US 20060244376A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2006/0244376 A1

Chun et al. (43) Pub. Date: Nov. 2, 2006

(54) ORGANIC LIGHT EMITTING DISPLAY AND METHOD OF FABRICATING THE SAME

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(21) Appl. No.: **11/413,926**

(22) Filed: **Apr. 28, 2006**

(30) **Foreign Application Priority Data**

May 2, 2005 (KR) 10-2005-0036874

Publication Classification

(51) **Int. Cl.**
H05B 33/02 (2006.01)
H01L 51/50 (2006.01)

(52) **U.S. Cl.** **313/506**; 313/501; 313/509

(57) **ABSTRACT**

An organic light emitting display capable of preventing the generation of screen distortion caused by a thick film phenomenon that occurs when the internal surface of a panel is coated with an absorbing member and a method of fabricating the same. The organic light emitting display includes a substrate on which an image display unit including at least one organic light emitting diode is formed. A panel is formed on the substrate to seal the image display unit. A first absorbing member is formed on the internal surface of the panel on the image display unit that faces the organic light emitting diode. A second absorbing member is formed on the circumference of the image display unit between the first absorbing member and the internal surface of the panel to overlap the circumference of the first absorbing member.

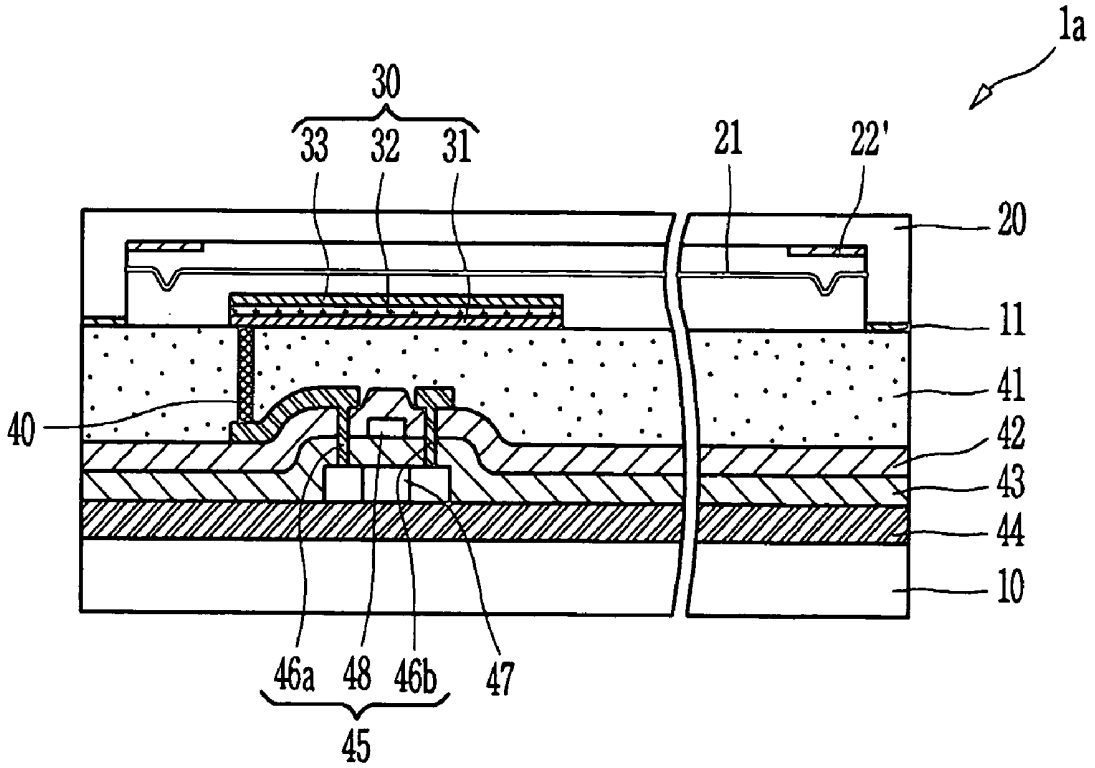


FIG. 1

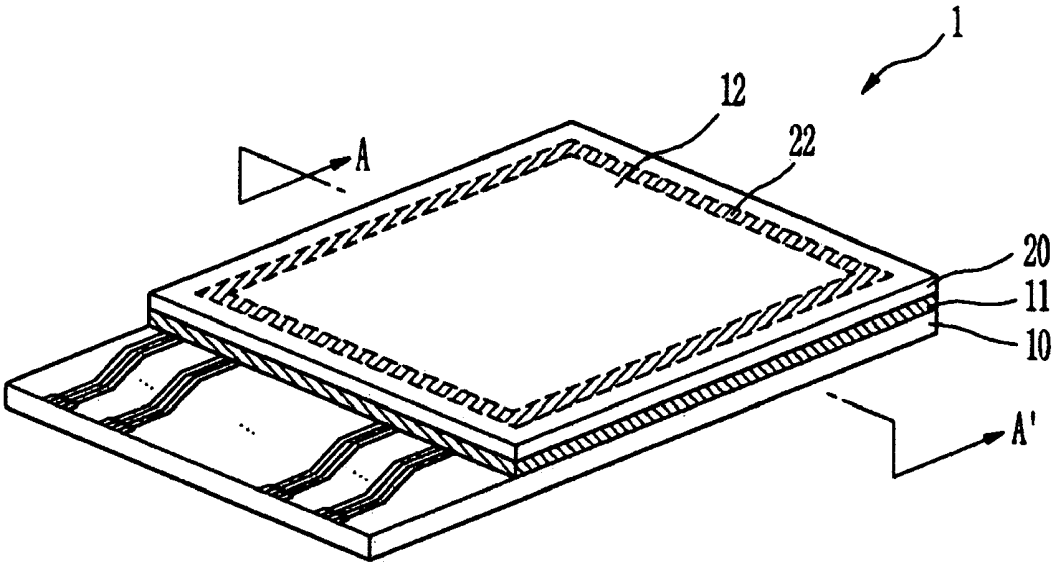


FIG. 2A

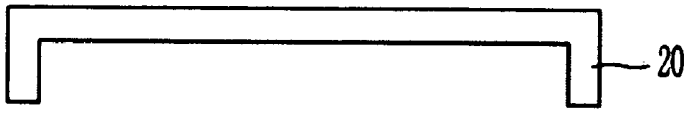


FIG. 2B

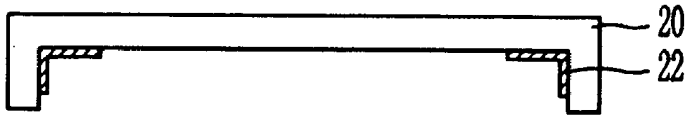


FIG. 2C

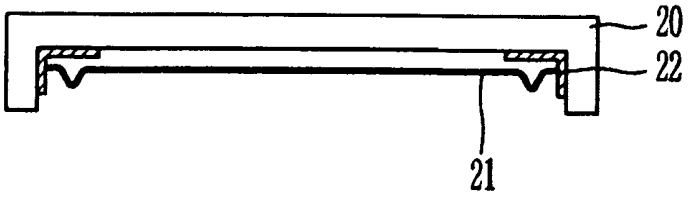


FIG. 3

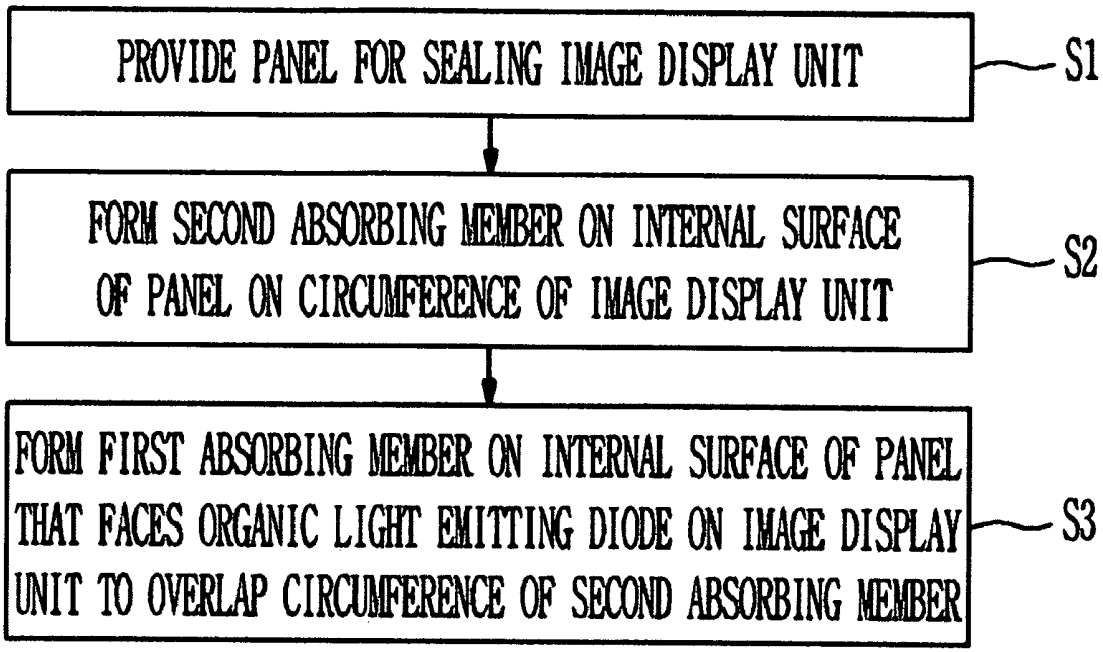
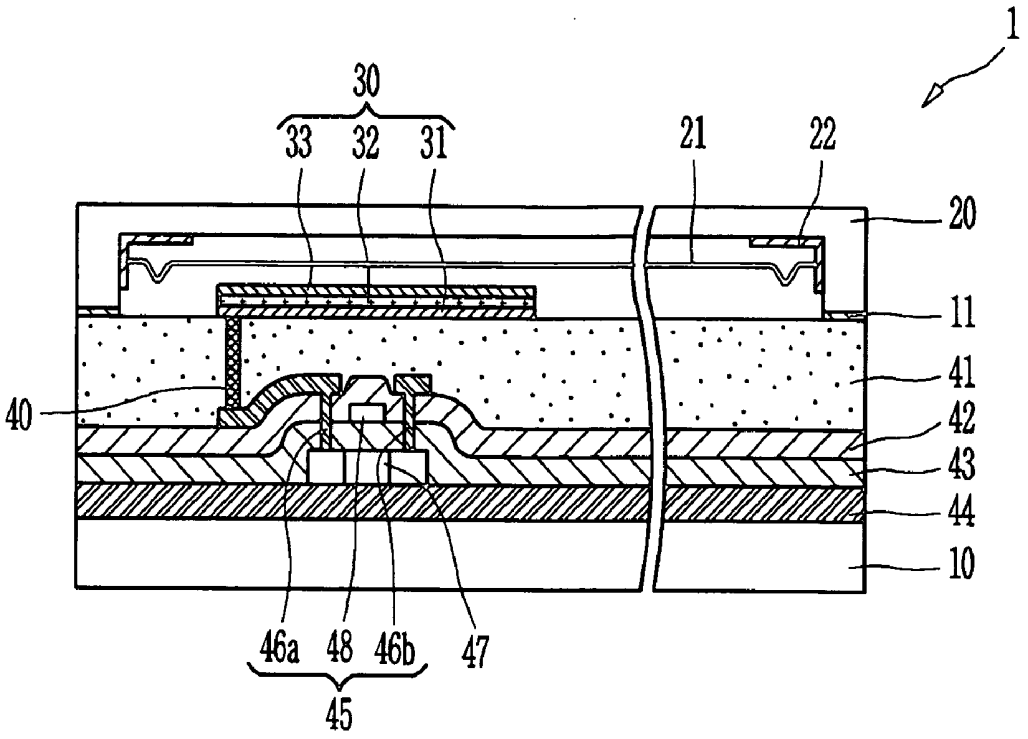

PROVIDE PANEL FOR SEALING IMAGE DISPLAY UNIT
S1
FORM SECOND ABSORBING MEMBER ON INTERNAL SURFACE OF PANEL ON CIRCUMFERENCE OF IMAGE DISPLAY UNIT
S2
FORM FIRST ABSORBING MEMBER ON INTERNAL SURFACE OF PANEL THAT FACES ORGANIC LIGHT EMITTING DIODE ON IMAGE DISPLAY UNIT TO OVERLAP CIRCUMFERENCE OF SECOND ABSORBING MEMBER
S3

FIG. 4


1
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33
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31
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22
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11
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40
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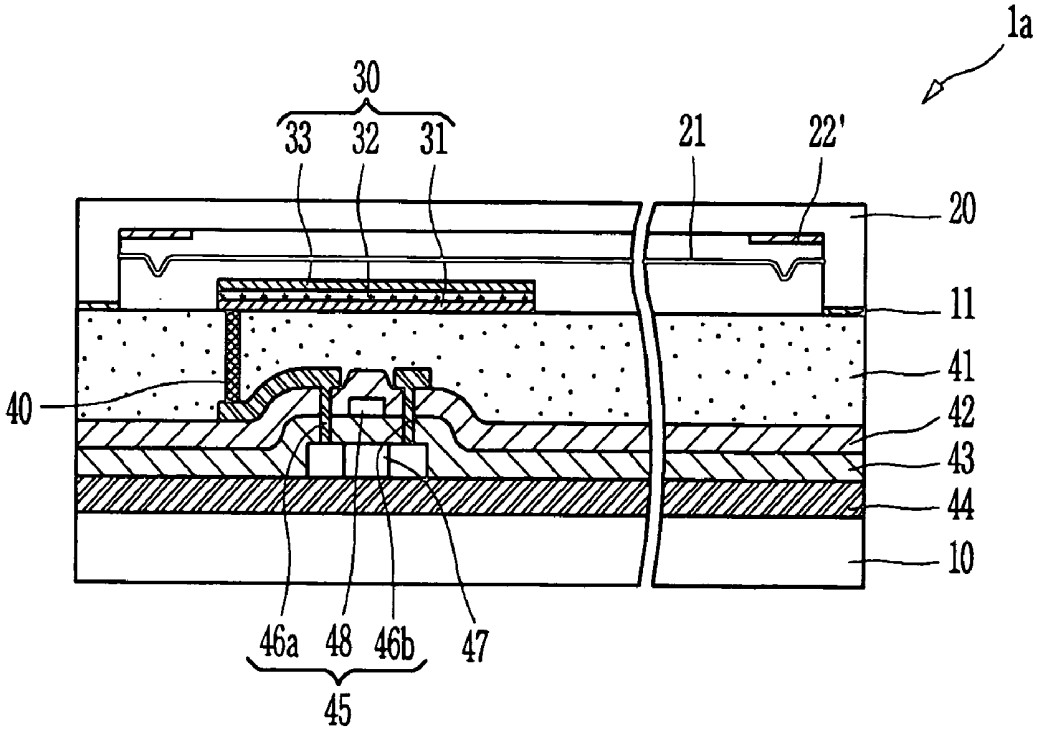
43
44
10
46a
48
46b
47
45

FIG. 5


1a
30
33
32
31
21
22'
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11
41
40
42
43
44
10
46a
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46b
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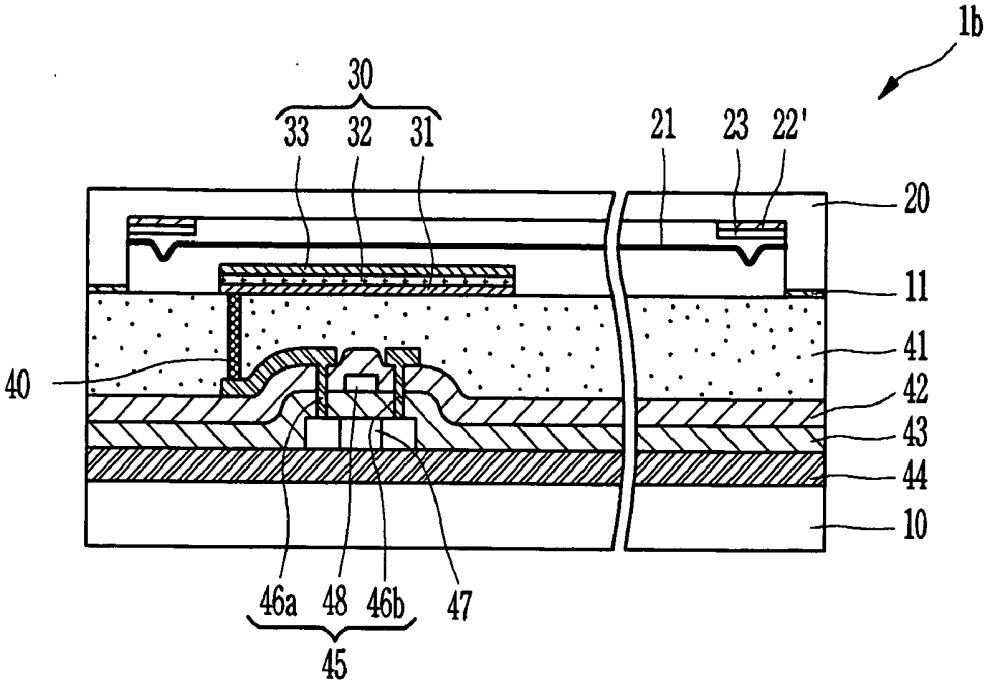
FIG. 6


1b
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22'
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FIG. 7

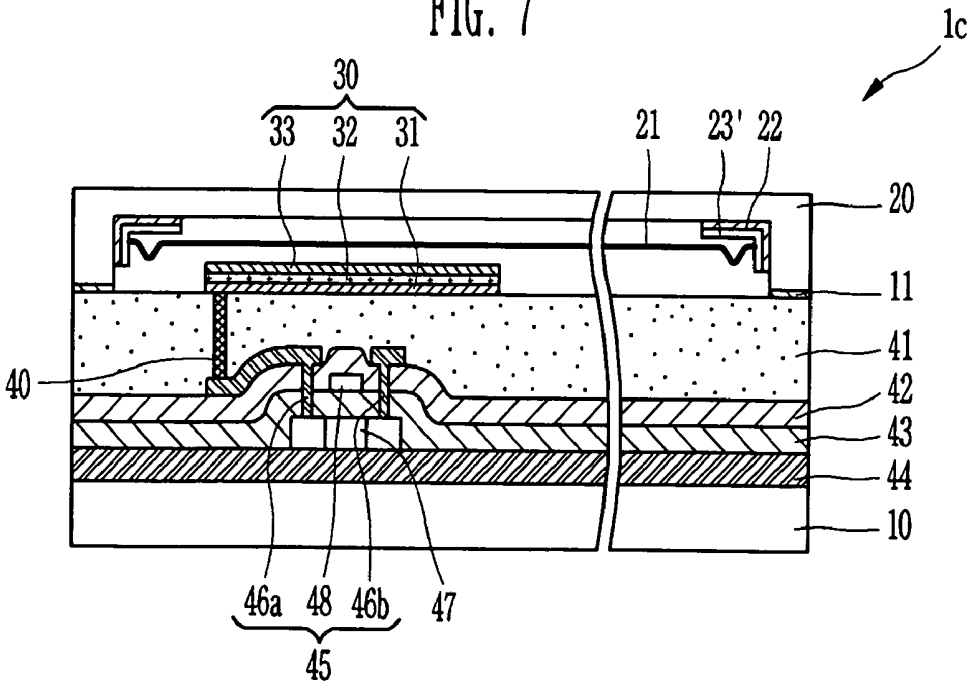
1c
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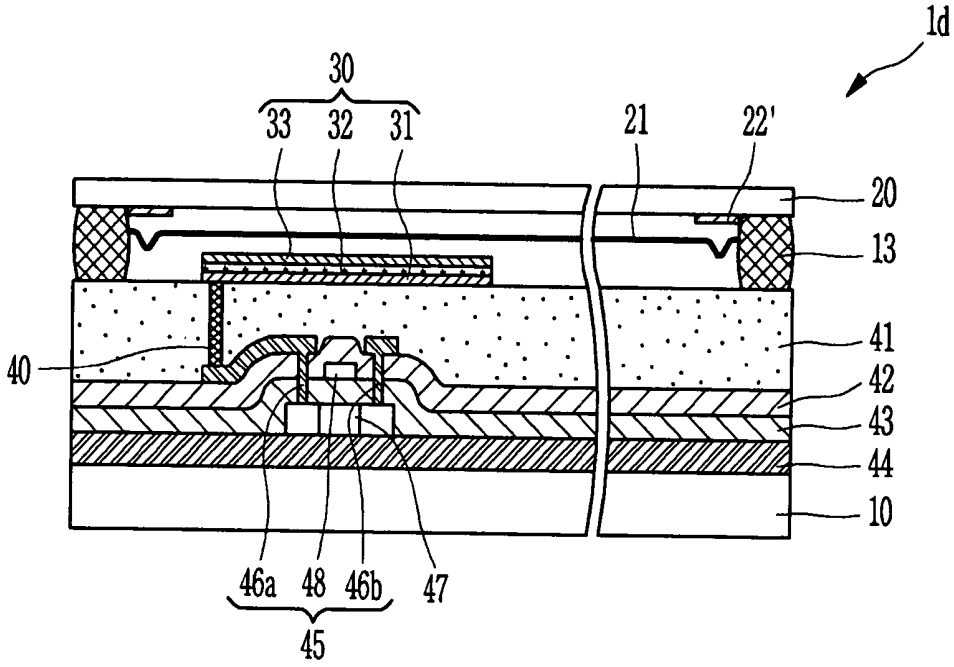
FIG. 8


1d
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22'
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13
41
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46a
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46b
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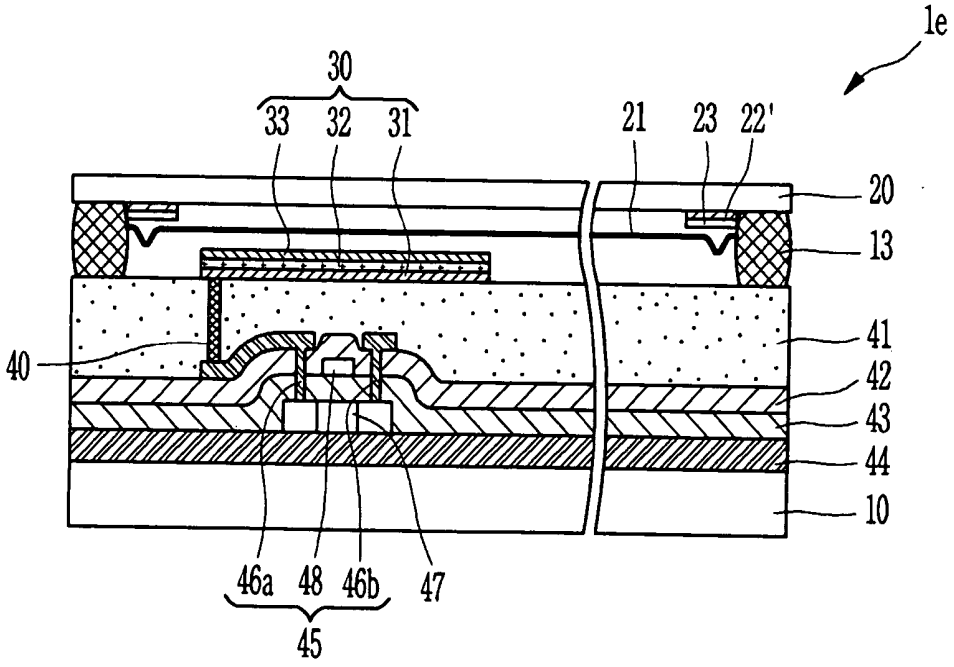
FIG. 9


1e
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21
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22'
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46a
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46b
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ORGANIC LIGHT EMITTING DISPLAY AND METHOD OF FABRICATING THE SAME

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the priority to and the benefit of Korean Patent Application No. 2005-0036874, filed on May 2, 2005, in the Korean Intellectual Property Office, the entire content of which is incorporated herein by reference.

BACKGROUND

[0002] 1. Field of the Invention

[0003] The present invention relates to an organic light emitting display and a method of fabricating the same, and more particularly, to an organic light emitting display capable of preventing the generation of screen distortion caused by a thick film phenomenon that occurs when the internal surface of a panel is coated with a first absorbing member and of increasing light efficiency to improve contrast, and a method of fabricating the same.

[0004] 2. Discussion of Related Art

[0005] Recently, various small and light flat panel displays (FPD) capable of reducing weight and volume that are disadvantages of cathode ray tubes (CRT) have been developed. FPDs include liquid crystal displays (LCD), light emitting displays (LED), field emission displays (FED), and plasma display panels (PDP).

[0006] Among the FPDs, the LEDs are used over a wide range of temperatures, are resistant to shock and vibration, and have a wide viewing angle and high response speed so that it is possible to provide high quality moving images. Therefore, the LEDs are spotlighted as next generation FPDs.

[0007] The LED can be categorized as an organic light emitting display using an organic light emitting diode and an inorganic light emitting display using an inorganic light emitting diode. The organic light emitting diode includes an anode electrode, a cathode electrode, and an organic emission layer positioned between the anode electrode and the cathode electrode to emit light by combination of electrons and holes. The inorganic light emitting diode includes an inorganic emission layer, for example, an emission layer formed of PN junction semiconductor unlike the organic light emitting diode.

[0008] The organic light emitting display includes a substrate on which an image display unit including at least one organic light emitting diode is formed and a panel formed on the substrate to seal the image display unit. The internal surface of the panel that faces the organic light emitting diode is coated with an absorbing member for absorbing moisture that can be received from the outside of the organic light emitting display.

[0009] In order to have the internal surface of the panel coated with the absorbing member, a spraying method or a screen printing method can be used. In accordance with the spraying method, a nozzle is used to form an absorbing member of uniform shape and thickness. In accordance with the screen printing method, after a net-shaped metal sheet is masked, an absorbing member of a desired shape is printed onto the internal surface of the panel using a squeeze.

[0010] However, when the absorbing member is formed using the screen printing method among the above-described methods, a thick film phenomenon in which the circumference of the absorbing member is thicker due to the compression force of the squeeze or the viscosity of the absorbing member occurs. The thick film phenomenon causes a difference in refractive indexes of the absorbing member so that screen distortion occurs. When the above-described spraying method is used, a dropping phenomenon occurs in a region, in particular, in the circumference of the absorbing member with which the internal surface of the panel is coated. Therefore, screen distortion may be caused even when the absorbing member is formed using the spraying method. Furthermore, the light emitted from the organic light emitting diode may not be transmitted only through the front of the panel but through the both sides of the panel. Therefore, emission efficiency may deteriorate.

SUMMARY OF THE INVENTION

[0011] In accordance with the present invention an organic light emitting display capable of preventing the generation of screen distortion caused by a thick film phenomenon that occurs when the internal surface of a panel is coated with an absorbing member, and a method of fabricating the same, is provided.

[0012] Further in accordance with the present invention, an organic light emitting display capable of preventing light emitted from an organic light emitting diode from being transmitted through other regions than an image display unit, and a method of fabricating the same, is provided.

[0013] The foregoing and/or other aspects of the present invention are achieved by providing an organic light emitting display having a substrate on which an image display unit including at least one organic light emitting diode is formed, a panel formed on the substrate to seal the image display unit, a first absorbing member formed on at least an internal surface of the panel on the image display unit that faces the organic light emitting diode, and a second absorbing member formed on the circumference of the image display unit between the first absorbing member and the internal surface of the panel to overlap the circumference of the first absorbing member.

[0014] The second absorbing member in an exemplary embodiment is angular ("ㄱ") or planar ("—") shaped. The second absorbing member prevents the light emitted from the organic light emitting diode from being transmitted through the circumference of the first absorbing member and may have a light absorbing function. The second absorbing member may be formed of a colored metal thin film or organic film and in one embodiment, may be of the color black. The second absorbing member may be a single-layered or multi-layered and the thickness of the second absorbing member may be in the range of 5 to 15 μm.

[0015] The first absorbing member may be formed of one of PNPL, BaO, and CaO. The first absorbing member may be formed by a screen printing method or a spraying method. The first absorbing member absorbs moisture received from the outside.

[0016] The panel have an "U" or planar shaped cross-section. The organic light emitting display further includes

a sealing member formed between the edge of the panel whose cross-section is planar shaped and the substrate to seal the image display unit. The panel may be transparent.

[0017] A method of fabricating the organic light emitting display includes: providing a substrate on which an image display unit including at least one organic light emitting diode is formed, providing a panel formed on the substrate to seal the image display unit, forming a second absorbing member on the internal surface of the panel along the circumference of the image display unit, forming a first absorbing member on the internal surface of the panel that faces the organic light emitting diode on the image display unit to at least partially overlap the circumference of the second absorbing member, forming an adhesive on the circumference of the substrate or the panel, and sealing the panel in which the first and second absorbing members are formed and the substrate on which the image display unit including the at least one organic light emitting diode is formed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] **FIG. 1** is a schematic perspective view of an organic light emitting display in accordance with the present invention.

[0019] **FIGS. 2A** to **2**C are cross-sectional views of a panel in accordance with the present invention in each fabrication process.

[0020] **FIG. 3** is a block diagram illustrating each fabrication process of the panel in accordance with the present invention.

[0021] **FIG. 4** is a cross-sectional view illustrating an organic light emitting display in accordance with a first embodiment taken along the line A-A' of **FIG. 1**.

[0022] **FIG. 5** is a cross-sectional view illustrating an organic light emitting display in accordance with a second embodiment taken along the line A-A' of **FIG. 1**.

[0023] **FIG. 6** is a cross-sectional view illustrating an organic light emitting display in accordance with a third embodiment taken along the line A-A' of **FIG. 1**.

[0024] **FIG. 7** is a cross-sectional view illustrating an organic light emitting display in accordance with a fourth embodiment taken along the line A-A' of **FIG. 1**.

[0025] **FIG. 8** is a cross-sectional view illustrating an organic light emitting display in accordance with a fifth embodiment taken along the line A-A' of **FIG. 1**.

[0026] **FIG. 9** is a cross-sectional view illustrating an organic light emitting display in accordance with a sixth embodiment taken along the line A-A' of **FIG. 1**.

DETAILED DESCRIPTION

[0027] Referring to **FIGS. 1 and 4**, the organic light emitting display **1** in accordance with the present invention includes a substrate **10** on which an image display unit **12** having at least one organic light emitting diode is formed, a panel **20** formed on the substrate **10** to seal the image display unit **12**, a first absorbing member **21** formed on the internal surface of the panel **20** on the image display unit **12** that faces the organic light emitting diode, and a second absorbing member **22** formed on the circumference of the image display unit **12** between the first absorbing member **21** and the panel **20** to overlap the circumference of first absorbing member **21** by a predetermined width. Here, a thin film transistor (TFT) and the organic light emitting diode are formed on the substrate **10**. A detailed description of the substrate will follow later.

[0028] The panel **20** may have various shapes. In accordance with the embodiments of the present invention, the panel **20** may have a "U" shaped cross-section (e.g., have an open-ended box shape), or have a planar shaped cross-section. Transparent plastic or glass having an insulation property is used as the panel **20**. In particular, since glass has a high insulation property and is transparent and resistant to water, glass is mainly used as the panel **20**.

[0029] When the panel **20** whose cross-section is planar shaped is used, a sealing member **13** (as seen in **FIGS. 8 and 9**) having a predetermined height is used in the part adhered to the substrate **10**. The sealing member **13** is formed to be thicker than the first and second absorbing members **21** and **22'** formed on the internal surface of the panel **20** by a predetermined thickness so that the organic light emitting diodes do not contact the absorbing members.

[0030] Referring back to **FIG. 4**, the first absorbing member **21** formed on the internal surface of the panel **20** is commonly formed of a physical desiccant such as zeolite, silica gel, carbon, and carbon nano tube, a desiccant obtained by dissolving an organic metal complex in a petroleum solvent such as toluene, xylene, and an aliphatic organic solvent, and a chemical adsorbent. The adsorbent is preferably a compound that chemically absorbs moisture and that maintains the absorbed moisture solid. Such a compound includes alkali earth metal oxide such as CaO, BaO, and MgO, sulfate such as Li_2SO_4, Na_2SO_4, $CaSO_4$, $MgSO_4$, $COSO_4$, $Ga_2(SO_4)_3$, $Ti(SO_4)_2$, and $NiSO_4$, and polymer nano particle layer (PNPL) and is not limited to the above. In accordance with the present embodiments, the first absorbing member **21** is formed of the PNPL and by the screen printing method or the spraying method. The first absorbing member **21** is formed at a dry atmosphere and in a decompressed state in order not to be affected by moisture and oxygen.

[0031] On the other hand, the second absorbing member **22** may be angular or planar shaped. The second absorbing member **22** is formed not to cover the image display unit **12**, in particular, the organic light emitting diode. The second absorbing member **22** prevents the light emitted from the organic light emitting diode from being transmitted through the circumference of the first absorbing member **21**. The second absorbing member **22** serves as an adsorbent. The second absorbing member **22** is formed of a colored metal thin film or a colored organic film, in particular, a black metal thin film or a black organic film having highest light shielding efficiency and may be formed of a single layer or a multiple layer. The second absorbing member **22** may be formed by variously combining the angular and planar shaped second absorbing members **22** to at least partially overlap the circumference of the first absorbing member **21** on the circumference of the image display unit **12**.

[0032] The thickness of the second absorbing member **22** is in the range of 5 to 15 μm. The width of the second absorbing member **22** in the part that overlaps the first absorbing member **21** on the internal surface of the panel **20**

is in the range of 0.8 to 1.2 mm. The height of the region that contacts the internal side of the panel **20** is in the range of 0.2 to 0.6 mm. In accordance with an embodiment of the present invention, the thickness of the second absorbing member **22** is 10 μm. However, modification can be made within the scope of the present invention.

[0033] **FIGS. 2A** to 2C are cross-sectional views of a panel on which the second absorbing member in accordance with the present invention is formed in each fabrication process. **FIG. 3** is a block diagram of the panel of **FIG. 2** in each fabrication process.

[0034] Referring to **FIGS. 2A** to 2C and **FIG. 3**, the panel **20** on which the second absorbing member in accordance with the present invention is formed is provided (**FIG. 2A** and S1 in **FIG. 3**). The panel **20** has a "U" shaped cross-section and is formed of transparent glass or plastic to transmit the light emitted from the organic light emitting diode (not shown). When the panel **20** is provided, the second absorbing member **22** is formed on the internal surface of the panel **20** (**FIG. 2B** and S2 in **FIG. 3**). The second absorbing member **22** is formed to have a predetermined width on the internal surface of the panel **20** and on the circumference of panel **20** so as not to cover the organic light emitting diode of the image display unit **12**. The second absorbing member **22** is formed of a colored metal film or a colored organic film that can absorb the light emitted from the organic light emitting diode. Next, the first absorbing member **21** is formed on the internal surface of the panel **20** that faces the organic light emitting diode (**FIG. 2C** and S3 in **FIG. 3**). As described above, the first absorbing member **21** is formed by the screen printing method or the spraying method and may be formed of various adsorbents. In accordance with the present embodiments, the first absorbing member **21** is formed of transparent PNPL.

[0035] According to the organic light emitting display **1** of the present invention, the region from the organic light emitting diode to the panel **20** includes transparent and semi-transparent members so that the light emitted from the organic light emitting diode is absorbed by the panel **20**.

[0036] Referring back to **FIG. 4**, a schematic cross-sectional view illustrates an organic light emitting display in accordance with a first embodiment taken along the line A-A' of **FIG. 1**. The organic light emitting display **1** includes a substrate **10** on which an image display unit **12** including at least one organic light emitting diode **30** is formed and a panel **20** formed on the substrate **10** and having a "U" shaped cross-section to seal the image display unit **12**.

[0037] A thin film transistor (TFT) **45** and the organic light emitting diode **30** are formed on the substrate **10**. A buffer layer **44** is formed on the substrate **10** of the TFT **45**. A semiconductor layer **47** is formed on the buffer layer **44**. A gate insulating film **43** is formed on the semiconductor layer **47**. The TFT **45** composed of a gate electrode **48**, a source electrode **46***a*, and a drain electrode **46***a* is formed on the gate insulating film **43**. An interlayer insulating film **42** is formed between the gate electrode **48** and the source and drain electrodes **46***a* and **46***b*. A planarizing film **41** is formed on the TFT **45**. A contact hole **40** for electrically connecting the planarizing film **41** and the organic light emitting diode **30** to each other is formed in the planarizing film **41**.

[0038] The organic light emitting diode **30** is formed on the planarizing film **41** and includes a first electrode (an anode electrode) **31**, an emission layer **32**, and a second electrode (a cathode electrode) **33**. Also, although not shown in the drawing, a hole injection layer (HIL) and a hole transfer layer (HTL) are formed between the first electrode **31** and the emission layer **32**, an electron transfer layer (ETL) and an electron injection layer (EIL) are sequentially stacked between the emission layer **32** and the second electrode **33**, and a pixel defining film (not shown) is further formed on the planarizing film **41** and the first electrode **31**. Here, the first electrode **31** may be formed of the cathode electrode and the second electrode **33** may be formed of the anode electrode.

[0039] The first absorbing member **21** formed on the image display unit **12** and the angular shaped second absorbing member **22** formed between the first absorbing member **21** and the internal surface of the panel **20** on the circumference of the image display unit **12** to at least partially overlap the circumference of the first absorbing member **21** are formed on the internal surface of the panel **20** that faces the organic light emitting diode **30** to prevent light from being transmitted through the top and side of the panel **20**. The second absorbing member **22** in accordance with the present invention shields external light and reflects the internal light emitted from the organic light emitting diode **30** to prevent light from leaking. Therefore, it is possible to improve contrast and light efficiency and to prevent screen distortion from being generated by the difference in refractive indexes caused by the difference in thickness of the circumference of the first absorbing member **21** on an actual screen due to a thick film phenomenon in which the circumference of the first absorbing member **21** becomes thicker in the process of coating the internal surface of the panel with the adsorbent.

[0040] FIGS. **5** to **9** are schematic cross-sectional views illustrating an organic light emitting display in accordance with second to sixth embodiments taken along the line A-A' of **FIG. 1**. Description of the same elements as the elements of the first embodiment will be omitted. In particular, description of the substrate **10** on which the TFT **45** and the organic light emitting diode **30** are formed will be omitted.

[0041] Referring to **FIG. 5**, in accordance with a second embodiment of the present invention, the organic light emitting display **1***a* includes a substrate **10** on which an image display unit **12** including at least one organic light emitting diode **30** is formed and a panel **20** formed on the substrate **10** and having a "U" shaped cross-section to seal the image display unit **12**. The first absorbing member **21** formed on the image display unit **12** and the planar shaped second absorbing member **22'** formed between the first absorbing member **21** and the internal surface of the panel **20** on the circumference of the image display unit **12** to at least partially overlap the circumference of the first absorbing member **21** are formed on the internal surface of the panel **20** that faces the organic light emitting diode **30** to prevent light from being transmitted through the top of the panel **20**.

[0042] Referring to **FIG. 6**, in accordance with a third embodiment of the present invention, the organic light emitting display **1***b* includes a substrate **10** on which an image display unit **12** including at least one organic light emitting diode **30** is formed and a panel **20** formed on the substrate **10** and having a "U" shaped cross-section to seal

the image display unit **12**. The first absorbing member **21** formed on the image display unit **12**, the planar shaped second absorbing member **22'** formed between the first absorbing member **21** and the internal surface of the panel **20** on the circumference of the image display unit **12** to at least partially overlap the circumference of the first absorbing member **21**, and a third absorbing member **23** are formed on the internal surface of the panel **20** that faces the organic light emitting diode **30** to prevent light from being transmitted through the top of the panel **20**. It is possible to improve the light-shielding efficiency when the third absorbing member **23** is added to the second absorbing member **22'**.

[**0043**] Referring to **FIG. 7**, in accordance with a fourth embodiment of the present invention, the organic light emitting display **1***c* includes a substrate **10** on which an image display unit **12** including at least one organic light emitting diode **30** is formed and a panel **20** formed on the substrate **10** and having a "U" shaped cross-section to seal the image display unit **12**. The first absorbing member **21** formed on the image display unit **12**, the angular shaped second absorbing member **22** formed between the first absorbing member **21** and the internal surface of the panel **20** on the circumference of the image display unit **12** to at least partially overlap the circumference of the first absorbing member **21**, and a third absorbing member **23'** are formed on the internal surface of the panel **20** that faces the organic light emitting diode **30** to prevent light from being transmitted through the top of the panel **20**. It is possible to improve the light-shielding efficiency when the third absorbing member **23'** is added to the second absorbing member **22**.

[**0044**] Referring to **FIG. 8**, in accordance with a fifth embodiment of the present invention, the organic light emitting display **1***d* includes a substrate **10** on which an image display unit **12** including at least one organic light emitting diode **30** is formed and a panel **20** formed on the substrate **10** and having a planar shaped cross-section to seal the image display unit **12**. The first absorbing member **21** formed on the image display unit **12**, the planar shaped second absorbing member **22'** formed between the first absorbing member **21** and the internal surface of the panel **20** on the circumference of the image display unit **12** to at least partially overlap the circumference of the first absorbing member **21**, and a sealing member **13** are formed on the internal surface of the panel **20** that faces the organic light emitting diode **30** to prevent light from being transmitted through the top of the panel **20**.

[**0045**] Referring to **FIG. 9**, in accordance with a sixth embodiment of the present invention, the organic light emitting display **1***e* includes a substrate **10** on which an image display unit **12** including at least one organic light emitting diode **30** is formed and a panel **20** formed on the substrate **10** and having a planar shaped cross-section to seal the image display unit **12**. The first absorbing member **21** formed on the image display unit **12**, the planar shaped second absorbing member **22'** formed between the first absorbing member **21** and the internal surface of the panel **20** on the circumference of the image display unit **12** to at least partially overlap the circumference of the first absorbing member **21**, the third absorbing member **23**, and the sealing member **13** are formed on the internal surface of the panel **20** that faces the organic light emitting diode **30** to prevent light from being transmitted through the top of the panel **20**. It is possible to improve the light-shielding efficiency when the third absorbing member **23** is added to the second absorbing member **22'**.

[**0046**] In accordance with the above-described embodiments, the second absorbing member formed on the internal surface of the panel is composed of one or two layers. However, the second absorbing member may be composed of two or more layers. Also, in accordance with the present embodiments, a top surface emission type organic light emitting diode is used. However, the present invention is not limited to the above. A bottom surface emission type organic light emitting diode may be used, for example.

[**0047**] As described above, in accordance with the present invention, it is possible to prevent the generation of the screen distortion caused by the thick film phenomenon that occurs in the conventional screen printing and spraying methods by additionally forming at least one-layered absorbing member on the circumference of the first absorbing member and to prevent light from leaking. Therefore, it is possible to improve light efficiency and to thus improve contrast. Also, it is possible to apply various processes so that it is possible to increase the width of selection and to thus improve product competitiveness.

[**0048**] Although exemplary embodiments of the present invention have been shown and described, it would be appreciated by those skilled in the art that changes might be made in this embodiment without departing from the principles and spirit of the invention, the scope of which is defined in the claims and their equivalents.

What is claimed is:

1. An organic light emitting display comprising:

a substrate on which an image display unit having at least one organic light emitting diode is formed;

a panel formed on the substrate to seal the image display unit;

a first absorbing member formed on at least an internal surface of the panel on the image display unit that faces the organic light emitting diode; and

a second absorbing member formed on the circumference of the image display unit between the first absorbing member and the internal surface of the panel, the second absorbing member overlapping the circumference of the first absorbing member.

2. The organic light emitting display as claimed in claim 1, wherein the second absorbing member is angular or planar shaped.

3. The organic light emitting display as claimed in claim 1, wherein the second absorbing member prevents the light emitted from the organic light emitting diode from being transmitted through the circumference of the first absorbing member.

4. The organic light emitting display as claimed in claim 3, wherein the second absorbing member is light absorbing.

5. The organic light emitting display as claimed in claim 1, wherein the second absorbing member is formed of a colored metal thin film or organic film.

6. The organic light emitting display as claimed in claim 5, wherein the second absorbing member is black.

7. The organic light emitting display as claimed in claim 1, wherein the second absorbing member is single-layered or multi-layered.

8. The organic light emitting display as claimed in claim 7, wherein the thickness of the second absorbing member is in the range of 5 to 15 μm.

9. The organic light emitting display as claimed in claim 1, wherein the first absorbing member is formed of one of PNPL, BaO, and CaO.

10. The organic light emitting display as claimed in claim 9, wherein the first absorbing member is formed by screen printing or a spraying.

11. The organic light emitting display as claimed in claim 1, wherein the first absorbing member absorbs moisture received from outside the organic light emitting display.

12. The organic light emitting display as claimed in claim 1, wherein the panel has a "U" shaped cross-section.

13. The organic light emitting display as claimed in claim 1, wherein the panel has a planar shaped cross-section.

14. The organic light emitting display as claimed in claim 13, further comprising a sealing member formed between the edge of the panel whose cross-section is planar shaped and the substrate to seal the image display unit.

15. The organic light emitting display as claimed in claim 1, wherein the panel is transparent.

16. A method of fabricating an organic light emitting display, the method comprising:

providing a substrate on which an image display unit having at least one organic light emitting diode is formed;

providing a panel formed on the substrate to seal the image display unit;

forming a second absorbing member on the internal surface of the panel along the circumference of the image display unit;

forming a first absorbing member on the internal surface of the panel that faces the organic light emitting diode on the image display unit, the first absorbing member at least partially overlapping the circumference of the second absorbing member;

forming an adhesive on the circumference of the substrate or the panel; and

sealing the panel in which the first and second absorbing members are formed and the substrate on which the image display unit having the at least one organic light emitting diode is formed.

17. The method as claimed in claim 16, wherein the second absorbing member is angular or planar shaped.

18. The method as claimed in claim 16, wherein the first absorbing member is formed of one of PNPL, BaO, and CaO.

19. The method as claimed in claim 18, wherein the first absorbing member is formed by screen printing or a spraying.

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专利名称(译)	有机发光显示器及其制造方法		
公开(公告)号	US20060244376A1	公开(公告)日	2006-11-02
申请号	US11/413926	申请日	2006-04-28
[标]申请(专利权)人(译)	CHUN PIL摹 KANG TAEW		
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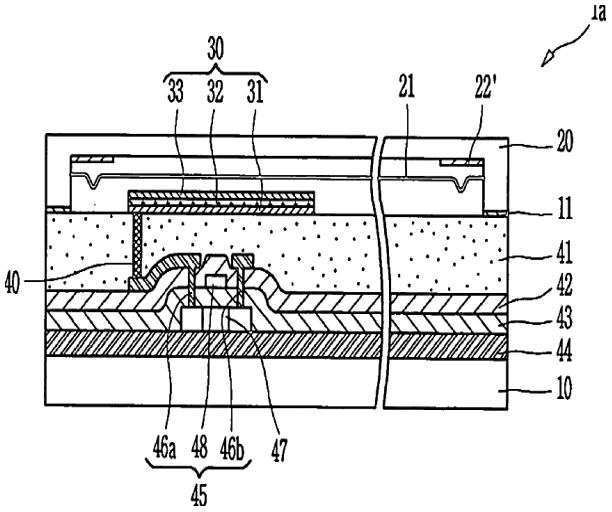
发明人	CHUN, PIL GEUN KANG, TAE WOOK		
IPC分类号	H05B33/02 H01L51/50		
CPC分类号	H01L51/5284 Y10T428/23 H01L2251/5315		
优先权	1020050036874 2005-05-02 KR		
其他公开文献	US7847478		
外部链接	Espacenet USPTO		

摘要(译)

一种有机发光显示器及其制造方法，其能够防止由于在面板的内表面涂覆有吸收构件时发生的厚膜现象引起的屏幕变形的产生。有机发光显示器包括基板，在基板上形成包括至少一个有机发光二极管的图像显示单元。在基板上形成面板以密封图像显示单元。第一吸收构件形成在图像显示单元上面向有机发光二极管的面板的内表面上。第二吸收构件形成在图像显示单元的圆周上，位于第一吸收构件和面板的内表面之间，以与第一吸收构件的圆周重叠。