(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 808 912 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
15.08.2012 Bulletin 2012/33

(51) Int Cl.:
H01L 51/54 *(2006.01)*

(21) Application number: **07000776.0**

(22) Date of filing: **16.01.2007**

(54) **Electron transport compound and organic light emitting device comprising the same**

Elektronentransportverbindung und Verwendung in einer organischen Leuchtdiode

Composé transporteur d'électrons et dispositif organique électroluminescent comprenant ce composé

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR

(30) Priority: **16.01.2006 KR 20060004687**
16.01.2006 KR 20060004688
16.01.2006 KR 20060004689

(43) Date of publication of application:
18.07.2007 Bulletin 2007/29

(73) Proprietor: **LG Display Co., Ltd.**
Seoul 150-721 (KR)

(72) Inventors:
- **Kim, Jung Keun**
  Yeongdeungpo-ga,
  150-797 Seoul (KR)
- **Seo, Jeongdae**
  Incheon (KR)
- **Jeong, Hyun Cheol**
  Jinju-si
  Gyeongsangnam-do 660-787 (KR)
- **Bin, Jong Kwan**
  Yongin-si
  Gyeonggi-do (KR)
- **Park, Chungun**
  Gwanak-gu
  Seoul (JP)

(74) Representative: **Viering, Jentschura & Partner**
Grillparzerstrasse 14
81675 München (DE)

(56) References cited:
WO-A1-2006/057325
US-A1- 2003 157 365
US-A1- 2004 265 629
US-A1- 2005 238 920

- **PARK Y H ET AL: "Theoretical investigation of tetra-substituted pyrenes for organic light emitting diodes" CURRENT APPLIED PHYSICS, NORTH-HOLLAND LNKD- DOI:10.1016/J.CAP. 2005.04.021, vol. 6, no. 4, 26 May 2005 (2005-05-26), pages 691-694, XP024973364 ISSN: 1567-1739 [retrieved on 2006-07-01]**

EP 1 808 912 B1

Description

BACKGROUND

Field

[0001] This document relates to an electron transport compound and an organic light emitting device comprising the same.

Related Art

[0002] Park et al. [Yong Hwan Park, Hyeon Hee Rho, No Gill Park, Young Sik Kim: Theoretical investigation of tetra-substituted pyrenes for organic light emitting diodes; Current Applied Physics 6 (2006) 691-694] studied 1,3,6,8-tetra-substituted pyrenes as blue fluorescent light emitting materials for organic light emitting diodes (OLEDs) to increase luminescence efficiency and color purity. These 1,3,6,8-tetra-substituted pyrenes were investigated theoretically by using the density functional theory DFT for energy calculation and geometry optimization of the ground electronic state of the compounds and by using the configuration interaction with single excitations (CIS) method.

[0003] Kinoshita et al. [Kinoshita et al., Organic element and organic EL display, US Patent Application Publication No.: US 2003/0157365 A1] describe an organic EL element having excellent light-emitting efficiency, light-emitting luminance, and color purity of blue light, and a highly efficient organic EL display using this organic EL element, in which organic EL element the light-emitting layer comprises an 1,3,6,8-tetraphenylpyrene compound as guest material and a carbazole derivative functioning as host material.

[0004] Sotoyama et al. [Sotoyama et al., 1,3,6,8-tetrasubstituted pyrene compound, organic electroluminescent element, and organic electroluminescent display, US Patent Application Publication No.: US 2005/0238920 A1] describe organic electroluminescent elements that are excellent in luminous efficiency, luminance, and color purity and exhibit long lifetime, which organic EL elements comprise an 1,3,6,8-tetrasubstituted pyrene compound as the light emitting material.

[0005] Oyamada et al. [Oyamada et al., Pyrene compound and, utilizing the same, light emitting transistor device and electroluminescence device, WO 2006/057325 A1] describe a light-emitting transistor element or an organic electroluminescence element, wherein a specific asymmetric pyrene-based compound is used in a light-emitting layer in the light-emitting transistor element.

[0006] In general, an organic light emitting display is a self-emitting display for emitting light by electrically exciting a fluorescent compound and has been spotlighted as a future generation display that can solve problems of a liquid crystal display as it can be driven in a low voltage, easily reduce a thickness, have a wide viewing angle and a fast response speed, etc.

[0007] The organic light emitting device comprises an organic emitting layer between an anode and a cathode. The organic light emitting device forms an exciton, which is a hole-electron pair, by coupling a hole received from the anode and an electron received from the cathode within the organic light emitting layer and emits light by generating energy when the exciton returns to a ground level. The organic light emitting device further comprises a hole(electron) injecting layer and/or a hole(electron) transporting layer between the anode or the cathode and the emitting layer.

[0008] A process of manufacturing organic light emitting device is as follows.

[0009] (1) First, an anode is formed on a transparent substrate. As the material for anode, Indium Tin Oxide (ITO) is generally used.

[0010] (2) A hole injecting layer (HIL) is formed on the anode. As the HIL, copper phthalocyanine (CuPc) is generally used and the thickness of the HIL is 10nm to 30nm.

[0011] (3) Next, a hole transport layer (HTL) is formed on the HIL. As the hole transport layer, 4,4'-bis[N-(1-naphthyl)-N-phenthylamino]-biphenyl (NPB) is generally used and the thickness of the HTL is 30nm to 60nm.

[0012] (4) An organic emitting layer is formed on the HTL. The organic emitting layer may comprise a host and a dopant. In a case of green light emitting layer, tris(8-hydroxy-quinolatealuminum (Alq_3) as the host is deposited in a thickness of about 30 to 60nm and as a dopant, N-Methylquinacridone (MQD) is doped in the host.

[0013] (5) An electron transport layer (ETL) and an electron injecting layer (EIL) are consecutively formed or one electron injecting and transport layer is formed on the organic emitting layer. In a case of green light emitting layer, because Alq_3 of (4) has good electron transport ability, an electron injecting/transport layer may not be separately used.

[0014] (6) Next, a cathode is formed and finally a protective layer is stacked.

[0015] However, conventional organic light emitting device, particularly, an electron transport compound for an electron injecting layer or an electron transport layer has problems of low electron transport efficiency in using for a display device and difficulty of deposition. Further, a conventional electron transport compound has a problem of a short lifetime due to high possibility of crystallization and deterioration.

SUMMARY

[0016] An object of this document is to provide an organic light emitting device having a pyrene based electron transport compound and an electron injecting and transport layer comprising the electron transport compound.

[0017] Another object of this document is to provide an electron transport compound that has high electron transport efficiency, and good deposition characteristics, prevents crystallization, and has no influence on a lifetime of organic light emitting device.

[0018] Another object of this document is to provide an organic light emitting device having high brightness, high efficiency, and a long lifetime using an electron transport compound.

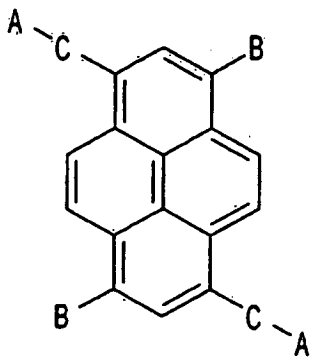
DESCRIPTION

[0019] Hereinafter, embodiments are described in detail.

[0020] Embodiment 1

[0021] In order to achieve the object, this document provides a pyrene based electron transport compound having chemical formula 1.

[Chemical formula 1-1]



[0022] Pyrene based compound of chemical formula 1-1 is a very important compound among hydrocarbons. In the pyrene based compound, carbons are numbered clockwise starting with a carbon having a substituent A-C. Accordingly, an electron transport compound according to an embodiment of this document comprises a pyrene based compound in which A-C is bonded to carbon 1 and 6, and B is bonded to carbon 3 and 8. The substituents A, B, and C may be substituted or not substituted.

[0023] The electron transport compound is a compound that injects an electron from a cathode to other layer or transports an injected electron to other layers. For example, in organic light emitting device, an electron transport compound is a compound that may be a material of an electron injecting layer, an electron transport layer, or an electron injecting and transport layer in which the electron injecting layer and the electron transport layer are mixed.

[0024] In this document, the electron injecting and transport layer is used to generally designate layers, which are related to injecting and transporting of an electron, such as an electron injecting layer, an electron transport layer, or an electron injecting and transport layer in which the electron injecting layer and the electron transport layer are mixed.

[0025] A that is substituted or is not substituted may be selected from a group consisting of pyridinyl, quinolinyl, isoquinolinyl, quinoxalinyl, bipyridinyl, terpyridinyl, and phenanthrolinyl.

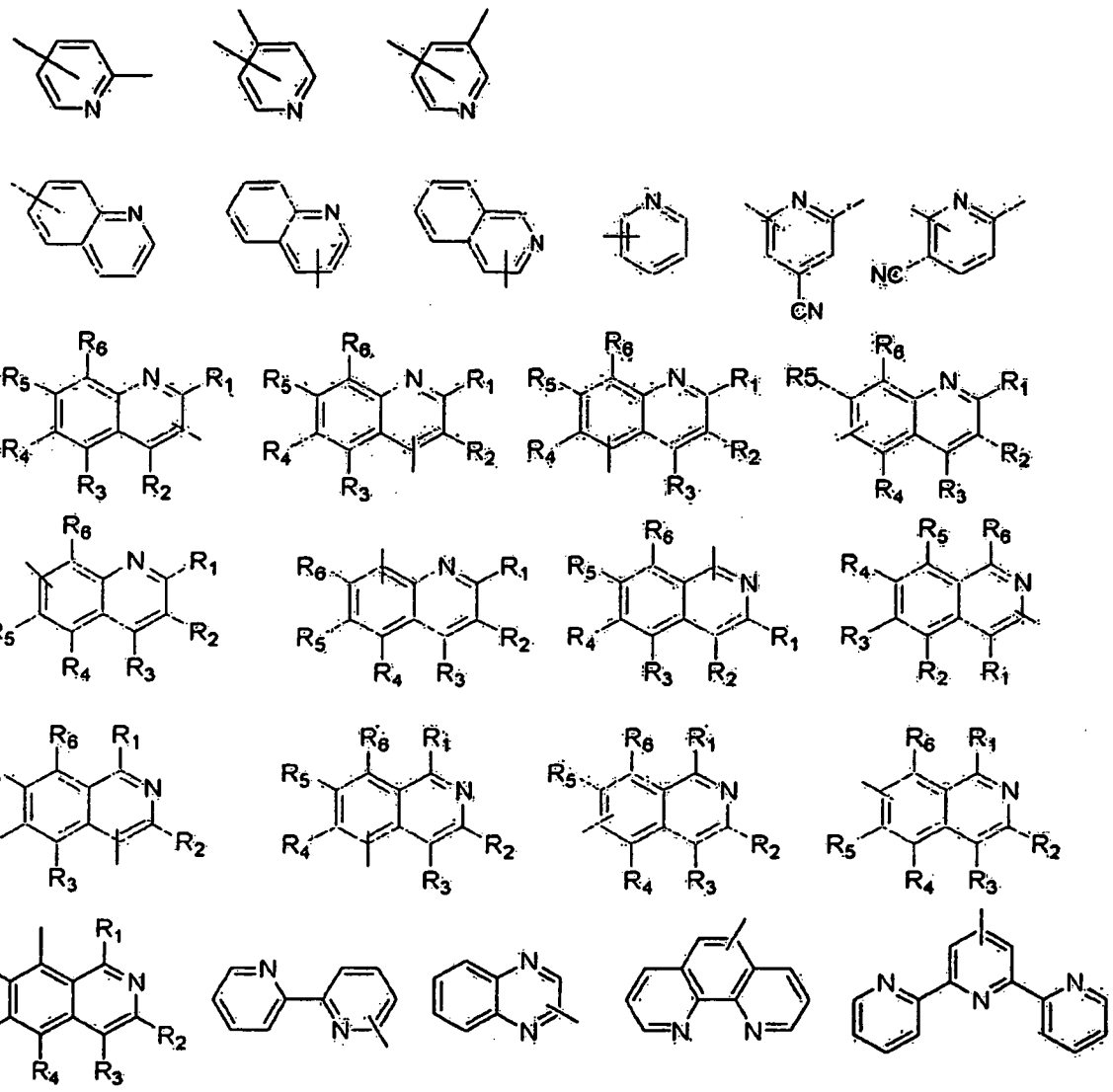
[0026] Further, B and C that are substituted or are not substituted may be selected from a group consisting of phenyl, biphenyl, naphthyl, fluorenyl, terphenyl, phenanthrolinyl, phenanthryl, and anthryl.

[0027] When the A, B, and C are substituted, a substituent of the A, B, and C may be selected from a group consisting of aryl, alkyl, aryloxy, alkoxy, allylamino, alkylamino, halogen, and cyano.

[0028] Further, when the A, B, and C are substituted, a substituent of the A, B, and C may be selected from a group consisting of phenyl, biphenyl, triphenylmethyl, phenylethylidene, diphenylethylidene, phenylmethylidyne, phenoxy, tolyoxy, methyl, ethyl, propyl, i-propyl, t-butyl, cyclohexyl, diphenylamino, morpholine, methoxy, ethoxy, propoxy, butoxy, dimethylamino, diphenylamino, fluorine, and chlorine.

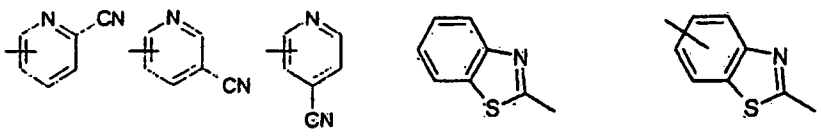
[0029] The A that is substituted or is not substituted is given by chemical formulas 1-2 and 1-3.

[Chemical formula 1-2]



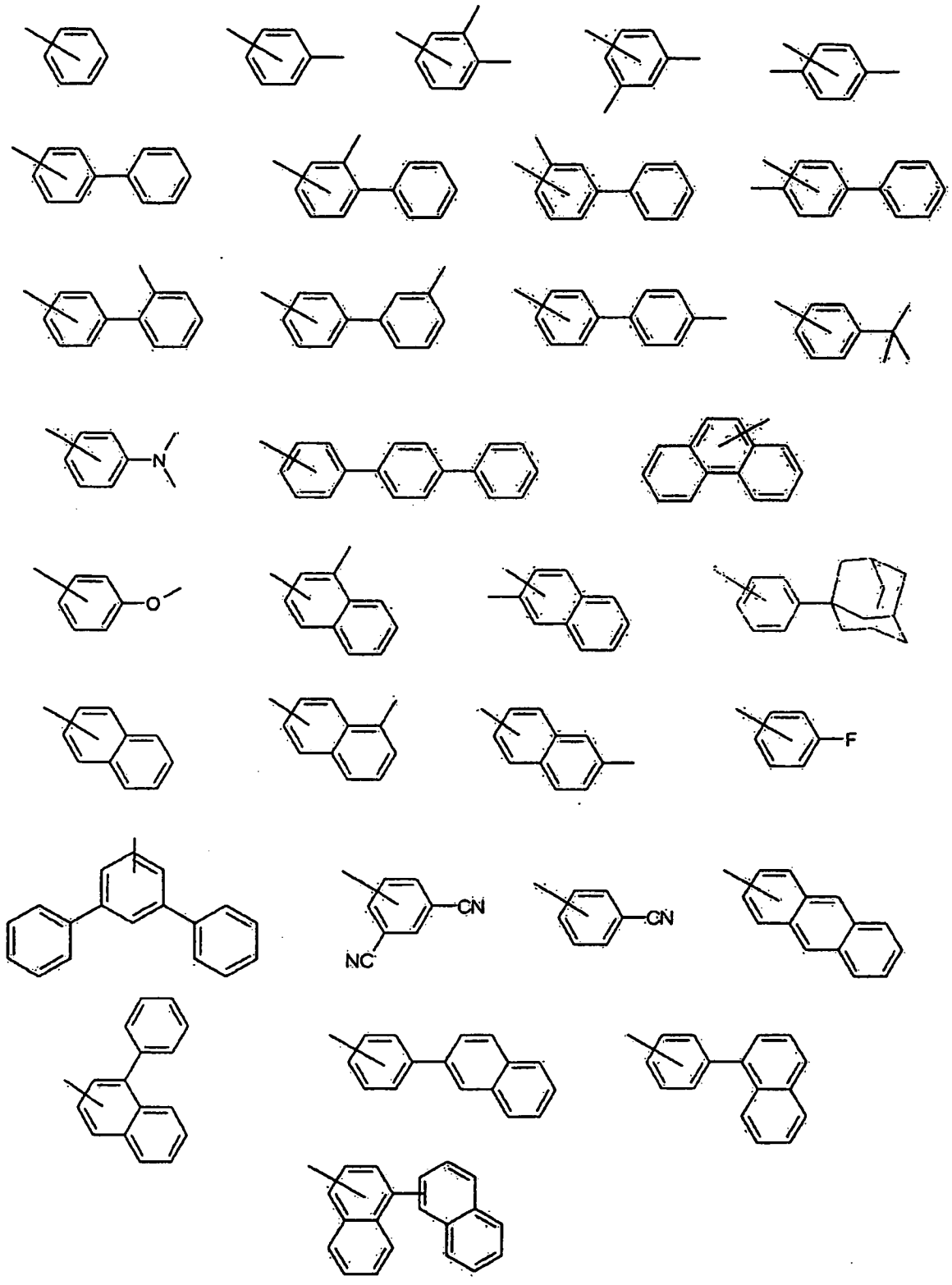
[0030] where any one of R1, R2, R3, R4, R5, and R6 is CH3, and the remaining ones are H.

[Chemical formula 1-3]



[0031] Similarly, the B and C that are substituted or not substituted are given by chemical formula 1-4.

[Chemical formula 1-4]



[0032] Various forms of electron transport compounds can be formed by combining the pyrene based electron transport compound of chemical formula 1-1 with substituents of chemical formulas 1-2 to 1-4. The electron transport compounds can be easily selected by those skilled in the art according to necessity of brightness, color purity, or a driving voltage.

[0033] This document provides organic light emitting device having the electron injecting and transport layer comprising the electron transport compound described above. The electron injecting and transport layer may be one or both of an electron injecting layer or an electron transport layer. The electron injecting and transport layer may be formed between

an organic light emitting layer and a cathode. The electron injecting and transport layer may have a different layer position when participating in injecting and transporting of an electron as described above.

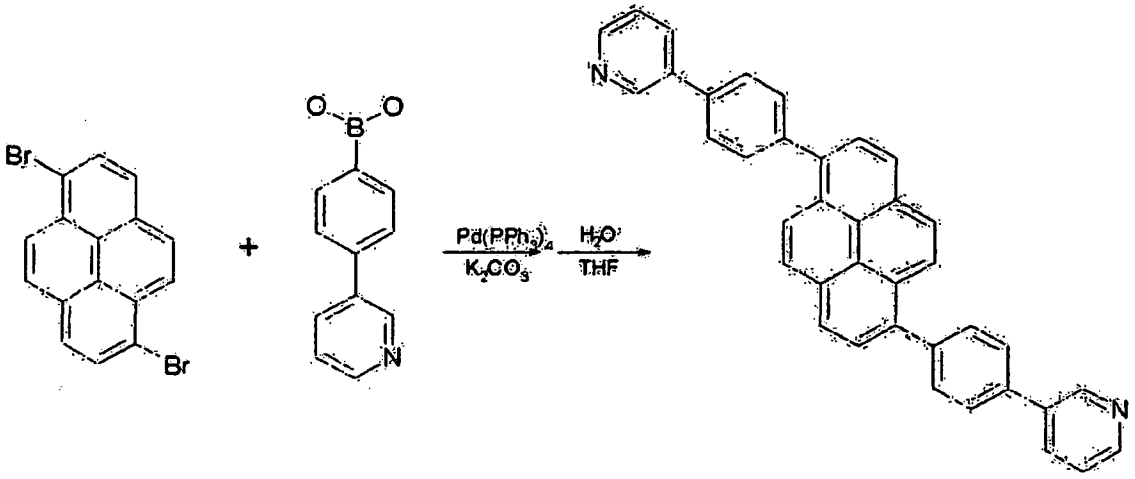
[0034] Below, synthesis examples of some compounds of the pyrene based electron transport compounds of chemical formula 1-1 are described. Only synthesis examples of some compounds are described, but synthesis examples of other pyrene based electron transport compounds of chemical formula 1-1 are similar to these synthesis examples, the synthesis examples can be easily executed by those skilled in the art, and thus descriptions thereof will be omitted.

[0035] [Synthesis Example]

[0036] 1,5-di(4-(3'-pyridine)phenyl)-3,6-diphenylpyrene among electron transport compounds of an electron injecting and transport layer of organic light emitting device according to a first embodiment of this document is synthesized as follows.

[0037] (1) Synthesis of 1,5-di(4-(3'-pyridine)-phenyl)pyrene

[Reaction equation 1-1]



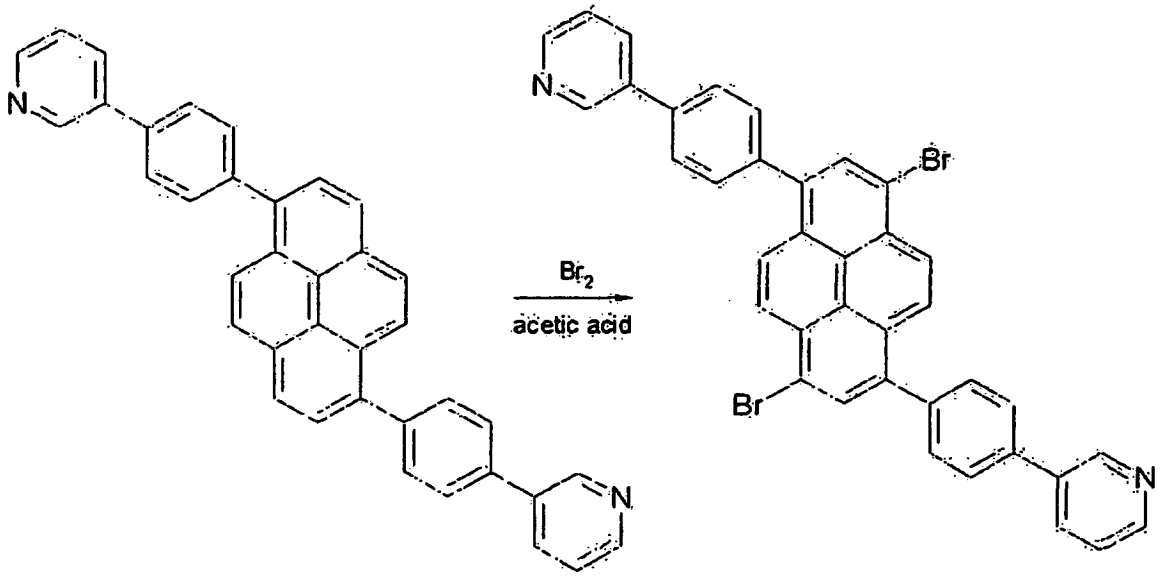
[0038] 8.3g (0.0416mol) of 4-(3'-pyridine)phenyl boronic acid and 5g (0.0139mol) of 1,5-dibromopyrene were put in 100mL of anhydrous THF and they were stirred in a dried three neck round bottom flask.

[0039] 1.0g of tetrakis(triphenylphosphine)palladium(0) and 15g of potassium carbonate were melted in 100mL of H_2O and added to the flask. Then they were stirred for 24 hours in a bath of 100□ and when a reaction was ended, THF was removed from a reaction mixture.

[0040] Thereafter, the reaction mixture was extracted using dichloromethane and water and distilled under a reduced pressure, then the distilled mixture was purified by passing through a silica gel column. The purified mixture was distilled under a reduced pressure again. The purified and distilled mixture was recrystallized using dichloromethane and methanol and filtered. Then 1,5-di(4-(3'-pyridine)-phenyl)pyrene was obtained.

[0041] (2) Synthesis of 3,6-dibromo-1,5-di(4-(3'-pyridine)-phenyl)pyrene

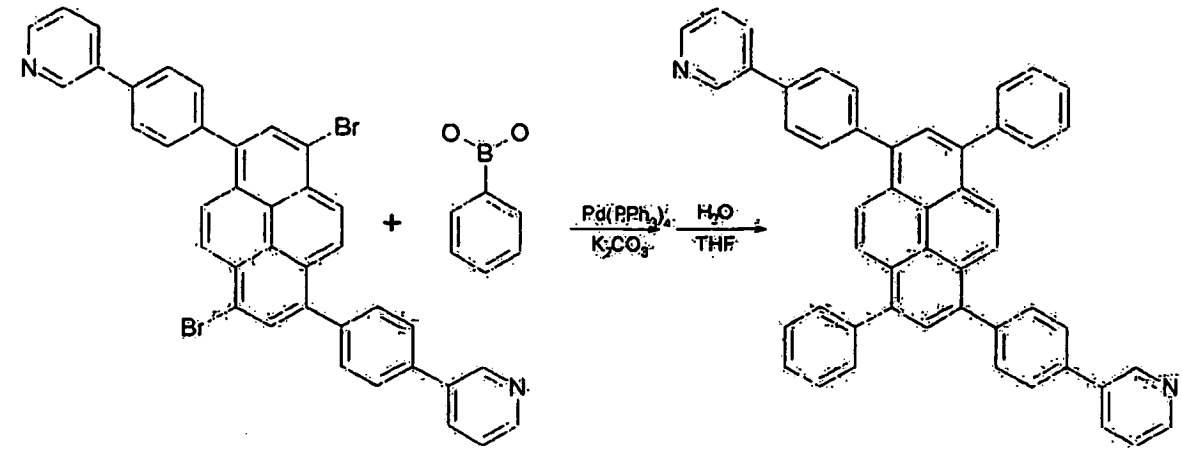
[Reaction Equation 1-2]



[0042] 1,5-di(4-(3'-pyridine)-phenyl)pyrene was put in 80mL of acetic acid and they were stirred in a dried three neck round bottom flask. After 1.9g (0.0118mol) of bromine (Br_2) was added to the reaction mixture at a room temperature and when a reaction was ended, filtering was performed. By washing and then drying the reaction mixture with excessive distilled water, 3,6-dibromo-1,5-di(4-(3'-pyridine)-phenyl)pyrene was obtained.

[0043] (3) Synthesis of 1,5-di(4-(3'-pyridine)phenyl)-3,6-diphenylpyrene

[Reaction Equation 1-3]



[0044] 3g (0.0045mol) of 3,6-dibromo-1,5-di(4-(3'-pyridine)-phenyl)pyrene and 1.65g (0.0135mol) of phenyl boronic acid were put in 80mL of anhydrous THF and they are stirred in a dried three neck round bottom flask.

[0045] 0.4g of tetrakis(triphenylphosphine)palladium(0) and 10g of potassium carbonate were melted in 80mL of H_2O and added to the three neck round bottom flask. Then the reaction mixture was stirred for 24 hours in a bath of 100°C and when a reaction was ended, THF was removed from the reaction mixture.

[0046] Thereafter, the reaction mixture was extracted using dichloromethane and water and distilled under a reduced pressure. The distilled mixture was purified by passing through a silica gel column, then distilled under a reduced pressure again. The purified and distilled mixture was recrystallized using dichloromethane and methanol and filtered. Then, 1,5-di(4-(3'-pyridine)phenyl)-3,6-diphenylpyrene, which is a final product was obtained.

[0047] [Brightness, color purity and driving voltage test 1]

[0048] In order to confirm brightness characteristic and color purity of organic light emitting device according to an embodiment of this document, conventional organic light emitting device and organic light emitting device according to an embodiment of this document were manufactured and brightness, color purity, and a driving voltage thereof were measured under the same condition.

[0049] In other words, organic light emitting device according to an embodiment of this document was manufactured using the electron transport compound synthesized in the synthesis example and conventional organic light emitting device was manufactured using a conventional material in the electron injecting and transport layer. Then brightness, color purity, and a driving voltage thereof were measured under the same condition.

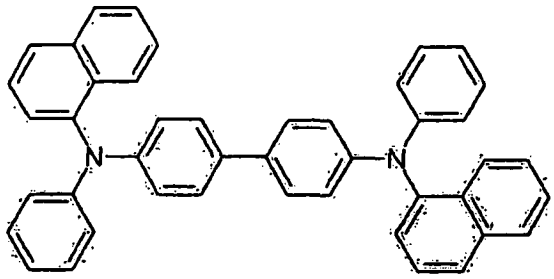
[0050] In examples, although some electron transport compounds according to embodiments of this document are described, an organic light emitting device manufactured using other pyrene based electron transport compound of chemical formula 1-1 may show the same or similar result as examples. The result may be expected by those skilled in the art and thus descriptions of other compounds will be omitted.

[0051] (1) A comparative example: Conventional organic light emitting device

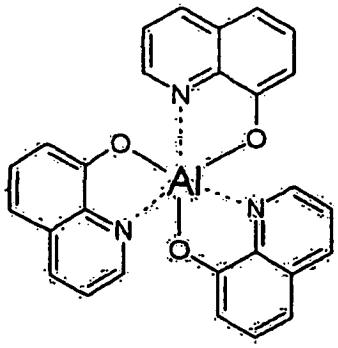
[0052] ITO glass was washed after being patterned so that a light emitting area thereof became 3mm X 3mm. After the substrate was mounted in a vacuum chamber, a hole injecting layer/a hole transport layer/a green organic emitting layer (host+dopant)/an electron injecting and transport layer/cathode (CuPc (650Å) /NPD(400Å) /Alq_3(200Å) +GD-1(1%) (50Å)/Alq_3(350Å)/LiF(5Å)/Al(1000Å)) were formed on ITO in $1.0X10^{-6}$torr (1Å = 0.1 nm; 1 torr = 133,5 Pa).

[0053] When current of 0.9mA was applied to the device, brightness was 1251cd/m^2, a driving voltage was 6.5V, and a value of a color coordinate CIE was x = 0.307 and y = 0.612.

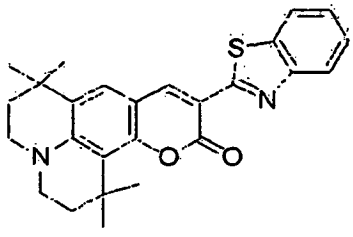
[Chemical formula 1-5]



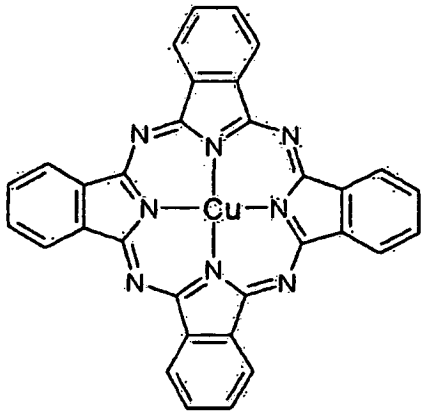
NPD



Alq_3



GD-1



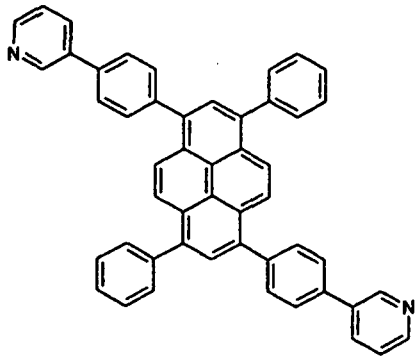
CuPc

[0054] (2) Example 1

[0055] ITO glass was washed after being patterned so that a light emitting area thereof became 3mm X 3mm. After the substrate was mounted in a vacuum chamber, a hole injecting layer/a hole transport layer/a green organic emitting layer (host+dopant)/an electron injecting and transport layer/cathode (CuPc(650Å) /NPD(400Å) /Alq_3 (200Å) +GD-1 (1%) (50Å) /PA-1(350Å)/LiF(5Å)/Al(1000Å)) were formed on ITO in $1.0X10^{-6}$ torr. PA-1 is a pyrene based electron transport compound of chemical formula 1-6.

[0056] When current of 0.9mA was applied to the device, brightness was 2452cd/m^2, a driving voltage was 4.7V, and a value of a color coordinate CIE was x = 0.301 and y = 0.606.

[Chemical formula 1-6]

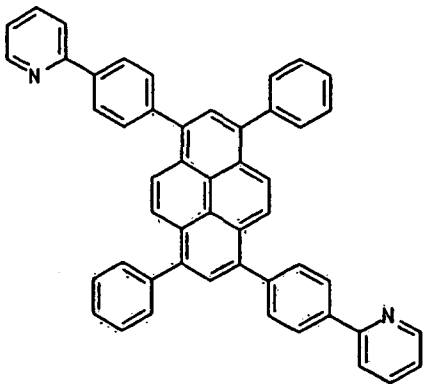


[0057] (3) Example 2

[0058] ITO glass was washed after being patterned so that a light emitting area thereof became 3mm X 3mm. After the substrate was mounted in a vacuum chamber, a hole injecting layer/a hole transport layer/a green organic emitting layer (host+dopant)/an electron injecting and transport layer/cathode CuPc (650Å) /NPD (400Å) /Alq_3(200Å) +GD-1 (1%) (50Å) /PA-2(350Å)/LiF(5Å)/Al(1000Å) were formed on ITO in $1.0X10^{-6}$torr. PA-2 is a pyrene based electron transport compound of chemical formula 1-7.

[0059] When current of 0.9mA was applied to the device, brightness was 2328cd/m^2, a driving voltage was 5.0V, and a value of a color coordinate CIE was x = 0.302 and y = 0.612.

[Chemical formula 1-7]

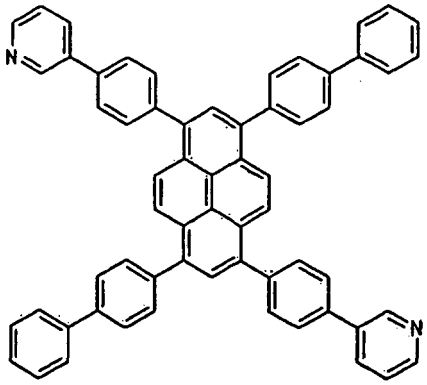


[0060] (4) Example 3

[0061] ITO glass was washed after being patterned so that a light emitting area thereof became 3mm X 3mm. After the substrate was mounted in a vacuum chamber, a hole injecting layer/a hole transport layer/a green organic emitting layer (host+dopant)/an electron injecting and transport layer/cathode (CuPc(650Å)/NPD(400Å)/Alq_3(200Å)+GD-1(1%) (50Å)/PB-1(350Å)/LiF(5Å)/A1(1000Å)) were formed on ITO in $1.0X10^{-6}$torr. PB-1 is a pyrene based electron transport

compound of chemical formula 1-8.

[Chemical formula 1-8]

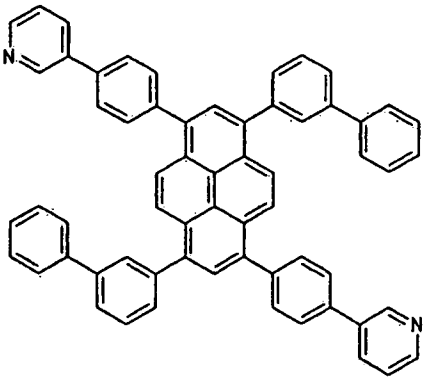


[0062] When current of 0.9mA was applied to the device, brightness was 2751cd/m^2, a driving voltage was 5.1V, and a value of a color coordinate CIE was x = 0.298 and y = 0.610.

[0063] (5) Example 4

[0064] ITO glass was washed after being patterned so that a light emitting area thereof became 3mm X 3mm. After the substrate was mounted in a vacuum chamber, a hole injecting layer/a hole transport layer/a green organic emitting layer (host+dopant)/an electron injecting and transport layer/cathode (CuPc (650Å) /NPD (400Å) /Alq_3 (200Å) +GD-1 (1%) (50Å) /PC-1(350Å)/LiF(5Å)/Al(1000Å)) were formed on ITO in 1.0X10^{-6}torr PC-1 is a pyrene based electron transport compound of chemical formula 1-9.

[Chemical formula 1-9]

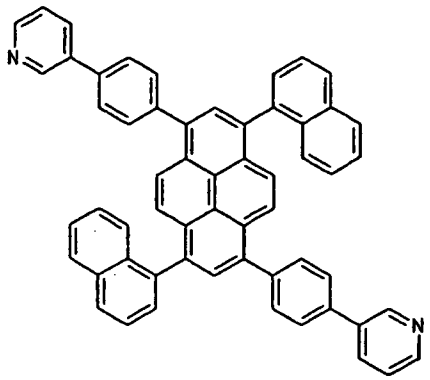


[0065] When current of 0.9mA was applied to the device, brightness was 2617cd/m^2, a driving voltage was 5.3V, and a value of a color coordinate CIE was x = 0.307 and y = 0.612.

[0066] (6) Example 5

[0067] ITO glass was washed after being patterned so that a light emitting area thereof became 3mm X 3mm. After the substrate was mounted in a vacuum chamber, a hole injecting layer/a hole transport layer/a green organic emitting layer (host+dopant)/an electron injecting and transport layer/cathode (CuPc(650Å)/NPD(400Å)/Alq_3(200Å) +GD-1(1%) (50Å) /PE-1(350Å)/LiF(5Å)/Al(1000Å)) were formed on ITO in 1.0X10^{-6}torr. PE-1 is a pyrene based electron transport compound of chemical formula 1-10.

[Chemical formula 1-10]

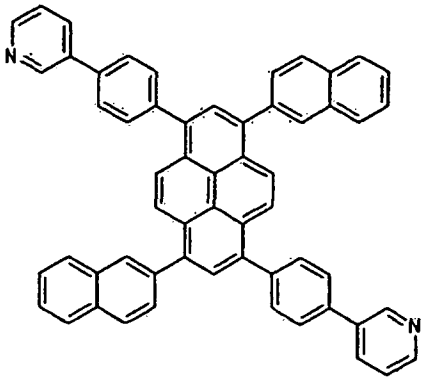


[0068] When current of 0.9mA was applied to the device, brightness was 2472cd/m^2, a driving voltage was 5.4V, and a value of a color coordinate CIE was x = 0.31 and y = 0.614.

[0069] (7) Example 6 - Organic light emitting device according to a sixth embodiment of this document

[0070] ITO glass was washed after being patterned so that a light emitting area thereof became 3mm X 3mm. After the substrate was mounted in a vacuum chamber, a hole injecting layer/a hole transport layer/a green organic emitting layer (host+dopant)/an electron injecting and transport layer/cathode (CuPc(650Å) /NPD(400Å) /Alq_3 (200Å) +GD-1 (1%) (50Å) /PF-1(350Å)/LiF(5Å)/Al(1000Å)) were formed on ITO in $1.0X10^{-6}$ torr. PF-1 is a pyrene based electron transport compound of chemical formula 1-11.

[Chemical formula 1-11]

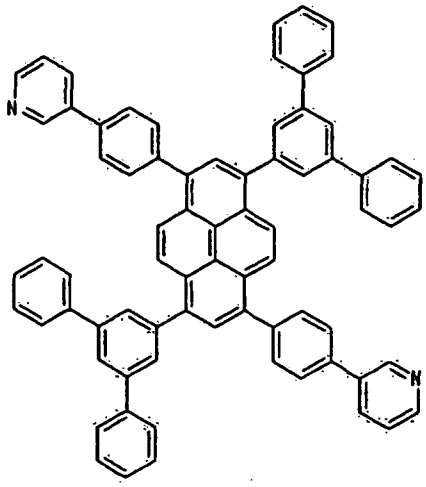


[0071] When current of 0. 9mA was applied to the device, brightness was 2217cd/m^2, a driving voltage was 5.5V, and a value of a color coordinate CIE was x = 0.302 and y = 0.610.

[0072] (8) Example 7 - Organic light emitting device according to a seventh embodiment of this document

[0073] ITO glass was washed after being patterned so that a light emitting area thereof became 3mm X 3mm. After the substrate was mounted in a vacuum chamber, a hole injecting layer/a hole transport layer/a green organic emitting layer (host+dopant)/an electron injecting and transport layer/cathode (CuPc (650Å) /NPD(400Å) /Alq_3(200Å) +GD-1 (1%) (50Å) /PK-1(350Å)/LiF(5Å)/Al(1000Å)) were formed on ITO in $1.0X10^{-6}$torr. PK-1 is a pyrene based electron transport compound of chemical formula 1-12.

[Chemical formula 1-12]



[0074] When current of 0.9mA was applied to the device, brightness was 2830cd/m^2, a driving voltage was 5.0V, and a value of a color coordinate CIE was x = 0.297 and y = 0.609.

[0075] As can be seen in the comparative example and examples, when organic light emitting device according to embodiments of this document comprise pyrene based electron transport compound of chemical formula 1-1 described above in an electron injecting and transport layer, a value of a color coordinate CIE was x = 0.397 to 0.307 and y = 0.606 to 0.612, and thus it can be seen that an electron injecting and transport layer performs its own function very effectively.

[0076] Referring to Table 1, brightness of organic light emitting device according to embodiments of this document improves by minimum 77.2% (the sixth embodiment) and maximum 26% (the seventh embodiment), compared to brightness of conventional organic light emitting device. It can be seen that a driving voltage of organic light emitting device according to embodiments of this document was decreased to 4.7V to 5.5V, compared to a driving voltage of conventional organic light emitting device.

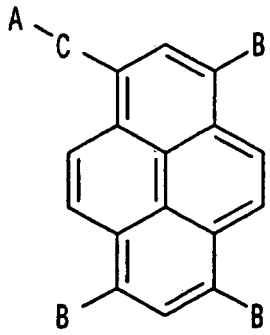
[Table 1]

	brightness	driving voltage
Comparative example	1251cd/m^2	6.5V
Example 1	2452cd/m^2	4.7V
Example 2	2328cd/m^2	5.0V
Example 3	2751cd/m^2	5.1V
Example 4	2617cd/m^2	5.3V
Example 5	2472cd/m^2	5.4V
Example 6	2217cd/m^2	5.5V
Example 7	2830cd/m^2	5.0V

[0077] Embodiment 2

[0078] In order to achieve the object, this document provides a pyrene based electron transport compound having chemical formula 2-1.

[Chemical formula 2-1]



[0079] Pyrene based compound of chemical formula 2-1 is a very important compound among hydrocarbons. In the pyrene based compound, carbons are numbered clockwise starting with a carbon having a substituent A-C. Accordingly, an electron transport compound according to an embodiment of this document comprises a pyrene based compound in which A-C is bonded to carbon 1 and B is bonded to carbon 3, 6 and 8. The substituents A, B, and C may be substituted or not substituted.

[0080] The electron transport compound is a compound that injects an electron from a cathode to other layer or transports an injected electron to other layers. For example, in organic light emitting device, an electron transport compound is a compound that may be a material of an electron injecting layer, an electron transport layer, or an electron injecting and transport layer in which the electron injecting layer and the electron transport layer are mixed.

[0081] In this document, the electron injecting and transport layer is used to generally designate layers, which are related to injecting and transporting of an electron, such as an electron injecting layer, an electron transport layer, or an electron injecting and transport layer in which the electron injecting layer and the electron transport layer are mixed.

[0082] A that is substituted or is not substituted may be selected from a group consisting of pyridinyl, quinolinyl, isoquinolinyl, quinoxalinyl, bipyridinyl, terpyridinyl, and phenanthrolinyl.

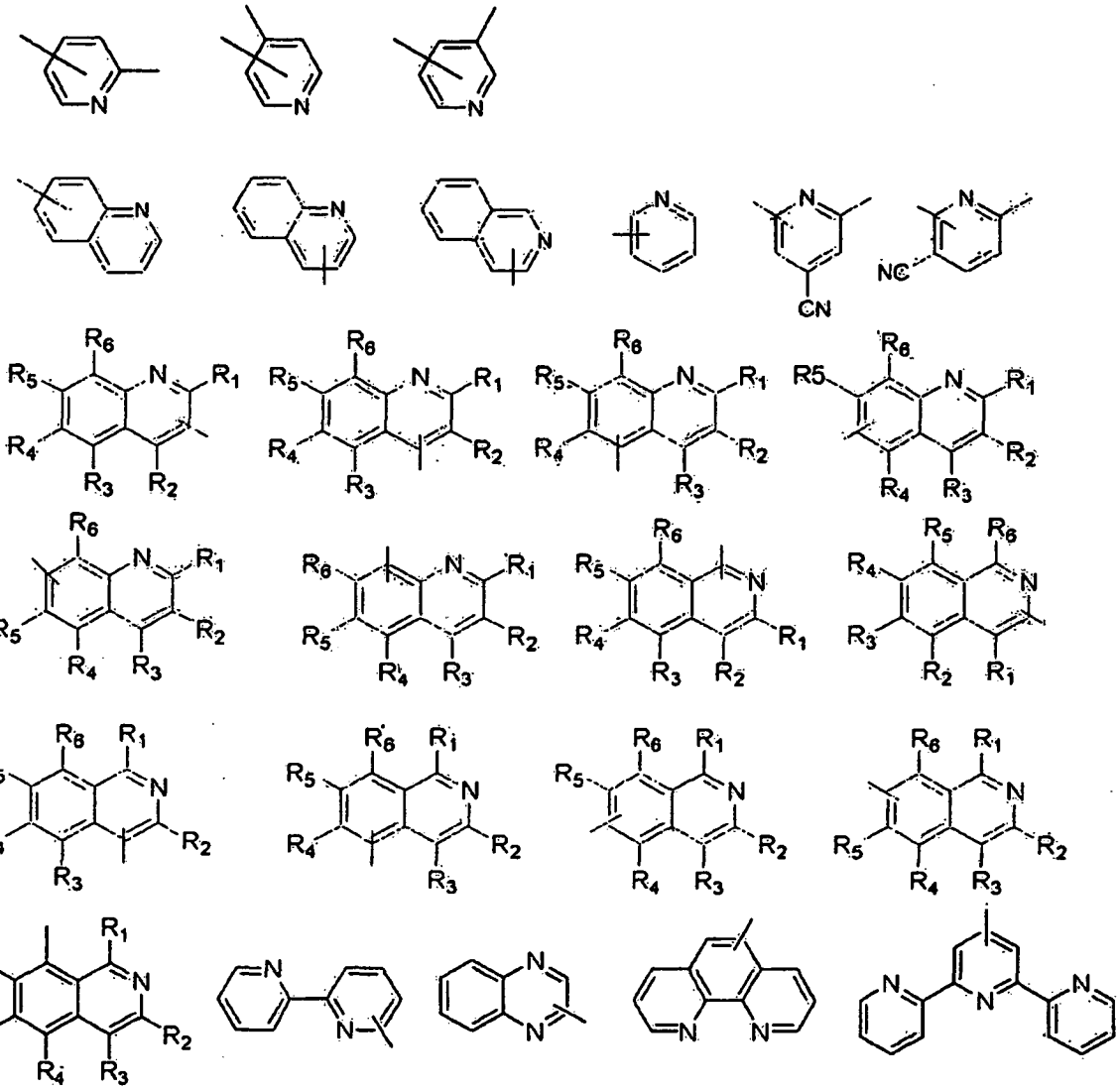
[0083] Further, B and C that are substituted or are not substituted may be selected from a group consisting of phenyl, biphenyl, naphthyl, fluorenyl, terphenyl, phenanthrolinyl, phenanthryl, and anthryl.

[0084] When the A, B, and C are substituted, a substituent of the A, B, and C may be selected from a group consisting of aryl, alkyl, aryloxy, alkoxy, allylamino, alkylamino, halogen, and cyano.

[0085] Further, when the A, B, and C are substituted, a substituent of the A, B, and C may be selected from a group consisting of phenyl, biphenyl, triphenylmethyl, phenylethylidene, diphenylethylidene, phenylmethylidyne, phenoxy, tolyoxy, methyl, ethyl, propyl, i-propyl, t-butyl, cyclohexyl, diphenylamino, morpholine, methoxy, ethoxy, propoxy, butoxy, dimethylamino, diphenylamino, fluorine, and chlorine.

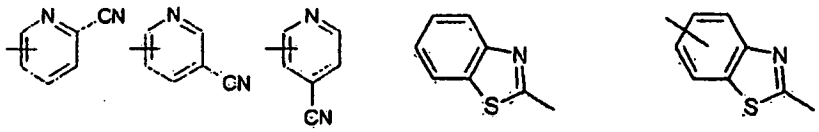
[0086] The A that is substituted or is not substituted is given by chemical formulas 2-2 and 2-3.

[Chemical formula 2-2]



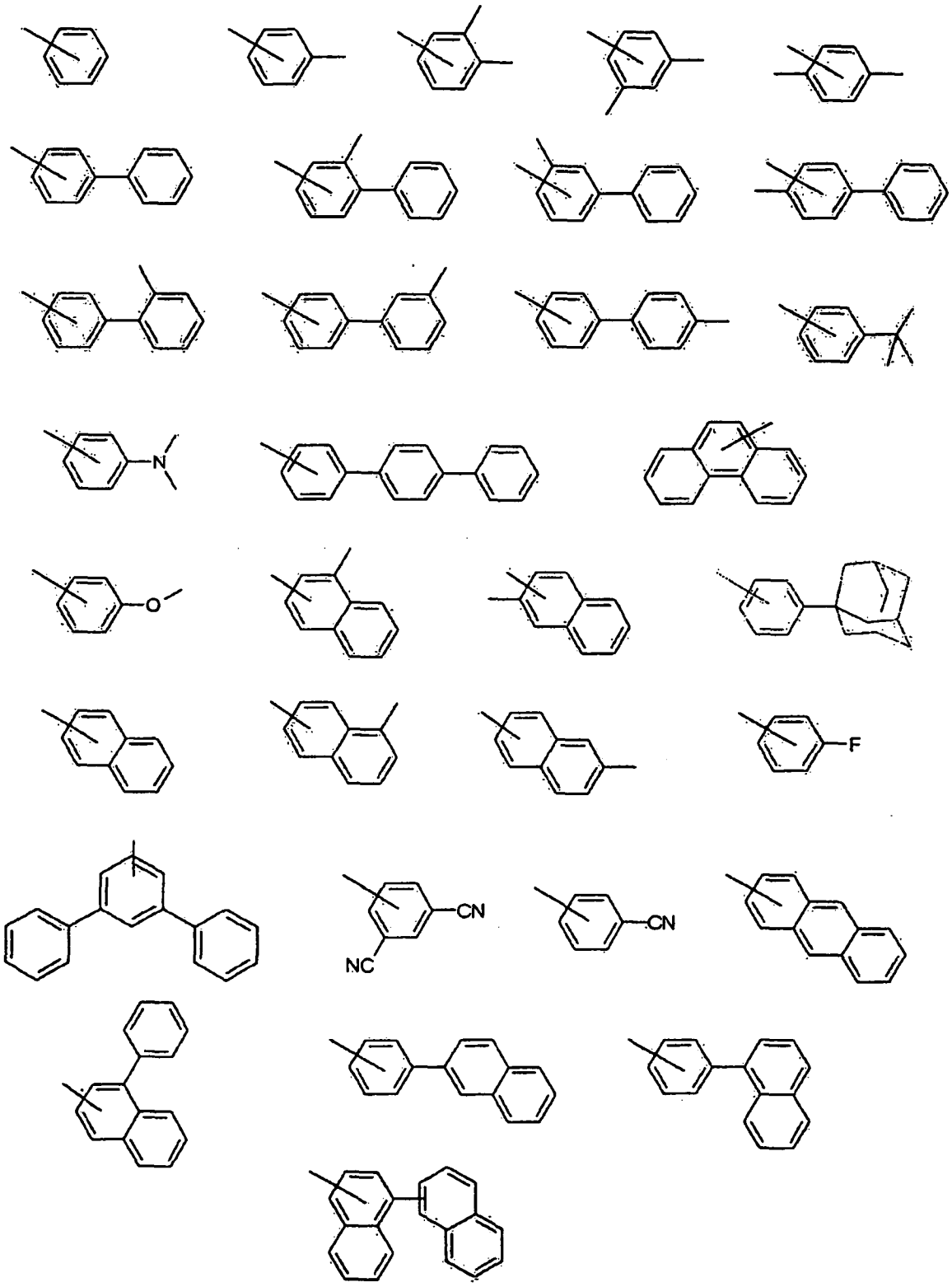
[0087] where any one of R1, R2, R3, R4, R5, and R6 is CH3, and the remaining ones are H.

[Chemical formula 2-3]



[0088] Similarly, the B and C that are substituted or not substituted are given by chemical formula 2-4.

[Chemical formula 2-4]



[0089] Various forms of electron transport compounds can be formed by combining the pyrene based electron transport compound of chemical formula 2-1 with substituents of chemical formulas 2-2 to 2-4. The electron transport compounds can be easily selected from organic light emitting device such as organic light emitting device by those skilled in the art according to necessity of brightness, color purity, or a driving voltage.

[0090] This document provides organic light emitting device having the electron injecting and transport layer comprising the electron transport compound described above. The electron injecting and transport layer may be one or both of an

electron injecting layer or an electron transport layer. The electron injecting and transport layer may be formed between an organic or inorganic light emitting layer and a cathode. The electron injecting and transport layer may have a different layer position when participating in injecting and transporting of an electron as described above.

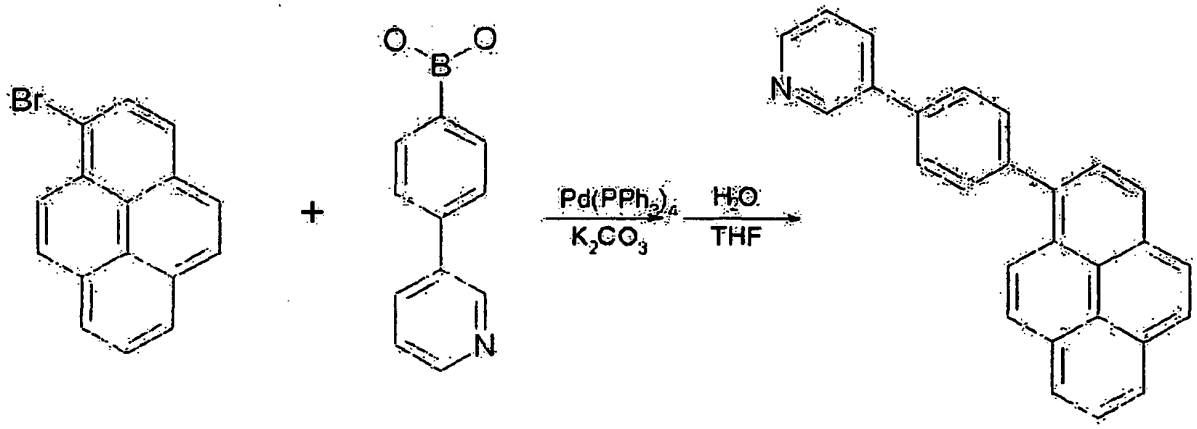
[0091] Below, synthesis examples of some compounds of the pyrene based electron transport compounds of chemical formula 2-1 are described. Only synthesis examples of some compounds are described, but synthesis examples of other pyrene based electron transport compounds of chemical formula 2-1 are similar to these synthesis examples, the synthesis examples can be executed by those skilled in the art, and thus descriptions thereof will be omitted.

[0092] [Synthesis Example]

[0093] 1-(4-(3'-pyridine)phenyl)-3,6,8-triphenylpyrene among electron transport compounds of an electron injecting and transport layer of organic light emitting device according to an embodiment of this document is synthesized as follows.

[0094] (1) Synthesis of 1-(4-(3'-pyridine)phenyl)pyrene

[Reaction equation 2-1]



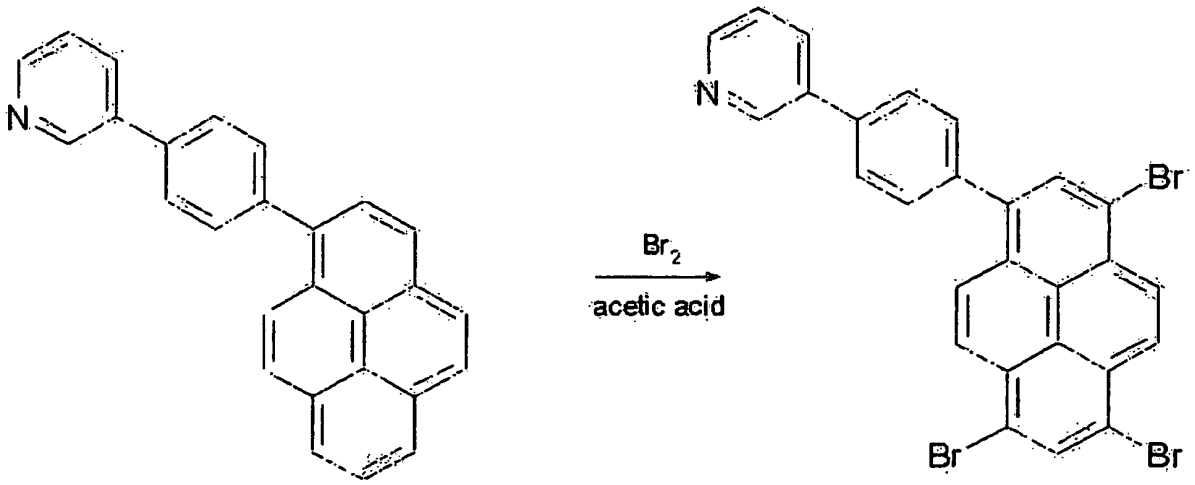
[0095] 5.31g (0.0267mol) of 4-(3'-pyridine) phenyl boronic acid and 5g (0.0178mol) of 1-bromopyrene were put in 100mL of anhydrous THF and they were stirred in a dried three neck round bottom flask.

[0096] 1.0g of tetrakis(triphenylphosphine)palladium(0) and 15g of potassium carbonate were melted in 100mL of H_2O and added to the flask. Then they were stirred for 24 hours in a bath of 100°C . When a reaction was ended, THF was removed from a reaction mixture.

[0097] Thereafter, the reaction mixture was extracted using dichloromethane and water and distilled under a reduced pressure then the distilled mixture was purified by passing through a silica gel column. The purified mixture was distilled under a reduced pressure again. The purified and distilled mixture was recrystallized using dichloromethane and methanol and filtered. Then 1-(4-(3'-pyridine)-phenyl)pyrene was obtained.

[0098] (2) Synthesis of 1-(4-(3'-pyridine)-phenyl)-3,6,8-tribromopyrene

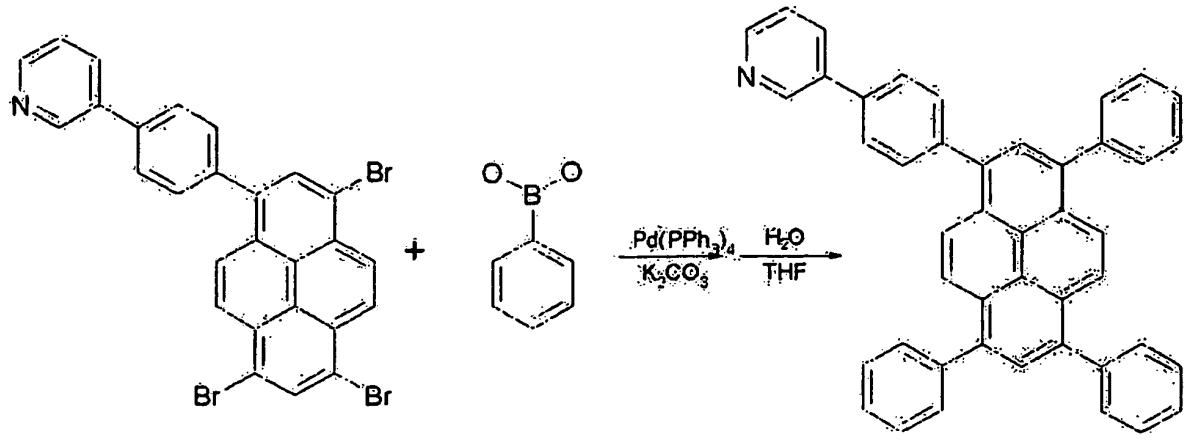
[Reaction Equation 2-2]



[0099] 3g (0.0084mol) of 1-(4-(3'-pyridine)-phenyl)pyrene was put in 80mL of acetic acid and they were stirred in a dried three neck round bottom flask. After 4.0g (0.0252mol) of bromine (Br_2) was added to the reaction mixture at a room temperature and when a reaction was ended, filtering was performed. By washing and then drying the reaction mixture with excessive distilled water, 1-(4-(3'-pyridine)-phenyl)-3,6,8-tribrmopyrene was obtained.

[0100] (3) Synthesis of 1-(4-(3'-pyridine)phenyl)-3,6,8-triphenylpyrene

[Reaction Equation 2-3]



[0101] 3g (0.00506mol) of 1-(4-(3'-pyridine)-phenyl)-3,6,8-tribromophylene and 2.47g (0.0202mol) of phenyl boronic acid were put in 80mL of anhydrous THF and they were stirred in a dried three neck round bottom flask.

[0102] 0.4g of (tetrakis(triphenylphosphine)palladium)(0) and 10g of potassium carbonate were melted in 80mL of H_2O and added to the flask. Then they were stirred for 24 hours in a bath of 100°C. When a reaction was ended, THF was removed from a reaction mixture.

[0103] Thereafter, the reaction mixture was extracted using dichloromethane and water and distilled under a reduced pressure then the distilled mixture was purified by passing through a silica gel column. The purified mixture was distilled under a reduced pressure again. The purified and distilled mixture was recrystallized using dichloromethane and methanol and filtered. Then 1-(4-(3'-pyridine)-phenyl)-3,6,8-triphenylenepyrene was obtained.

[0104] [Brightness, color purity and driving voltage test 2]

[0105] In order to confirm brightness characteristic and color purity of organic light emitting device according to an embodiment of this document, conventional organic light emitting device and organic light emitting device according to

an embodiment of this document were manufactured and brightness, color purity, and a driving voltage thereof were measured under the same condition.

[0106] In other words, organic light emitting device according to an embodiment of this document was manufactured using the electron transport compound synthesized in the synthesis example and conventional organic light emitting device was manufactured using a conventional material in the electron injecting and transport layer. Then brightness, color purity, and a driving voltage thereof were measured under the same condition.

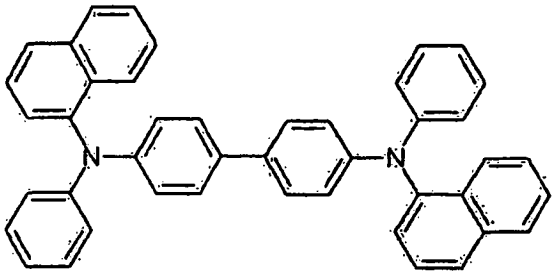
[0107] In examples, although some electron transport compounds according to embodiments of this document are described, an organic light emitting device manufactured using other pyrene based electron transport compound of chemical formula 1-1 may show the same or similar result as examples. The result may be expected by those skilled in the art and thus descriptions of other compounds will be omitted.

[0108] (1) A comparative example: Conventional organic light emitting device

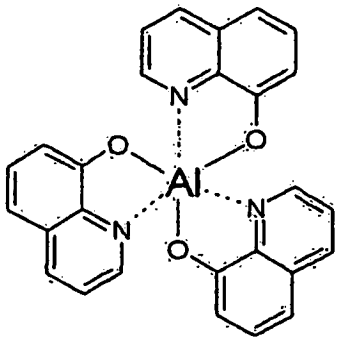
[0109] ITO glass was washed after being patterned so that a light emitting area thereof became 3mm X 3mm. After the substrate was mounted in a vacuum chamber, a hole injecting layer/a hole transport layer/a green organic emitting layer (host+dopant)/an electron injecting and transport layer/cathode (CuPc(650Å) /NPD(400Å) /Alq_3(200Å) +GD-1(1%) (50Å)/Alq_3(350Å)/LiF(5Å)/Al(1000Å)) were formed on ITO in $1.0X10^{-6}$torr.

[0110] When current of 0.9mA was applied to the device, brightness was 1251cd/m^2, a driving voltage was 6.5V, and a value of a color coordinate CIE was x = 0.307 and y = 0.612.

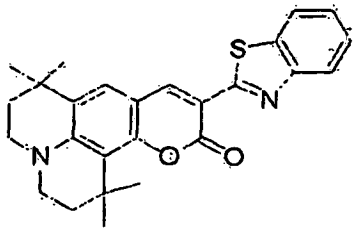
[Chemical formula 2-5]



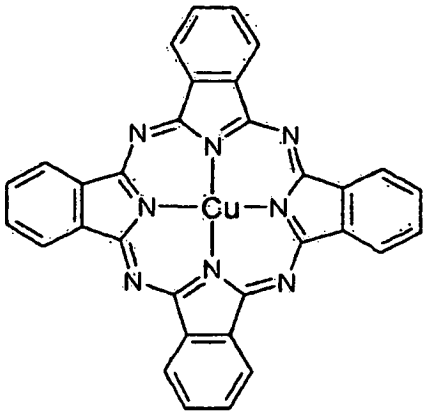
NPD



Alq_3



GD-1



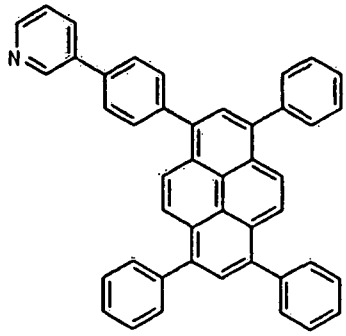
CuPc

[0111] (2) Example 1

[0112] ITO glass was washed after being patterned so that a light emitting area thereof became 3mm X 3mm. After the substrate was mounted in a vacuum chamber, a hole injecting layer/a hole transport layer/a green organic emitting layer (host+dopant)/an electron injecting and transport layer/cathode (CuPc (650Å) /NPD (400Å) /Alq_3 (200Å) +GD-1 (1%) (50Å) /TPA-1(350Å)/LiF(5Å)/Al(1000Å)) were formed on ITO in $1.0X10^{-6}$torr. TPA-1 is an electron transport compound of 1-(4-(3'-pyridine)phenyl)-3,6,8-trhenylpyrene of chemical formula 2-6 in which A is pyridine and B and C are phenyl.

[0113] When current of 0.9mA was applied to the device, brightness was 2511/m^2, a driving voltage was 5.1V, and a value of a color coordinate CIE was x = 0.301 and y = 0.610.

[Chemical formula 2-6]

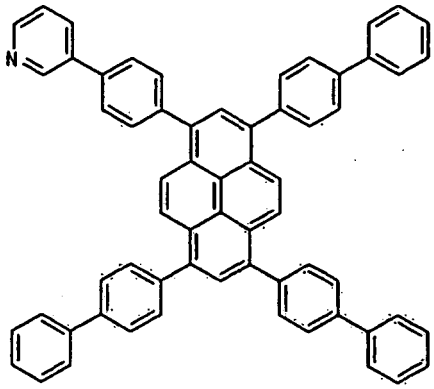


[0114] (3) Example 2

[0115] ITO glass was washed after being patterned so that a light emitting area thereof became 3mm X 3mm. After the substrate was mounted in a vacuum chamber, a hole injecting layer/a hole transport layer/a green organic emitting layer (host+dopant)/an electron injecting and transport layer/cathode CuPc(650Å) /NPD (400Å) /Alq_3(200Å) +GD-1 (1%) (50Å) /TPB-1(350Å)/LiF(5Å)/Al(1000Å)were formed on ITO in $1.0X10^{-6}$torr. TPB-8 is a pyrene based electron transport compound of chemical formula 2-7 in which A is pyridine, B is biphenyl and C is phenyl.

[0116] When current of 0.9mA was applied to the device, brightness was 2830cd/m^2, a driving voltage was 5.1V, and a value of a color coordinate CIE was x = 0.300 and y = 0.607.

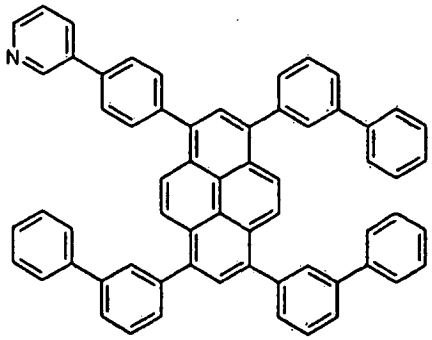
[Chemical formula 2-7]



[0117] (4) Example 3

[0118] ITO glass was washed after being patterned so that a light emitting area thereof became 3mm X 3mm. After the substrate was mounted in a vacuum chamber, a hole injecting layer/a hole transport layer/a green organic emitting layer (host+dopant)/an electron injecting and transport layer/cathode (CuPc (650Å) /NPD (400Å) /Alq_3 (200Å) +GD-1 (1%) (50Å) /TPC-1(350Å)/LiF(5Å)/Al(1000Å)) were formed on ITO in $1.0X10^{-6}$torr. TPC-1 is a pyrene based electron transport compound of chemical formula 2-8.

[Chemical formula 2-8]

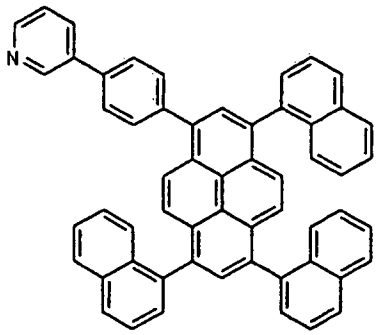


[0119] When current of 0.9mA was applied to the device, brightness was 2770cd/m^2, a driving voltage was 5.3V, and a value of a color coordinate CIE was x = 0.302 and y = 0.611.

[0120] (5) Example 4

[0121] ITO glass was washed after being patterned so that a light emitting area thereof became 3mm X 3mm. After the substrate was mounted in a vacuum chamber, a hole injecting layer/a hole transport layer/a green organic emitting layer (host+dopant)/an electron injecting and transport layer/cathode (CuPc (650Å) /NPD (400Å) /Alq_3 (200Å) +GD-1 (1%) (50Å) /TPE-1(350Å)/LiF(5Å)/Al(1000Å)) were formed on ITO in 1.0X10^{-6}torr TPE-1 is a pyrene based electron transport compound of chemical formula 2-9.

[Chemical formula 2-9]

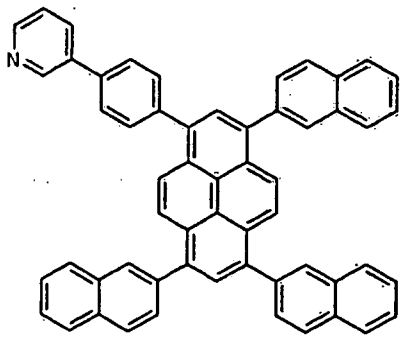


[0122] When current of 0.9mA was applied to the device, brightness was 2069cd/m^2, a driving voltage was 5.5V, and a value of a color coordinate CIE was x = 0.304 and y = 0.614.

[0123] (6) Example 5

[0124] ITO glass was washed after being patterned so that a light emitting area thereof became 3mm X 3mm. After the substrate was mounted in a vacuum chamber, a hole injecting layer/a hole transport layer/a green organic emitting layer (host+dopant)/an electron injecting and transport layer/cathode (CuPc(650Å)/NPD(400Å)/Alq_3(200Å) +GD-1 (1%) (50Å) /TPF-1(350Å)/LiF(5Å)/Al(1000Å)) were formed on ITO in 1.0X10^{-6}torr. TPF-1 is a pyrene based electron transport compound of chemical formula 2-10.

[Chemical formula 2-10]

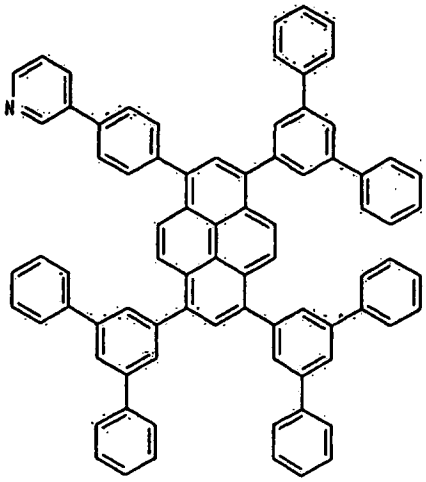


[0125] When current of 0.9mA was applied to the device, brightness was 2466cd/m^2, a driving voltage was 5.7V, and a value of a color coordinate CIE was x = 0.300 and y = 0.610.

[0126] (7) Example 6

[0127] ITO glass was washed after being patterned so that a light emitting area thereof became 3mm X 3mm. After the substrate was mounted in a vacuum chamber, a hole injecting layer/a hole transport layer/a green organic emitting layer (host+dopant)/an electron injecting and transport layer/cathode (CuPc(650Å) /NPD(400Å) /Alq_3 (200Å) +GD-1(1%) (50Å) /TPK-1(350Å)/LiF(5Å)/Al(1000Å)) were formed on ITO in 1.0X10^{-6} torr. TPK-1 is a pyrene based electron transport compound of chemical formula 2-11.

[Chemical formula 2-11]



[0128] When current of 0.9mA was applied to the device, brightness was 2750cd/m^2, a driving voltage was 5.2V, and a value of a color coordinate CIE was x = 0.302 and y = 0.610.

[0129] As can be seen in a comparative experiment example, when organic light emitting device according to embodiments of this document use the pyrene based electron transport compound of chemical formula 2-1 described above in an electron injecting and transport layer, a value of a color coordinate CIE was x = 0.300 to 0.307 and y = 0.607 to 0.614, and thus it can be seen that an electron injecting and transport layer performs its own function.

[0130] As can be seen in Table 2, brightness of organic light emitting device according to embodiments of this document improves by minimum 77.2% (the sixth embodiment) and maximum 26% (the seventh embodiment), compared to brightness of conventional organic light emitting device. It can be seen that a driving voltage of organic light emitting device according to embodiments of this document was decreased to 5.1V to 5.7V.

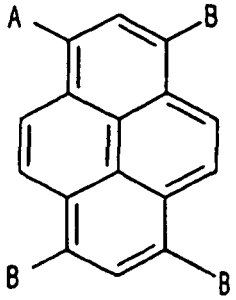
[0131] [Table 2]

	brightness	driving voltage
Comparative example	1251cd/m^2	6.5V
Example 1	2511cd/m^2	5.1V
Example 2	2830cd/m^2	5.1V
Example 3	2770cd/m^2	5.3V
Example 4	2069cd/m^2	5.5V
Example 5	2466cd/m^2	5.7V
Example 6	2750cd/m^2	5.2V

[0132] Further possible molecular structure

[0133] In order to achieve the object, this document provides a pyrene based electron transport compound having chemical formula 3-1.

[Chemical formula 3-1]



[0134] Pyrene based compound of chemical formula 3-1 is a very important compound among hydrocarbons. In the pyrene based compound, carbons are numbered clockwise starting with a carbon having a substituent A. Accordingly, an electron transport compound according to an example of this document comprises a pyrene based compound in which A is bonded to carbon 1, and B is bonded to carbon 3,6 and 8. The substituents A and B may be substituted or not substituted.

[0135] The electron transport compound is a compound that injects an electron from a cathode to other layer or transports an injected electron to other layers. For example, in organic light emitting device, an electron transport compound is a compound that may be a material of an electron injecting layer, an electron transport layer, or an electron injecting and transport layer in which the electron injecting layer and the electron transport layer are mixed.

[0136] In this document, an electron injecting and transport layer is used to generally designate layers, which are related to injecting and transporting of an electron, such as an electron injecting layer, an electron transport layer, or an electron injecting and transport layer in which the electron injecting layer and the electron transport layer are mixed.

[0137] A that is substituted or is not substituted may be selected from a group consisting of pyridinyl, quinolinyl, isoquinolinyl, quinoxalinyl, bipyridinyl, terpyridinyl, and phenanthrolinyl.

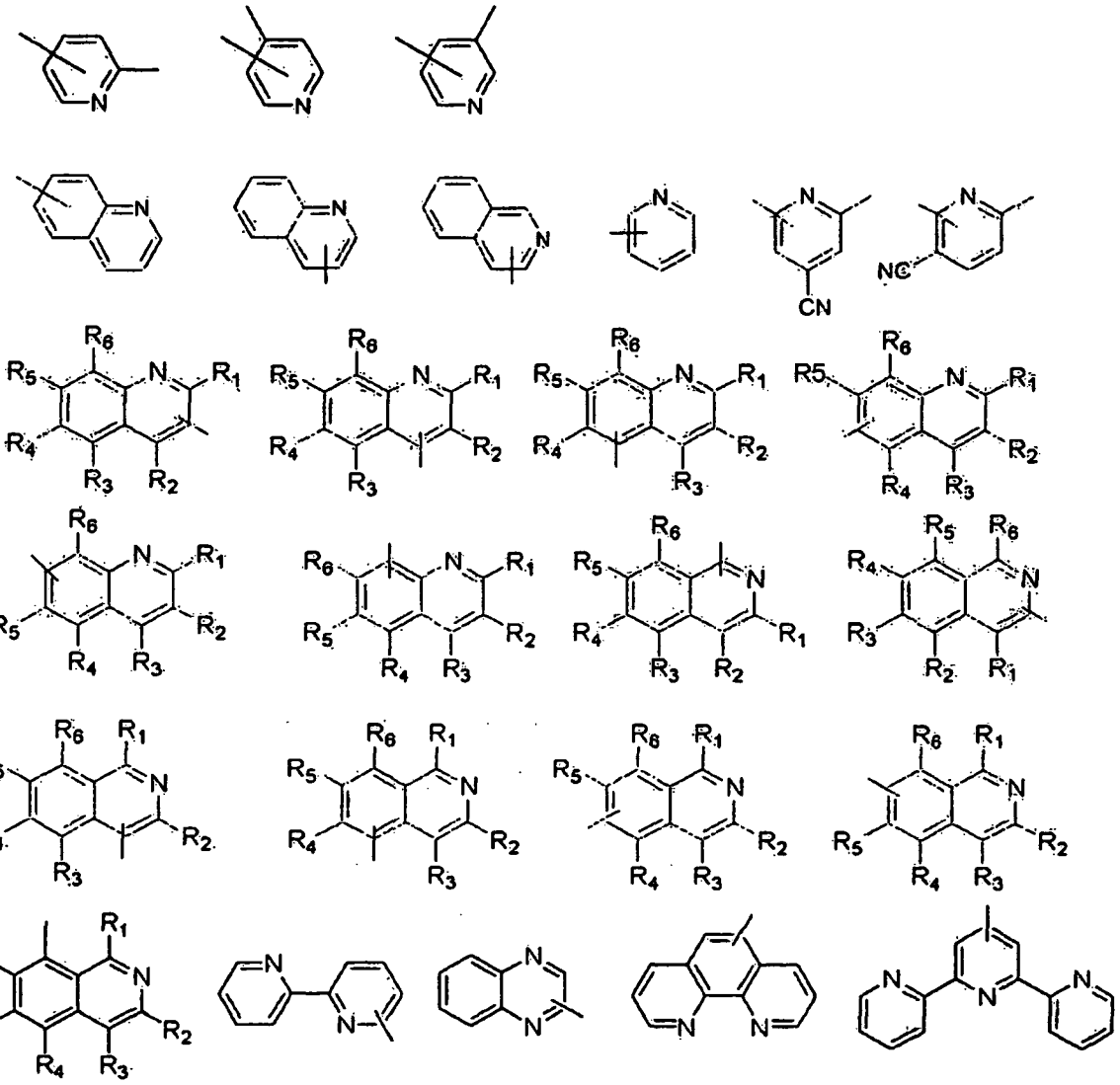
[0138] Further, B and C that are substituted or are not substituted may be selected from a group consisting of phenyl, biphenyl, naphthyl, fluorenyl, terphenyl, methyl, ethyl, propyl, i-propyl, halogen, phenanthrolinyl, phenanthryl, and anthryl.

[0139] When the A and B are substituted, a substituent of the A and B may be selected from a group consisting of aryl, alkyl, aryloxy, alkoxy, allylamino, alkylamino, halogen, and cyano.

[0140] Further, when the A and B are substituted, a substituent of the A and B may be selected from a group consisting of phenyl, biphenyl, triphenylmethyl, phenylethylidene, diphenylethylidene, phenylmethylidyne, phenoxy, tolyoxy, methyl, ethyl, propyl, i-propyl, t-butyl, cyclohexyl, diphenylamino, morpholine, methoxy, ethoxy, propoxy, butoxy, dimethylamino, diphenylamino, fluorine, and chlorine.

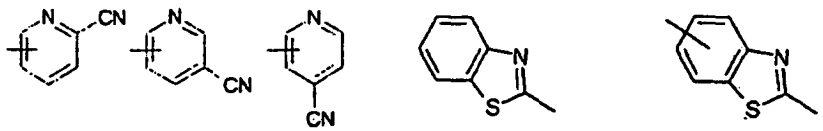
[0141] The A that is substituted or is not substituted is given by chemical formulas 3-2 and 3-3.

[Chemical formula 3-2]



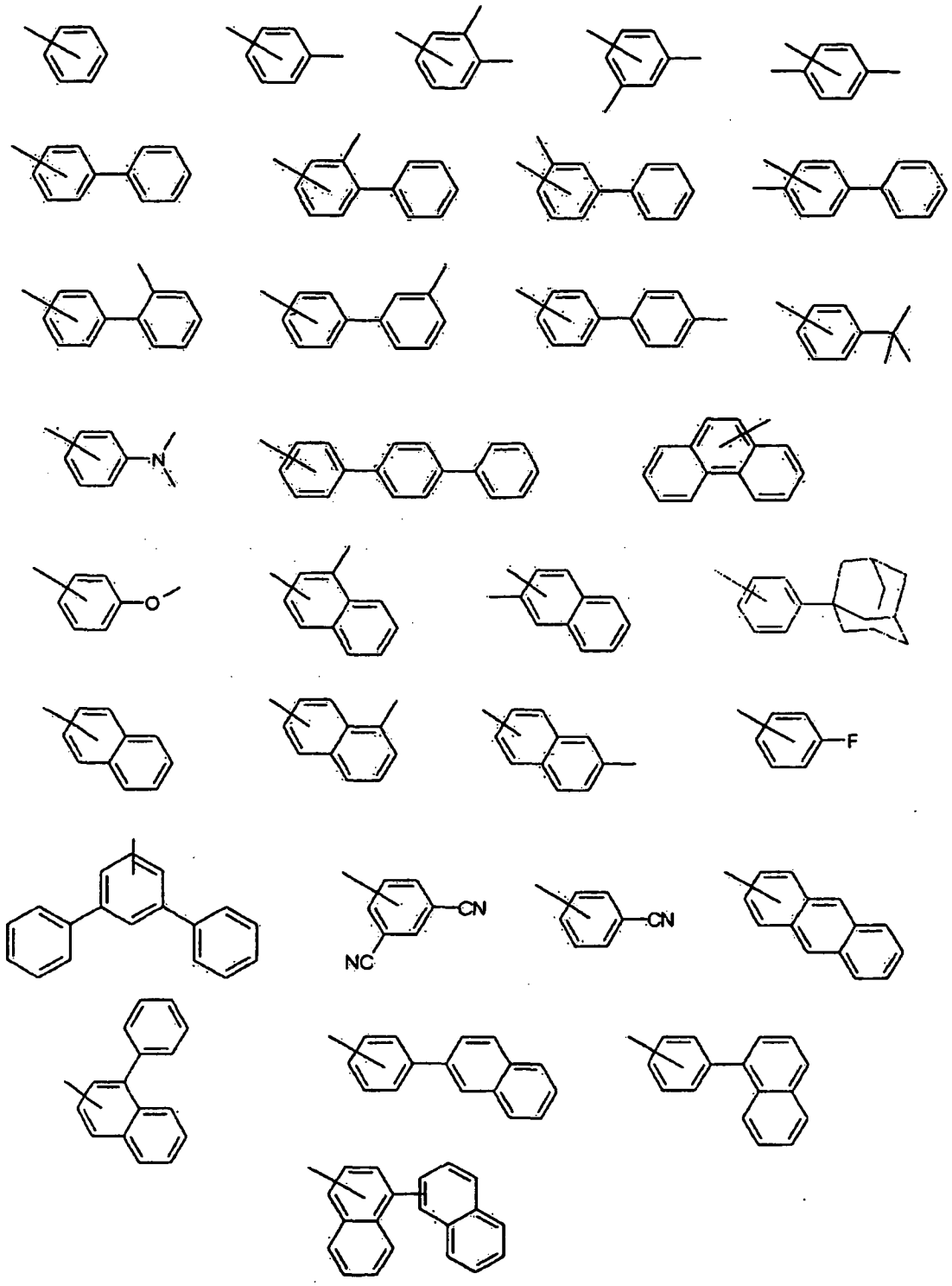
[0142] where any one of R1, R2, R3, R4, R5, and R6 is CH3, and the remaining ones are H.

[Chemical formula 3-3]



[0143] Similarly, the B that is substituted or not substituted is given by chemical formula 3-4.

[Chemical formula 3-4]



[0144] Various forms of electron transport compounds can be formed by combining the pyrene based electron transport compound of chemical formula 3-1 with substituents of chemical formulas 3-2 to 3-4. The electron transport compounds can be easily selected by those skilled in the art according to necessity of brightness, color purity, or a driving voltage.

[0145] This document provides organic light emitting device having the electron injecting and transport layer comprising the electron transport compound described above. The electron injecting and transport layer may be one or both of an electron injecting layer or an electron transport layer. The electron injecting and transport layer may be formed between an organic or inorganic light emitting layer and a cathode. The electron injecting and transport layer may have a different layer position when participating in injecting and transporting of an electron as described above.

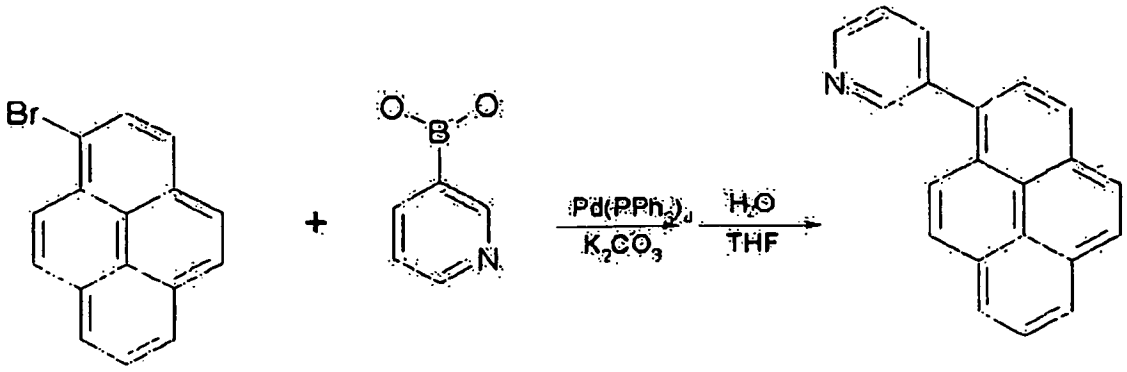
[0146] Below, synthesis examples of some compounds of the pyrene based electron transport compounds of chemical formula 3-1 are described. Only synthesis examples of some compounds are described, but synthesis examples of other pyrene based electron transport compounds of chemical formula 3-1 are similar to these synthesis examples, the synthesis examples can be executed by those skilled in the art, and thus descriptions thereof will be omitted.

[0147] [Synthesis Example]

[0148] 1-(3'-pyridine)-3,6,8-triphenyl-pyrene among electron transport compounds of an electron injecting and transport layer of organic light emitting device according to an example of this document is synthesized as follows.

[0149] Synthesis of 1-(3'-pyridine) pyrene

[Reaction Equation 3-1]



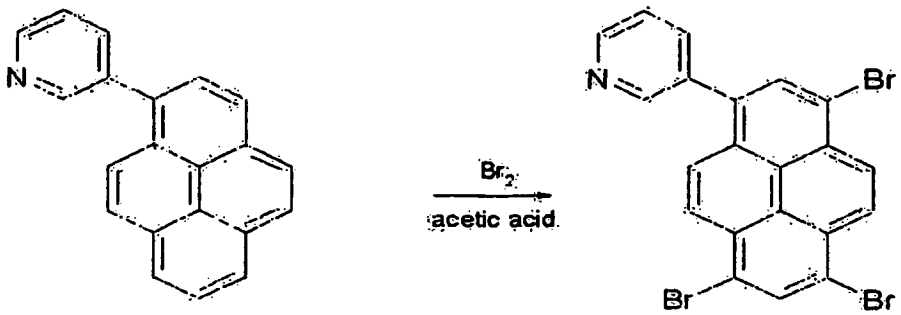
[0150] 6.56g (0.053mol) of pyridinyl boronic acid and 5g (0.0178mol) of 1-bromopyrene were put in 100mL of anhydrous THF and they were stirred in a dried three neck round bottom flask.

[0151] 0.9g of (tetrakis (triphenylphosphine)palladium) (0) and 15g of potassium carbonate were melted in 100mL of H_2O added to the flask. Then they were stirred for 24 hours in a bath of 100°C and then when a reaction was ended, THF was removed from the reaction mixture.

[0152] Thereafter, the reaction mixture was extracted using dichloromethane and water and distilled under a reduced pressure, then the distilled mixture was purified by passing through a silica gel column. The purified mixture was distilled under a reduced pressure again. The purified and distilled mixture was recrystallized using dichloromethane and methanol and filtered. Then 1-(3'-pyridine)pyrene was obtained.

[0153] (2) Synthesis of 1-(3'-pyridine)-3,4,6-tribromopyrene

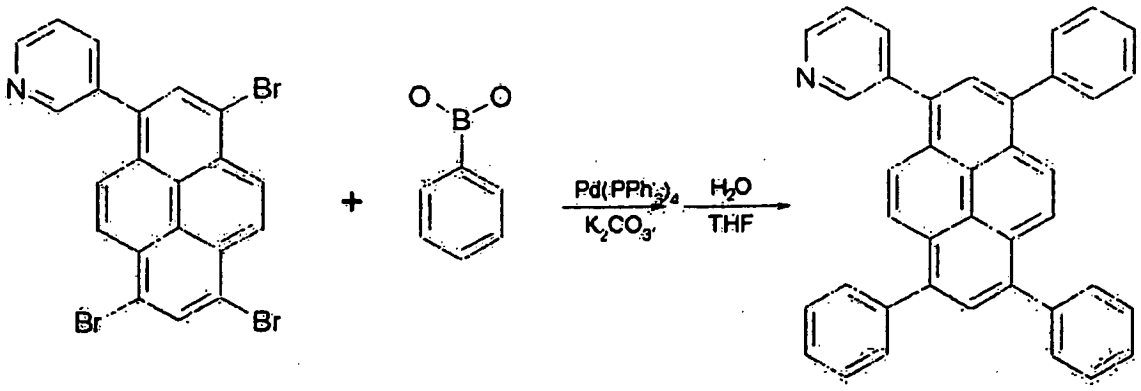
[Reaction Equation 3-2]



[0154] 3g (0.0107mol) of 1-(3'-pyridine)pyrene was put in 80mL of acetic acid and was stirred in a dried three neck round bottom flask. After 5.15g (0.0322mol) of bromine (Br_2) was added to the reaction mixture at a room temperature and when a reaction was ended, filtering was performed. By washing and then drying the reaction mixture with excessive distilled water, 1-(3'-pyridine)-3,6,8,-tribromopyrene was obtained.

[0155] (3) Synthesis of 1-(3'-pyridine)-3,6,8,-triphenyl-pyrene

[Reaction Equation 3-3]



[0156] 3g (0.0058lmol) of 1-(3'-pyridine)-3,6,8,-tribromopyrene and 2.83g (0.0232mol) of phenyl boronic acid were put in 80mL of anhydrous THF and they were stirred in a dried three neck round bottom flask.

[0157] 0.5g of (tetrakis (triphenylphosphine) palladium) (0) and 10g of potassium carbonate were melted in 80mL of H_2O and H_2O and added to the flask. Then they were stirred for 24 hours in a bath of 100°C and when a reaction was ended, THF was removed from the reaction mixture.

[0158] Thereafter, the reaction mixture was extracted using dichloromethane and water and distilled under a reduced pressure, then distilled mixture was purified by passing through a silica gel column. The purified mixture was distilled under a reduced pressure again. The purified and distilled mixture was recrystallized using dichloromethane and methanol and filtered. 1-(3'-pyridine)-3,6,8-triphenyl-pyrene, which is a final product was obtained.

[Brightness, color purity and driving voltage test 3]

[0159] In order to confirm brightness characteristic and color purity of organic light emitting device according to an example of this document, conventional organic light emitting device and organic light emitting device according to an example of this document were manufactured and brightness, color purity, and a driving voltage thereof were measured under the same condition.

[0160] In other words, organic light emitting device according to an example of this document was manufactured using the electron transport compound synthesized in the synthesis example and conventional organic light emitting device was manufactured using a conventional material in the electron injecting and transport layer. Then brightness, color purity, and a driving voltage thereof were measured under the same condition.

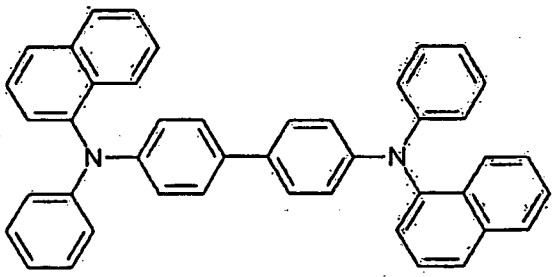
[0161] In examples, although some electron transport compounds according to examples of this document are described, an organic light emitting device manufactured using other pyrene based electron transport compound of chemical formula 1-1 may show the same or similar result as examples. The result may be expected by those skilled in the art and thus descriptions of other compounds will be omitted.

(1) A comparative example: Conventional organic light emitting device

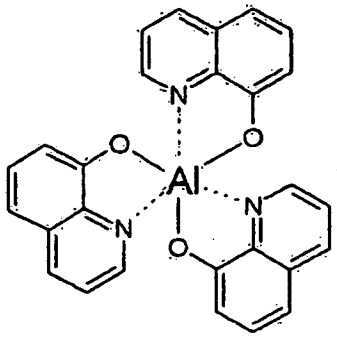
[0162] ITO glass was washed after being patterned so that a light emitting area thereof became 3mm X 3mm. After the substrate was mounted in a vacuum chamber, a hole injecting layer/hole transport layer/green color organic emitting layer (host+dopant)/electron injecting and transport layer/cathode (CuPc (650Å) /NPD (400 Å) /Alq_3 (200 Å) +GD-1(1%) (50 Å)/Alq_3(350 Å)/LiF(5 Å)/Al(1000 Å))was formed on ITO in $1.0X10^{-6}$torr.
1(1%) (50Å)/Alq_3(350Å)/LiF(5Å)/Al(1000Å)) was formed on ITO in $1.0X10^{-6}$torr.

[0163] When current of 0.9mA was applied to the device, brightness was 1251cd/m^2, a driving voltage was 6.5V, and a value of a color coordinate CIE was x = 0.307 and y = 0.612.

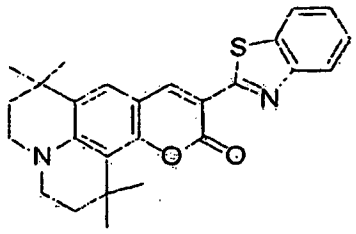
[Chemical formula 3-5]



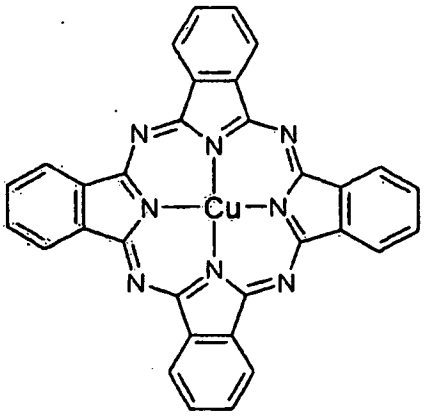
NPD



Alq_3



GD-1



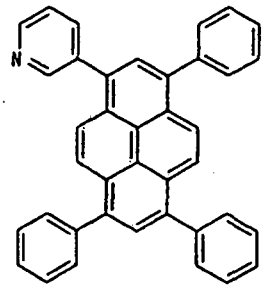
CuPc

[0164] (2) Example 1

[0165] ITO glass was washed after being patterned so that a light emitting area thereof became 3mm X 3mm. After the substrate was mounted in a vacuum chamber, a hole injecting layer/a hole transport layer/a green organic emitting layer (host+dopant)/an electron injecting and transport layer/cathode (CuPc (650Å) /NPD (400Å) /Alq_3 (200Å) +GD-1 (1%) (50Å) /TA-8(350Å)/LiF(5Å)/Al(1000Å)) were formed on ITO in $1.0X10^{-6}$torr. TA-8 is an electron transport compound of 1-(3'-pyridine)-3,6,8-triphenyl-pyrene of chemical formula 3-6 in which A is pyridine and B and C are phenyl.

[0166] When current of 0.9mA was applied to the device, brightness was 2403cd/m^2, a driving voltage was 5.87V, and a value of a color coordinate CIE was x = 0.301 and y = 0.621.

[Chemical formula 3-6]

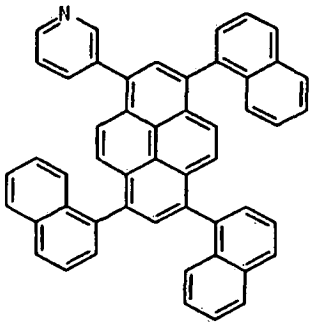


[0167] (3) Example 2

[0168] ITO glass was washed after being patterned so that a light emitting area thereof became 3mm X 3mm. After the substrate was mounted in a vacuum chamber, , a hole injecting layer/a hole transport layer/a green organic emitting layer (host+dopant)/an electron injecting and transport layer/cathode (CuPc (650Å) /NPD(400Å) /Alq_3 (200Å) +GD-1 (1%) (50Å) /TB-8(350Å)/LiF(5Å)/Al(1000Å)) were formed on ITO in 1.0X10^{-6}torr. TB-8 is a pyrene based electron transport compound of chemical formula 3-7 in which A is pyridine and B and C are phenyl.

[0169] When current of 0.9mA was applied to the device, brightness was 2511cd/m^2, a driving voltage was 5.7V, and a value of a color coordinate CIE was x = 0.301 and y = 0.607.

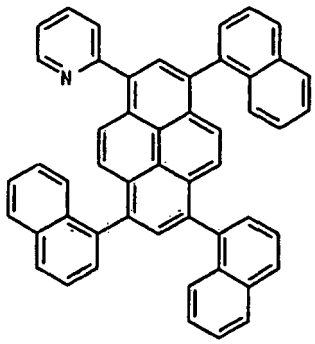
[Chemical formula 3-7]



[0170] (4) Example 3

[0171] ITO glass was washed after being patterned so that a light emitting area thereof became 3mm X 3mm. After the substrate was mounted in a vacuum chamber, a hole injecting layer/a hole transport layer/a green organic emitting layer (host+dopant)/an electron injecting and transport layer/cathode (CuPc(650Å)/NPD(400Å)/Alq_3(200Å)+GD-1(1%) (50Å)/TB-7(350Å)/LiF(5Å)/Al(1000Å)) were formed on ITO in 1.0X10^{-6}torr. TB-7 is a pyrene based electron transport compound of chemical formula 3-8 in which A is pyridine and B is phenyl.

[Chemical formula 3-8]

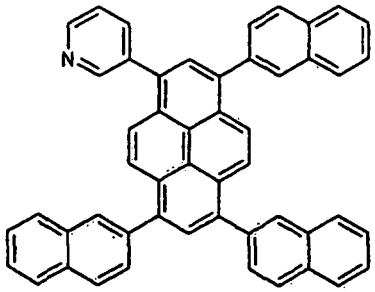


[0172] When current of 0.9mA was applied to the device, brightness was 2398cd/m^2, a driving voltage was 5.3V, and a value of a color coordinate CIE was x = 0.304 and y = 0.630.

[0173] (5) Example 4

[0174] ITO glass was washed after being patterned so that a light emitting area thereof became 3mm X 3mm. After the substrate was mounted in a vacuum chamber, , a hole injecting layer/a hole transport layer/a green organic emitting layer (host+dopant)/an electron injecting and transport layer/cathode (CuPc (650Å) /NPD (400Å) /Alq_3 (200Å) +GD-1 (1%) (50Å) /TC-8(350Å)/LiF(5Å)/Al(1000Å)) were formed on ITO in $1.0X10^{-6}$torr. TC-8 is a pyrene based electron transport compound of chemical formula 3-9.

[Chemical formula 3-9]

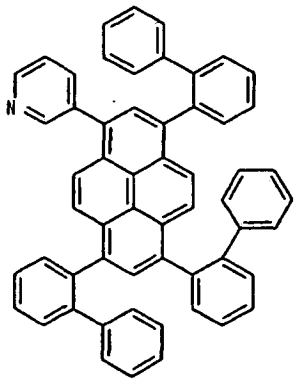


[0175] When current of 0.9mA was applied to the device, brightness was 2382cd/m^2, a driving voltage was 5.6V, and a value of a color coordinate CIE was x = 0.299 and y = 0.617.

[0176] (6) Example 5

[0177] ITO glass was washed after being patterned so that a light emitting area thereof became 3mm X 3mm. After the substrate was mounted in a vacuum chamber, a hole injecting layer/a hole transport layer/a green organic emitting layer (host+dopant)/an electron injecting and transport layer/cathode (CuPc (650Å) /NPD (400Å) /Alq_3 (200Å) +GD-1 (1%) (50Å) /TD-8(350Å)/LiF(5Å)/Al(1000Å)) were formed on ITO in $1.0X10^{-6}$torr. TD-8 is a pyrene based electron transport compound of chemical formula 3-10.

[Chemical formula 3-10]

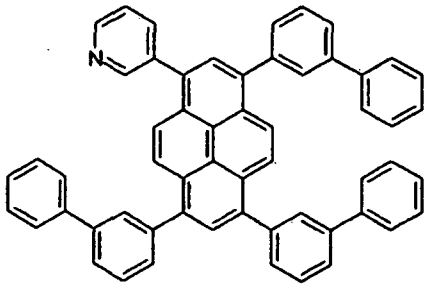


[0178] When current of 0.9mA was applied to the device, brightness was 2698cd/m^2, a driving voltage was 5.5V, and a value of a color coordinate CIE was x = 0.300 and y = 0.638.

[0179] (7) Example 6

[0180] ITO glass was washed after being patterned so that a light emitting area thereof became 3mm X 3mm. After the substrate was mounted in a vacuum chamber, a hole injecting layer/a hole transport layer/a green organic emitting layer (host+dopant)/an electron injecting and transport layer/cathode (CuPc (650Å) /NPD(400Å) /Alq_3 (200Å) +GD-1 (1%) (50Å)/TE-8(350Å)/LiF(5Å)/Al(1000Å)) were formed on ITO in $1.0X10^{-6}$torr. TE-8 is a pyrene based electron transport compound of chemical formula 3-11.

[Chemical formula 3-11]

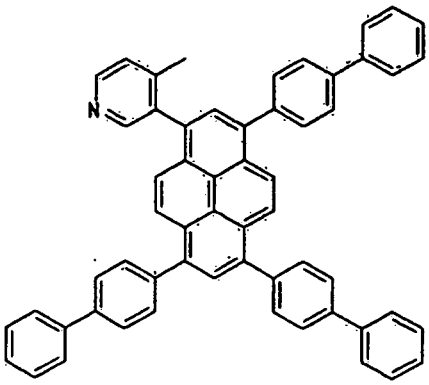


[0181] When current of 0.9mA was applied to the device, brightness was 2732cd/m^2, a driving voltage was 5.4V, and a value of a color coordinate CIE was x = 0.300 and y = 0.610.

[0182] (8) Example 7

[0183] ITO glass was washed after being patterned so that a light emitting area thereof became 3mm X 3mm. After the substrate was mounted in a vacuum chamber, a hole injecting layer/a hole transport layer/a green organic emitting layer (host+dopant)/an electron injecting and transport layer/cathode (CuPc (650Å) /NPD (400Å) /Alq_3 (200Å) +GD-1 (1%) (50Å) /TF-8(350Å)/LiF(5Å)/Al(1000Å)) were formed on ITO in 1.0X10^{-6}torr. TF-8 is a pyrene based electron transport compound of chemical formula 3-12.

[Chemical formula 3-12]

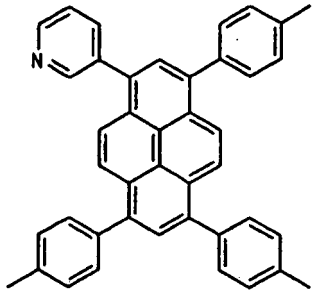


[0184] When current of 0.9mA was applied to the device, brightness was 2287cd/m^2, a driving voltage was 5.5V, and a value of a color coordinate CIE was x = 0.300 and y = 0.618.

[0185] (9) Example 8

[0186] ITO glass was washed after being patterned so that a light emitting area thereof became 3mm X 3mm. After the substrate was mounted in a vacuum chamber a hole injecting layer/a hole transport layer/a green organic emitting layer (host+dopant)/an electron injecting and transport layer/cathode (CuPc (650Å)/NPD(400Å) /Alq_3 (200Å) +GD-1 (1%) (50Å)/TG-8(350Å)/LiF(5Å)/Al(1000Å)) were formed on ITO in 1.0X10^{-6}torr. TG-8 is a pyrene based electron transport compound of chemical formula 3-13.

[Chemical formula 3-13]

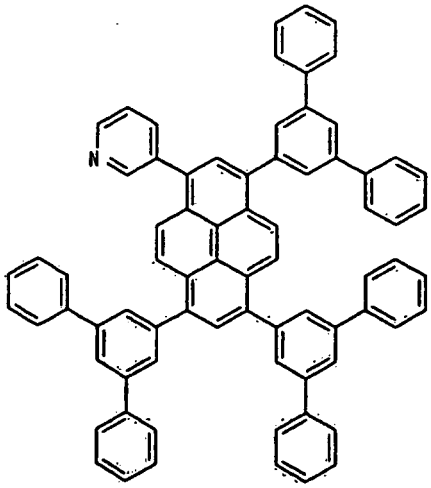


[0187] When current of 0.9mA was applied to the device, brightness was 2096cd/m^2, a driving voltage was 5.7V, and a value of a color coordinate CIE was x = 0.304 and y = 0.629.

[0188] (10) Example 9

[0189] ITO glass was washed after being patterned so that a light emitting area thereof became 3mm X 3mm. After the substrate was mounted in a vacuum chamber, a hole injecting layer/a hole transport layer/a green organic emitting layer (host+dopant)/an electron injecting and transport layer/cathode (CuPc(650Å) /NPD(400Å) /Alq_3 (200Å) +GD-1 (1%) (50Å) /TJ-8(350Å)/LiF(5Å)/Al(1000Å)) were formed on ITO in 1.0X10^{-6}torr. TJ-8 is a pyrene based electron transport compound of chemical formula 3-14.

[Chemical formula 3-14]



[0190] When current of 0.9mA was applied to the device, brightness was 2937cd/m^2, a driving voltage was 6.1V, and a value of a color coordinate CIE was x = 0.307 and y = 0.609.

[0191] As can be seen in the comparative example and examples, when organic light emitting devices according to examples of this document comprise the pyrene based electron transport compound of chemical formula 3-1 described above in an electron injecting and transport layer, a value of a color coordinate CIE was x = 0.300 to 0.307 and y = 0.600 to 0.630, and thus it can be seen that an electron injecting and transport layer performs its own function.

[0192] Referring to Table 3, brightness of organic light emitting device according to examples of this document improves by minimum 67.5% (the eighth example) and maximum 135% (the ninth example), compared to brightness of conventional organic light emitting device. It can be seen that a driving voltage of organic light emitting device according to examples of this document was decreased to 5.4V to 5.8V, compared to a driving voltage of conventional organic light emitting device.

[0193] [Table 3]

	brightness	driving voltage
Comparative example	1251cd/m^2	6.5V
Example 1	2403cd/m^2	5.8V

(continued)

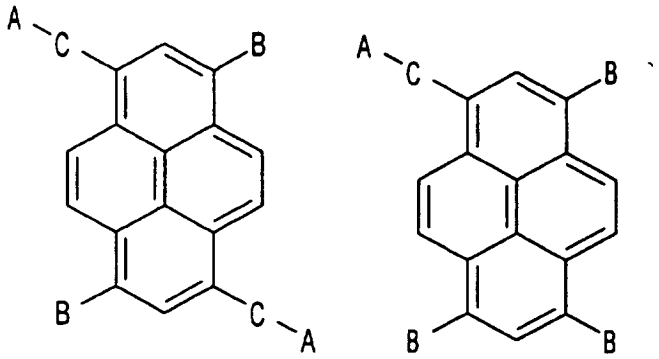
	brightness	driving voltage
Example 2	2511cd/m^2	5.7V
Example 3	2398cd/m^2	5.3V
Example 4	2382cd/m^2	5.6V
Example 5	2698cd/m^2	5.5V
Example 6	2732cd/m^2	5.4V
Example 7	2287cd/m^2	5.5V
Example 8	2096cd/m^2	5.7V
Example 9	2937cd/m^2	6.1V

[0194] As described above, this document can provide an electron transport compound that has high electron transport efficiency and good deposition characteristics, prevents crystallization, and has no influence on a lifetime of diodes.

[0195] As a result, organic light emitting device according to examples of this document can have improved brightness and a considerably low driving voltage while performing a function as an electron injecting and transport layer, compared to conventional organic light emitting device.

Claims

1. An electron transport compound comprising pyrene-based compound,
characterized in that the pyrene-based compound has one of the following chemical formulas,



wherein A is selected from a group consisting of pyridinyl, quinolinyl, isoquinolinyl, quinoxalinyl, bipyridinyl, terpyridinyl, and phenanthrolinyl, and
B and C are selected from a group consisting of phenyl, biphenyl, naphthyl, fluorenyl, terphenyl, phenanthrolinyl, phenanthryl, and anthryl.

2. The electron transport compound of claim 1, wherein when the A, B, and C are substituted, a substituent of the A, B, and C is selected from a group consisting of aryl, alkyl, aryloxy, alkoxy, allylamino, alkylamino, halogen, and cyano.

3. The electron transport compound of claim 1, wherein when the A, B, and C are substituted, a substituent of the A, B, and C is selected from a group consisting of phenyl, biphenyl, triphenylmethyl, phenylethylidene, diphenylethylidene, phenylmethylidyne, phenoxy, tolyoxy, methyl, ethyl, propyl, i-propyl, t-butyl, cyclohexyl, diphenylamino, morpholine, methoxy, ethoxy, propoxy, butoxy, dimethylamino, diphenylamino, fluorine, and chlorine.

4. An organic light emitting device having an electron injecting and transport layer comprising the electron transport compound of Claim 1.

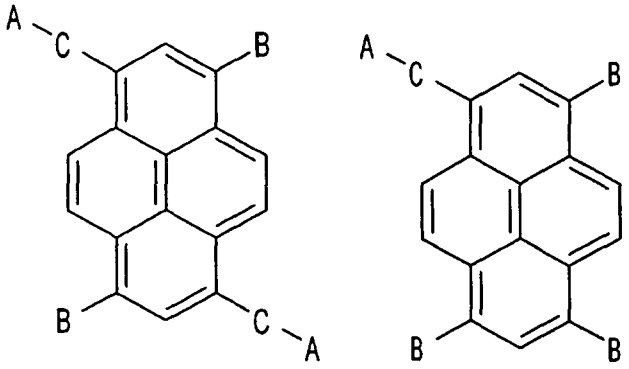
5. The organic light emitting device of claim 4, wherein the electron injecting and transport layer is one or both of an

electron injecting layer or an electron transport layer.

6. The organic light emitting device of claim 5, wherein the organic light emitting device comprises an anode, an emitting layer comprising an organic material and a cathode, wherein the electron injecting and transport layer is formed between the emitting layer and a cathode.

Patentansprüche

1. Elektronentransport-Verbindung, aufweisend eine Verbindung auf Pyrenbasis,
dadurch charakterisiert, dass die Verbindung auf Pyren-Basis eine der folgenden chemischen Formeln aufweist,



wobei A aus einer Gruppe, bestehend aus Pyridinyl, Chinolinyl, Isochinolinyl, Chinoxalinyl, Bipyridinyl, Terpyridinyl und Phenanthrolinyl, ausgewählt ist, und
B und C ausgewählt sind aus einer Gruppe, bestehend aus Phenyl, Biphenyl, Naphthyl, Fluorenyl, Terphenyl, Phenanthrolinyl, Phenanthryl und Anthryl.

2. Elektronentransport-Verbindung gemäß Anspruch 1, wobei, wenn A, B und C substituiert vorliegen, ein Substituent von A, B und C aus einer Gruppe, bestehend aus Aryl, Alkyl, Aryloxy, Alkoxy, Allylamino, Alkylamino, Halogen, und Cyano, ausgewählt ist.

3. Elektronentransport-Verbindung gemäß Anspruch 1, wobei, wenn A, B und C substituiert vorliegen, ein Substituent aus einer Gruppe, bestehend aus Phenyl, Biphenyl, Triphenylmethyl, Phenylethyliden, Diphenylethyliden, Phenylmethylidin, Phenoxy, Tolyoxy, Methyl, Ethyl, Propyl, i-Propyl, t-Butyl, Cyclohexyl, Diphenylamino, Morpholin, Methoxy, Ethoxy, Propoxy, Butoxy, Dimethylamino, Diphenylamino, Fluor und Chlor, ausgewählt ist.

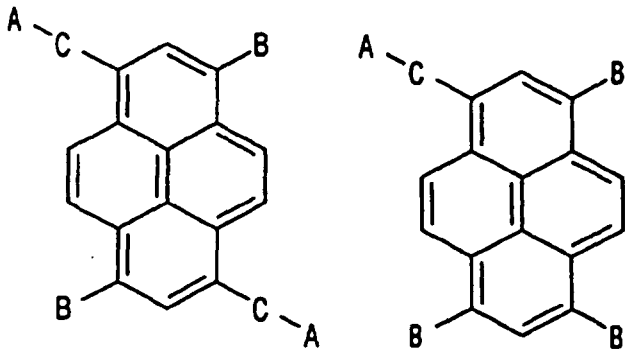
4. Organische Licht-emittierende Vorrichtung mit einer Elektroneninjizierenden und -transport-Schicht, aufweisend die Elektronentransport-Verbindung gemäß Anspruch 1.

5. Organische Licht-emittierende Vorrichtung gemäß Anspruch 4, wobei die Elektronen-injizierende und -transport-Schicht eines oder beides von einer Elektroneninjizierenden Schicht und einer Elektronentransport-Schicht ist.

6. Organische Licht-emittierende Vorrichtung gemäß Anspruch 5, wobei die organische Licht-emittierende Vorrichtung aufweist: eine Anode, eine ein organisches Material aufweisende emittierende Schicht und eine Kathode, wobei die Elektronen-injizierende und -transport-Schicht zwischen der emittierenden Schicht und der Kathode ausgebildet ist.

Revendications

1. Composé transporteur d'électrons comprenant un composé à base de pyrène,
caractérisé en ce que le composé à base de pyrène présente l'une des formules chimiques suivantes ;



où A est choisi dans un groupe comprenant les groupes pyridinyle, quinolinyle, isoquinolinyle, quinoxalinyle, bipyridinyle, terpyridinyle et phénanthrolinyle ; et
B et C sont choisis dans un groupe comprenant les groupes phényle, diphényle, naphtyle, fluorenyle, terphényle, phénanthrolinyle, phénanthryle et anthryle.

2. Composé transporteur d'électrons selon la revendication 1, dans lequel, lorsque A, B et C sont substitués, un substituant de A, B et C est choisi dans un groupe comprenant les groupes aryle, alkyle, aryloxy, alcoxy, allylamino, alkylamino, halogène et cyano.

3. Composé transporteur d'électrons selon la revendication 1, dans lequel, lorsque A, B et C sont substitués, un substituant de A, B et C est choisi dans un groupe comprenant les groupes phényle, diphényle, triphénylméthyle, phényléthylidène, diphényléthylidène, phénylméthylidyne, phénoxy, tolyoxy, méthyle, éthyle, propyle, i-propyle, t-butyle, cyclohexyle, diphénylamino, morpholine, méthoxy, éthoxy, propoxy, butoxy, diméthylamino, diphénylamino, fluor et chlore.

4. Dispositif électroluminescent organique présentant une couche d'injection et de transport d'électrons qui comprend le composé transporteur d'électrons selon la revendication 1.

5. Dispositif électroluminescent organique selon la revendication 4, dans lequel la couche d'injection et de transport d'électrons est une couche d'injection d'électrons et/ou une couche de transport d'électrons.

6. Dispositif électroluminescent organique selon la revendication 5, dans lequel le dispositif électroluminescent organique comprend une anode, une couche émettrice qui comprend un matériau organique et une cathode, dans lequel la couche d'injection et de transport d'électrons est formée entre la couche émettrice et une cathode.

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 20030157365 A1 **[0003]**
- US 20050238920 A1 **[0004]**
- WO 2006057325 A1 **[0005]**

Non-patent literature cited in the description

- **YONG HWAN PARK ; HYEON HEE RHO ; NO GILL PARK ; YOUNG SIK KIM.** Theoretical investigation of tetra-substituted pyrenes for organic light emitting diodes. *Current Applied Physics,* 2006, vol. 6, 691-694 **[0002]**

专利名称(译)	电子传输化合物和包含其的有机发光器件		
公开(公告)号	EP1808912B1	公开(公告)日	2012-08-15
申请号	EP2007000776	申请日	2007-01-16
申请(专利权)人(译)	LG电子株式会社.		
当前申请(专利权)人(译)	LG DISPLAY CO. , LTD.		
[标]发明人	KIM JUNG KEUN SEO JEONGDAE JEONG HYUN CHEOL BIN JONG KWAN PARK CHUNGUN		
发明人	KIM, JUNG KEUN SEO, JEONGDAE JEONG, HYUN CHEOL BIN, JONG KWAN PARK, CHUNGUN		
IPC分类号	H01L51/54		
CPC分类号	H01L51/0054 H01L51/0067 H01L51/0081 H01L51/5048 Y10S428/917		
代理机构(译)	庆祝活动，JENTSCHURA＆PARTNER		
优先权	1020060004687 2006-01-16 KR 1020060004688 2006-01-16 KR 1020060004689 2006-01-16 KR		
其他公开文献	EP1808912A3 EP1808912A2		
外部链接	Espacenet		

摘要(译)

提供一种具有芘基电子传输化合物的有机发光器件和包含该电子传输化合物的电子注入和传输层。

[Chemical formula 1-1]