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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 organic electroluminescent devices comprising the same. Since the organic electroluminescent compounds exhibit high luminous efficiency in blue color, and excellent life property of the material, they may be used to manufacture OLEDs having very good operation life.

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 dopant.

Background Art

[2] 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].

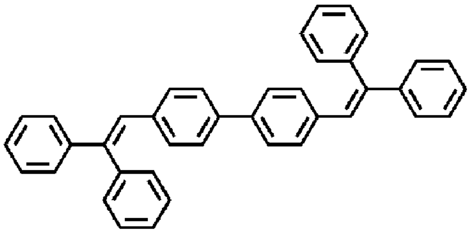
[3] In an organic EL device, the most important factor that determines its performance including luminescence efficiency and operation life is the electroluminescent material. Some requirements of the electroluminescent material include high fluorescence quantum yield in solid state, high electron and hole mobility, resistance to decomposition during vacuum deposition, ability to form uniform film and stability.

[4] Organic electroluminescent materials can be 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, in view 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, so that realization of full-colored display devices is anticipated thereby.

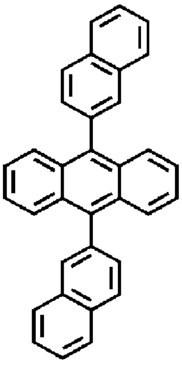
[5] In the meanwhile, for conventional blue materials, a number of materials have been developed and commercialized since the development of diphenylvinyl-biphenyl (DPVBi) (Compound a) by Idemitsu-Kosan. In addition to the blue material system from Idemitsu-Kosan, dinaphthylanthracene (DNA) (Compound b) of Kodac, tetra(t-butyl)perylene (Compound c) system or the like have been known. However, extensive research and development should be performed with respect to these materials.

[6] The distryl compound system of Idemitsu-Kosan, which is known to have highest efficiency up to now, has 6 lm/W power efficiency and beneficial device lifetime of more than 30,000 hr. However, when it is applied to a full-colored display, the lifetime is merely several thousand hours, owing to decrease of color purity over operation time. In case of blue electroluminescence, it becomes advantageous from the aspect of the luminous efficiency, if the electroluminescent wavelength is shifted a little toward longer wavelength. However, it is not easy to apply the material to a display of high quality because of unsatisfactory color purity in blue. Furthermore, the research and development of such materials are urgent because of the problems in color purity, efficiency and thermal stability.

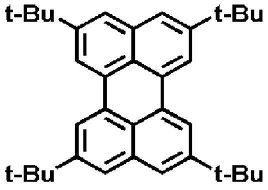
[7]



Compound a



Compound b



Compound c

Disclosure of Invention

Technical Problem

[8] With intensive efforts to overcome the problems of conventional techniques as described above, the present inventors have invented novel electroluminescent compounds which realize organic electroluminescent devices having excellent luminous efficiency and noticeably improved life property.

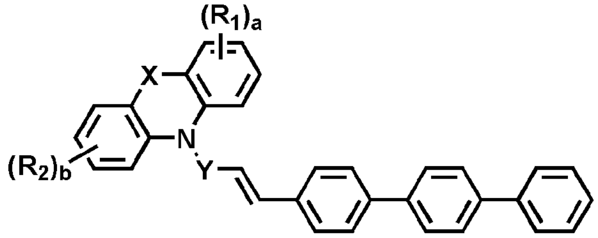
[9] The object of the present invention is to provide organic electroluminescent compounds having the backbone to provide better luminous efficiency and device life with appropriate color coordinate as compared to conventional dopant material, while overcoming the problems described above, and an organic electroluminescent device having high luminous efficiency and improved life property.

Solution to Problem

[10] Provided are novel organic electroluminescent compounds, and organic electroluminescent devices comprising the same. Specifically, the organic electroluminescent compounds according to the invention are represented by Chemical Formula 1 or 2. Since the organic electroluminescent compounds exhibit high luminous efficiency and excellent life property of the material, they may be used to manufacture OLEDs having very good operation life.

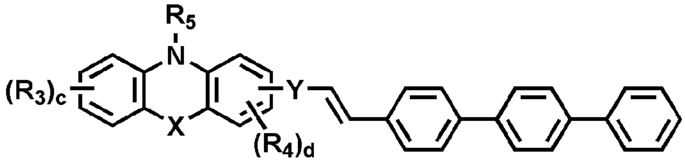
[11] [Chemical Formula 1]

[12]



[13] [Chemical Formula 2]

[14]



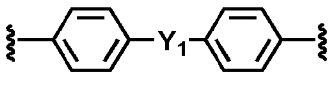
[15] wherein

[16] R_1 through R_5 independently represent hydrogen, (C1-C60)alkyl, (C3-C60)cycloalkyl, (C6-C60)aryl, (C2-60)heteroaryl containing one or more heteroatom(s) selected from N, O, S, P, Si and Se, (C1-60)alkoxy, (C1-C60)alkylthio, (C6-60)aryloxy, (C6-C60)arylthio, (C6-30)aryl(C1-C30)alkylamino, tri(C1-C30)alkylsilyl, di(C1-C30)alkyl(C6-C30)arylsilyl or tri(C6-C30)arylsilyl;

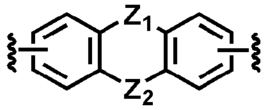
[17] X represents a chemical bond, $-(CR_6R_7)_m-$, $-N(R_8)-$, $-Si(R_9)(R_{10})-$, -O-, -S-, -Se- or $-(CR_{11})C=C(R_{12})-$;

[18] R_6 through R_{12} independently represent hydrogen, (C1-C60)alkyl, (C3-C60)cycloalkyl, (C6-C60)aryl, (C2-60)heteroaryl containing one or more heteroatom(s) selected from N, O, S, Si and Se, (C1-60)alkoxy, (C1-C60)alkylthio, (C6-60)aryloxy, (C6-C60)arylthio, mono- or di(C1-60)alkylamino, mono- or di(C6-60)arylamino, (C6-30)aryl(C1-C30)alkylamino, tri(C1-C30)alkylsilyl, di(C1-C30)alkyl(C6-C30)arylsilyl or tri(C6-C30)arylsilyl, or R_6 and R_7, R_9 and R_{10}, and R_{11} and R_{12} are linked via (C3-C60)alkylene or (C3-C60)alkenylene with or without a fused ring to form an aliphatic ring or a mono- or polycyclic aromatic ring;

[19] Y represents (C6-C60)arylene, adamantylene, (C3-C60)heteroarylene containing one or more heteroatom(s) selected from N, O, S, P, Si and Se,



or



;

[20] Y_1 represents (C2-60)heteroarylene containing one or more heteroatom(s) selected from N, O, S, P, Si and Se;

[21] Z_1 and Z_2 independently represent a chemical bond, $-(CR_{13}R_{14})_n-$, $-N(R_{15})-$, $-Si(R_{16})(R_{17})-$, -O-, -S-, -Se- or $-(R_{18})C=C(R_{19})-$, provided that Z_1 and Z_2 are not chemical bonds at the same time;

[22] R_{13} through R_{19} independently represent hydrogen, (C1-C60)alkyl, (C3-C60)cycloalkyl, (C6-C60)aryl, (C2-60)heteroaryl containing one or more heteroatom(s) selected from N, O, S, Si and Se, (C1-60)alkoxy, (C1-C60)alkylthio, (C6-60)aryloxy, (C6-C60)arylthio, mono- or di(C1-60)alkylamino, mono- or di(C6-60)arylamino, (C6-30)aryl(C1-C30)alkylamino, tri(C1-C30)alkylsilyl, di(C1-C30)alkyl(C6-C30)arylsilyl or tri(C6-C30)arylsilyl, or R_{13} and R_{14}, R_{16} and R_{17}, and R_{18} and R_{19} are linked via (C3-C60)alkylene or (C3-C60)alkenylene with or without a fused ring to form an aliphatic ring or a mono- or polycyclic aromatic ring;

[23] a, b and c independently represent an integer from 1 to 4;

[24] d represents an integer from 1 to 3; and

[25] m and n independently represent an integer from 1 to 4.

[26]

[27] In the present invention, "alkyl", "alkoxy" and other substituents including "alkyl" moiety include both linear and branched species. The term "aryl" described herein means an organic radical derived from aromatic hydrocarbon via elimination of one hydrogen atom. Each ring includes a monocyclic or fused ring system including from 4 to 7, preferably from 5 to 6 cyclic atoms. Specific examples of the aryl include phenyl, naphthyl, biphenyl, anthryl, indenyl, fluorenyl, phenanthryl, triphenylenyl, pyrenyl, perylenyl, chrysenyl, naphthacenyl and fluoranthenyl, but they are not restricted thereto.

[28] The term "heteroaryl" described herein means an aryl group including from 1 to 4 heteroatom(s) selected from N, O, S, P, Si and Se for the aromatic cyclic backbone atoms, and carbon atom(s) for remaining aromatic cyclic backbone atoms. The heteroaryl may be a 5- or 6-membered monocyclic heteroaryl or a polycyclic heteroaryl which is fused with one or more benzene ring(s), and may be partially saturated.

[29] The heteroaryl groups may include divalent aryl groups of which the heteroatoms are oxidized or quarternized to form N-oxides, quaternary salts, or the like. Specific examples of the heteroaryl include monocyclic heteroaryl groups such as furyl, thienyl, pyrrolyl, imidazolyl, pyrazolyl, thiazolyl, thiadiazolyl, isothiazolyl, isoxazolyl, oxazolyl, oxadiazolyl, triazinyl, tetrazinyl, triazolyl, tetrazolyl, furazanyl, pyridyl, pyrazinyl, pyrimidinyl, pyridazinyl; polycyclic heteroaryl groups such as benzofuryl, benzothienyl, isobenzofuryl, benzimidazolyl, benzothiazolyl, benzisothiazolyl, benzisoxazolyl, benzoxazolyl, isoindolyl, indolyl, indazolyl, benzothiadiazolyl, quinolyl, isoquinolyl, cinnolinyl, quinazolinyl, quinolizinyl, quinoxalinyl, carbazolyl, phenanthridinyl and benzodioxolyl; and corresponding N-oxides (for example, pyridyl N-oxide, quinolyl N-oxide) and quaternary salts thereof; but they are not restricted thereto.

[30] The substituents comprising "(C1-C60)alkyl" moiety described herein may contain 1 to 60 carbon atoms, 1 to 20 carbon atoms, or 1 to 10 carbon atoms. The substituents comprising "(C6-C60)aryl" moiety may contain 6 to 60 carbon atoms, 6 to 20 carbon atoms, or 6 to 12 carbon atoms. The substituents comprising "(C3-C60)heteroaryl" moiety may contain 3 to 60 carbon atoms, 4 to 20 carbon atoms, or 4 to 12 carbon atoms. The substituents comprising "(C3-C60)cycloalkyl" moiety may contain 3 to 60 carbon atoms, 3 to 20 carbon atoms, or 3 to 7 carbon atoms. The substituents comprising "(C2-C60)alkenyl or alkynyl" moiety may contain 2 to 60 carbon atoms, 2 to 20 carbon atoms, or 2 to 10 carbon atoms.

[31] Y represents 1,2-phenylene, 1,3-phenylene, 1,4-phenylene, 1,2-naphthylene, 1,3-naphthylene, 1,4-naphthylene, 1,5-naphthylene, 1,6-naphthylene, 1,7-naphthylene, 1,8-naphthylene, 2,3-naphthylene, 2,6-naphthylene, 2,7-naphthylene, 1,2-anthracenylene, 1,3-anthracenylene, 1,4-anthracenylene, 1,5-anthracenylene, 1,6-anthracenylene, 1,7-anthracenylene, 1,8-anthracenylene, 1,9-anthracenylene, 1,10-anthracenylene, 2,3-anthracenylene, 2,6-anthracenylene, 2,7-anthracenylene, 2,9-anthracenylene, 2,10-anthracenylene, 9,10-anthracenylene, 4,2'-biphenylene, 4,3'-biphenylene, 4,4'-biphenylene, 1,2-triphenylenylene, 1,3-triphenylenylene, 1,4-triphenylenylene, 1,6-triphenylenylene, 1,7-triphenylenylene, 1,8-triphenylenylene, 1,10-triphenylenylene, 1,11-triphenylenylene, 1,12-triphenylenylene, 2,3-triphenylenylene, 2,6-triphenylenylene, 2,7-triphenylenylene, 2,11-triphenylenylene, 1,2-fluoranthenylene, 1,3-fluoranthenylene, 1,4-fluoranthenylene, 1,5-fluoranthenylene, 1,6-fluoranthenylene, 1,7-fluoranthenylene, 1,8-fluoranthenylene, 1,9-fluoranthenylene, 1,10-fluoranthenylene, 2,3-fluoranthenylene, 2,4-fluoranthenylene, 2,5-fluoranthenylene, 2,7-fluoranthenylene, 2,8-fluoranthenylene, 2,9-fluoranthenylene, 2,10-fluoranthenylene, 3,4-fluoranthenylene, 3,7-fluoranthenylene, 3,8-fluoranthenylene, 3,9-fluoranthenylene, 3,10-fluoranthenylene, 7,8-fluoranthenylene, 7,9-fluoranthenylene, 7,10-fluoranthenylene, 8,9-fluoranthenylene, 1,2-chrysenylene, 1,3-chrysenylene, 1,4-chrysenylene, 1,5-chrysenylene, 1,6-chrysenylene, 1,7-chrysenylene, 1,8-chrysenylene, 1,9-chrysenylene, 1,10-chrysenylene, 1,11-chrysenylene, 1,12-chrysenylene, 2,3-chrysenylene, 2,4-chrysenylene, 2,5-chrysenylene, 2,6-chrysenylene, 2,8-chrysenylene, 2,9-chrysenylene, 2,10-chrysenylene, 2,11-chrysenylene, 2,12-chrysenylene, 3,4-chrysenylene, 3,5-chrysenylene, 3,6-chrysenylene, 3,9-chrysenylene, 3,10-chrysenylene, 3,11-chrysenylene, 3,12-chrysenylene, 4,5-chrysenylene, 4,6-chrysenylene, 4,11-chrysenylene, 4,12-chrysenylene, 5,6-chrysenylene, 5,11-chrysenylene, 5,12-chrysenylene, 6,12-chrysenylene, 4,4"-p-terphenylene, 1,1'-binaphthylene, 9,9'-bianthracenylene,

1,2-phenanthrylene, 1,3-phenanthrylene, 1,4-phenanthrylene, 1,5-phenanthrylene, 1,6-phenanthrylene, 1,7-phenanthrylene, 1,8-phenanthrylene, 1,9-phenanthrylene, 1,10-phenanthrylene, 2,3-phenanthrylene, 2,4-phenanthrylene, 2,5-phenanthrylene, 2,6-phenanthrylene, 2,7-phenanthrylene, 2,9-phenanthrylene, 2,10-phenanthrylene, 3,4-phenanthrylene, 3,5-phenanthrylene, 3,6-phenanthrylene, 3,9-phenanthrylene, 3,10-phenanthrylene, 4,5-phenanthrylene, 4,9-phenanthrylene, 4,10-phenanthrylene, 9,10-phenanthrylene, 1,2-pyrenylene, 1,3-pyrenylene, 1,4-pyrenylene, 1,5-pyrenylene, 1,6-pyrenylene, 1,7-pyrenylene, 1,8-pyrenylene, 1,9-pyrenylene, 1,10-pyrenylene, 2,4-pyrenylene, 2,5-pyrenylene, 2,7-pyrenylene, 4,5-pyrenylene, 4,9-pyrenylene, 4,10-pyrenylene, 1,2-perylenylene, 1,3-perylenylene, 1,4-perylenylene, 1,5-perylenylene, 1,6-perylenylene, 1,7-perylenylene, 1,8-perylenylene, 1,9-perylenylene, 1,10-perylenylene, 1,11-perylenylene, 1,12-perylenylene, 2,3-perylenylene, 2,4-perylenylene, 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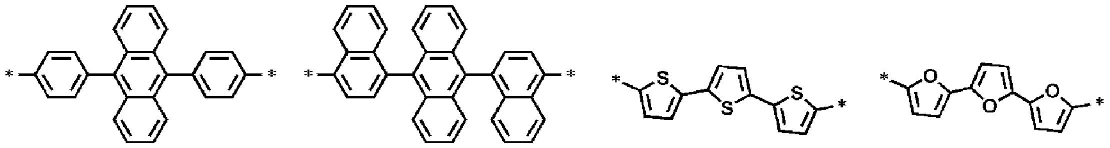
[32]



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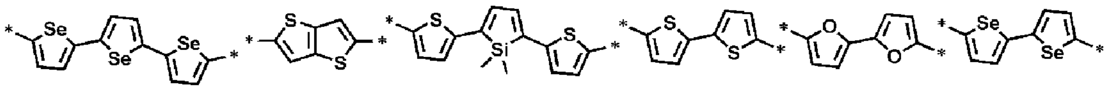

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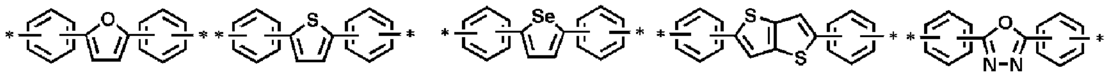

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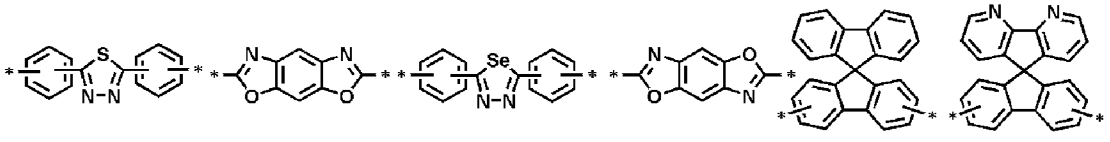

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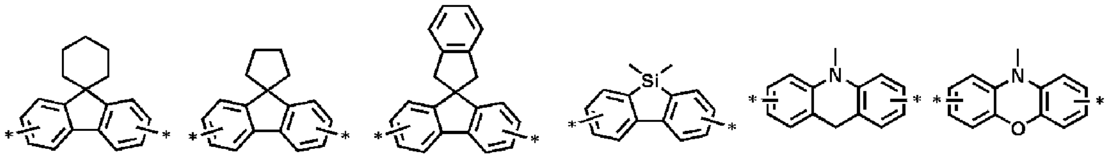

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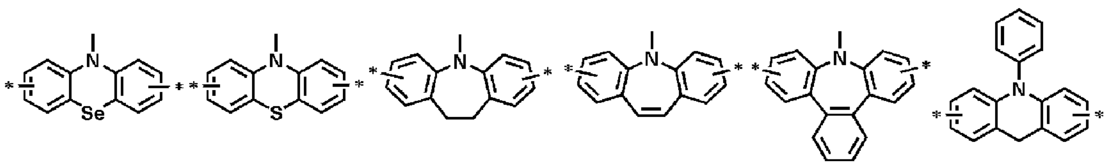

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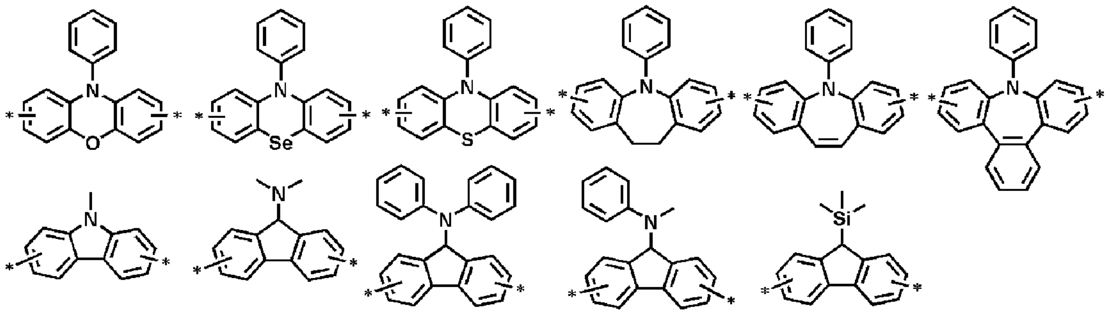
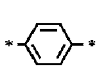


[39]

[40] More specifically, the Y is a divalent group selected from following structures.

[41]



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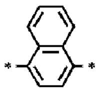

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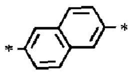

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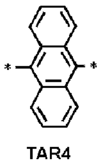

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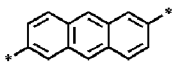

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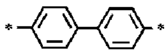

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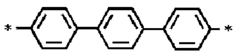

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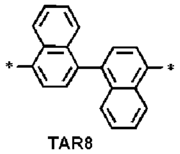

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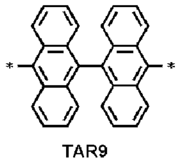

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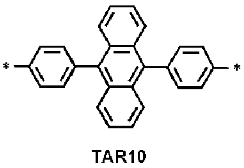

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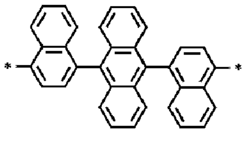

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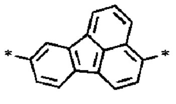

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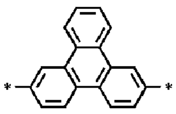
[43]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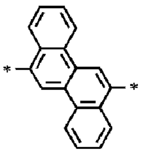
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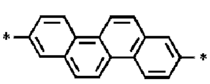
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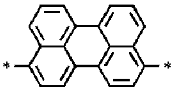
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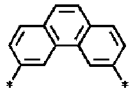
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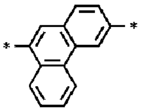
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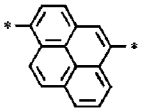
[44]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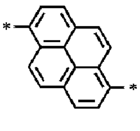
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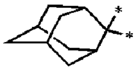
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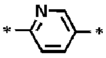
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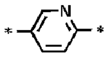
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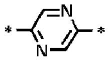
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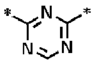
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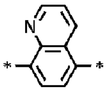
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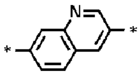
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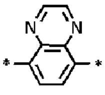
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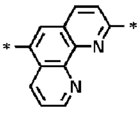
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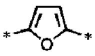
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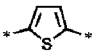
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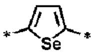
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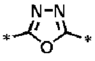
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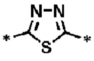
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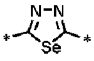
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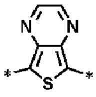
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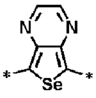
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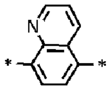
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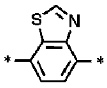
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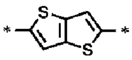
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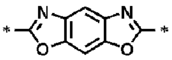
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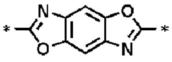
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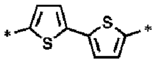
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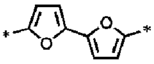
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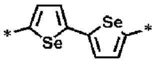
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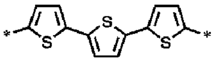
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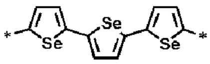
THA26

[48]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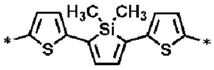
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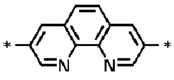
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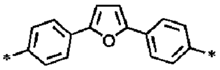
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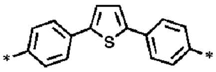
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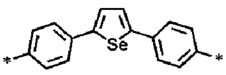
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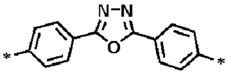
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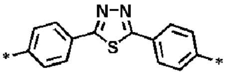
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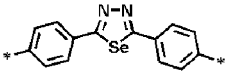
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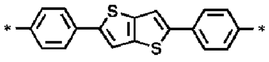
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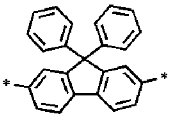
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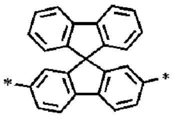
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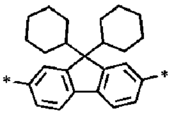
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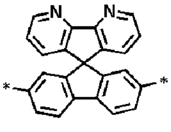
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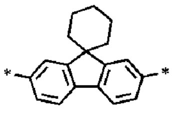
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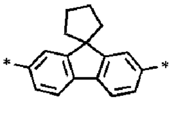
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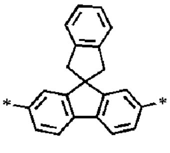
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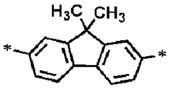
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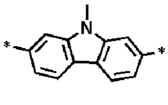
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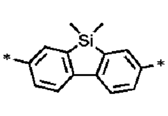
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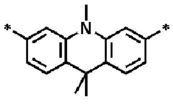
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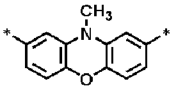
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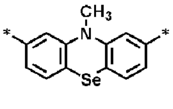
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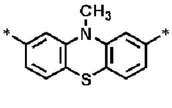
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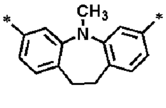
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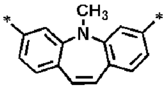
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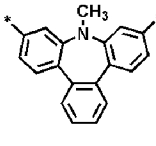
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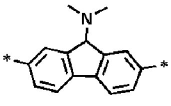
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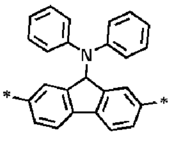
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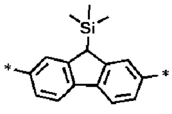
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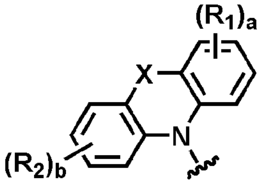
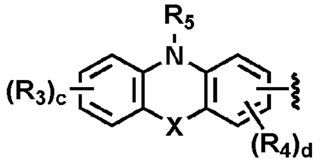
[54] The  or  is selected from following structures but are not limited thereto:

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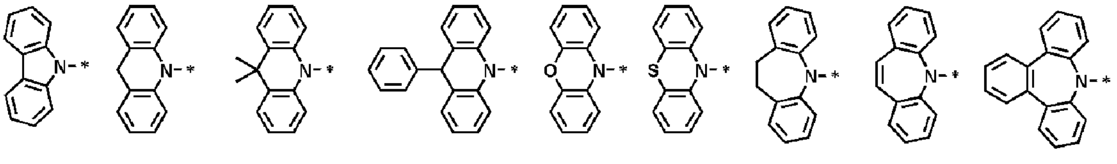

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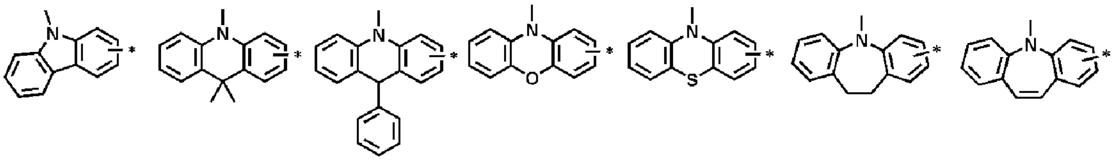

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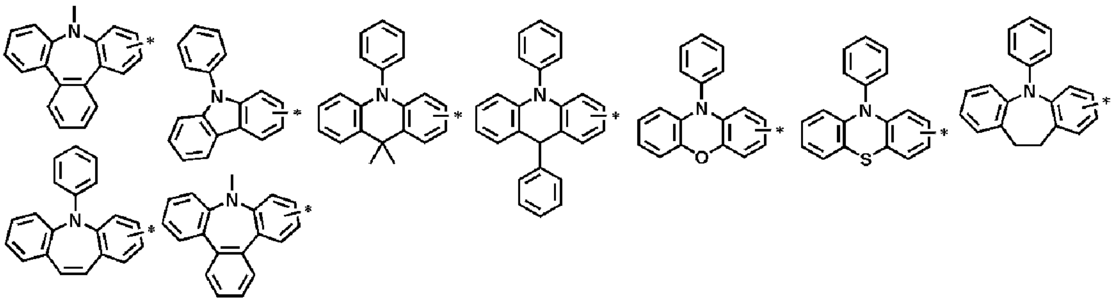
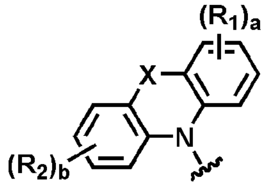
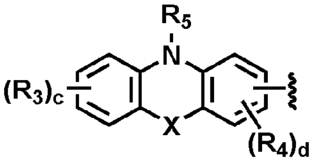


[58]

[59] More specifically, the  or  is selected from following structures.

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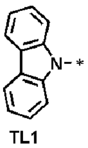
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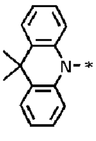
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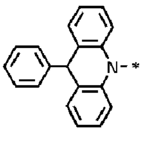
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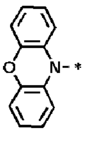
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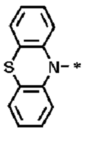
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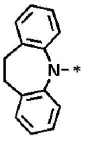
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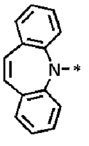
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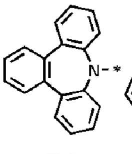
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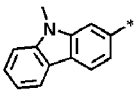
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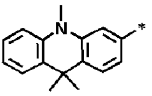
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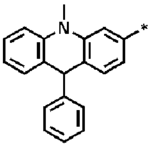
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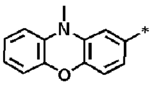
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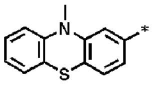
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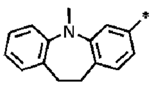
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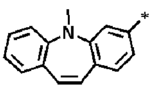
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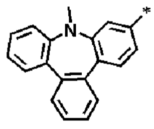
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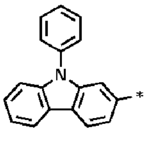
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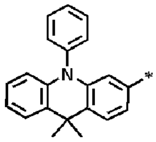
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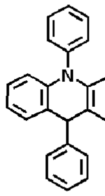
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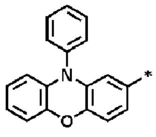
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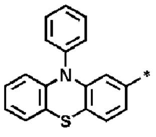
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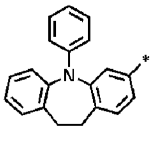
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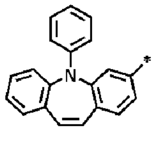
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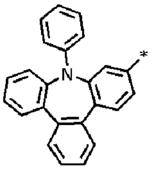
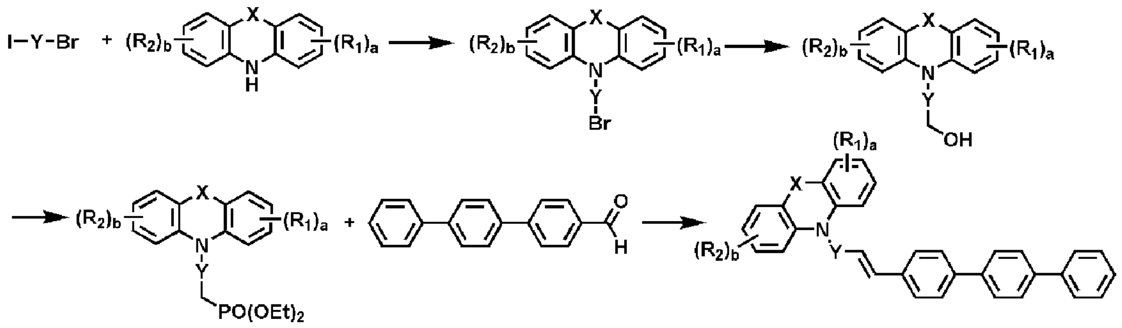

TL24

[63]

[64] The organic electroluminescent compound according to the present invention may be prepared as shown in following Schemes 1 to 4.

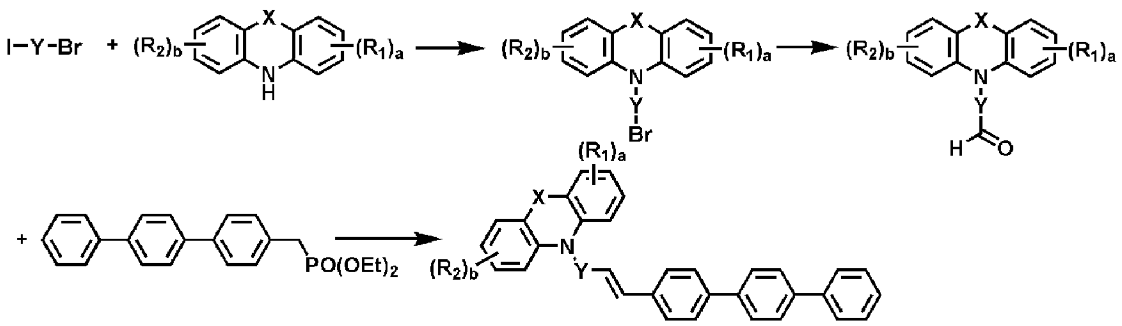
[65] [Scheme 1]

[66]



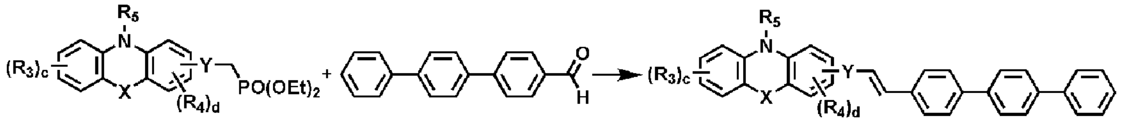
[67] [Scheme 2]

[68]



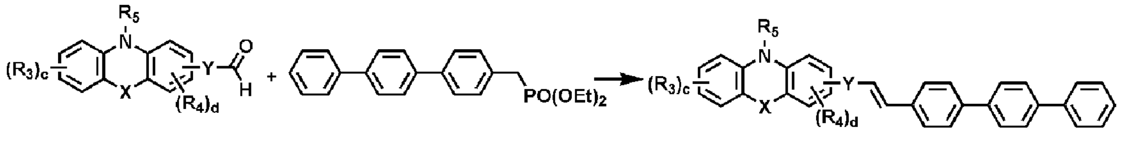
[69] [Scheme 3]

[70]



[71] [Scheme 4]

[72]



[73] Wherein

[74] R_1 through R_5, X, Y, a, b, c and d are the same as defined in Chemical Formulas 1 and 2.

[75] 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 or 2.

[76] The organic layer comprises an electroluminescent layer, which includes one or more hosts with one or more organic electroluminescent compounds of Chemical Formula 1 or 2 as a dopant.

[77] The host 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 3 or 4.

[78] [Chemical Formula 3]

[79] $(Ar_1)_e\text{-}L_1\text{-}(Ar_2)_f$

[80] [Chemical Formula 4]

[81] $(Ar_3)_g\text{-}L_2\text{-}(Ar_4)_h$

[82] wherein

[83] L_1 represents (C6-C60)arylene or (C4-C60)heteroarylene;

[84] L_2 represents anthracenylene;

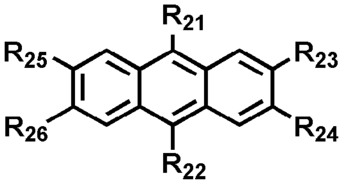
[85] Ar_1 through Ar_4 are independently selected from hydrogen, deuterium, (C1-C60)alkyl, (C1-C60)alkoxy, halogen, (C4-C60)heteroaryl, (C5-C60)cycloalkyl and (C6-C60)aryl, and the cycloalkyl, aryl or heteroaryl of Ar_1 through Ar_4 may be further substituted by one or more substituent(s) selected from the group consisting of (C6-C60)aryl or (C4-C60)heteroaryl with or without one or more substituent(s) selected from (C1-C60)alkyl substituted or unsubstituted by halogen, (C1-C60)alkoxy, (C3-C60)cycloalkyl, halogen, cyano, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl and tri(C6-C60)arylsilyl; (C1-C60)alkyl substituted or unsubstituted by halogen, (C1-C60)alkoxy, (C3-C60)cycloalkyl, halogen, cyano, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl and tri(C6-C60)arylsilyl; and

[86] e, f, g and h independently represent an integer from 0 to 4.

[87] The host of the Chemical Formulas 3 and 4 may be exemplified as Compounds of Chemical Formulas 5 to 7.

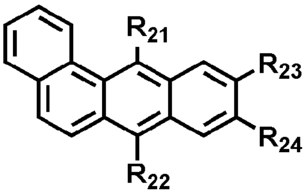
[88] [Chemical Formula 5]

[89]



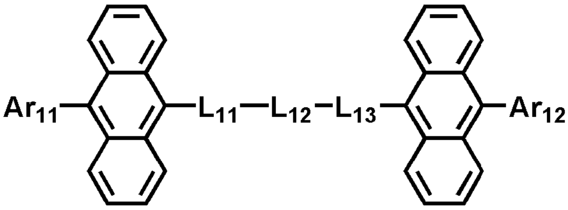
[90] [Chemical Formula 6]

[91]



[92] [Chemical Formula 7]

[93]



[94] wherein

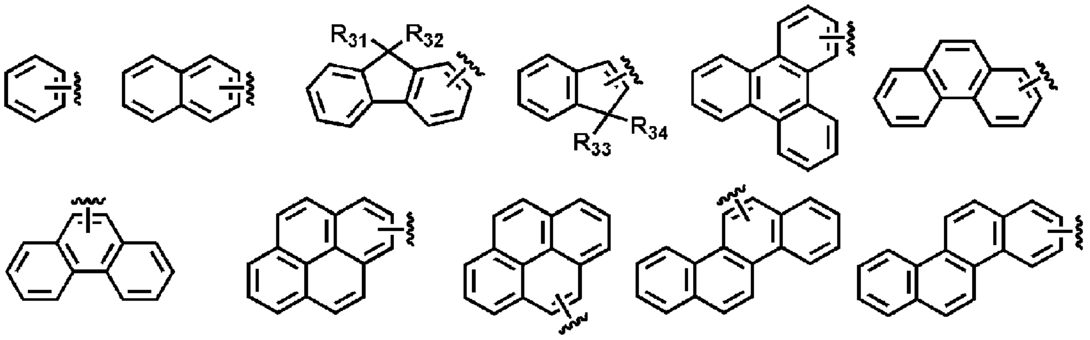
[95] R_{21} and R_{22} independently represent hydrogen, deuterium, (C1-C60)alkyl, halogen, (C6-C60)aryl, (C4-C60)heteroaryl, 5- or 6-membered heterocycloalkyl containing one or more heteroatom(s) selected from N, O and S, or (C3-C60)cycloalkyl, and the aryl or heteroaryl of R_{21} and R_{22} may be further substituted by one or more substituent(s) selected from the group consisting of (C1-C60)alkyl, halo(C1-C60)alkyl, (C1-C60)alkoxy, (C3-C60)cycloalkyl, (C6-C60)aryl, (C4-C60)heteroaryl, halogen, cyano, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl and tri(C6-C60)arylsilyl;

[96] R_{23} through R_{26} independently represent hydrogen, deuterium, (C1-C60)alkyl, (C1-C60)alkoxy, halogen, (C4-C60)heteroaryl, (C5-C60)cycloalkyl or (C6-C60)aryl, and the heteroaryl, cycloalkyl or aryl of R_{103} through R_{106} may be further substituted by one or more substituent(s) selected from the group consisting of (C1-C60)alkyl substituted or unsubstituted by halogen, (C1-C60)alkoxy, (C3-C60)cycloalkyl, halogen, cyano, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl and tri(C6-C60)arylsilyl;

[97] L_{11} and L_{13} independently represent a chemical bond or (C6-C60)arylene with or without one or more substituent(s) selected from (C1-C60)alkyl, (C1-C60)alkoxy, (C6-C60)aryl, (C4-C60)heteroaryl and halogen;

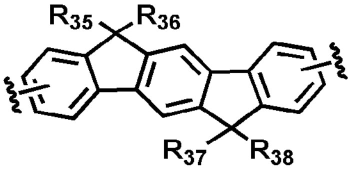
[98] Ar_{11} and Ar_{12} independently represent aryl selected from the following structures or (C4-C60)heteroaryl;

[99]



[100] wherein

[101] the aryl or heteroaryl of Ar_{11} and Ar_{12} may be further substituted by one or more substituent(s) selected from (C1-C60)alkyl, (C1-C60)alkoxy, (C6-C60)aryl and (C4-C60)heteroaryl;

[102] L_{12} represents (C6-C60)arylene, (C4-C60)heteroarylene or , and the arylene or heteroarylene of L_{12} may be further substituted by one or more substituent(s) selected from (C1-C60)alkyl, (C1-C60)alkoxy, (C6-C60)aryl, (C4-C60)heteroaryl and halogen;

[103] R_{31} through R_{34} independently represent hydrogen, deuterium, (C1-C60)alkyl or (C6-C60)aryl, or they may be linked with an adjacent substituent via (C3-C60)alkylene or (C3-C60)alkenylene with or without a fused ring to form an aliphatic ring or a mono- or polycyclic aromatic ring; and

[104] R_{35} through R_{38} independently represent hydrogen, deuterium, (C1-C60)alkyl, (C1-C60)alkoxy, (C6-C60)aryl, (C4-C60)heteroaryl or halogen, or they may be linked with an adjacent substituent via (C3-C60)alkylene or (C3-C60)alkenylene with or without a fused ring to form an aliphatic ring or a mono- or polycyclic aromatic ring.

[105] The electroluminescent layer means the layer where electroluminescence occurs, and it may be a single layer or a multi-layer that two or more layers are laminated. When a mixture of host-dopant is used according to the constitution of the present invention, noticeable improvement in luminous efficiency by the electroluminescent host may be confirmed.

[106] The doping concentration may be 0.5 to 10 wt%. When compared with existing other host materials, the electroluminescent host according to the present invention provides excellent conductivity for holes and electrons, as well as very superior stability and remarkably improved luminescence efficiency and operation life.

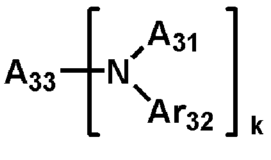
[107] Accordingly, when the compound represented by Chemical Formulas 3 to 7 is selected as an electroluminescent host, it may considerably compensate for the

electrical disadvantage of the organic electroluminescent compound represented by Chemical Formula 1 or 2 according to the present invention.

[108] The organic electroluminescent device may comprise organic electroluminescent compound of Chemical Formula 1 or 2 and may comprise one or more compounds selected from the group consisting of arylamine or styrylamine compounds. Examples of arylamine or styrylamine compounds include the compounds of following Chemical Formula 8 but are not limited thereto.

[109] [Chemical Formula 8]

[110]

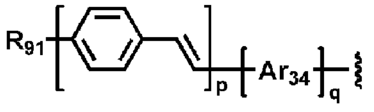


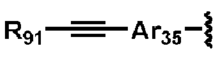
[111] Wherein

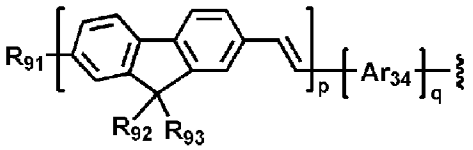
[112] Ar_{31} and Ar_{32} independently represent C1-C60)alkyl, (C6-C60)aryl, (C4-C60)heteroaryl, (C6-C60)arylamino, (C1-C60)alkylamino, 5- to 6-membered heterocycloalkyl containing one or more selected from N, O and S or (C3-C60)cycloalkyl, and Ar_{31} and Ar_{32} are linked to an adjacent substituent via (C3-C60)alkylene or (C3-C60)alkenylene with or without a fused ring to form an aliphatic ring or a mono- or polycyclic aromatic ring;

[113] when k is 1, Ar_{33} represents (C6-C60)aryl or (C4-C60)heteroaryl or substituents having following structures;

[114]

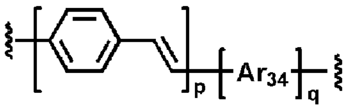


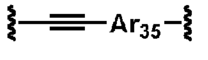


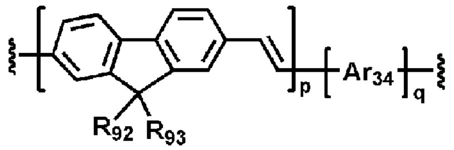


[115] when k is 2, Ar_{33} represents (C6-C60)arylene, (C4-C60)heteroarylene or substituents having following structures;

[116]







[117] Ar_{34} and Ar_{35} independently represent (C6-C60)arylene or (C4-C60)heteroarylene;

[118] R_{91} through R_{93} independently represent hydrogen, (C1-C60)alkyl or (C6-C60)aryl;

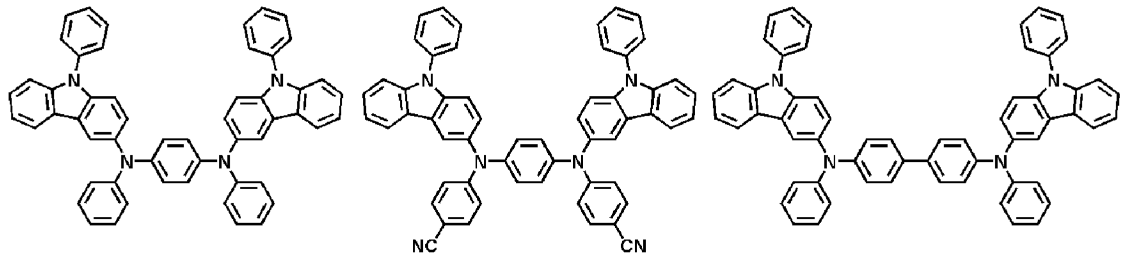
[119] p represents an integer of 1 to 4, and q represents an integer of 0 or 1,

[120] alkyl, aryl, heteroaryl, arylamino, alkylamino, cycloalkyl or heterocycloalkyl of the Ar_{31} and Ar_{32}, or aryl, heteroaryl, arylene or heteroarylene of the Ar_{33}, or arylene and heteroarylene of the Ar_{34} and Ar_{35}, or alkyl or aryl of R_{191} through R_{193} may be further substituted by one or more substituent(s) selected from the group consisting of halogen, (C1-C60)alkyl, (C6-C60)aryl, (C4-C60)heteroaryl, 5- to 6-membered hetero-

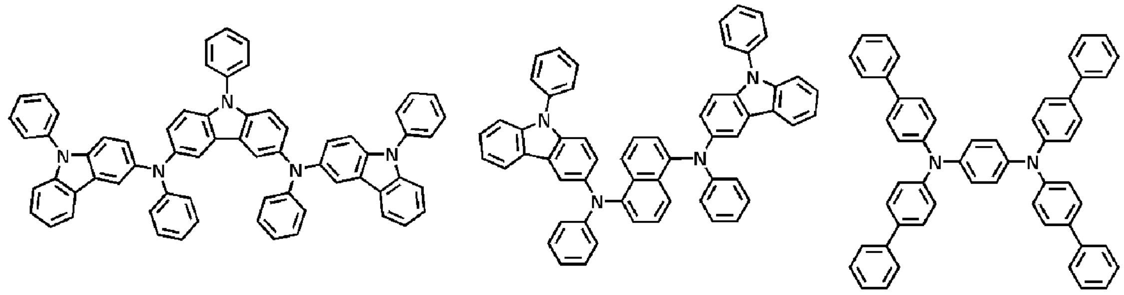
cycloalkyl containing one or more selected from N, O and S, (C3-C60)cycloalkyl, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl, tri(C6-C60)arylsilyl, adamantyl, (C7-C60)bicycloalkyl, (C2-C60)alkenyl, (C2-C60)alkynyl, cyano, (C1-C60)alkylamino, (C6-C60)arylamino, (C6-C60)ar(C1-C60)alkyl, (C6-C60)aryloxy, (C1-C60)alkyloxy, (C6-C60)arylthio, (C1-C60)alkylthio, (C1-C60)alkoxycarbonyl, (C1-C60)alkylcarbonyl, (C6-C60)arylcarbonyl, carboxyl, nitro, and hydroxyl.

[121] More specifically, the arylamine Compound or styrylarylamine Compound may be exemplified as following Compounds, but is not limited to the following Compounds.

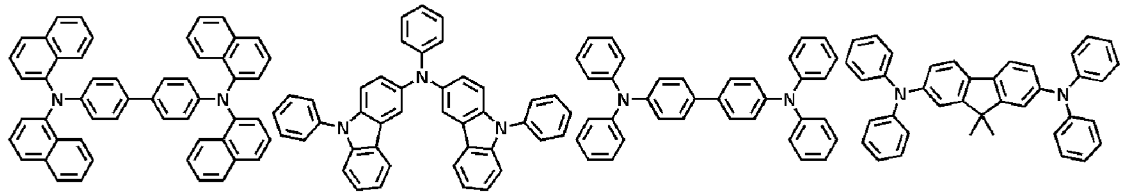
[122]



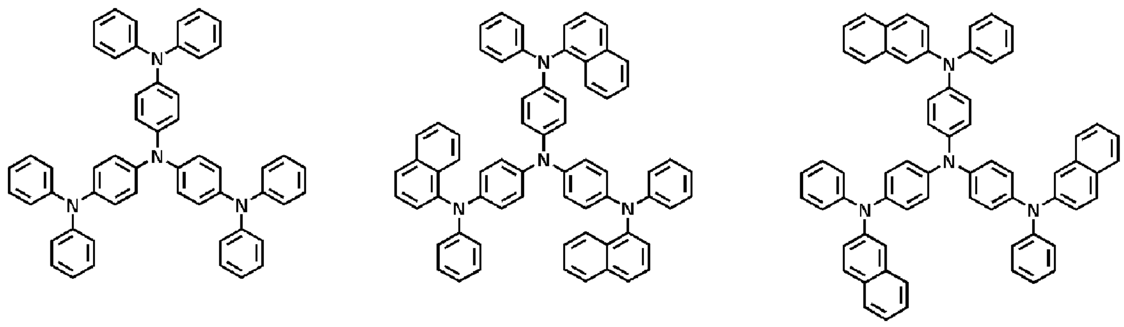
[123]



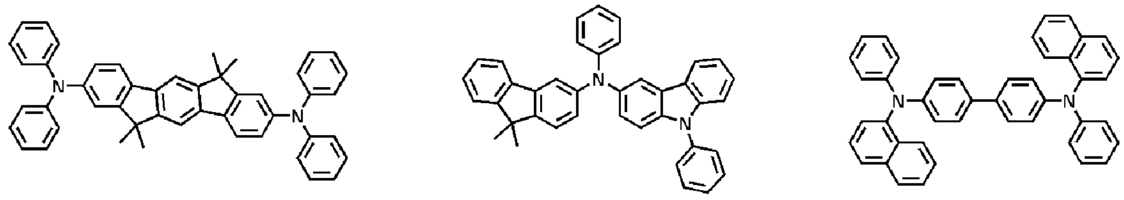
[124]



[125]

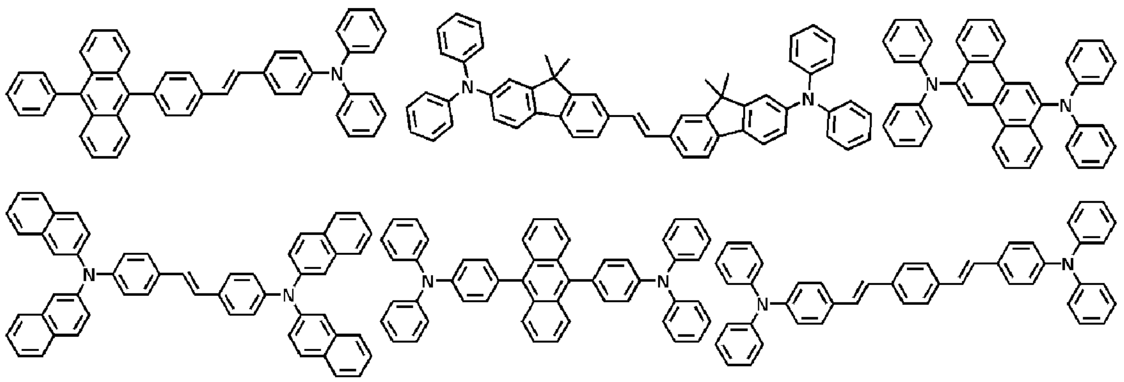


[126]



[127]

[128]



[129]

[130] In the organic electroluminescent device, the organic layer may further comprise one or more metal(s) selected from the group consisting of Group 1, Group 2, 4th period and 5th transition metals, lanthanide metals and d-transition metals besides the organic electroluminescent compound of Chemical Formula 1 or 2. The organic layer may comprise an electroluminescent layer and a charge generating layer.

[131] The present invention realizes an organic electroluminescent device having a pixel structure of independent light-emitting mode, which comprises an organic electroluminescent device containing the organic electroluminescent compound of Chemical Formula 1 or 2 as a sub-pixel and one or more sub-pixel(s) comprising one or more metal compound(s) selected from the group consisting of Ir, Pt, Pd, Rh, Re, Os, Tl, Pb, Bi, In, Sn, Sb, Te, Au and Ag, patterned in parallel at the same time.

[132] Also, the organic layer may form 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 at the same time.

[133] 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. 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.

[134] 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.

Advantageous Effects of Invention

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

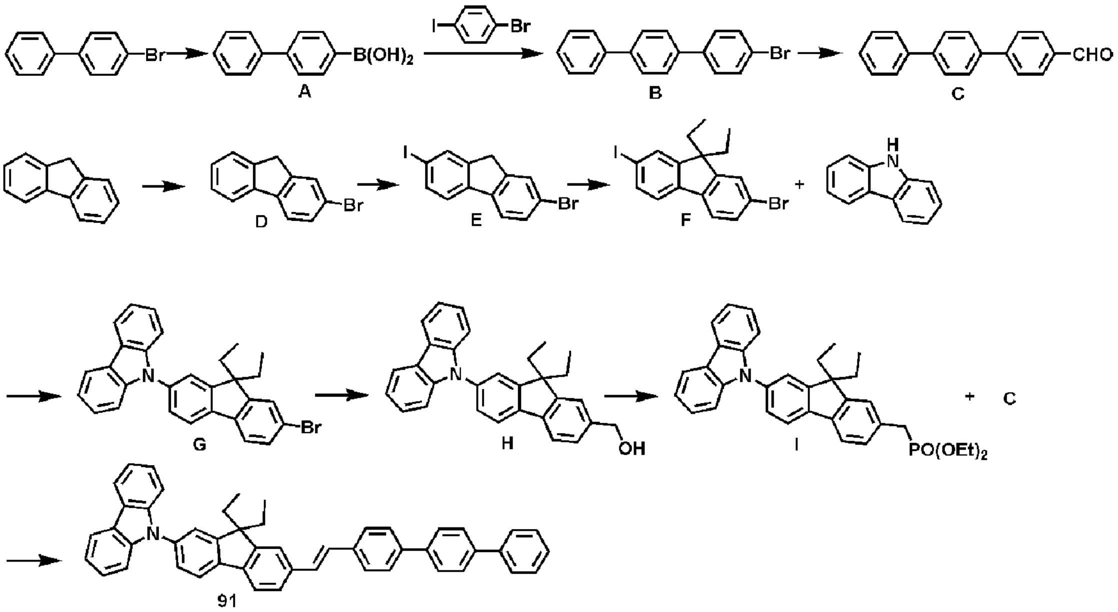
Mode for the Invention

[136] 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.

[137]

[138] [Preparation Example 1] Preparation of Compound **91**

[139]



[140] **Preparation of Compound A**

[141] 4-bromobiphenyl (30g, 0.12mol) was added to a one-neck flask and an argon atmosphere was established in a vacuum. Tetrahydrofuran (THF) (500ml) was added and the mixture was stirred at -78℃ for 10 minutes. After adding n-BuLi(2.5M in hexane)

(77ml, 0.19mol), the mixture was stirred for 1 hour and 30 minutes at -78℃. Then, trimethyl borate (21.9ml, 0.19mol) was added at -78℃. After stirring the mixture for 30 minutes at -78℃, the mixture was stirred at room temperature for 4 hours. After the reaction was completed, extraction was performed using distilled water and ethyl acetate (EA). The organic layer was dried with $MgSO_4$ and the solvent was removed using a rotary evaporator. Pure Compound **A** (21g, 84%) was separated by column chromatography using hexane and EA as an eluent.

[142] **Preparation of Compound B**

[143] 1-bromo-4-iodobenzene (29g, 0.10mol), Compound **A** (21g, 0.10mol) and tetrakis(triphenylphosphine)Palladium (5.9g, 5.1mmol) were added to a two-neck(two-neck) flask. After stirring the mixture while adding toluene, 2M K_2CO_3 (265ml, 0.5mol) and ethanol (265ml) were added. After refluxing at 100℃ for 5 hours, the mixture was cooled to room temperature when the reaction was completed. Then, after extracting with distilled water and EA, the organic layer was dried with $MgSO_4$ and the solvent was removed using a rotary evaporator. Pure Compound B (23g, 74%) was separated by column chromatography using hexane and EA as an eluent.

[144] **Preparation of Compound C**

[145] Compound **B** (2g, 0.074mol) was added to the one-neck flask and a nitrogen atmosphere was established. After adding THF, the mixture was stirred at -78℃ for 10 minutes. After adding n-butyllithium(2.5M in hexane) (44.6ml, 0.11mol) dropwise, the mixture was stirred for 1 hour at -78℃. Then, after adding DMF (8.1ml, 0.11mmol) and stirring for 10 minutes, the mixture was stirred at room temperature for 4 hours. After the reaction was completed, HCl (2.5 mL) was added and extraction was performed at room temperature using distilled water and EA. The organic layer was dried with $MgSO_4$ and the solvent was removed using a rotary evaporator. Pure Compound **C** (19g, 89%) was separated by column chromatography using hexane and EA as an eluent.

[146] **Preparation of Compound D**

[147] 9H-fluorene (60g, 0.36mol) was added to the one-neck flask and an argon atmosphere was established in a vacuum. Propylene carbonate (500ml) was added and stirred at 60℃ until 9H-fluorene was dissolved. NBS (64g, 0.36mol) was added and the mixture was stirred at 60℃ for 1 hour. Upon completion of the reaction, a solid produced by filtration with distilled water was dissolved with EA and the mixture was extracted with distilled water. The organic layer was dried with $MgSO_4$ and the solvent was removed using a rotary evaporator. Pure Compound **D** (64g, 73%) was obtained by recrystallization using ethanol.

[148] **Preparation of Compound E**

[149] Compound **D** (40g, 0.16mol), iodine (16.9g, 0.066mol), iodic acid (6.89g, 0.039mol)

were added to the two-neck flask. distilled water (30ml), acetic acid (600mL), and sulfuric acid (14.4mL) were added and the mixture was stirred at 85°C for 4 hours. Upon completion of the reaction, the mixture was completely cooled to room temperature and washed with acetic acid and distilled water. Pure Compound **E** (49g, 82%) was obtained by filtration.

[150] **Preparation of Compound F**

[151] Compound **E** (49g, 0.13mol), KOH (33g, 0.60mol), and KI (2.2g, 0.013mol) were added to the one-neck flask, an argon atmosphere was established in a vacuum. DMSO(anhydrous) (500ml) was added and the mixture was stirred at 0°C for 10 minutes. After adding bromoethane (23mL, 0.30mol) dropwise, the mixture was stirred at -10°C for 30 minutes and then stirred at room temperature for 9 hours. Upon completion of the reaction, a solid produced by adding excess distilled water was filtered and the filtered solid was extracted with methylene chloride (MC). The organic layer was dried with $MgSO_4$ and the solvent was removed using a rotary evaporator. Pure Compound **F** (37g, 66%) was separated by column chromatography using hexane as an eluent.

[152] **Preparation of Compound G**

[153] After Compound **F** (30g, 0.07mol), carbazole (15.2g, 0.09mol), cupper (2.5g, 0.03mol), 18-crown-6 (1.4g, 0.005mol), and K_2CO_3 (38.8g, 0.28mol) were added to the two-neck flask, an argon atmosphere was established in a vacuum. 1,2-dichlorobenzene (250ml) was added and the mixture was stirred under reflux at 180°C for 6 hours. Upon completion of the reaction, cupper was removed by using celite filter and the reaction mixture was dissolved with MC. After removing a solvent, Pure Compound **G** (23g, 76%) was separated by column chromatography using dichloromethane and hexane as an eluent.

[154] **Preparation of Compound H**

[155] Compound **G** (20g, 0.042mol) was added to the one-neck flask and a nitrogen atmosphere was established. After adding THF, the mixture was stirred at -78°C for 10 minutes. After adding n-butyllithium(2.5M in hexane) (40ml, 0.063mol) dropwise, the mixture was stirred at -78°C for 1 hour. DMF (4.8ml, 0.063mmol) was added and the mixture was stirred for 10 minutes and then stirred at room temperature for 4 hours. Upon completion of the reaction, HCl (2.5mL) wad added and cooled to room temperature. The reaction mixture was extracted with distilled water and EA. The organic layer was dried with $MgSO_4$ and the solvent was removed using a rotary evaporator. Pure Compound **H** (13g, 72%) was separated by column chromatography using hexane and EA as an eluent.

[156] **Preparation of Compound I**

[157] Compound **H** (13g, 0.031mol) and triethylphosphite (10mL, 0.062mol) were added

to the one-neck flask. After iodine (7.9g, 0.031mol) was added at 0°C, the mixture was stirred for 30 minutes and then stirred at room temperature for 12 hours. After the reaction was completed, phosphite was removed using a vacuum sublimator and extraction was performed using distilled water and EA. The organic layer was dried with $MgSO_4$ and the solvent was removed using a rotary evaporator. Pure Compound **I** (16g, 87%) was separated by column chromatography using hexane and EA as an eluent.

[158] **Preparation of Compound 91**

[159] After Compound **I** (16g, 0.029mol) and Compound **C** (7.6g, 0.029mol) were added to the one-neck flask, an argon atmosphere was established in a vacuum. After adding THF (600mL), the mixture was stirred at 0°C for 10 minutes and potassium tert-butoxide (35.7mL, 0.035mol) was slowly added thereto. After stirring the mixture at 0°C for 10 minutes, the mixture was further stirred at room temperature for 3 hours and extracted with distilled water and EA. The organic layer was dried with $MgSO_4$ and the solvent was removed using a rotary evaporator. Pure Compound Compound **91** (17g, 89%) was separated by column chromatography using hexane and EA as an eluent.

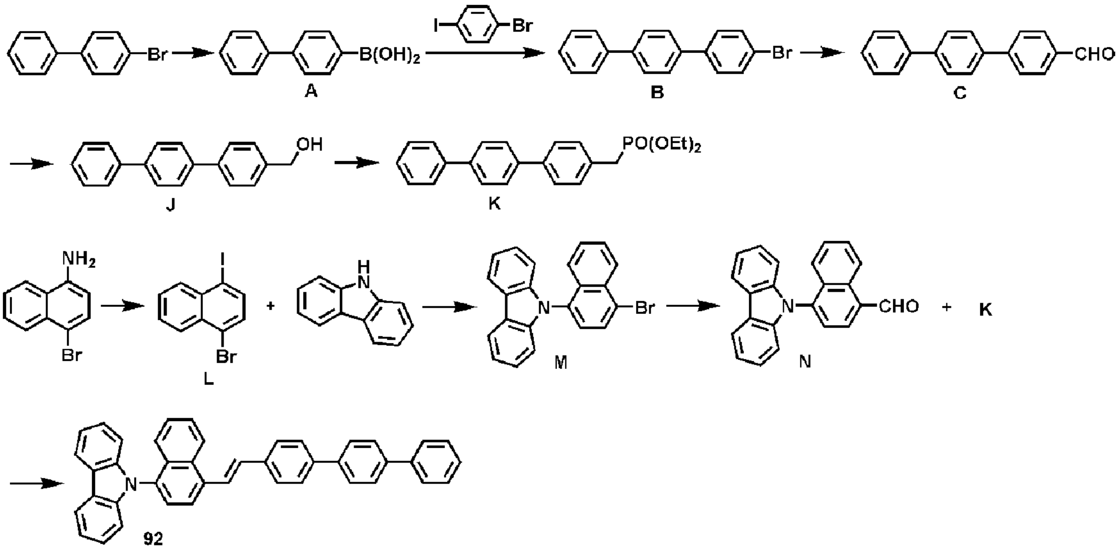
[160] ^{1}H NMR($CDCl_3$, 200 MHz): δ = 0.9(6H, m), 1.91(4H, m), 6.95(2H, m), 7.17(1H, m), 7.25~7.34(9H, m), 7.41(1H, m), 7.5~7.56(8H, m), 7.63~7.64(3H, m), 7.87(2H, m), 7.94(1H, m), 8.12(1H, m), 8.55(1H, m).

[161] MS/FAB: 641.84(found), 641.34(calculated)

[162]

[163] [Preparation Example 2] Preparation of Compound **92**

[164]



[165] **Preparation of Compound A**

[166] 4-bromobiphenyl (30g, 0.12mol) was added to the one-neck flask and an argon atmosphere was established in a vacuum. After adding THF (500 mL) and stirring at 78°C for 10 minutes, n-BuLi(2.5M in hexane) (77ml, 0.19mol) was added dropwise.

The mixture was stirred at -78°C for 1 hour and 30 minutes and trimethyl borate (21.9ml, 0.19mol) was added at -78°C. The mixture was stirred at -78°C for 30 minutes and then stirred at room temperature for 4 hours. Upon completion of the reaction, the mixture was extracted with distilled water and EA. The organic layer was dried with $MgSO_4$ and the solvent was removed using a rotary evaporator. Pure Compound **A** (21g, 84%) was separated by column chromatography using hexane and EA as an eluent.

[167] **Preparation of Compound B**

[168] 1-bromo-4-iodobenzene (29g, 0.10mol), Compound **A** (21g, 0.10mol) and tetrakis(triphenylphosphine)Palladium (5.9g, 5.1mmol) were added to the two-neck flask. The mixture was stirred while adding toluene. After adding 2M K_2CO_3 (265ml, 0.5mol) and ethanol (265ml), the mixture was stirred under reflux at 100°C for 5 hours. Upon completion of the reaction, the mixture was cooled to room temperature and extracted with distilled water and EA. The organic layer was dried with $MgSO_4$ and the solvent was removed using a rotary evaporator. Pure Compound **B** (23g, 74%) was separated by column chromatography using hexane and EA as an eluent.

[169] **Preparation of Compound C**

[170] Compound **B** (2g, 0.074mol) was added to the one-neck flask and a nitrogen atmosphere was established. After adding THF, the mixture was stirred at constant temperature of -78°C for 10 minutes. After adding n-butyllithium(2.5M in hexane) (44.6ml, 0.11mol) dropwise, the mixture was stirred at -78°C for 1 hour. After adding DMF (8.1ml, 0.11mmol) thereto, the mixture was stirred for 10 minutes and then stirred at room temperature for 4 hours. After the reaction was completed, HCl (2.5mL) was added. The mixture was cooled to room temperature and extracted with distilled water and EA. The organic layer was dried with $MgSO_4$ and the solvent was removed using a rotary evaporator. Pure Compound **C** (19g, 89%) was separated by column chromatography using hexane and EA as an eluent.

[171] **Preparation of Compound J**

[172] Compound **C** (20g, 0.077mol) was added to the one-neck flask and a nitrogen atmosphere was established. After adding ethanol (300ml), the mixture was stirred at constant temperature of 0°C for 10 minutes. After adding sodium borohydride (3.2g, 0.085mol), the mixture was stirred at room temperature for 6 hours. After the reaction was completed, HCl (5mL) was added and the mixture was extracted with distilled water and EA. The organic layer was dried with $MgSO_4$ and the solvent was removed using a rotary evaporator. Pure Compound **J** (17.4g, 86%) was separated by column chromatography using hexane and EA as an eluent.

[173] **Preparation of Compound K**

[174] Compound **J** (15g, 0.057mol) and triethylphosphite (19.4mL, 0.12mol) were added

to the one-neck flask. After adding iodine (14.5g, 0.057mol) at 0℃, the mixture was stirred for 30 minutes and then stirred at room temperature for 12 hours. After the reaction was completed, phosphite was removed using a vacuum sublimator and extraction was performed using distilled water and EA. The organic layer was dried with $MgSO_4$ and the solvent was removed using a rotary evaporator. Pure Compound **K** (16g, 72%) was separated by column chromatography using hexane and EA as an eluent.

[175] **Preparation of Compound L**

[176] 1-amino-4-bromonaphthalene (60g, 0.27mol) was added to the one-neck flask and an argon atmosphere was established in a vacuum. After adding acetonitrile (500ml), the mixture was stirred at 0℃ until 1-amino-4-bromonaphthalene is dissolved. t-Butylnitrite (42g, 48ml, 0.41mol), and copper bromide (73g, 0.32mol) was stirred at room temperature for 3 hours. Upon completion of the reaction, 1N HCl aqueous solution (600ml) was added and stirred. After filtering a produced solid, the obtained solid was washed with distilled water and ether. Pure Compound **L** (76g, 85%) was obtained by column.

[177] **Preparation of Compound M**

[178] Compound **L** (40g, 0.12mol), carbazole (24.1g, 0.14mol), cupper (3.3g, 0.05mol), 18-crown-6 (2.3g, 0.009mol), and K_2CO_3 (66.3g, 0.48mol) were added to the two-neck flask and an argon atmosphere was established in a vacuum. 1,2-dichlorobenzene (250ml) was added and the mixture was stirred under reflux at 180℃ for 6 hours. Upon completion of the reaction, cupper was removed by using Celite filter and the reaction mixture was dissolved with MC. After removing a solvent, Pure Compound **M** (36g, (81%) was separated by column chromatography using dichloromethane and hexane as an eluent.

[179] **Preparation of Compound N**

[180] Compound **M** (20g, 0.054mol) was added to the one-neck flask and a nitrogen atmosphere was established. After adding THF, the mixture was stirred at -78℃ for 10 minutes. After adding n-butyllithium(2.5M in hexane) (32ml, 0.081mol) dropwise, the mixture was stirred at -78℃ for 1 hour. After adding DMF (6.3ml, 0.081mmol), the mixture was stirred for 10 minutes and then stirred at room temperature for 4 hours. Upon completion of the reaction, HCl (3mL) was added. The mixture was cooled to room temperature and extracted with distilled water and EA. The organic layer was dried with $MgSO_4$ and the solvent was removed using a rotary evaporator. Pure Compound **N** (12.4g, 71%) was separated by column chromatography using hexane and EA as an eluent.

[181] **Preparation of Compound 92**

[182] Compound **K** (10g, 0.026mol) and Compound **N** (8.4g, 0.026mol) were added to the

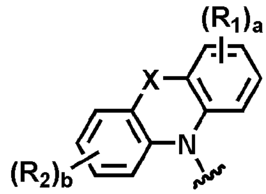
one-neck flask and an argon atmosphere was established in a vacuum. After adding THF (600 mL) and stirring at 0℃ for 10 minutes, potassium tert-butoxide (1.0M in THF) (31 mL, 0.031mol) was slowly added. After stirring the mixture at 0℃ for 10 minutes, the mixture was further stirred at room temperature for 3 hours and extracted with distilled water and EA. The organic layer was dried with $MgSO_4$ and the solvent was removed using a rotary evaporator. Pure Compound **92** (12g, 84%) was separated by column chromatography using hexane and EA as an eluent.

[183] ^1H NMR($CDCl_3$, 200 MHz): δ = 6.95(2H, m), 7.25~7.33(7H, m), 7.41(1H, m), 7.5~7.55(13H, m), 7.9~7.94(3H, m), 8.08~8.12(2H, m), 8.55(1H, m).

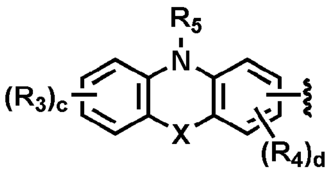
[184] MS/FAB: 547.69(found), 547.23(calculated).

[185]

[186] Compounds **1** to **90** 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 Table 1. In Table 1 below, "L" represents



or



.

[187] Table 1

[Table 1]

Compd.	L	Y	^{1}H NMR(CDCl$_3$, 200 MHz)	MS/FAB	
				found	calculated
1	**TL1**	**TAR1**	δ = 6.95(2H, m), 7.25~7.33(7H, m), 7.41(1H, m), 7.5~7.56(9H, m), 7.62~7.64(5H, m), 7.94(1H, m), 8.12(1H, m), 8.55(1H, m)	497.6	497.2
2	**TL1**	**TAR6**	δ = 6.95(2H, m), 7.25~7.33(7H, m), 7.41(1H, m), 7.5~7.56(9H, m), 7.63~7.68(7H, m), 7.79(2H, m), 7.94(1H, m), 8.12(1H, m), 8.55(1H, m)	573.7	573.2
3	**TL1**	**TAR11**	δ = 6.95(2H, m), 7.25~7.41(12H, m), 7.5~7.56(11H, m), 7.63~7.66(4H, m), 7.91~7.96(9H, m), 8.08~8.12(2H, m), 8.55(3H, m)	850.1	849.3
4	**TL1**	**TAR16**	δ = 6.95(2H, m), 7.25~7.41(13H, m), 7.5~7.56(8H, m), 7.63~7.64(3H, m), 7.9~7.94(5H, m), 8.12(1H, m), 8.55(1H, m)	671.8	671.3
5	**TL1**	**TAR20**	δ = 6.95(2H, m), 7.25~7.33(7H, m), 7.41(1H, m), 7.5~7.56(7H, m), 7.63~7.64(3H, m), 7.7~7.71(4H, m), 7.8(1H, m), 7.9~8(3H, m), 8.1~8.12(2H, m), 8.55(1H, m)	621.8	621.2
6	**TL1**	**THA1**	δ = 6.95(2H, m), 7.25~7.33(7H, m), 7.41~7.52(8H, m), 7.59~7.63(3H, m), 7.77(1H, m), 7.9~7.94(2H, m), 8.12(1H, m), 8.36(1H, m), 8.55(1H, m)	498.6	498.2
7	**TL1**	**THA10**	δ = 6.95~6.99(2H, m), 7.25~7.35(9H, m), 7.41~7.52(8H, m), 7.59~7.63(3H, m), 7.94(1H, m), 8.12(1H, m), 8.55(1H, m)	503.7	503.2
8	**TL1**	**THA7**	δ = 6.95(2H, m), 7.25~7.33(8H, m), 7.41(1H, m), 7.5~7.56(7H, m), 7.63~7.64(3H, m), 7.83(1H, m), 7.94(1H, m), 8.12(1H, m), 8.55(1H, m), 8.7(2H, m)	549.7	549.2

9	**TL1**	**TY2**	δ = 6.95(2H, m), 7.25~7.33(7H, m), 7.41(1H, m), 7.5~7.56(9H, m), 7.63~7.79(11H, m), 7.94(1H, m), 8.12(1H, m), 8.55(1H, m)	655.8	655.2
10	**TL1**	**THA26**	δ = 6.54(1H, m), 6.82(1H, m), 6.95~6.99(2H, m), 7.07(4H, m), 7.25~7.33(7H, m), 7.41~7.52(8H, m), 7.59~7.63(3H, m), 7.94(1H, m), 8.12(1H, m), 8.55(1H, m)	619.7	619.2
11	**TL1**	**TY7**	δ = 6.95(2H, m), 7.25(7H, s), 7.25~7.33(2H, m), 7.41(1H, m), 7.5~7.56(9H, m), 7.63~7.68(5H, m), 7.79(4H, m), 7.94(1H, m), 8.12(1H, m), 8.55(1H, m)	711.9	711.2
12	**TL1**	**THA21**	δ = 6.95~6.99(2H, m), 7.25(5H, m), 7.26(2H, s), 7.29~7.33(2H, m), 7.41~7.52(8H, m), 7.59~7.63(3H, m), 7.94(1H, m), 8.12(1H, m), 8.55(1H, m)	579.6	579.2
13	**TL1**	**TF5**	δ = 1.48(6H, m), 2.02(4H, m), 6.95(2H, m), 7.17(1H, m), 7.25~7.34(9H, m), 7.41(1H, m), 7.5~7.56(8H, m), 7.63~7.64(3H, m), 7.87(2H, m), 7.94(1H, m), 8.12(1H, m), 8.55(1H, m)	653.9	653.3
14	**TL1**	**TF17**	δ = 2.26(6H, s), 5(1H, s), 6.95(2H, m), 7.17(1H, m), 7.25~7.34(9H, m), 7.41(1H, m), 7.5~7.56(8H, m), 7.63~7.64(3H, m), 7.87(2H, m), 7.94(1H, m), 8.12(1H, m), 8.55(1H, m)	628.8	628.3
15	**TL1**	**TF10**	δ = 3.2(3H, s), 3.81(2H, s), 6.41(1H, m), 6.49(1H, m), 6.56(1H, m), 6.95~7.03(5H, m), 7.25~7.33(7H, m), 7.41(1H, m), 7.5~7.56(7H, m), 7.63~7.64(3H, m), 7.94(1H, m), 8.12(1H, m), 8.55(1H, m)	614.8	614.3
16	**TL1**	**TF15**	δ = 3.2(3H, s), 6.61(1H, m), 6.86(1H, m), 6.94~6.99(4H, m), 7.25~7.34(13H, m), 7.41(1H, m), 7.5~7.52(5H, m), 7.63(1H, m),	600.7	600.3

			7.94(1H, m), 8.12(1H, m), 8.55(1H, m)		
17	**TL2**	**TAR4**	δ = 3.81(2H, s), 6.51(2H, m), 6.69(2H, m), 6.95~7.01(6H, m), 7.25(4H, m), 7.38~7.41(5H, m), 7.51~7.56(6H, m), 7.64(2H, m), 7.88~7.9(4H, m)	611.8	611.3
18	**TL2**	**TAR9**	δ = 3.81(2H, s), 6.51(2H, m), 6.69(2H, m), 6.95~7.01(6H, m), 7.25(4H, m), 7.38~7.41(9H, m), 7.51~7.56(6H, m), 7.64(2H, m), 7.88~7.91(8H, m)	788.0	787.3
19	**TL4**	**TAR14**	δ = 6.59(2H, m), 6.77(2H, m), 6.89(2H, m), 6.91(1H, s), 6.92~6.95(4H, m), 7.25(4H, m), 7.41(1H, m), 7.51~7.56(6H, m), 7.64(2H, m), 7.82~7.88(4H, m), 8.12(2H, m), 8.93(2H, m), 9.09(1H, s)	663.8	663.3
20	**TL4**	**TAR18**	δ = 6.59(2H, m), 6.77(2H, m), 6.89~6.95(7H, m), 7.25(4H, m), 7.41(1H, m), 7.51~7.56(6H, m), 7.64(2H, m), 7.82~7.88(2H, m), 7.98(1H, m), 8.12(2H, m), 8.93(1H, m), 9.09(1H, m)	613.7	613.2
21	**TL5**	**THA29**	δ = 6.95~6.97(4H, m), 7.12~7.25(11H, m), 7.41~7.44(3H, m), 7.51~7.52(4H, m), 7.59(2H, m), 7.72(1H, m), 7.83(1H, m), 8.25(1H, m), 8.5(1H, m), 8.97(1H, m)	631.8	631.2
22	**TL5**	**THA4**	δ = 6.95~6.99(4H, m), 7.16~7.25(10H, m), 7.41~7.44(3H, m), 7.51~7.52(4H, m), 7.59(2H, m), 8.25(1H, s)	532.7	532.2
23	**TL6**	**THA13**	δ = 2.88(4H, m), 6.58(2H, m), 6.76(2H, m), 6.95~7.04(6H, m), 7.25(4H, m), 7.41~7.44(3H, m), 7.51~7.52(4H, m), 7.59(2H, m)	533.7	533.2
24	**TL6**	**THA18**	δ = 2.88(4H, m), 6.58(2H, m), 6.73~6.76(3H, m), 6.95(2H, m), 7.02~7.04(4H, m), 7.11(1H, m), 7.25(4H, m), 7.41(1H, m), 7.51~7.56(6H, m), 7.64(2H, m), 9.23(1H, s)	582.8	582.2
25	**TL6**	**THA2**	δ = 2.88(4H, m), 6.3(1H, m), 6.58(2H, m),	696.0	695.2

		5	6.76(2H, m), 6.95~7.04(6H, m), 7.25~7.28(5H, m), 7.35(1H, m), 7.41~7.44(3H, m), 7.51~7.52(4H, m), 7.59(2H, m), 7.73(3H, m)		
26	**TL7**	**TY4**	δ = 6.63(2H, m), 6.69(2H, m), 6.81(2H, m), 6.95~7.05(6H, m), 7.25(6H, m), 7.41(1H, m), 7.51~7.56(10H, m), 7.64(2H, m), 7.79(2H, m)	667.8	667.3
27	**TL7**	**TF1**	δ = 6.58~6.63(3H, m), 6.75~6.81(3H, m), 6.95~7.05(6H, m), 7.11(4H, m), 7.25~7.26(8H, m), 7.33(4H, m), 7.41(1H, m), 7.51~7.56(7H, m), 7.62~7.64(3H, m), 7.71(1H, m), 7.87(1H, m)	764.0	763.3
28	**TL7**	**TF6**	δ = 1.51(4H, m), 2.09(4H, m), 6.58~6.63(3H, m), 6.75~6.81(3H, m), 6.95~7.05(6H, m), 7.25(6H, m), 7.41(1H, m), 7.51~7.56(7H, m), 7.62~7.64(3H, m), 7.71(1H, m), 7.87(1H, m)	665.9	665.3
29	**TL7**	**TF18**	δ = 5(1H, s), 6.58~6.63(3H, m), 6.75~6.81(5H, m), 6.95~7.05(6H, m), 7.23~7.25(10H, m), 7.33(4H, m), 7.41(1H, m), 7.51~7.56(7H, m), 7.62~7.64(3H, m), 7.71(1H, m), 7.87(1H, m)	779.0	778.3
30	**TL7**	**TF11**	δ = 3.2(3H, s), 5.7(1H, m), 5.91(1H, m), 6.49(1H, m), 6.63~6.67(3H, m), 6.81(2H, m), 6.92~7.05(7H, m), 7.13(1H, m), 7.25(6H, m), 7.41(1H, m), 7.51~7.56(6H, m), 7.64(2H, m)	642.8	642.3
31	**TL8**	**THA27**	δ = 6.59(1H, s), 6.69(2H, m), 6.81~6.87(4H, m), 7.14(5H, s), 7.16(2H, m), 7.25(4H, m), 7.41~7.59(13H, m), 7.85(2H, m)	884.7	887.0
32	**TL8**	**TY5**	δ = 6.69(4H, m), 6.87(2H, m), 6.95(2H, m), 7.16(2H, m), 7.25(4H, m), 7.41~7.56(13H, m), 7.64(2H, m), 7.76~7.85(6H, m)	733.9	733.3
33	**TL8**	**TF2**	δ = 6.58(1H, m), 6.69~6.75(3H, m),	812.0	811.3

			6.87(2H, m), 6.95(2H, m), 7.16~7.25(10H, m), 7.35(2H, m), 7.41~7.56(12H, m), 7.62~7.64(3H, m), 7.71~7.75(3H, m), 7.85~7.87(3H, m)		
34	**TL8**	**TF7**	δ = 3.49(4H, s), 6.58(1H, m), 6.69~6.75(3H, m), 6.87(2H, m), 6.95(2H, m), 7.16~7.25(10H, m), 7.41~7.56(12H, m), 7.62~7.64(3H, m), 7.71(1H, m), 7.85~7.87(3H, m)	764.0	763.3
35	**TL8**	**TF13**	δ = 3.2(3H, m), 5.88(1H, m), 6.47(1H, m), 6.69(2H, m), 6.87~6.97(5H, m), 7.16~7.25(11H, m), 7.41~7.54(9H, m), 7.85(2H, m)	682.9	682.2
36	**TL8**	**TF16**	δ = 3.2(3H, m), 5.8(1H, m), 6.01(1H, m), 6.57(1H, m), 6.69(2H, m), 6.87~6.92(3H, m), 7.16(2H, m), 7.25(8H, m), 7.32(1H, m), 7.41~7.54(11H, m), 7.63(1H, m), 7.85(4H, m)	726.9	726.3
37	**TL9**	**TAR7**	δ = 3.82(3H, s), 6.95(2H, m), 7.25(12H, m), 7.41~7.42(3H, m), 7.51~7.64(14H, m), 7.79(1H, m), 8.17~8.18(2H, m)	663.85	663.29
38	**TL9**	**TAR17**	δ = 3.82(3H, s), 6.95(2H, m), 7.25(4H, m), 7.41~7.42(3H, m), 7.51~7.64(10H, m), 7.71(2H, m), 7.79(1H, m), 7.98~8.04(2H, m), 8.12~8.18(4H, m), 9.09(1H, m), 9.15(1H, m)	611.77	611.26
39	**TL9**	**THA2**	δ = 3.82(3H, s), 7.2~7.25(5H, m), 7.41(1H, m), 7.42~7.51(14H, m), 7.79~7.83(2H, m), 8.17~8.18(2H, m), 8.85(1H, m)	512.64	512.23
40	**TL9**	**THA15**	δ = 3.82(3H, s), 6.95~6.99(2H, m), 7.25(4H, m), 7.41~7.44(5H, m), 7.51~7.52(4H, m), 7.59~7.62(4H, m), 7.79(1H, m), 8.17~8.18(2H, m), 8.63(2H, m)	569.72	569.19
41	**TL9**	**THA25**	δ = 3.82(3H, s), 6.95~6.99(2H, m), 7.25(4H, m), 7.35(1H, m), 7.41~7.44(5H,	681.93	681.16

			m), 7.51~7.52(4H, m), 7.59~7.62(4H, m), 7.73~7.79(6H, m), 8.17~8.18(2H, m)		
42	**TL9**	**TF1**	δ = 3.82(3H, s), 6.95(2H, m), 7.11(4H, m), 7.25~7.26(6H, m), 7.33(4H, m), 7.41~7.42(3H, m), 7.51~7.56(12H, m), 7.71~7.79(3H, m), 7.87~7.93(2H, m), 8.17~8.18(2H, m)	751.95	751.32
43	**TL9**	**TF18**	δ = 3.82(3H, s), 5(1H, s), 6.77(2H, m), 6.95(2H, m), 7.23~7.25(8H, m), 7.33(4H, m), 7.41~7.42(3H, m), 7.51~7.56(12H, m), 7.71~7.79(3H, m), 7.87~7.93(2H, m), 8.17~8.18(2H, m)	766.97	766.33
44	**TL9**	**TF16**	δ = 3.2(3H, s), 3.82(3H, s), 6.57~6.59(2H, m), 6.88~6.95(4H, m), 7.25(4H, m), 7.41(1H, m), 7.42(2H, m), 7.47(2H, m), 7.51~7.57(12H, m), 7.79~7.85(3H, m), 8.17~8.18(2H, m)	690.87	690.30
45	**TL10**	**TAR10**	δ = 1.72(6H, s), 3.2(3H, s), 6.52(1H, m), 6.69(2H, m), 6.78(1H, m), 6.95(2H, m), 7.05~7.14(3H, m), 7.25(8H, m), 7.39~7.41(5H, m), 7.51~7.56(8H, m), 7.64(4H, m), 7.91(4H, m)	806.04	805.37
46	**TL10**	**TAR19**	δ = 1.72(6H, s), 3.2(3H, s), 6.52(1H, m), 6.69(2H, m), 6.78(1H, m), 6.95(2H, m), 7.05~7.14(3H, m), 7.25(4H, m), 7.41(1H, m), 7.51~7.56(6H, m), 7.64(2H, m), 7.71(2H, m), 7.82~7.88(3H, m), 8.04(1H, m), 8.12(1H, m), 8.18(1H, m)	677.87	677.31
47	**TL10**	**THA9**	δ = 1.72(6H, s), 3.2(3H, s), 6.52(1H, m), 6.69(1H, m), 6.78~6.82(2H, m), 6.95~7.14(7H, m), 7.25(4H, m), 7.41~7.44(3H, m), 7.51~7.52(4H, m), 7.59(2H, m)	543.70	543.26
48	**TL10**	**TY1**	δ = 1.72(6H, s), 3.2(3H, s), 6.52(1H, m), 6.69(2H, m), 6.78(1H, m), 6.95(2H, m), 7.05~7.14(5H, m), 7.25(6H, m), 7.41(1H,	695.89	695.32

			m), 7.51~7.56(8H, m), 7.64(2H, m), 7.85(2H, m), 7.95(2H, m)		
49	**TL10**	**THA28**	δ = 0.14(6H, s), 1.72(6H, s), 3.2(3H, s), 6.52(1H, m), 6.69(1H, m), 6.78(1H, m), 6.95~7.03(3H, m), 7.04(2H, s), 7.05~7.14(4H, m), 7.25(4H, m), 7.35(2H, m), 7.41~7.44(3H, m), 7.51~7.52(4H, m), 7.59(2H, m), 7.89(1H, m)	750.10	749.26
50	**TL10**	**TF4**	δ = 1.72(6H, s), 3.2(3H, s), 6.52(1H, m), 6.69(2H, m), 6.78~6.81(3H, m), 6.95(2H, m), 7.05~7.14(3H, m), 7.25(4H, m), 7.41(1H, m), 7.48~7.56(9H, m), 7.63~7.64(3H, m), 7.71~7.77(2H, m), 7.87~7.93(2H, m), 8.51(2H, m)	793.99	793.35
51	**TL10**	**TF9**	δ = 0.66(6H, s), 1.72(6H, s), 3.2(3H, s), 6.52(1H, m), 6.69(2H, m), 6.78(1H, m), 6.95(2H, m), 7.05~7.14(3H, m), 7.25(4H, m), 7.35(1H, m), 7.41(1H, m), 7.51~7.56(6H, m), 7.64~7.66(3H, m), 7.76(1H, m), 7.82(1H, m), 7.89(1H, m), 7.95(1H, m)	685.97	685.32
52	**TL12**	**TAR3**	δ = 3.2(3H, s), 6.56(1H, m), 6.73(1H, m), 6.82(1H, m), 6.92~6.98(5H, m), 7.07(1H, m), 7.25(4H, m), 7.41(1H, m), 7.51~7.64(10H, m), 7.73(1H, m), 7.8(1H, m), 7.92~7.95(2H, m)	577.71	577.24
53	**TL12**	**TAR13**	δ = 3.2(3H, s), 6.56(1H, m), 6.73(1H, m), 6.82(1H, m), 6.92~6.98(5H, m), 7.07(1H, m), 7.25(4H, m), 7.41(1H, m), 7.51~7.56(6H, m), 7.64(2H, m), 7.82~7.88(2H, m), 7.98~8.04(2H, m), 8.12(2H, m), 8.18(1H, m), 8.93(1H, m), 9.09(1H, m), 9.15(1H, m)	677.83	677.27
54	**TL12**	**THA6**	δ = 3.2(3H, s), 6.56(1H, m), 6.73(1H, m), 6.82(1H, m), 6.92~6.98(5H, m), 7.07(1H, m), 7.25(4H, m), 7.41~7.44(3H, m),	578.70	578.24

			7.51~7.52(4H, m), 7.59(2H, m), 8.03(1H, m), 8.12(1H, m), 8.27(1H, m), 8.5(1H, m), 8.97(1H, m)		
55	**TL12**	**THA12**	δ = 3.2(3H, s), 6.56(1H, m), 6.73(1H, m), 6.82(1H, m), 6.92~6.99(5H, m), 7.25(4H, m), 7.41~7.44(4H, m), 7.51~7.52(4H, m), 7.59(2H, m)	519.59	519.19
56	**TL12**	**THA22**	δ = 3.2(3H, s), 6.56(1H, m), 6.73(1H, m), 6.82(1H, m), 6.92~6.99(5H, m), 7.07(1H, m), 7.25(4H, m), 7.35(1H, m), 7.41~7.44(3H, m), 7.51~7.52(4H, m), 7.59(2H, m), 7.73(3H, m)	615.81	615.17
57	**TL12**	**TY5**	δ = 3.2(3H, s), 6.56(1H, m), 6.73(1H, m), 6.82(1H, m), 6.92~6.98(5H, m), 7.07(1H, m), 7.25(6H, m), 7.41(1H, m), 7.51~7.56(8H, m), 7.64(2H, m), 7.79~7.85(4H, m)	687.85	687.23
58	**TL12**	**TF7**	δ = 3.2(3H, s), 3.49(4H, s), 6.56(1H, m), 6.73(1H, m), 6.82(1H, m), 6.92~6.98(5H, m), 7.07(1H, m), 7.2~7.25(8H, m), 7.41(1H, m), 7.51~7.56(7H, m), 7.63~7.64(3H, m), 7.71~7.77(2H, m), 7.87~7.93(2H, m)	717.89	717.30
59	**TL12**	**TF12**	δ = 3.2(6H, s), 6.53~6.56(2H, m), 6.73(1H, m), 6.82~6.98(8H, m), 7.07~7.11(2H, m), 7.22~7.28(6H, m), 7.41(1H, m), 7.51~7.56(6H, m), 7.64(2H, m)	709.73	710.18
60	**TL13**	**TAR6**	δ = 3.2(3H, s), 6.9~6.97(5H, m), 7.16~7.25(12H, m), 7.41(1H, m), 7.51~7.56(8H, m), 7.64(4H, m)	619.82	619.23
61	**TL13**	**TAR16**	δ = 3.2(3H, s), 6.9~6.97(5H, m), 7.16~7.25(8H, m), 7.39~7.41(5H, m), 7.51~7.64(10H, m), 7.91~7.97(4H, m)	717.92	717.25
62	**TL13**	**THA1**	δ = 3.2(3H, s), 6.95~6.97(3H, m), 7.16~7.25(8H, m), 7.41~7.52(10H, m), 7.59(2H, m), 7.97(1H, m), 8.33(1H, m)	544.71	544.20
63	**TL13**	**THA7**	δ = 3.2(3H, s), 6.9~6.97(5H, m),	595.75	595.21

			7.16~7.25(8H, m), 7.41(1H, m), 7.51~7.56(6H, m), 7.64(2H, m), 7.9(2H, m), 8.74(2H, m)		
64	**TL13**	**THA26**	δ = 3.2(3H, s), 6.82(1H, m), 6.9~6.99(5H, m), 7.07(5H, m), 7.16~7.25(8H, m), 7.41~7.44(3H, m), 7.51~7.52(4H, m), 7.59(2H, m)	665.80	665.20
65	**TL13**	**THA21**	δ = 3.2(3H, s), 6.9~6.99(5H, m), 7.16~7.25(8H, m), 7.26(2H, s), 7.41~7.44(3H, m), 7.51~7.52(4H, m), 7.59(2H, m)	625.74	625.18
66	**TL13**	**TF17**	δ = 2.26(6H, s), 3.2(3H, s), 5(1H, s), 6.9~6.97(5H, m), 7.16~7.25(8H, m), 7.41(1H, m), 7.51~7.56(7H, m), 7.63~7.64(3H, m), 7.71~7.77(2H, m), 7.87~7.93(2H, m)	674.89	674.28
67	**TL13**	**TF15**	δ = 3.2(6H, s), 6.53(1H, m), 6.82~6.99(10H, m), 7.16~7.34(10H, m), 7.41(1H, m), 7.51~7.56(6H, m), 7.64(2H, m)	672.88	672.26
68	**TL14**	**TAR9**	δ = 2.88(4H, m), 3.2(3H, s), 6.55(1H, m), 6.72(2H, m), 6.81(1H, m), 6.95(2H, m), 7.05~7.13(3H, m), 7.25(4H, m), 7.39~7.41(9H, m), 7.51~7.56(6H, m), 7.64(2H, m), 7.91(8H, m)	816.04	815.36
69	**TL14**	**TAR18**	δ = 2.88(4H, m), 3.2(3H, s), 6.55(1H, m), 6.72(2H, m), 6.81(1H, m), 6.95(2H, m), 7.05~7.13(3H, m), 7.25(4H, m), 7.41(1H, m), 7.51~7.56(6H, m), 7.64(2H, m), 7.82~7.98(4H, m), 8.12(2H, m), 8.93(1H, m), 9.09(1H, m)	639.82	639.29
70	**TL14**	**THA4**	δ = 2.88(4H, m), 3.2(3H, s), 6.55(1H, m), 6.72(1H, m), 6.81(1H, m), 6.95~7.13(5H, m), 7.25(4H, m), 7.41~7.44(3H, m), 7.51~7.52(4H, m), 7.59(2H, m), 7.91(1H, m), 8.7(1H, s)	542.67	542.25

71	**TL14**	**THA18**	δ = 2.88(4H, m), 3.2(3H, s), 6.55(1H, m), 6.72(2H, m), 6.81(1H, m), 6.95(2H, m), 7.05~7.13(3H, m), 7.25(4H, m), 7.41~7.42(2H, m), 7.51~7.56(6H, m), 7.64(2H, m), 7.77(1H, m), 9.23(1H, s)	596.78	596.23
72	**TL14**	**THA19**	δ = 2.88(4H, m), 3.2(3H, s), 6.55(1H, m), 6.72(1H, m), 6.81(1H, m), 6.95~7.13(6H, m), 7.25(5H, s), 7.25(0H, m), 7.41~7.44(3H, m), 7.47(1H, s), 7.51~7.52(4H, m), 7.59(2H, m)	601.82	601.19
73	**TL14**	**TF3**	δ = 1.4(8H, m), 1.48(12H, m), 2.19(2H, m), 2.88(4H, m), 3.2(3H, s), 6.55(1H, m), 6.72(2H, m), 6.81(1H, m), 6.95(2H, m), 7.05~7.13(3H, m), 7.25(4H, m), 7.41(1H, m), 7.51~7.56(7H, m), 7.63~7.64(3H, m), 7.71~7.77(2H, m), 7.87~7.93(2H, m)	792.10	791.45
74	**TL14**	**TF19**	δ = 0.21(9H, s), 2.88(4H, m), 3.2(3H, s), 3.9(1H, s), 6.55(1H, m), 6.72(2H, m), 6.81(1H, m), 6.95(2H, m), 7.05~7.13(3H, m), 7.25(4H, m), 7.41(1H, m), 7.51~7.56(7H, m), 7.63~7.64(3H, m), 7.71~7.77(2H, m), 7.87~7.93(2H, m)	700.00	699.33
75	**TL15**	**TAR2**	δ = 3.2(3H, s), 6.6(1H, m), 6.77(1H, m), 6.86(1H, m), 6.95~6.99(5H, m), 7.08(1H, m), 7.25~7.34(6H, m), 7.41(1H, m), 7.51~7.56(8H, m), 7.64(2H, m), 7.93~7.96(3H, m), 8.55(1H, m)	587.75	587.26
76	**TL15**	**TAR12**	δ = 3.2(3H, s), 6.6(1H, m), 6.77(1H, m), 6.86(1H, m), 6.95~6.99(5H, m), 7.08(1H, m), 7.19~7.34(7H, m), 7.41(1H, m), 7.48~7.64(11H, m), 7.74~7.79(2H, m), 7.9(2H, m)	661.83	661.28
77	**TL15**	**THA5**	δ = 3.2(3H, s), 6.6(1H, m), 6.77(1H, m), 6.86(1H, m), 6.95~6.99(5H, m), 7.08(1H, m), 7.25~7.34(6H, m), 7.41(1H, m), 7.51~7.66(10H, m), 8.21(1H, m), 8.38(1H,	588.74	588.26

			m), 8.83(1H, m)		
78	**TL15**	**THA11**	δ = 3.2(3H, s), 6.41(1H, m), 6.6(1H, m), 6.7(1H, m), 6.77~6.85(3H, m), 6.99(2H, m), 7.08(1H, m), 7.14(1H, s), 7.23~7.28(6H, m), 7.41~7.44(3H, m), 7.48(1H, s), 7.51~7.52(4H, m), 7.59(2H, m)	590.61	591.15
79	**TL15**	**TY3**	δ = 3.2(3H, s), 6.6(1H, m), 6.77(1H, m), 6.86(1H, m), 6.95~6.99(5H, m), 7.08(1H, m), 7.25~7.45(13H, m), 7.48(2H, s), 7.51~7.64(10H, m)	742.81	743.21
80	**TL15**	**TY4**	δ = 3.2(3H, s), 6.6(1H, m), 6.77(1H, m), 6.86(1H, m), 6.95~6.99(5H, m), 7.08(1H, m), 7.25~7.34(8H, m), 7.41(1H, m), 7.51~7.56(8H, m), 7.64(2H, m), 7.79~7.85(4H, m)	681.82	681.28
81	**TL15**	**TF6**	δ = 1.51(4H, m), 2.09(4H, m), 3.2(3H, s), 6.6(1H, m), 6.77(1H, m), 6.86(1H, m), 6.95~6.99(5H, m), 7.08(1H, m), 7.25~7.34(6H, m), 7.41(1H, m), 7.51~7.56(7H, m), 7.63~7.64(3H, m), 7.71~7.77(2H, m), 7.87~7.93(2H, m)	679.89	679.32
82	**TL15**	**TF11**	δ = 3.2(6H, s), 6.49(1H, m), 6.6(1H, m), 6.77~6.92(10H, m), 7.07~7.13(3H, m), 7.25~7.34(6H, m), 7.41(1H, m), 7.51~7.56(6H, m), 7.64(2H, m)	656.81	656.28
83	**TL16**	**TAR5**	δ = 3.2(3H, s), 6.57(1H, m), 6.66(1H, m), 6.83(1H, m), 6.92~6.95(3H, m), 7.19~7.25(5H, m), 7.41(1H, m), 7.47(2H, m), 7.51~7.56(12H, m), 7.85(2H, m), 7.91~7.97(2H, m), 8.07(1H, m), 8.13(1H, m), 8.31(2H, m)	687.87	687.29
84	**TL16**	**TAR15**	δ = 3.2(3H, s), 6.57(1H, m), 6.66(1H, m), 6.83(1H, m), 6.92~6.95(3H, m), 7.19~7.25(5H, m), 7.41~7.52(13H, m), 7.71(2H, m), 7.85~7.88(3H, m), 8.04(1H, m), 8.1(1H, m), 8.28(1H, m), 8.34(1H, m),	737.93	737.31

			8.93(2H, m), 8.99(1H, m)		
85	**TL16**	**THA8**	δ = 3.2(3H, s), 6.57(1H, m), 6.66(1H, m), 6.83(1H, m), 6.92(1H, m), 7.19~7.25(6H, m), 7.37(1H, m), 7.41(1H, m), 7.44(2H, m), 7.47~7.56(12H, m), 7.85~7.9(3H, m), 8.24(1H, m), 8.38(1H, m), 8.83(1H, m)	689.84	689.28
86	**TL16**	**THA14**	δ = 3.2(3H, s), 5.67(1H, m), 6.66(1H, m), 6.79~6.83(2H, m), 7.06(1H, m), 7.19~7.25(6H, m), 7.41~7.51(13H, m), 7.85(2H, m)	642.65	643.15
87	**TL16**	**THA24**	δ = 3.2(3H, s), 6.47(1H, m), 6.66(1H, m), 6.76~6.85(4H, m), 7.14(3H, s), 7.19~7.25(5H, m), 7.41~7.47(5H, m), 7.48(1H, s), 7.51~7.59(8H, m), 7.85(2H, m)	769.69	771.09
88	**TL16**	**THA20**	δ = 3.2(3H, s), 6.66(1H, m), 6.83(1H, m), 6.92~6.99(3H, m), 7.17~7.25(6H, m), 7.26(2H, s), 7.41~7.51(13H, m), 7.85(2H, m)	669.77	669.24
89	**TL16**	**TF8-1**	δ = 3.2(3H, s), 3.82(3H, s), 6.57(1H, m), 6.66(1H, m), 6.83(1H, m), 6.92~6.95(3H, m), 7.17~7.25(6H, m), 7.33(1H, m), 7.41(1H, m), 7.47~7.56(13H, m), 7.79~7.85(3H, m), 8.05(1H, m), 8.18(1H, m)	690.87	690.30
90	**TL16**	**TF14**	δ = 2.88(4H, m), 3.2(6H, s), 6.48(1H, m), 6.57(1H, m), 6.66~6.72(2H, m), 6.81~6.83(2H, m), 6.92~6.95(3H, m), 7.07~7.13(3H, m), 7.19~7.25(5H, m), 7.41~7.52(13H, m), 7.85(2H, m)	718.92	718.33

[188] [Examples 1-11] Manufacture of OLED device using the organic electroluminescent compound according to the present invention

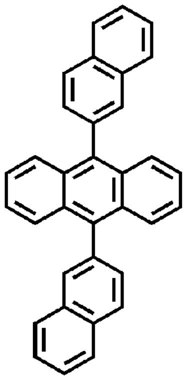
[189] An OLED device was manufactured using the electroluminescent material according to the present invention. First, a transparent electrode ITO thin film (15Ω/□) obtained from a glass for OLED (produced by Samsung Corning) was subjected to ultrasonic washing with trichloroethylene, acetone, ethanol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

stored in isopropanol before use. 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.

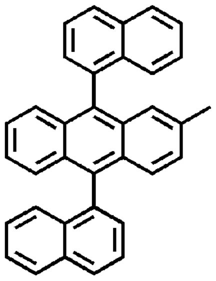
[190] Then, *N*,*N'*-bis(α-naphthyl)-*N*,*N'*-diphenyl-4,4'-diamine (NPB) was placed in another cell of the vacuum vapor deposition apparatus, and electric current was applied to the cell to evaporate NPB, thereby forming a hole transport layer having a thickness of 20 nm on the hole injection layer.

[191] After forming the hole injection layer and the hole transport layer, an electroluminescent layer was formed thereon as follows. DNA (Examples 1 to 4), H-36(Examples 8 to 11) or H-38(Examples 5 to 7) was placed in a cell of the vacuum vapor deposition apparatus as host, and the organic electroluminescent compound according to the present invention was placed in another cell as a dopant. The two materials were vapor-deposited at a rate of 100:1 to form an electroluminescent layer having a thickness of 30 nm on the hole transport layer.

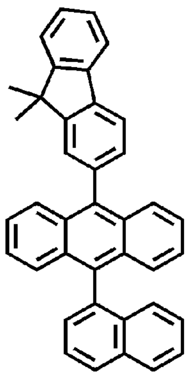
[192]



DNA



H-36



H-38

[193] Then, 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) 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.

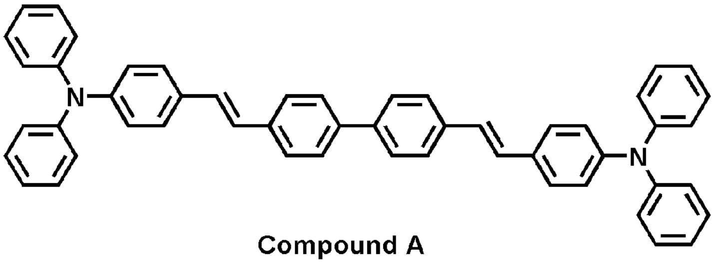
[194] Each compound used in the OLED had been purified by vacuum sublimation at 10^{-6} torr.

[195]

[196] [Comparative Example 1] Manufacture of OLED device using existing electroluminescent material

[197] After forming a hole injection layer and a hole transport layer in the same manner as Example 1, blue-emitting DNA was placed in another cell of the vacuum vapor deposition apparatus as host, and Compound **A** was placed in still another cell. The two materials were vapor-deposited at a rate of 100:1 to form an electroluminescent layer having a thickness of 30 nm on the hole transport layer.

[198]



Compound A

[199] Then, after forming an electron transport layer and an electron injection layer in the same manner as Example 1, an Al cathode was vapor-deposited with a thickness of 150 nm using another vacuum vapor deposition apparatus to manufacture an OLED.

[200] Luminescence efficiency of the OLED devices manufactured in Examples 1 to 11 and Comparative Example 1 was measured at 1,000 cd/m^2. The result is given in Table 2.

[201] Table 2

[Table 2]

No.		EL material 1	EL material 2		Luminescence efficiency (cd/A)	Color
			L	Y		
Example	1	DNA	TL1	THA1	2.2	Deep blue
	2	DNA	TL1	TF8	1.9	Deep blue
	3	DNA	TL1	TAR6	2.5	Deep blue
	4	DNA	TL8	TF6	4.0	Deep blue
	5	H-38	TL1	THA10	5.0	blue
	6	H-38	TL5	THA9	4.5	blue
	7	H-38	TL8	TF8-1	3.5	blue
	8	H-36	TL1	THA2	2.6	Deep blue
	9	H-36	TL1	TF1	3.1	Deep blue
	10	H-36	TL5	THA10	4.7	blue
	11	H-36	TL8	TF11	5.1	blue
Comp. Ex. 1		DNA	Compound A		9	jade green

[202] As seen from Table 2, the organic electroluminescent compounds of the present

invention provide pure blue color as compared to the existing electroluminescent compound. That, when a blue color having the level of about CIE y = 0.1 is required for realizing the color close to the NTSC standard in the organic electroluminescent display, the organic electroluminescent compounds of the present invention may be useful. As described, the organic electroluminescent compound of the present invention is used as a blue-emitting material having the high purity.

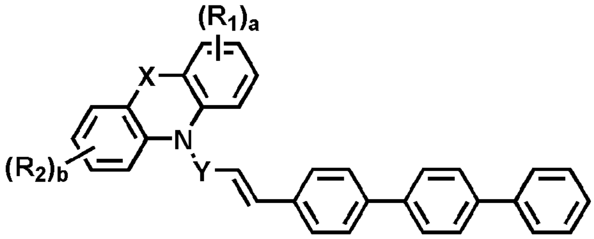
Industrial Applicability

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

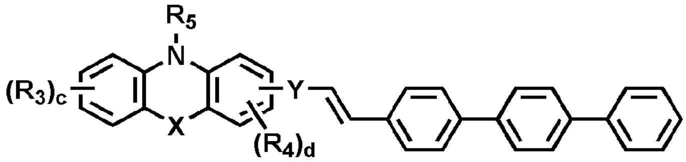
Claims

[Claim 1] An organic electroluminescent compound represented by Chemical Formula 1 or 2:

[Chemical Formula 1]



[Chemical Formula 2]

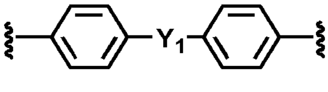
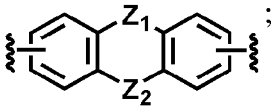


wherein

R_1 through R_5 independently represent hydrogen, (C1-C60)alkyl, (C3-C60)cycloalkyl, (C6-C60)aryl, (C2-60)heteroaryl containing one or more heteroatom(s) selected from N, O, S, P, Si and Se, (C1-60)alkoxy, (C1-C60)alkylthio, (C6-60)aryloxy, (C6-C60)arylthio, (C6-30)aryl(C1-C30)alkylamino, tri(C1-C30)alkylsilyl, di(C1-C30)alkyl(C6-C30)arylsilyl or tri(C6-C30)arylsilyl;

X represents a chemical bond, $-(CR_6R_7)_m-$, $-N(R_8)-$, $-Si(R_9)(R_{10})-$, -O-, -S-, -Se- or $-(CR_{11})C=C(R_{12})-$;

R_6 through R_{12} independently represent hydrogen, (C1-C60)alkyl, (C3-C60)cycloalkyl, (C6-C60)aryl, (C2-60)heteroaryl containing one or more heteroatom(s) selected from N, O, S, Si and Se, (C1-60)alkoxy, (C1-C60)alkylthio, (C6-60)aryloxy, (C6-C60)arylthio, mono- or di(C1-60)alkylamino, mono- or di(C6-60)arylamino, (C6-30)aryl(C1-C30)alkylamino, tri(C1-C30)alkylsilyl, di(C1-C30)alkyl(C6-C30)arylsilyl or tri(C6-C30)arylsilyl, or R_6 and R_7, R_9 and R_{10}, and R_{11} and R_{12} are linked via (C3-C60)alkylene or (C3-C60)alkenylene with or without a fused ring to form an aliphatic ring or a mono- or polycyclic aromatic ring;

Y represents (C6-C60)arylene, adamantylene, (C3-C60)heteroarylene containing one or more heteroatom(s) selected from N, O, S, P, Si and Se,  or  ;

Y_1 represents (C2-60)heteroarylene containing one or more heteroatom(s) selected from N, O, S, P, Si and Se;

Z_1 and Z_2 independently represent a chemical bond, $-(CR_{13}R_{14})_n-$, $-N(R_{15})-$, $-Si(R_{16})(R_{17})-$, -O-, -S-, -Se- or $-(R_{18})C{=}C(R_{19})-$, provided that Z_1 and Z_2 are not chemical bonds at the same time;

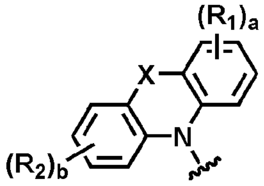
R_{13} through R_{19} independently represent hydrogen, (C1-C60)alkyl, (C3-C60)cycloalkyl, (C6-C60)aryl, (C2-60)heteroaryl containing one or more heteroatom(s) selected from N, O, S, Si and Se, (C1-60)alkoxy, (C1-C60)alkylthio, (C6-60)aryloxy, (C6-C60)arylthio, mono- or di(C1-60)alkylamino, mono- or di(C6-60)arylamino, (C6-30)aryl(C1-C30)alkylamino, tri(C1-C30)alkylsilyl, di(C1-C30)alkyl(C6-C30)arylsilyl or tri(C6-C30)arylsilyl, or R_{13} and R_{14}, R_{16} and R_{17}, and R_{18} and R_{19} are linked via (C3-C60)alkylene or (C3-C60)alkenylene with or without a fused ring to form an aliphatic ring or a mono- or polycyclic aromatic ring;

a, b and c independently represent an integer from 1 to 4;

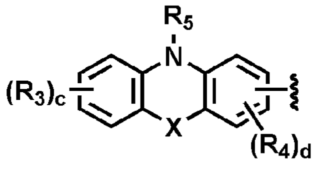
d represents an integer from 1 to 3; and

m and n independently represent an integer from 1 to 4.

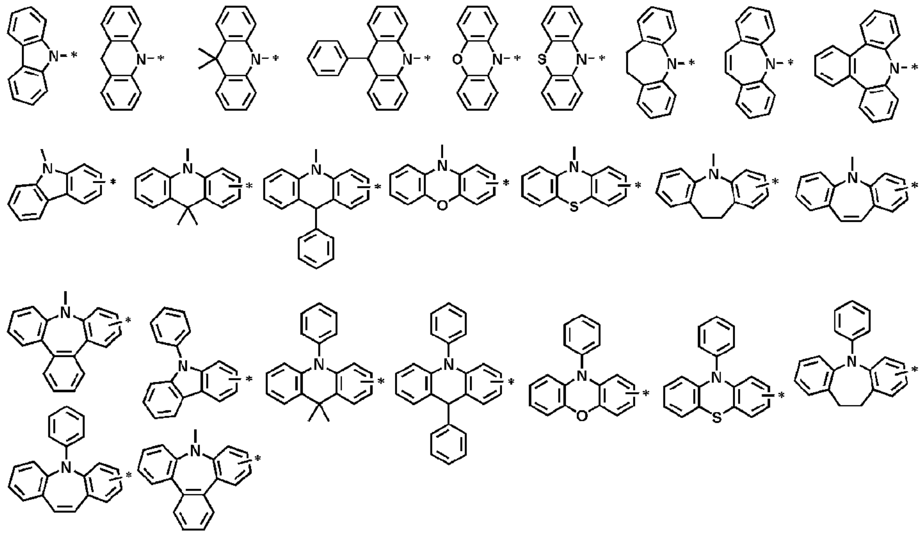
[Claim 2] The organic electroluminescent compound according to claim 1, the



or



is selected from following structures:



[Claim 3] An organic electroluminescent device comprising the organic electroluminescent compound according to any one of claims 1 to 2.

[Claim 4] The organic electroluminescent device according to claim 3, which comprises a first electrode; a second electrode; and at least one organic layer(s) interposed between the first electrode and the second electrode, wherein the organic layer comprises one or more of the organic electroluminescent compound(s) and one or more of host(s) selected from the compounds represented by Chemical Formula 3 or Chemical Formula 4:

[Chemical Formula 3]

$(Ar_1)_e\text{-}L_1\text{-}(Ar_2)_f$

[Chemical Formula 4]

$(Ar_3)_g\text{-}L_2\text{-}(Ar_4)_h$

wherein

L_1 represents (C6-C60)arylene or (C4-C60)heteroarylene;

L_2 represents anthracenylene;

Ar_1 through Ar_4 are independently selected from hydrogen, deuterium, (C1-C60)alkyl, (C1-C60)alkoxy, halogen, (C4-C60)heteroaryl, (C5-C60)cycloalkyl and (C6-C60)aryl, and the cycloalkyl, aryl or heteroaryl of Ar_1 through Ar_4 may be further substituted by one or more substituent(s) selected from the group consisting of (C6-C60)aryl or (C4-C60)heteroaryl with or without one or more substituent(s) selected from (C1-C60)alkyl substituted or unsubstituted by halogen, (C1-C60)alkoxy, (C3-C60)cycloalkyl, halogen, cyano, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl and tri(C6-C60)arylsilyl; (C1-C60)alkyl substituted or unsubstituted by halogen, (C1-C60)alkoxy, (C3-C60)cycloalkyl, halogen, cyano, tri(C1-C60)alkylsilyl, di(C1-C60)alkyl(C6-C60)arylsilyl and tri(C6-C60)arylsilyl; and

e, f, g and h independently represent an integer from 0 to 4.

[Claim 5] The organic electroluminescent device according to claim 4, wherein the organic layer comprises one or more compound(s) selected from the group consisting of arylamine compounds and styrylarylamine compounds.

[Claim 6] The organic electroluminescent device according to claim 4, wherein the organic layer further comprises one or more metal(s) selected from the group consisting of Group 1, Group 2, 4th period and 5th transition metals, lanthanide metals and d-transition metals.

[Claim 7] The organic electroluminescent device according to claim 4, 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.

[Claim 8] The organic electroluminescent device according to claim 4, wherein the organic layer comprises an electroluminescent layer and a charge generating layer.

[Claim 9] The organic electroluminescent device according to claim 4, wherein a mixed region of a reductive dopant and an organic substance, or a mixed region of an oxidative dopant and an organic substance is placed on the inner surface of one or both of the pair of electrodes.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2011/000404

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

C07D 209/82 (2006.01)	*C07D 209/86* (2006.01)	*C07D 403/04* (2006.01)	*C07F 7/02* (2006.01)
C07D 405/04 (2006.01)	*C09K 11/06* (2006.01)	*C07D 219/00* (2006.01)	*C07D 405/10* (2006.01)
C09K 11/59 (2006.01)	*C07D 219/02* (2006.01)	*C07D 409/10* (2006.01)	*C09K 11/88* (2006.01)
C07D 223/22 (2006.01)	*C07D 413/04* (2006.01)	*H01L 27/32* (2006.01)	*C07D 265/38* (2006.01)
C07D 413/10 (2006.01)	*H01L 51/54* (2006.01)	*C07D 279/22* (2006.01)	*C07D 417/04* (2006.01)
C07D 401/04 (2006.01)	*C07D 421/10* (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 sub structure search based on the compound of Formula 1 and 2 of claim 1

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	KWON, Y.S. et al. "Synthesis and Electroluminescence of Blue Fluorescent Diarylaminofluorene Derivatives for Organic Light-Emitting Diodes", Journal of Nanoscience and Nanotechnology, (2009), vol. 9, 7056-7060	
X	See compounds YS-5 & YS-6, Abstract, OLED Fabrication and Measurement pp 7058	1 –6, 8, 9
Y	As above	7
	Ho M. H et al., "Iminodibenzyl-substituted distyrylarylenes as dopants for blue and white organic light-emitting devices", Organic Electronics, (2008), 9(1), page 101 - 110	
Y	See paragraph 2, abstract, Scheme 1 page 102	7

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

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

Date of the actual completion of the international search 08 April 2011	Date of mailing of the international search report 12 APR 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 **Peter Welsh** AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No : +61 2 6283 2926

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KIM K. S. et al "Blue organic light-emitting devices using novel styrylarylene host and dopant material", Dyes and Pigments, 77 (2008) 23-244 See abstract, Scheme 2 page 240 compound 4, Section 3.3 page 243	
P, X	WO 2010/050779 A1 (GRACEL DISPLAY INC.) 6 May 2010. See Abstract, Compound 288 and 384 – 393, pages 27, 33- 34 and Compound B, page 99	1 - 9

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			
WO	2010050779	EP	2182039	KR	20100048210

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

END OF ANNEX