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

(11) EP 2 209 149 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
21.07.2010 Bulletin 2010/29

(51) Int Cl.:
H01L 51/52 *(2006.01)*

(21) Application number: **10150999.0**

(22) Date of filing: **18.01.2010**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR
Designated Extension States:
AL BA RS

(30) Priority: **20.01.2009 KR 20090004572**

(71) Applicant: **Samsung Mobile Display Co., Ltd.**
Yongin-city, Gyunggi-do 446-711 (KR)

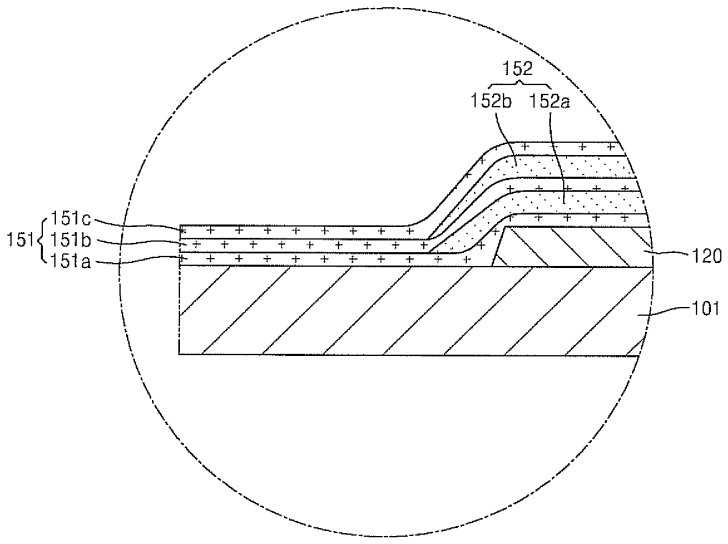
(72) Inventors:
- **Kim, So-Yeon**
  Gyunggi-Do 446-711 (KR)
- **Han, Sung-Wook**
  Gyunggi-Do 446-711 (KR)
- **Han, Dong-Won**
  Gyunggi-Do 446-711 (KR)
- **Kwack, Jin-Ho**
  Gyunggi-Do 446-711 (KR)
- **Kim, Hyo-Jin**
  Gyunggi-Do 446-711 (KR)

(74) Representative: **Gulde Hengelhaupt Ziebig & Schneider**
Patentanwälte - Rechtsanwälte
Wallstrasse 58/59
10179 Berlin (DE)

(54) Organic light emitting display apparatus

(57) An organic light-emitting display apparatus for encapsulating an organic light-emitting device and/or improving its electrical properties. The organic light-emitting display apparatus includes: a substrate (101); a display portion on the substrate and including an organic light-emitting device (120); a non-display portion on both the substrate and the peripheral region of the display portion; and an encapsulation portion on the display portion and including a first encapsulation layer formed of an inorganic material (151) and a second encapsulation layer formed of an organic material (152) that are alternately stacked on the display portion, wherein an end portion of the first encapsulation layer contacts the substrate (101).

FIG. 2



EP 2 209 149 A1

Description

CROSS-REFERENCE TO RELATED PATENT APPLICATION

[0001] This application claims priority to and the benefit of Korean Patent Application No. 10-2009-0004572, filed on January 20, 2009, in the Korean Intellectual Property Office, the entire content of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] The present invention relates to an organic light-emitting display apparatus, and, more particularly, to an organic light-emitting display apparatus for encapsulating an organic light-emitting device.

2. Description of the Related Art

[0003] Organic and inorganic light-emitting display apparatuses are flat panel display apparatuses. In addition, organic and inorganic light-emitting display apparatuses are self-emitting display apparatuses that have wide viewing angle, good contrast, and rapid response speed. In addition, organic light-emitting display apparatuses including a light-emitting layer formed of an organic material have better brightness, lower driving voltage, and higher response speed characteristics than inorganic light-emitting display apparatuses, and can provide multicolored images. However, organic light-emitting display apparatuses can easily deteriorate due to contamination from outside air and penetration of moisture. In order to protect the organic light-emitting devices (e.g., the organic light-emitting diodes) of the organic light-emitting display apparatuses from the deterioration caused by the contamination of outside air and/or penetration of moisture, a thin film encapsulation method of alternately stacking organic layers and inorganic layers has been developed. The thin film encapsulation method can be used on an organic light-emitting display apparatus having a large, flexible, bendable, and/or ultra-thin film display.

[0004] With reference to a region horizontal to an upper portion of an organic light-emitting device (e.g., an organic light-emitting diode) included in an encapsulation layer region of an alternately stacked structure, impurities, air, or moisture may easily penetrate into the peripheral region of the organic light-emitting device.

[0005] Also, during a process of depositing organic layers, an organic light-emitting device is exposed to ultraviolet (UV) rays when liquefied or gasified organic monomer is cured by irradiating UV to form polymer, which deteriorates the properties of the organic layers included in the organic light-emitting device, and changes the interface properties between the organic layers and electrodes included in the organic light-emitting device. Thus, the electrical properties of the organic light-emitting device may be deteriorated and/or a leakage current may occur when a voltage is applied to the organic light-emitting device, thereby increasing power consumption of the organic light-emitting display apparatus that includes the organic light-emitting device and reducing the lifespan thereof.

SUMMARY OF THE INVENTION

[0006] An aspect of an embodiment of the present invention is directed toward an organic light-emitting display apparatus for protecting an organic light-emitting device (e.g., an organic light-emitting diode) from external impurities, such as gas and moisture, and/or improving the electrical properties of the organic light-emitting device.

[0007] According to an embodiment of the present invention, there is provided an organic light-emitting display apparatus including: a substrate; a display portion on the substrate and including an organic light-emitting device (preferably a plurality of organic light-emitting diodes which are arranged in a matrix); a non-display portion being a peripheral region of the display portion on the substrate; and an encapsulation layer on the display portion (preferably on the organic light-emitting device) and including at least a first encapsulation layer composed of an inorganic material and at least a second encapsulation layer composed of an organic material, the first and second encapsulation layers being alternately stacked on the display portion (preferably on the organic light-emitting device), wherein at least a portion of an end portion of the encapsulation layer which contacts the non-display portion of the substrate, includes only the first encapsulation layer.

[0008] Preferably the complete circumference of the (outmost) end portion of the encapsulation layer, which contacts the non-display portion of the substrate, comprises only the first encapsulation layer. That is, the first and second encapsulation layers are alternately stacked in the display portion but the first and second encapsulation layers are not alternately stacked in the portion of the outer circumference of the first encapsulation layer. That is, the stacked structure of the encapsulation layer extends over the display portion and in an area of the non-display portion which is adjacent to the display portion, the stacked structure of the encapsulation layer transforms into a structure of only the first encapsulation layer so that in a more outmost region of the encapsulation layer (of the non-display portion) the lateral end portions of the encapsulation layer is only formed of the first encapsulation layer. Accordingly, the second encapsulation layer is not present in the lateral end portions of the encapsulation layer.

[0009] Preferably, the second encapsulation layer narrows in a region which is adjacent to the edge of the organic light-emitting device, i.e. a region which is located

directly adjacent to the outer circumference of a projection of the organic light-emitting device onto the (second) encapsulation layer along an axis being perpendicular to the substrate. That is, the at least one second encapsulation layer comprises a tapered portion in said region. This tapered portion forms a step in the region where the encapsulation layer contacts the edge of the organic light-emitting device which can more efficiently avoid cracking in said stepped region.

[0010] An area of the second encapsulation layer may be greater than that of the display portion. Preferably, a respective area of all second encapsulation layers may be greater than the area of the display portion. Accordingly, the second encapsulation layer completely covers the display portion. In more particular, a projection of the second encapsulation layer along a first axis onto the display portion completely covers the display portion, wherein the first axis is parallel to the normal vector of the upper surface of the substrate. Preferably, the upper surface of the substrate is a completely planar surface. More preferably, the upper surface of the substrate is a completely planar surface in the area of the display portion.

[0011] The thickness of the second encapsulation layer may be greater than that of the first encapsulation layer. Preferably the respective thickness of all second encapsulation layers may be greater than the thickness of the thickest first encapsulation layer. Preferably, the first encapsulation layer and/or the second encapsulation layer comprise a uniform thickness in the display portion. Preferably, the number of first encapsulation layers and the number of second encapsulation layers is equal to each other. Alternatively, one more first encapsulation layers is provided compared to the number of second encapsulation layers (the lowest and the uppermost layer are then first encapsulation layers and the second encapsulation layers are stacked therebetween). Preferably, the number of first encapsulation layers and the number of second encapsulation layers ranges between 2 and 20. More preferably, the number of first encapsulation layers and the number of second encapsulation layers ranges between 2 and 6. Preferably, all first encapsulation layers have the same thickness. Preferably, all second encapsulation layers have the same thickness.

[0012] An area of the first encapsulation layer may be greater than that of the second encapsulation layer. Preferably, a respective area of all first encapsulation layers may be greater the respective largest area of the second encapsulation layers. Accordingly, the first encapsulation layer (at least one first encapsulation layer) completely covers the second encapsulation layer (at least one second encapsulation layer). In more particular, a projection of the first encapsulation layer along the first axis onto the second encapsulation layer completely covers the encapsulation layer.

[0013] The first encapsulation layer may include a lowest layer of the encapsulation portion that is closest to the display portion.

[0014] The second encapsulation layer may include a lowest layer of the encapsulation portion that is closest to the display portion.

[0015] The organic light-emitting display apparatus may further include: a light function layer disposed between the display portion and the encapsulation portion. The light function layer is preferably adapted to reflect UV (ultraviolet light) and to increase the light extraction efficiency of the display portion. In the sense of the present invention, ultraviolet light is radiation having a wavelength between 150 nm and 380 nm, more preferably between 200 nm and 380. Preferably, the light function layer has a reflectance for ultraviolet light of more than 0.2, more preferably of more than 0.4, more preferably of more than 0.6, more preferably of more than 0.8 and still more preferably of more than 0.9. Preferably, the light function layer has a reflectance for visible light (380 nm - 780 nm) emitted by the organic light-emitting device of less than 0.6, more preferably of less than 0.4, more preferably of less than 0.2 and still more preferably of less than 0.1.

[0016] The light function layer may be formed of a material selected from the group consisting of Alq3, benzophenone, photo acryl, BaF_2, CsF, $Na_5Al_3F_{14}$, KCl, SiO, and combinations thereof.

[0017] The thickness of the light function layer may be between about 20 nm and about 200 nm. More preferably, the thickness of the light function layer ranges between 100 nm and 150nm, more preferably, the thickness of the light function layer ranges between 110 nm and 140nm and still more preferably, the thickness of the light function layer ranges between 120 nm and 130nm. Preferably, the light function layer has a uniform thickness. Preferably, the light function layer has a uniform thickness at least in an area of the display portion.

[0018] At least one of the first encapsulation layer or the second encapsulation layer of the encapsulation portion (encapsulation layer) may have a flat surface at a position corresponding to the display portion. Preferably, all first encapsulation layers and/or all second encapsulation layers have a flat surface at a position corresponding to the display portion. In the sense of the present invention, a flat surface means a planar surface having a maximum curvature (on the upper side) of less than 1/R, wherein R is the radius of curvature and preferably R is greater than 0.1m, more preferably R is greater than 1 m, more preferably R is greater than 10m, more preferably R is greater than 100m and still more preferably R is greater than 1 km.

[0019] The encapsulation portion (=encapsulation layer) may have a flat surface at a position corresponding to the display portion.

[0020] Preferably the first encapsulation layer comprises a first, first encapsulation layer on the display portion, wherein the second encapsulation layer comprises a first, second encapsulation layer on the first, first encapsulation layer, and wherein the first encapsulation fur-

ther comprises a second, first encapsulation layer on the first, second encapsulation layer.

[0021] Preferably the second encapsulation layer further comprises a second, second encapsulation layer on the second, first encapsulation layer, and wherein the first encapsulation layer further comprises a third, first encapsulation layer on the second, second encapsulation layer.

[0022] Preferably each of the first, first encapsulation layer, the second, first encapsulation layer, and the third, first encapsulation layer is on an outermost perimeter of the substrate.

[0023] According to an embodiment of the present invention, there is provided an organic light-emitting display apparatus comprising: a substrate; a display portion on the substrate and comprising an organic light-emitting device; a non-display portion being a peripheral region of the display portion on the substrate; and an encapsulation layer on the display portion and comprising a first, first encapsulation layer on the display portion, a first, second encapsulation layer on the first, first encapsulation layer, and a second, first encapsulation layer on the first, second encapsulation layer, wherein an end portion of the first, first encapsulation layer contacts the substrate and an end portion of the second, first encapsulation layer contacts the end portion of the first, first encapsulation layer, and wherein each of the first, first encapsulation layer and the second, first encapsulation layer is composed of an inorganic material and the first, second encapsulation layer is composed of an organic material.

[0024] Preferably each of the first, first encapsulation layer and the second, first encapsulation layer is on an outermost perimeter of the substrate.

[0025] Preferably the organic light-emitting display apparatus further comprises: a light function layer between the display portion and the encapsulation portion.

[0026] According to an embodiment of the present invention, there is provided a method for manufacturing an organic light-emitting display apparatus as described above. In this method, the second encapsulation layer is formed by depositing liquefied or gasified monomer and curing the deposited monomer by irradiating UV, and the light function layer is disposed between the display portion and the encapsulation portion, thereby preventing damage to a portion (or a lower portion) of an organic light-emitting device due to the irradiated UV (or protecting this portion of the organic light-emitting device from damage caused by the irradiated UV).

[0027] The light function layer may be a single layer, but the present invention is not limited thereto. That is, the light function layer may be a multilayer structure, the number of layers preferably ranging between 2 and 10. In this regard, preferably each layer of the light function layer is formed of a material having a different refraction index, and accordingly the reflection of UV increases. Preferably, the light function layer is a multilayer and the thickness of each layer is 1/4 the wavelength of UV selected from 200 nm and 380 nm. Advantageously, the light function layer increases the reflection of UV. The light function layer preferably resonates light generated by the display portion, thereby increasing the light extraction efficiency of the display portion. The thickness of each layer may be between about 20 nm and about 200 nm. More preferably, the thickness of each layer ranges between 100 nm and 150nm, more preferably, the thickness of each layer ranges between 110 nm and 140nm and still more preferably, the thickness of each layer ranges between 120 nm and 130nm. Preferably, each layer has a uniform thickness. Preferably, each layer has a uniform thickness at least in an area of the display portion.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] The accompanying drawings, together with the specification, illustrate exemplary embodiments of the present invention, and, together with the description, serve to explain the principles of the present invention.

[0029] FIG. 1 is a schematic cross-sectional view of an organic light-emitting display apparatus according to an embodiment of the present invention;

[0030] FIG. 2 is a schematic enlarged view of an encapsulation portion of the organic light-emitting display apparatus shown in FIG. 1;

[0031] FIG. 3 is a schematic plan view of the organic light-emitting display apparatus shown in FIG. 1 taken from a direction X; and

[0032] FIG. 4 is a schematic cross-sectional view of an organic light-emitting display apparatus according to another embodiment of the present invention.

DETAILED DESCRIPTION

[0033] In the following detailed description, only certain exemplary embodiments of the present invention are shown and described, by way of illustration. As those skilled in the art would recognize, the invention may be embodied in many different forms and should not be construed as being limited to the embodiments set forth herein. Also, in the context of the present application, when an element is referred to as being "on" another element, it can be directly on the other element or be indirectly on the other element with one or more intervening elements interposed therebetween. Like reference numerals designate like elements throughout the specification.

[0034] FIG. 1 is a schematic cross-sectional view of an organic light-emitting display apparatus 100 according to an embodiment of the present invention.

[0035] Referring to FIG. 1, a display portion 120, which includes an organic light-emitting device (e.g., an organic light-emitting diode) for forming an image, and an encapsulation portion 150, which encapsulates the display portion 120, are formed on a substrate 101. A region of the substrate 101 excluding the display potion 120 is referenced as a non-display portion 140 and is shown in FIG. 3. The non-display portion 140 may extend between the

edge (or edge portion) of the substrate 101 and the edge (or edge portion) of the display portion 120. The edge (or edge portion) of the display portion 120 may be the outer edge of the outermost light emitting diodes or the outer circumference of the outermost light emitting diodes.

[0036] FIG. 2 is a schematic enlarged view of the encapsulation portion 150 of FIG.

1. Here, the encapsulation portion 150 is shown to include a first encapsulation layer 151 composed of three first encapsulation layers 151 a, 151b, and 151c and a second encapsulation layer 152 composed of two second encapsulation layers 152a and 152b. In more detail, a first, first encapsulation layer 151 a is formed on the display portion 120 and then a first, second encapsulation layer 152a is formed on the first, first encapsulation layer 151 a. A second, first encapsulation layer 151 b; a second, second encapsulation layer 152b; and a third, first encapsulation layer 151c are sequentially formed on the first, second encapsulation layer 152a. However, the present invention is not limited to the above method of forming the encapsulation layers. For example, the second encapsulation layer may be formed on the display portion before the first encapsulation layer is formed on the display portion. That is, either the first encapsulation layer 151 or the second encapsulation layer 152 may be the lowest layer of the encapsulation portion 150 that is closest to the display portion 120.

[0037] The first encapsulation layer 151 is formed of an inorganic material to block or prevent gas or moisture from penetrating from outside. In more detail, the first encapsulation layer 151 may be formed of a metal nitride and/or oxide containing calcium oxide, alumina, silica, titania, indium oxide, silicon oxide, silicon nitride, and/or aluminum nitride. The second encapsulation layer 152 is formed of an organic material to relieve stress from the inside of the first encapsulation layer 151, fill out any possible defects, such as cracks, pinholes, etc., formed in the surface of the first encapsulation layer 151, and make the encapsulation portion 150 to be overall smooth. The second encapsulation layer 152 may contain acrylic, meta acrylic, polyester, PET, polyethylene, and/or polypropylene.

[0038] Although two pairs of the first encapsulation layer 151 and the second encapsulation layer 152 are alternately stacked in FIG. 2, the present invention is not limited thereto. That is, the number of times the first encapsulation layer 151 and the second encapsulation layer 152 are alternately stacked is not limited in the present invention, and two or more pairs of the first encapsulation layer 151 and the second encapsulation layer 152 may be alternately stacked.

[0039] An area of the second encapsulation layer 152 is greater than that of the display portion 120, so as to cover the display portion 120. An area of the first encapsulation layer 151 is greater than that of the second encapsulation layer 152, so that the area of the first encapsulation layer 151 is greater than the areas of the display portion 120 and the second encapsulation layer 152.

[0040] The first encapsulation layer 151 and the second encapsulation layer 152 are alternately stacked on the upper portion of the display portion 120. Only the first encapsulation layer 151 is stacked on the peripheral region of the display portion 120. As a result, an end portion of the first encapsulation layer 151 contacts the substrate 101, and only the first encapsulation layer 151 is stacked on the outermost circumference of the encapsulation portion 150 on the peripheral region of the display portion 120. Also, the first, first encapsulation layer 151 a that is the lowest layer of the encapsulation portion 150 contacts the substrate 101 as shown in FIG. 2.

[0041] In general, an organic layer that is more vulnerable to moisture than an inorganic layer is easily deformed and moisture may be transferred therein. Thus, if the second encapsulation layer 152 and the first encapsulation layer 151 are alternately stacked on the peripheral region of the display portion 120 formed on the substrate 101, moisture more easily penetrates into the display portion 120 through the second encapsulation layer 152 than the first encapsulation layer 151. To protect from such penetration, an end region of the encapsulation portion 150 that is the outermost circumference of the substrate 101 does not include the second encapsulation layer 152 on the peripheral region of the display portion 120 in the encapsulation structure of the present embodiment.

[0042] Therefore, the organic light-emitting display apparatus 100 effectively prevents a defect caused by contaminates, such as moisture, dust, or gas that may penetrate into the side surface of the display portion 120, in particular, a defect that occurs on the edge of the display portion 120, thereby improving the image quality properties of the organic light-emitting display apparatus 100.

[0043] In one embodiment, the thickness of the second encapsulation layer 152 is greater than that of the first encapsulation layer 151. The first encapsulation layer 151 may be formed by using sputtering, chemical vapor deposition (CVD), ion beam assisted deposition (IBAD), etc. The first encapsulation layer 151 that is formed to be too thick may have too many defects that occur and may increase the manufacturing process and cost due to a slow filming operation. Thus, in one embodiment of the present invention, the first encapsulation layer 151 is formed as a thin film (or multiple thin films). Also, the second encapsulation layer 152 containing an organic material is formed by depositing liquefied or gasified monomer and curing the deposited monomer by irradiating UV. Thus, the second encapsulation layer 152 having a greater thickness than the first encapsulation layer 151 can be more easily manufactured than the first encapsulation layer 151, and may have a uniform thickness and elaborate structure.

[0044] The second encapsulation layer 152 having a

greater thickness than the first encapsulation layer 151 can flatten the encapsulation portion 150 formed on the upper portion of the display portion 120 so that the encapsulation portion 150 has an overall elaborate structure and protects the display portion 120 from contamination of outside air and/or penetration of moisture. Also, on the regions corresponding to the upper and side portions of the display portion 120 shown in FIG. 2, the thickness of the second encapsulation layer 152 is greater than that of the first encapsulation layer 151.

[0045] FIG. 4 is a schematic cross-sectional view of an organic light-emitting display apparatus 200 according to another embodiment of the present invention. Referring to FIG. 4, a display portion 220 is formed on a substrate 201. An encapsulation portion 250 is formed on the substrate 201 to encapsulate the display portion 220. A light function layer 230 is disposed between the display portion 220 and the encapsulation portion 250. For purposes of convenience of description, differences between the present embodiment and the previous embodiment will now be described. The substrate 201, the display portion 220, and the encapsulation portion 250 are the same (or substantially the same) as described in the previous embodiment and thus their detailed descriptions are not provided again.

[0046] Since a second encapsulation layer is formed by depositing liquefied or gasified monomer and curing the deposited monomer by irradiating UV, the light function layer 230 is disposed between the display portion 220 and the encapsulation portion 250, thereby preventing damage to a portion (or a lower portion) of an organic light-emitting device due to the irradiated UV (or protecting this portion of the organic light-emitting device from damage caused by the irradiated UV).

[0047] The light function layer 230 is formed of a material that reflects UV and increases a light extraction efficiency of the display portion 220. In more detail, the light function layer 230 is formed of Alq3, benzophenone, photo acryl, BaF_2, CsF, $Na_5Al_3F_{14}$, KCl, and/or SiO, and, in particular, may be formed of Alq3.

[0048] Although the light function layer 230 is shown as a single layer in the present embodiment, the present invention is not limited thereto. That is, the light function layer 230 may be a multilayer structure. In this regard, if each layer of the light function layer 230 is formed of a material having a different refraction index, the reflection of UV increases. When the light function layer 230 is the multilayer and if the thickness of each layer is 1/4 the wavelength of UV, the light function layer 230 increases the reflection of UV. The light function layer 230 resonates light generated by the display portion 220, thereby increasing the light extraction efficiency of the display portion 220. The thickness of the light function layer 230 is between about 20 nm and about 200 nm in order to increase the light extraction efficiency and the color purity of the display portion 220. If the thickness of the light function layer 230 is less than 20 nm, the light function layer 230 may be vulnerable to the penetration of UV, which deteriorates device properties. In one embodiment of the present invention, the thickness of the light function layer 230 is more than 50 nm. Because the light extraction efficiency and the color purity of the display portion 220 may be reduced if the thickness of the light function layer 230 exceeds 200 nm, the thickness of the light function layer 230 is less than 200 nm in another embodiment of the present invention. In one embodiment of the present invention, the thickness of the light function layer 230 is less than 150 nm.

[0049] In view of the foregoing and according to an embodiment of the present invention, an organic light-emitting display apparatus can easily encapsulate an organic light-emitting device and improve its electrical properties.

[0050] While the present invention has been described in connection with certain exemplary embodiments, it is to be understood that the invention is not limited to the disclosed embodiments, but, on the contrary, is intended to cover various modifications and equivalent arrangements included within the scope of the appended claims, and equivalents thereof.

Claims

1. An organic light-emitting display apparatus comprising:

   a substrate (101, 201);
   a display portion (120, 220) located on the substrate (101, 201),
   an organic light-emitting device arranged in the display portion (120, 220);
   a non-display portion (140) being a peripheral region of the display portion (120, 220) located on the substrate (101, 201); and
   an encapsulation layer (150, 250) formed on the display portion (120, 220) and comprising at least a first encapsulation layer (151) composed of an inorganic material and at least a second encapsulation layer (152) composed of an organic material, the first and second encapsulation layers (151, 152) being alternately stacked on the display portion (120, 220),
   characterized in that
   at least a portion of an end portion of the encapsulation layer (150, 250), which contacts the non-display portion (140) of the substrate (101, 201), comprises only the first encapsulation layer (151).

2. The organic light-emitting display apparatus of claim 1, wherein a surface area of the second encapsulation layer (152) is greater than a surface area of the display portion (120, 220).

3. The organic light-emitting display apparatus accord-

ing to any one of the preceding claims, wherein a thickness of the second encapsulation layer (152) is greater than a thickness of the first encapsulation layer (151).

4. The organic light-emitting display apparatus according to any one of the preceding claims, wherein a surface area of the first encapsulation layer (151) is greater than a surface area of the second encapsulation layer (152).

5. The organic light-emitting display apparatus according to any one of the preceding claims, wherein the first encapsulation layer (152) comprises a lowest layer of the encapsulation layer (150) closest to the display portion (120, 220) or wherein the second encapsulation layer (152) comprises a lowest layer of the encapsulation layer (150) that is closest to the display portion (120, 220).

6. The organic light-emitting display apparatus according to any one of the preceding claims, wherein the first encapsulation layer (151) is formed of a material selected from the group consisting of metal nitride, metal oxide, calcium oxide, alumina, silica, titania, indium oxide, silicon oxide, silicon nitride, aluminum nitride and combinations thereof; and/or the second encapsulation layer (152) comprises one material selected the group consisting of from acrylic, meta acrylic, polyester, PET, polyethylene, polypropylene and combinations thereof.

7. The organic light-emitting display apparatus according to any one of the preceding claims, further comprising a light function layer (230) arranged between the display portion (120, 220) and the encapsulation layer (250), the light function layer (230) being adapted to reflect ultraviolet light.

8. The organic light-emitting display apparatus of claim 7, wherein the light function layer (230) comprises a material selected from the group consisting of Afq3, benzophenone, photo acryl, BaF_2, CsF, $Na_5Al_3F_{14}$, KCI, SiO, and combinations thereof.

9. The organic light-emitting display apparatus according to any of claims 7 and 8, wherein the light function layer (230) is a single layer with a thickness between from 20 nm and 200 nm.

10. The organic light-emitting display apparatus according to any of claims 7 and 8, wherein the light function layer (230) is a multilayer structure, wherein each layer of the multilayer structure of the light function layer (230) has a thickness between from 20 nm and 200 nm and wherein the each layer of the multilayer structure of the light function layer (230) is formed of a material having a different refraction index.

11. The organic light-emitting display apparatus according to any one of the preceding claims, wherein at least one of the first encapsulation layer (151) and the second encapsulation layer (152) has a flat surface at a position corresponding to the display portion (120).

12. The organic light-emitting display apparatus according to any one of the preceding claims, wherein the encapsulation layer (150, 250) has a flat surface at a position corresponding to the display portion (120, 250).

13. The organic light-emitting display apparatus according to any one of the preceding claims, wherein the first encapsulation layer (151) comprises two layers (151a, 151b) arranged on the organic light-emitting device, wherein the second encapsulation layer (152) comprises one layer (152a) interposed between the two layers (151 a, 151 b) of the first encapsulation layer (151).

14. The organic light-emitting display apparatus of claim 13, wherein the second encapsulation layer (152) comprises two layers (152a, 152b) and the first encapsulation layer (151) comprises three layers (151a, 151b, 151c) arranged on the display portion (120, 220), respectively, and wherein the two layers (152a, 152b) of the second encapsulation layer (152) are interposed between the outermost of the three layers (151a, 151b, 151c) of the first encapsulation layer (151), and wherein the layers (151a, 152a, 151b, 152b, 151c) of the first and second encapsulation layers (151, 152) are alternately stacked on each other.

15. The organic light-emitting display apparatus of claim 14, wherein each of the three layers (151a, 151b, 151c) of the first encapsulation layer (151) laterally terminates on the edge of the outermost perimeter of the substrate (101).

FIG. 1

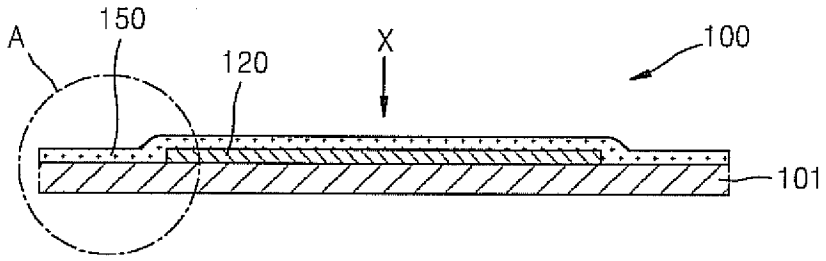


FIG. 2

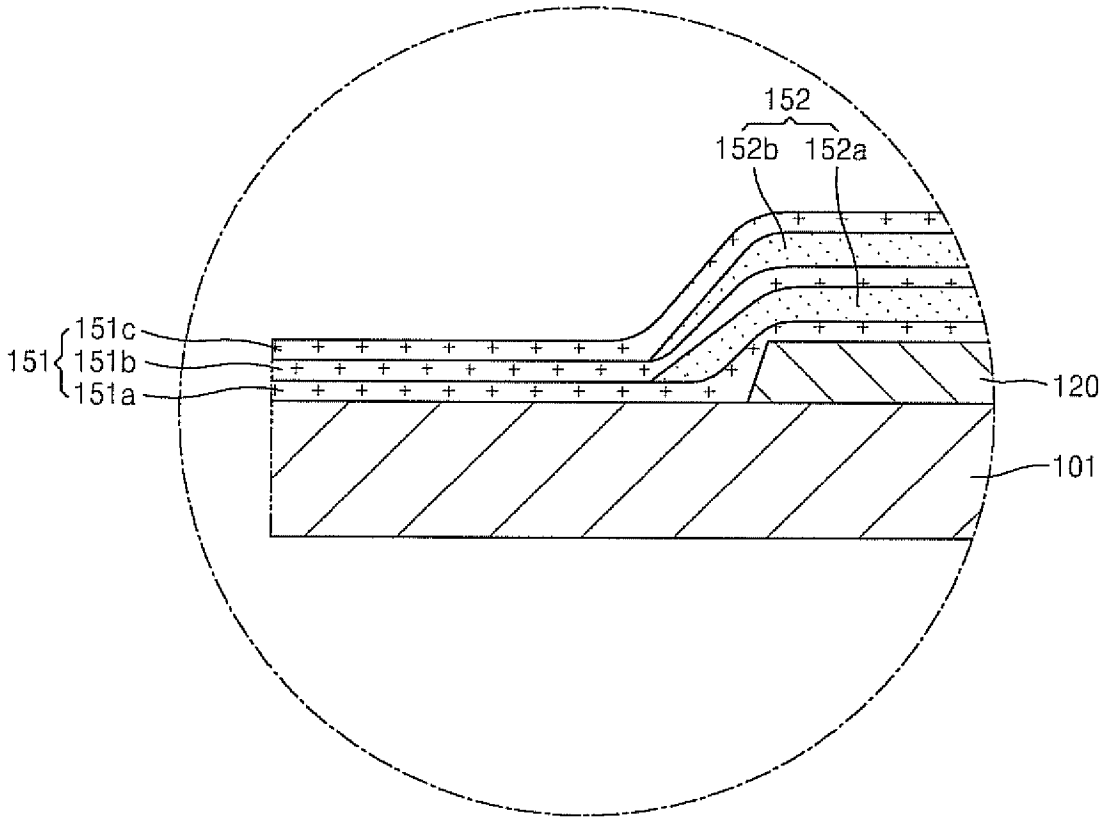


FIG. 3

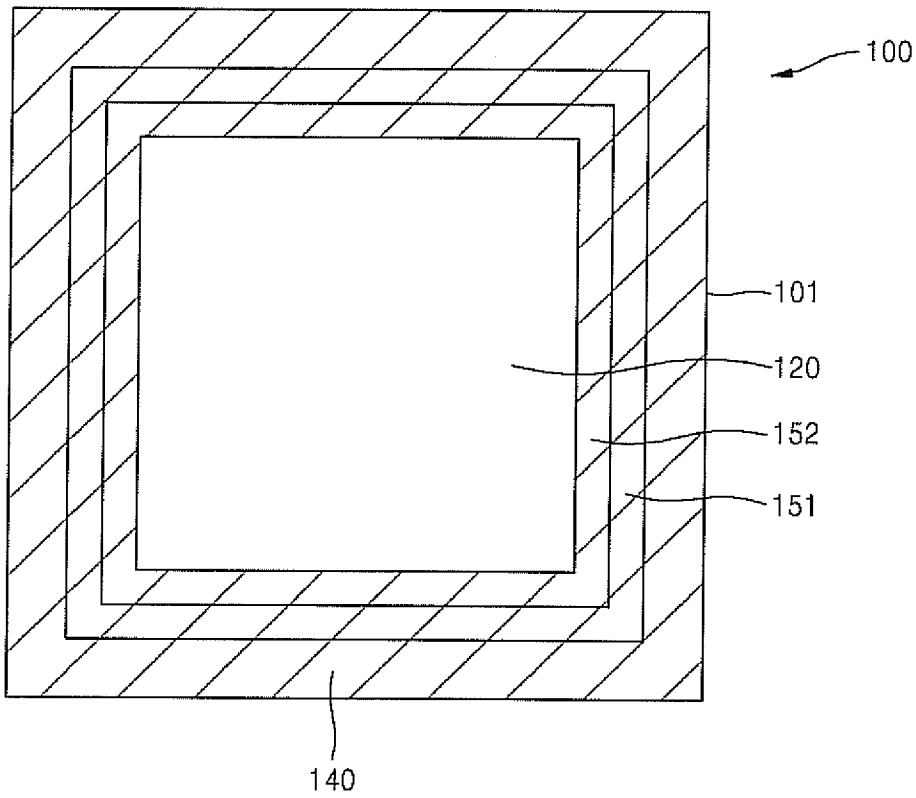
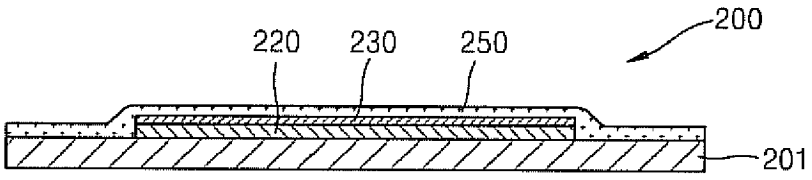


FIG. 4



Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 10 15 0999

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	US 2005/239294 A1 (ROSENBLUM MARTIN P [US] ET AL) 27 October 2005 (2005-10-27) * paragraphs [0053] - [0062] - paragraphs [0088] - [0089]; figures 14A, 14B,15 *	1-6, 11-14 7-10	INV. H01L51/52
X	US 2008/238301 A1 (SHIM HONG-SHIK [KR] ET AL) 2 October 2008 (2008-10-02) * paragraphs [0041] - [0047]; figure 3 *	1,2,4,5, 11-15	
Y	US 2008/296600 A1 (KWACK JIN-HO [KR] ET AL) 4 December 2008 (2008-12-04) * the whole document *	7-10	
A	US 2007/181872 A1 (LEE YOUNG-GU [KR] ET AL) 9 August 2007 (2007-08-09) * paragraph [0007]; figure 2 *	6	
A	US 2003/184219 A1 (DUGGAL ANIL RAJ [US] ET AL) 2 October 2003 (2003-10-02) * paragraph [0040]; figure 7 *	9	
			TECHNICAL FIELDS SEARCHED (IPC) H01L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	7 April 2010	Persat, Nathalie

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 10 15 0999

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

07-04-2010

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2005239294 A1	27-10-2005	NONE	
US 2008238301 A1	02-10-2008	KR 20080088991 A	06-10-2008
US 2008296600 A1	04-12-2008	KR 20080105308 A	04-12-2008
US 2007181872 A1	09-08-2007	NONE	
US 2003184219 A1	02-10-2003	CN 1656626 A	17-08-2005
		EP 1493195 A2	05-01-2005
		JP 2005522016 T	21-07-2005
		TW 284007 B	11-07-2007
		WO 03100832 A2	04-12-2003

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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

- KR 1020090004572 **[0001]**

专利名称(译)	有机发光显示装置		
公开(公告)号	EP2209149A1	公开(公告)日	2010-07-21
申请号	EP2010150999	申请日	2010-01-18
[标]申请(专利权)人(译)	三星显示有限公司		
申请(专利权)人(译)	三星移动显示器有限公司.		
当前申请(专利权)人(译)	三星DISPLAY CO.，LTD.		
[标]发明人	KIM SO YEON HAN SUNG WOOK HAN DONG WON KWACK JIN HO KIM HYO JIN		
发明人	KIM, SO-YEON HAN, SUNG-WOOK HAN, DONG-WON KWACK, JIN-HO KIM, HYO-JIN		
IPC分类号	H01L51/52		
CPC分类号	H01L51/5256 H01L51/5265 H01L51/5271		
优先权	1020090004572 2009-01-20 KR		
外部链接	Espacenet		

摘要(译)

一种有机发光显示装置，用于封装有机发光器件和/或改善其电性能。有机发光显示装置包括：基板（101）;基板上的显示部分，包括有机发光装置（120）;基板和显示部分的周边区域上的非显示部分;显示部分上的封装部分，包括由无机材料（151）形成的第一封装层和由有机材料（152）形成的第二封装层，所述第二封装层交替地堆叠在显示部分上，其中所述封装层的端部第一封装层接触衬底（101）。

FIG. 2