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Choi et al.

(10) **Patent No.: US 8,164,257 B2**

(45) **Date of Patent: Apr. 24, 2012**

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

(75) Inventors: **Dong Soo Choi**, Suwon-si (KR); **Jin Woo Park**, Suwon-si (KR)

(73) Assignee: **Samsung Mobile Display Co., Ltd.**, Yongin (KR)

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(22) Filed: **Sep. 29, 2006**

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(51) **Int. Cl.**
H05B 33/12 (2006.01)

(52) **U.S. Cl.** **313/512**; 313/504

(58) **Field of Classification Search** 313/498–512; 315/169.3; 345/36, 45, 76
See application file for complete search history.

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Primary Examiner — Nimeshkumar Patel
Assistant Examiner — Christopher Raabe
(74) *Attorney, Agent, or Firm* — Knobbe Martens Olson & Bear LLP

(57) **ABSTRACT**

Disclosed are an organic light emitting display and a method of fabricating the same that are capable of preventing deterioration of adhesive strength of a glass frit for sealing a substrate. An organic light emitting device according to one embodiment of the present invention includes a first substrate including a pixel region and a non-pixel region, an array of organic light emitting pixels formed over the pixel region of the first substrate, and a second substrate placed over the first substrate, the array being interposed between the first and second substrates. The organic light emitting device of this embodiment further includes an electrically conductive line formed over the non-pixel region of the first substrate, and a frit seal interposed between the first and second substrates and surrounding the array such that the array is encapsulated by the first substrate, the second substrate and the frit seal, wherein the electrically conductive line comprises a portion overlapping the frit seal in a segment of the device such that the portion of the electrically conductive line substantially eclipses the frit seal when viewed from the first substrate.

24 Claims, 10 Drawing Sheets

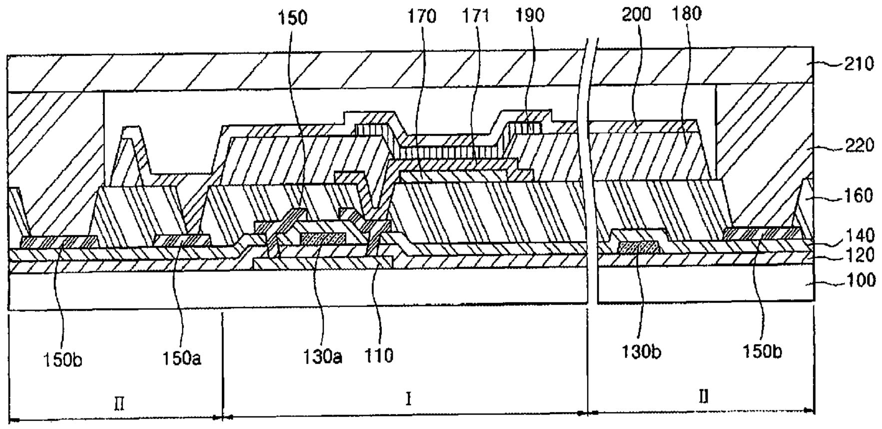

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FIG. 1

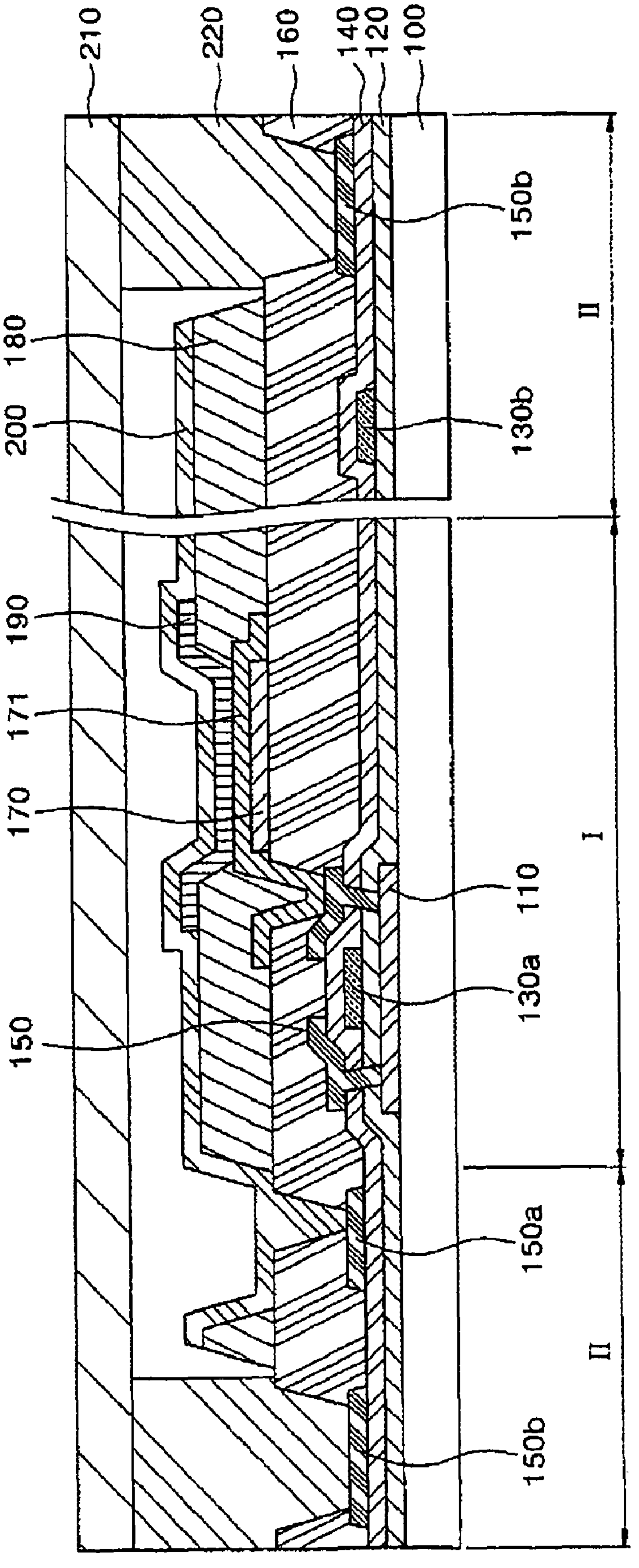
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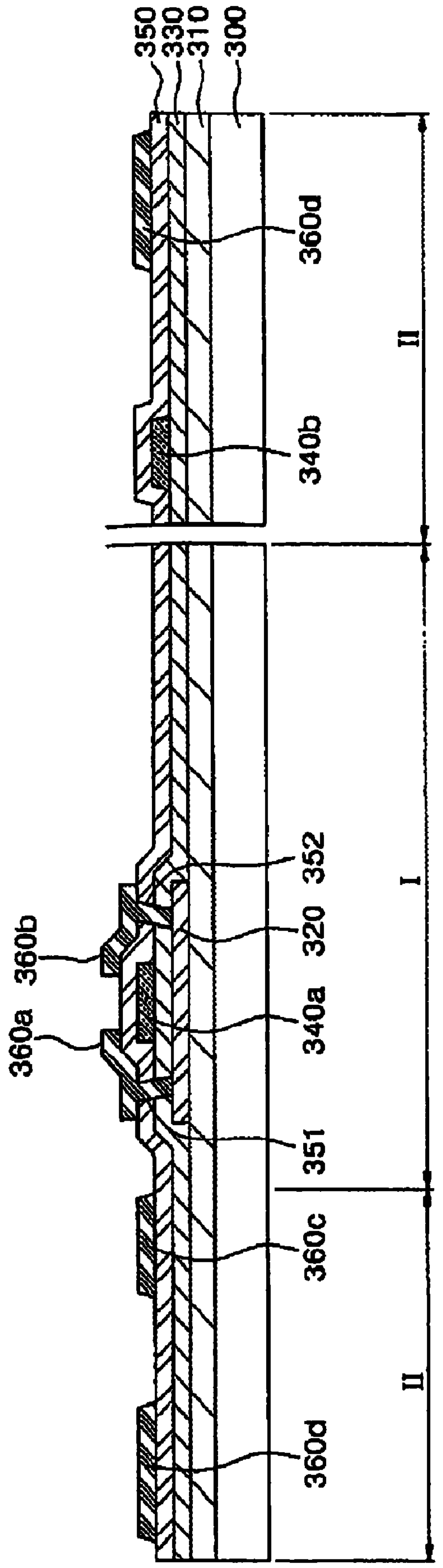
FIG. 2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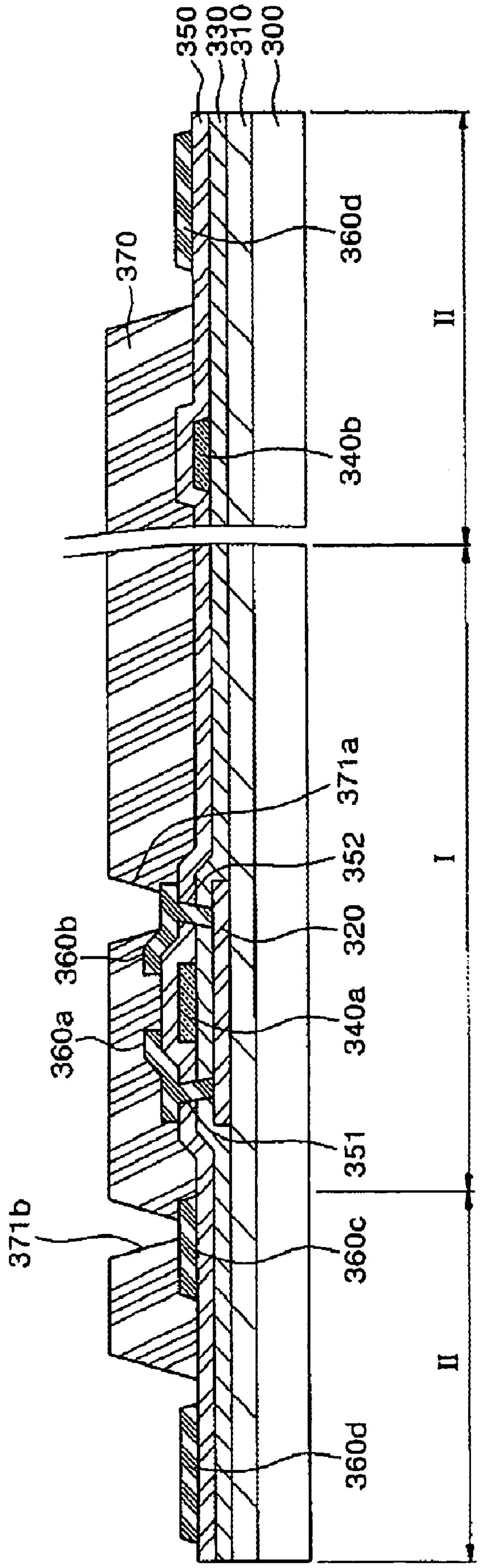
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FIG. 4

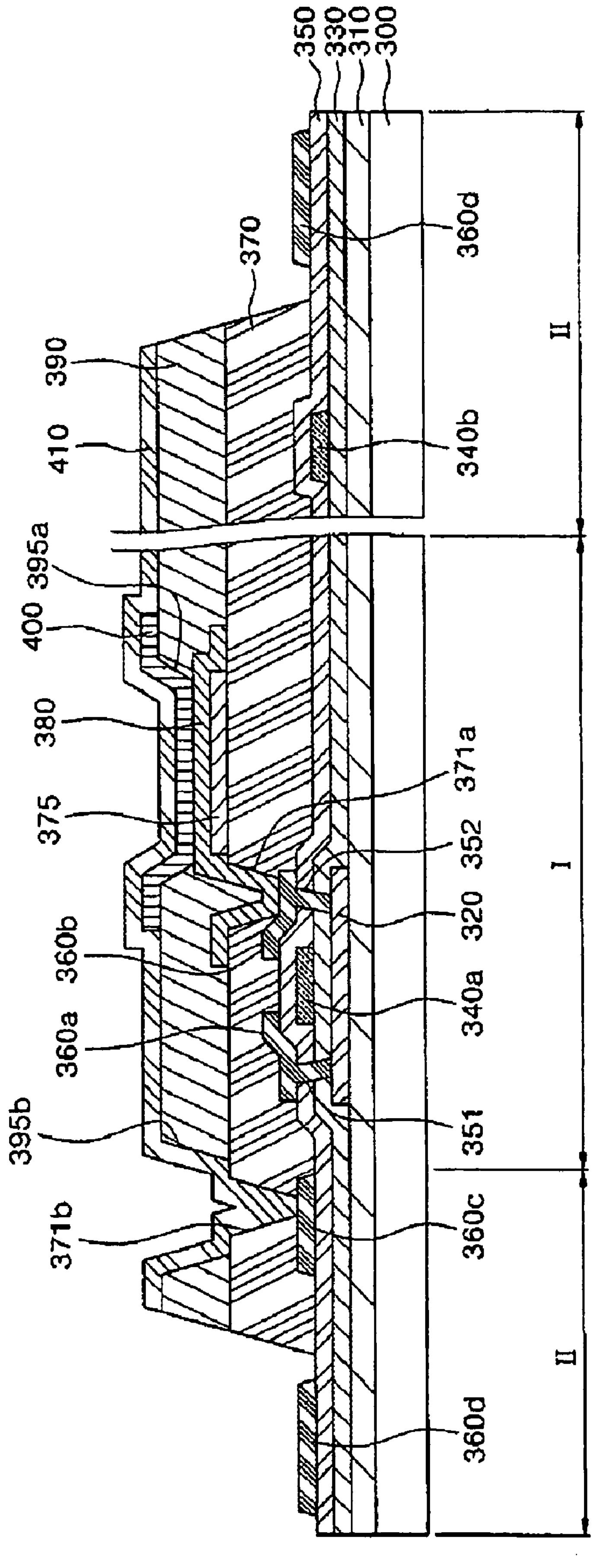
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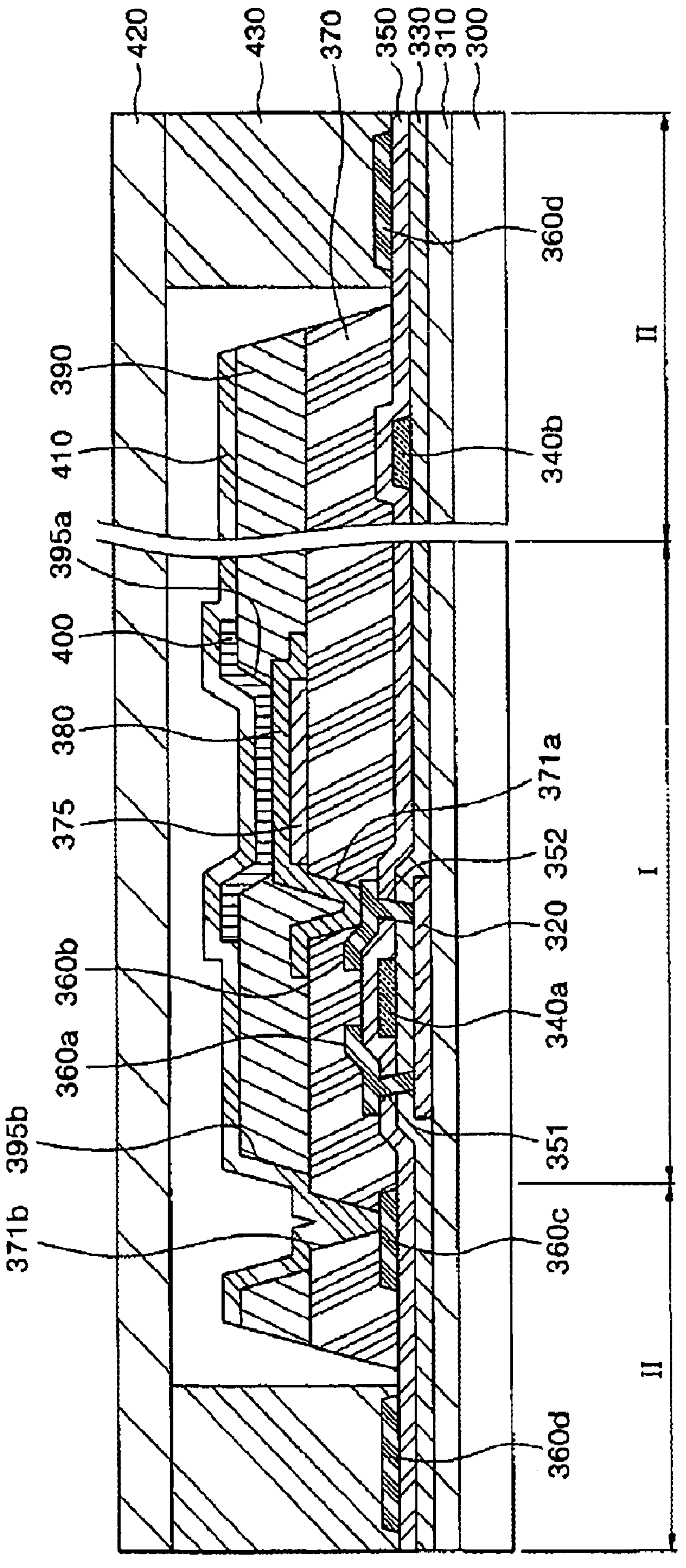
FIG. 5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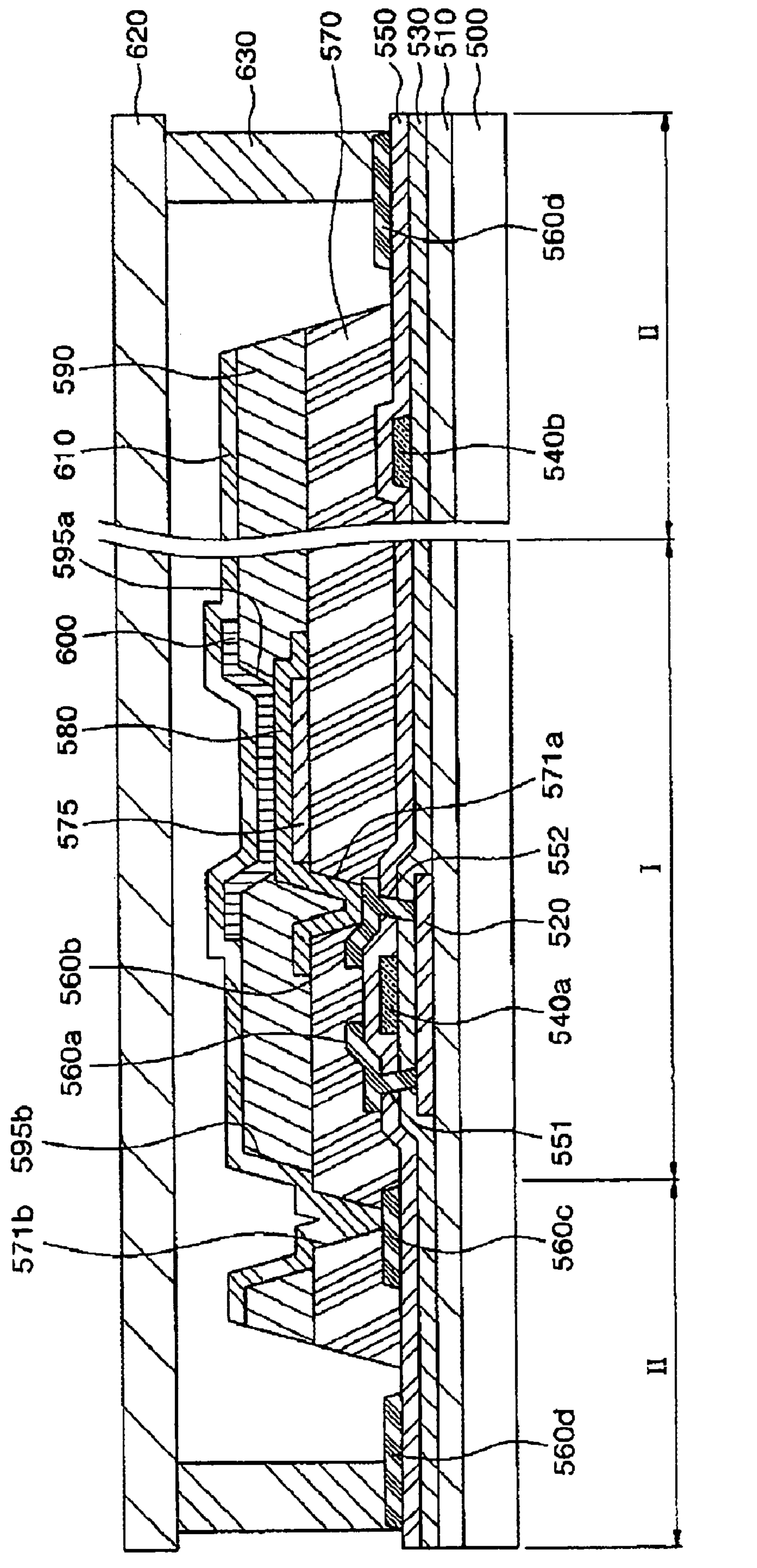

620
630
570
550
530
510
500
560d
590
610
595a
600
580
575
560b
560a
595b
571b
II
540b
I
571a
552
520
540a
551
560c
II
560d

FIG. 6

FIG. 7A

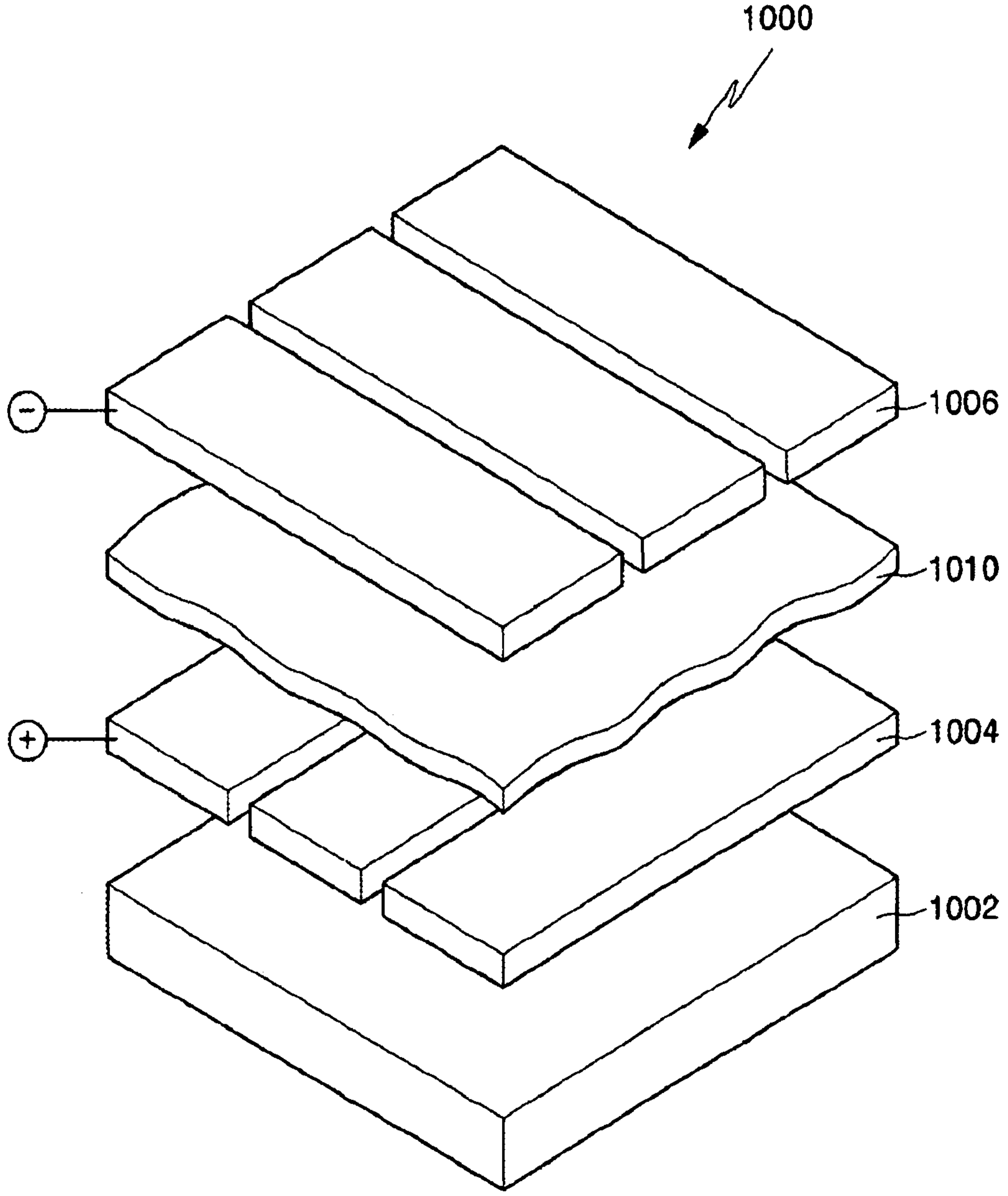


FIG. 7B

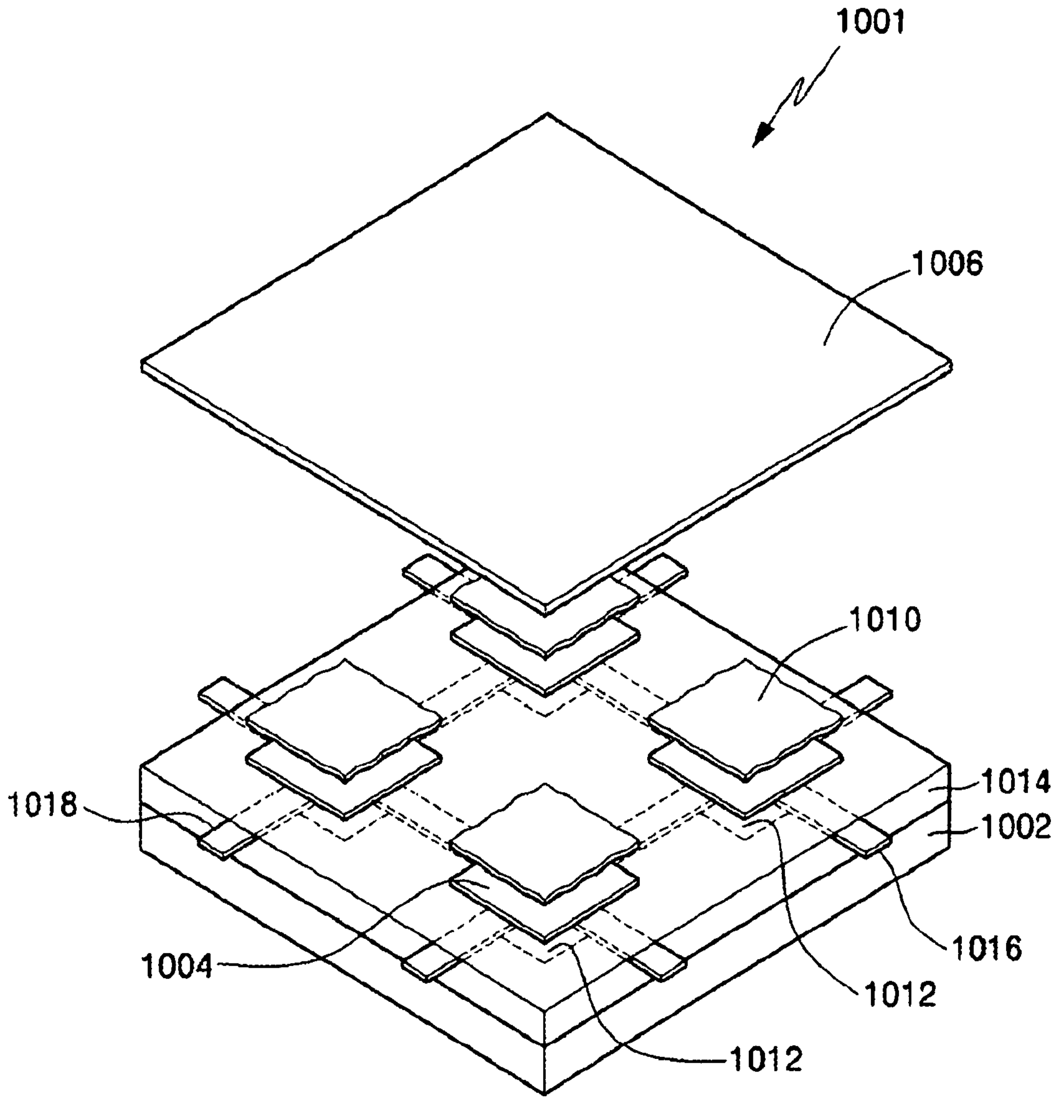


FIG. 7C

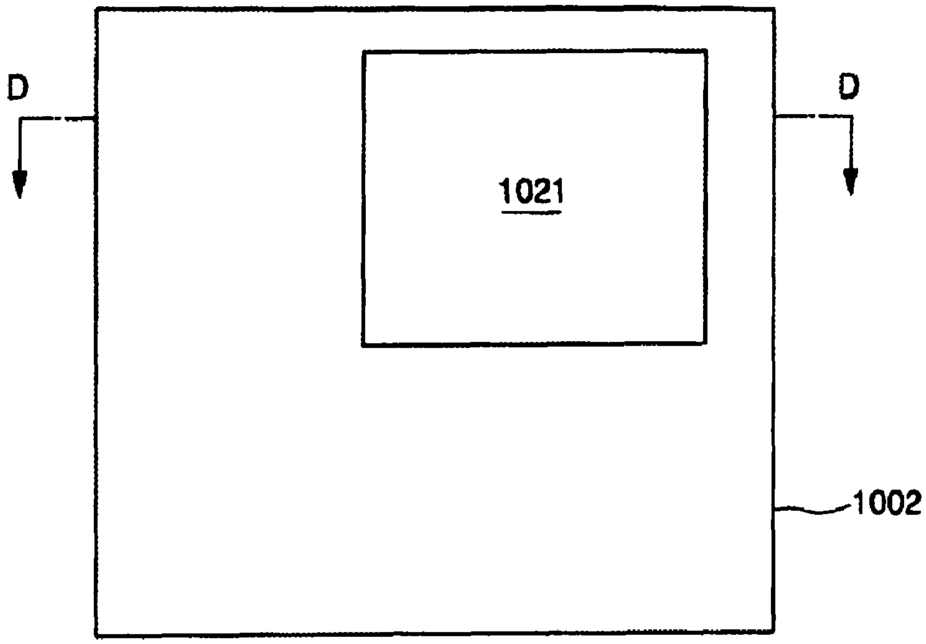


FIG. 7D

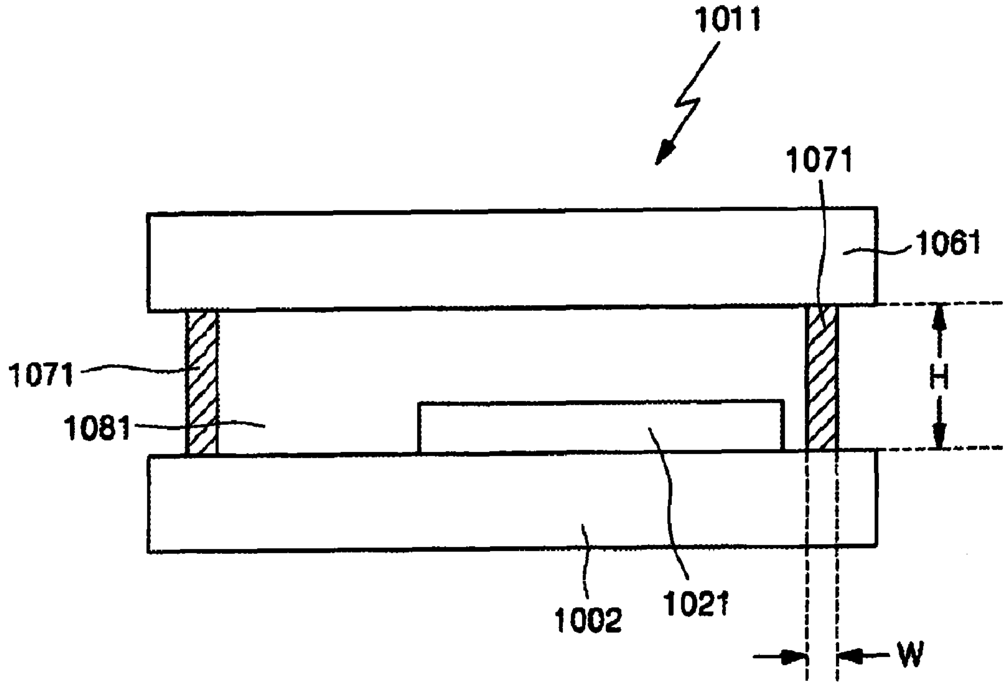
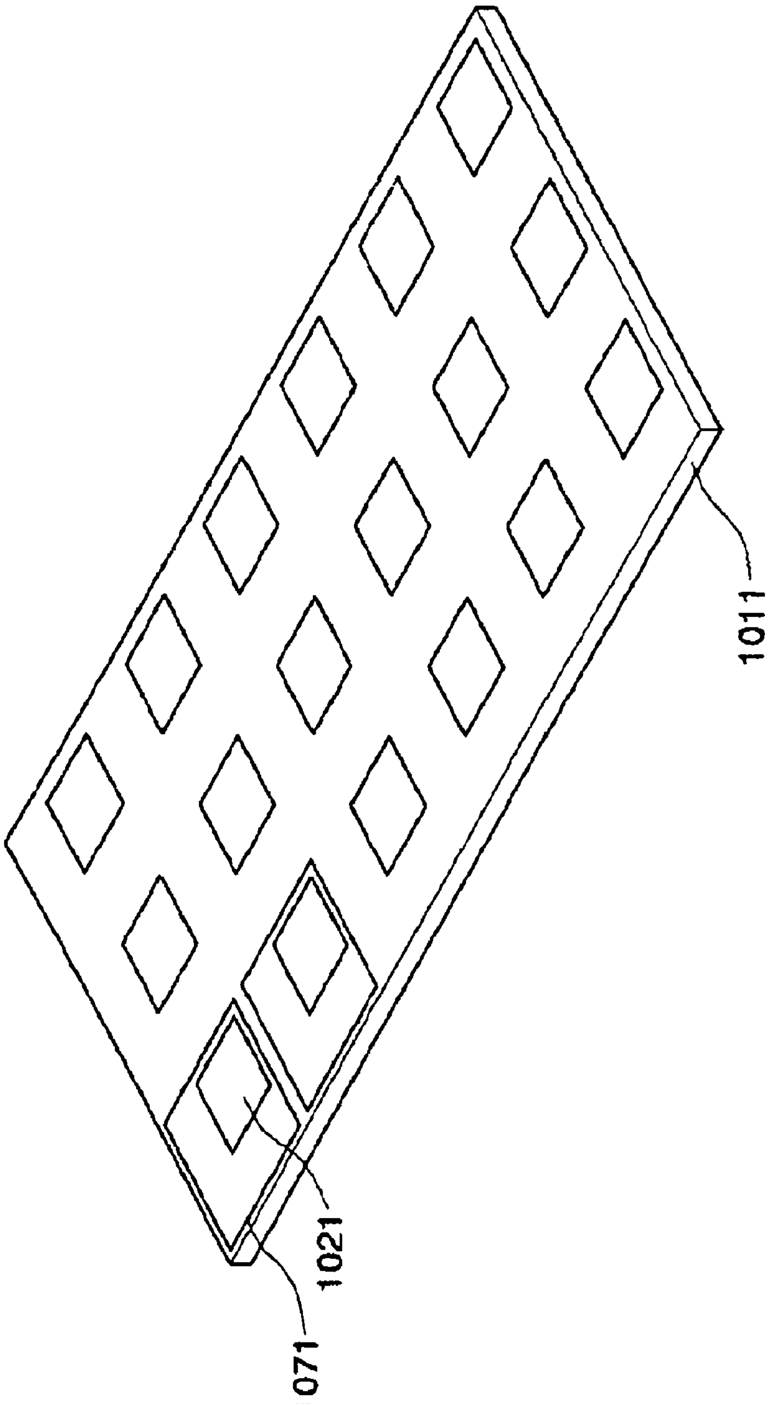


FIG. 7E



ORGANIC LIGHT EMITTING DISPLAY AND METHOD OF FABRICATING THE SAME

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority to and the benefit of Korean Patent Application Nos. 10-2006-0007962, filed Jan. 25, 2006, and 10-2006-0027321, filed Mar. 27, 2006, the disclosures of which are incorporated herein by reference in their entirety. This application is related to and incorporates herein by reference the entire contents of the following concurrently filed applications:

Title	Filing Date	Application No.
ORGANIC LIGHT-EMITTING DISPLAY DEVICE AND METHOD OF FABRICATING THE SAME	Sep. 29, 2006	11/541,055
ORGANIC LIGHT-EMITTING DISPLAY DEVICE AND METHOD OF MANUFACTURING THE SAME	Sep. 29, 2006	11/529,914
ORGANIC LIGHT EMITTING DISPLAY DEVICE	Sep. 29, 2006	11/541,139
ORGANIC LIGHT-EMITTING DISPLAY DEVICE WITH FRIT SEAL AND REINFORCING STRUCTURE	Sep. 29, 2006	11/541,047
ORGANIC LIGHT EMITTING DISPLAY DEVICE METHOD OF FABRICATING THE SAME	Sep. 29, 2006	11/540,150
ORGANIC LIGHT EMITTING DISPLAY AND METHOD OF FABRICATING THE SAME	Sep. 29, 2006	11/541,009
ORGANIC LIGHT-EMITTING DISPLAY DEVICE WITH FRIT SEAL AND REINFORCING STRUCTURE BONDED TO FRAME	Sep. 29, 2006	11/540,151
METHOD FOR PACKAGING ORGANIC LIGHT EMITTING DISPLAY WITH FRIT SEAL AND REINFORCING STRUCTURE	Sep. 29, 2006	11/529,910
METHOD FOR PACKAGING ORGANIC LIGHT EMITTING DISPLAY WITH FRIT SEAL AND REINFORCING STRUCTURE	Sep. 29, 2006	11/540,084
ORGANIC LIGHT-EMITTING DISPLAY DEVICE AND THE PREPARATION METHOD OF THE SAME	Sep. 29, 2006	11/540,008
ORGANIC LIGHT EMITTING DISPLAY AND FABRICATING METHOD OF THE SAME	Sep. 29, 2006	11/541,048
ORGANIC LIGHT-EMITTING DISPLAY AND METHOD OF MAKING THE SAME	Sep. 29, 2006	11/540,021
ORGANIC LIGHT EMITTING DISPLAY AND FABRICATING METHOD OF THE SAME	Sep. 29, 2006	11/540,024
ORGANIC LIGHT EMITTING DISPLAY DEVICE AND MANUFACTURING METHOD THEREOF	Sep. 29, 2006	11/529,995
ORGANIC LIGHT-EMITTING DISPLAY DEVICE AND MANUFACTURING METHOD OF THE SAME	Sep. 29, 2006	11/540,157
ORGANIC LIGHT EMITTING DISPLAY AND FABRICATING METHOD OF THE SAME	Sep. 29, 2006	11/540,149
ORGANIC LIGHT EMITTING DISPLAY AND METHOD OF FABRICATING THE SAME	Sep. 29, 2006	11/529,916
ORGANIC LIGHT EMITTING DISPLAY DEVICE METHOD OF FABRICATING THE SAME	Sep. 29, 2006	11/529,891

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to organic light emitting display devices. More particularly, the present invention relates to packaging organic light emitting display devices.

2. Description of the Related Art

With the goal of improving upon the shortcomings of conventional displays such as cathode ray tubes, attention has recently been focused on flat panel displays such as liquid crystal displays, organic light emitting displays, plasma display panels (PDP), and so on.

Since the liquid crystal display is a passive device rather than an emissive device, it is difficult to make having high brightness and contrast, a wide viewing angle, and a large-sized screen. While the PDP is an emissive device, it is heavy, consumes much power, and requires a complex manufacturing process, compared to other displays.

Meanwhile, since the organic light emitting display (OLED) is an emissive device, it has a wide viewing angle, and high contrast. In addition, since it does not require a backlight, it can be made lightweight, compact, and power efficient. Further, the OLED can be driven at a low DC voltage, has a rapid response speed, and is formed entirely of solid material. As a result, the OLED has the ability to withstand external impact and a wide range of temperatures, and can be fabricated by a simple method at low cost.

The discussion of this section is to provide a general background of organic light-emitting devices and does not constitute an admission of prior art.

SUMMARY OF CERTAIN INVENTIVE ASPECTS

One aspect of the invention provides an organic light emitting device. This device includes a first substrate comprising a pixel region and a non-pixel region, an array of organic light emitting pixels formed over the pixel region of the first substrate, and a second substrate placed over the first substrate, the array being interposed between the first and second substrate. The device further includes an electrically conductive line formed over the non-pixel region of the first substrate, and a frit seal interposed between the first and second substrates and surrounding the array such that the array is encapsulated by the first substrate, the second substrate and the frit seal, wherein the electrically conductive line comprises a portion overlapping the frit seal in a segment of the device such that the portion of the electrically conductive line substantially eclipses the frit seal when viewed from the first substrate.

In the above-described device, the portion of the electrically conductive line may substantially totally eclipse the frit seal when viewed from the first substrate. The frit seal may contact the electrically conductive line. There may be substantially no organic material between the frit seal and the electrically conductive line. The device may further comprise at least one layer located between the electrically conductive line and the first substrate, the at least one layer comprising an organic material. The electrically conductive material may further comprise a portion that does not overlap the frit seal. The electrically conductive line may extend along a peripheral edge of the first substrate, and wherein the frit seal extends along the peripheral edge of the first edge. The electrically conductive line may be made of metal. In another segment of the device, the frit seal may further comprise a non-eclipsed portion that is not eclipsed by the electrically conductive line when viewed from the first substrate.

Still referring to the above described device, the frit seal may have a width taken in a cross-sectional plane, and the electrically conductive line may have a width taken in the cross-sectional plane, and wherein the width of the frit seal is substantially smaller than the width of the electrically conductive line. The electrically conductive line may comprise a power supply line electrically connected to the array. The electrically conductive line may comprise a portion overlapping the frit seal in substantially throughout the device such that the portion of the electrically conductive line substantially eclipses the frit seal when viewed from the first substrate.

Yet still referring to the above described device, the device may further comprise a planarization layer formed over at least part of the non-pixel region of the first substrate, wherein the frit seal does not contact the planarization layer. The device may further comprise an organic planarization layer formed over at least part of the non-pixel region of the first substrate, wherein the organic planarization layer comprises a recess exposing the electrically conductive line. The device may further comprise a plurality of thin film transistors interposed between the first substrate and the array, wherein the electrically conductive line is made of a material used in the plurality of thin film transistors.

Another aspect of the invention provides a method of making an organic light emitting device. The method includes providing an unfinished device comprising a first substrate, an array of organic light emitting pixels formed over the first substrate, and an electrically conductive line formed over the first substrate and not overlapping the array, further providing a second substrate, and interposing a frit between the first and second substrates such that the array is interposed between the first and second substrates, that the frit surrounds the array and that a portion of the electrically conductive line overlaps the frit in a segment of the device, whereby the portion of the electrically conductive line substantially eclipses the frit in the segment. The method further includes melting and resolidifying at least part of the frit so as to interconnect the unfinished device and the second substrate via the frit, wherein the frit connects to the electrically conductive line with or without a material therebetween, and wherein the frit connects to the second substrate with or without a material therebetween.

In the above described method, interposing may comprise contacting the frit with the portion of the electrically conductive line and the second substrate. The unfinished device may further comprise a planarization layer generally formed over the electrically conductive line with an opening exposing part of the conductive line, and wherein interposing the frit comprises contacting the frit with the electrically conductive line through the opening. Providing the unfinished device may further comprise providing the planarization layer over the electrically conductive line, and selectively etching the planarization layer to form the opening. The melting may comprise irradiating a laser beam or infrared ray to at least part of the frit. The interposing of the frit may comprise forming the frit over at least one of the first and second substrates, and arranging the first and second substrate so as to interpose the frit therebetween. Forming the frit may comprise screen-printing or dispensing a material of the frit over at least one of the first and second substrates. The unfinished device may further comprise one or more additional arrays of organic light emitting pixels and one or more additional electrically conductive lines formed over the first substrate.

Still referring to the above described method, the method may further include forming one or more additional frits between the first and second substrates such that each additional frit surrounds one of the additional arrays and contacts a portion of one of the additional electrically conductive lines. The one of the additional electrically conductive lines may substantially eclipse the additional frit. The method may further include cutting the resulting product including the additional arrays into two or more pieces, where one of the pieces comprises the frit and the array interposed between the first and second substrate.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other features of the present invention will be described in reference to certain exemplary embodiments thereof with reference to the attached drawings in which:

FIG. **1** is a cross-sectional view of an organic light emitting display according to an embodiment;

FIGS. **2** to **5** are cross-sectional views of an organic light emitting display in accordance with an embodiment;

FIG. **6** is a cross-sectional view of an organic light emitting display in accordance with another embodiment;

FIG. **7**A is a schematic exploded view of a passive matrix type organic light emitting display device in accordance with one embodiment.

FIG. **7**B is a schematic exploded view of an active matrix type organic light emitting display device in accordance with one embodiment.

FIG. **7**C is a schematic top plan view of an organic light emitting display in accordance with one embodiment.

FIG. **7**D is a cross-sectional view of the organic light emitting display of FIG. **7**C, taken along the line d-d.

FIG. **7**E is a schematic perspective view illustrating mass production of organic light emitting devices in accordance with one embodiment.

DETAILED DESCRIPTION OF CERTAIN INVENTIVE EMBODIMENTS

The present invention will now be described more fully hereinafter with reference to the accompanying drawings, in which some embodiments of the invention are shown. This invention may, however, be embodied in different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. In the drawings, the thickness of layers and regions may be exaggerated for clarity. Like reference numerals designate like elements throughout the specification.

An organic light emitting display (OLED) is a display device comprising an array of organic light emitting diodes. Organic light emitting diodes are solid state devices which include an organic material and are adapted to generate and emit light when appropriate electrical potentials are applied.

OLEDs can be generally grouped into two basic types dependent on the arrangement with which the stimulating electrical current is provided. FIG. **7**A schematically illustrates an exploded view of a simplified structure of a passive matrix type OLED **1000**. FIG. **7**B schematically illustrates a simplified structure of an active matrix type OLED **1001**. In both configurations, the OLED **1000**, **1001** includes OLED pixels built over a substrate **1002**, and the OLED pixels include an anode **1004**, a cathode **1006** and an organic layer **1010**. When an appropriate electrical current is applied to the anode **1004**, electric current flows through the pixels and visible light is emitted from the organic layer.

Referring to FIG. **7**A, the passive matrix OLED (PMOLED) design includes elongate strips of anode **1004** arranged generally perpendicular to elongate strips of cathode **1006** with organic layers interposed therebetween. The intersections of the strips of cathode **1006** and anode **1004** define individual OLED pixels where light is generated and emitted upon appropriate excitation of the corresponding strips of anode **1004** and cathode **1006**. PMOLEDs provide the advantage of relatively simple fabrication.

Referring to FIG. 7B, the active matrix OLED (AMOLED) includes driving circuits **1012** arranged between the substrate **1002** and an array of OLED pixels. An individual pixel of AMOLEDs is defined between the common cathode **1006** and an anode **1004**, which is electrically isolated from other anodes. Each driving circuit **1012** is coupled with an anode **1004** of the OLED pixels and further coupled with a data line **1016** and a scan line **1018**. In embodiments, the scan lines **1018** supply select signals that select rows of the driving circuits, and the data lines **1016** supply data signals for particular driving circuits. The data signals and scan signals stimulate the local driving circuits **1012**, which excite the anodes **1004** so as to emit light from their corresponding pixels.

In the illustrated AMOLED, the local driving circuits **1012**, the data lines **1016** and scan lines **1018** are buried in a planarization layer **1014**, which is interposed between the pixel array and the substrate **1002**. The planarization layer **1014** provides a planar top surface on which the organic light emitting pixel array is formed. The planarization layer **1014** may be formed of organic or inorganic materials, and formed of two or more layers although shown as a single layer. The local driving circuits **1012** are typically formed with thin film transistors (TFT) and arranged in a grid or array under the OLED pixel array. The local driving circuits **1012** may be at least partly made of organic materials, including organic TFT.

AMOLEDs have the advantage of fast response time improving their desirability for use in displaying data signals. Also, AMOLEDs have the advantages of consuming less power than passive matrix OLEDs.

Referring to common features of the PMOLED and AMOLED designs, the substrate **1002** provides structural support for the OLED pixels and circuits. In various embodiments, the substrate **1002** can comprise rigid or flexible materials as well as opaque or transparent materials, such as plastic, glass, and/or foil. As noted above, each OLED pixel or diode is formed with the anode **1004**, cathode **1006** and organic layer **1010** interposed therebetween. When an appropriate electrical current is applied to the anode **1004**, the cathode **1006** injects electrons and the anode **1004** injects holes. In certain embodiments, the anode **1004** and cathode **1006** are inverted; i.e., the cathode is formed on the substrate **1002** and the anode is opposingly arranged.

Interposed between the cathode **1006** and anode **1004** are one or more organic layers. More specifically, at least one emissive or light emitting layer is interposed between the cathode **1006** and anode **1004**. The light emitting layer may comprise one or more light emitting organic compounds. Typically, the light emitting layer is configured to emit visible light in a single color such as blue, green, red or white. In the illustrated embodiment, one organic layer **1010** is formed between the cathode **1006** and anode **1004** and acts as a light emitting layer. Additional layers, which can be formed between the anode **1004** and cathode **1006**, can include a hole transporting layer, a hole injection layer, an electron transporting layer and an electron injection layer.

Hole transporting and/or injection layers can be interposed between the light emitting layer **1010** and the anode **1004**. Electron transporting and/or injecting layers can be interposed between the cathode **1006** and the light emitting layer **1010**. The electron injection layer facilitates injection of electrons from the cathode **1006** toward the light emitting layer **1010** by reducing the work function for injecting electrons from the cathode **1006**. Similarly, the hole injection layer facilitates injection of holes from the anode **1004** toward the light emitting layer **1010**. The hole and electron transporting layers facilitate movement of the carriers injected from the respective electrodes toward the light emitting layer.

In some embodiments, a single layer may serve both electron injection and transportation functions or both hole injection and transportation functions. In some embodiments, one or more of these layers are lacking. In some embodiments, one or more organic layers are doped with one or more materials that help injection and/or transportation of the carriers. In embodiments where only one organic layer is formed between the cathode and anode, the organic layer may include not only an organic light emitting compound but also certain functional materials that help injection or transportation of carriers within that layer.

There are numerous organic materials that have been developed for use in these layers including the light emitting layer. Also, numerous other organic materials for use in these layers are being developed. In some embodiments, these organic materials may be macromolecules including oligomers and polymers. In some embodiments, the organic materials for these layers may be relatively small molecules. The skilled artisan will be able to select appropriate materials for each of these layers in view of the desired functions of the individual layers and the materials for the neighboring layers in particular designs.

In operation, an electrical circuit provides appropriate potential between the cathode **1006** and anode **1004**. This results in an electrical current flowing from the anode **1004** to the cathode **1006** via the interposed organic layer(s). In one embodiment, the cathode **1006** provides electrons to the adjacent organic layer **1010**. The anode **1004** injects holes to the organic layer **1010**. The holes and electrons recombine in the organic layer **1010** and generate energy particles called "excitons." The excitons transfer their energy to the organic light emitting material in the organic layer **1010**, and the energy is used to emit visible light from the organic light emitting material. The spectral characteristics of light generated and emitted by the OLED **1000**, **1001** depend on the nature and composition of organic molecules in the organic layer(s). The composition of the one or more organic layers can be selected to suit the needs of a particular application by one of ordinary skill in the art.

OLED devices can also be categorized based on the direction of the light emission. In one type referred to as "top emission" type, OLED devices emit light and display images through the cathode or top electrode **1006**. In these embodiments, the cathode **1006** is made of a material transparent or at least partially transparent with respect to visible light. In certain embodiments, to avoid losing any light that can pass through the anode or bottom electrode **1004**, the anode may be made of a material substantially reflective of the visible light. A second type of OLED devices emits light through the anode or bottom electrode **1004** and is called "bottom emission" type. In the bottom emission type OLED devices, the anode **1004** is made of a material which is at least partially transparent with respect to visible light. Often, in bottom emission type OLED devices, the cathode **1006** is made of a material substantially reflective of the visible light. A third type of OLED devices emits light in two directions, e.g. through both anode **1004** and cathode **1006**. Depending upon the direction(s) of the light emission, the substrate may be formed of a material which is transparent, opaque or reflective of visible light.

In many embodiments, an OLED pixel array **1021** comprising a plurality of organic light emitting pixels is arranged over a substrate **1002** as shown in FIG. **7**C. In embodiments, the pixels in the array **1021** are controlled to be turned on and off by a driving circuit (not shown), and the plurality of the pixels as a whole displays information or image on the array **1021**. In certain embodiments, the OLED pixel array **1021** is arranged with respect to other components, such as drive and control electronics to define a display region and a non-display region. In these embodiments, the display region refers to the area of the substrate **1002** where OLED pixel array **1021** is formed. The non-display region refers to the remaining areas of the substrate **1002**. In embodiments, the non-display region can contain logic and/or power supply circuitry. It will be understood that there will be at least portions of control/drive circuit elements arranged within the display region. For example, in PMOLEDs, conductive components will extend into the display region to provide appropriate potential to the anode and cathodes. In AMOLEDs, local driving circuits and data/scan lines coupled with the driving circuits will extend into the display region to drive and control the individual pixels of the AMOLEDs.

One design and fabrication consideration in OLED devices is that certain organic material layers of OLED devices can suffer damage or accelerated deterioration from exposure to water, oxygen or other harmful gases. Accordingly, it is generally understood that OLED devices be sealed or encapsulated to inhibit exposure to moisture and oxygen or other harmful gases found in a manufacturing or operational environment. FIG. **7**D schematically illustrates a cross-section of an encapsulated OLED device **1011** having a layout of FIG. **7**C and taken along the line d-d of FIG. **7**C. In this embodiment, a generally planar top plate or substrate **1061** engages with a seal **1071** which further engages with a bottom plate or substrate **1002** to enclose or encapsulate the OLED pixel array **1021**. In other embodiments, one or more layers are formed on the top plate **1061** or bottom plate **1002**, and the seal **1071** is coupled with the bottom or top substrate **1002**, **1061** via such a layer. In the illustrated embodiment, the seal **1071** extends along the periphery of the OLED pixel array **1021** or the bottom or top plate **1002**, **1061**.

In embodiments, the seal **1071** is made of a frit material as will be further discussed below. In various embodiments, the top and bottom plates **1061**, **1002** comprise materials such as plastics, glass and/or metal foils which can provide a barrier to passage of oxygen and/or water to thereby protect the OLED pixel array **1021** from exposure to these substances. In embodiments, at least one of the top plate **1061** and the bottom plate **1002** are formed of a substantially transparent material.

To lengthen the life time of OLED devices **1011**, it is generally desired that seal **1071** and the top and bottom plates **1061**, **1002** provide a substantially non-permeable seal to oxygen and water vapor and provide a substantially hermetically enclosed space **1081**. In certain applications, it is indicated that the seal **1071** of a frit material in combination with the top and bottom plates **1061**, **1002** provide a barrier to oxygen of less than approximately 10^{-3} cc/m^2-day and to water of less than 10^{-6} g/m^2-day. Given that some oxygen and moisture can permeate into the enclosed space **1081**, in some embodiments, a material that can take up oxygen and/or moisture is formed within the enclosed space **1081**.

The seal **1071** has a width W, which is its thickness in a direction parallel to a surface of the top or bottom substrate **1061**, **1002** as shown in FIG. **7**D. The width varies among embodiments and ranges from about 300 μm to about 3000 μm, optionally from about 500 μm to about 1500 μm. Also, the width may vary at different positions of the seal **1071**. In some embodiments, the width of the seal **1071** may be the largest where the seal **1071** contacts one of the bottom and top substrate **1002**, **1061** or a layer formed thereon. The width may be the smallest where the seal **1071** contacts the other. The width variation in a single cross-section of the seal **1071** relates to the cross-sectional shape of the seal **1071** and other design parameters.

The seal **1071** has a height H, which is its thickness in a direction perpendicular to a surface of the top or bottom substrate **1061**, **1002** as shown in FIG. **7**D. The height varies among embodiments and ranges from about 2 μm to about 30 μm, optionally from about 10 μm to about 15 μm. Generally, the height does not significantly vary at different positions of the seal **1071**. However, in certain embodiments, the height of the seal **1071** may vary at different positions thereof.

In the illustrated embodiment, the seal **1071** has a generally rectangular cross-section. In other embodiments, however, the seal **1071** can have other various cross-sectional shapes such as a generally square cross-section, a generally trapezoidal cross-section, a cross-section with one or more rounded edges, or other configuration as indicated by the needs of a given application. To improve hermeticity, it is generally desired to increase the interfacial area where the seal **1071** directly contacts the bottom or top substrate **1002**, **1061** or a layer formed thereon. In some embodiments, the shape of the seal can be designed such that the interfacial area can be increased.

The seal **1071** can be arranged immediately adjacent the OLED array **1021**, and in other embodiments, the seal **1071** is spaced some distance from the OLED array **1021**. In certain embodiment, the seal **1071** comprises generally linear segments that are connected together to surround the OLED array **1021**. Such linear segments of the seal **1071** can extend, in certain embodiments, generally parallel to respective boundaries of the OLED array **1021**. In other embodiment, one or more of the linear segments of the seal **1071** are arranged in a non-parallel relationship with respective boundaries of the OLED array **1021**. In yet other embodiments, at least part of the seal **1071** extends between the top plate **1061** and bottom plate **1002** in a curvilinear manner.

As noted above, in certain embodiments, the seal **1071** is formed using a frit material or simply "frit" or glass frit," which includes fine glass particles. The frit particles includes one or more of magnesium oxide (MgO), calcium oxide (CaO), barium oxide (BaO), lithium oxide (Li_2O), sodium oxide (Na_2O), potassium oxide (K_2O), boron oxide (B_2O_3), vanadium oxide (V_2O_5), zinc oxide (ZnO), tellurium oxide (TeO_2), aluminum oxide (Al_2O_3), silicon dioxide (SiO_2), lead oxide (PbO), tin oxide (SnO), phosphorous oxide (P_2O_5), ruthenium oxide (Ru_2O), rubidium oxide (Rb_2O), rhodium oxide (Rh_2O), ferrite oxide (Fe_2O_3), copper oxide (CuO), titanium oxide (TiO_2), tungsten oxide (WO_3), bismuth oxide (Bi_2O_3), antimony oxide (Sb_2O_3), lead-borate glass, tin-phosphate glass, vanadate glass, and borosilicate, etc. In embodiments, these particles range in size from about 2 μm to about 30 μm, optionally about 5 μm to about 10 μm, although not limited only thereto. The particles can be as large as about the distance between the top and bottom substrates **1061**, **1002** or any layers formed on these substrates where the frit seal **1071** contacts.

The frit material used to form the seal **1071** can also include one or more filler or additive materials. The filler or additive materials can be provided to adjust an overall thermal expansion characteristic of the seal **1071** and/or to adjust the absorption characteristics of the seal **1071** for selected frequencies of incident radiant energy. The filler or additive material(s) can also include inversion and/or additive fillers to adjust a coefficient of thermal expansion of the frit. For example, the filler or additive materials can include transition metals, such as chromium (Cr), iron (Fe), manganese (Mn), cobalt (Co), copper (Cu), and/or vanadium. Additional materials for the filler or additives include $ZnSiO_4$, $PbTiO_3$, ZrO_2, eucryptite.

In embodiments, a frit material as a dry composition contains glass particles from about 20 to 90 about wt %, and the remaining includes fillers and/or additives. In some embodiments, the frit paste contains about 10-30 wt % organic materials and about 70-90% inorganic materials. In some embodiments, the frit paste contains about 20 wt % organic materials and about 80 wt % inorganic materials. In some embodiments, the organic materials may include about 0-30 wt % binder(s) and about 70-100 wt % solvent(s). In some embodiments, about 10 wt % is binder(s) and about 90 wt % is solvent(s) among the organic materials. In some embodiments, the inorganic materials may include about 0-10 wt % additives, about 20-40 wt % fillers and about 50-80 wt % glass powder. In some embodiments, about 0-5 wt % is additive(s), about 25-30 wt % is filler(s) and about 65-75 wt % is the glass powder among the inorganic materials.

In forming a frit seal, a liquid material is added to the dry frit material to form a frit paste. Any organic or inorganic solvent with or without additives can be used as the liquid material. In embodiments, the solvent includes one or more organic compounds. For example, applicable organic compounds are ethyl cellulose, nitro cellulose, hydroxyl propyl cellulose, butyl carbitol acetate, terpineol, butyl cellusolve, acrylate compounds. Then, the thus formed frit paste can be applied to form a shape of the seal **1071** on the top and/or bottom plate **1061**, **1002**.

In one exemplary embodiment, a shape of the seal **1071** is initially formed from the frit paste and interposed between the top plate **1061** and the bottom plate **1002**. The seal **1071** can in certain embodiments be pre-cured or pre-sintered to one of the top plate and bottom plate **1061**, **1002**. Following assembly of the top plate **1061** and the bottom plate **1002** with the seal **1071** interposed therebetween, portions of the seal **1071** are selectively heated such that the frit material forming the seal **1071** at least partially melts. The seal **1071** is then allowed to resolidify to form a secure joint between the top plate **1061** and the bottom plate **1002** to thereby inhibit exposure of the enclosed OLED pixel array **1021** to oxygen or water.

In embodiments, the selective heating of the frit seal is carried out by irradiation of light, such as a laser or directed infrared lamp. As previously noted, the frit material forming the seal **1071** can be combined with one or more additives or filler such as species selected for improved absorption of the irradiated light to facilitate heating and melting of the frit material to form the seal **1071**.

In some embodiments, OLED devices **1011** are mass produced. In an embodiment illustrated in FIG. **7**E, a plurality of separate OLED arrays **1021** is formed on a common bottom substrate **1101**. In the illustrated embodiment, each OLED array **1021** is surrounded by a shaped frit to form the seal **1071**. In embodiments, common top substrate (not shown) is placed over the common bottom substrate **1101** and the structures formed thereon such that the OLED arrays **1021** and the shaped frit paste are interposed between the common bottom substrate **1101** and the common top substrate. The OLED arrays **1021** are encapsulated and sealed, such as via the previously described enclosure process for a single OLED display device. The resulting product includes a plurality of OLED devices kept together by the common bottom and top substrates. Then, the resulting product is cut into a plurality of pieces, each of which constitutes an OLED device **1011** of FIG. **7**D. In certain embodiments, the individual OLED devices **1011** then further undergo additional packaging operations to further improve the sealing formed by the frit seal **1071** and the top and bottom substrates **1061**, **1002**.

FIG. **1** is a cross-sectional view of an organic light emitting display according to an embodiment. Referring to FIG. **1**, the organic light emitting display includes a semiconductor layer **110**, a gate insulating layer **120**, a gate electrode **130***a*, a scan driver **130***b*, an interlayer insulating layer **140**, and source and drain electrodes **150**, which are disposed on a substrate **100** having a pixel region I and a non-pixel region II. In addition, the organic light emitting display further includes a common power supply line **150***b*, and a second electrode power supply line **150***a*, which are formed of source and drain interconnections.

A planarization layer **160** is disposed on the entire surface of the substrate **100**. The planarization layer **160** is formed of an organic material such as acryl-based resin or polyimide-based resin. The planarization layer **160** has via-holes for exposing the common power supply line **150***b*, the second electrode power supply line **150***a*, and the source and/or drain electrodes **150**. The common power supply line **150***b* is partially exposed to enhance adhesive strength when the substrate is sealed using a glass frit.

A first electrode **171** including a reflective layer **170** is disposed on the substrate **100**, and a pixel defining layer **180** is disposed on the entire surface of the substrate **100**. An organic layer **190** including at least an emission layer is disposed on the first electrode **171**, and a second electrode **200** is disposed thereon. An encapsulation substrate **210** is disposed opposite to the substrate **100**, and the substrate **100** and the encapsulation substrate **210** are sealed with a glass frit **220**, thereby forming an organic light emitting display.

However, in the foregoing embodiment, the organic light emitting display includes an organic planarization layer disposed under the glass frit for sealing the substrate so that the organic planarization layer may be damaged due to a large amount of heat generated when a laser beam is radiated to the glass frit. As a result, adhesive strength at an interface in which the glass frit is adhered to the organic planarization layer may be lowered.

FIGS. **2** to **5** are cross-sectional views of an organic light emitting display in accordance with another embodiment. Referring to FIG. **2**, a substrate **300** including a pixel region I, and a non-pixel region II is provided. The substrate **300** may be an insulating glass substrate, a plastic substrate, or a conductive substrate.

A buffer layer **310** is formed on the surface of the substrate **300**. The buffer layer **310** may be a silicon oxide layer, a silicon nitride layer, or a composite layer of silicon oxide and silicon nitride. In one aspect, the buffer layer **310** functions as a passivation layer for preventing impurities from out-diffusing from the substrate **300**.

A semiconductor layer **320** is formed on the buffer layer **310** in the pixel region I. The semiconductor layer **320** may be an amorphous silicon layer or a polysilicon layer. A gate insulating layer **330** is formed on the surface of the substrate **300** and the semiconductor layer **320**. The gate insulating layer **330** may be a silicon oxide layer, a silicon nitride layer, or a composite layer of silicon oxide and silicon nitride.

After forming the gate insulating layer **330**, a gate electrode **340***a* is formed on the gate insulating layer **330** located above a portion of the semiconductor layer **320**. The gate electrode **340***a* may be comprised of Al, Cu, and/or Cr.

An interlayer insulating layer **350** is formed on the surface of the substrate **300** and the gate electrode **340***a*. The interlayer insulating layer **350** may be a silicon oxide layer, a silicon nitride layer, or a composite layer of silicon oxide and silicon nitride.

The interlayer insulating layer **350** and the gate insulating layer **330** in the pixel region I are then etched to form contact holes **351** and **352** for exposing the semiconductor layer **320**. Source and drain electrodes **360***a* and **360***b* are formed on the interlayer insulating layer **350** in the pixel region I connecting to the semiconductor layer **320** through the contact holes **351** and **352**. The source and drain electrodes **360***a* and **360***b* may be formed of one or more materials including, for example, Mo, Cr, Al, Ti, Au, Pd and Ag.

Further, at the same time the source and drain electrodes **360***a* and **360***b* are formed, the electrically conductive line **360***d* is formed in the non-pixel region II. The electrically conductive line **360***d* may act as a common power supply line. In addition, a second electrode power supply line **360***c* may also be formed at the same time. Furthermore, at the same time the gate electrode **340***a* is formed, a scan driver line **340***b* may be formed in the non-pixel region II.

While a top gate thin film transistor configuration is described in this embodiment, a bottom gate thin film transistor having a gate electrode disposed under a semiconductor layer may also be formed. In addition, while the electrically conductive line, in this embodiment, is formed at the same time the source and drain electrodes are formed, the electrically conductive line may also be formed at the same time the gate electrode or the first electrode is formed.

Referring to FIG. **3**, an organic planarization layer **370** is formed on the surface of the substrate **300**. The organic planarization layer **370** may be formed using an organic material such as acryl-based resin, polyimide-based resin, or benzocyclobutene (BCB). The organic planarization layer **370** is then etched to form via-holes **371***a* and **371***b* for exposing at least one of the source and/or drain electrodes **360***a* and **360***b* in the pixel region I, and the second electrode power supply line **360***c* in the non-pixel region II.

In addition, the organic planarization layer **370** in the non-pixel region II, where the electrically conductive line **360***d* is located, is removed by etching to form a recess exposing the electrically conductive line **360***d*. When the substrate is sealed using a glass frit, the glass frit is irradiated with a laser beam to adhere the substrates. At this time, if the organic planarization layer still existed under the glass frit, the planarization layer may be damaged due to a large amount of heat generated from the laser. As a result, the glass frit may be delaminated from an interface with the planarization layer to decrease adhesive strength thereof. Therefore, the organic planarization layer at the edge of the substrate **300**, to which the glass frit is to be adhered, is removed to prevent the above problems.

Referring to FIG. **4**, a first electrode **380** including a reflective layer **375** is formed on the organic planarization layer **370** in the pixel region I. The first electrode **380** is disposed on a bottom surface of the via-hole **371** to be in contact with one of the exposed source and/or drain electrodes **360***a* and **360***b*, and extends onto the organic planarization layer **370**. The first electrode **380** may be formed of indium tin oxide (ITO) or indium zinc oxide (IZO).

After forming the first electrode **380**, a pixel defining layer **390** is formed on the surface of the substrate **300** including at least the first electrode **380**. The pixel defining layer is formed to a thickness sufficient to fill the via-hole **371***a*, in which the first electrode **380** is disposed. The pixel defining layer **390** may be formed of an organic layer or an inorganic layer, preferably, an organic layer. More preferably, the pixel defining layer **390** is formed of one selected from the group including BCB, acryl-based polymer, and polyimide. The material comprising the pixel defining layer **390** preferably has high flowability such that the pixel defining layer can be evenly formed on the entire surface of the substrate.

At this time, the pixel defining layer **390** is etched to form openings **395***a* for exposing the first electrode **380** in the pixel region I, and a portion of the second electrode power supply line **360***c* in the non-pixel region II. In addition, the pixel defining layer **390** in the non-pixel region II, at which the electrically conductive line **360***d* is disposed, is also removed by etching.

After forming the pixel defining layer **390** and etching the opening **395***a*, an organic layer **400** is formed on the first electrode **380** exposed through the opening **395***a*. The organic layer **400** includes at least an emission layer, and may further include at least one of a hole injection layer, a hole transport layer, an electron transport layer, and an electron injection layer.

Next, a second electrode **410** is formed on the surface of the substrate **300**. The second electrode **410** is a transmissive electrode, and may be formed of Mg, Ag, Al, Ca, or an alloy thereof, which is transparent and has a low work function. At this time, the second electrode **410** is etched to expose the electrically conductive line **360***d* in the non-pixel region II.

Referring to FIG. **5**, an encapsulation substrate **420** opposite to the substrate **300** is provided. The encapsulation substrate **420** may be formed of an etched insulating glass or a non-etched insulating glass.

In one embodiment, a glass frit **430** is applied to the edge of the encapsulation substrate **420** opposite to the substrate **300**. The glass frit **430** may be formed of material selected from the group consisting of magnesium oxide (MgO), calcium oxide (CaO), barium oxide (BaO), lithium oxide (Li_2O), sodium oxide (Na_2O), potassium oxide (K_2O), boron oxide ($B_2)_3$), vanadium oxide (V_2O_5), zinc oxide (ZnO), tellurium oxide (TeO_2), aluminum oxide (Al_2O_3), silicon dioxide (SiO_2), lead oxide (PbO), tin oxide (SnO), phosphorous oxide (P_2O_5), ruthenium oxide (Ru_2O), rubidium oxide (Rb_2O), rhodium oxide (Rh_2O), ferrite oxide (Fe_2O_3), copper oxide (CuO), titanium oxide (TiO_2), tungsten oxide (WO_3), bismuth oxide (Bi_2O_3), antimony oxide (Sb_2O_3), lead-borate glass, tin-phosphate glass, vanadate glass, and borosilicate, and a composite thereof. The glass frit **430** may be applied by a dispensing method or a screen printing method.

In the example shown in FIG. **5**, the glass frit **430** has a width larger than that of the electrically conductive line **360***d*. As the glass frit **430** has a larger width, the adhesive strength increases. Therefore, it is possible to protect an element from external moisture or oxygen. In this embodiment, the glass frit **430** is applied on the encapsulating substrate **420**. In other embodiments, the glass frit **430** may be applied on the substrate **300**, or on both the substrate **300** and the encapsulation substrate **420**.

After applying the glass frit **430**, the substrate **300** and the encapsulation substrate **420** are aligned and adhered to each other. At this time, the glass frit **430** is in contact with the electrically conductive line **360***d* and the interlayer insulating layer **350** on the substrate **300**.

After contacting the substrate **300** with the encapsulation substrate **420** via the glass frit **430**, the glass frit **430** is irradiated with a laser beam. The glass frit **430** is melted and solidified to adhere the substrate **300** and the encapsulation substrate **420**, thereby completing the organic light emitting display of an embodiment.

It should be noted, that while the example described above in reference to FIGS. **2-5** showed a single organic light emitting pixel being encapsulated, similar procedures may be used to encapsulate an array of organic light emitting pixels. Additionally, multiple arrays of organic light emitting pixels may be encapsulated between a single substrate **300** and a single encapsulation substrate **420** and be surrounded by additional glass frits **430** (e.g., in a mass production configuration). The multiple arrays may be cut apart resulting in individual arrays encapsulated by the substrate **300**, the encapsulation substrate **420** and a glass frit **430**.

As described above, if the organic planarization layer is disposed under the glass frit for sealing the substrate, the organic planarization layer may be damaged due to the large amount of heat generated when the laser beam is radiated to the glass frit. As a result, the glass frit may be delaminated from an interface with the planarization layer to decrease adhesive strength thereof. On the other hand, the organic planarization layer in the area of the glass frit may be removed to prevent adhesive strength of the glass frit from being lowered.

FIG. **6** is a cross-sectional view of an organic light emitting display in accordance with another embodiment of the present invention. Referring to FIG. **6**, the organic light emitting display is formed in a manner similar to the embodiment discussed above in reference to FIGS. **2-5**, where a glass frit **630** is applied on an encapsulating substrate **620**, and a substrate **500** is adhered to the encapsulating substrate **620**. The glass frit **630** is then irradiated with a laser beam such that the glass frit **630** is melted and solidified, thereby completing the organic light emitting display.

In this embodiment, the glass frit **630** has a width equal to or smaller than that of the electrically conductive line **560***d*. In the embodiment shown in FIG. **5**, the glass frit **430** was wider than the electrically conductive line **560***d*. In one aspect of this embodiment, the electrically conductive line **560***d* substantially eclipses or totally eclipses the glass frit **630** as viewed from the substrate **300**. While the wider glass frit **430** may provide increased adhesive strength compared to the glass frit **630**, a narrower glass frit such as the glass frit **630** may be sufficient, depending on the embodiment. In addition, since an organic planarization layer does not exist under the glass frit (either the glass frit **430** or the glass frit **630**), it is possible to prevent the adhesive strength of either of the glass frits **430** or **630** from being lowered.

In this embodiment, the glass frit **630** is applied on the encapsulating substrate **620**. In other embodiments, the glass frit **430** may be applied on the substrate **500**, or on both the substrate **500** and the encapsulating substrate **620**.

As described above, in the embodiment where the organic planarization layer is disposed under the glass frit for sealing the substrate so that the organic planarization layer may be damaged due to the large amount of heat generated when the laser beam is radiated to the glass frit. As a result, the glass frit may be delaminated from an interface with the planarization layer to decrease adhesive strength thereof. However, in other embodiments, the organic planarization layer under the glass frit is removed to prevent adhesive strength of the glass frit from being lowered. Therefore, it is possible to prevent intrusion of external moisture or oxygen to improve reliability of an element.

While the foregoing embodiments of the present invention exemplarily describe the electrically conductive line positioned at both sides of the substrate and disposed under the glass frit, the electrically conductive line may be disposed on and under the substrate and under the glass frit.

As can be seen from the foregoing, an organic light emitting display and a method of fabricating the same in accordance with the present invention can prevent adhesive strength of a glass frit from being lowered when a substrate is sealed using the glass frit, thereby improving reliability.

Although the present invention has been described with reference to certain exemplary embodiments thereof, it will be understood by those skilled in the art that a variety of modifications and variations may be made to the present invention without departing from the spirit or scope of the present invention defined in the appended claims, and their equivalents.

What is claimed is:

1. An organic light emitting device comprising:

a first substrate comprising a pixel region and a non-pixel region;

an array of organic light emitting pixels formed over the pixel region of the first substrate;

a second substrate placed over the first substrate, the array being interposed between the first and second substrates;

an electrically conductive line formed over the non-pixel region of the first substrate; and

a frit seal interposed between the first and second substrates and surrounding the array such that the array is encapsulated by the first substrate, the second substrate and the frit seal, wherein the electrically conductive line comprises a portion overlapping the frit seal in a segment of the device such that the portion of the electrically conductive line substantially eclipses the frit seal when viewed from the first substrate, wherein the frit seal contacts the electrically conductive line and wherein there is substantially no material between the frit seal and the electrically conductive line.

2. The device of claim **1**, wherein the portion of the electrically conductive line substantially totally eclipses the frit seal when viewed from the first substrate.

3. The device of claim **1**, wherein the device further comprises at least one layer located between the electrically conductive line and the first substrate, the at least one layer comprising an organic material.

4. The device of claim **1**, wherein the electrically conductive line further comprises a portion that does not overlap the frit seal.

5. The device of claim **1**, wherein the electrically conductive line extends along a first edge of the first substrate, and wherein the frit seal extends along a peripheral edge of the first edge.

6. The device of claim **1**, wherein the electrically conductive line is made of metal.

7. The device of claim **1**, wherein in another segment of the device, the frit seal further comprises a non-eclipsed portion that is not eclipsed by the electrically conductive line when viewed from the first substrate.

8. The device of claim **1**, wherein the frit seal has a width taken in a cross-sectional plane, and the electrically conductive line has a width taken in the cross-sectional plane, and wherein the width of the frit seal is substantially smaller than the width of the electrically conductive line.

9. The device of claim **1**, wherein the electrically conductive line comprises a power supply line electrically connected to the array.

10. The device of claim **1**, wherein the electrically conductive line comprises a portion overlapping the frit seal in substantially throughout the device such that the portion of the electrically conductive line substantially eclipses the frit seal when viewed from the first substrate.

11. The device of claim **1**, further comprising a planarization layer formed over at least part of the non-pixel region of the first substrate, wherein the frit seal does not contact the planarization layer.

12. The device of claim **1**, further comprising an organic or inorganic planarization layer formed over at least part of the non-pixel region of the first substrate, wherein the organic planarization layer comprises a recess exposing the electrically conductive line.

13. The device of claim **1**, further comprising a plurality of thin film transistors interposed between the first substrate and the array, wherein the electrically conductive line is made of a material used in the plurality of thin film transistors.

14. The device of claim **1**, wherein the frit seal comprises one or more materials selected from the group consisting of magnesium oxide (MgO), calcium oxide (CaO), barium oxide (BaO), lithium oxide (Li_2O), sodium oxide (Na_2O), potassium oxide (K_2O), boron oxide (B_2O_3), vanadium oxide (V_2O_5), zinc oxide (ZnO), tellurium oxide (TeO_2), aluminum oxide (Al_2O_3), silicon dioxide (SiO_2), lead oxide (PbO), tin oxide (SnO), phosphorous oxide (P_2O_5), ruthenium oxide (Ru_2O), rubidium oxide (Rb_2O), rhodium oxide (Rh_2O), ferrite oxide (Fe_2O_3), copper oxide (CuO), titanium oxide (TiO_2), tungsten oxide (WO_3), bismuth oxide (Bi_2O_3), antimony oxide (Sb_2O_3), lead-borate glass, tin-phosphate glass, vanadate glass, and borosilicate.

15. A method of making the organic light emitting device of claim **1**, the method comprising:

- providing an unfinished device comprising the first substrate;
- further providing the second substrate;
- interposing a frit between the first and second substrates such that the array is interposed between the first and second substrates, that the frit surrounds the array and that a portion of the electrically conductive line overlaps the frit in a segment of the device; and
- melting and resolidifying at least part of the frit so as to form the fit seal that interconnects the unfinished device and the second substrate, wherein the frit seal connects to the electrically conductive line with or without a material therebetween, and wherein the frit seal connects to the second substrate with or without a material therebetween.

16. The method of claim **15**, wherein interposing comprises contacting the frit with the portion of the electrically conductive line and the second substrate.

17. The method of claim **15**, wherein the unfinished device further comprises a planarization layer generally formed over the electrically conductive line with an opening exposing part of the conductive line, and wherein interposing the frit comprises contacting the frit with the electrically conductive line through the opening.

18. The method of claim **17**, wherein providing the unfinished device comprises:

- providing the planarization layer over the electrically conductive line; and
- selectively etching the planarization layer to form the opening.

19. The method of claim **15**, wherein the melting comprises irradiating a laser beam or infrared ray to at least part of the frit.

20. The method of claim **15**, wherein interposing the frit comprises:

- forming the frit over at least one of the first and second substrates; and
- arranging the first and second substrate so as to interpose the frit therebetween.

21. The method of claim **20**, wherein forming the frit comprises screen-printing or dispensing a material of the frit over at least one of the first and second substrates.

22. The method of claim **15**, wherein the unfinished device further comprises one or more additional arrays of organic light emitting pixels and one or more additional electrically conductive lines formed over the first substrate;

- wherein the method further comprises forming one or more additional frits between the first and second substrates such that each additional fit surrounds one of the additional arrays and contacts a portion of one of the additional electrically conductive lines.

23. The method of claim **22**, wherein the one of the additional electrically conductive lines substantially eclipses the additional frit.

24. The method of claim **22**, further comprising cutting the resulting product of claim **22** into two or more pieces, wherein one of the pieces comprises the frit and the array interposed between the first and second substrate.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 8,164,257 B2
APPLICATION NO. : 11/540103
DATED : April 24, 2012
INVENTOR(S) : Choi et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

At column 12, line 40, please delete “$(B_2)_3)$,” and insert --(B_2O_3),--, therefor.

At column 15, line 40, please delete “fit” and insert --frit--, therefor.

At column 16, line 34, please delete “fit” and insert --frit--, therefor.

Signed and Sealed this
Twelfth Day of March, 2013

Teresa Stanek Rea
Acting Director of the United States Patent and Trademark Office

专利名称(译)	有机发光显示器及其制造方法		
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[标]申请(专利权)人(译)	崔东SOO 朴镇宇		
申请(专利权)人(译)	崔东SOO 朴镇宇		
当前申请(专利权)人(译)	三星移动显示器有限公司.		
[标]发明人	CHOI DONG SOO PARK JIN WOO		
发明人	CHOI, DONG SOO PARK, JIN WOO		
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优先权	1020060027321 2006-03-27 KR 1020060007962 2006-01-25 KR		
其他公开文献	US20070170859A1		
外部链接	Espacenet USPTO		

摘要(译)

公开了一种有机发光显示器及其制造方法，其能够防止用于密封基板的玻璃料的粘合强度的劣化。根据本发明一个实施方案的有机发光器包括：第一基板，包括像素区域和非像素区域;有机发光像素阵列，形成在第一基板的像素区域上;以及第二基板，在第一衬底上方，阵列插入在第一和第二衬底之间。本实施例的有机发光装置还包括形成在第一基板的非像素区域上方的导电线，以及插入在第一基板和第二基板之间并围绕阵列的玻璃料密封，使得阵列被第一基板封装。基板，第二基板和玻璃料密封件，其中导电线包括在器件的一段中与玻璃料密封件重叠的部分，使得当从第一基板观察时，导电线的该部分基本上遮盖玻璃料密封件。