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(54) Organic light-emitting display device with frit seal and reinforcing structure

Organische lichtemittierende Anzeigevorrichtung mit Frittedichtung und Verstärkungsstruktur

Dispositif d'affichage électroluminescent organique avec soudure au verre fritté et structure renforcée

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(73) Proprietor: **Samsung Display Co., Ltd.**
Gyeonggi-do (KR)

(72) Inventors:
- **Choi, Dong-Soo, Samsung SDI Co., Ltd. Yongsin-si Gyeonggi-do (KR)**
- **Lim, Dae Ho, Samsung SDI Co., Ltd. Yongsin-si Gyeonggi-do (KR)**
- **Park, Jin-Woo, Samsung SDI Co., Ltd. Yongsin-si Gyeonggi-do (KR)**
- **Lee, Jong Woo, Samsung SDI Co., Ltd. Yongsin-si Gyeonggi-do (KR)**
- **Lee, Ung Soo, Samsung SDI Co., Ltd. Yongsin-si Gyeonggi-do (KR)**
- **Sin, Sang Wook, Samsung SDI Co., Ltd. Yongsin-si Gyeonggi-do (KR)**
- **Lee, Jae Sun, Samsung SDI Co., Ltd. Yongsin-si Gyeonggi-do (KR)**

(74) Representative: **Mounteney, Simon James**
Marks & Clerk LLP
90 Long Acre
London
WC2E 9RA (GB)

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Description

BACKGROUND

1. Field of the Invention

[0001] The present invention relates to organic light-emitting display devices and, more particularly, to packaging such devices.

2. Discussion of Related Art

[0002] Organic light-emitting display devices have found favour as next-generation displays since they offer excellent visibility, and they may be also manufactured to have a light weight and thin shape and be driven at a low voltage. U.S. Patent No. 6,998,776 B2 discloses an organic light-emitting display that includes a first substrate plate, a second substrate plate and a frit connecting the plates.

[0003] US2003/0155861, US20040069017, US2003/0122476 and JP2004103337 disclose encapsulated OLED displays

SUMMARY OF CERTAIN INVENTIVE ASPECTS

[0004] The invention provides an organic light-emitting display device in accordance with claim 1.

[0005] In the foregoing device, the portion of the structure may contact the frit seal. Alternatively, the structure does not contact the frit seal. The structure comprises another portion that is not interposed between the first and second substrates. The structure comprises a cured polymeric resin. The structure comprises at least one selected from the group consisting of cyanoacrylate, acrylate, epoxy, acrylate, urethane acrylate and cured polymers of two or more of the foregoing. The structure substantially surrounds the frit seal. The structure is configured to improve sealing of the enclosed space.

[0006] Still in the forgoing device, the frit seal may be connected to the first substrate via a material formed between the frit seal and the first substrate. The structure may contact the first substrate. The structure may be connected to the first substrate via another material between the structure and the first substrate. The first substrate may comprise a first edge and the second substrate may comprise a second edge extending generally along the first edges, and wherein the frit seal may extend along the first and second edge while apart from the first and second edges, wherein the structure may contact the first and second substrates, and extends along the first and second edges. The structure may contact first and second edges. The first substrate comprises a first edge and the frit seal may be apart from the first edge from about 0.3 to about 0.7 mm. The first substrate may comprise a front surface of the device, the front surface facing away from the second substrate, and wherein the structure may provide a side surface of the device. The side surface may be substantially planar. The frit seal may comprise 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.

[0007] Another aspect of the invention provides a method of making an organic light-emitting display device in accordance with claim 15.

[0008] In the foregoing method, forming the structure may comprise placing a curable liquid material in the vicinity of the frit seal while not contacting the frit seal, whereby at least part of the curable liquid material may spontaneously move toward the frit seal by capillary action, and solidifying the curable liquid material, thereby forming the structure. The first substrate may comprise a first surface and the second substrate may comprise a second surface facing the first surface, wherein the first surface, second surface and the frit seal may together define a gap outside the enclosed space, and wherein forming the structure may comprise applying a curable material into the gap. The curable material may be liquid, and the curable material spontaneously moves toward the frit seal when being applied into the gap. Forming the structure may further comprise curing the curable material by activating a curing process of the curable material. The gap may be formed throughout the periphery of the unfinished device, and wherein forming the structure may comprise applying the curable material into the gap substantially throughout the periphery of the unfinished device.

[0009] Still in the foregoing method, forming the structure may comprise placing a curable material in vicinity of the frit seal, and curing the curable material. Forming the structure may comprise providing a dispenser containing the curable material, applying the curable material onto a surface of the unfinished device using the dispenser, whereby a portion of the curable material is formed between the first and second substrates, and curing the curable material. Forming the structure may comprise providing a medium retaining the curable material, applying the curable material on a surface of the unfinished device using the medium, whereby a portion of the curable material is formed between the first and second substrates, and curing the curable material. Forming the structure may comprise providing a curable material in liquid, dipping a periphery of the unfinished device into the liquid curable material, whereby a portion of the liquid curable material is formed between the first and second substrates; and curing the curable material.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Embodiments of the invention will now be described by way of example and with reference to the accompanying drawings, in which:

FIG. 1 is a cross-sectional view showing an organic light-emitting display device;
FIG. 2 is a plan view showing an organic light-emitting display device according to the present invention;
FIG. 3a is a cross-sectional view showing the organic light-emitting display device of Fig. 2;
FIG. 3b is a view corresponding to FIG. 3a, but showing an alternative embodiment not forming part of the invention;
FIGs. 4a to 4d are cross-sectional views showing a process for preparing an organic light-emitting display device according to an embodiment of the present invention;
FIGs. 5a to 5d show a process for packaging an organic light-emitting display device according to an embodiment of the present invention;
FIG. 6 is a cross-sectional view showing an organic light-emitting display device according to another embodiment of the present invention;
FIG. 7A is a schematic exploded view of a passive matrix type organic light emitting display device in accordance with one embodiment;
FIG 7B is a schematic exploded view of an active matrix type organic light emitting display device in accordance with one embodiment;
FIG. 7C is a schematic top plan view of an organic light emitting display in accordance with one embodiment;
FIG. 7D is a cross-sectional view of the organic light emitting display of FIG. 7C, taken along the line d-d; and
FIG. 7E is a schematic perspective view illustrating mass production of organic light emitting devices in accordance with one embodiment.

DETAILED DESCRIPTION OF EMBODIMENTS

[0011] Hereinafter, various embodiments of the present invention will be described in detail. However, it would be appreciated by those skilled in the art that modifications and changes might be made in the embodiments without departing from the principles of the invention. For example, changes of materials constituting an organic light-emitting layer, absence of color-changing layers or green-barrier layers, and changes of height and width may be easily made by those skilled in the art.

[0012] 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.

[0013] OLEDs can be generally grouped into two basic types dependent on the arrangement with which the stimulating electrical current is provided. Fig. 7A schematically illustrates an exploded view of a simplified structure of a passive matrix type OLED 1000. Fig. 7B 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.

[0014] Referring to Fig. 7A, 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.

[0015] Referring to Fig. 7B, the active matrix OLED (AMOLED) includes localdriving 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. The scan lines 1018 supply scan 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.

[0016] 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.

[0017] Referring to common features of the PMOLED and AMOLED designs, the substrate 1002 provides structural support for the OLED pixels and circuits. 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 cases, the anode 1004 and cathode 1006 are inverted; i.e., the cathode is formed on the substrate 1002 and the anode is opposingly arranged.

[0018] 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 arrangement, 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.

[0019] 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.

[0020] In some structures, a single layer may serve both electron injection and transportation functions or both hole injection and transportation functions. In some cases, one or more of these layers are lacking. In some cases, one or more organic layers are doped with one or more materials that help injection and/or transportation of the carriers. In structures 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.

[0021] 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 structures, these organic materials are macromolecules including oligomers and polymers. In some structures, the organic materials for these layers are 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.

[0022] 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 case, 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.

[0023] 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 devices, the cathode 1006 is made of a material transparent or at least partially transparent with respect to visible light. In certain configurations, 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.

[0024] In many cases, an OLED pixel array 1021 comprising a plurality of organic light emitting pixels is arranged over a substrate 1002 as shown in Fig. 7C. 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 arrangements, 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 structures, 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. 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.

[0025] 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. 7D schematically illustrates a cross-section of an encapsulated OLED device 1011 having a layout of Fig. 7C and taken along the line d-d of Fig. 7C. In this structure, 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 structures, 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 arrangement, the seal 1071 extends along the periphery of the OLED pixel array 1021 or the bottom or top plate 1002, 1061.

[0026] The seal 1071 is made of a frit material as will be further discussed below. In various arrangements, 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. Typically, at least one of the top plate 1061 and the bottom plate 1002 are formed of a substantially transparent material.

[0027] 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 cases, a material that can take up oxygen and/or moisture is formed within the enclosed space 1081.

[0028] 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. 7D. The width varies among devices 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 cases, 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.

[0029] 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. 7D. The height varies among devices 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 cases, the height of the seal 1071 may vary at different positions thereof.

[0030] In the illustrated structure, the seal 1071 has a generally rectangular cross-section. In other structures, 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 cases, the shape of the seal can be designed such that the interfacial area can be increased.

[0031] The seal 1071 can be arranged immediately adjacent the OLED array 1021, and in other cases, the seal 1071 is spaced some distance from the OLED array 1021. In certain structures, 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 devices, generally parallel to respective boundaries of the OLED array 1021. In other structures, 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 structures, at least part of the seal 1071 extends between the top plate 1061 and bottom plate 1002 in a curvilinear manner.

[0032] As noted above, in certain cases, 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. 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.

[0033] 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.

[0034] Typically, 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 cases, the frit paste contains about 10-30 wt% organic materials and about 70-90% inorganic materials. In some cases, the frit paste contains about 20 wt% organic materials and about 80 wt% inorganic materials. In some cases, the organic materials may include about 0-30 wt% binder(s) and about 70-100 wt% solvent(s). In some cases, about 10 wt% is binder(s) and about 90 wt% is solvent(s) among the organic materials. In some cases, the inorganic materials may include about 0-10 wt% additives, about 20-40 wt% fillers and about 50-80 wt% glass powder. In some cases, 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.

[0035] 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. Typically, 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.

[0036] In one arrangement, 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 structures 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.

[0037] Typically, 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.

[0038] In some cases, OLED devices 1011 are mass produced. In the device illustrated in Fig. 7E, a plurality of separate OLED arrays 1021 is formed on a common bottom substrate 1101. In the illustrated structure, each OLED array 1021 is surrounded by a shaped frit to form the seal 1071. A 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. 7D. In certain cases, 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.

[0039] One problem of the organic light-emitting display device is that the device can deteriorate when moisture contacts organic materials constituting the organic light-emitting elements. FIG. 1 is a cross-sectional view showing an encapsulation structure of an organic light-emitting device that can prevent moisture from contacting organic materials. In the illustrated structure, the organic light-emitting display device includes a deposition substrate 1, an encapsulation substrate 2, a sealing material 3 and a moisture-absorbing material 4. The deposition substrate 1, which is equivalent to the bottom plate 1002, includes a pixel region including at least one organic light-emitting diode or pixel, and a non-pixel region formed outside the pixel region, and the encapsulation substrate 2, which is equivalent to the top plate 1061, is attached against a surface in which an organic light-emitting diode of the deposition substrate 1 is formed.

[0040] In order to attach the deposition substrate 1 to the encapsulation substrate 2, the sealing material 3 is applied along edges of the deposition substrate 1 and the encapsulation substrate 2, and the sealing material 3 is then cured using UV irradiation, etc. A moisture-absorbing material 4 is included in the encapsulation substrate 2 for the purpose of capturing moisture and certain gases such as hydrogen, oxygen. Even in the illustrated device, however, the sealing material 3 may not completely prevent moisture or air entering into the enclosed space. Also, there may be cracks in the sealing material 3 and in the interfacial area where the sealing material 3 contacts the substrate for various reasons.

[0041] FIG. 2 is a simple plan view showing an organic light-emitting display device according to an embodiment of the present invention; and FIGs. 3a and 3b are cross-sectional views taken along a line A-A' of FIG. 2. Referring to figures, the organic light-emitting display device includes a substrate 100, an encapsulation substrate 200, a frit 150 and a reinforcement material 160. For the sake of convenience, the deposition substrate 101 refers to a base, on which circuits and layers are formed, and the substrate 100 refers to an unfinished product including the deposition substrate 101 and circuits and layers formed thereon, including an array of organic light emitting pixels.

[0042] The substrate 100 is a plate including an organic light-emitting diode or pixel, and includes a pixel region 100a in which at least one organic light-emitting diode is formed, and a non-pixel region 100b formed outside the pixel region 100a, the organic light-emitting diode including a first electrode 119, an organic layer 121 and a second electrode 122. Hereinafter, the pixel region 100a is referred to as a region for displaying a predetermined image using the light emitted from an organic light-emitting diode, and the non-pixel region 100b is referred to as the entire region except the pixel region 100a on the substrate 100 in the description of this application.

[0043] The pixel region 100a includes a plurality of scan lines (S1 to Sm) arranged in a horizontal direction, and a plurality of data lines (D1 to Dm) arranged in a vertical direction, and a plurality of pixels are formed in the scan lines (S1 to Sm) and the data lines (D1 to Dm), the pixels receiving signals from a driver integrated circuit 300 for driving organic light-emitting diodes or pixels. Also, a driver integrated circuit (Driver IC) for driving an organic light-emitting diode, and metal wirings electrically attached to each of the scan lines (S1 to Sm) and the data lines (D1 to Dm) of the pixel region are formed in the non-pixel region 100b. In an embodiment, the driver integrated circuit includes a data driving unit 170 and scan driving units 180, 180'.

[0044] The organic light-emitting diodes or pixels are driven in an active matrix method, as shown in the drawings, and its configuration will be described in brief. A buffer layer 111 is formed on a base substrate 101, and the buffer layer 111 is formed of insulating materials such as silicon oxide (SiO_2) or silicon nitride (SiNx). The buffer layer 111 prevents the substrate 100 from being damaged by factors such as heat from the outside, etc. On at least one region of the buffer layer 111 is formed a semiconductor layer 112 including an active layer 112a and an ohmic contact layer 112b. On the semiconductor layer 112 and the buffer layer 111 is formed a gate insulating layer 113, and on one region of the gate insulating layer 113 is formed a gate electrode 114 having a size corresponding to a width of the active layer 112a.

[0045] An interlayer insulating layer 115 includes the gate electrode 114 and is formed on the gate insulating layer 113, and source and drain electrodes 116a and 116b are formed on a predetermined region of the interlayer insulating layer 115. The source and drain electrodes 116a and 116b are formed so that they can be connected to one exposed region of the ohmic contact layer 112b, and an overcoat 117 includes the source and drain electrodes 116a,116b and is formed on the interlayer insulating layer 115. A first electrode 119 is formed on one region of the overcoat 117, wherein the first electrode 119 is connected with one exposed region of either one of the source and drain electrodes 116a and 116b by means of a via hole 118.

[0046] A pixel definition layer 120 includes the first electrode 119 and is formed on the overcoat 117, the pixel definition layer 120 having an opening (not shown) to which at least one region of the first electrode 119 is exposed. An organic layer 121 is formed on the opening of the pixel definition layer 120, and a second electrode layer 122 includes the organic layer 121 and is formed on the pixel definition layer 120. A passivation layer may be further formed in an upper portion of the second electrode layer 122. In other embodiments, various modifications and changes may be made in an active matrix structure or a passive matrix structure of the organic light-emitting device, and their detailed descriptions are omitted since each of the structures can be understood from the description of the invention by those skilled in the art.

[0047] An encapsulation substrate 200 is a member for encapsulating at least one pixel region 100a of the substrate in which the organic light-emitting diode is formed, and is formed of transparent materials in the case of top emission or dual emission and formed of translucent materials in the case of bottom emission. Various materials of the encapsulation substrate 200 can be used, for example, a glass may be used, for example in the case of the top emission, although not limited thereto.

[0048] The encapsulation substrate 200 is formed in a plate shape, and encapsulates a pixel region in which the organic light-emitting diode is formed on at least the substrate 100. For example, the entire region is encapsulated except a data driving unit and a pad unit. The frit 150 is formed between the encapsulation substrate 200 and the non-pixel region 100b of the substrate 100 to seal the pixel region 100a so that the air or any fluid is prevented from passing through or being infiltrated. The frit 150 forms a line spaced apart at a constant distance from an edge of the region in which the encapsulation substrate 200 and the substrate 100 address each other. This is to define a space that accommodates a reinforcement material 160, as described later, and a spaced distance ranges from about 0.3 to about 0.7 mm. In an embodiment, the frit 150 includes a glass material, a moisture-absorbing material for absorbing a laser, a filler for reducing a thermal expansion coefficient, etc., and is applied to the encapsulation substrate 200 in a state of frit paste, melted and cured in an interface between the encapsulation substrate 200 and the substrate 100 using a laser or an infrared ray to seal the interface between the encapsulation substrate 200 and the substrate 100. In an embodiment, the line in which the frit 150 is formed has a width of about 0.5 to about 1.5 mm.

[0049] The frit is preferably not overlapped with metal wiring wherever possible because the metal wiring may otherwise be damaged due to irradiation by a laser or an infrared ray.

[0050] The reinforcement material or structure 160 is formed in an outer side of the line of the frit 150. The reinforcement material 160 prevents the organic light-emitting display device from being damaged or broken, and functions as a sealing material if the frit 150 is not attached or its adhesive force is reduced when it is deliquesced by other materials. The reinforcement material 160 can be formed spaced apart at a predetermined distance from the frit 150, or formed adjacent to the frit 150, as shown in Figures 3a and 3b. The reinforcement material 160 is formed outside of the frit 150 in a gap between the substrate 100 and the encapsulation substrate 200, and along side surfaces of the substrate 100 and the encapsulation substrate 200, as shown in FIG. 3a. In an embodiment not forming part of the present invention the reinforcement material 160 may be also formed only in a gap between the substrate 100 and the encapsulation substrate 200, as shown in FIG. 3b.

[0051] Curable materials, which are naturally cured, thermally cured or UV-cured, may be used as the reinforcement material 160 and may be in liquid form. For example, cyanoacrylate may be used as a naturally cured material; acrylate may be used as a material that is thermally cured at a temperature of about 80°C or less; and epoxy, acrylate and urethane acrylate may be used as UV-cured materials.

[0052] Hereinafter, embodiments of a method for packaging an organic light-emitting display device according to the present invention will be described in detail. FIGs. 4a to 4d are process views showing a process for preparing an organic light-emitting display device. Firstly, a frit 150 is applied in a linear shape in a point spaced apart at a predetermined distance from an edge of an encapsulation substrate 200, and the frit 150 is formed in a point corresponding to a non-pixel region 100a of the substrate 100, as described later. The height of the frit 150 ranges from about 10 to about 20μm. The frit 150 is applied to the encapsulation substrate 200 at a state of the frit paste, sintered to remove moisture or organic binders that are all included in the paste, and then cured. (See FIG. 4a)

[0053] Substrate 100 including a pixel region including an organic light-emitting diode, and a non-pixel region in which a driver integrated circuit and a metal wiring, etc. are formed is provided, and encapsulation substrate 200 is presented to it (See FIG. 4b). Next, a laser or an infrared ray is applied to the frit 150 between the substrate 100 and the encapsulation substrate 200, in order to melt the frit 150 between the substrate 100 and the encapsulation substrate 200. The laser or infrared ray has, for example, a wavelength of about 800 to about 1200 nm (and in another embodiment, about 810 nm), its power ranges from about 25 to about 45 watts. The region except the frit is masked. Layers of copper and aluminum may be used as materials of the mask. The substrate 100 and the encapsulation substrate 200 are attached to each other by curing the melted frit 150 (See FIG. 4c).

[0054] After the formation of the frit, the reinforcement material or structure 160 is formed in a gap between the substrate 100 and the encapsulation substrate 200, and (when forming a structure such as shown in FIG. 3a) alongside surfaces of the substrate and the encapsulation substrate. Gaps exist in side regions of the substrate 100 and the encapsulation substrate 200 since the frit 150 is not formed adjacent to the edges, but formed at a predetermined distance inwards from the sides of the substrates. The liquid reinforcement material 160 is applied to or injected into the edge regions or sides by using a dispenser and then cured. The gap between the substrate 100 and the encapsulation substrate 200 is identical to the height of the frit such that, when the liquid for the reinforcement material is supplied to the side regions or edges, then the liquid infiltrates the gaps due to capillary action, and then cured (See FIG. 4d). If it has been formed, any material situated on the side surface of the substrate 100 and the encapsulation substrate 200 may be optionally removed.

[0055] If the materials of the reinforcement material 160 are naturally cured, then preparation of an organic light-emitting device is completed without an additional process. If the materials of the reinforcement material 160 are UV-cured, then an additional process for masking and irradiating the reinforcement material 160 with UV rays is required. If the materials of the reinforcement material 160 are thermally cured, then an additional process for subjecting the reinforcement material to heat is required.

[0056] The aforementioned method is used when an organic light-emitting display device is prepared in a unit cell. A method in which a plurality of organic light-emitting display devices is prepared will now be described with reference to FIGs. 5a to 5e. In this embodiment, a frit paste 350 is applied onto a mother plate 400, from which a plurality of encapsulation substrates are formed, at positions spaced apart from imaginary lines which will be edges of portions which are formed into each of the encapsulation substrates. The frit paste 350 includes a glass material, a laser-absorbing material, a filler for reducing a thermal expansion coefficient, an organic binder, etc. The frit paste is sintered at a temperature of approximately 400 to 600°C after the frit paste is applied thereto, wherein the organic binder or moisture, etc. are evaporated in the sintering procedure. (See FIG. 5a)

[0057] Subsequently, the encapsulation substrate mother plate 400 in which the frit 350 is sintered is provided to a substrate mother plate 300 prepared separately (See FIG. 5b). Subsequently, the substrate mother plate 300 and the encapsulation substrate mother plate 400 are attached to each other by directing a laser or an infrared ray at the frit 350 formed between the substrate mother plate 300 and the mother plate 400 of the encapsulation substrate. The irradiated laser or infrared ray has, for example, a wavelength of about 810 to about

1200 nm. Its power ranges from about 25 to about 45 watts. A region where the laser or infrared ray may be irradiated is masked and the laser or infrared ray may be irradiated in a direction toward the encapsulation substrate, the substrate, or in both directions. The insides of the substrate and the encapsulation substrate are maintained at a lower pressure than an atmospheric pressure when the substrate and the encapsulation substrate are brought against each other (See FIG. 5c).

[0058] In the illustrated embodiment, subsequently, the substrate mother plate 300 and encapsulation substrate mother plate 400 are scribed or cut into a plurality of separate display devices, and organic light-emitting display devices may be prepared by applying a reinforcement material 360 to the side surfaces of the display devices by using a dispenser (See FIG. 5d). In one embodiment, only the encapsulation substrate is scribed and the separate encapsulation substrate is brought to a ddress to only a certain region of the substrate.

[0059] Hereinafter, another embodiment of an organic light-emitting display device according to the present invention will be described in detail. An encapsulation substrate 600 used in this embodiment does not have a usual plate shape, but a cap shape, and therefore the encapsulation substrate 600 will be described in brief on the basis of parts different to the other embodiments discussed above. If a capped encapsulation substrate 600 is used, then the amount of frits 550 to be used may be reduced and the time needed to melt the frit 550 by applying a laser or an infrared ray may be also shortened.

[0060] In the illustrated embodiment, the encapsulation substrate 600 includes an encapsulation unit 610 and a spacer unit 620. The encapsulation unit 610 is an encapsulation plate corresponding to an organic light-emitting unit in which organic light-emitting diodes of the substrate 500 is formed, and the spacer unit 620 may separate the substrate 500 and the encapsulation substrate 600 apart at a predetermined distance. In an embodiment, the frit 550 is formed on the spacer unit 620, and applied in a linear shape at a position spaced apart with a predetermined distance from an edge toward the inner side, and then cured.

[0061] The spacer unit 620 of the encapsulation substrate 600 and the substrate 500 are presented to each other, and then the encapsulation substrate 600 and the substrate 500 are attached to each other by applying a laser or an infrared ray to the frit 550 formed on the spacer unit 620. A liquid of a reinforcement material 560 is applied to gaps between the substrate 500 and the spacer unit 620 of the encapsulation substrate 600 outside the frit 550, and the liquid of the reinforcement material 560 enters into gaps due to capillary action.

[0062] The present invention has been described in detail with reference to embodiments. However, it will be appreciated that modifications and changes might be made to the embodiments without departing from the scope of the invention as defined in the appended claims.

Claims

1. An organic light-emitting display device, comprising:

   a first glass substrate (100);
   a second glass substrate (200) placed over the first glass substrate;
   an array of organic light-emitting pixels interposed between the first and second glass substrates;
   a frit seal (150) interposed between the first glass substrate and the second glass substrate while surrounding the array, wherein the frit seal, the first glass substrate and the second glass substrate in combination define an enclosed space in which the array is located; and
   a structure (160) comprising a portion interposed between the first and second glass substrates wherein the structure is located outside the frit seal defining the enclosed space,

   characterised in that the structure extends along side surfaces of the first glass substrate and of the second glass substrate and comprises at least one selected from the group consisting of cyanoacrylate, acrylate, epoxy, urethane acrylate and cured polymers of two or more of the foregoing and the structure improves structural strength of the device and the structure is configured to improve sealing of the enclosed space.

2. A device according to Claim 1, wherein the portion of the structure contacts the frit seal.

3. A device according to Claim 1, wherein the portion of the structure does not contact the frit seal.

4. A device according to any preceding Claim, wherein the structure comprises another portion that is not interposed between the first and second glass substrates.

5. A device according to any preceding Claim, wherein the structure substantially surrounds the frit seal.

6. A device according to any preceding Claim, wherein the frit seal is connected to the first glass substrate via a material formed between the frit seal and the first glass substrate.

7. A device according to any preceding Claim, wherein the structure contacts the first glass substrate.

8. A device according to any one of Claims 1 to 7, wherein the structure is connected to the first glass substrate via another material between the structure and the first glass substrate.

9. A device according to any preceding Claim, wherein the first glass substrate comprises a first edge and the second glass substrate comprises a second edge extending generally along the first edge, and wherein the frit seal extends along the first and second edges while apart from the first and second edges, wherein the structure contacts the first and second glass substrates and extends along the first and second edges.

10. A device according to Claim 9, wherein the structure contacts the first and second edges.

11. A device according to any preceding Claim, wherein the first glass substrate comprises a first edge and the frit seal is separated from the first edge by a distance of from 0.3 to 0.7 mm.

12. A device according to any preceding Claim, wherein the first glass substrate comprises a front surface of the device, the front surface facing away from the second glass substrate, and wherein the structure provides a side surface of the device.

13. A device according to Claim 12, wherein the side surface is substantially planar.

14. A device according to any preceding Claim, 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 an organic light-emitting display device according to claim 1, the method comprising:

providing an unfinished device comprising:

a first glass substrate (100);
a second glass substrate (200) placed over the first glass substrate,
an array of organic light-emitting pixels interposed between the first and second glass substrates, and
a frit seal (150) interposed between the first glass substrate and the second glass substrate while surrounding the array, wherein the frit seal, the first glass substrate and the second glass substrate in combination define an enclosed space, in which the array is located; and

forming said structure (160) outside the enclosed space such that the structure comprises a portion interposed between the first and second glass substrates.

16. A method according to Claim 15, wherein forming the structure comprises:

placing a curable liquid material in the vicinity of the frit seal while not contacting the frit seal, whereby at least part of the curable liquid material moves toward the frit seal by capillary action; and
solidifying the curable liquid material, thereby forming the structure.

17. A method according to Claim 15, wherein the first glass substrate comprises a first surface and the second glass substrate comprises a second surface facing the first surface, wherein the first surface, second surface and the frit seal together define a gap outside the enclosed space, and wherein forming the structure comprises applying a curable material into the gap.

18. A method according to Claim 17, wherein the curable material is liquid, and the curable material moves toward the frit seal when being applied into the gap.

19. A method according to Claim 17 or 18, wherein forming the structure further comprises curing the curable material by activating a curing process of the curable material.

20. A method according to Claim 17, 18 or 19, wherein the gap is formed throughout the periphery of the unfinished device, and wherein forming the structure comprises applying the curable material into the gap substantially throughout the periphery of the unfinished device.

21. A method according to Claim 15, wherein forming the structure comprises:

placing a curable material in vicinity of the frit seal; and
curing the curable material.

22. A method according to Claim 15, wherein forming the structure comprises:

providing a dispenser containing a curable material;
applying the curable material onto a surface of the unfinished device using the dispenser,

whereby a portion of the curable material is formed between the first and second glass substrates; and
curing the curable material.

23. A method according to Claim 15, wherein forming the structure comprises:

providing a medium retaining a curable material;
applying the curable material on a surface of the unfinished device using the medium, whereby a portion of the curable material is formed between the first and second glass substrates; and
curing the curable material.

24. A method according to Claim 15, wherein forming the structure comprises:

providing a curable material in liquid;
dipping a periphery of the unfinished device into the liquid curable material, whereby a portion of the liquid curable material is formed between the first and second glass substrates; and
curing the curable material.

Patentansprüche

1. Organische lichtemittierende Anzeigevorrichtung, umfassend:

ein erstes Glassubstrat (100);
ein zweites Glassubstrat (200), das über dem ersten Glassubstrat platziert ist;
ein Bildfeld von organischen lichtemittierenden Pixeln, das zwischen den ersten und zweiten Glassubstraten eingefügt ist;
eine Frittedichtung (150), die zwischen dem ersten Glassubstrat und dem zweiten Glassubstrat eingefügt ist, während sie das Bildfeld umgibt, wobei die Frittedichtung, das erste Glassubstrat und das
zweite Glassubstrat in Verbindung einen geschlossenen Raum festlegen, in dem sich das Bildfeld befindet; und
eine Struktur (160), die einen Abschnitt umfasst, der zwischen den ersten und zweiten Glassubstraten eingefügt ist, wobei die Struktur sich außerhalb der Frittedichtung befindet, die den geschlossenen Raum festlegt,

dadurch gekennzeichnet, dass sich die Struktur entlang der Seitenflächen des ersten Glassubstrats und des zweiten Glassubstrats erstreckt und mindestens eines aus der folgenden Gruppe umfasst:

Cyanoacrylat, Acrylat, Epoxy, Urethanacrylat und ausgehärtete Polymere von zwei oder mehr der vorangegangenen, und die Struktur verbessert die strukturelle Stärke des Geräts, und die Struktur ist konfiguriert, die Abdichtung des geschlossenen Raums zu verbessern.

2. Vorrichtung nach Anspruch 1, wobei der Abschnitt der Struktur die Frittedichtung berührt.

3. Vorrichtung nach Anspruch 1, wobei der Abschnitt der Struktur die Frittedichtung nicht berührt.

4. Vorrichtung nach einem der vorstehenden Ansprüche, wobei die Struktur einen anderen Abschnitt umfasst, der nicht zwischen den ersten und zweiten Glassubstraten eingefügt ist.

5. Vorrichtung nach einem der vorstehenden Ansprüche, wobei die Struktur die Frittedichtung solide umgibt.

6. Vorrichtung nach einem der vorstehenden Ansprüche, wobei die Frittedichtung mit dem ersten Glassubstrat durch ein Material, das zwischen der Frittedichtung und dem ersten Glassubstrat gebildet ist, verbunden ist.

7. Vorrichtung nach einem der vorstehenden Ansprüche, wobei die Struktur das erste Glassubstrat berührt.

8. Vorrichtung nach einem der Ansprüche 1 bis 7, wobei die Struktur mit dem ersten Glassubstrat über ein anderes Material zwischen der Struktur und dem ersten Glassubstrat verbunden ist.

9. Vorrichtung nach einem der vorstehenden Ansprüche, wobei das erste Glassubstrat eine erste Kante umfasst und das zweite Glassubstrat eine zweite Kante umfasst, die sich grundsätzlich entlang der ersten Kante erstreckt, und wobei die Frittedichtung sich entlang der ersten und zweiten Kanten erstreckt, während sie von den ersten und zweiten Kanten entfernt ist, wobei die Struktur die ersten und zweiten Glassubstrate berührt und sich entlang der ersten und zweiten Kanten erstreckt.

10. Vorrichtung nach Anspruch 9, wobei die Struktur die ersten und zweiten Kanten berührt.

11. Vorrichtung nach einem der vorstehenden Ansprüche, wobei das erste Glassubstrat eine erste Kante umfasst und die Frittedichtung durch einen Abstand von 0,3 bis 0,7 mm von der ersten Kante getrennt ist.

12. Vorrichtung nach einem der vorstehenden Ansprüche, wobei das erste Glassubstrat eine Vorderfläche der Vorrichtung umfasst, wobei die Vorderfläche von dem zweiten Glassubstrat weg zeigt, und wobei die Struktur eine Seitenfläche der Vorrichtung bereitstellt.

13. Vorrichtung nach Anspruch 12, wobei die Seitenfläche im Wesentlichen eben ist.

14. Vorrichtung nach einem der vorstehenden Ansprüche, wobei die Frittedichtung eines oder mehrere Materialien umfasst, die aus der Gruppe ausgewählt sind, die besteht aus: Magnesiumoxid (MgO), Calziumoxid (CaO), Bariumoxid (BaO), Lithiumoxid (Li_2O), Natriumoxid (Na_2O), Kaliumoxid (K_2O), Boroxid (B_2O_3), Vanadiumoxid (V_2O_5), Zinkoxid (ZnO), Telluroxid (TeO_2), Aluminiumoxid (Al_2O_3), Siliciumdioxid (SiO_2), Bleioxid (PbO), Zinnoxid (SnO), Phosphoroxid (P_2O_5), Rutheniumoxid (Ru_2O), Rubidiumoxid (Rb_2O), Rhodiumoxid (Rh_2O), Ferritoxid (Fe_2O_3), Kupferoxid (CuO), Titanoxid (TiO_2), Wolframoxid (WO_3), Bismutoxid (Bi_2O_3), Antimonoxid (Sb_2O_3), Bleiboratglas, Zinnphosphatglas, Vanadatglas und Borosilikat.

15. Verfahren zur Herstellung einer organischen lichtemittierenden Anzeigevorrichtung nach Anspruch 1, wobei das Verfahren umfasst:

Bereitstellen einer unfertigen Vorrichtung, die Folgendes umfasst:

ein erstes Glassubstrat (100);
ein zweites Glassubstrat (200), das über dem ersten Glassubstrat platziert ist,
ein Bildfeld von organischen lichtemittierenden Pixeln, das zwischen den ersten und zweiten Glassubstraten eingefügt ist, und
eine Frittedichtung (150), die zwischen dem ersten Glassubstrat und dem zweiten Glassubstrat eingefügt ist,

während sie das Bildfeld umgibt, wobei die Frittedichtung, das erste Glassubstrat und das zweite Glassubstrat in Verbindung einen geschlossenen Raum festlegen, in dem sich das Bildfeld befindet; und
das Bilden der genannten Struktur (160) außerhalb des geschlossenen Raums, sodass die Struktur einen Abschnitt umfasst, der zwischen den ersten und zweiten Glassubstraten eingefügt ist.

16. Verfahren nach Anspruch 15, wobei das Bilden der Struktur umfasst:

Platzieren eines härtbaren flüssigen Materials in der Umgebung der Frittedichtung, während die Frittedichtung nicht berührt wird, wodurch sich zumindest ein Teil des härtbaren flüssigen Materials durch Kapillarwirkung in Richtung der Frittedichtung bewegt; und
Verfestigen des härtbaren flüssigen Materials und damit Bilden der Struktur.

17. Verfahren nach Anspruch 15, wobei das erste Glassubstrat eine erste Oberfläche umfasst und das zweite Glassubstrat eine zweite Oberfläche umfasst, die der ersten Oberfläche zugewandt ist, wobei die erste Oberfläche, die zweite Oberfläche und die Frittedichtung zusammen einen Zwischenraum außerhalb des geschlossenen Raums festlegen, und wobei das Bilden der Struktur das Auftragen eines härtbaren Materials in den Zwischenraum umfasst.

18. Verfahren nach Anspruch 17, wobei das härtbare Material flüssig ist, und das härtbare Material sich in Richtung der Frittedichtung bewegt, wenn es in den Zwischenraum aufgetragen wird.

19. Verfahren nach Anspruch 17 oder 18, wobei das Bilden der Struktur ferner das Härten des härtbaren Materials durch die Aktivierung eines Härtungsverfahrens des härtbaren Materials umfasst.

20. Verfahren nach Anspruch 17, 18 oder 19, wobei der Zwischenraum durch den Rand der unfertigen Vorrichtung gebildet wird, und wobei das Bilden der Struktur das Auftragen des härtbaren Materials in den Zwischenraum im Wesentlichen durch den Rand der unfertigen Vorrichtung umfasst.

21. Verfahren nach Anspruch 15, wobei das Bilden der Struktur Folgendes umfasst:

Platzieren eines härtbaren Materials in der Umgebung der Frittedichtung; und
Härten des härtbaren Materials.

22. Verfahren nach Anspruch 15, wobei das Bilden der Struktur Folgendes umfasst:

Bereitstellen einer Abgabevorrichtung, die ein härtbares Material enthält;
Auftragen des härtbaren Materials auf eine Fläche der unfertigen Vorrichtung mittels der Abgabevorrichtung, wobei ein Anteil des härtbaren Materials zwischen den ersten und zweiten Glassubstraten gebildet wird; und
Härten des härtbaren Materials.

23. Verfahren nach Anspruch 15, wobei das Bilden der Struktur Folgendes umfasst:

Bereitstellen eines Mediums, das ein härtbares Material enthält;
Auftragen des härtbaren Materials auf eine Fläche der unfertigen Vorrichtung mittels des Me-

diums, wodurch ein Anteil des härtbaren Materials zwischen den ersten und zweiten Glassubstraten gebildet wird; und
Härten des härtbaren Materials.

24. Verfahren nach Anspruch 15, wobei das Bilden der Struktur Folgendes umfasst:

Bereitstellen eines härtbaren Materials in Flüssigkeit;
Eintauchen eines Randes der unfertigen Vorrichtung in das flüssige härtbare Material, wobei ein Anteil des flüssigen härtbaren Materials zwischen den ersten und zweiten Glassubstraten gebildet wird; und
Härten des härtbaren Materials.

Revendications

1. Dispositif d'affichage électroluminescent organique, qui comprend :

un premier substrat en verre (100) ;
un second substrat en verre (200) placé pardessus le premier substrat en verre ;
un réseau de pixels électroluminescents organiques interposés entre le premier et le second substrat en verre ;
un joint fritté (150) interposé entre le premier substrat en verre et le second substrat en verre tout en entourant le réseau, le joint fritté, le premier substrat en verre et le second substrat en verre définissant ensemble un espace fermé dans lequel se trouve le réseau ; et
une structure (160) qui comprend une partie interposée entre le premier et le second substrats, la structure étant située à l'extérieur du joint fritté qui définit l'espace fermé, **caractérisé en ce que** la structure s'étend le long des surfaces latérales du premier substrat en verre et du second substrat en verre, et comprend au moins l'un du groupe qui consiste en du cyanoacrylate, de l'acrylate, de l'époxy, de l'acrylate d'uréthane et des polymères durcis de deux ou plusieurs de ce qui précède, et la structure améliore la résistance structurelle du dispositif, et est configurée pour améliorer l'étanchéité de l'espace fermé.

2. Dispositif selon la revendication 1, dans lequel la partie de la structure est en contact avec le joint fritté.

3. Dispositif selon la revendication 1, dans lequel la partie de la structure n'est pas en contact avec le joint fritté.

4. Dispositif selon l'une quelconque des revendications, dans lequel la structure comprend une autre partie qui n'est pas interposée entre le premier et le second substrats en verre.

5. Dispositif selon l'une quelconque des revendications précédentes, dans lequel la structure entoure sensiblement le joint fritté.

6. Dispositif selon l'une quelconque des revendications précédentes, dans lequel le joint fritté est relié au premier substrat en verre par un matériau formé entre le joint fritté et le premier substrat en verre.

7. Dispositif selon l'une quelconque des revendications précédentes, dans lequel la structure touche le premier substrat en verre.

8. Dispositif selon l'une quelconque des revendications 1 à 7, dans lequel la structure est reliée au premier substrat en verre par le biais d'un autre matériau situé entre la structure et le premier substrat en verre.

9. Dispositif selon l'une quelconque des revendications précédentes, dans lequel le premier substrat en verre comprend un premier bord et le second substrat en verre comprend un second bord qui s'étend généralement le long du premier bord, et dans lequel le joint fritté s'étend le long du premier et du second bords tout en étant séparé du premier et du second bords, la structure étant en contact avec le premier et le second substrats en verre et s'étendant le long du premier et du second bords.

10. Dispositif selon la revendication 9, dans lequel la structure est en contact avec le premier et le second bords.

11. Dispositif selon l'une quelconque des revendications précédentes, dans lequel le premier substrat en verre comprend un premier bord et le joint fritté est séparé du premier bord par une distance comprise entre 0,3 et 0,7 mm.

12. Dispositif selon l'une quelconque des revendications précédentes, dans lequel le premier substrat en verre comprend une surface avant du dispositif, la surface avant étant située à l'opposé du second substrat en verre, et la structure offrant une surface latérale du dispositif.

13. Dispositif selon la revendication 12, dans lequel la surface latérale est sensiblement plane.

14. Dispositif selon l'une quelconque des revendications précédentes, dans lequel le joint fritté comprend un ou plusieurs matériau(x) choisi(s) parmi le groupe qui consiste en de l'oxyde de magnésium (MgO), de l'oxyde de calcium (CaO), de l'oxyde de baryum

(BaO), de l'oxyde de lithium (Li_2O), de l'oxyde de sodium (Na_2O), de l'oxyde de potassium (K_2O), de l'oxyde de bore (B_2O_3), de l'oxyde de vanadium (V_2O_5), de l'oxyde de zinc (ZnO), de l'oxyde de tellure (TeO_2), de l'oxyde d'aluminium (Al_2O_3), du dioxyde de silicium (SiO_2), de l'oxyde de plomb (PbO), de l'oxyde d'étain (SnO), de l'oxyde de phosphore (P_2O_5), de l'oxyde de ruthénium (Ru_2O), de l'oxyde de rubidium (Rb_2O), de l'oxyde de rhodium (Rh_2O), de l'oxyde de fer (Fe_2O_3), de l'oxyde de cuivre (CuO), de l'oxyde de titane (TiO_2), de l'oxyde de tungstène (WO_3), de l'oxyde de bismuth (Bi_2O_3), de l'oxyde d'antimoine (Sb_2O_3), du verre au borate de plomb, du verre de phosphate d'étain, du verre de vanadate, et du borosilicate.

15. Procédé de fabrication d'un dispositif d'affichage électroluminescent organique selon la revendication 1, qui comprend :

le fait de prévoir un dispositif inachevé qui comprend :

un premier substrat en verre (100) ;
un second substrat en verre (200) placé pardessus le premier substrat en verre,
un réseau de pixels électroluminescents organiques interposés entre le premier et le second substrats en verre, et
un joint fritté (150) interposé entre le premier substrat en verre et le second substrat en verre tout en entourant le réseau, le joint fritté, le premier et le second substrats en verre définissant ensemble un espace fermé dans lequel se situe le réseau ; et
la formation de ladite structure (160) à l'extérieur de l'espace fermé de sorte que la structure comprenne une partie interposée entre le premier et le second substrats en verre.

16. Procédé selon la revendication 15, dans lequel la formation de la structure comprend :

le placement d'un matériau liquide durcissable près du joint fritté, sans toucher ce dernier, moyennant quoi au moins une partie du matériau liquide durcissable se déplace vers le joint fritté par action capillaire ; et
la solidification du matériau liquide durcissable, afin de former la structure.

17. Procédé selon la revendication 15, dans lequel le premier substrat en verre comprend une première surface, et le second substrat en verre comprenant une seconde surface qui fait face à la première surface, la première surface, la seconde surface et le joint fritté définissant ensemble un espace à l'extérieur de l'espace fermé, et dans lequel la formation de la structure comprend l'application d'un matériau durcissable à l'intérieur de l'espace.

18. Procédé selon la revendication 17, dans lequel le matériau durcissable est liquide, et le matériau durcissable se déplace vers le joint fritté lorsqu'il est appliqué à l'intérieur de l'espace.

19. Procédé selon les revendications 17 ou 18, dans lequel la formation de la structure comprend en outre le durcissement du matériau durcissable en activant un processus de durcissement du matériau durcissable.

20. Procédé selon les revendications 17, 18 ou 19, dans lequel l'espace est formé à sur la périphérie du dispositif inachevé, et dans lequel la formation de la structure comprend l'application du matériau durcissable dans l'espace, sensiblement sur la périphérie du dispositif inachevé.

21. Procédé selon la revendication 15, dans lequel la formation de la structure comprend :

le placement d'un matériau durcissable près du joint fritté ; et
le durcissement du matériau durcissable.

22. Procédé selon la revendication 15, dans lequel la formation de la structure comprend :

le fait de prévoir un distributeur qui contient un matériau durcissable ;
l'application du matériau durcissable sur une surface du dispositif inachevé à l'aide du distributeur, moyennant quoi une partie du matériau durcissable est formée entre le premier et le second substrats en verre ; et
le durcissement du matériau durcissable.

23. Procédé selon la revendication 15, dans lequel la formation de la structure comprend :

le fait de prévoir un milieu qui contient un matériau durcissable ;
l'application du matériau durcissable sur une surface du dispositif inachevé à l'aide du milieu, moyennant quoi une partie du matériau durcissable est formée entre le premier et le second substrats en verre ; et
le durcissement du matériau durcissable.

24. Procédé selon la revendication 15, dans lequel la formation de la structure comprend :

le fait de prévoir un matériau durcissable sous forme liquide ;

l'immersion d'une périphérie du dispositif inachevé dans le matériau liquide durcissable, moyennant quoi une partie du matériau durcissable est formée entre le premier et le second substrats en verre ; et
le durcissement du matériau durcissable.

FIG. 1

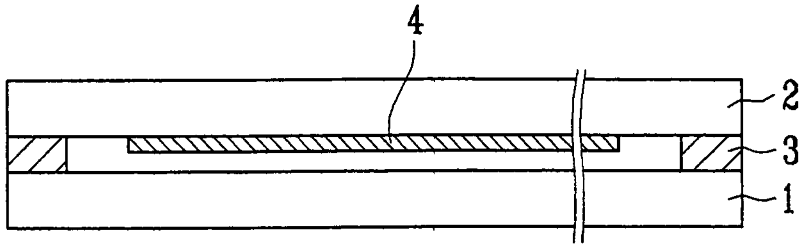

4
2
3
1

FIG. 2

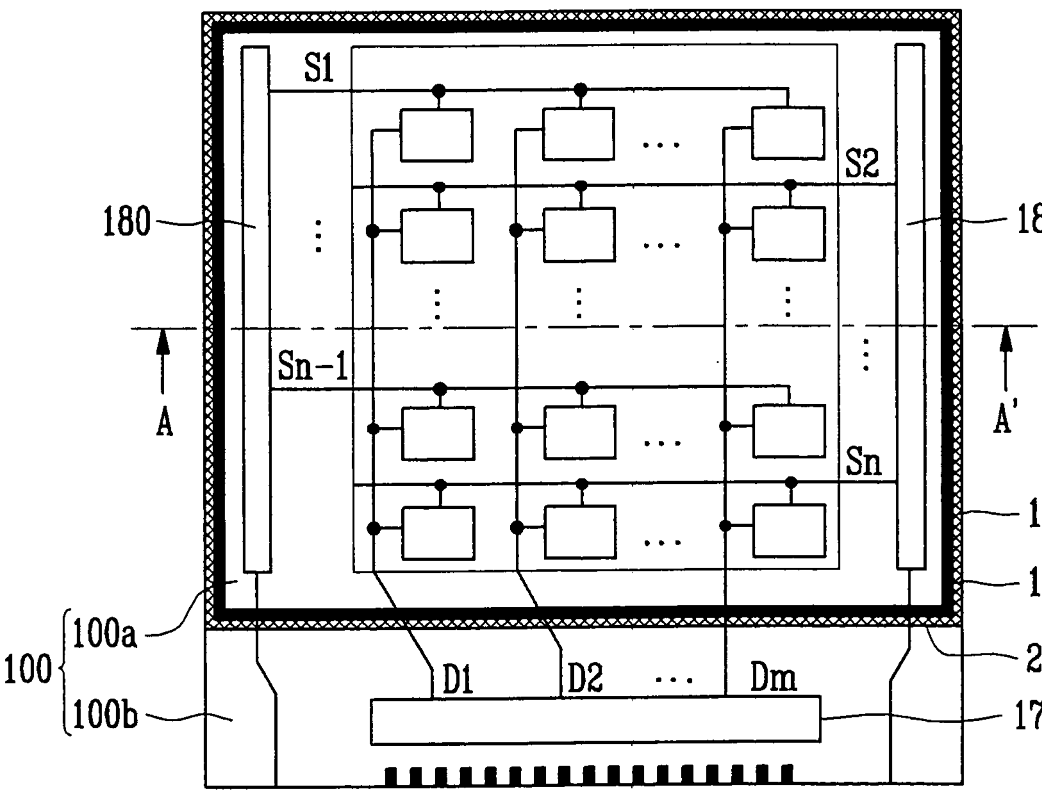
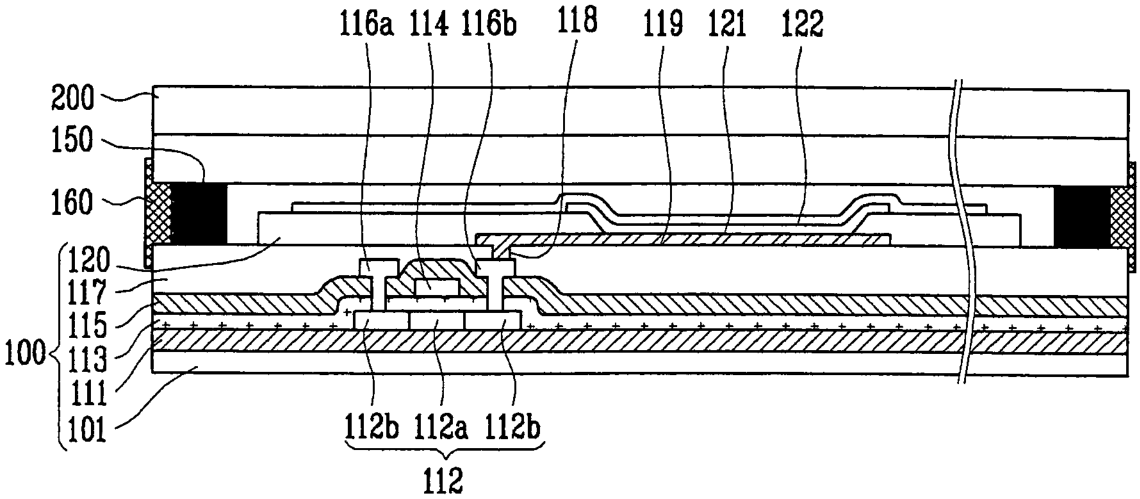

S1
S2
180
180'
Sn-1
A
A'
Sn
160
150
100a
100
100b
200
D1
D2
Dm
170

FIG. 3A


116a
114
116b
118
119
121
122
200
150
160
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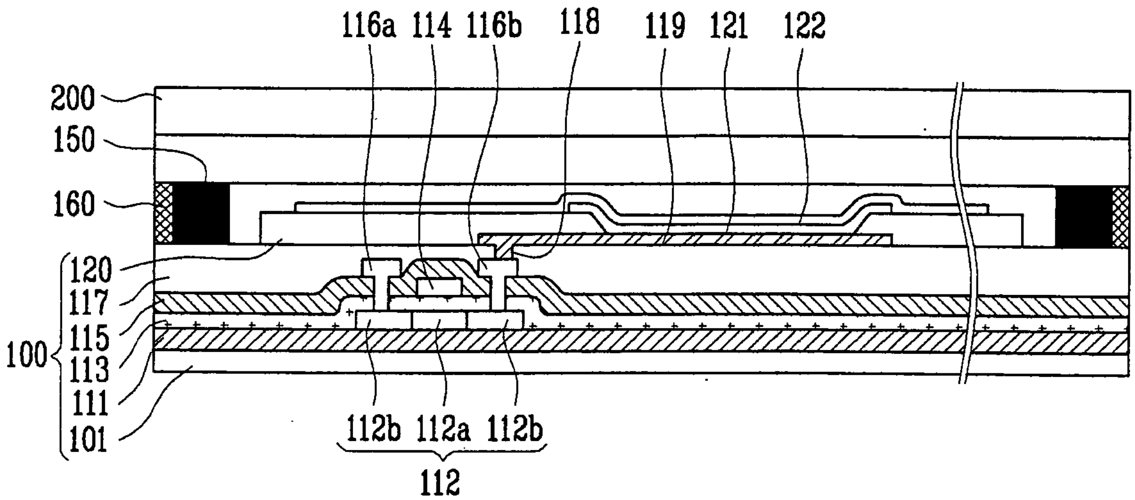
117
115
100
113
111
101
112b
112a
112b
112

FIG. 3B


116a
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116b
118
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115
100
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112b
112

FIG. 4A

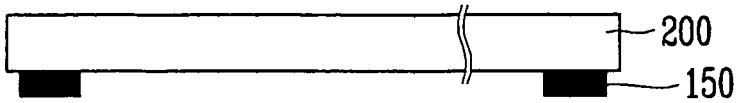


FIG. 4B

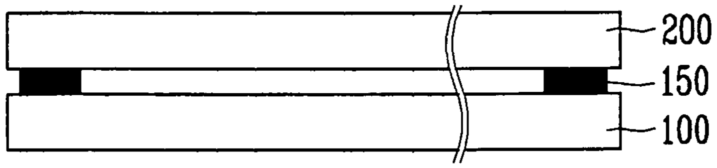


FIG. 4C

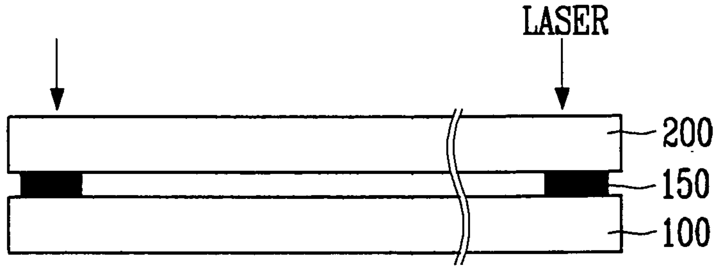


FIG. 4D

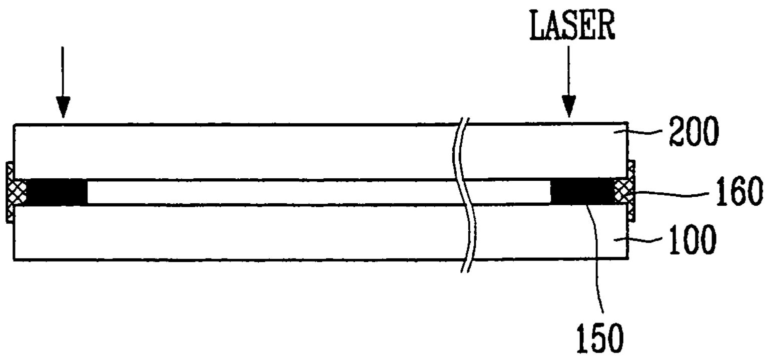


FIG. 5A

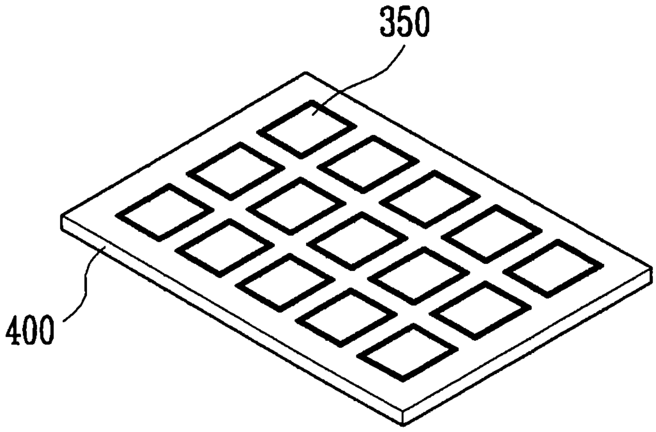


FIG. 5B

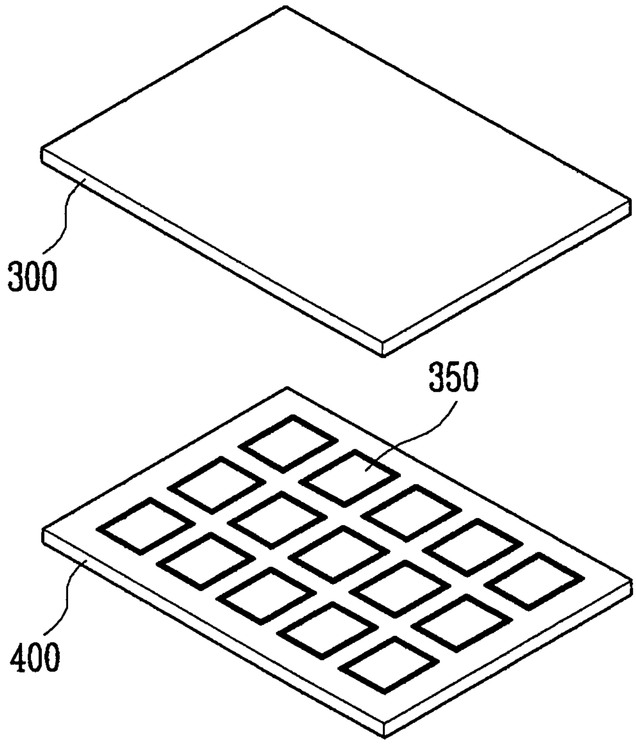


FIG. 5C

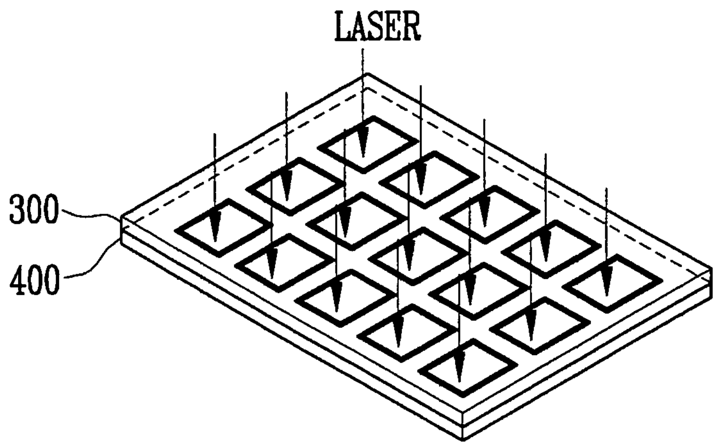


FIG. 5D

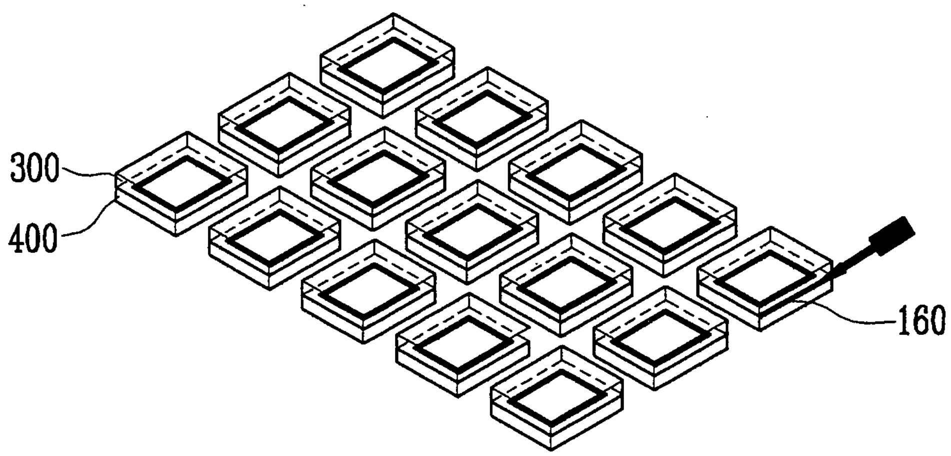


FIG. 6

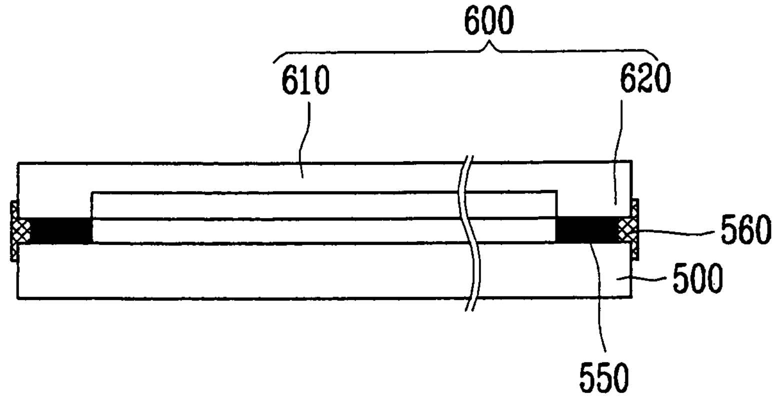


FIG. 7A

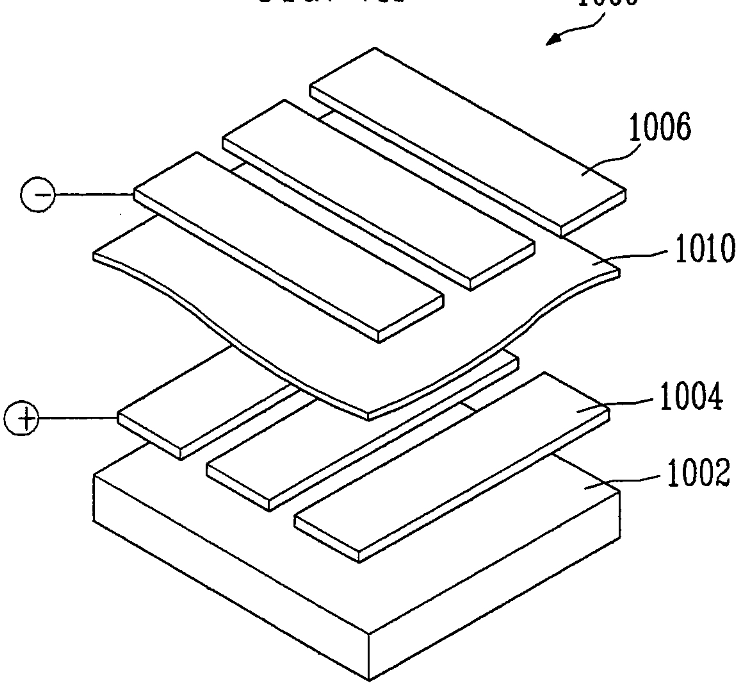


FIG. 7B

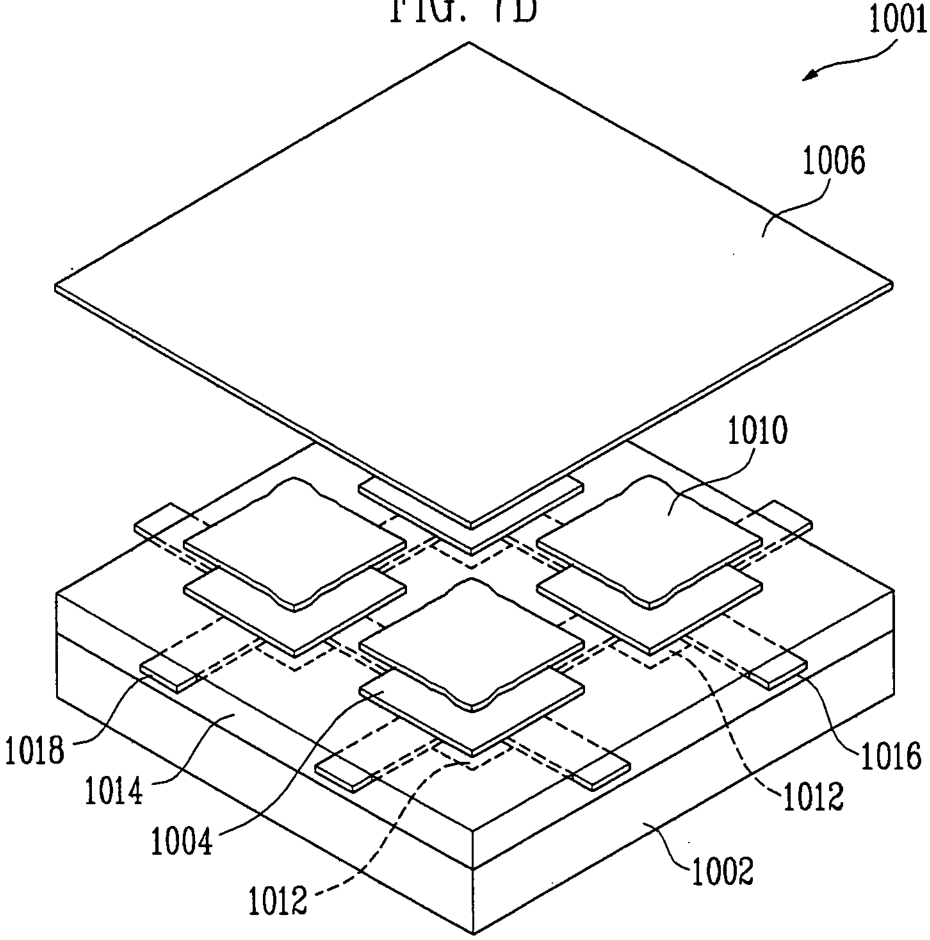


FIG. 7C

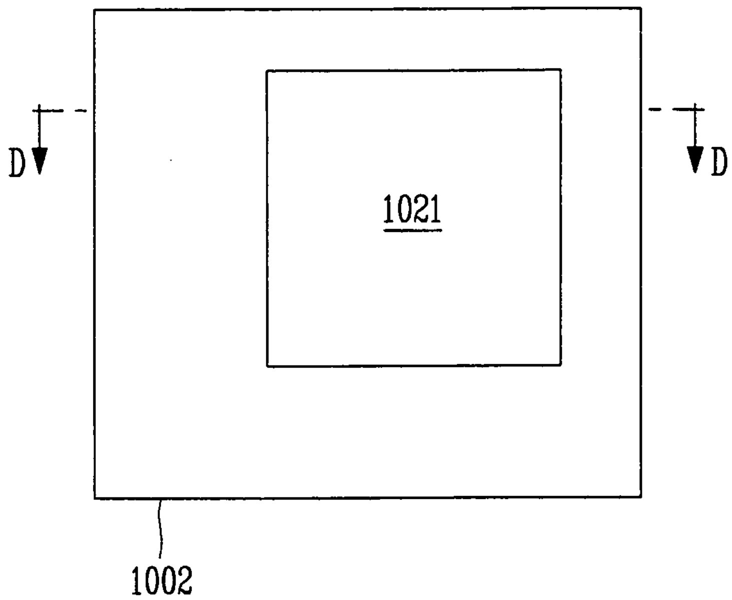


FIG. 7D

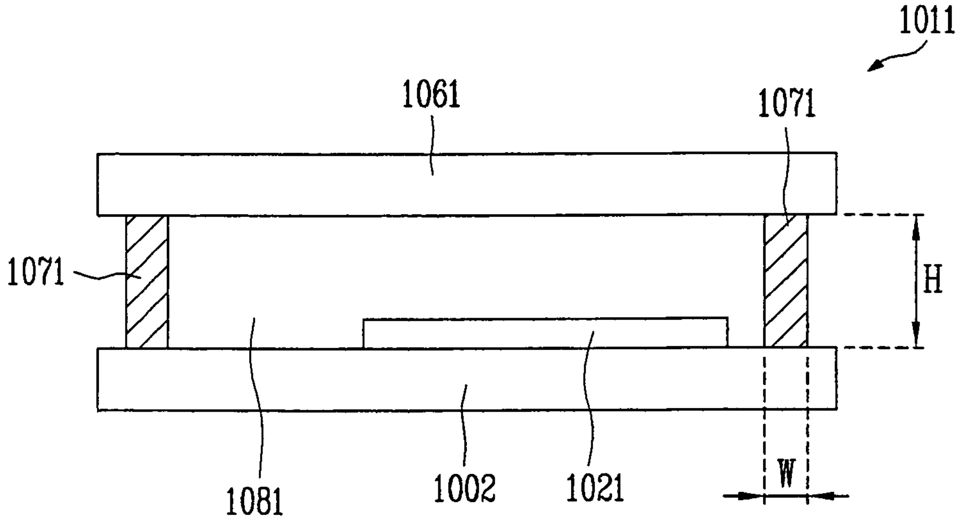
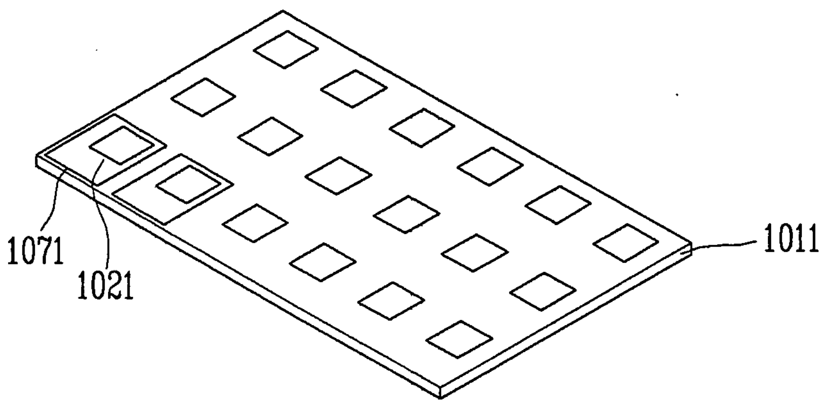


FIG. 7E



REFERENCES CITED IN THE DESCRIPTION

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专利名称(译)	具有熔接密封和加强结构的有机发光显示装置		
公开(公告)号	[EP1811587B1](EP1811587B1)	公开(公告)日	2016-12-14
申请号	EP2007250228	申请日	2007-01-19
[标]申请(专利权)人(译)	三星斯笛爱股份有限公司		
申请(专利权)人(译)	三星SDI CO. , LTD.		
当前申请(专利权)人(译)	三星DISPLAY CO. , LTD.		
[标]发明人	CHOI DONG SOO SAMSUNG SDI CO LTD PARK JIN WOO SAMSUNG SDI CO LTD LEE JONG WOO SAMSUNG SDI CO LTD		
发明人	CHOI, DONG-SOO, SAMSUNG SDI CO., LTD. LIM, DAE HO, SAMSUNG SDI CO., LTD. PARK, JIN-WOO, SAMSUNG SDI CO., LTD. LEE, JONG WOO, SAMSUNG SDI CO., LTD. LEE, UNG SOO, SAMSUNG SDI CO., LTD. SIN, SANG WOOK, SAMSUNG SDI CO., LTD. LEE, JAE SUN, SAMSUNG SDI CO., LTD.		
IPC分类号	H01L27/32 H01L51/52 C03C8/24 C03C17/40 C03C27/06 H05B33/04 H01L51/56		
CPC分类号	H05B33/04 C03C8/24 C03C17/40 C03C27/06 C03C2217/252 C03C2217/253 C03C2218/34 H01L27/3244 H01L27/3281 H01L51/5246 H01L51/56 H01L2251/566		
优先权	1020060006148 2006-01-20 KR		
其他公开文献	EP1811587A3 EP1811587A2		
外部链接	Espacenet		

摘要(译)

一种有机发光显示装置，其中基板和封装基板通过使用玻璃料彼此附接。有机发光显示装置包括第一基板和非像素区域，第一基板包括其中形成有机发光二极管的像素区域。有机发光二极管包括在第一电极和第二电极之间的有机发光层。第二基板附着到第一基板。在第一基板的非像素区域和第二基板之间提供玻璃料，以附接第一基板和第二基板。在玻璃料外部形成树脂增强材料。

FIG. 1

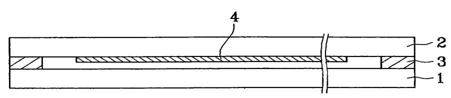

FIG. 2