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(54) **1,8-NAPHTHYRIDINE COMPOUND AND ORGANIC LIGHT-EMITTING DEVICE USING THE SAME**

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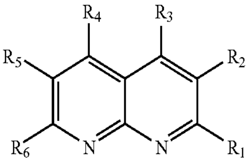
(57) **ABSTRACT**

Provided a novel 1,8-naphthyridine compound represented by the following general formula [I]:

[I]



wherein R_1 to R_6 each represent one selected from the group consisting of a hydrogen atom; an alkyl group, an aralkyl group, an aryl group, a heterocyclic group, a condensed polycyclic aromatic group, a condensed polycyclic heterocyclic group and an aryloxy group which may be substituted; a substituted amino group; a halogen atom; a triflurometyl group; and a cyano group, and may be the same as or different from one another, provided that at least two of R_1 to R_6 each represent one selected from the group consisting of an aralkyl group, an aryl group, a heterocyclic group, a condensed polycyclic aromatic group, a condensed polycyclic heterocyclic group and an aryloxy group which may be substituted; and a substituted amino group.

FIG. 1

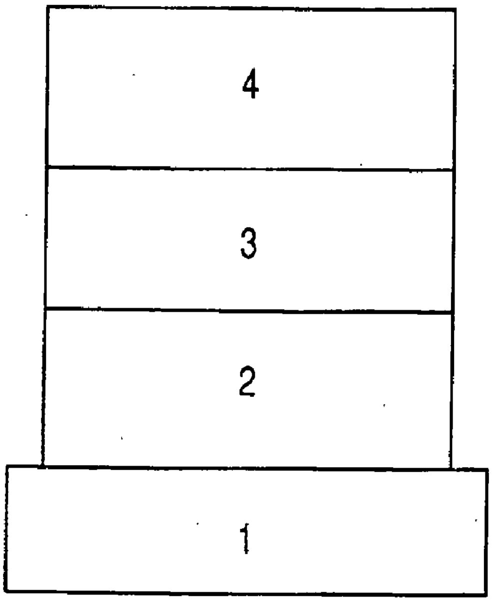


FIG. 2

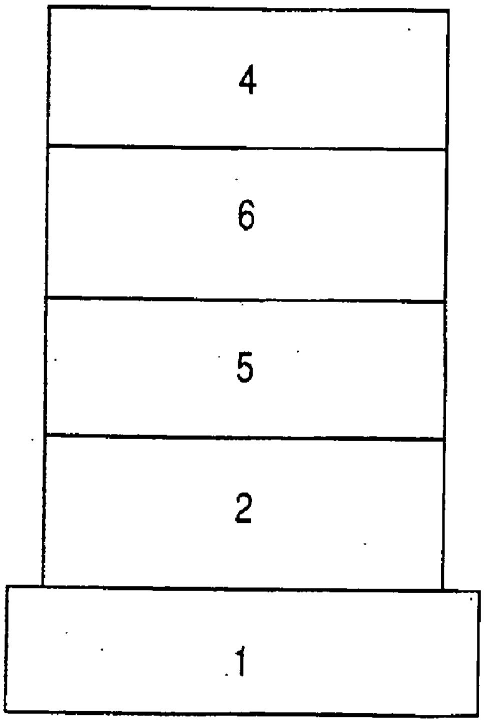


FIG. 3

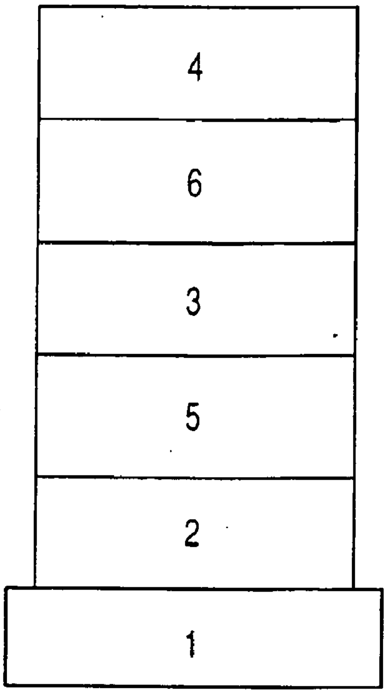


FIG. 4

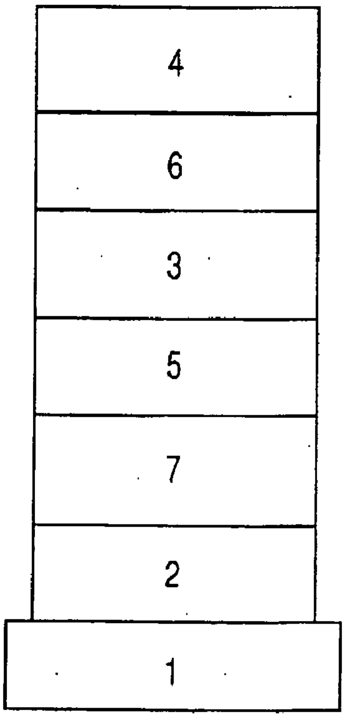


FIG. 5

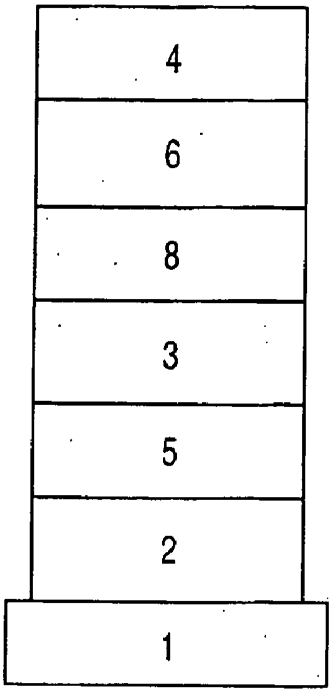
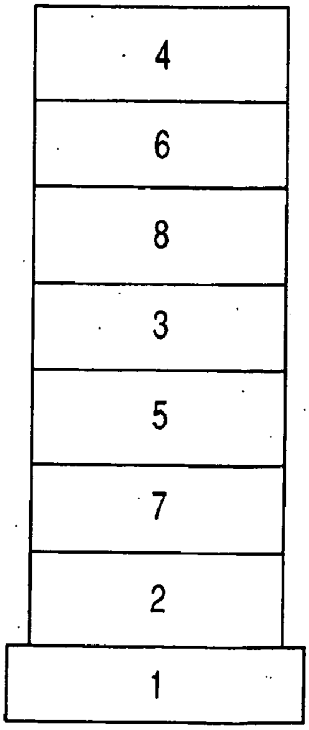


FIG. 6



1,8-NAPHTHYRIDINE COMPOUND AND ORGANIC LIGHT-EMITTING DEVICE USING THE SAME

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a novel organic compound and an organic light-emitting device using the same.

[0003] 2. Related Background Art

[0004] An organic light-emitting device includes an anode, a cathode, and a thin film containing a fluorescent organic compound or a phosphorescent organic compound, which is sandwiched between the anode and the cathode. An electron and a hole are injected from the respective electrodes, whereby an exciton of the fluorescent compound or the phosphorescent compound is generated. The device utilizes light radiated when the exciton returns to its ground state.

[0005] The recent progress of an organic light-emitting device is significant, and suggests that the device can be used in wide applications because of making it possible to form a thin, light-weight organic light-emitting device having a high luminance at a low applied voltage, a variety of emission wavelengths, and high-speed responsiveness. However, at present, improvements in initial characteristics such as a luminous efficiency, and duration characteristics such as duration against luminance degradation due to long-term light emission have been needed. Those initial characteristics and duration characteristics result from all layers for forming the device, including a hole injection layer, a hole transport layer, a light emission layer, a hole blocking layer, an electron transport layer, an electron injection layer, and the like.

[0006] Examples of conventionally known materials to be used in the hole blocking layer, the electron transport layer, and the electron injection layer include phenanthroline compounds, aluminum quinolinol complexes, oxadiazole compounds, and triazole compounds. For example, in each of Japanese Patent Application Laid-open Nos. H05-331459, H07-082551, 2001-267080, 2001-131174, H02-216791 and H10-233284, and U.S. Pat. Nos. 4,539,507, 4,720,432 and 4,885,211, each of the above materials is used in a light emission layer or an electron transport layer. However, the initial characteristics and duration characteristics of an organic light-emitting device of each of those documents are not sufficient.

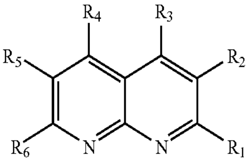
[0007] An object of the present invention is to provide a novel 1,8-naphthyridine compound.

[0008] Another object of the present invention is to provide an organic light-emitting device having a high emission luminance and a high emission efficiency by using the novel 1,8-naphthyridine compound. Another object of the present invention is to provide an organic light-emitting device having high durability and showing small degradation of luminance due to long-term light emission.

[0009] Further another object of the present invention is to provide an organic light-emitting device that can be easily produced at a relatively low cost.

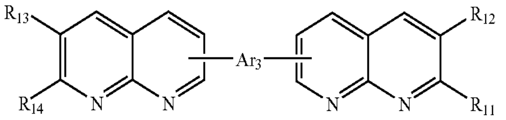
SUMMARY OF THE INVENTION

[0010] That is, a 1,8-naphthyridine compound of the present invention is represented by the following general formulae [I] to [III]:



[I]

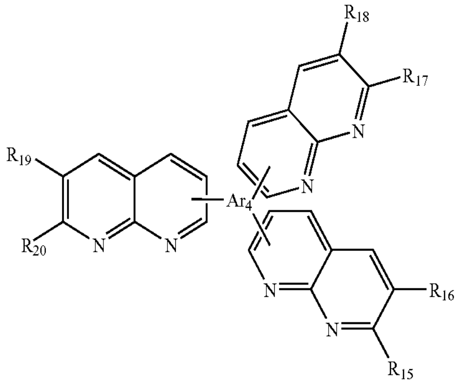
wherein R_1 to R_6 each represent one selected from the group consisting of a hydrogen atom, a substituted or unsubstituted alkyl group, a substituted or unsubstituted aralkyl group, a substituted or unsubstituted aryl group, a substituted or unsubstituted heterocyclic group, a substituted or unsubstituted condensed polycyclic aromatic group, a substituted or unsubstituted condensed polycyclic heterocyclic group, a substituted or unsubstituted aryloxy group, a substituted amino group, a halogen atom, a trifluromethyl group, and a cyano group, and R_1 to R_6 may be the same as or different from one another, provided that at least two of R_1 to R_6 each represent one selected from the group consisting of a substituted or unsubstituted aralkyl group, a substituted or unsubstituted aryl group, a substituted or unsubstituted heterocyclic group, a substituted or unsubstituted condensed polycyclic aromatic group, a substituted or unsubstituted condensed polycyclic heterocyclic group, a substituted or unsubstituted aryloxy group, and a substituted amino group;



[II]

wherein R_{11} to R_{14} each represent one selected from the group consisting of a hydrogen atom, a substituted or unsubstituted alkyl group, a substituted or unsubstituted aralkyl group, a substituted or unsubstituted aryl group, a substituted or unsubstituted heterocyclic group, a substituted or unsubstituted condensed polycyclic aromatic group, a substituted or unsubstituted condensed polycyclic heterocyclic group, a substituted or unsubstituted aryloxy group, a substituted amino group, a halogen atom, a trifluromethyl group, and a cyano group, and R_{11} to R_{14} may be the same as or different from one another; and Ar_3 represents one selected from the group consisting of a divalent, substituted or unsubstituted aromatic group, a divalent, substituted or unsubstituted heterocyclic group, a divalent, substituted or unsubstituted condensed polycyclic aromatic group, and a divalent, substituted or unsubstituted condensed polycyclic heterocyclic group;

[III]



wherein R_{15} to R_{20} each represent one selected from the group consisting of a hydrogen atom, a substituted or unsubstituted alkyl group, a substituted or unsubstituted aralkyl group, a substituted or unsubstituted aryl group, a substituted or unsubstituted heterocyclic group, a substituted or unsubstituted condensed polycyclic aromatic group, a substituted or unsubstituted condensed polycyclic heterocyclic group, a substituted or unsubstituted aryloxy group, a substituted amino group, a halogen atom, a trifluromethyl group, and a cyano group, and R_{15} to R_{20} may be the same as or different from one another; aand; Ar_4 represents one selected from the group consisting of a trivalent, substituted or unsubstituted aromatic group, a trivalent, substituted or unsubstituted heterocyclic group, a trivalent, substituted or unsubstituted condensed polycyclic aromatic group, and a trivalent, substituted or unsubstituted condensed polycyclic heterocyclic group.

[0011] An organic light-emitting device of the present invention includes at least: a pair of electrodes composed of an anode and a cathode; and one or more layers each containing an organic compound, the layers being interposed between the pair of electrodes, wherein at least one layer of the layers each containing the organic compound contains at least one kind of the 1,8-naphthyridine compound.

[0012] An organic light-emitting device using the 1,8-naphthyridine compound of the present invention provides light emission having a high luminance at a low applied voltage, and is excellent in durability. In particular, an organic layer containing the 1,8-naphthyridine compound of the present invention is excellent as an electron transport layer and as the light emission layer.

[0013] Furthermore, the device can be produced by a vacuum deposition method, a casting method, or the like. The device having a large area can be easily produced at a relatively low cost.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] **FIG. 1** is a sectional view showing an example of an organic light-emitting device according to the present invention;

[0015] **FIG. 2** is a sectional view showing another example of the organic light-emitting device according to the present invention;

[0016] **FIG. 3** is a sectional view showing further another example of the organic light-emitting device according to the present invention;

[0017] **FIG. 4** is a sectional view showing still further another example of the organic light-emitting device according to the present invention;

[0018] **FIG. 5** is a sectional view showing still further another example of the organic light-emitting device according to the present invention; and

[0019] **FIG. 6** is a sectional view showing still further another example of the organic light-emitting device according to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0020] Hereinafter, the present invention will be described in detail.

[0021] First, a 1,8-naphthyridine compound of the present invention will be described.

[0022] The 1,8-naphthyridine compound of the present invention is represented by any one of the above-described general formulae [I] to [III].

[0023] The 1,8-naphthyridine compound represented by the general formula [I] is preferably a compound in which R_2 to R_5 each represent one selected from a hydrogen atom, a substituted or unsubstituted alkyl group, a halogen atom, a trifluromethyl group, and a cyano group, and R_1 and R_6 each represent a group selected from a substituted or unsubstituted aralkyl group, a substituted or unsubstituted aryl group, a substituted or unsubstituted heterocyclic group, a substituted or unsubstituted condensed polycyclic aromatic group, a substituted or unsubstituted condensed polycyclic heterocyclic group, a substituted or unsubstituted aryloxy group, and a substituted amino group.

[0024] Specific examples of the substituents in the general formulae [I] to [III] will be shown below.

[0025] The alkyl group includes methyl, ethyl, n-propyl, iso-propyl, n-butyl, ter-butyl, octyl, and the like.

[0026] The aralkyl group includes benzyl, phenethyl, and the like.

[0027] The aryl group includes phenyl, biphenyl, terphenyl, and the like.

[0028] The heterocyclic group includes thienyl, pyrrolyl, pyridyl, bipyridyl, terpyridyl, oxazolyl, oxadiazolyl, thiazolyl, thiadiazolyl, and the like.

[0029] The condensed polycylic aromatic group includes fluorenyl, naphthyl, fluoranthenyl, anthryl, phenanthryl, pyrenyl, tetracenyl, pentacenyl, perylenyl, triphenylenyl, and the like.

[0030] The condensed polycyclic heterocyclic group includes quinolyl, carbazolyl, acridinyl, phenazyl, phenanthrolyl, and the like.

[0031] The aryloxy group includes phenoxyl, fluorenoxyl, naphthoxyl, and the like.

[0032] The substituted amino group includes dimethylamino, diethylamino, dibenzylamino, diphenylamino, ditolylamino, dianisolylamino, fluorenylphenylamino, difluorenyl, naphthylphenylamino, dinaphthylamino, and the like.

[0033] The halogen atom includes fluorine, chlorine, bromine, iodine, and the like.

[0034] The divalent or trivalent aromatic group, heterocyclic group, condensed polycyclic aromatic group, and condensed polycyclic heterocyclic group include the above-mentioned aryl group, heterocyclic group, condensed polycyclic aromatic group, condensed polycyclic heterocyclic group and the like which are modified to have divalence or trivalence.

[0035] Substituents which the above-mentioned substituents may have include alkyl groups such as methyl, ethyl, n-propyl, iso-propyl, n-butyl, ter-butyl and octyl; aralkyl groups such as benzyl and phenethyl; aryl groups such as phenyl, biphenyl and terphenyl; heterocyclic groups such as thienyl, pyrrolyl, pyridyl, bipyridyl, terpyridyl, oxazolyl, oxadiazolyl, thiazolyl and thiadiazolyl; condensed polycyclic aromatic groups such as fluorenyl, naphthyl, fluoranthenyl, anthryl, phenanthryl, pyrenyl, tetracenyl, pentacenyl, perylenyl and triphenylenyl; condensed polycyclic heterocyclic groups such as quinolyl, carbazolyl, acridinyl, phenazyl and phenanthrolyl; aryloxy groups such as phenoxyl, fluorenoxyl and naphthoxyl; substituted amino groups such as dimethylamino, diethylamino, dibenzylamino, diphenylamino, ditolylamino, dianisolylamino, fluorenylphenylamino, difluorenyl, naphthylphenylamino and dinaphthylamino; halogen atoms such as fluorine, chlorine, bromine and iodine; trifluoromethyl; cyano; and the like.

[0036] Next, representative examples of the 1,8-naphthyridine compound of the present invention will be shown below. However, the present invention is not limited to these examples.

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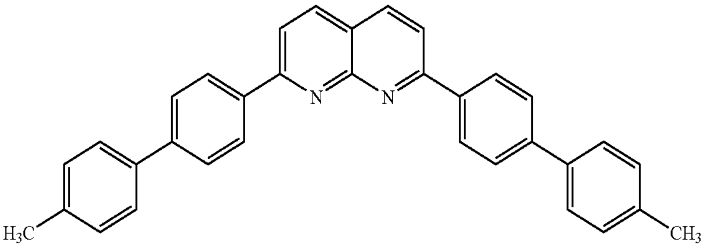

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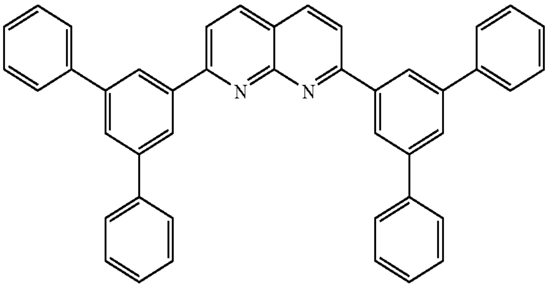

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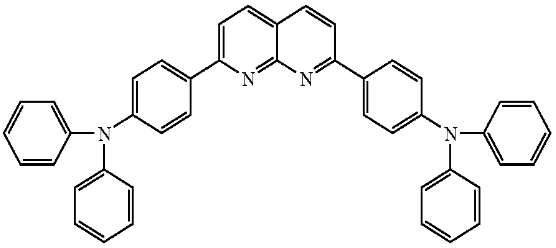

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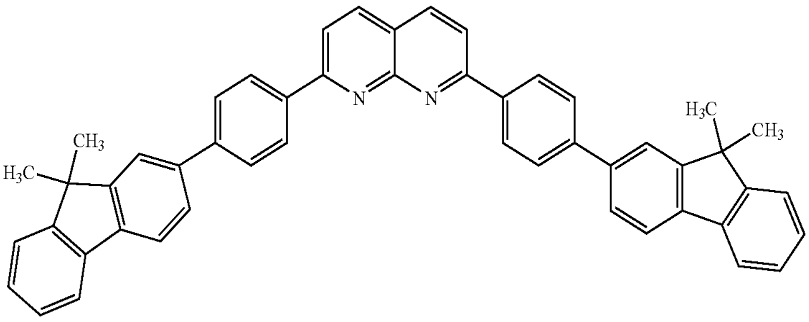

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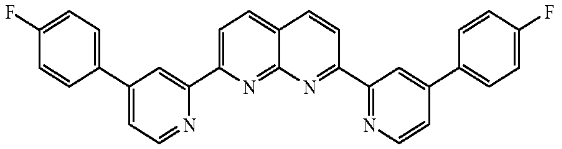

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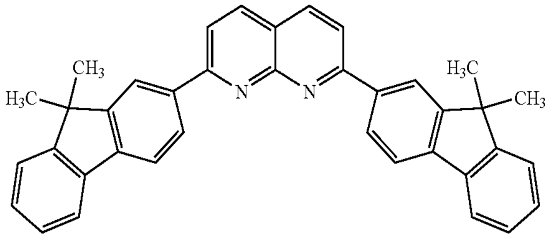

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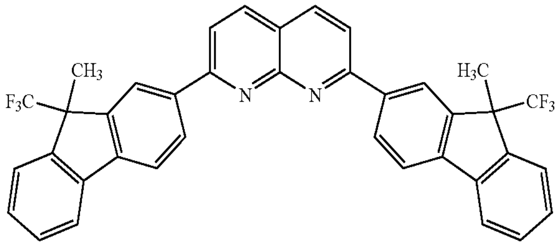

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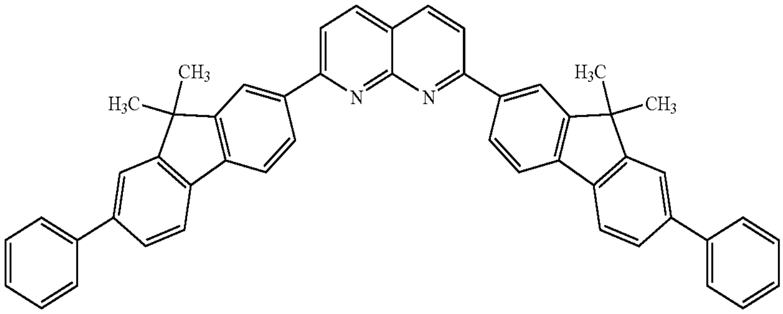

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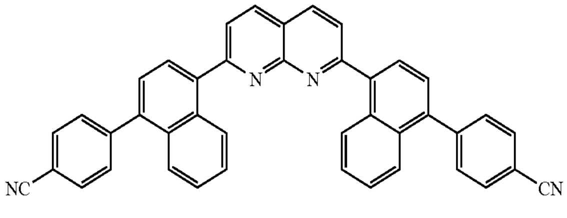

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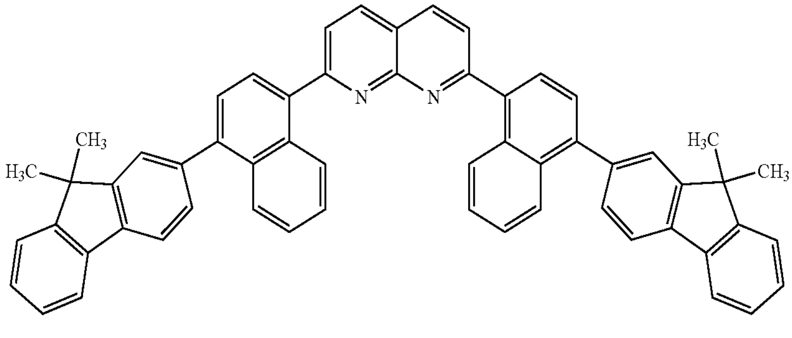

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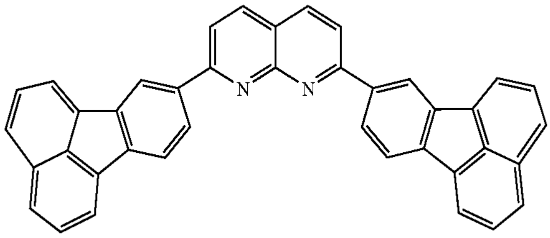

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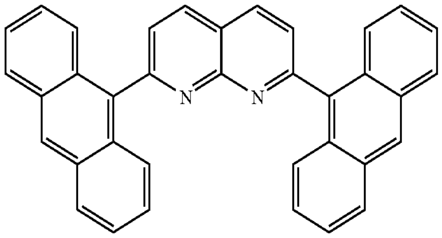

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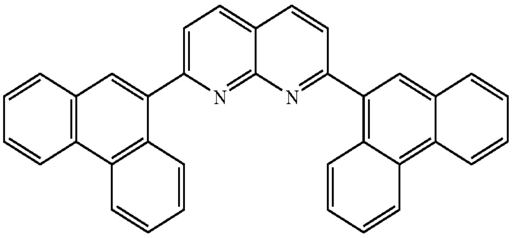

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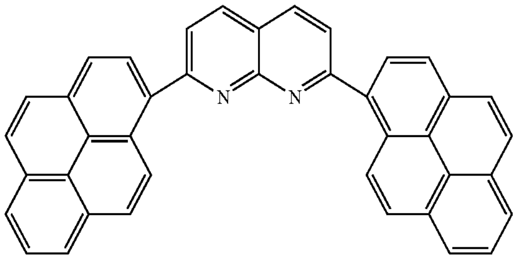

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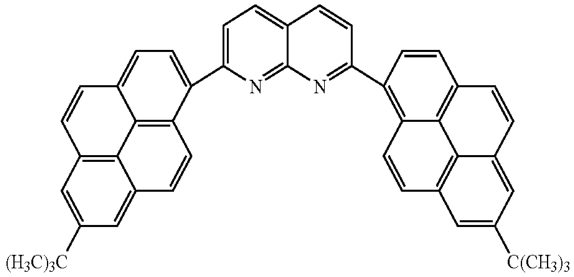

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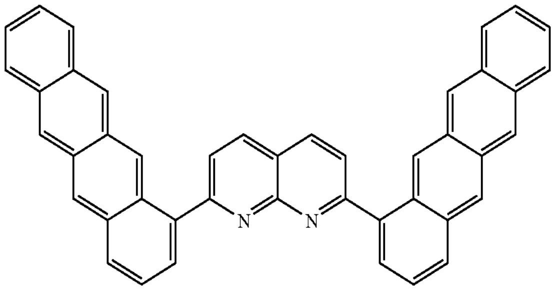

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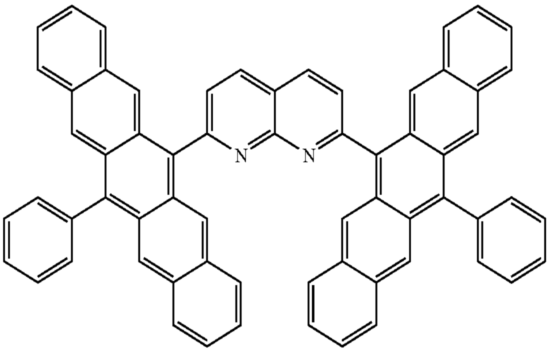

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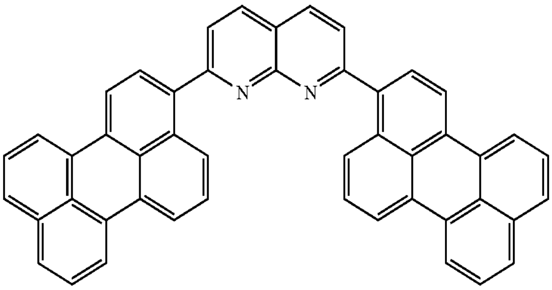

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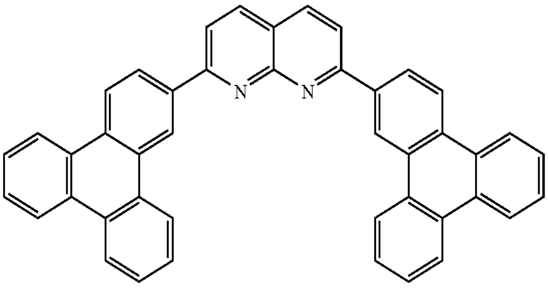

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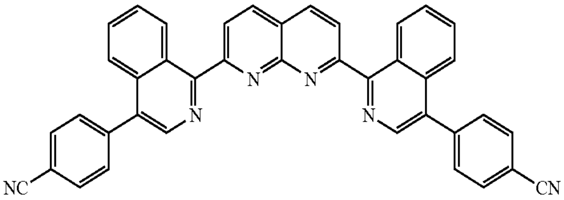

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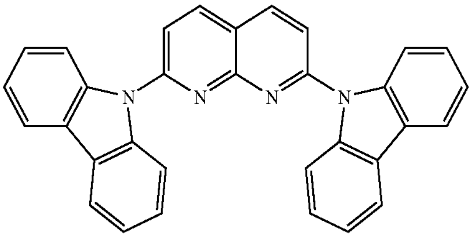

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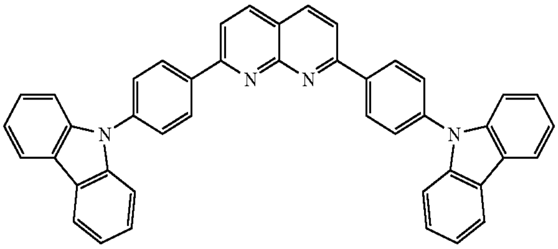

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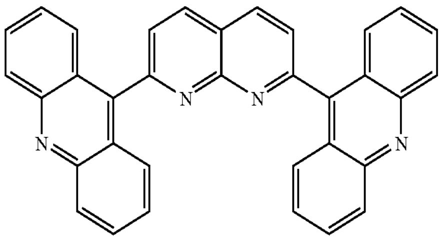

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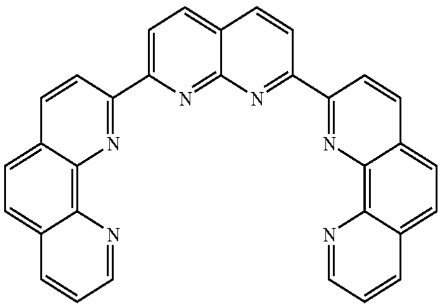

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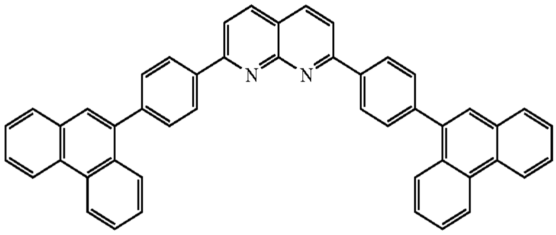

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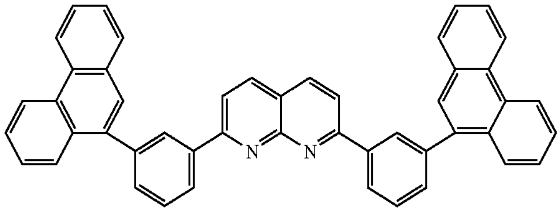

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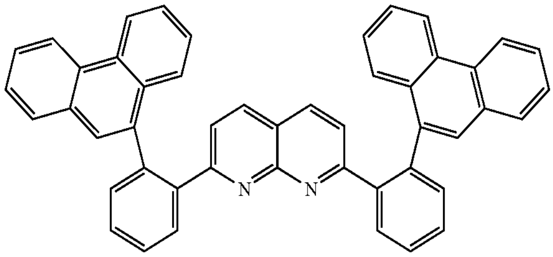

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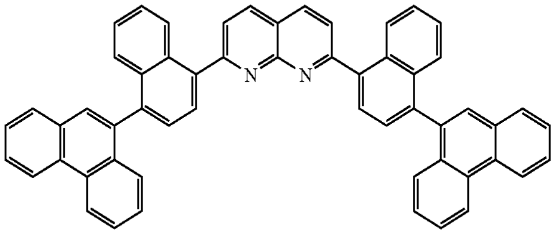

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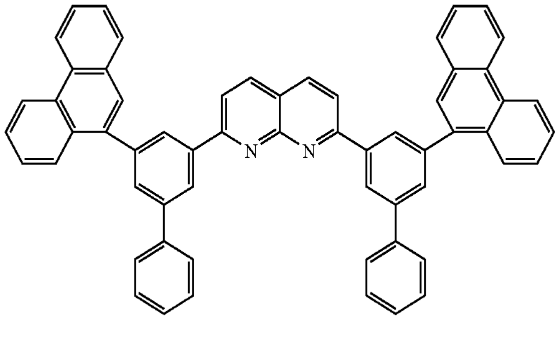

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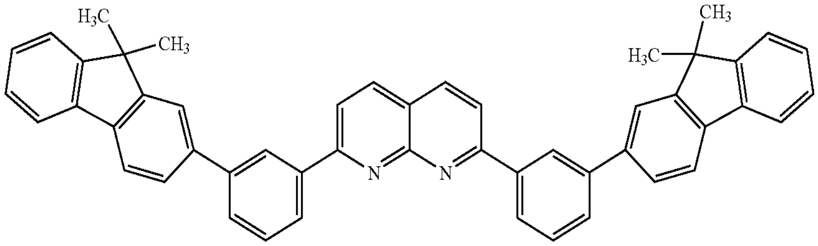

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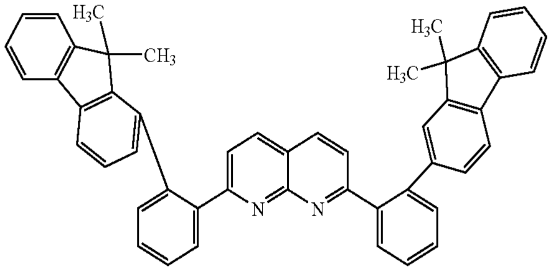

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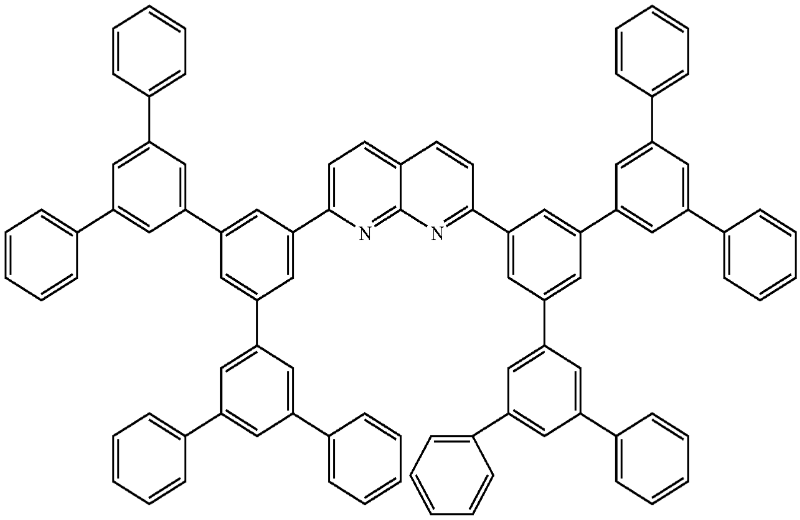

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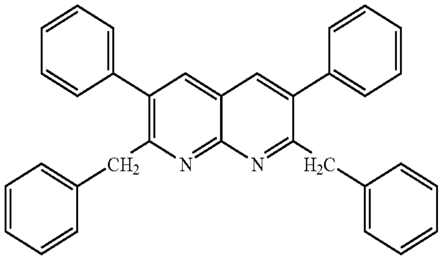

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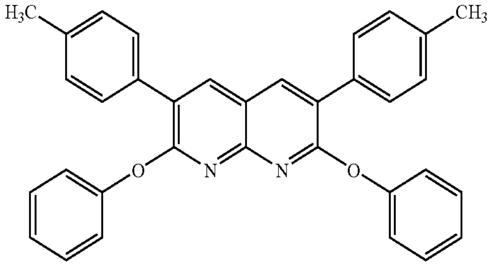

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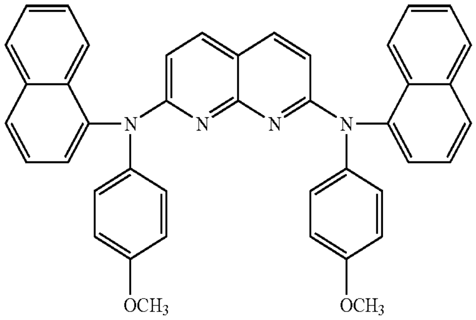

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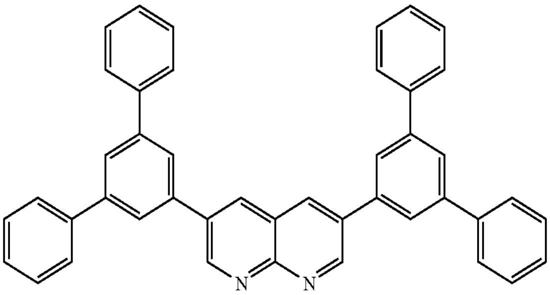

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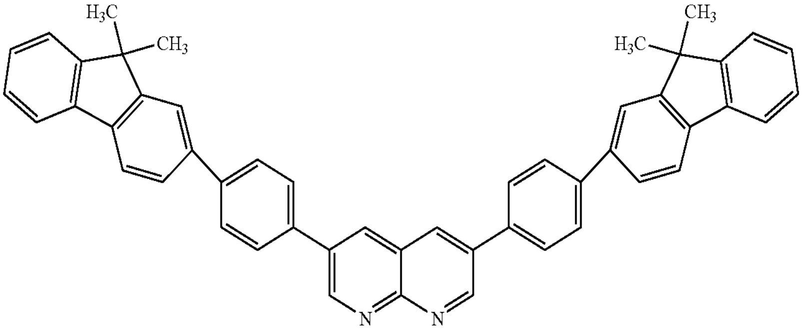

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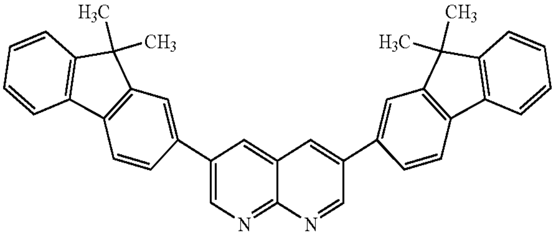

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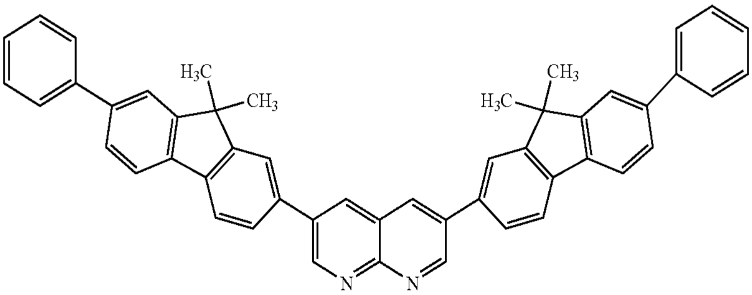

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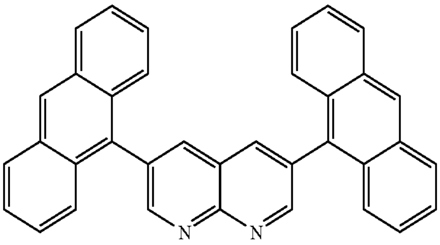

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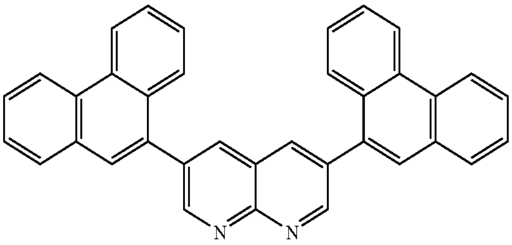

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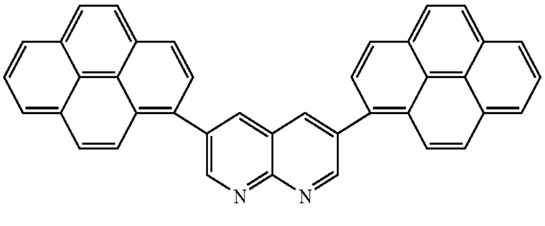

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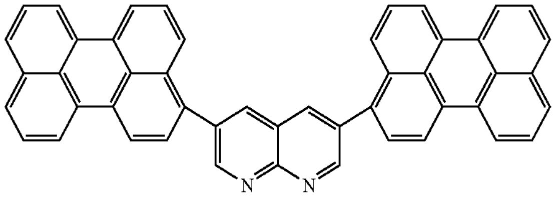

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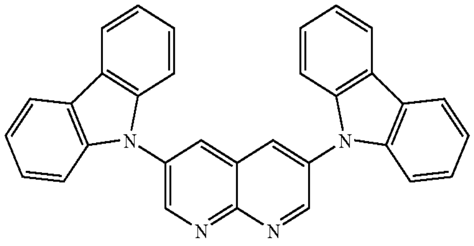

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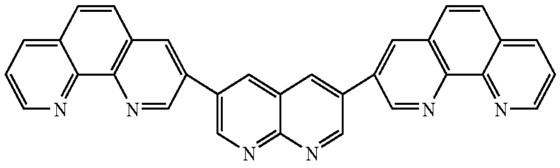

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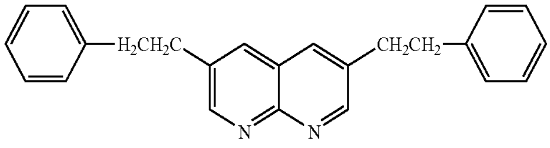

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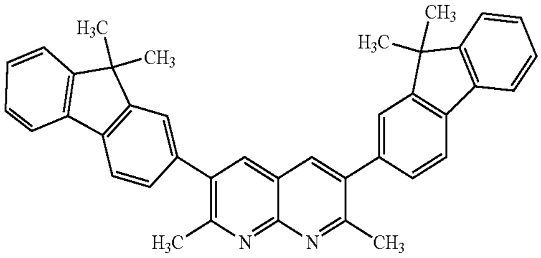

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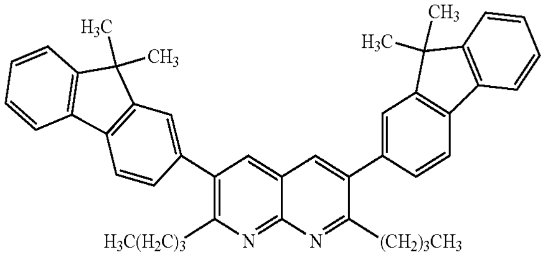

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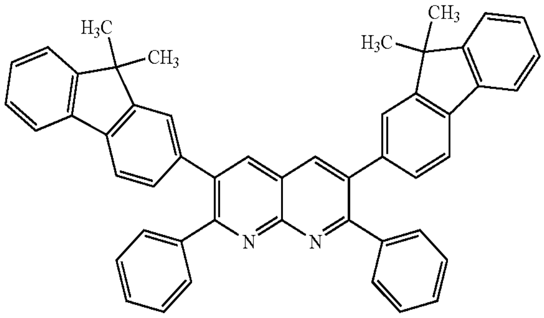

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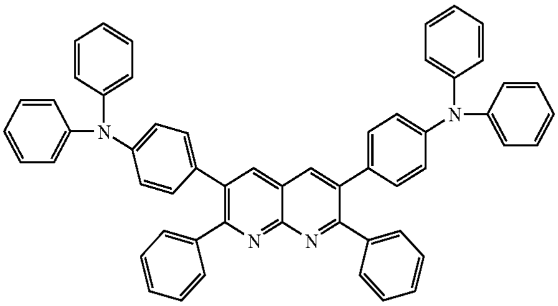

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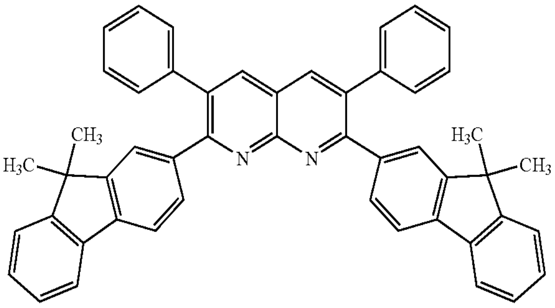

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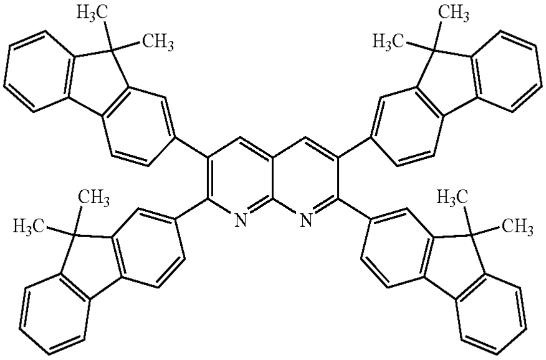

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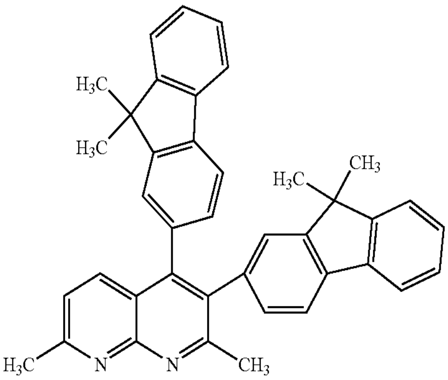

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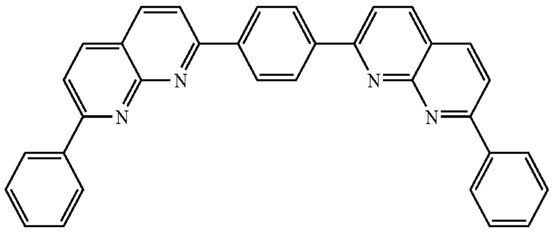

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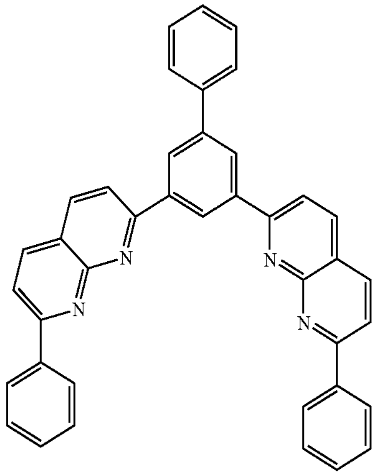

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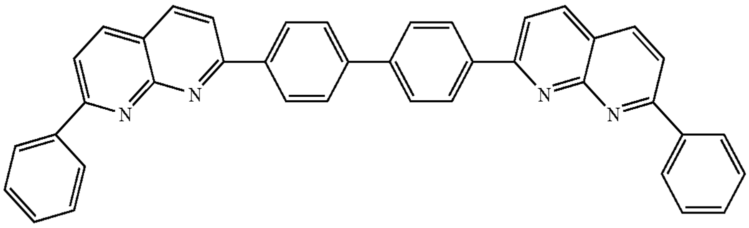

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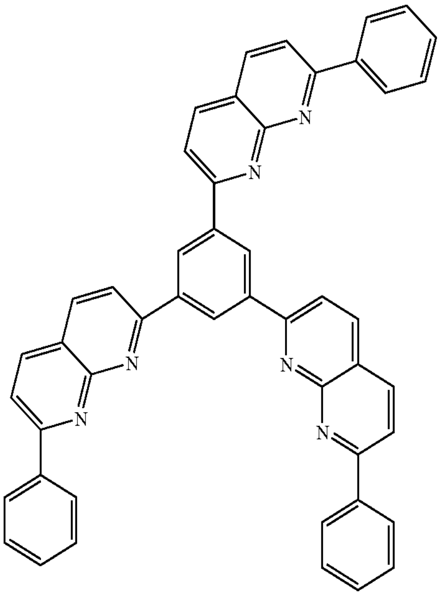

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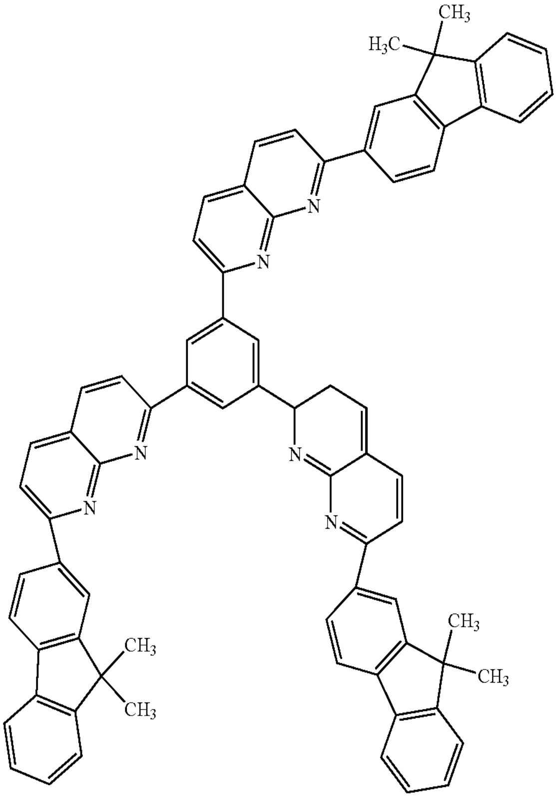

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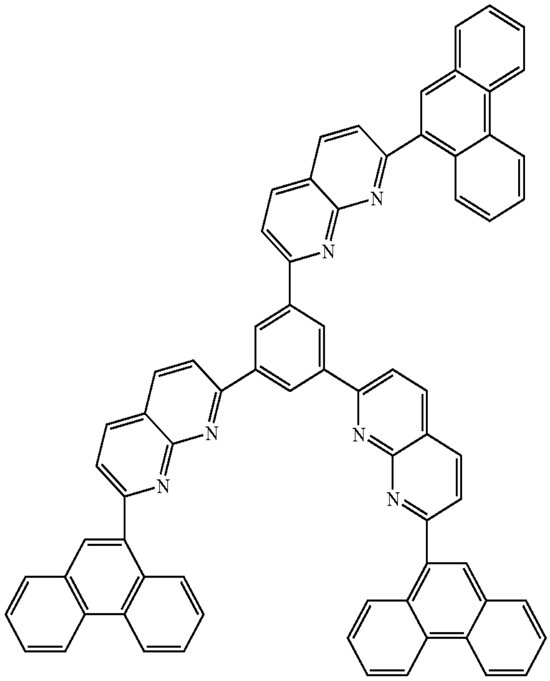

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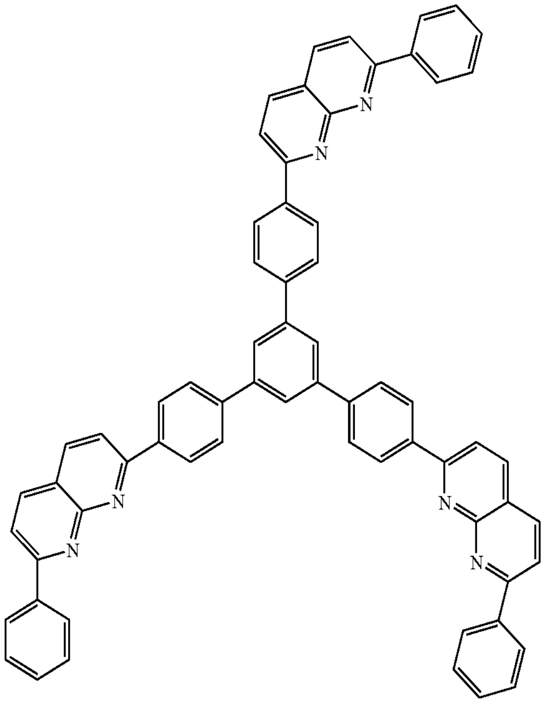


[0037] The 1,8-naphthyridine compound of the present invention can be synthesized by means of a generally known method. Examples of the method include methods described in J. Org. Chem., 46, 833 (1981), J. Heterocycl. Chem., 13, 961 (1976), and Z. Chem. 18, 382 (1978). A 1,8-naphthyridine compound intermediate is produced by means of any one of those methods. Furthermore, the 1,8-naphthyridine compound can be produced from the above intermediate by means of a synthesis method such as a Suzuki Coupling method using a palladium catalyst (see, for example, Chem. Rev., 95, 2457, (1995)).

[0038] The 1,8-naphthyridine compound of the present invention is superior to a conventional compound in electron-transporting property, light-emitting property, and durability. In addition, the 1,8-naphthyridine compound is useful as a layer containing an organic compound of an organic light-emitting device, in particular, an electron transport layer or a light emission layer. In addition, a layer formed of the 1,8-naphthyridine compound by means of a vacuum deposition method, a solution application method, or the like hardly causes crystallization or the like, and is excellent in stability with the elapse of time. In particular, a compound having a relatively low HOMO among the 1,8-naphthyridine compounds of the present invention has high hole-blocking property, and is particularly preferable as a hole blocking layer or an electron transport layer.

[0039] Next, an organic light-emitting device of the present invention will be described in detail.

[0040] An organic light-emitting device of the present invention includes at least: a pair of electrodes composed of an anode and a cathode; and one or more layers each containing an organic compound, the layers being interposed between the pair of electrodes, in which at least one layer of the layers each containing the organic compound contains at least one kind of the 1,8-naphthyridine compound according to the present invention.

[0041] In an organic light-emitting device of the present invention, the layer containing at least one kind of the 1,8-naphthyridine compound preferably is one of a hole blocking layer, an electron transport layer, a light emission layer, and an electron injection layer.

[0042] In the organic light-emitting device of the present invention, the layer containing at least the 1,8-naphthyridine compound of the present invention can be formed between the anode and the cathode by means of a vacuum deposition method or a solution application method. The thickness of the organic layer is thinner than 10 μm, and the layer is formed into a thin film having a thickness of preferably 0.5 μm or less, or more preferably 0.01 to 0.5 μm.

[0043] **FIGS. 1, 2, 3, 4, 5** and **6** show preferable examples of the organic light-emitting device of the present invention.

[0044] Reference numerals of the respective drawings will be described.

[0045] Reference numeral **1** denotes a substrate; **2**, an anode; **3**, a light emission layer; **4**, a cathode; **5**, a hole transport layer; **6**, an electron transport layer; **7**, a hole injection layer; and **8**, a hole/exciton blocking layer.

[0046] **FIG. 1** is a sectional view showing an example of the organic light-emitting device of the present invention. **FIG. 1** shows a constitution in which the anode **2**, the light emission layer **3**, and the cathode **4** are sequentially provided on the substrate **1** in mentioned order. The light-emitting device to be used in this example is useful for the case where the device itself has a single compound with a hole-transporting ability, an electron-transporting ability, and light-emitting property or the case where compounds having the respective properties are used as a mixture.

[0047] **FIG. 2** is a sectional view showing another example of the organic light-emitting device of the present invention. **FIG. 2** shows a constitution in which the anode **2**, the hole transport layer **5**, the electron transport layer **6**, and the cathode **4** are sequentially provided on the substrate **1**. In this case, a material having one or both of hole-transporting property and electron-transporting property is used as a luminescent substance in each layer. This case is useful when the device is used in combination with a mere hole-transporting substance or electron-transporting substance having no light-emitting property. In addition, in this case, a light emission layer is composed of the hole transport layer **5** or the electron transport layer **6**.

[0048] **FIG. 3** is a sectional view showing another example of the organic light-emitting device of the present invention. **FIG. 3** shows a constitution in which the anode **2**, the hole transport layer **5**, the light emission layer **3**, the electron transport layer **6**, and the cathode **4** are sequentially provided on the substrate **1**. This constitution separates a carrier-transporting function and a light-emitting function. In addition, the device is timely used in combination with compounds having respective properties such as hole-transporting property, electron-transporting property, and light-emitting property, so that the degree of freedom in selection of materials extremely increases. In addition, various compounds different from each other in emission wavelength can be used. As a result, the range of luminescent colors can be widened. Furthermore, an emission efficiency can be improved by effectively confining each carrier or exciton in the central light emission layer **3**.

[0049] **FIG. 4** is a sectional view showing another example of the organic light-emitting device of the present invention. **FIG. 4** shows the same constitution as that of **FIG. 3** except that the hole injection layer **7** is inserted on the side of the anode **2**. This constitution has an improved effect on adhesiveness between the anode **2** and the hole transport layer **5** or on hole-injecting property, and is effective in lowering voltage.

[0050] **FIGS. 5 and 6** are sectional views each showing another example of the organic light-emitting device of the present invention. **FIGS. 5 and 6** are different from **FIGS. 3 and 4** in that a layer for inhibiting the passing of a hole or an exciton to the side of the cathode (hole/exciton blocking layer **8**) is added. In each of those figures, the device is constituted in such a manner that the hole/exciton blocking layer is inserted into a gap between the light emission layer **3** and the electron transport layer **6**. In this constitution, the use of a compound having an extremely high ionization potential in the hole/exciton blocking layer **8** is effective in improving an emission efficiency.

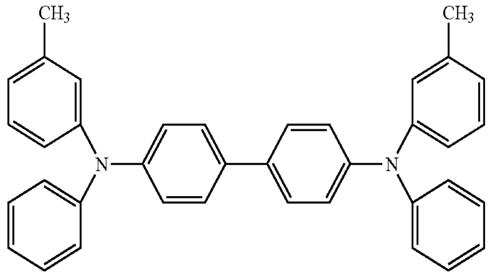
[0051] It should be noted that the device constitutions shown in **FIGS. 1, 2, 3, 4, 5** and **6** are merely very basic constitutions, and the constitution of an organic light-emitting device using the compound of the present invention is not limited to these constitutions. The device may adopt any one of various layer constitutions. For example, an insulating layer may be provided to an interface between an electrode and an organic layer. Alternatively, an adhesive layer or an interference layer may be provided. Alternatively, a hole transport layer may be composed of two layers different from each other in ionization potential.

[0052] The 1,8-naphthyridine compound of the present invention is superior to a conventional compound in electron-transporting property, light-emitting property, and durability, and can be used in any one of the constitutions shown in **FIGS. 1, 2, 3, 4, 5** and **6**.

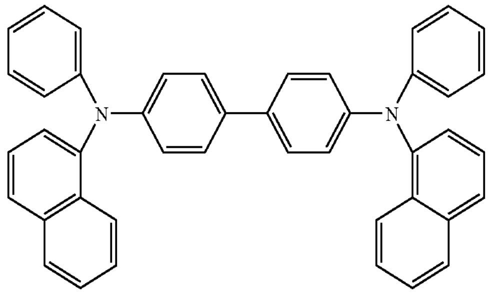
[0053] The organic light-emitting device of the present invention uses the 1,8-naphthyridine compound of the present invention preferably as a component for its electron transport layer or its light emission layer. In addition, the device can use a conventionally known hole-transporting compound, light-emitting compound, electron-transporting compound, or the like together with the compound of the present invention as required.

[0054] Examples of those compounds will be given below.

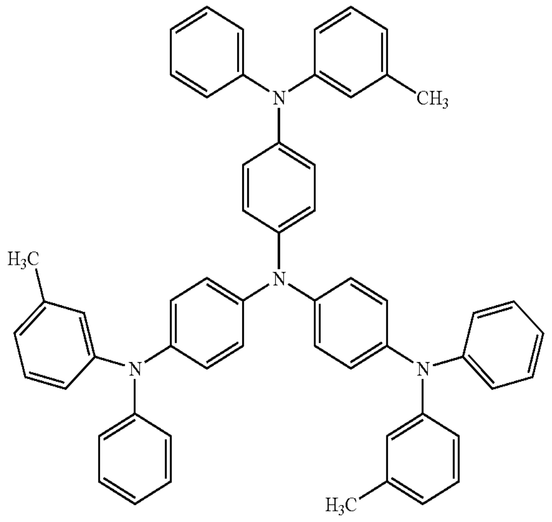
[0055] Hole-Transporting Compound



TPD



α-NPD



m-MTDATA

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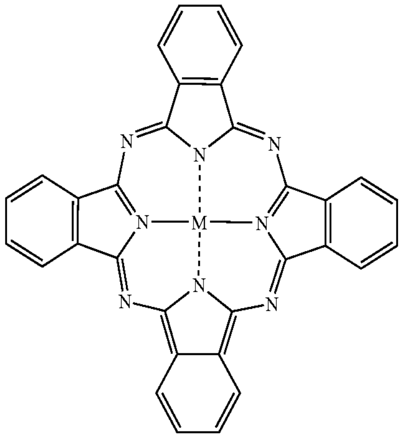
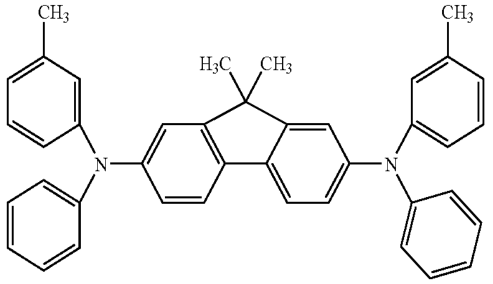
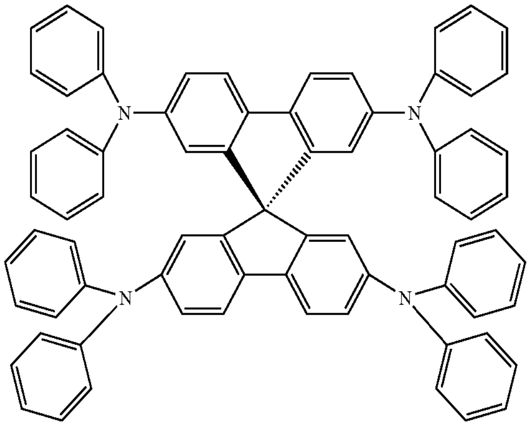


Met: Cu, Md, AlCl, TiO, SiCl$_2$, etc

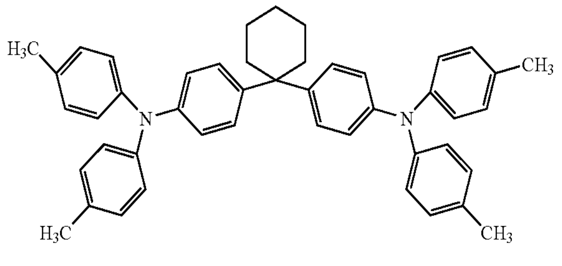
Met-Pc



DTDPFL



spiro-TPD



TPAC

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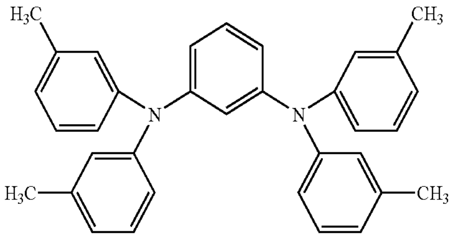
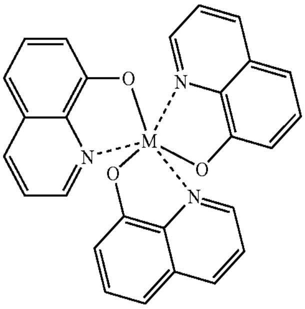
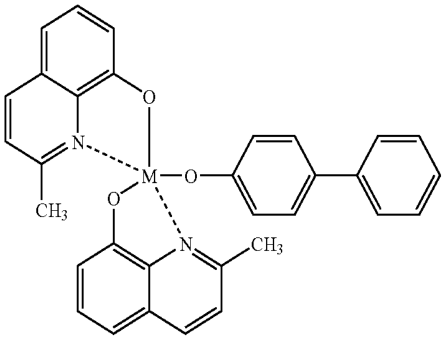


PDA

[0056] Electron-Transporting Luminescent Material



M: Al, Ga



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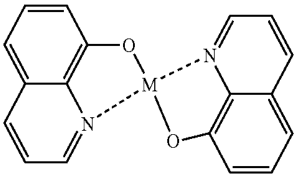

M: Zn, Mg, Be

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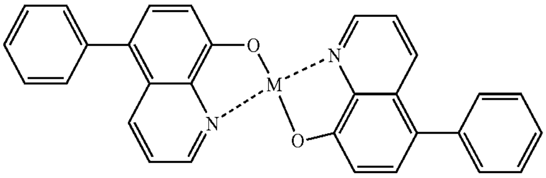
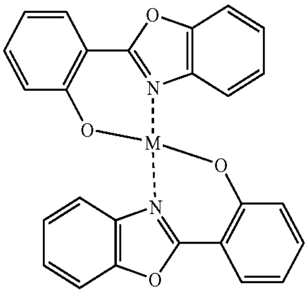
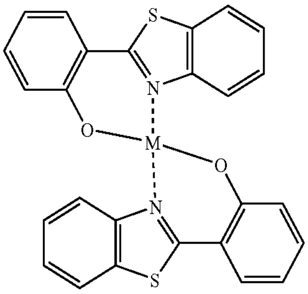


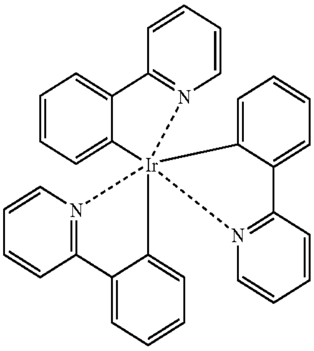
M: Zn, Mg, Be



M: Zn, Mg, Be



M: Zn, Mg, Be



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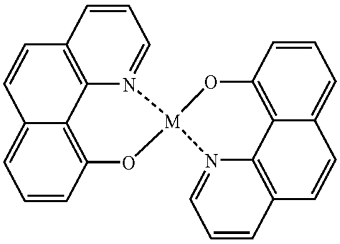

M:Zn, Mg, Be

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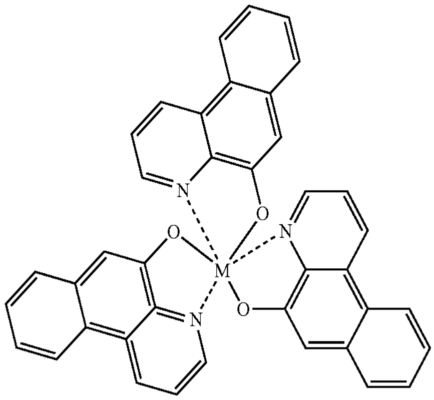
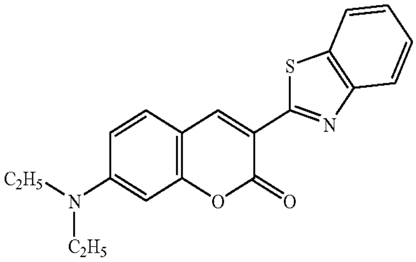
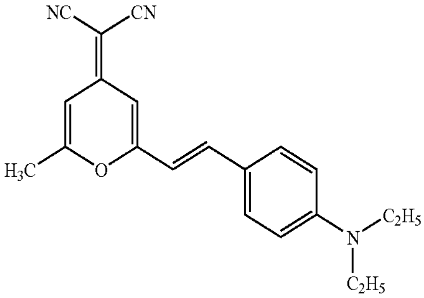


M:Al, Ga

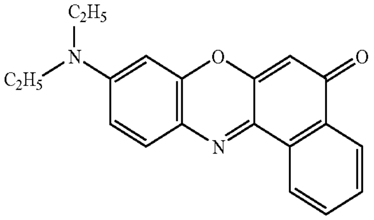
[0057] Luminescent Material



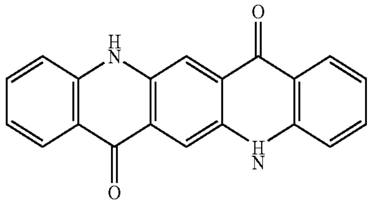
Coumarin6



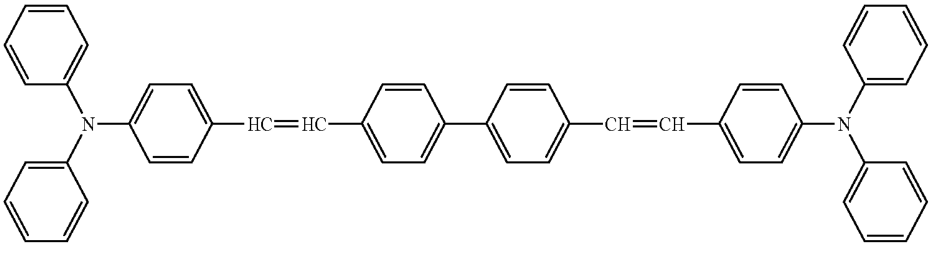
DCM-1



Nile red



Quinacridone



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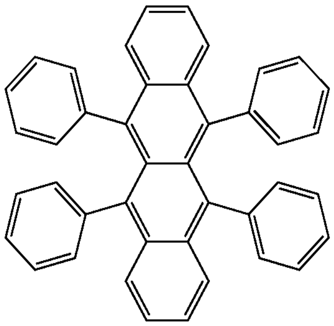
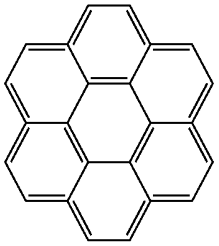


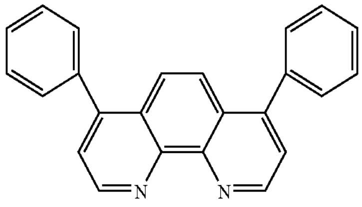
Rubrene



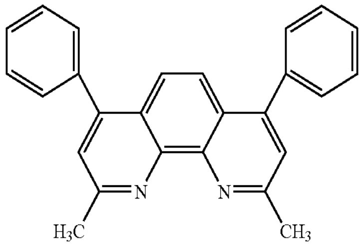
Coronene

[0058] Light Emission Layer Matrix Material and Electron-Transporting Material

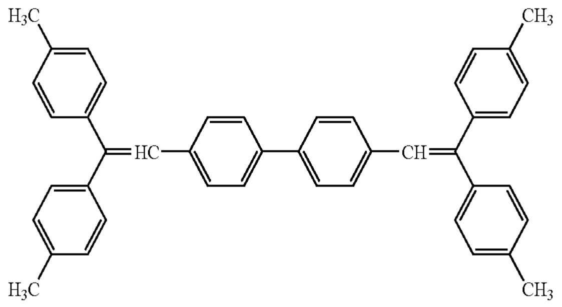
[0059] 発光層マトリックス材料および電子輸送材料



BPhen



BCP



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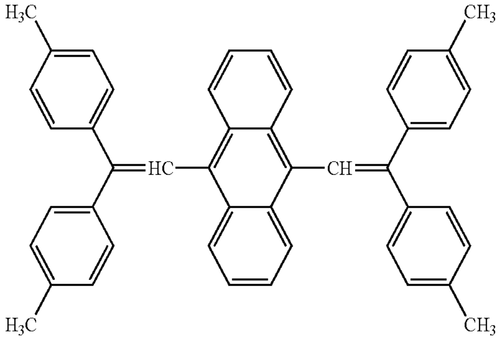

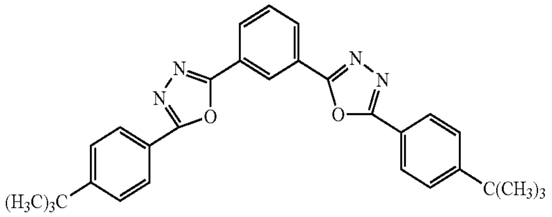

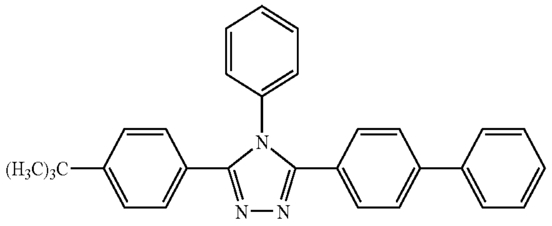

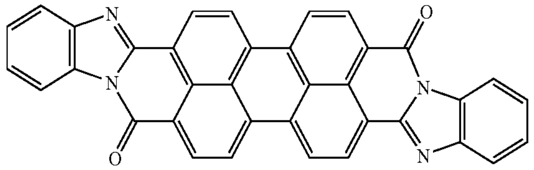

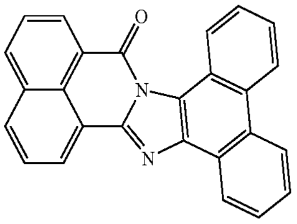

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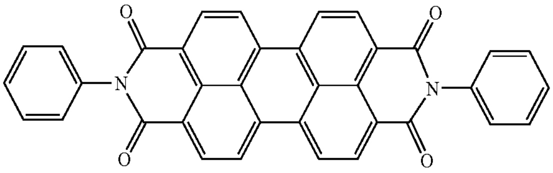

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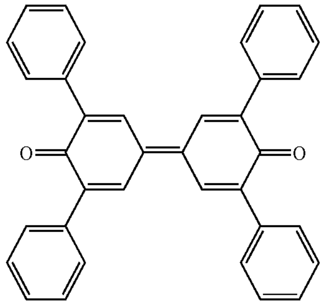
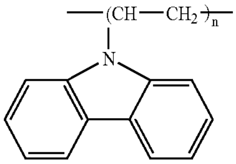
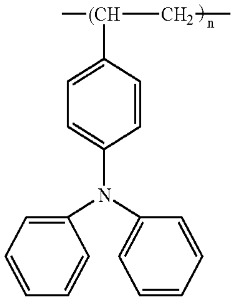


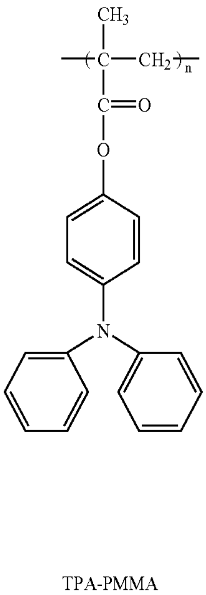
[0060] Polymer-Based Hole-Transporting Material



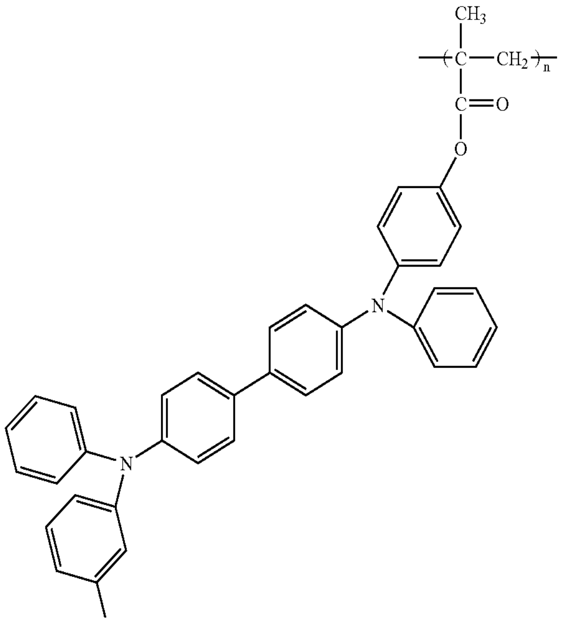
PVCz



DPA-PS

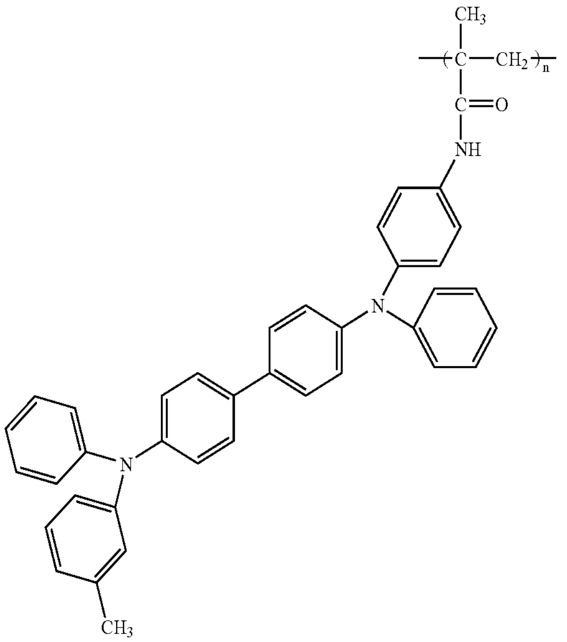


TPA-PMMA

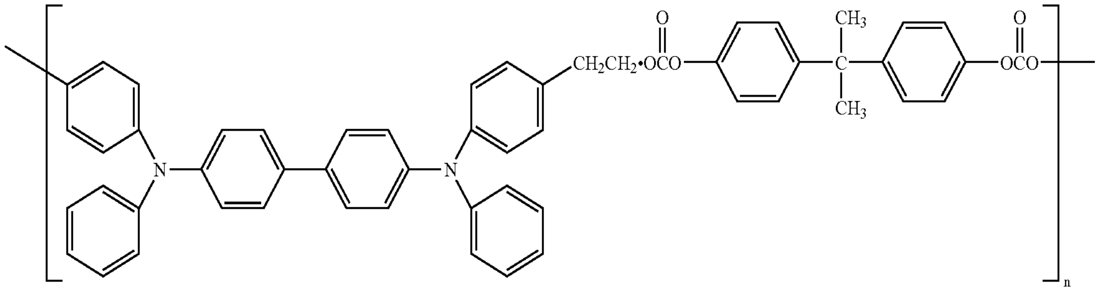


TPD-PMMA

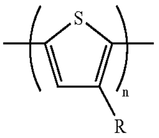
-continued



TPD-PMAA

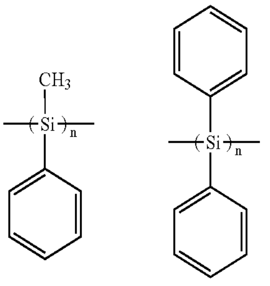


TPD-PCA



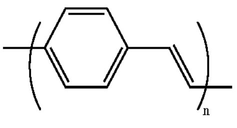
R:C_6H_{13}, C_8H_{17}, C_{12} H_{25}

Poly thiophene



Polysilane

[0061] ポリマー系発光材料およ



[0062] Polymer-based luminescent material and transporting material emitting device of the present invention, each of a layer containing the 1,8-naphthyridine compound of the present invention and layers each containing any another organic compound is generally formed into a thin film by means of a vacuum deposition method or an application method involving dissolving the compound into an appropriate solvent. In particular, in the case of film formation by means of the application method, each of the layers can be combined with an appropriate binder resin to form a layer.

[0063] The binder resin can be selected from a wide range of binder resins, and examples of the binder resin include, but not limited to, a polyvinyl carbazole resin, a polycarbonate resin, a polyester resin, a polyallylate resin, a polystyrene resin, an acrylic resin, a methacrylic resin, a butyral resin, a polyvinyl acetal resin, a diallyl phthalate resin, a phenol resin, an epoxy resin, a silicone resin, a polysulfone resin, and a urea resin. Each of those binder resins may be used alone, or any one of the binder resins may be mixed with one or two or more other binder resins to be used as a copolymer.

[0064] An anode material having as large a work function as possible is desirable. Examples of an anode material that can be used include: metal elements such as gold, silver, platinum, nickel, palladium, cobalt, selenium, and vanadium, and alloys of them; and metal oxides such as tin oxide, zinc oxide, indium tin oxide (ITO), and indium zinc oxide. A conductive polymer such as polyaniline, polypyrrole, polythiophene, or polyphenylene sulfide can also be used. Each of those electrode substances may be used alone, or two or more of them may be used in combination.

[0065] On the other hand, a cathode material having as small a work function as possible is desirable. Examples of a cathode material that can be used include metal elements such as lithium, sodium, potassium, cesium, calcium, magnesium, aluminum, indium, silver, lead, tin, and chromium, alloys of two or more of them, and salts of the metal elements. A metal oxide such as indium tin oxide (ITO) can also be used. In addition, a cathode may have a single layer constitution, or may have a multilayer constitution.

[0066] A substrate to be used in the present invention is not particularly limited; provided that an opaque substrate such as a metallic substrate or a ceramic substrate, or a transparent substrate such as glass, quartz, or a plastic sheet is used. In addition, a luminescent color can be controlled by using a color filter film, a fluorescent color conversion filter film, a dielectric reflection film, or the like as the substrate.

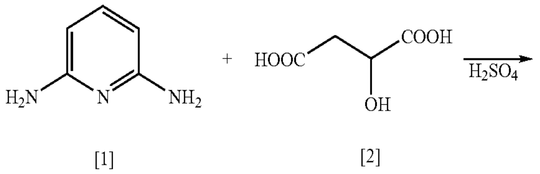
[0067] The produced device may be provided with a protective layer or a sealing layer for the purpose of preventing the device from contacting with oxygen, moisture, or the like. Examples of the protective layer include: inorganic material films such as a diamond thin film, a metal oxide, and a metal nitride; polymer films such as of a fluorine resin, polyparaxylene, polyethylene, a silicone resin, and polystyrene; and a photocurable resin. In addition, the device itself can be covered with glass, a gas impervious film, metal, or the like, and can be packaged with an appropriate sealing resin.

[0068] Hereinafter, the present invention will be described more specifically by way of examples. However, the present invention is not limited to the following examples.

SYNTHESIS EXAMPLE 1

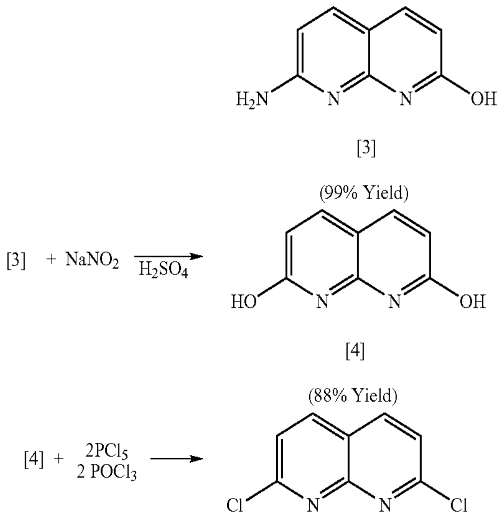
Synthesis of Exemplified Compound No. 6

[0069]



[1] [2]

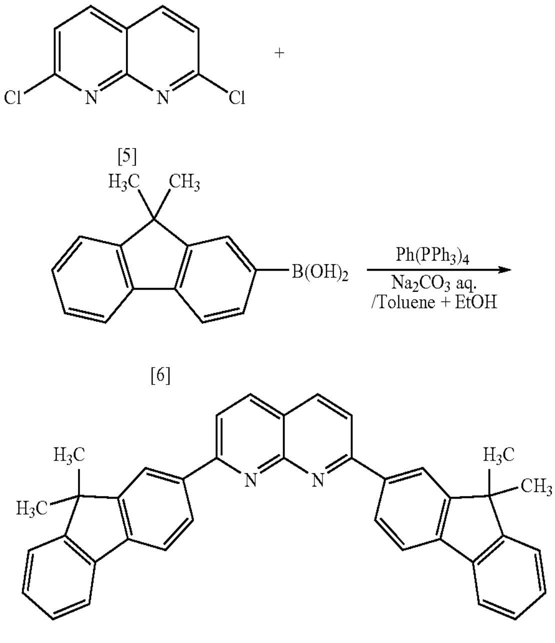
-continued



[5]

(11% Yield)

[0070] 2,7-dichloro-1,8-naphthyridine [5] (white crystal) was obtained from the above compound [1] in a total yield of 9.6% according to the synthesis method described in J. Org. Chem., 46, 833 (1981).



No. 6

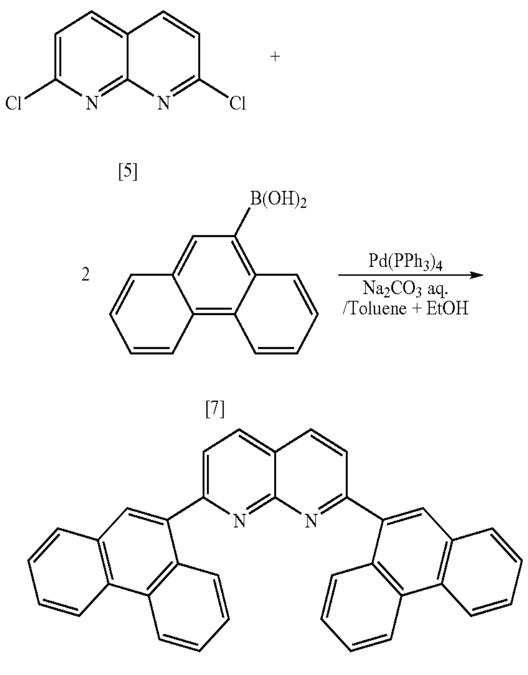
(85% Yield)

[0071] 1.0 g (5.78 mmol) of 2,7-dichloro-1,8-naphthyridine [5], 4.1 g (17.3 mmol) of 9,9-dimethylfluorene-2-boronic acid [6], 200 ml of toluene, and 100 ml of ethanol were loaded into a 500-ml three-necked flask. An aqueous solution prepared by dissolving 24 g of sodium carbonate into 120 ml of water was dropped to the mixture while stirring under a nitrogen atmosphere at room temperature. Next, 0.33 g (0.29 mmol) of tetrakis(triphenylphosphine-)palladium (0) was added to the mixture. After the mixture had been stirred at room temperature for 30 minutes, the temperature of the mixture was increased to 77° C., and the mixture was stirred for 4 hours. After the reaction, an organic layer was extracted with chloroform, dried with anhydrous sodium sulfate, and purified with a silica gel column (toluene developing solvent), whereby 2.5 g of Exemplified Compound No. 6 (white crystal) were obtained (85% yield).

SYNTHESIS EXAMPLE 2

Synthesis of Exemplified Compound No. 13

[0072]



No. 13

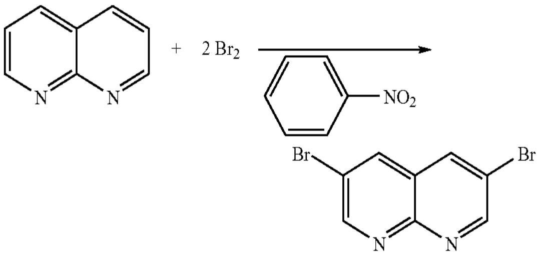
(77% Yield)

[0073] 1.0 g (5.78 mmol) of 2,7-dichloro-1,8-naphthyridine [5], 3.2 g (14.5 mmol) of Phenanthene-9-boronic acid [7], 200 ml of toluene, and 100 ml of ethanol were loaded into a 500-ml three-necked flask. An aqueous solution prepared by dissolving 20 g of sodium carbonate into 100 ml of water was dropped to the mixture while stirring under a nitrogen atmosphere at room temperature. Next, 0.33 g (0.29 mmol) of tetrakis(triphenylphosphine)palladium (0) was added to the mixture. After the mixture had been stirred at room temperature for 30 minutes, the temperature of the mixture was increased to 77° C., and the mixture was stirred for 4 hours. After the reaction, an organic layer was extracted with chloroform, dried with anhydrous sodium sulfate, and purified with a silica gel column (mixed developing solvent of toluene and ethl acetate), whereby 2.1 g of Exemplified Compound No. 13 (white crystal) were obtained (77% yield).

SYNTHESIS EXAMPLE 3

Synthesis of Exemplified Compound No. 38

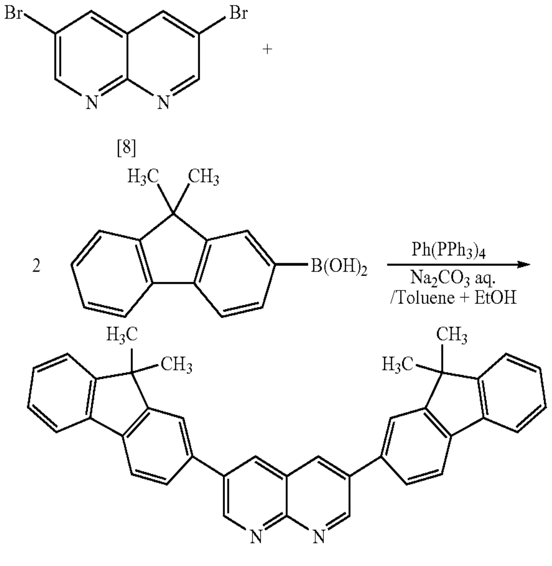
[0074]



[8]

(23% Yield)

[0075] 3,6-dibromo-1,8-naphthyridine [8] (white crystal) was obtained in a total yield of 23% according to the synthesis method described in J. Heterocyel. Chem., 13, 961 (1976).



No. 38

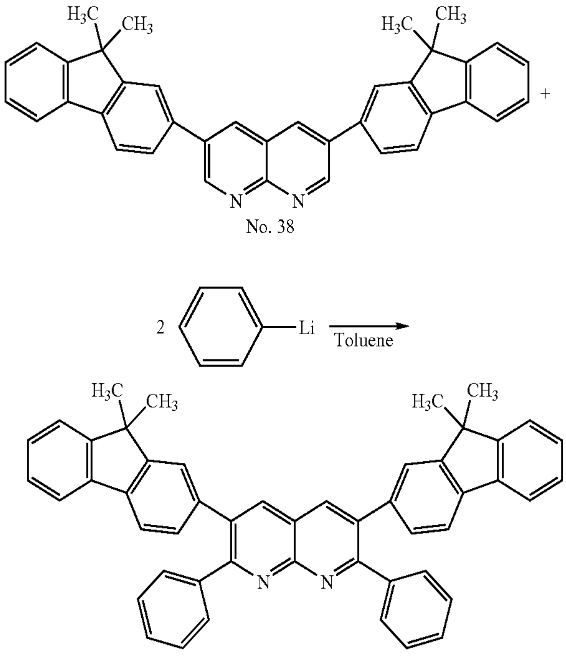
(90% Yield)

[0076] 1.0 g (3.47 mmol) of 3,6-dibromo-1,8-naphthyridine [8], 2.5 g (10.4 mmol) of 9,9-dimethylfluorene-2-boronic acid [6], 200 ml of toluene, and 100 ml of ethanol were loaded into a 500-ml three-necked flask. An aqueous solution prepared by dissolving 20 g of sodium carbonate into 100 ml of water was dropped to the mixture while stirring under a nitrogen atmosphere at room temperature. Next, 0.20 g (0.17 mmol) of tetrakis(triphenylphosphine-)palladium (0) was added to the mixture. After the mixture had been stirred at room temperature for 30 minutes, the temperature of the mixture was increased to 77° C., and the mixture was stirred for 4 hours. After the reaction, an organic layer was extracted with chloroform, dried with anhydrous sodium sulfate, and purified with a silica gel column (mixed developing solvent of chloroform and heptane), whereby 1.6 g of Exemplified Compound No. 38 (white crystal) were obtained (90% yield).

SYNTHESIS EXAMPLE 4

Synthesis of Exemplified Compound No. 49

[0077]



No. 38

No. 49
(11% Yield)

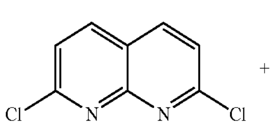
[0078] Synthesis was performed with reference to the synthesis method described in Z. Chem., 18, 382 (1978).

[0079] 1.0 g (1.94 mmol) of Exemplified Compound No. 38 and 100 ml of toluene were loaded into a 300-ml three-necked flask. 20 ml (19.4 mmol) of a phenyllithium/cyclohexane solution [0.98 mol/l] were dropped to the mixture while stirring under a nitrogen atmosphere at −78° C. After the temperature of the mixture had been gradually increased to room temperature, the mixture was stirred for 8 hours. After the reaction, an organic layer was extracted with chloroform, dried with anhydrous sodium sulfate, and purified with a silica gel column (mixed developing solvent of toluene and ethyl acetate), whereby 0.14 g of Exemplified Compound No. 49 (white crystal) was obtained (11% yield).

SYNTHESIS EXAMPLE 5

Synthesis of Exemplified Compound No. 57

[0080]



[5]

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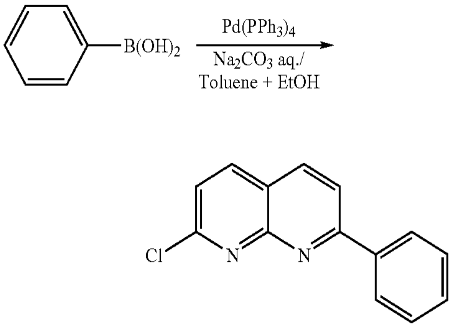
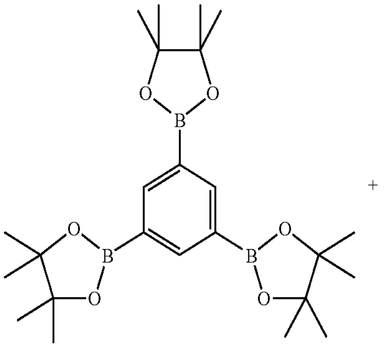
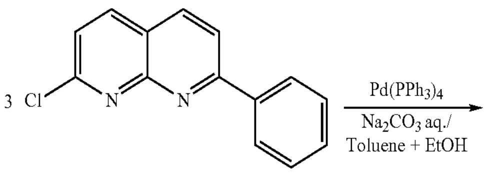


[9]
(35% Yield)

[0081] 3.0 g (17.3 mmol) of 2,7-dichloro-1,8-naphthyridine [5], 1.6 g (13.0 mmol) of Phenyl boronic acid, 200 ml of toluene, and 100 ml of ethanol were loaded into a 500-ml three-necked flask. An aqueous solution prepared by dissolving 24 g of sodium carbonate into 120 ml of water was dropped to the mixture while stirring under a nitrogen atmosphere at room temperature. Next, 1.00 g (0.87 mmol) of tetrakis(triphenylphosphine)palladium (0) was added to the mixture. After the mixture had been stirred at room temperature for 30 minutes, the temperature of the mixture was increased to 77° C., and the mixture was stirred for 1 hours. After the reaction, an organic layer was extracted with chloroform, dried with anhydrous sodium sulfate, and purified with a silica gel column (mixed developing solvent of toluene and ethyl acetate), whereby 1.5 g of 2-chloro-7-Phenyl-1,8-haphthyridine [9] (white crystal) were obtained (35% yield).



[10]



[9]

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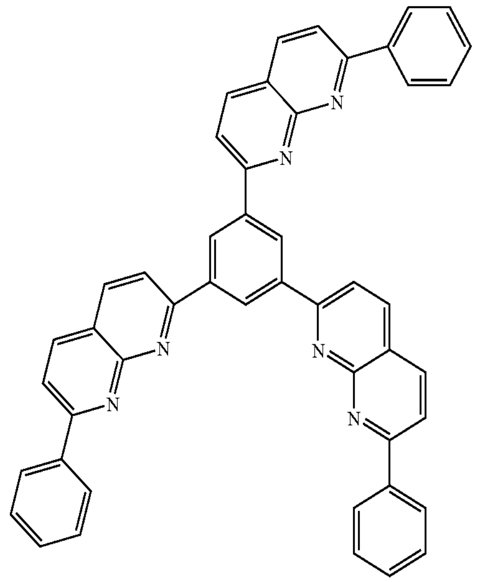


No. 57
(73% yield)

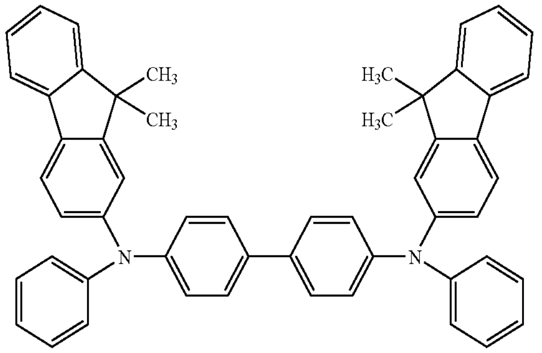
[0082] 1.0 g (4.15 mmol) of 2-chloro-7-phenyl-1,8-naphthyridine [9], 0.47 g (1.04 mmol) of tripinacol [10], 40 ml of toluene, and 20 ml of ethanol were loaded into a 500-ml three-necked flask. An aqueous solution prepared by dissolving 4 g of sodium carbonate into 20 ml of water was dropped to the mixture while stirring under a nitrogen atmosphere at room temperature. Next, 0.17 g (0.15 mmol) of tetrakis(triphenylphosphine)palladium (0) was added to the mixture. After the mixture had been stirred at room temperature for 30 minutes, the temperature of the mixture was increased to 77° C., and the mixture was stirred for 6 hours. After the reaction, an organic layer was extracted with chloroform, dried with anhydrous sodium sulfate, and purified with a silica gel column (mixed developing solvent of toluene and ethyl acetate), whereby 0.50 g of Exemplified Compound No. 57 (yellow crystal) were obtained (73% yield).

EXAMPLE 1

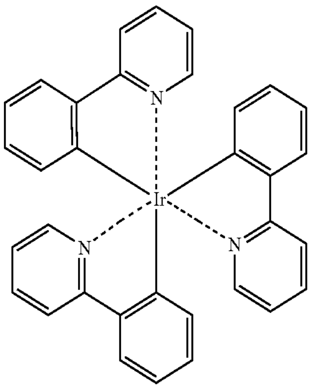
[0083] An organic light-emitting device having the structure shown in **FIG. 3** was produced.

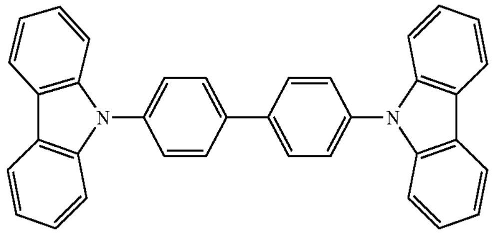
[0084] Indium tin oxide (ITO) as the anode **2** was formed into a film having a thickness of 120 nm on a glass substrate as the substrate **1** by means of a sputtering method, and the obtained substrate was used as a transparent conductive supporting substrate. The obtained substrate was subjected to ultrasonic cleaning with acetone and isopropyl alcohol (IPA) sequentially, and was then subjected to boiling cleaning with IPA, followed by drying. Furthermore, the transparent conductive supporting substrate was subjected to UV/ozone cleaning before use.

[0085] A solution of a compound represented by the following structural formula in chloroform was formed into a film having a thickness of 20 nm on the transparent conductive supporting substrate by means of a spin coating method, whereby the hole transport layer **5** was formed.



[0086] Furthermore, an Ir complex and CBP (at a weight ratio of 5:100) represented by the following structural formulae were formed into a film having a thickness of 20 nm by means of a vacuum deposition method, whereby the light emission layer **3** was formed. Film formation was performed under conditions including: a degree of vacuum upon deposition of 1.0×10^{-4} Pa; and a film forming rate of 0.2 to 0.3 nm/sec.





CBP

[0087] Furthermore, a synthesis of exemplified compound No. 6 was formed into a film having a thickness of 40 nm by means of a vacuum deposition method, whereby the electron transport layer **6** was formed. Film formation was performed under conditions including: a degree of vacuum upon deposition of 1.0×10^{-4} Pa; and a film forming rate of 0.2 to 0.3 nm/sec.

[0088] Next, a metal layer film having a thickness of 50 nm as the cathode **4** was formed of a deposition material composed of aluminum and lithium (having a lithium concentration of 1 atomic %) on the organic layer by means of a vacuum deposition method. Furthermore, an aluminum layer having a thickness of 150 nm was formed by means of a vacuum deposition method. Film formation was performed under conditions including: a degree of vacuum upon deposition of 1.0×10^{-4} Pa; and a film forming rate of 1.0 to 1.2 nm/sec.

[0089] Furthermore, the thus obtained device was covered with a protective glass plate and sealed with an acrylic resin-based adhesive under a nitrogen atmosphere.

[0090] A direct voltage of 10 V was applied to the thus obtained device using the ITO electrode (anode **2**) as a positive electrode and the Al—Li electrode (cathode **4**) as a negative electrode. As a result, a current flowed in the device at a current density of 18 mA/cm^2, and green light emission having a luminance of 4,700 cd/m^2 was observed.

[0091] Furthermore, a voltage was applied for 100 hours with a current density kept at 6.0 mA/cm^2. As a result, an initial luminance was 950 cd/m^2 was changed to 900 cd/m^2 after 100 hours, and luminance degradation was small.

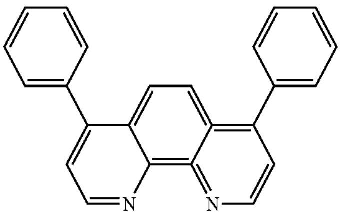
EXAMPLES 2 TO 23

[0092] In each of Examples 2 to 23, an organic light-emitting device was produced in the same manner as in Example 1 except that a compound shown in Table 1 was used instead of Exemplified Compound No. 6, and the device was similarly evaluated. Table 1 also shows the evaluated results.

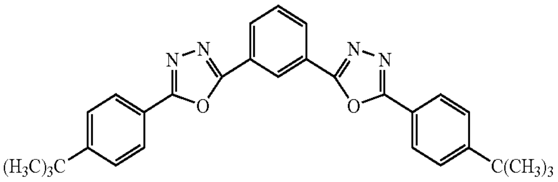
COMPARATIVE EXAMPLES 1 TO 3

[0093] In each of Comparative Examples 1 to 3, an organic light-emitting device was produced in the same manner as in Example 1 except that a compound represented by the following structure formulae was used instead of Exemplified Compound No. 6, and the device was similarly evaluated. Table 1 shows the evaluated results.

Comparative Compound No. 1



Comparative Compound No. 2



[0094] Comparative Compound No. 3

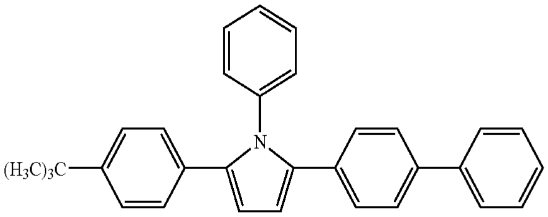


TABLE 1

		Initial		Duration		
Example No.	Exemplified Compound No.	Applied voltage (V)	Luminance (cd/m^2)	Current density (mA/cm^2)	Initial luminance (cd/m^2)	Luminance after 100 hrs. (cd/m^2)
Ex. 1	6	10	4700	6.0	950	900
Ex. 2	1	10	4100	6.0	760	660
Ex. 3	5	10	3900	6.0	740	680
Ex. 4	8	10	4500	6.0	900	860
Ex. 5	9	10	4000	6.0	800	650
Ex. 6	20	10	3800	6.0	820	750
Ex. 7	23	10	4500	6.0	930	820
Ex. 8	25	10	4400	6.0	840	690
Ex. 9	27	10	4600	6.0	880	750
Ex. 10	30	10	4800	6.0	980	890
Ex. 11	33	10	4200	6.0	850	810
Ex. 12	36	10	4000	6.0	820	770
Ex. 13	37	10	3700	6.0	790	670
Ex. 14	39	10	3700	6.0	830	730
Ex. 15	40	10	4000	6.0	790	690
Ex. 16	41	10	3600	6.0	720	640
Ex. 17	46	10	3900	6.0	800	680
Ex. 18	48	10	4700	6.0	930	890
Ex. 19	49	10	4700	6.0	940	890
Ex. 20	54	10	4300	6.0	900	840
Ex. 21	55	10	4400	6.0	920	880
Ex. 22	56	10	4500	6.0	890	860

TABLE 1-continued

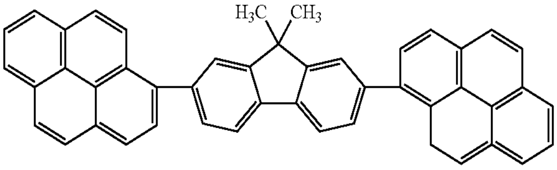
		Initial		Duration		
Example No.	Exemplified Compound No.	Applied voltage (V)	Luminance (cd/m^2)	Current density (mA/cm^2)	Initial luminance (cd/m^2)	Luminance after 100 hrs. (cd/m^2)
Ex. 23	59	10	5100	6.0	990	920
Comparative Ex. 1	Comparative Compound No. 1	10	3200	6.0	720	350
Comparative Ex. 2	Comparative Compound No. 2	10	2300	6.0	580	250
Comparative Ex. 3	Comparative Compound No. 3	10	1800	6.0	530	200

EXAMPLE 24

[0095] An organic light-emitting device having the structure shown in **FIG. 3** was produced.

[0096] In the same manner as in Example 1, the hole transport layer **5** was formed on the transparent conductive supporting substrate.

[0097] Furthermore, a fluorine compound represented by the following structural formulae was formed into a film having a thickness of 20 nm by means of a vacuum deposition method, whereby the light emission layer **3** was formed. Film formation was performed under conditions including: a degree of vacuum upon deposition of 1.0×10^{-4} Pa; and a film forming rate of 0.2 to 0.3 nm/sec.



[0098] Furthermore, a synthesis of exemplified compound No. 2 was formed into a film having a thickness of 40 nm by means of a vacuum deposition method, whereby the electron transport layer **6** was formed. Film formation was performed under conditions including: a degree of vacuum upon deposition of 1.0×10^{-4} Pa; and a film forming rate of 0.2 to 0.3 nm/sec.

[0099] Next, the cathode **4** was formed in the same manner as in Example 1, followed by sealing.

[0100] A direct voltage of 5 V was applied to the thus obtained device using the ITO electrode (anode **2**) as a positive electrode and the Al—Li electrode (cathode **4**) as a negative electrode. As a result, a current flowed in the device at a current density of 65 mA/cm^2, and blue light emission having a luminance of 3,300 cd/m^2 was observed.

[0101] Furthermore, a voltage was applied for 100 hours with a current density kept at 30 mA/cm^2. As a result, an initial luminance of 1,700 cd/m^2 was changed to 1,300 cd/m^2 after 100 hours, and luminance degradation was small.

EXAMPLES 25 TO 44

[0102] In each of Examples 25 to 44, an organic light-emitting device was produced in the same manner as in Example 24 except that a compound shown in Table 2 was used instead of Exemplified Compound No. 2, and the device was similarly evaluated. Table 2 also shows the evaluated results.

COMPARATIVE EXAMPLES 4 TO 6

[0103] In each of Comparative Examples 4 to 6, an organic light-emitting device was produced in the same manner as in Example 24 except that a comparative compound No. 1, 2 or 3 was used instead of Exemplified Compound No. 2, and the device was similarly evaluated. Table 2 shows the evaluated results.

TABLE 2

		Initial		Duration		
Example No.	Exemplified Compound No.	Applied voltage (V)	Luminance (cd/m^2)	Current density (mA/cm^2)	Initial luminance (cd/m^2)	Luminance after 100 hrs. (cd/m^2)
Ex. 24	2	5	3300	30	1700	1300
Ex. 25	4	5	3100	30	1400	1100
Ex. 26	6	5	3500	30	1900	1500

TABLE 2-continued

		Initial		Duration		
Example No.	Exemplified Compound No.	Applied voltage (V)	Luminance (cd/m^2)	Current density (mA/cm^2)	Initial luminance (cd/m^2)	Luminance after 100 hrs. (cd/m^2)
Ex. 27	7	5	3000	30	1400	1000
Ex. 28	10	5	2700	30	900	650
Ex. 29	13	5	3500	30	1700	1400
Ex. 30	24	5	3400	30	1600	1100
Ex. 31	26	5	3400	30	1800	1200
Ex. 32	28	5	3300	30	1600	1300
Ex. 33	29	5	3100	30	1300	950
Ex. 34	31	5	3100	30	1200	850
Ex. 35	32	5	2900	30	1300	1000
Ex. 36	34	5	2800	30	950	750
Ex. 37	38	5	2700	30	1000	700
Ex. 38	45	5	2800	30	1000	750
Ex. 39	47	5	3200	30	1300	1000
Ex. 40	51	5	3200	30	1100	850
Ex. 41	53	5	2800	30	950	800
Ex. 42	57	5	3300	30	1500	1300
Ex. 43	58	5	3200	30	1600	1300
Ex. 44	60	5	3000	30	1200	850
Comparative Ex. 4	Comparative Compound No. 1	5	2400	30	750	400
Comparative Ex. 5	Comparative Compound No. 2	5	1300	30	550	200
Comparative Ex. 6	Comparative Compound No. 3	5	900	30	500	200

EXAMPLE 45

[0104] An organic light-emitting device having the structure shown in **FIG. 2** was produced.

[0105] In the same manner as in Example 1, the hole transport layer **5** was formed on the transparent conductive supporting substrate.

[0106] Furthermore, a synthesis of exemplified compound No. 3 was formed into a film having a thickness of 40 nm by means of a vacuum deposition method to form the electron transport layer **6** also serving as the light emission layer. Film formation was performed under conditions including: a degree of vacuum upon deposition of 1.0×10^{-4} Pa; and a film forming rate of 0.2 to 0.3 nm/sec.

[0107] Next, the cathode **4** was formed in the same manner as in Example 1, followed by sealing.

[0108] A direct voltage of 5 V was applied to the thus obtained device using the ITO electrode (anode **2**) as a positive electrode and the Al—Li electrode (cathode **4**) as a negative electrode. As a result, a current flowed in the device at a current density of 45 mA/cm^2, and blue light emission having a luminance of 1,800 cd/m^2 was observed.

[0109] Furthermore, a voltage was applied for 100 hours with a current density kept at 30 mA/cm^2. As a result, an initial luminance was 100 cd/m^2 was changed to 750 cd/m^2 after 100 hours, and luminance degradation was small.

EXAMPLES 46 TO 61

[0110] In each of Examples 46 to 61, an organic light-emitting device was produced in the same manner as in Example 45 except that a compound shown in Table 3 was used instead of Exemplified Compound No. 3, and the device was similarly evaluated. Table 3 also shows the evaluated results.

COMPARATIVE EXAMPLES 7 TO 9

[0111] In each of Comparative Examples 7 to 9, a light-emitting device was produced in the same manner as in Example 45 except that a comparative compound No 1, 2 or 3 was used instead of Exemplified Compound No. 3, and the device was similarly evaluated. Table 3 shows the evaluated results.

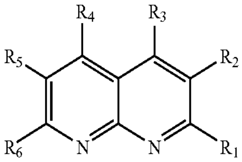
TABLE 3

		Initial		Duration		
						Luminance
Example No.	Exemplified Compound No.	Applied voltage (V)	Luminance (cd/m^2)	Current density (mA/cm^2)	Initial luminance (cd/m^2)	after 100 hrs. (cd/m^2)
Ex. 45	3	5	1800	30	1100	750
Ex. 46	11	5	2000	30	1200	850
Ex. 47	12	5	1700	30	900	650
Ex. 48	14	5	2200	30	1400	1100
Ex. 49	15	5	2000	30	1000	800
Ex. 50	16	5	1500	30	750	550
Ex. 51	17	5	1400	30	700	500
Ex. 52	18	5	2100	30	1400	1000
Ex. 53	19	5	1600	30	900	650
Ex. 54	21	5	1600	30	1000	750
Ex. 55	22	5	1500	30	1000	700
Ex. 56	35	5	1300	30	700	550
Ex. 57	42	5	1900	30	1200	850
Ex. 58	43	5	1700	30	900	650
Ex. 59	44	5	1800	30	1000	700
Ex. 60	50	5	2000	30	1200	950
Ex. 61	52	5	2300	30	1400	1100
Comparative Ex. 7	Comparative Compound No. 1	5	350	30	250	100
Comparative Ex. 8	Comparative Compound No. 2	5	200	30	150	No light emission
Comparative Ex. 9	Comparative Compound No. 3	5	250	30	150	No light emission

[0112] This application claims priority from Japanese Patent Application No. 2005-180391 filed on Jun. 21, 2005, which is hereby incorporated by reference herein.

What is claimed is:

1. A 1,8-naphthyridine compound represented by the following general formula [I]:

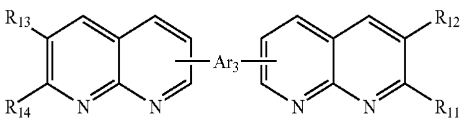


[I]

wherein R_1 to R_6 each represent one selected from the group consisting of a hydrogen atom, a substituted or unsubstituted alkyl group, a substituted or unsubstituted aralkyl group, a substituted or unsubstituted aryl group, a substituted or unsubstituted heterocyclic group, a substituted or unsubstituted condensed polycyclic aromatic group, a substituted or unsubstituted condensed polycyclic heterocyclic group, a substituted or unsubstituted aryloxy group, a substituted amino group, a halogen atom, a trifluromethyl group, and a cyano group, and R_1 to R_6 may be the same as or different from one another, provided that at least two of R_1 to R_6 each represent one selected from the group consisting of a substituted or unsubstituted aralkyl group, a substituted or unsubstituted aryl group, a substituted or unsubstituted heterocyclic group, a substituted or unsubstituted condensed polycyclic aromatic group, a substituted or unsubstituted condensed polycyclic heterocyclic group, a substituted or unsubstituted aryloxy group, and a substituted amino group.

2. A 1,8-naphthyridine compound according to claim 1, wherein R_2 to R_5 each represent one selected from the group consisting of a hydrogen atom, a substituted or unsubstituted alkyl group, a halogen atom, a trifluromethyl group, and a cyano group; and R_1 and R_6 each represent one selected from the group consisting of a substituted or unsubstituted aralkyl group, a substituted or unsubstituted aryl group, a substituted or unsubstituted heterocyclic group, a substituted or unsubstituted condensed polycyclic aromatic group, a substituted or unsubstituted condensed polycyclic heterocyclic group, a substituted or unsubstituted aryloxy group, and a substituted amino group.

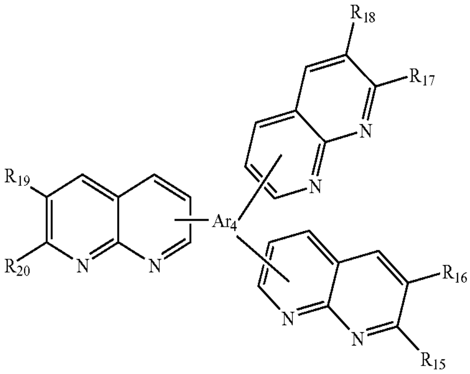
3. A 1,8-naphthyridine compound represented by the following general formula [II]:



[II]

wherein R_{11} to R_{14} each represent one selected from the group consisting of a hydrogen atom, a substituted or unsubstituted alkyl group, a substituted or unsubstituted aralkyl group, a substituted or unsubstituted aryl group, a substituted or unsubstituted heterocyclic group, a substituted or unsubstituted condensed polycyclic aromatic group, a substituted or unsubstituted condensed polycyclic heterocyclic group, a substituted or unsubstituted aryloxy group, a substituted amino group, a halogen atom, a triflurómethyl group, and a cyano group, and R_{11} to R_{14} may be the same as or different from one another; and Ar_3 represents one selected from the group consisting of a divalent, substituted or unsubstituted aromatic group, a divalent, substituted or unsubstituted heterocyclic group, a divalent, substituted or unsubstituted condensed polycyclic aromatic group, and a divalent, substituted or unsubstituted condensed polycyclic heterocyclic group.

4. A 1,8-naphthyridine compound represented by the following general formula [III]:



[III]

wherein R_{15} to R_{20} each represent one selected from the group consisting of a hydrogen atom, a substituted or unsubstituted alkyl group, a substituted or unsubstituted aralkyl group, a substituted or unsubstituted aryl group, a substituted or unsubstituted heterocyclic group, a substituted or unsubstituted condensed polycyclic aromatic group, a substituted or unsubstituted condensed polycyclic heterocyclic group, a substituted or unsubstituted aryloxy group, a substituted amino group, a halogen atom, a triflurómethyl group, and a cyano group, and R_{15} to R_{20} may be the same as or different from one another; and Ar_4 represents one selected from the group consisting of a trivalent, substituted or unsubstituted aromatic group, a trivalent, substituted or unsubstituted heterocyclic group, a trivalent, substituted or unsubstituted condensed polycyclic aromatic group, and a trivalent, substituted or unsubstituted condensed polycyclic heterocyclic group.

5. An organic light-emitting device comprising:

a pair of electrodes composed of an anode and a cathode; and

one or more layers each containing an organic compound, the layers being interposed between the pair of electrodes,

wherein at least one layer of the layers containing the organic compounds contains at least one kind of the 1,8-naphthyridine compound according to claim 1.

6. An organic light-emitting device according to claim 5, wherein the layer containing at least one kind of the 1,8-naphthyridine compound is one of a hole blocking layer, an electron transport layer, a light emission layer, and an electron injection layer.

7. An organic light-emitting device comprising:

a pair of electrodes composed of an anode and a cathode; and

one or more layers each containing an organic compound, the layers being interposed between the pair of electrodes,

wherein at least one layer of the layers containing the organic compound contains at least one kind of the 1,8-naphthyridine compound according to claim 2.

8. An organic light-emitting device according to claim 7, wherein the layer containing at least one kind of the 1,8-naphthyridine compound is one of a hole blocking layer, an electron transport layer, a light emission layer, and an electron injection layer.

9. An organic light-emitting device comprising:

a pair of electrodes composed of an anode and a cathode; and

one or more layers each containing an organic compounds, the layers being interposed between the pair of electrodes,

wherein at least one layer of the layers each containing the organic compounds contains at least one kind of the 1,8-naphthyridine compound according to claim 3.

10. An organic light-emitting device according to claim 9, wherein the layer containing at least one kind of the 1,8-naphthyridine compound is one of a hole blocking layer, an electron transport layer, a light emission layer, and an electron injection layer.

11. An organic light-emitting device comprising:

a pair of electrodes composed of an anode and a cathode; and

one or more layers each containing an organic compound, the layers being interposed between the pair of electrodes,

wherein at least one layer of the layers containing the organic compound contains at least one kind of the 1,8-naphthyridine compound according to claim 4.

12. An organic light-emitting device according to claim 11, wherein the layer containing at least one kind of the 1,8-naphthyridine compound is one of a hole blocking layer, an electron transport layer, a light emission layer, and an electron injection layer.

* * * * *

专利名称(译)	1,8-萘啶化合物和使用其的有机发光器件		
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IPC分类号	H01L51/54 H05B33/12 C07D471/02		
CPC分类号	C07D471/04 H05B33/14 C09K2211/1007 C09K2211/1011 C09K2211/1014 C09K2211/1029 C09K2211/1033 C09K2211/1044 C09K2211/1048 C09K2211/1059 C09K2211/1088 C09K2211/185 C09K2211/186 C09K2211/188 H01L51/0054 H01L51/0058 H01L51/0072 H01L51/5012 H01L51/5048 C09K11/06 Y10S428/917		
优先权	2005180391 2005-06-21 JP		
其他公开文献	US7833634		
外部链接	Espacenet USPTO		

摘要(译)

提供由下列通式[I]表示的新的1,8-二氮杂萘化合物： 其中R1-R6各自代表选自氢原子的一种;烷基，芳烷基，芳基，杂环基，稠合多环芳香基，稠合多环杂环基和可被取代的芳氧基;取代的氨基;卤素原子;三氟甲基;只要R 1至R 6中的至少两个代表选自芳烷基，芳基，杂环基，稠合多环中的一种，可以是氰基，并且可以彼此相同或不同。芳香族基团，稠合多环杂环基和可被取代的芳氧基;和取代的氨基。

[I]