US 20170301874A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2017/0301874 A1

TADOKORO et al. (43) Pub. Date: Oct. 19, 2017

(54) **ORGANIC EL PANEL AND METHOD FOR PRODUCING SAME**

(71) Applicant: **NIPPON SEIKI CO., LTD.**, Niigata (JP)

(72) Inventors: **Toyoyasu TADOKORO**, Niigata (JP); **Yotaro SHIRAISHI**, Niigata (JP); **Takashi IKEDA**, Niigata (JP)

(21) Appl. No.: **15/513,549**

(22) PCT Filed: **Sep. 18, 2015**

(86) PCT No.: **PCT/JP2015/076752**

§ 371 (c)(1),
(2) Date: **Mar. 22, 2017**

(30) **Foreign Application Priority Data**

Sep. 24, 2014 (JP) 2014-194283

Publication Classification

(51) **Int. Cl.**

H01L 51/50	(2006.01)
H01L 51/52	(2006.01)
H01L 51/00	(2006.01)
H01L 51/52	(2006.01)
H01L 51/56	(2006.01)
H01L 51/52	(2006.01)

(52) **U.S. Cl.**

CPC ***H01L 51/5012*** (2013.01); ***H01L 51/56*** (2013.01); ***H01L 51/5253*** (2013.01); ***H01L 51/0021*** (2013.01); ***H01L 51/5209*** (2013.01); ***H01L 51/5212*** (2013.01)

(57) **ABSTRACT**

Provided is a narrow-frame organic EL panel for suppressing unevenness in the brightness of light emission. The present invention involves positioning the following on a translucent support substrate: a translucent first electrode to which power is supplied from an external power source via common wiring, a second electrode for forming a pair with the first electrode, and an organic EL element in which an organic layer having at least a light-emitting layer is sandwiched between the first electrode and the second electrode. In addition, a sealing member is positioned so as to cover the organic EL element in an airtight manner, an auxiliary electrode having a lower specific resistance than that of the first electrode is formed on the first electrode, a groove is provided in at least a section of the sealing member, and an auxiliary conductive part comprising a conductive material is positioned in the groove.

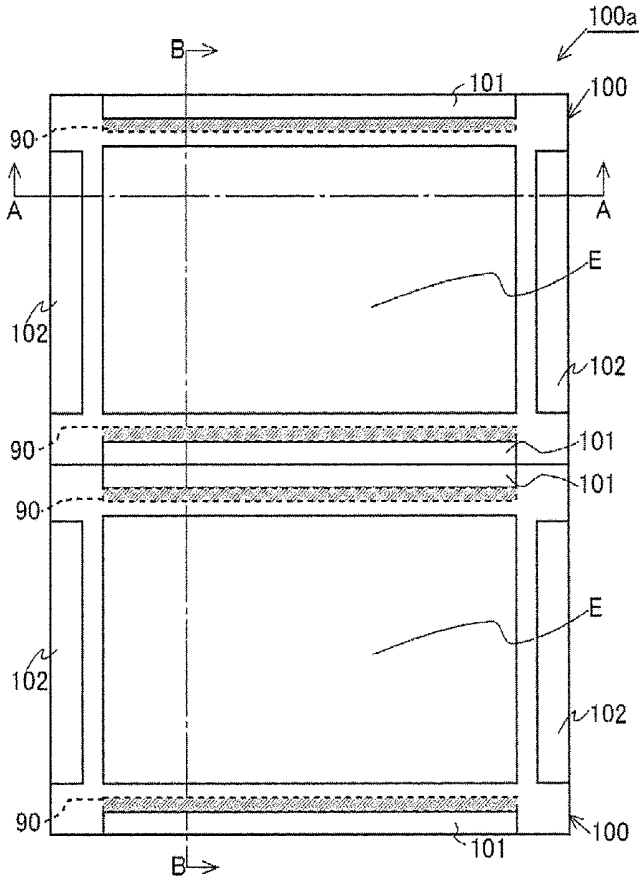


FIG 1

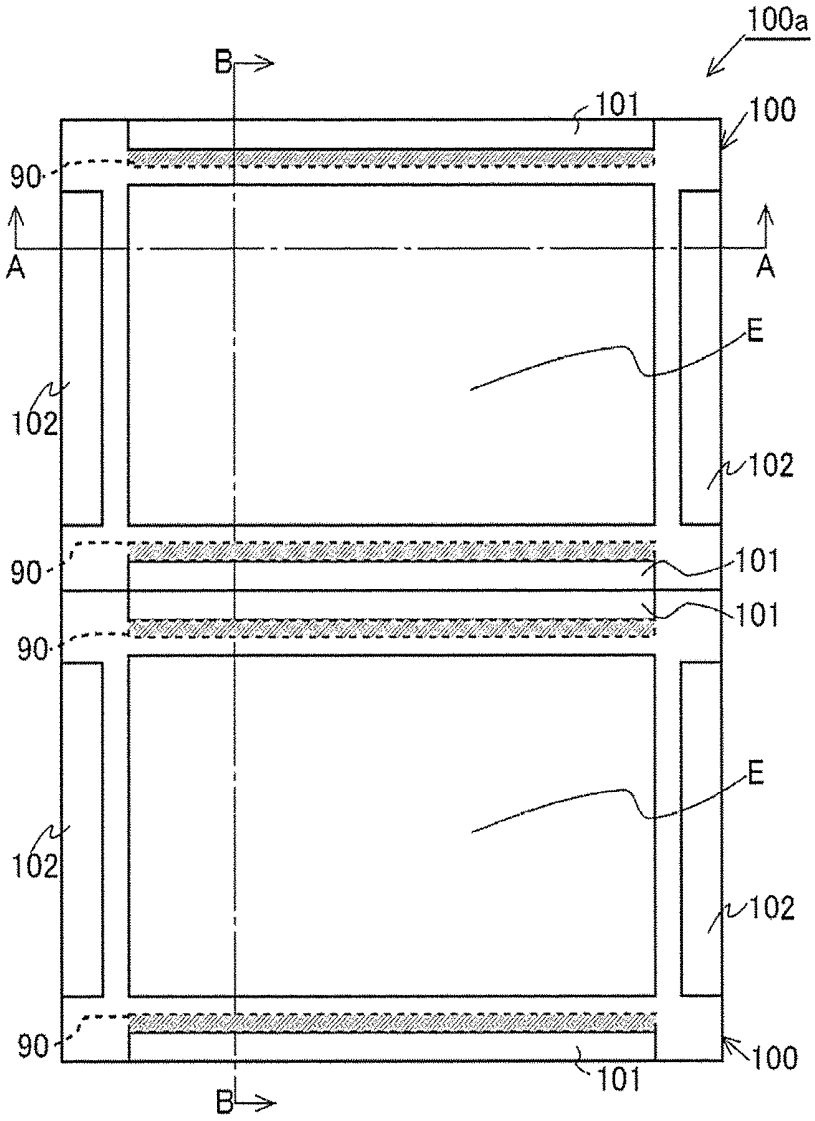

100a
B
101
100
90
A
A
E
102
102
90
101
101
90
E
102
102
90
100
101
B

FIG 2

A—A

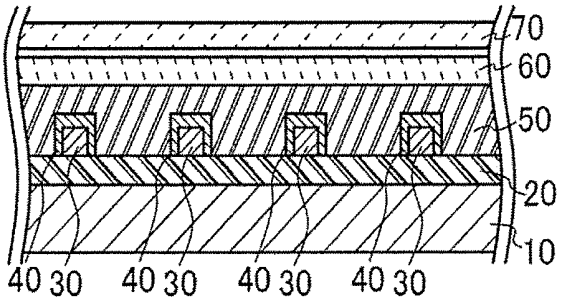

70
60
50
20
10
40 30
40 30
40 30
40 30

FIG 3

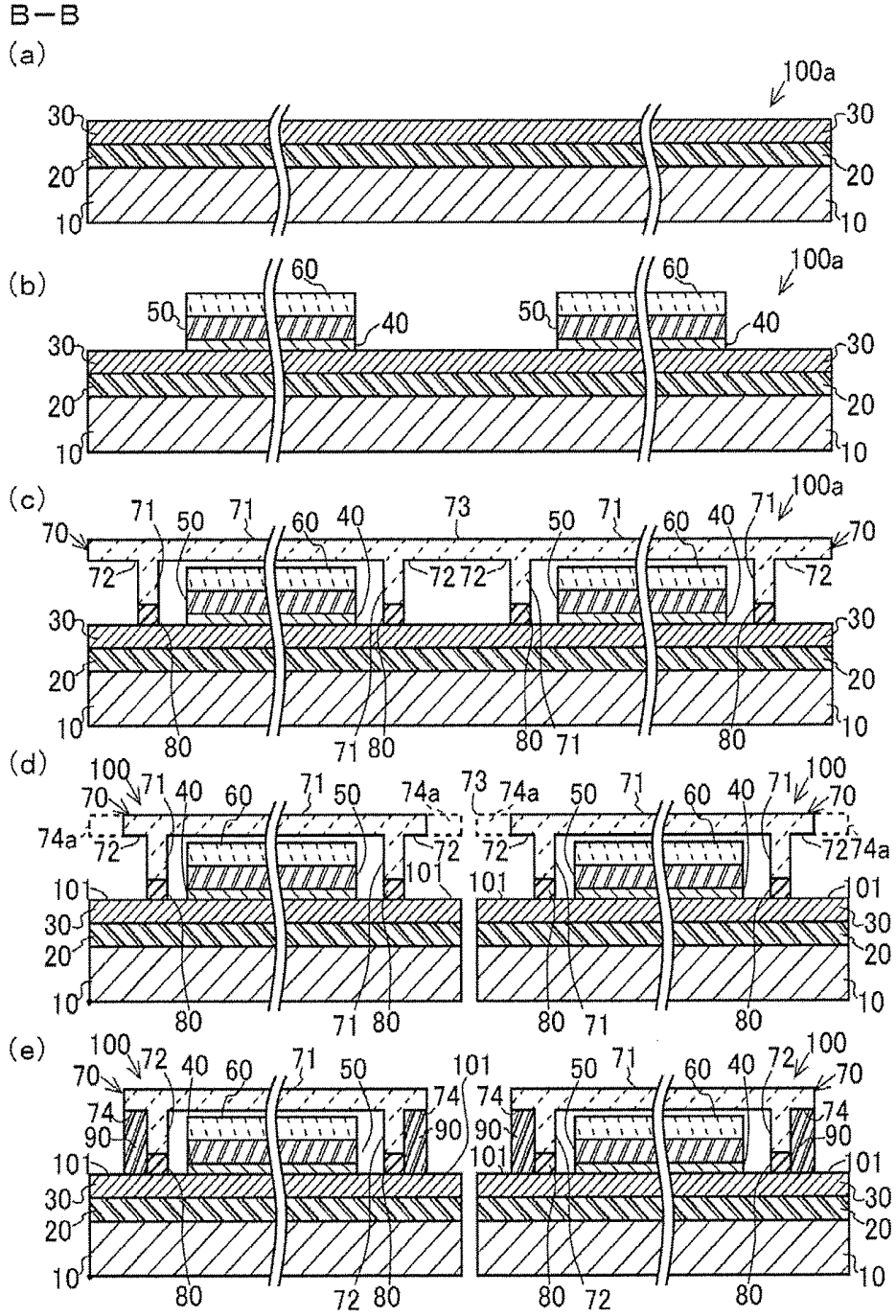


FIG 4

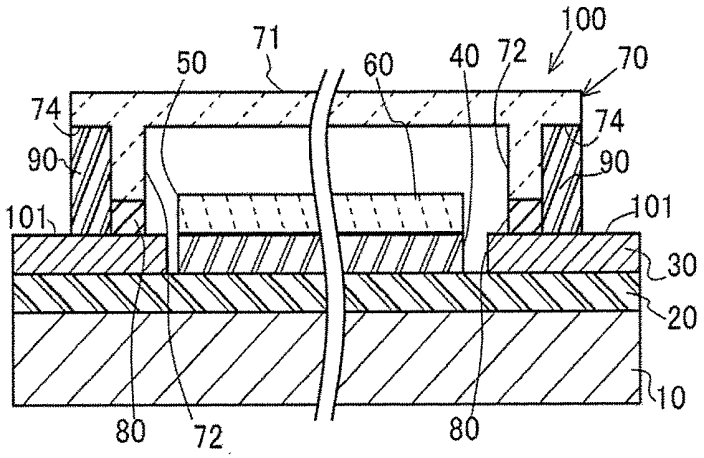

100
71
50
60
40
72
70
74
74
90
90
101
101
30
20
10
80
72
80

FIG 5

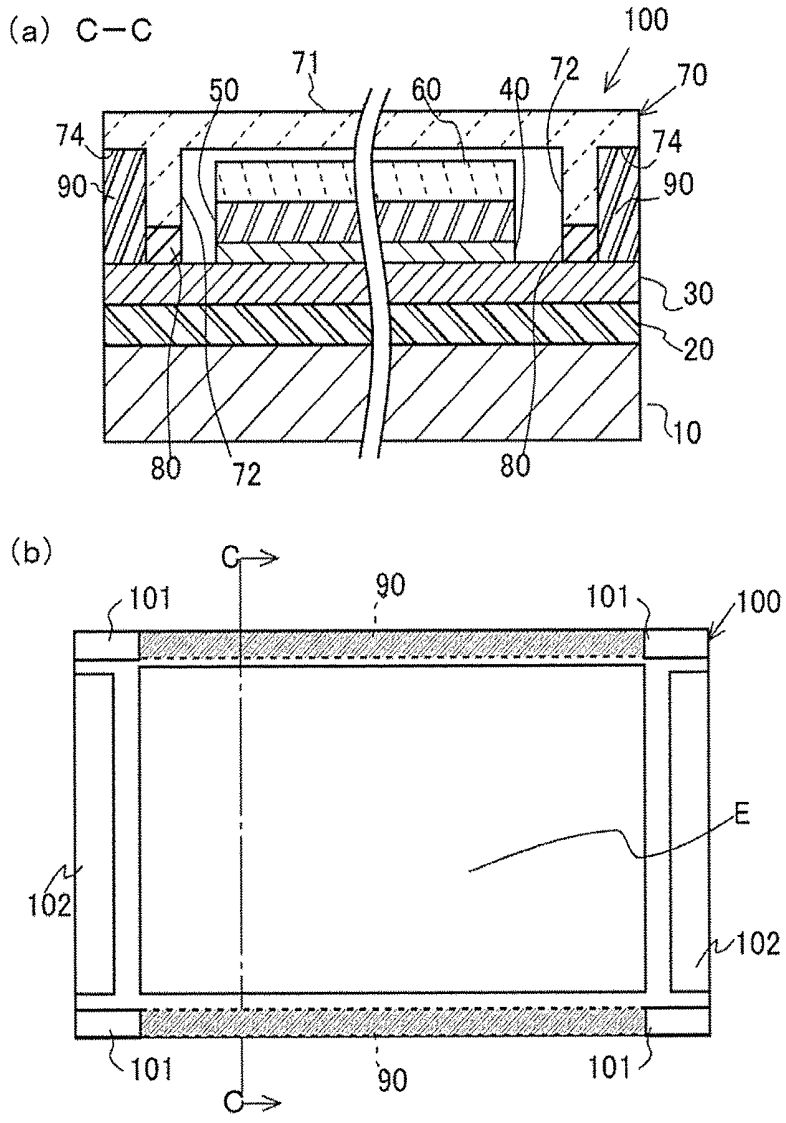
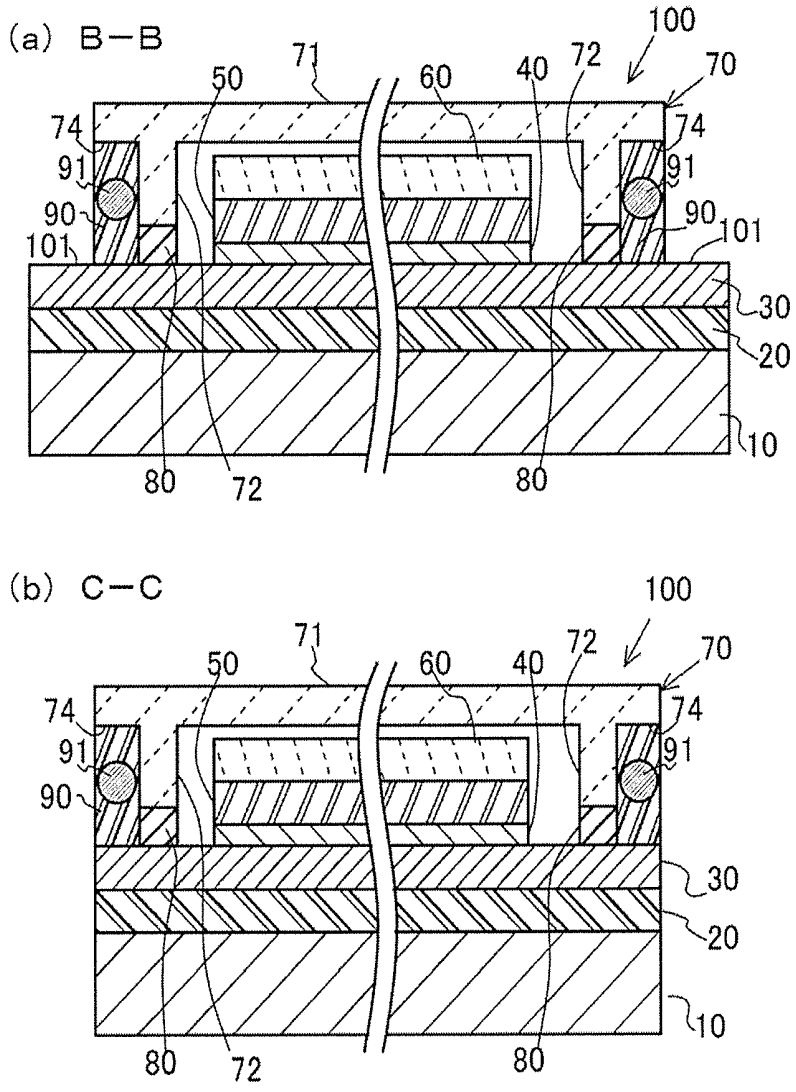

(a) C−C
100
71
72
50
60
40
70
74
74
90
90
30
20
10
80
72
80
(b)
C
101
90
101
100
E
102
102
101
90
101
C

FIG 6


(a) B−B
100
71
50
60
40
72
70
74
74
91
91
90
90
101
101
30
20
10
80
72
80
(b) C−C
100
71
50
60
40
72
70
74
74
91
91
90
30
20
10
80
72
80

ORGANIC EL PANEL AND METHOD FOR PRODUCING SAME

TECHNICAL FIELD

[0001] The present invention relates to an organic EL panel and a method for producing the same.

BACKGROUND ART

[0002] It is necessary to suppress voltage drop in common wiring in order to cause an organic EL panel to uniformly emit light, and PTL 1 discloses an organic EL panel that places an auxiliary electrode having a lower electrical resistivity than that of a transparent electrode on common wiring of the transparent electrode to reduce an electrical resistivity of the transparent electrode and suppress voltage drop caused by the transparent electrode.

CITATION LIST

Patent Literature

[0003] PTL 1: JP-A-2003-123990

SUMMARY OF INVENTION

Technical Problem(s)

[0004] However, an organic EL panel serving as a light source is required to uniformly emit light at a high brightness, and therefore, in the case where the organic EL panel is formed to have a large area or a long length, an electric current flowing through common wiring is increased, and voltage drop in the common wiring is further increased. In order to suppress voltage drop in the common wiring, it is necessary to increase a wiring width of the common wiring, and therefore an area of the common wiring from an external power source placed in an outer region (frame) in a light-emitting unit of the organic EL panel is increased and the frame of the organic EL panel is increased. Thus, it is difficult to reduce a size of the organic EL panel.

[0005] The invention has been made in view of the above problems, and an object thereof is to provide a narrow-frame organic EL panel for suppressing unevenness in light emission luminance and a method for producing the same.

Solution to Problem(s)

[0006] In order to achieve the above object, an organic EL panel according to a first aspect of the invention includes: a translucent first electrode to which power is supplied from an external power source via common wiring; a second electrode paired with the first electrode; an organic layer sandwiched between the first electrode and the second electrode, the organic layer having at least a light-emitting layer; a support substrate supporting the first electrode, the second electrode, and the organic layer; and a sealing member covering the first electrode, the second electrode, and the organic layer between the sealing member and the support substrate, wherein: an auxiliary electrode having a lower resistivity than a resistivity of the first electrode is provided on the first electrode; and a groove is provided in at least a part of the sealing member and an auxiliary conductive part is provided in the groove, the auxiliary conductive part being in contact with the auxiliary electrode and being made of a conductive material.

[0007] A method for producing an organic EL panel according to a second aspect is a method for producing an organic EL panel by dividing a common substrate into a plurality of organic EL panels, including: a step of forming a first electrode made of a translucent conductive material on a translucent support substrate and forming an auxiliary electrode having a lower resistivity than a resistivity of the conductive material on a part of the first electrode; a step of sequentially laminating an organic layer and a second electrode paired with the first electrode, the organic layer being a layer in which the auxiliary electrode is covered with an insulating material and having at least a light-emitting layer on the first electrode; a step of sealing the first electrode, the auxiliary electrode, the second electrode, and the organic layer with a sealing member on the support substrate; a division step of dividing the common substrate generated in the above step into a plurality of organic EL panels; and a step of forming an auxiliary conductive part made of a conductive material in a groove formed by the sealing member on an outer surface of the organic EL panel generated in the division step so that the auxiliary conductive part is brought into contact with the auxiliary electrode.

Advantageous Effects of Invention

[0008] According to the invention, it is possible to provide a narrow-frame organic EL panel for suppressing unevenness in light emission luminance and a method for producing the same.

BRIEF DESCRIPTION OF DRAWINGS

[0009] FIG. **1** is a planar view of a multi-organic EL substrate in an embodiment of the invention.

[0010] FIG. **2** is a cross-sectional view of the multi-organic EL substrate in the above embodiment, which is across-sectional view taken along A-A in FIG. **1**.

[0011] FIG. **3** is cross-sectional views of the multi-organic EL substrate in the above embodiment, which is cross-sectional views taken along B-B in FIG. **1**.

[0012] FIG. **4** is a cross-sectional view of the organic EL panel in the above embodiment, which is a cross-sectional view that does not cross an auxiliary electrode.

[0013] FIG. **5** is (a) a cross-sectional view and (b) a planar view of an organic EL panel in a modification example.

[0014] FIG. **6** is cross-sectional views of an organic EL panel in a modification example.

DESCRIPTION OF EMBODIMENTS

[0015] Hereinafter, an embodiment of the invention will be described with reference to the attached drawings.

[0016] An organic EL panel **100** mainly includes a support substrate **10**, a first electrode **20** formed on the support substrate **10**, an auxiliary electrode **30** formed on a part of the first electrode **20**, an insulating layer **40**, an organic layer **50**, a second electrode **60**, a sealing member **70**, an adhesive agent **80**, and an auxiliary conductive part **90**. The organic EL panel **100** includes first terminal parts **101** and second terminal parts **102**, connects the first terminal parts **101** to an anode of an external power source (not shown) and connects the second terminal parts **102** to a cathode of the external power source, and causes a light-emitting unit E to emit light by supplying power to the first terminal parts **101** (second terminal parts **102**). The organic EL panel **100** in this embodiment is formed by generating a plurality of organic

EL panels **100** with the use of a common substrate (multi-organic EL substrate **100***a*) and then dividing the common substrate. In this way, the individual organic EL panels **100** are formed.

[0017] The support substrate **10** is made of a rectangular transparent glass material and is an electrically insulating substrate. Although a glass material is used for the support substrate **10** in this example, not only the glass material but also transparent materials such as plastics and ceramics can be used for the substrate.

[0018] The first electrode **20** is made of a translucent conductive material such as ITO and is translucent wiring obtained by forming an electrode film on the support substrate **10** by means such as a vapor deposition method or a sputtering method and then patterning the electrode film to a predetermined shape by a photolithography method or the like. Although the first electrode **20** is formed on the whole light-emitting unit E in this embodiment, the first electrode **20** may be formed as a plurality of stripes vertical to left and right sides of the organic EL panel **100** in FIG. **1**. The first electrode **20** has a common wiring structure in which the first electrode **20** is electrically connected to the external power source via the first terminal parts **101** described below and power is supplied to the whole first electrode **20** on the basis of supply of power from the external power source via the first terminal parts **101**.

[0019] The auxiliary electrode **30** is non-translucent wiring obtained by forming a metal such as aluminum having a lower resistivity than that of the translucent conductive material of the first electrode **20** on the first electrode **20** by means such as the sputtering method so that the metal has a film of a single layer or laminated layers having a film thickness of 50 to 1500 nm and patterning the metal to a predetermined shape by means such as the photolithography method. In this embodiment, the auxiliary electrode **30** is formed on the first electrode **20** as a plurality of stripes vertical to the left and right sides of the organic EL panel **100** in FIG. **1**.

[0020] The insulating layer **40** is made of, for example, a polymide-based transparent insulating material and is formed as layered thin films of about 1.0 μm by a spin coating method or the like and is then patterned to a desired shape by the photolithography method. The insulating layer **40** is formed between the auxiliary electrode **30** and the organic layer **50** described below so as to cover the auxiliary electrode **30** formed as a stripe on the first electrode **20**, thereby preventing short circuit between the first electrode **20** and the second electrode **60** described below.

[0021] The organic layer **50** is formed on the first electrode **20**, is formed by sequentially laminating a hole injection transport layer, a light-emitting layer, an electron transport layer, and an electron injection layer by means such as the vapor deposition method, and emits, for example, white light. Note that, in the organic layer **50**, the light-emitting layer may be formed by a single layer or may be formed by adding another layer.

[0022] The second electrode **60** is formed as a layer by providing a metallic conductive material having a higher conductivity than that of the first electrode **20** such as aluminum or magnesium silver on a back surface side of the organic layer **50** by means such as the vapor deposition method. The second electrode **60** has a common wiring structure in which the second electrode **60** is electrically connected to the external power source via the second terminal parts **102** described below and power is supplied to the whole second electrode **60** on the basis of supply of power from the external power source via the second terminal parts **102**.

[0023] The sealing member **70** is obtained by forming a plate member made of, for example, a glass material so that the plate member has a recessed shape by an appropriate method such as sandblasting, cutting, or etching and includes a plate part **71** facing to the organic layer **50**, a support part **72** extending toward the support substrate **10** so as to surround the plate part **71**, a division part **73** to be divided when the multi-organic EL substrate **100***a* is divided into the plurality of organic EL panels **100**, and a groove **74** formed on the outside of the support part **72**, the groove being formed by the plate part **71** and the support part **72**. In this embodiment, the groove **74** is formed by any one of a thermal press molding method, an etching method, a sandblasting method, and a cutting method.

[0024] The adhesive agent **80** is made of, for example, ultraviolet-curable epoxy resin and is used to cause the support part **72** to adhere to the support substrate **10** (auxiliary electrodes **30**), and therefore the organic layer **50** is provided on the support substrate **10** in an airtight manner, and the organic layer **50** is sealed by the sealing member **70** and the support substrate **10** (auxiliary electrodes **30**). Further, the sealing member **70** is formed to be slightly smaller than the support substrate **10** so that end parts of the first electrode **20** and the second electrode **60** are exposed to the outside, and a part of the support part **72** is provided to be overlaid with the first electrode **20** and the second electrode **60**.

[0025] The auxiliary conductive part **90** is made of, for example, a conductive paste having a volume resistivity of 1.5×10^{-4} Ω/cm and a viscosity of 10 Pa·s. After the multi-organic EL substrate **100***a* is divided, the auxiliary conductive part **90** is applied to the groove **74** formed by the plate part **71**, the support part **72**, and the auxiliary electrode **30** on side surfaces of each organic EL panel **100** so that the auxiliary conductive part **90** is electrically connected to the auxiliary electrode **30** and is then cured by heat.

[0026] The first terminal part **101** is a part of the first electrode **20** and the auxiliary electrode **30** formed on the support substrate **10**, the part being extracted from the inside of the sealing member **70** to the outside thereof, and electrically connects the first electrode **20** and the auxiliary electrode **30** to the external power source.

[0027] The second terminal part **102** is formed by laminating a metal layer (not shown) made of a metal material having a low resistivity, such as chromium, on a base part (not shown) which is made of the same material as that of the first electrode **20** at the same time and electrically connects the second electrode **60** to the external power source.

[0028] The organic EL panel **100** is made up of the above parts. The organic EL panel **100** is a so-called bottom-emission type organic EL panel that emits light from the support-substrate-**10** side.

[0029] A method for producing the organic EL panel **100** will be described with reference to FIG. **3**. FIG. **3** is cross-sectional views of the multi-organic EL substrate **100***a*, which is cross-sectional views taken along B-B in FIG. **1**. Note that, although FIG. **3** is cross-sectional views passing through the auxiliary electrode **30**, FIG. **4** is a

cross-sectional view that does not pass through the auxiliary electrode **30**, which is seen from the same direction.

[0030] First, in a "first electrode forming step, FIG. **3**(*a*)", the first electrode **20** and the auxiliary electrode **30** are formed on the support substrate **10** by means such as the vapor deposition method or the sputtering method, and then the slit-like first electrode **20** and auxiliary electrode **30** are formed on the support substrate **10** by the photolithography method or the like.

[0031] Next, the insulating layer **40** is formed to have a thin film shape on a back surface side of the auxiliary electrode **30** by the spin coating method or the like and is then patterned to a desired shape by the photolithography method. Then, in an "organic layer forming step and second electrode forming step, FIG. **3**(*b*)", the organic layer **50** is laminated to correspond to the first electrode **20**, and the second electrode **60** is further laminated on the organic layer **50**.

[0032] Next, in a "bonding step, FIG. **3**(*c*)", the sealing member **70** to which the adhesive agent **80** is applied and the support substrate **10** are overlaid in a nitrogen atmosphere while being kept in parallel by an overlaying device (not shown) so that each plate part **71** corresponds to the light-emitting unit E, and the support part **72** of the sealing member **70** and the support substrate **10** (auxiliary electrodes **30**) are bonded and fixed by irradiation with ultraviolet rays, and thus the multi-organic EL substrate **100***a* including the plurality of organic EL panels **100** is obtained.

[0033] Next, in a "cutting step, FIG. **3**(*d*)", the division part **73**, which is a boundary between the plurality of organic EL panels **100** in the multi-organic EL substrate **100***a* obtained in the bonding step, is cut by means such as a scribing method, and an excess part **74***a*, which is an excess portion of the groove **74**, is cut by means such as the scribing method, and thus the individual organic EL panels **100** are obtained.

[0034] Then, in an "applying step, FIG. **3**(*e*)", the auxiliary conductive part **90** is applied to the groove **74** of the organic EL panel **100** with the use of a needle or the like, and after application, the auxiliary conductive part **90** is cured.

[0035] The organic EL panel **100** in this embodiment described above is obtained by providing, on the translucent support substrate **10**, the translucent first electrode **20** to which power is supplied from an external power source via common wiring, the second electrode **60** paired with the first electrode **20**, and an organic EL element in which the organic layer **50** having at least a light-emitting layer is sandwiched between the first electrode **20** and the second electrode **60** and providing the sealing member **70** covering the organic EL element in an airtight manner, and the auxiliary electrode **30** having a lower resistivity than that of the first electrode **20** is formed on the first electrode **20**, the groove **74** is provided on at least a part of the sealing member **70**, and the auxiliary conductive part **90** made of a conductive material is placed in the groove **74**.

[0036] With this, an electrical resistivity against the first electrode **20** over the whole light-emitting unit E can be kept low even in the case where the width of the first terminal part **101** of the common wiring is not increased. That is, it is possible to cause the light-emitting unit E to uniformly emit light while keeping the electrical resistivity of the common wiring low, and therefore it is possible to provide the narrow-frame organic EL panel **100** having a narrow frame.

[0037] Note that the invention is not limited by the embodiment described above and the drawings. It is possible to make modifications (including elimination of constituent elements) as appropriate without changing the scope of the invention.

[0038] In the above embodiment, the organic EL element (organic layer **50**), the support part **72** of the sealing member **70**, the auxiliary conductive part **90**, and the first terminal part **101** are placed in order from the center of the organic EL panel **100** to the outside thereof, and the first terminal part **101** is placed at an edge of the organic EL panel **100**. However, as shown in FIG. **5**(*a*), the auxiliary conductive parts **90** may be placed on the outside of the organic EL panel **100**, and the first terminal parts **101** may be placed at both ends of the second terminal part **102** (vertical parts of the second terminal part **102** in FIG. **5**(*b*)) so that electricity can be conducted to the auxiliary conductive parts **90**. With this, it is unnecessary to provide a space for providing the first terminal part **101** on one opposite side of the organic EL panel **100**, and therefore it is possible to provide the narrow-frame organic EL panel **100** having a narrow frame.

[0039] As shown in FIGS. **6**(*a*) and **6**(*b*), a conducting wire **91**, which has a volume resistivity of 1.5×10^{-7} Ω/cm and is made of, for example, a tin coating copper wire having a diameter of 0.2 mm, may be provided in the auxiliary conductive part **90**. With this structure, it is possible to keep the electrical resistivity of the common wiring (first electrode **20**) lower and cause the light-emitting unit E to uniformly emit light, and therefore it is possible to provide the narrow-frame organic EL panel **100** having a narrow frame.

INDUSTRIAL APPLICABILITY

[0040] The invention is suitable for an organic EL panel serving as a light source.

REFERENCE SIGNS LIST

[0041] **100** organic EL panel
[0042] **100***a* multi-organic EL substrate
[0043] **101** first terminal part
[0044] **102** second terminal part
[0045] **10** support substrate
[0046] **20** first electrode
[0047] **30** auxiliary electrode
[0048] **40** insulating layer
[0049] **50** organic layer
[0050] **60** second electrode
[0051] **70** sealing member
[0052] **71** plate part
[0053] **72** support part
[0054] **73** division part
[0055] **74** groove
[0056] **80** adhesive agent
[0057] **90** auxiliary conductive part
[0058] **91** conducting wire
[0059] E light-emitting unit

1. An organic EL panel, comprising:
a translucent first electrode to which power is supplied from an external power source via common wiring;
a second electrode paired with the first electrode;
an organic layer sandwiched between the first electrode and the second electrode, the organic layer having at least a light-emitting layer;

a support substrate supporting the first electrode, the second electrode, and the organic layer; and

a sealing member covering the first electrode, the second electrode, and the organic layer between the sealing member and the support substrate, wherein:

an auxiliary electrode having a lower resistivity than a resistivity of the first electrode is provided on the first electrode; and

a groove is provided in at least a part of the sealing member and an auxiliary conductive part is provided in the groove, the auxiliary conductive part being in contact with the auxiliary electrode and being made of a conductive material.

2. The organic EL panel according to claim **1**, wherein

the groove is provided on an outer surface of the sealing member.

3. The organic EL panel according to claim **1**, wherein

the sealing member includes a plate part facing to the organic layer and a support part extending toward the support substrate so as to surround the plate part, a part of the plate part extends from the support part to the outside, and the groove is formed by the support part and the plate part extending from the support part to the outside.

4. The organic EL panel according to claim **1**, wherein

the auxiliary conductive part is made of a conductive paste.

5. The organic EL panel according to claim **1**, wherein

the auxiliary conductive part includes a conducting wire electrically connected to the auxiliary electrode.

6. A method for producing an organic EL panel by dividing a common substrate into a plurality of organic EL panels, comprising:

a step of forming a first electrode made of a translucent conductive material on a translucent support substrate and forming an auxiliary electrode having a lower resistivity than a resistivity of the conductive material on a part of the first electrode;

a step of sequentially laminating an organic layer and a second electrode paired with the first electrode, the organic layer being a layer in which the auxiliary electrode is covered with an insulating material and having at least a light-emitting layer on the first electrode;

a step of sealing the first electrode, the auxiliary electrode, the second electrode, and the organic layer with a sealing member on the support substrate;

a division step of dividing the common substrate generated in the above step into a plurality of organic EL panels; and

a step of forming an auxiliary conductive part made of a conductive material in a groove formed by the sealing member on an outer surface of the organic EL panel generated in the division step so that the auxiliary conductive part is brought into contact with the auxiliary electrode.

* * * * *

专利名称(译)	有机EL板及其制造方法		
公开(公告)号	US20170301874A1	公开(公告)日	2017-10-19
申请号	US15/513549	申请日	2015-09-18
[标]申请(专利权)人(译)	日本精机株式会社		
申请(专利权)人(译)	日本精机股份有限公司.		
当前申请(专利权)人(译)	日本精机股份有限公司.		
[标]发明人	TADOKORO TOYOYASU SHIRAISHI YOTARO IKEDA TAKASHI		
发明人	TADOKORO, TOYOYASU SHIRAISHI, YOTARO IKEDA, TAKASHI		
IPC分类号	H01L51/50 H01L51/52 H01L51/00 H01L51/56		
CPC分类号	H01L51/5012 H01L51/5212 H01L51/5209 H01L51/0021 H01L51/5253 H01L51/56 H01L51/524 H01L51/5262 H05B33/04 H05B33/22 H01L51/5243 H01L51/5246 H01L51/525		
优先权	2014194283 2014-09-24 JP		
外部链接	Espacenet USPTO		

摘要(译)

本发明提供一种窄框有机EL面板，其用于抑制发光亮度的不均匀。本发明涉及将下面的部件定位在半透明支撑基板上：半透明的第一电极，其通过公共布线从外部电源供电，第二电极用于与第一电极形成一对，以及有机EL元件，其中具有至少一个发光层的有机层夹在第一电极和第二电极之间。另外，密封构件定位成以气密方式覆盖有机EL元件，在第一电极上形成具有比第一电极低的电阻率的辅助电极，至少在凹槽中设置凹槽。密封构件的截面和包括导电材料的辅助导电部分位于凹槽中。