 8.55(1H, m)	444.55	444.14
39	δ = 6.96(2H, m), 7.2~7.25(4H, m), 7.33(2H, m), 7.68(4H, m), 7.79(4H, m), 7.94(2H, m), 8.55(2H, m)	496.64	496.11
40	δ = 1.72(6H, s), 6.55(2H, m), 6.69~6.73(4H, m), 6.96~7.05(5H, m), 7.2~7.25(2H, m), 7.33(1H, m), 7.54(2H, m), 7.68(2H, m), 7.79(2H, m), 7.94(1H, m), 8.55(1H, m)	532.70	532.20
41	δ = 6.96(1H, m), 7.2~7.25(2H, m), 7.33(1H, m), 7.41~7.52(8H, m), 7.58(2H, m), 7.68(2H, m), 7.79(2H, m), 7.92~7.94(2H, m), 8.07(1H, m), 8.28(1H, m), 8.55(1H, m)	517.64	517.16
42	δ = 0.66(6H, s), 6.69~6.73(6H, m), 6.96(1H, m), 7.2~7.33(7H, m), 7.54(2H, m), 7.68(2H, m), 7.79(2H, m), 7.94(1H, m), 8.55(1H, m)	548.77	548.17
43	δ = 1.16(2H, m), 1.48(2H, m), 1.58(2H, m), 1.73(2H, m), 2.95(2H, m), 6.52(1H, m), 6.66~6.69(3H, m), 6.96(1H, m), 7.05~7.08(2H, m), 7.2~7.25(2H, m), 7.33(1H, m), 7.57(2H, m), 7.68(2H, m), 7.79(2H, m), 7.94(1H, m), 8.55(1H, m)	496.66	496.20
44	δ = 6.96(1H, m), 7.2~7.25(3H, m), 7.33(1H, m), 7.67~7.68(6H, m), 7.79(4H, m), 7.94~7.97(4H, m), 8.16(1H, m), 8.43(1H, m), 8.54~8.55(2H, m)	541.66	541.16
45	δ = 6.59(2H, m), 6.69(2H, m), 6.77(2H, m), 6.89~6.96(5H, m), 7.2~7.25(2H, m), 7.33(1H, m), 7.54(2H, m), 7.68(2H, m), 7.79(2H, m), 7.94(1H, m), 8.55(1H, m)	506.62	506.15

[106]

[107]

[108] Table 6

[Table 6]

	^{1}H NMR($CDCl_3$, 200 MHz)	MS/FAB	
compound		found	calculated
46	δ = 6.69(2H, m), 6.96~6.97(3H, m), 7.16~7.25(8H, m), 7.33(1H, m), 7.54(2H, m), 7.68(2H, m), 7.79(2H, m), 7.94(1H, m), 8.55(1H, m)	522.68	522.18
47	δ = 6.38(4H, m), 6.56(4H, m), 6.63(2H, m), 6.69(2H, m), 6.81(1H, m), 6.96(1H, m), 7.2~7.25(4H, m), 7.33(1H, m), 7.54(2H, m), 7.68(2H, m), 7.79(2H, m), 7.94(1H, m), 8.55(1H, m)	581.73	581.19
48	δ = 2.88(4H, m), 6.58(2H, m), 6.69(2H, m), 6.76(2H, m), 6.96~7.04(5H, m), 7.2~7.25(2H, m), 7.33(1H, m), 7.54(2H, m), 7.68(2H, m), 7.79(2H, m), 7.94(1H, m), 8.55(1H, m)	518.67	518.18
49	δ = 6.63(2H, m), 6.69(2H, m), 6.81(2H, m), 6.96~7.05(5H, m), 7.2~7.25(4H, m), 7.33(1H, m), 7.54(2H, m), 7.68(2H, m), 7.79(2H, m), 7.94(1H, m), 8.55(1H, m)	516.65	516.17
50	δ = 6.69(4H, m), 6.87(2H, m), 6.96(1H, m), 7.16~7.25(4H, m), 7.33(1H, m), 7.47(2H, m), 7.54(4H, m), 7.68(2H, m), 7.79~7.85(4H, m), 7.94(1H, m), 8.55(1H, m)	566.71	566.18
51	δ = 6.96(1H, m), 7.2~7.33(6H, m), 7.46~7.52(4H, m), 7.63~7.68(3H, m), 7.79(2H, m), 7.94(2H, m), 8.09~8.12(2H, m), 8.55(2H, m)	490.62	490.15
52	δ = 6.96(1H, m), 7.2~7.25(7H, m), 7.33(2H, m), 7.45~7.5(3H, m), 7.58(2H, m), 7.68~7.69(3H, m), 7.77~7.79(3H, m), 7.87(1H, m), 7.94(2H, m), 8.55(2H, m)	566.71	566.18

[109]

[110]

[111]

[112]

[113] Table 7

[Table 7]

	^{1}H NMR($CDCl_3$, 200 MHz)	MS/FAB	
compound		found	calculated
53	δ = 6.96(1H, m), 7.2~7.33(6H, m), 7.41(1H, m), 7.5~7.51(3H, m), 7.63~7.68(5H, m), 7.79(6H, m), 7.94(2H, m), 8.12(1H, m), 8.23(1H, s), 8.55(2H, m)	644.78	644.20
54	δ = 6.96(1H, m), 7.2~7.25(2H, m), 7.33(1H, m), 7.41(2H, m), 7.48~7.51(5H, m), 7.57(1H, m), 7.68~7.7(3H, m), 7.79(2H, m), 7.94(1H, m), 8.24~8.28(5H, m), 8.55(1H, m)	556.68	556.17
55	δ = 6.96(1H, m), 7.2~7.25(2H, m), 7.33(1H, m), 7.41(3H, m), 7.51~7.52(8H, m), 7.66~7.68(5H, m), 7.79(4H, m), 7.94(1H, m), 8.23(1H, s), 8.28(2H, m), 8.55(1H, m)	631.79	631.22
56	δ = 7.25(1H, m), 7.33(1H, m), 7.41~7.42(3H, m), 7.51(4H, m), 7.79(4H, m), 7.94(1H, m), 8.13(1H, m), 8.55(1H, m), 8.63(1H, s), (H,)	387.43	387.14
57	δ = 7.25(1H, m), 7.33~7.55(19H, m), 7.89~7.96(4H, m), 8.13(1H, m), 8.55~8.57(2H, m)	569.73	569.19
58	δ = 7.25(3H, m), 7.33(1H, m), 7.41~7.42(3H, m), 7.51(4H, m), 7.68(2H, m), 7.79~7.85(8H, m), 7.94(1H, m), 8.13(1H, m), 8.23(1H, s), 8.55(1H, m)	539.62	539.20
59	δ = 0.14(6H, s), 5.2(1H, m), 6.6(1H, m), 7.25(2H, m), 7.41(2H, m), 7.51~7.54(5H, m), 7.68(2H, m), 7.79(6H, m), 8.23(1H, s), 8.4(1H, m)	505.68	505.20
60	δ = 0.14(6H, s), 5.2(1H, m), 6.6(1H, m), 7.25(2H, m), 7.41(2H, m), 7.48~7.57(7H, m), 7.68~7.7(3H, m), 7.79(2H, m), 8.24~8.28(5H, m), 8.4(1H, m)	582.77	582.22
61	δ = 0.14(6H, s), 5.2(1H, m), 6.6(1H, m), 7.25(2H, m), 7.41(2H, m), 7.51~7.54(9H, m), 7.85(4H, m), 8.3(4H, m), 8.4(1H, m), 8.63(1H, s), (H,)	581.78	581.23

[114]

[115]

[116] Table 8

[Table 8]

	^{1}H NMR($CDCl_3$, 200 MHz)	MS/FAB	
compound		found	calculated
62	δ = 6.19(1H, m), 7.25~7.26(2H, m), 7.33(1H, m), 7.41~7.51(9H, m), 7.58(2H, m), 7.79(4H, m), 7.94(1H, m), 8.55(1H, m), 8.63(1H, s), (H,)	462.54	462.18
63	δ = 6.19(1H, m), 7.25~7.26(2H, m), 7.33(1H, m), 7.41~7.52(14H, m), 7.58(2H, m), 7.66~7.68(5H, m), 7.79(4H, m), 7.94(1H, m), 8.23(1H, s), 8.28(2H, m), 8.55(1H, m)	690.83	690.28
64	δ = 6.19(1H, m), 7.25~7.26(2H, m), 7.33(1H, m), 7.41~7.51(9H, m), 7.58(2H, m), 7.68(2H, m), 7.79(6H, m), 7.94(1H, m), 8.23(1H, s), 8.55(1H, m)	538.64	538.22
65	δ = 6.19(1H, m), 7.25~7.26(7H, m), 7.33(2H, m), 7.45~7.5(6H, m), 7.58(4H, m), 7.68~7.69(3H, m), 7.77~7.79(3H, m), 7.87(1H, m), 7.94(2H, m), 8.55(2H, m)	625.76	625.25
66	δ = 2.06(3H, m), 7.25(1H, m), 7.33(1H, m), 7.41~7.52(12H, m), 7.58(2H, m), 7.66~7.68(5H, m), 7.79(4H, m), 7.94(1H, m), 8.23(1H, s), 8.24~8.28(4H, m), 8.55(1H, m)	705.85	705.29
67	δ = 2.06(3H, m), 7.25(1H, m), 7.33(1H, m), 7.41~7.51(7H, m), 7.58(2H, m), 7.68(2H, m), 7.79(6H, m), 7.94(1H, m), 8.23(1H, s), 8.24(2H, m), 8.55(1H, m)	553.65	553.23
68	δ = 2.06(3H, m), 7.25(6H, m), 7.33(2H, m), 7.4~7.5(5H, m), 7.58(2H, m), 7.68~7.69(3H, m), 7.77~7.79(3H, m), 7.87(1H, m), 7.94(2H, m), 8.42(2H, m), 8.55(2H, m)	641.76	641.26

[117]

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

[119] 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.

[120] 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.

[121] Then, *N,N'*-bis(--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.

[122] After forming the hole injection layer and the hole transport layer, an electroluminescent layer was formed thereon as follows. Compound 30 was placed in a cell of a vacuum vapor deposition apparatus as a host, and $Ir(ppy)_3$ [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 through doping at 4 to 10 wt%.

[123] Subsequently, tris(8-hydroxyquinoline)-aluminum(III) (Alq) was vapor-deposited with a thickness of 20 nm as an electron transport layer on the electroluminescent 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.

[124] Each compound used in the OLED was purified by vacuum sublimation at 10^{-6}torr.

[125] As a result, it was confirmed that current of 3.7 mA/cm^2 flows at voltage of 6.8 V and a green light of 1060 cd/m^2 was emitted.

[126] [Example 2]

[127] An OLED device was manufactured as in Example 1 except that Compound 34 was added as a host material on the electroluminescent layer and $Ir(ppy)_3$ [tris(2-phenylpyridine)iridium] was used as an electroluminescent dopant.

[128] As a result, it was confirmed that current of 3.5 mA/cm^2 flows at voltage of 6.5 V and a green light of 1075 cd/m^2 was emitted.

[129] [Example 3]

[130] An OLED device was manufactured as in Example 1 except that Compound 51 was added as a host material on the electroluminescent layer and $Ir(ppy)_3$ [tris(2-phenylpyridine)iridium] was used as an electroluminescent dopant.

[131] As a result, it was confirmed that current of 3.9 mA/cm^2 flows at voltage of 6.9 V and a green light of 1070 cd/m^2 was emitted.

[132] [Example 4]

[133] An OLED device was manufactured as in Example 1 except that Compound 13 was added as a host material on the electroluminescent layer and $(piq)_2$ Ir(acac)[bis-(1-phenylisoquinolyl)iridium(III)acetylacetonate] was used as an electroluminescent dopant.

[134] As a result, it was confirmed that current of 13.8 mA/cm^2 flows at voltage of 7.0 V and a red light of 1120 cd/m^2 was emitted.

[135] [Example 5]

[136] An OLED device was manufactured as in Example 1 except that Compound 34 was added as a host material on the electroluminescent layer and $(piq)_2$ Ir(acac)[bis-(1-phenylisoquinolyl)iridium(III)acetylacetonate] was used as an electroluminescent dopant.

[137] As a result, it was confirmed that current of 14.2 mA/cm^2 flows at voltage of 6.8 V and a red light of 1095 cd/m^2 was emitted.

[138] [Comparative Example 1]

[139] An OLED was manufactured in the same manner as Example 1 except that 4,4'-bis(carbazol-9-yl)biphenyl(CBP) instead of the compounds of the present invention as a host material at one cell of the vacuum vapor deposition apparatus, $Ir(ppy)_3$[tris(2-phenyl pyridine)iridium] as a dopant and Bis(2-methyl-8-quinolinato)(*p*-phenyl-phenolato)aluminum(III) (BAlq) as a hole blocking layer were used.

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

[141] [Comparative Example 2]

[142] An OLED was manufactured in the same manner as Example 1 except that 4,4'-bis(carbazol-9-yl)biphenyl(CBP) instead of the compounds of the present invention as a host material at one cell of the vacuum vapor deposition apparatus,$(piq)_2$ Ir(acac)[bis-(1-phenylisoquinolyl)iridium(III)acetylacetonate] as a dopant and Bis(2-methyl-8-quinolinato)(*p*-phenyl-phenolato)aluminum(III) (BAlq) as a hole blocking layer were used.

[143] As a result, it was confirmed that current of 15,3 mA/cm^2 flows at voltage of 7.5 V and a red light of 1000 cd/m^2 was emitted.

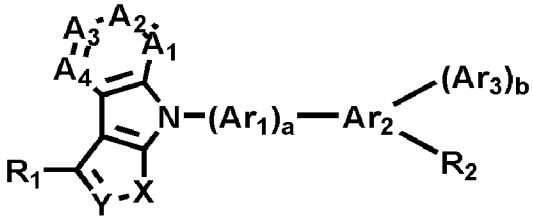
[144] The organic electroluminescent compounds according to the present invention have excellent properties compared with the conventional material. In addition, the device using the organic electroluminescent compound according to the present invention as host material has excellent electroluminescent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

[145]

Claims

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

(1)



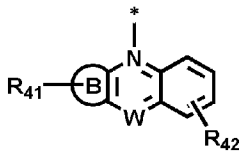
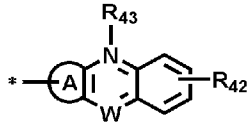
wherein

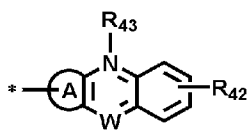
A_1 through A_4 independently represent CR_3 or N;

X represents $-N(R_{10})-$, -S-, -O- or $-Si(R_{11})(R_{12})-$;

Y represents CR_4 or N;

Ar_1 and Ar_2 independently represent (C6-C30)arylene with or without substituent(s) or (C3-C30)heteroarylene with or without substituent(s), and Ar_3 represents (C6-C30)aryl with or without substituent(s) or (C3-C30)heteroaryl with or without substituent(s);

R_1 through R_4 and R_{10} through R_{12} 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, $NR_{21}R_{22}$, $BR_{23}R_{24}$, $PR_{25}R_{26}$, $P(=O)R_{27}R_{28}$, $R_{29}R_{30}R_{31}Si-$, $R_{32}Z-$, (C6-C30)ar(C1-C30)alkyl 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 (C3-C30)alkylene or (C3-C30)alkenylene with or without a

fused ring to form an alicylic ring, a mono- or polycyclic aromatic ring or a mono- or polycyclic heteroaromatic ring;

A ring and B ring independently represent (C5-C30)cycloalkyl with or without substituent(s), (C6-C30)aryl with or without sub-stituent(s),(C6-C30)heteroaryl with or without substituent(s);

R_{21} through R_{32} 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);

Z represents S or O;

W represents $-(CR_{51}R_{52})_m-$, $-(R_{51})C=C(R_{52})-$, $-N(R_{53})-$, -S-, -O-, $-Si(R_{54})(R_{55})-$, $-P(R_{56})-$, $-P(=O)(R_{57})-$, -C(=O)- or $-B(R_{58})-$;

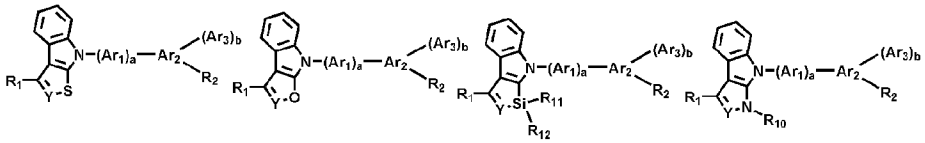
R_{41} through R_{43} and R_{51} through R_{58} are the same as R_1 through R_3;

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

m represents an integer from 0 to 2; and

a and b independently represent an integer from 0 to 4; and they may be identical or different when a and b are larger than 2.

[Claim 2] The organic electroluminescent compound according to claim 1, which is selected from the following compounds:



wherein

Ar_1 throughAr_3, Y, R_1,R_2, R_{10} throughR_{12}, a and b are the same as defined in Chemical Formula 1 of claim 1.

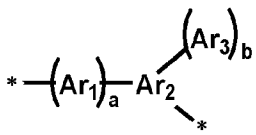
[Claim 3] The organic electroluminescent compound according to claim 1, wherein the substituent further substituted by the Ar_1 andAr_3, R_1 through R_4, R_{10} through R_{12}, R_{21} through R_{32}, R_{41} through R_{43} and R_{51} through R_{58} may be further substituted by one or more substituent(s) selected from the group consisting of deuterium, halogen, (C1-C30)alkyl with or without halogen substituent(s), (C6-C30)aryl, (C6-C30)aryl with or without (C6-C30)aryl substituent(s), (C6-C30)aryl with or without (C6-C30)heteroaryl substituent(s), (C3-C30)heteroaryl with or without (C6-C30)aryl substituent(s), (C3-C30)heteroaryl, 5- to 7-membered heterocycloalkyl, 5- to 7-membered heterocycloalkyl fused with one or more aromatic ring(s), (C3-C30)cycloalkyl, (C3-C30)cycloalkyl fused with one or more

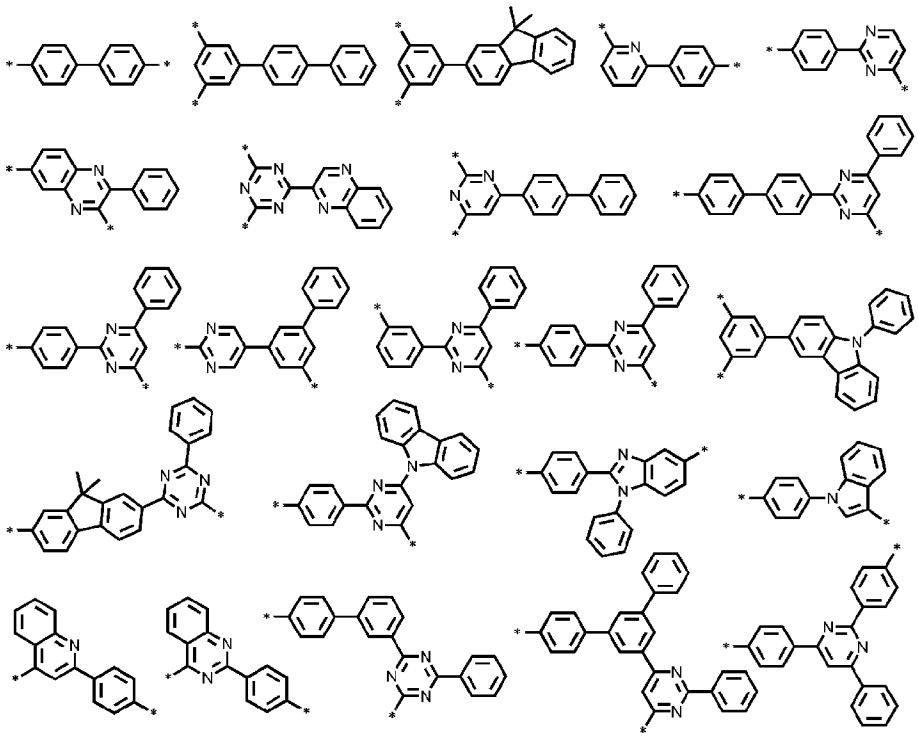
aromatic ring(s), $NR_{61}R_{62}$, $BR_{63}R_{64}$, $PR_{65}R_{66}$, $P(=O)R_{67}R_{68}$, $R_{69}R_{70}R_{71}Si$-, $R_{72}Z$-, $R_{73}C(=O)$-, $R_{74}C(=O)O$-, (C2-C30)alkenyl, (C2-C30)alkynyl, cyano, carbazolyl, (C6-C30)ar(C1-C30)alkyl, (C1-C30)alkyl(C6-C30)aryl, carboxyl, nitro and hydroxyl, or may be linked to an adjacent substituent to form a ring;

R_{61} through R_{72} independently represent (C1-C30)alkyl, (C6-C30)aryl or (C3-C30)heteroaryl;

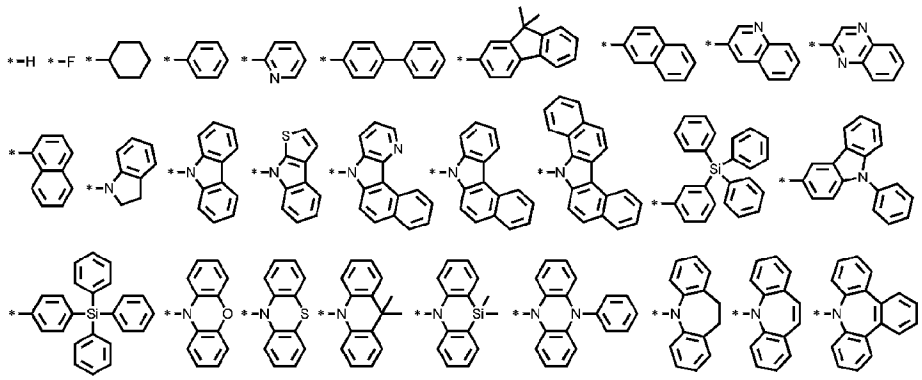
Z represents S or O; and

R_{73} and R_{74} independently represent (C1-C30)alkyl, (C1-C30)alkoxy, (C6-C30)aryl or (C6-C30)aryloxy.

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



[Claim 5] The organic electroluminescent compound according to claim 1, wherein R_1 and R_2 are independently selected from the following structures:



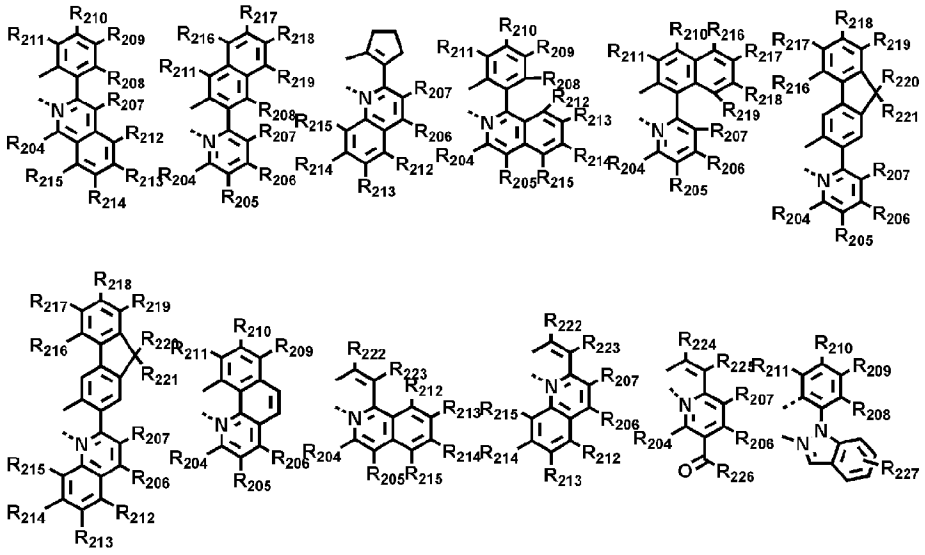
[Claim 6] An organic electroluminescent device comprising the organic electroluminescent compound according to any of claims 1 to 5.

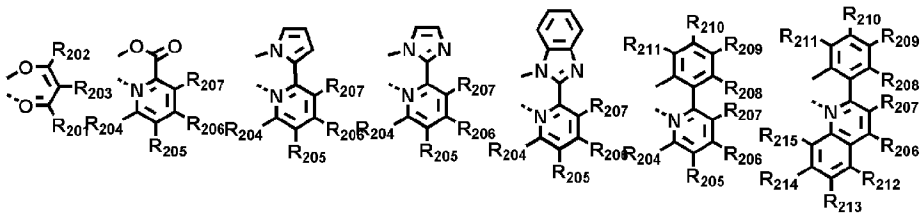
[Claim 7] The organic electroluminescent device according to claim 6, which comprises a first electrode; a second electrode; and one or more organic layer(s) interposed between the first electrode and the second electrode, wherein the organic layer comprises one or more organic electroluminescent compound(s)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

$M^1L^{101}L^{102}L^{103}$ (2)

wherein

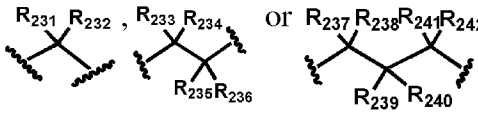
M^1 is selected from the group consisting of Group 7, Group 8, Group 9, Group 10, Group 11, Group 13, Group 14, Group 15 and Group 16 metals, and ligands L^{101}, L^{102} and $L^{103}$are independently selected from the following structures:





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, deuterium, (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, deuterium, (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, deuterium, (C1-C30)alkyl with or without substituent(s), (C6-C30)aryl with or without substituent(s) or halogen; and

Q represents  wherein R_{231} through R_{242} independently represent hydrogen, deuterium, (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), or 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/KR2011/000652

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

C07D 495/04 (2006.01) ***C07F 7/10*** (2006.01) ***H01L 51/50*** (2006.01)
C07D 487/04 (2006.01) ***C09K 11/06*** (2006.01) ***H05B 33/14*** (2006.01)
C07D 491/048 (2006.01) ***H01L 27/32*** (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)
Substructure Search of full scope of formula 1 in STN file Registry and CA

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2007/0196687 A1 (OSHIYAMA ET AL.) 23 August 2007 See compounds I-20, I-22 and I-23 on page 15 and whole document.	1-10
X	BOEINI, H. Z. "Highly efficient synthesis of thieno[2,3-b]indole derivatives" *Helvetica Chimica Acta* (2009), 92(7), 1268-1272 See product 3e in the table on page 1270	1-3
A	ACKERMANN, L. ET AL. "Domino N-H/C-H bond activation: palladium-catalyzed synthesis of annulated heterocycles using dichloro(hetero)arenes" *Angewandte Chemie, International Edition* (2007), 46(10), 1627-1629 See whole document	

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"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
03 May 2011	11 MAY 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 **KEITH WAGG** AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No : +61 3 9935 9607

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/KR2011/000652

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			
US	2007196687	EP	1731584	US	7790890	WO	2005/097940

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

END OF ANNEX