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(54) ORGANIC ELECTROLUMINESCENCE DISPLAY DEVICE AND MANUFACTURING METHOD THEREOF

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(57) ABSTRACT

An organic electroluminescence display device, and a manufacturing method thereof. An organic electroluminescence display device includes a first substrate formed with an organic electroluminescence element having a first electrode, an organic thin film layer and a second electrode and a metal wiring for transmitting signals to the organic electroluminescence element, a second substrate arranged in an upper side of the first substrate, a frit provided between the first substrate and the second substrate, a reflective layer and a protective film provided between the metal wiring and the frit, wherein the first substrate and the second substrate are attached to each other by the frit.

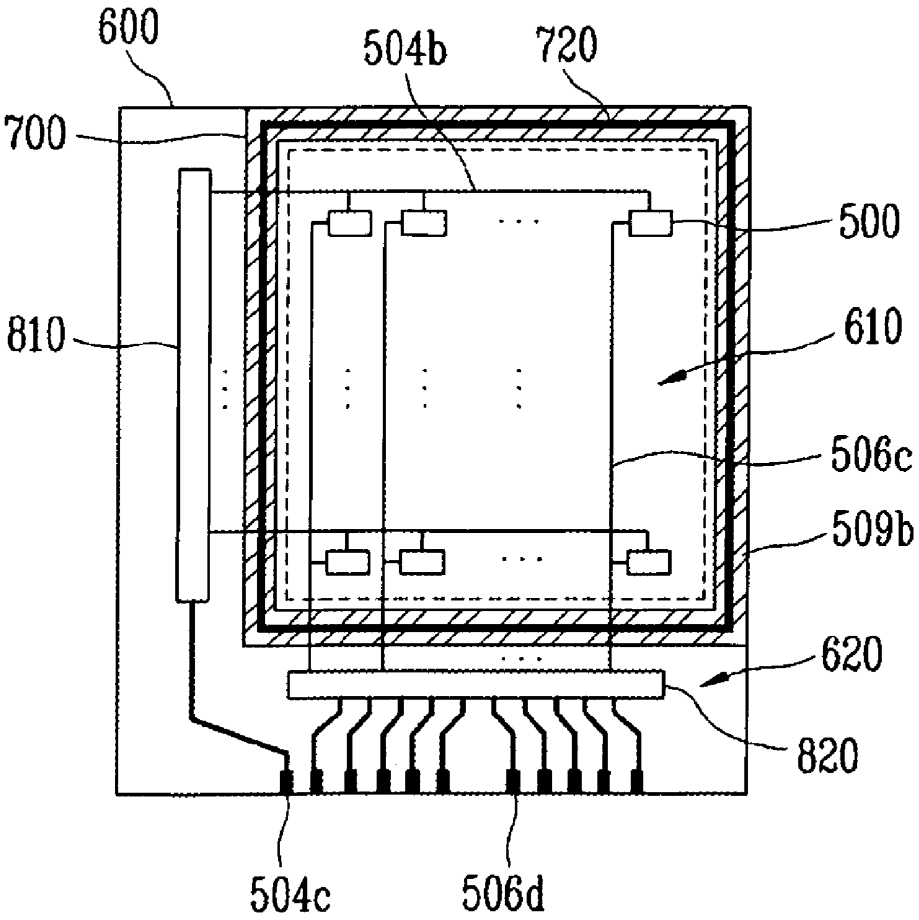


FIG. 1

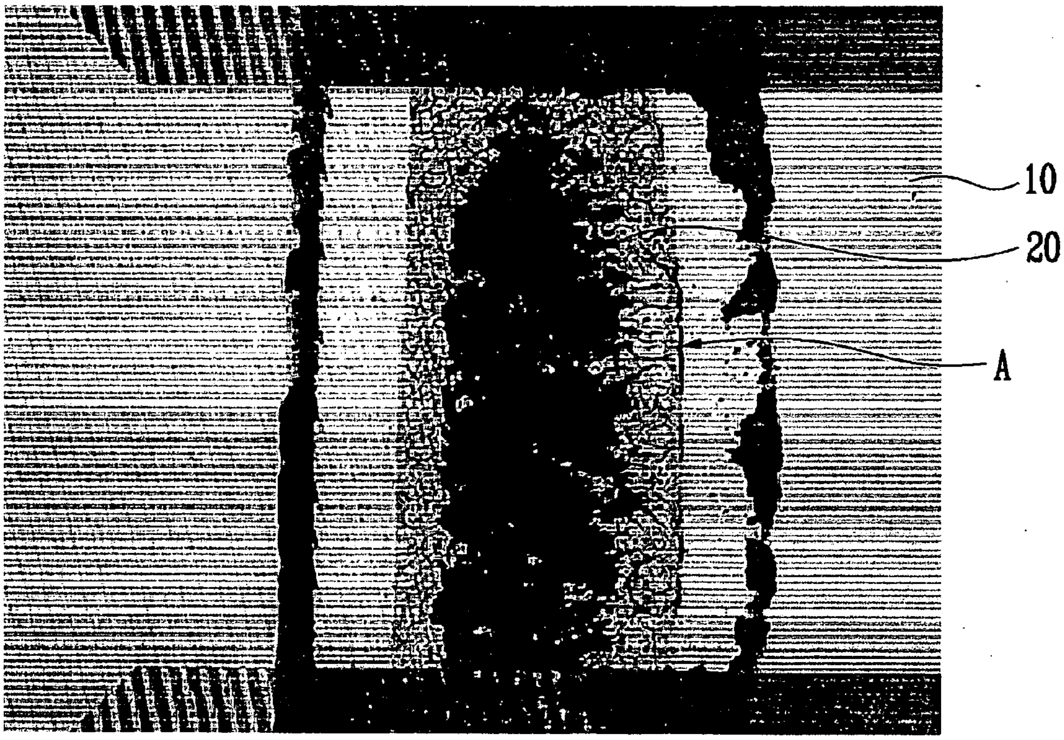


FIG. 2A

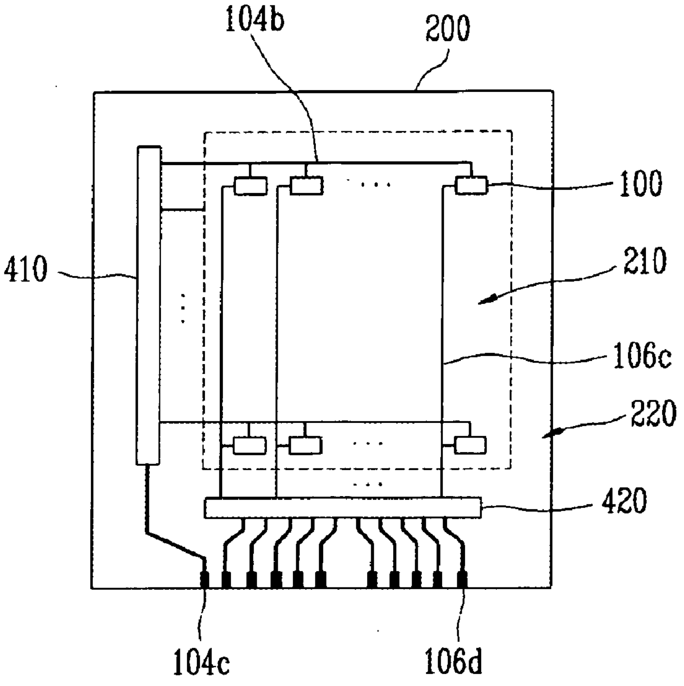

104b
200
100
410
210
106c
220
420
104c
106d

FIG. 2B

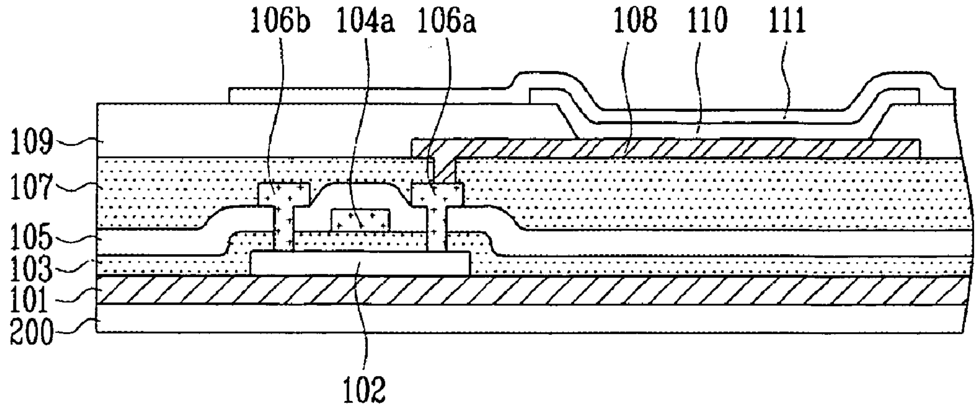

106b
104a
106a
108
110
111
109
107
105
103
101
200
102

FIG. 3A

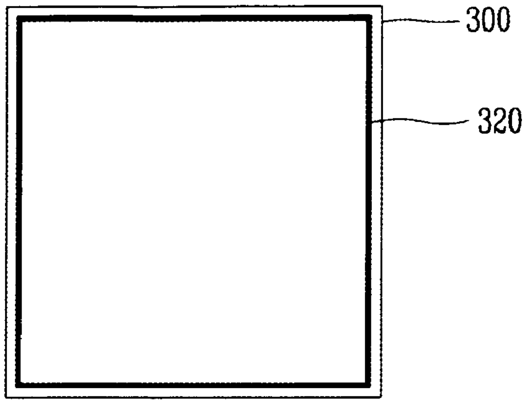


FIG. 3B

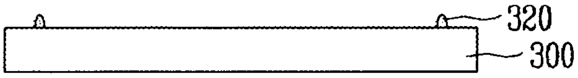


FIG. 4

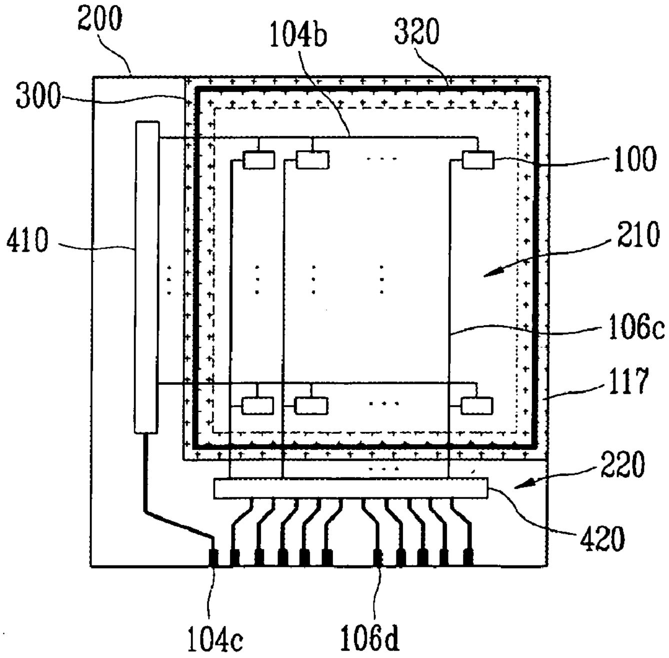


FIG. 5A

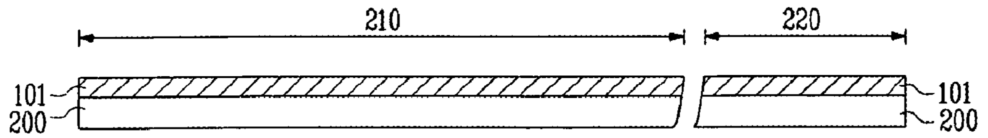


FIG. 5B

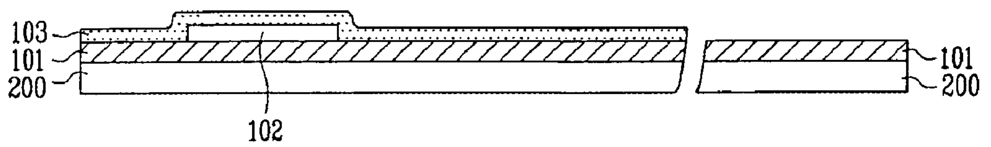


FIG. 5C

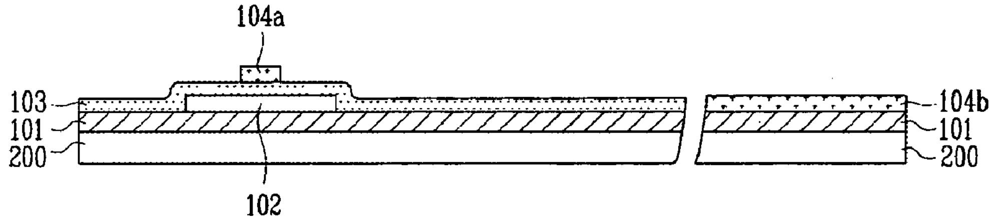


FIG. 5D

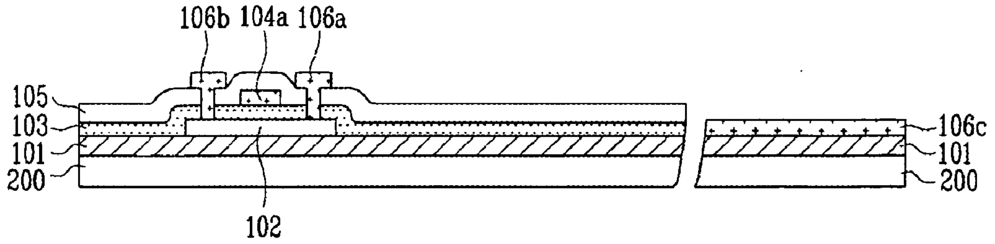


FIG. 5E

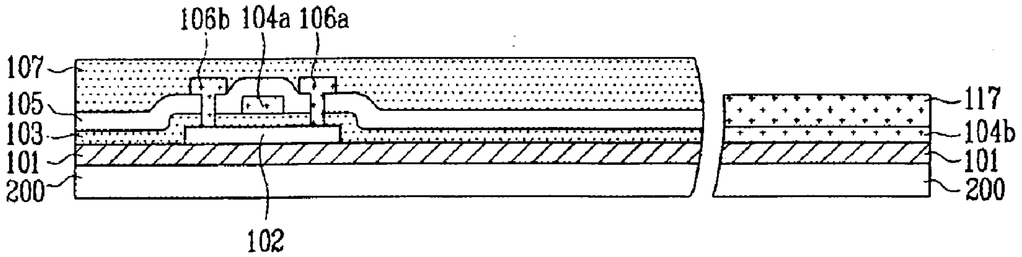


FIG. 5F

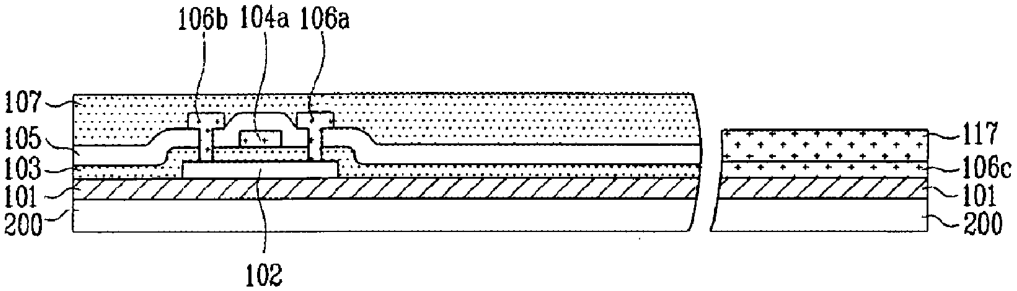


FIG. 5G

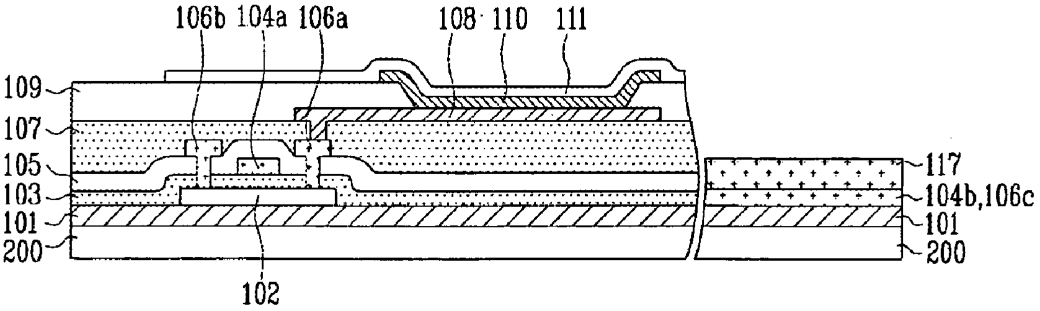


FIG. 6A

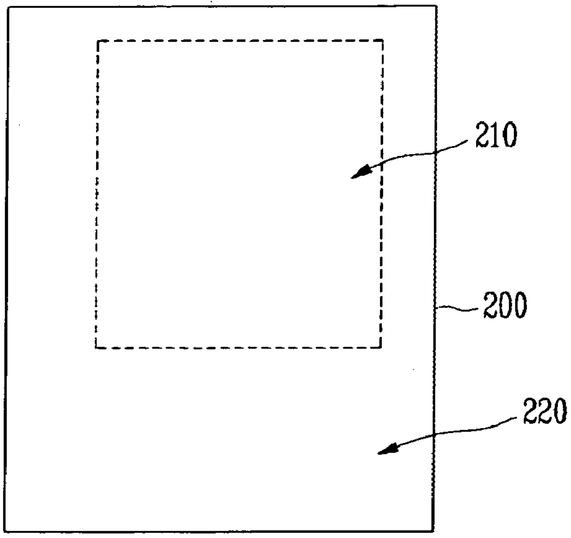


FIG. 6B

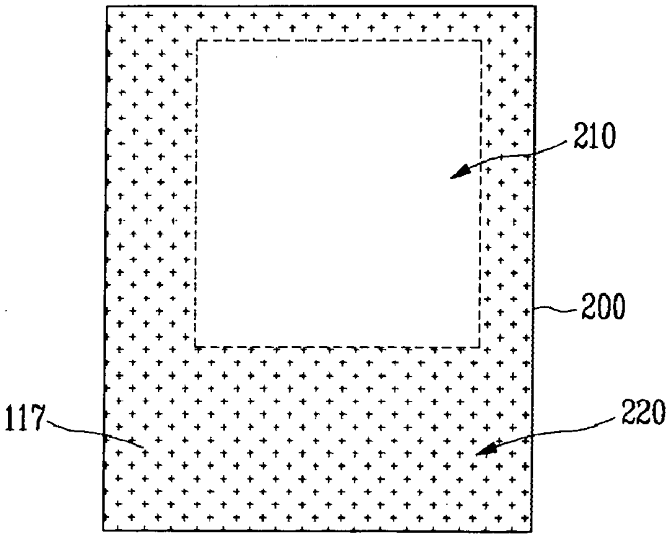


FIG. 7

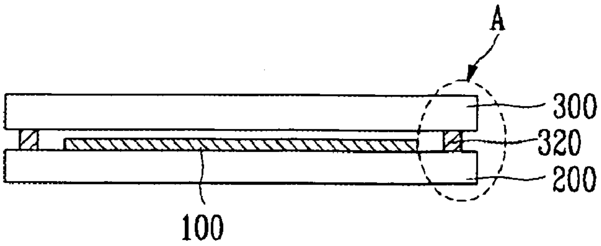


FIG. 8A

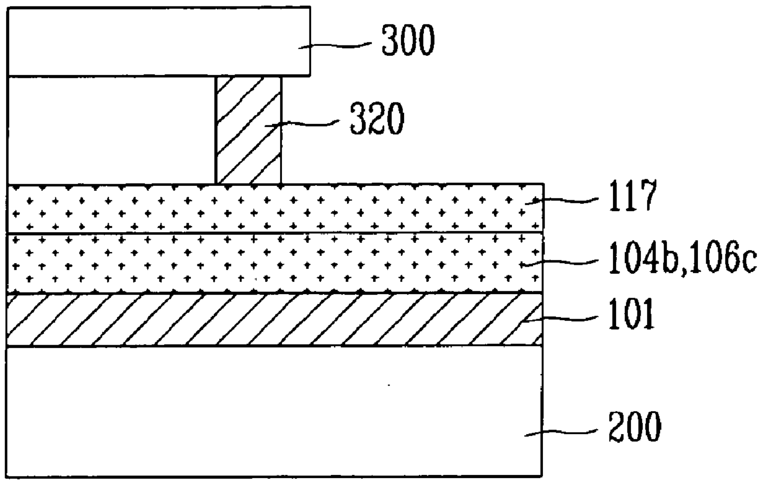


FIG. 8B

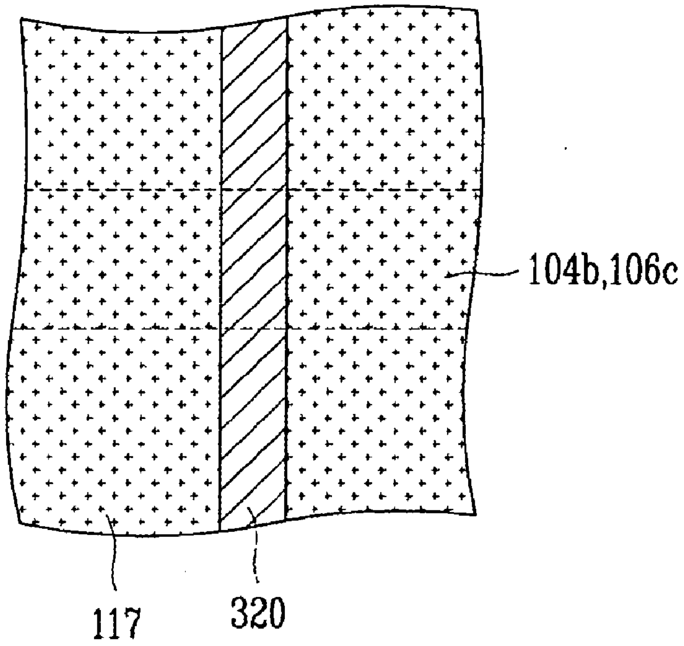


FIG. 9A

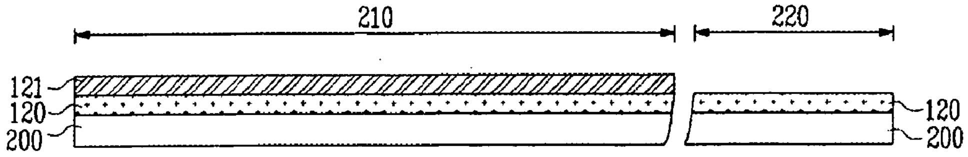


FIG. 9B

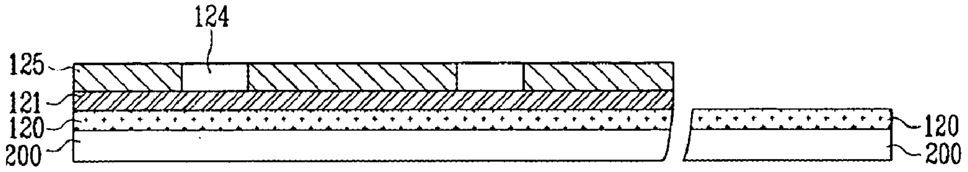


FIG. 9C

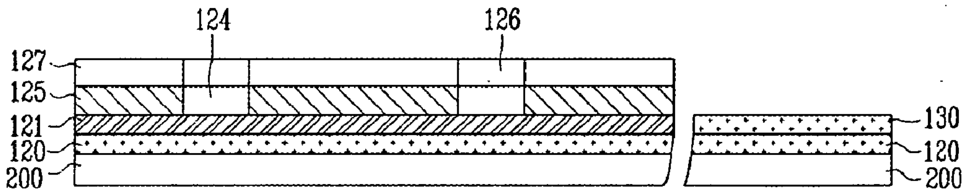


FIG. 10A

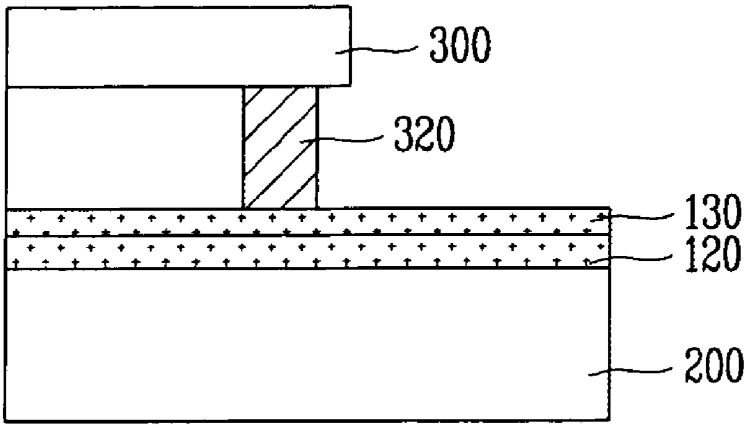


FIG. 10B

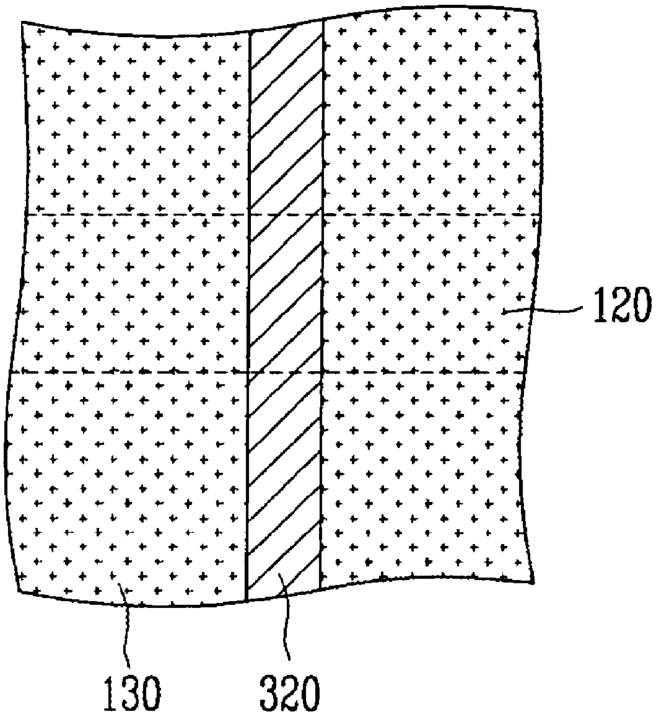


FIG. 11A

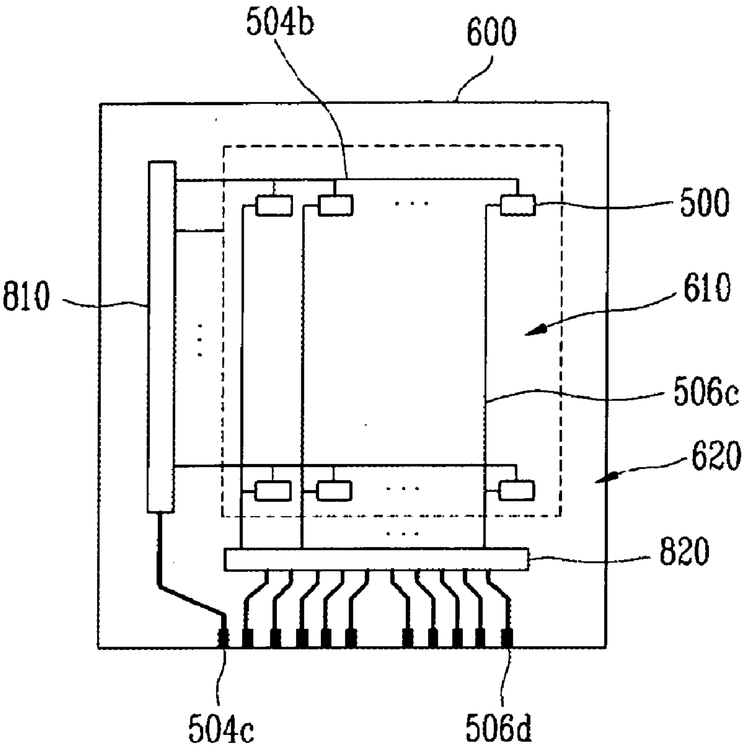


FIG. 11B

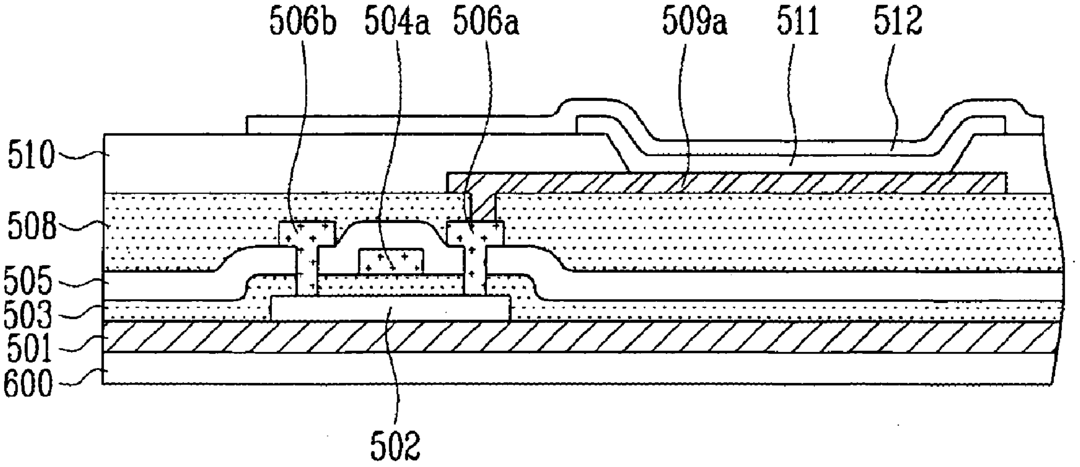


FIG. 12A

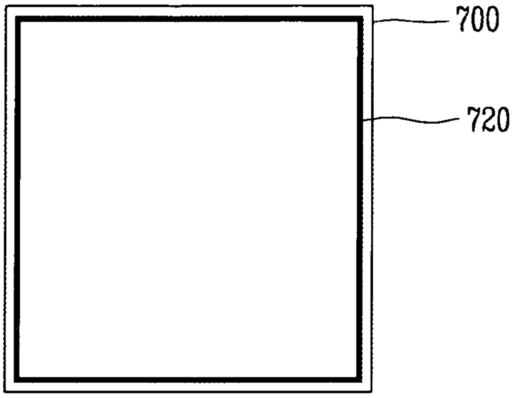


FIG. 12B

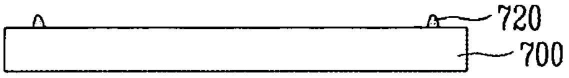


FIG. 13

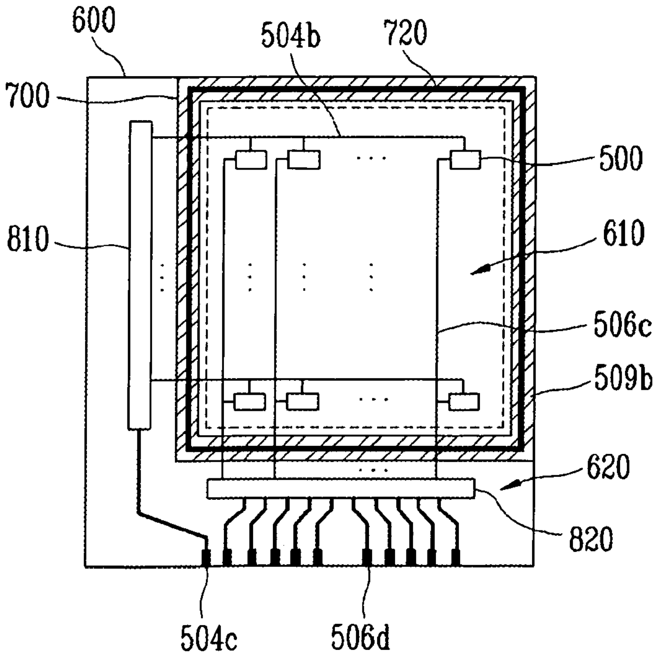


FIG. 14A

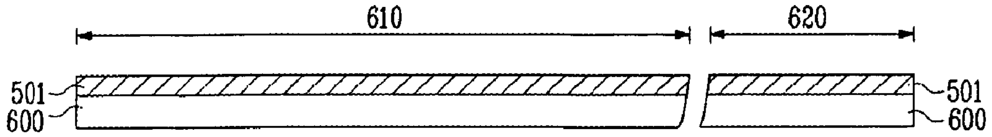


FIG. 14B

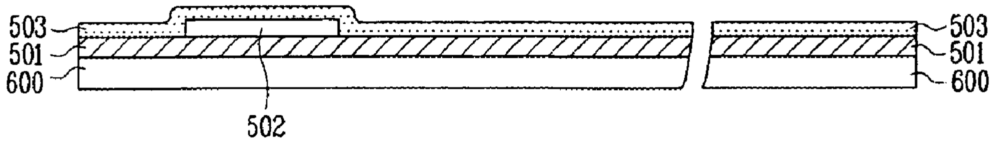


FIG. 14C

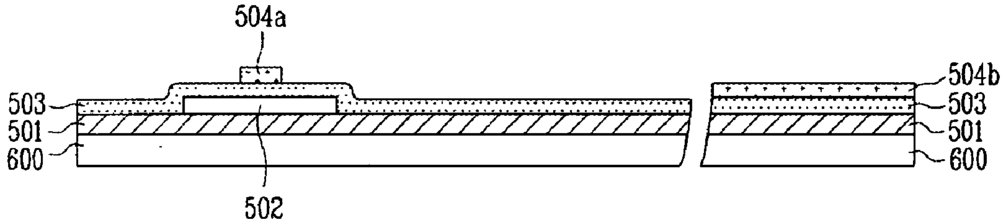


FIG. 14D

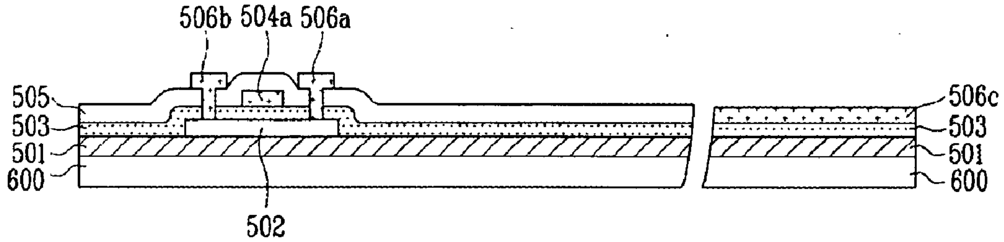


FIG. 14E

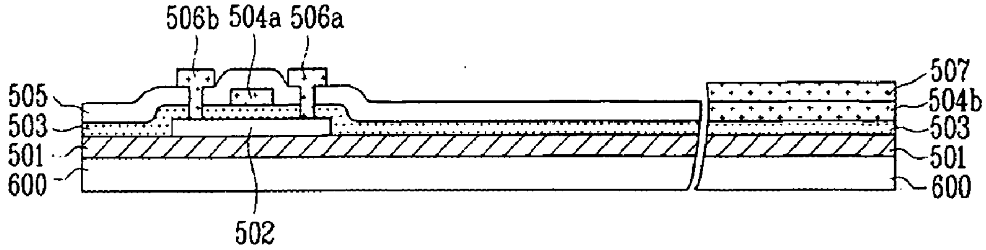


FIG. 14F

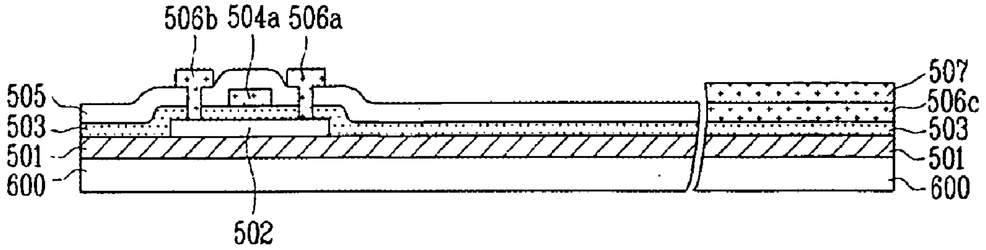


FIG. 14G

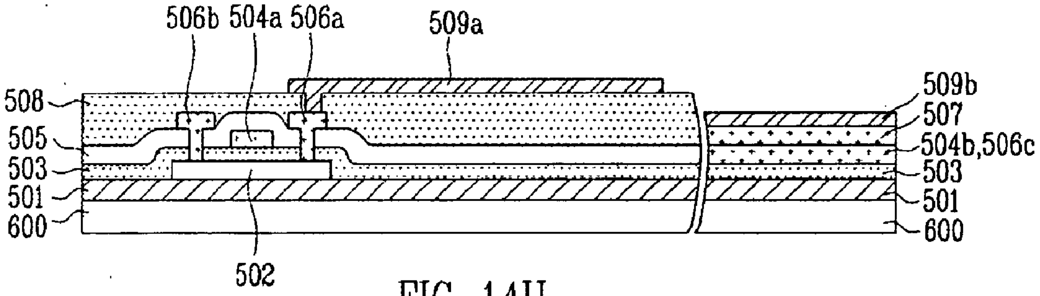


FIG. 14H

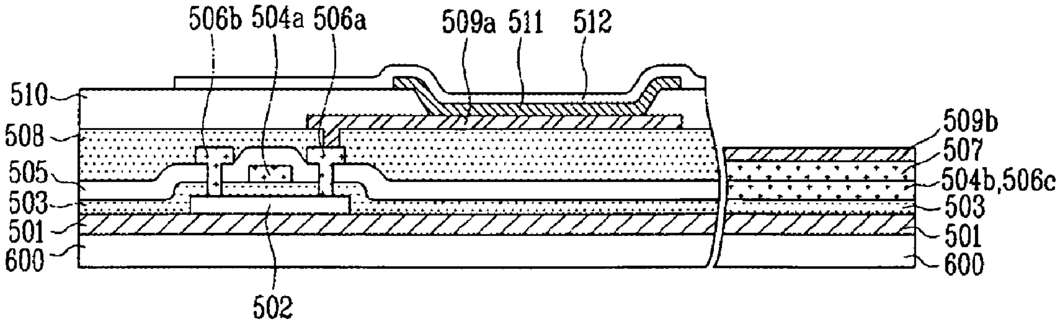


FIG. 15A

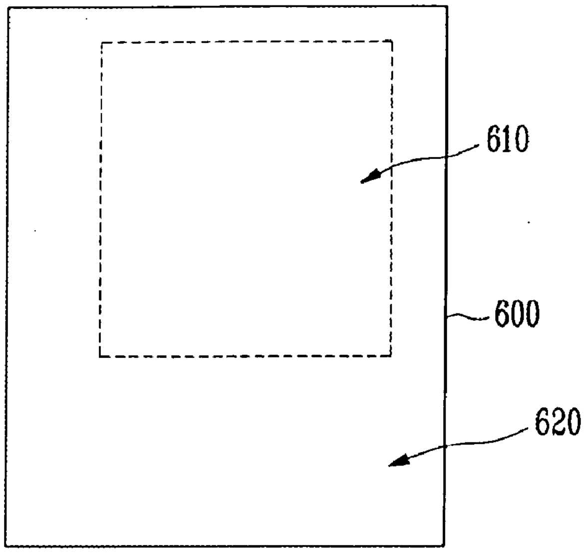


FIG. 15B

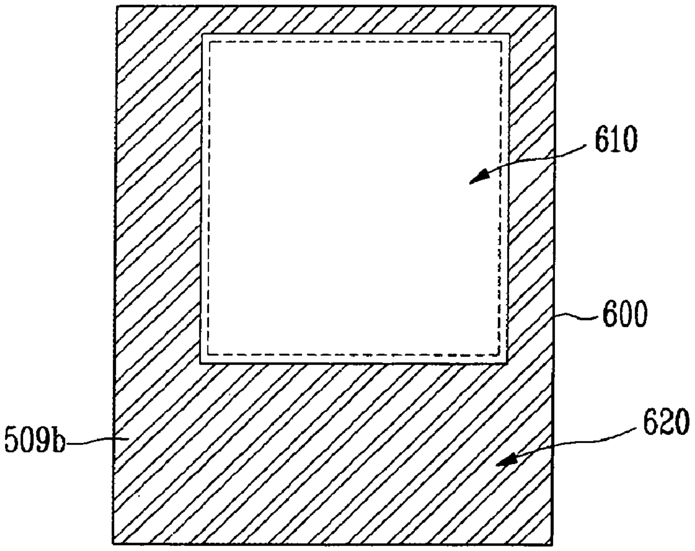


FIG. 16

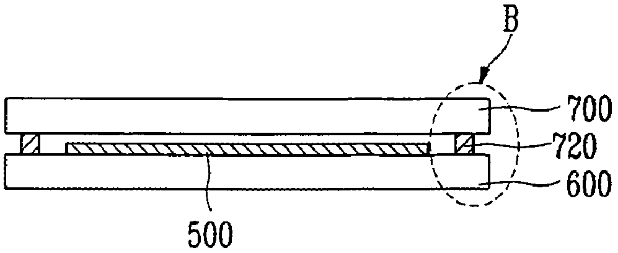


FIG. 17A

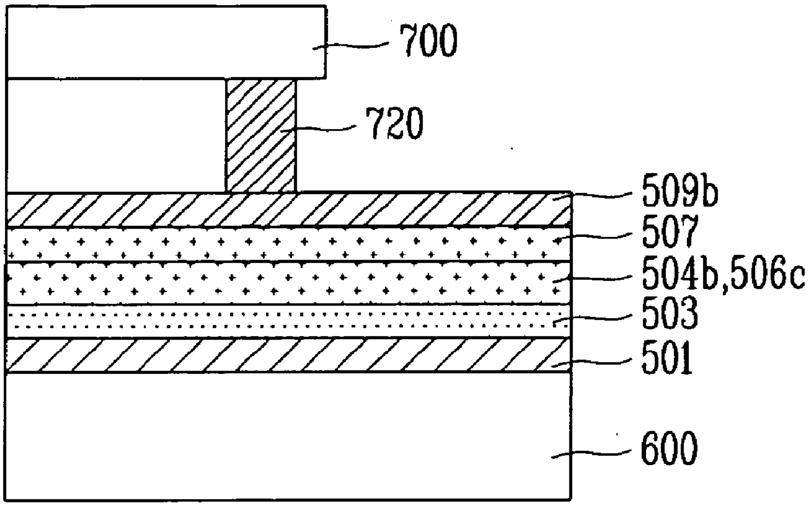
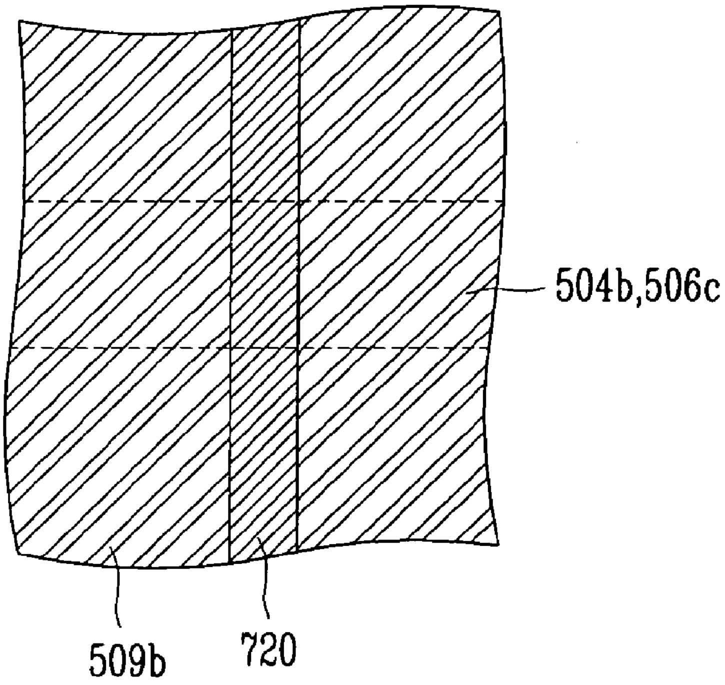


FIG. 17B



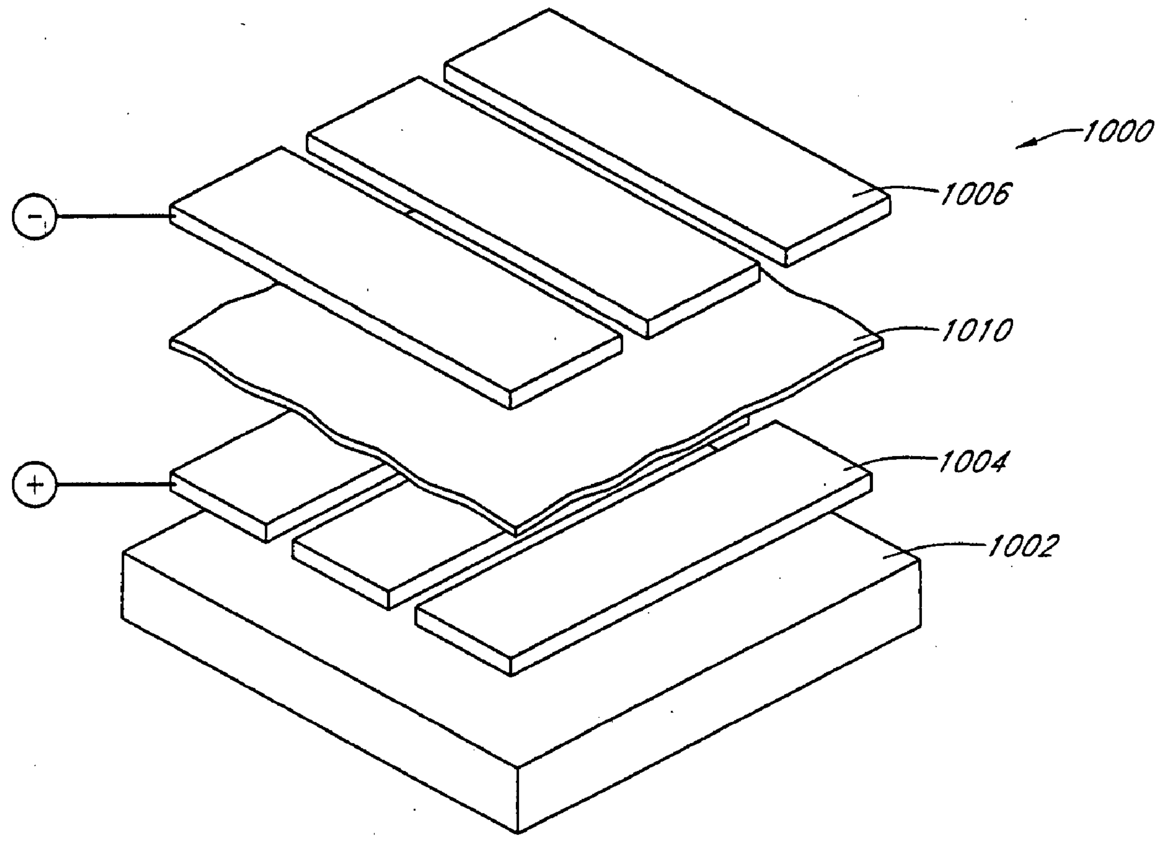


FIG. 18

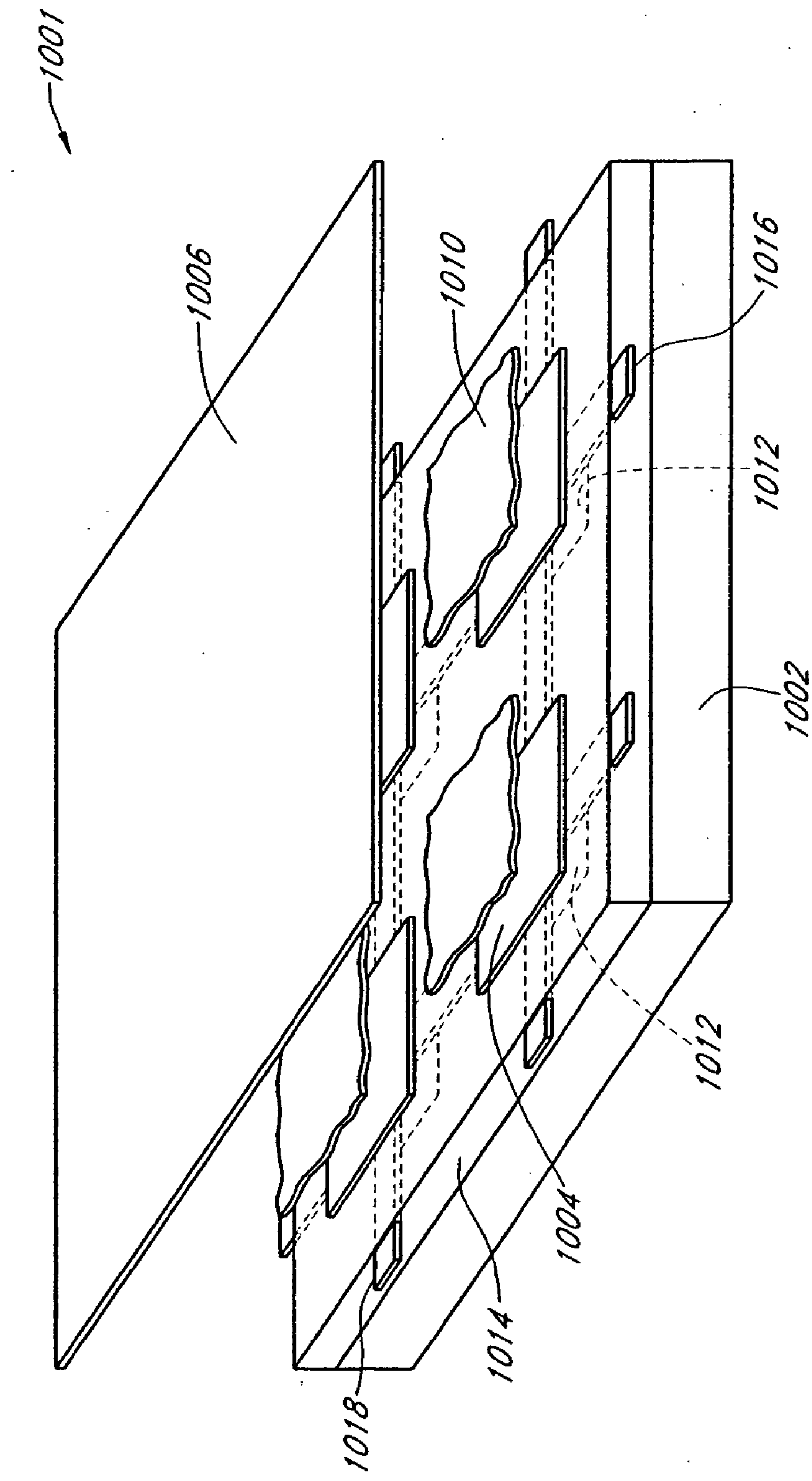


FIG. 19

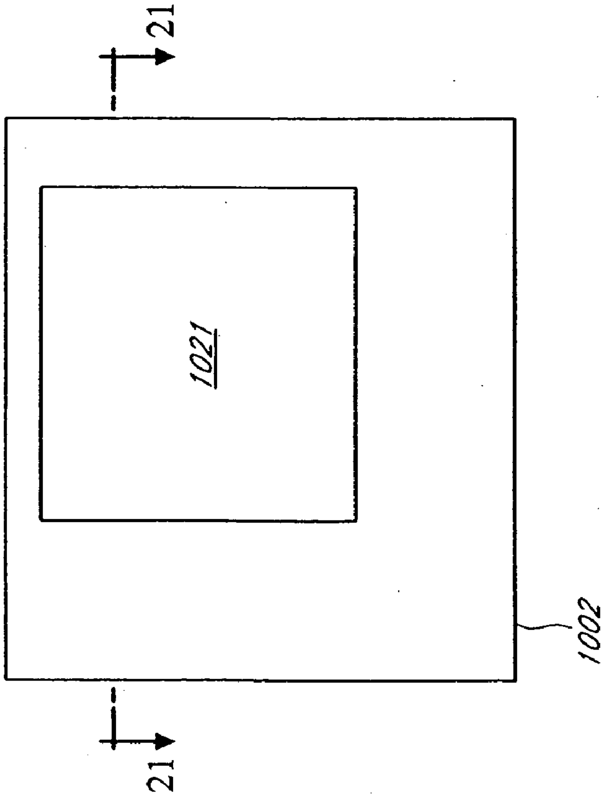


FIG. 20

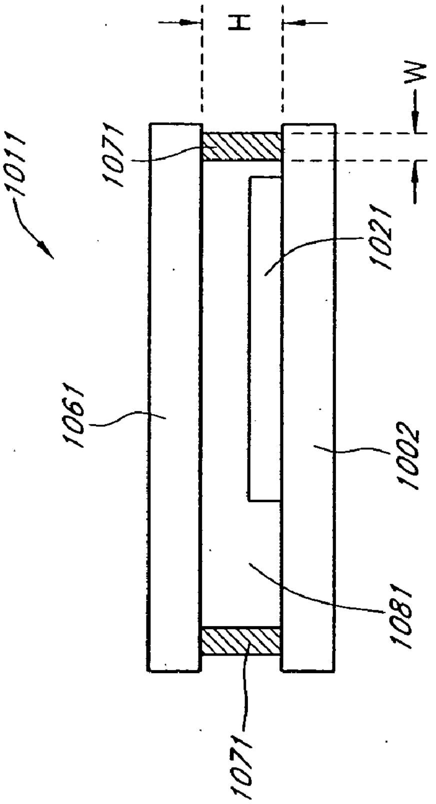


FIG. 21

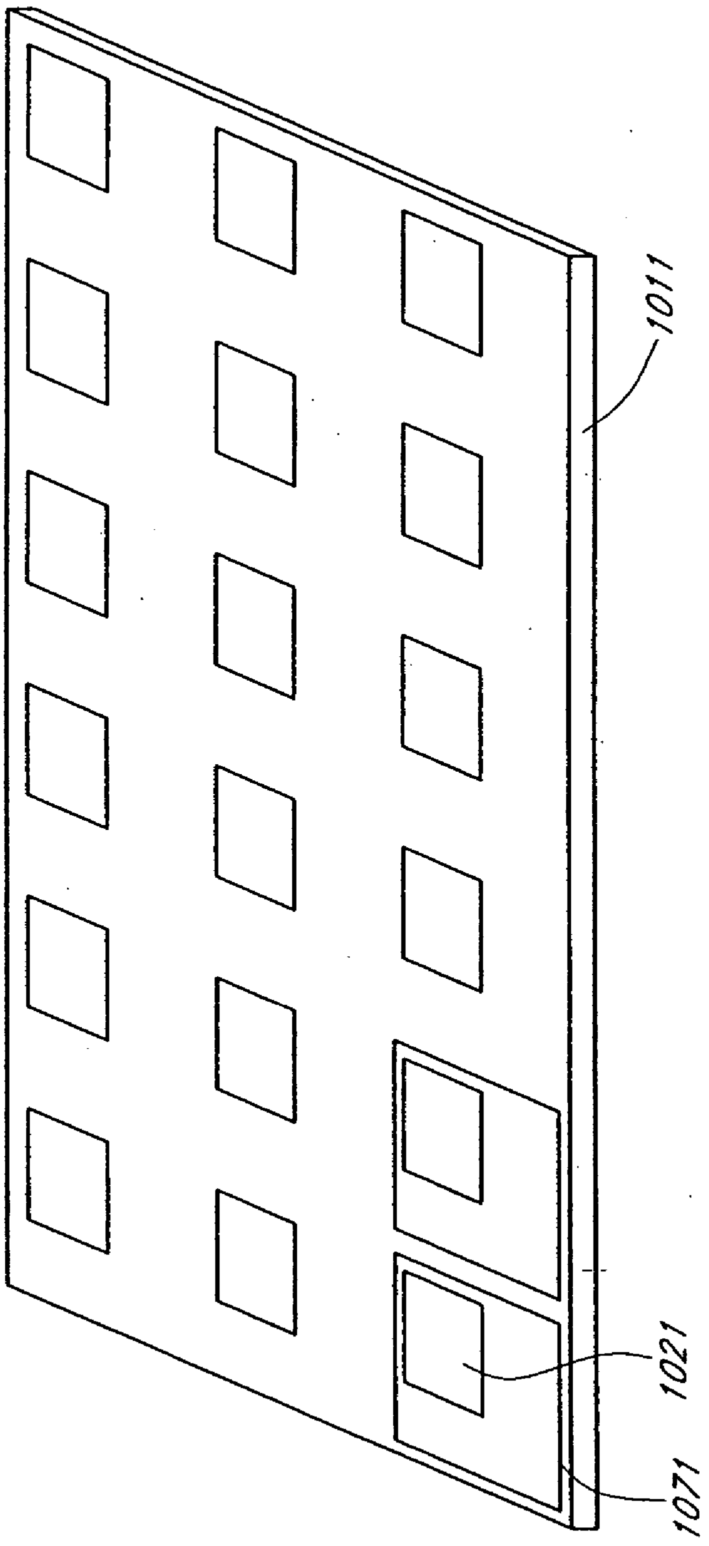


FIG. 22

ORGANIC ELECTROLUMINESCENCE DISPLAY DEVICE AND MANUFACTURING METHOD THEREOF

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of Korean Patent Application Nos. 10-2006-0016316, filed on Feb. 20, 2006, and 10-2006-0020109, filed on Mar. 2, 2006 in the Korean Intellectual Property Office, the disclosures of which are incorporated herein by reference in its entirety.

BACKGROUND

[0002] 1. Field

[0003] The invention relates to an organic electroluminescence display device and a manufacturing method thereof, and more specifically, to an organic electroluminescence display device encapsulated by a frit and a manufacturing method thereof.

[0004] 2. Discussion of the Related Technology

[0005] In general, organic electroluminescence display devices comprise a substrate on which a pixel region and a non-pixel region are provided, and a vessel or another substrate arranged to be opposite to the substrate and attached to the substrate by a sealant such as epoxy for its encapsulation.

[0006] On the pixel region of the substrate is formed multiple light-emitting elements connected in a matrix form between a scan line and a data line, the light-emitting elements comprising an anode electrode, a cathode electrode, and an organic thin film layer formed between the anode electrode and cathode electrode. The organic thin film layer generally comprising an hole transport layer, an organic light-emitting layer and an electron transport layer.

[0007] The light-emitting elements configured as described above are vulnerable to oxygen exposure because the organic materials are easily oxidized by moisture in the air. In addition, the cathode electrode is generally made of metal materials, subject to oxidation which can cause deterioration to electrical and light-emitting properties. To avoid the above problems, a powder-type moisture absorbent or a film-type moisture absorbent is generally provided on a vessel manufactured in the form of a metal material can or cup, or a substrate made of glass, plastic, etc. to get rid of moisture, oxygen and hydrogen from the exterior.

[0008] However, such methods of coating the powder-type moisture absorbent generally involves relatively complicated processes and raises cost for materials and the processes. In addition, such methods result in the increase of the thickness of the display device and is difficult to be applied to an screen light-emitting type display. In addition, such methods of attaching the film-type moisture absorbent have limited capability to eliminate all moisture and also have low durability and reliability. This further limits use of such methods in large scale production. The above discussion is simply to describe the general field of light emitting displays and is not a discussion of the prior art.

[0009] Methods have been developed which encapsulate light-emitting elements by forming side walls with frits to overcome the afore-mentioned problems.

[0010] International patent application No. PCT/KR2002/000994 (May 24, 2002) discloses an encapsuation container formed with side walls using a glass frit and a manufacturing method thereof.

[0011] U.S. patent application Ser. No. 10/414,794 (Apr. 16, 2003) discloses a glass package encapsulated by attaching a first and a second glass plates through a frit and a manufacturing method thereof.

[0012] Korean patent laying-open gazette No. **2001-0084380** (Sep. 6, 2001) discloses a frit frame encapsulation method using a laser.

[0013] Korean patent laying-open gazette No. **2002-0051153** (Jun. 28, 2002) discloses a packaging method of encapsulating an upper substrate and a lower substrate with a frit layer using a laser.

SUMMARY OF CERTAIN INVENTIVE ASPECTS

[0014] Embodiments of the invention provide an organic electroluminescence display device which inhibits damage to metal wirings due to heat by avoiding the metal wirings of a lower part of a frit and a part intersecting the frit from being directly exposed to heat, and a manufacturing method thereof.

[0015] An organic electroluminescence display device according to one embodiment comprises a first substrate formed with an organic electroluminescence element, a metal wiring for conducting signals to the organic electroluminescence element, a second substrate arranged on an upper side of the first substrate, a frit provided between the first substrate and the second substrate, and a reflective layer formed between the metal wiring and the frit.

[0016] An organic electroluminescence display device according to another embodiment comprises a first substrate formed with an organic electroluminescence element, a transistor for controlling the operation of the organic electroluminescence element and a metal wiring for transmitting signals to the organic electroluminescence element, a second substrate arranged in a upper side of the first substrate, a frit provided between the first substrate and the second substrate, and a reflective layer formed between the metal wiring and the frit.

[0017] An organic electroluminescence display device according to still another embodiment comprises a first substrate formed with an organic electroluminescence element comprising a first electrode, an organic thin film layer and a second electrode and a metal wiring for conducting signals to the organic electroluminescence element, a second substrate arranged at a upper side of the first substrate, a frit provided between the first substrate and the second substrate, a reflective layer provided between the metal wiring and the frit, and a protective film formed on the reflective film.

[0018] An organic electroluminescence display device according to a further embodiment comprises a first substrate formed with an organic electroluminescence element comprising a first electrode, an organic thin film layer and a second electrode, a transistor for controlling the organic electroluminescence element and a metal wiring for transmitting signals to the organic electroluminescence element, a second substrate arranged in a upper side of the first substrate, a frit provided between the first substrate and the second substrate, a reflective layer provided between the metal wiring and the frit, and a protective film formed on the reflective film.

[0019] A manufacturing method of an organic electroluminescence display device according one embodiment comprises providing an organic electroluminescence element on a pixel region of a first substrate and providing a wiring connected to the organic electroluminescence element on a non-pixel region of the first substrate, providing a reflective layer on an upper surface of the non-pixel region including the wiring, forming a frit along a surrounding of the second substrate, and arranging the second substrate on an upper side of the first substrate and attaching the frit to the first substrate.

[0020] A manufacturing method of an organic electroluminescence display device according to another embodiment comprises forming an organic electroluminescence element on a pixel region of a first substrate and a transistor for controlling the organic electroluminescence element, and a metal wiring for transmitting signals to the organic electroluminescence element on a non-pixel region, forming a reflective layer on the upper surface of the non-pixel region including the wiring, forming a frit along a surrounding of the second substrate, arranging the second substrate on an upper side of the first substrate and then attaching the frit to the first substrate.

[0021] A manufacturing method of an organic electroluminescence display device according to a further embodiment forming a buffer layer on a first substrate including a pixel region and a non-pixel region, forming a semiconductor layer on the buffer layer of the pixel region and then forming a gate insulating film on the upper surface of the non-pixel region, forming a gate electrode and a first metal wiring on the gate insulating film of the pixel region and forming on the gate insulating film of the non-pixel region the first metal wiring extended from the first metal wiring of the pixel region, forming a between-layer insulating film on the upper surface of the pixel region and then forming a contact hole so that a predetermined portion of the semiconductor layer is exposed, forming on the between-layer insulating film of the pixel region a source and drain electrodes and a second metal wiring connected through the contact hole to the semiconductor layer and forming on the gate insulating film of the non-pixel region the second metal wiring extended from the second metal wiring of the pixel region, forming a reflective layer on the upper surface of the non-pixel region including the first and second metal wirings, forming a flattened layer on the upper surface of the pixel region and then forming a via hole so that the source and drain electrodes are exposed, forming an inorganic electrode layer on the upper surface of the pixel region and non-pixel region and then patterning the inorganic electrode layer, with a first electrode formed on the pixel region, the first electrode connected through the via hole to the source or drain electrode, and with a protective film formed on the non-pixel region, forming an organic thin film layer and a second electrode on the first electrode, forming a frit along a surrounding of the second substrate, and arranging the second substrate on an upper surface of the first substrate and then attaching the frit to the first substrate.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] These and other aspects and advantages of the invention will become apparent and more readily appreciated from the following description of the embodiments, taken in conjunction with the accompanying drawings of which:

[0023] FIG. **1** is a picture for illustrating damage to a metal wiring by irradiating a laser beam.

[0024] FIGS. **2***a*, **3***a* and **4** are plan views of illustrating an organic electroluminescence display device according to one embodiment of the invention.

[0025] FIGS. **2***b* and **3***b* are sectional views for illustrating FIGS. **2***a* and **3***a*.

[0026] FIGS. **5***a* through **5***g* and FIG. **7** are plan views of illustrating a manufacturing method of an organic electroluminescence display device according to one embodiment of the invention.

[0027] FIGS. **6***a* and **6***b* are plane views for illustrating FIGS. **5***a* and **5***e*.

[0028] FIGS. **8***a* and **8***b* are an enlarged sectional view and a plane view of region 'A' circled in FIG. **7**.

[0029] FIGS. **9***a* through **9***c* are plan views illustrating a manufacturing method of an organic electroluminescence display device according to another embodiment.

[0030] FIGS. **10***a* and **10***b* are an enlarged sectional view and a plane view of region 'A' circled in FIG. **7**.

[0031] FIGS. **11***a*, **12***a* and **13** are plan views illustrating an organic electroluminescence display device according to a further

[0032] FIGS. **11***b* and **12***b* are sectional views for illustrating FIGS. **11***a* and **12***a*.

[0033] FIGS. **14***a* through **14***h* and FIG. **16** are sectional views of illustrating a manufacturing method of an organic electroluminescence display device according to a further embodiment.

[0034] FIGS. **15***a* and **15***b* are plan views for illustrating FIGS. **14***a* and **14***g*.

[0035] FIGS. **17***a* and **17***b* are an enlarged sectional view and a plan view of region 'B' circled in FIG. **16**.

[0036] FIG. **18** is a schematic exploded view of a passive matrix type organic light emitting display device in accordance with one embodiment.

[0037] FIG. **19** is a schematic exploded view of an active matrix type organic light emitting display device in accordance with one embodiment.

[0038] FIG. **20** is a schematic top plan view of an organic light emitting display in accordance with one embodiment.

[0039] FIG. **21** is a cross-sectional view of the organic light emitting display of FIG. **20**, taken along the line **21**-**21**.

[0040] FIG. **22** is a schematic perspective view illustrating mass production of organic light emitting devices in accordance with one embodiment.

DETAILED DESCRIPTION OF CERTAIN EMBODIMENTS

[0041] A method for encapsulating a light emitting element using a frit, which attaches a substrate on which the frit is coated to another substrate on which light emitting elements are formed, and then causes the frit to be fused and attached to the substrates by illuminating a laser beam, has a limitation in that when the laser beam is irradiated to the frit, metal wirings **10** of a lower part of the frit **20** and a part (region 'A'FIG. **1**) intersecting the frit may be directly exposed by heat due to the laser beam, possibly resulting in heat damage. The thusly heat damaged metal wirings may develop cracks or their resistance and electrical properties can be changed, thus compromising the electrical properties and reliability of elements.

[0042] Embodiments provide an organic electroluminescence display device capable of mitigating the above problems, and a manufacturing method thereof.

[0043] Hereafter, embodiments of the invention will be described in a more detailed manner with reference to the accompanying drawings. It should be understood that the following embodiments will be provided to allow those skilled in the art to fully understand the invention, but the invention is not limited thereto, and various modifications can be made.

[0044] 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.

[0045] OLEDs can be generally grouped into two basic types dependent on the arrangement with which the stimulating electrical current is provided. FIG. **18** schematically illustrates an exploded view of a simplified structure of a passive matrix type OLED **1000**. FIG. **19** 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.

[0046] Referring to FIG. **18**, 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.

[0047] Referring to FIG. **19**, the active matrix OLED (AMOLED) includes local 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 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.

[0048] 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.

[0049] 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.

[0050] 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.

[0051] 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.

[0052] 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.

[0053] 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.

[0054] 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.

[0055] 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.

[0056] 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. **20**. 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.

[0057] 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. **21** schematically illustrates a cross-section of an encapsulated OLED device **1011** having a layout of FIG. **20** and taken along the line **21-21** of FIG. **20**. 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**.

[0058] 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.

[0059] 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**.

[0060] 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. **21**. 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.

[0061] 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. **21**. 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.

[0062] 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.

[0063] 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.

[0064] 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.

[0065] 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.

[0066] 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.

[0067] 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**.

[0068] 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.

[0069] 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**.

[0070] In some embodiments, OLED devices **1011** are mass produced. In an embodiment illustrated in FIG. **22**, 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. **21**. 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**.

[0071] FIG. **1** is a picture for illustrating damage to a metal wiring by irradiating a laser beam. FIGS. **2***a*, **3***a* and **4** are plan views illustrating an organic electroluminescence display device according to one embodiment of the invention, and FIGS. **2***b* and **3***b* are sectional views for illustrating FIGS. **2***a* and **3***a*.

[0072] Referring to FIG. **2***a*, a substrate **200** defines a pixel region **210** and a non-pixel region **220**. The non-pixel region **220** is a remaining region excluding the pixel region **210**, and may be a peripheral region of the pixel region **210** or a region surrounding the pixel region **210**. Multiple organic electroluminescence elements **100** are formed between a scan line **104***b* and a data line **106***c* on the pixel region **210** of the substrate **200**. On the non-pixel region **220** of the substrate **200** are formed a scan line **104***b* and a data line **106***c* extended from the scan line **104***b* and the data line **106***c*, respectively, of the pixel region **210**, a power supply line (not shown) for generating the organic electroluminescence elements **100**, and a scan driver **410** and a data driver **420** for processing signals from the exterior through pads **104***c* and **106***d* and supplying them to the scan line **104***b* and data line **106***c*.

[0073] Referring to FIG. **2***b*, the organic electroluminescence element **100** is composed of an anode electrode **108** and cathode electrode **111**, and an organic thin film layer **110** formed between the anode electrode **108** and cathode electrode **111**. The organic thin film layer **110** is formed as a structure in which a hole transport layer, an organic light-emitting layer and an electron transport layer are deposited, and may further comprise a hole injection layer and an electron injection layer.

[0074] In a passive matrix type, the organic electroluminescence element **100** as configured above is connected in a matrix form between a scan line **104***b* and a data line **106***c*, and in an active matrix type, the organic electroluminescence element **100** is connected in a matrix form between the scan line **104***b* and data line **106***c*, the active matrix type further comprising a thin film transistor TFT for controlling the organic electroluminescence element **100** and a capacitor for sustaining a signal. The thin film transistor comprises a source, a drain and a gate. A semiconductor layer **102** provides a source and drain regions, to which a source and drain electrodes **106***a* and **106***b*, and a channel region, on an upper side of which is a gate electrode **104***a* electrically insulated from the semiconductor layer **102** by a gate insulation film **103**.

[0075] Referring to FIGS. **3***a* and **3***b*, on the encapsulation substrate **300** is formed a frit **320** along the surrounding of the encapsulation substrate **300**. The frit **320** encapsulates the pixel region **210** to inhibit oxygen and moisture from penetrating into the organic electroluminescence element **100**, which is formed to surround an external side of the pixel region **210** and may be formed of a material, for example, such as a glass frit doped with at least one kind of transition metal, which may be fused by laser beam or infrared ray.

[0076] Referring to FIG. **4**, the encapsulation substrate **300** is arranged on the upper side of the substrate **200**. The encapsulation substrate **300** is arranged on the upper side of the substrate **200** so as to be superposed to the pixel region **210** and a part of the non-pixel region **220**. A reflective layer **117** made of a metal having low heat absorption ratio and high reflectivity is provided between the frit **320** and the scan line **104***b*, data line **106***c* and the power supply line formed on the non-pixel region **220**. Although most metals can reflect light, one embodiment employs a single layer or stacking structure of metals having low heat absorption ratio and high reflectivity, for example, such as metals selected from a group comprising Cu, Au, Al, Ag, etc, and/or alloys of these metals.

[0077] As described above, a laser beam and/or infrared ray is irradiated under a condition where the encapsulation substrate **300** is attached onto the substrate **200**, such that the frit **320** is fused and attached to the substrate **200**.

[0078] A manufacturing method of an organic electroluminescence display device configured as above will be described below with reference to FIGS. **5***a* through **5***g* and FIGS. **6***a* and **6***b* in accordance with one embodiment.

[0079] Referring to FIGS. **5***a* and **6***a*, a substrate **200** is prepared, on which a pixel region **210** and a non-pixel region **220** are defined. The non-pixel region **220** is a remaining region except for the pixel region **210**, which may be defined as a predetermined peripheral region of the pixel region **210** or a region surrounding the pixel region **210**. A buffer layer **101** is formed on the pixel region **210** and non-pixel region **220** of the substrate **200**. The buffer layer **101**, which serves to inhibit the damage to the substrate **200** due to heat and isolate diffusion of ions from the substrate **200** to the outside, is formed as an insulating film such as silicon oxide film SiO2 and/or silicon nitride film SiNx.

[0080] Referring to FIG. **5***b*, a semiconductor layer **102**, which provides an active layer, is formed on the buffer layer **101** of the pixel region **210**, and then a gate insulating film **103** is formed on the upper surface of the pixel region **210** including the semi conductor layer **102**. The semiconductor layer **102** provides a source and drain regions and a channel region for a thin film transistor.

[0081] Referring to FIG. **5***c*, a gate electrode **104***a* is formed on the gate insulating film **103** placed on the upper side of the semiconductor layer **102**. On the pixel region **210** is formed a scan line connected to the gate electrode **104***a* and on the non-pixel region **220** are formed a scan line **104** extended from the scan line **104** of the pixel region **210** and a pad **104***c* to receive signals from the exterior. The gate electrode **104***a,* scan line **104***b* and pad **104***c* are made of metals such as Mo, W, Ti, Al, and/or alloys thereof, and can be formed as an stacking structure. The non-pixel region **220** of FIG. **5***c* is a sectional surface of a part formed with the scan line **104***b.*

[**0082**] Referring to FIG. **5***d,* a between-layer insulating film **105** is formed on the upper surface of the pixel region **210** including the gate electrode **104***a.* Contact holes are formed through which parts of the semiconductor layer **102** are exposed by patterning the between-layer insulating film **105** and gate insulating film **103**, and a source electrode **106***a* and a drain electrode **106***b* are formed to be connected through the contact holes to the semiconductor layer **102**. On the pixel region **210** is formed a scan line connected to the gate electrode **106***a* and on the non-pixel region **220** are formed a scan line **106** extended from the scan line **106** of the pixel region **210** and a pad **104***c* to receive signals from the exterior. The source and drain electrodes **106***a* and **106***b,* data line **106***c* and pad **106***d* are made of metals such as Mo, W, Ti, Al, and/or alloys thereof, and formed as a stacking structure. The non-pixel region **220** of FIG. **5***d* is a sectional surface of a part formed with the data line **106***c.*

[**0083**] Referring to FIGS. **5***e* and **5***f* and FIG. **6***b,* a flattened layer **107** is formed on the upper surface of the pixel region **210** to flatten the surface. A reflective layer **117**, which is formed of a metal having low heat absorption ratio and high reflectivity, is formed on the upper surface of the non-pixel region **220** including the scan line **104***b,* data line **106***c* and power supply line.

[**0084**] In another embodiment, it is also possible to form the reflective layer **117** made of a metal having low heat absorption ratio and high reflectivity on the upper surface of the non-pixel region **220** including the scan line **104***b,* data line **106***c* and power supply line, and then to form a flattened layer **107** on the upper surface of the pixel region **210** to flatten the surface.

[**0085**] A single layer or stacking structure of metals having low heat absorption ratio and high reflectivity, for example, such as metals selected from a group comprising Cu, Au, Al, Ag, etc, and/or alloys of these metals may be used. For the reference, the reflectivity of Cu, Au, Al, and Ag is Cu (0.976), Au (0.986), Al (0.868), and Ag (0.969), respectively. The non-pixel region **220** of FIG. **5***e* is a sectional surface of a part formed with the scan line **104***b,* and the non-pixel region **220** of FIG. **5***f* is a sectional surface of a part formed with the data line **106***c.*

[**0086**] Although the above embodiment forms the flattened layer **107** only on the pixel region **210**, it is also possible of the flattened layer **107** to remain on the non-pixel region **220**. In addition, it is possible of pads **104***c* and **106***d* to be exposed in the procedure of patterning so that the reflective layer **117** is formed only on the non-pixel region **220** after forming the reflective region **117** on the upper surface.

[**0087**] Referring to FIG. **5***g,* a via hole is formed through which parts of the source or drain electrode **106***a* or **106***b* are exposed by patterning the flattened layer **107** of the pixel region **210**. An anode electrode **108** is formed to be connected through the via hole to the source or drain electrode **106***a* or **106***b.* A pixel definition film **109** is formed on the flattened layer **107** so that a part of the anode electrode **108** is exposed. An organic thin film **110** is formed on the exposed anode electrode **108** and a cathode electrode **111** is formed on the pixel definition film **109** including the organic thin film layer **110** to complete the organic electroluminescence element **100**.

[**0088**] In one embodiment the scan line **104***b,* data line **106***c* and power supply line are not exposed by the reflective layer **117**. Although a construction is suggested where the reflective layer **117** is formed on the surface of the non-pixel region **220** including the scan line **104***b,* data line **106***c* and power supply line, it is also possible to implement a construction where the reflective layer **117** is formed only on the scan line **104***b,* data line **106***c* and power supply line of the non-pixel region **220**.

[**0089**] Turning again to FIGS. **3***a* and **3***b,* a encapsulation substrate **300** is provided whose size is such an extent that a part of the pixel region **210** is superposed to a part of the non-pixel region **220**. A substrate made of a transparent material such as glass is employed as the encapsulation substrate **300**, and in one embodiment a substrate made of silicon oxide SiO2 is employed.

[**0090**] The frit **320** is formed along the surrounding of the encapsulation substrate **300**. The frit **320** encapsulates the pixel region **210** to inhibit oxygen and moisture from being penetrated therein, which is formed to surround a part of the non-pixel region **220** including the pixel region **210**.

[**0091**] In certain embodiments, the frit is generally as a powder-type glass material and in other embodiments provide a paste state of frit. A laser and/or infrared light absorber, an organic binder, a filler for reducing the thermal expansion coefficient, etc., can be provided. The frit is cured after a firing process. For example, a frit may include at least one kind of transition metal dopant.

[**0092**] Referring to FIG. **7**, the encapsulation substrate **300** is arranged on the upper side of the substrate **200** manufactured through processes shown in FIGS. **5***a* through **5***g*. The frit **320** is attached to the substrate **200** by irradiating laser beam and/or infrared ray along the frit **320** under a condition where the encapsulation substrate **300** is arranged on the upper side of the substrate **200** to be superposed to the pixel region **210** and a part of the non-pixel region **220**. The laser beam or infrared ray is absorbed to the frit **320**, which in turn generates heat, and thereby the frit **320** is fused and attached to the substrate **200**.

[**0093**] In one embodiment using the laser, the laser beam is irradiated on the order of power of 36 W to 38 W, and is moved in a substantially constant speed along the frit **320** so as to sustain a constant fusion temperature and adhesive strength. The movement speed of the laser or infrared ray is on the order of 10 to 30 mm/sec, and in one embodiment approximately, 20 mm/sec.

[**0094**] Although one embodiment describes a case where the gate insulating film **103** and between-layer insulating film **105** are formed only on the pixel region **210**, it is also possible to form them on the pixel region **210** and non-pixel region **220**. In addition, although the description is made with respect to a case where the reflective layer **117** is formed before and after forming the flattened layer **107** as shown in FIG. **5***e*, it is also possible to form the reflective layer **117** of a metal having low heat absorption ratio and high reflectivity on the upper surface of the non-pixel region **220** including the scan line **104***b*, data line **106***c* and power supply line after forming the organic electroluminescence element **100** as shown in FIG. **5***g*. And, although the embodiment has been described with respect to a case where the frit **320** is formed to seal only the pixel region **210**, it is not limited thereto, but may be formed to include the scan driver **410**. In that case, the size of the encapsulation substrate **300** should also be changed. In addition, a case has been described where the frit **320** is formed on the encapsulation substrate **300**, it is not limited thereto, but may also be formed on the substrate **200**.

[0095] The organic electroluminescence display device according to one embodiment forms the reflective layer **117** with a metal having low absorption ratio and high reflectivity on the upper side of metal wirings such as the scan line **104***b*, data line **106***c* and power supply line of the non-pixel region **220**. Therefore, when a laser beam is irradiated to fuse and attach the frit **320** to the substrate **200**, metal wirings such as the scan line **104***b*, data line **106***c* and power supply line placed in a lower side of the frit **320** and a part intersecting the frit **320** fail to be directly exposed to heat due to the laser beam as shown in FIGS. **8***a* and **8***b*. A part of laser beam or infrared ray passing through the frit **320** is reflected by the reflective layer **117** and heat generated from the frit **320** is not absorbed well in the reflective layer **117**. This in turn reduces heat transfer to the metal wirings, making it possible to inhibit damage to the metal wirings due to heat. Therefore, cracks of the metal wirings or substantial variations of self resistance and electrical property are inhibited, thereby making it possible to sustain electrical property and reliability of elements.

[0096] Although one embodiment has been described with respect to a manufacturing method of an active matrix-type organic electroluminescence display device including a thin film transistor for controlling the operation of the organic electroluminescence element **100**, with the organic electroluminescence element **100** connected in a matrix type between the scan line **104***b* and data line **106***c*, it is also possible to manufacture a passive matrix-type organic electroluminescence display device with the organic electroluminescence element **100** connected in a matrix type between the scan line **104***b* and data line **106***c*, using the above embodiment. Another embodiment including a manufacturing method of a passive matrix-type organic electroluminescence display device, will be described below with reference to FIGS. **9***a* through **9***c*.

[0097] Referring to FIG. **9***a*, a conductive material such as Cr, W, Ti, ITO is deposited on the upper surface of the substrate **200**, and then patterned to form a wiring **120** on the substrate **200** of the non-pixel region **220**. The wiring **120** is formed on the pixel region **210** and non-pixel region **220** of the substrate **200**. An anode electrode **121** is formed on the pixel region **210** or wiring **120** of the substrate **200**. Before forming the wiring **120**, a buffer layer (not shown) may be formed on the pixel region **120** and non-pixel region **220** of the substrate **200**, which is made of an insulating film such as silicon oxide film SiO2 and/or silicon nitride SiNx.

[0098] Referring to FIG. **9***b*, after forming the insulating film **124** on the upper surface of the pixel region **120**, the insulating film **124** is patterned so that a part of the anode electrode **121** is exposed, defining a pixel. An organic thin film layer **125** is formed on the exposed anode electrode **121**.

[0099] Referring to FIG. **9***c*, a separation film **126** is formed on the upper surface of the pixel region **120**, and then it is patterned so that the organic thin film layer **125** is exposed. A cathode electrode **127** is formed on the organic thin film layer **125** to thereby complete the organic electroluminescence element **100**. A reflective layer **130** is formed with a metal having low absorption ratio and high reflectivity on the upper surface of the non-pixel region **220** including the wiring **120**. A patterning is made so that the reflective layer **130** remains only on the wiring **120**. A single layer or stacking structure of metals having low heat absorption ratio and high reflectivity, for example, such as metals selected from a group comprising Cu, Au, Al, Ag, etc, or an alloy of the metals may be used.

[0100] The procedures hereinafter set forth, i.e. preparing the encapsulation substrate **300** and attaching the encapsulation substrate **300** to the substrate **100** have been described above with reference to FIGS. **3***a* and **3***b*, and FIG. **7**, and thus their detailed description will be omitted.

[0101] The organic electroluminescence display device according to this embodiment forms the reflective layer **130** with a metal having low absorption ratio and high reflectivity on the upper side of the wiring **120** of the non-pixel region **220**. Therefore, when a laser beam is irradiated to fuse and attach the frit **320** to the substrate **200**, the wiring **120** of a lower side of the frit **320** and a part intersecting the frit **320** are less directly exposed to heat due to the laser beam as shown in FIGS. **10***a* and **10***b*. A part of laser beam or infrared ray passing through the frit **320** is reflected by the reflective layer **130** and heat generated from the frit **320** is not absorbed well in the reflective layer **130**, which in turn reduced heat transfer to the wiring **120**, making it possible to inhibit damage to the wiring **120** due to heat. Therefore, cracks of the wirings or substantial variation of self resistance and electrical properties are reduced, thereby making it possible to sustain electrical property and reliability of elements.

[0102] FIGS. **11***a*, **12***a* and **13** are plan views of illustrating an organic electroluminescence display device according to a third embodiment of the invention, and FIGS. **11***b* and **12***b* are sectional views for illustrating FIGS. **11***a* and **12***a*.

[0103] Referring to FIG. **11***a*, a substrate **600** is divided into a pixel region **610** and a non-pixel region **620**. The non-pixel region **620** may be a region surrounding the pixel region **610** or a remaining region except for the pixel region **610**. Multiple organic electroluminescence elements **500** are formed between a scan line **504***b* and a data line **506***c* on the pixel region **610** of the substrate **600**, and on the non-pixel region **620** of the substrate **600** are formed a scan line **504***b* and a data line **506***c* extended from the scan line **504***b* and the data line **506***c*, respectively, of the pixel region **610**, a power supply line (not shown) for generating the organic electroluminescence elements **500**, and a scan driver **810** and a data driver **820** for processing signals from the exterior through pads **504***c* and **506***d* and supplying them to the scan line **504***b* and data line **506***c*.

[0104] Referring to FIG. **11***b*, the organic electroluminescence element **500** is composed of an anode electrode **509***a* and cathode electrode **512**, and an organic thin film layer **512** formed between the anode electrode **509***a* and cathode electrode **511**. The organic thin film layer **511** is formed as a structure in which an hole transport layer, an organic light-emitting layer and an electron transport layer are deposited, and may further comprise an hole injection layer and an electron injection layer.

[0105] In a passive matrix type, the organic electroluminescence element **500** as configured above is connected in a matrix form between a scan line **504***b* and a data line **506***c*, and in an active matrix type, the organic electroluminescence element **500** is connected in a matrix form between the scan line **504***b* and data line **506***c*, the active matrix type further comprising a thin film transistor (TFT) for controlling the organic electroluminescence element **500** and a capacitor for sustaining a signal. The thin film transistor comprises a source, a drain and a gate. A semiconductor layer **502** provides a source and drain regions, to which a source and drain electrodes **506***a* and **506***b*, and a channel region, on an upper side of which is a gate electrode **504***a* electrically insulated from the semiconductor layer **503** by a gate insulation film **502**.

[0106] Referring to FIGS. **12***a* and **12***b*, on the encapsulation substrate **700** is formed a frit **720** along the surrounding of the encapsulation substrate **700**. The frit **720** encapsulates the pixel region **610** to inhibit oxygen and moisture from penetrating therein, and is formed to surround a part of the non-pixel region **620** including the pixel region **610** and may be formed of a material, for example, such as a glass frit with at least one kind of transition metal dopant, which may be fused by laser beam and/or infrared ray.

[0107] Referring to FIG. **13**, the encapsulation substrate **700** is arranged on the upper side of the substrate **600**. The encapsulation substrate **700** is arranged on the upper side of the substrate **600** so as to be superposed to the pixel region **610** and a part of the non-pixel region **620**. A reflective layer **507** and a protective film **509***b* are provided in a stacking structure between the frit **720** and the scan line **504***b*, data line **506***c* and the power supply line formed on the non-pixel region **620**. The reflective layer **507** is formed as a single layer or a stacking structure of metals selected from a group, for example, Cu, Au, Al, Ag, etc. having low heat absorption ratio and high reflectivity, or an alloy of the metals. The protective film **509***b* is formed of an opaque inorganic electrode material in the front surface light emitting type, and a transparent inorganic electrode material in the back surface light emitting type. The opaque inorganic electrode material may be an inorganic material selected from a group comprising, for example, ACX(alloy of Al), Ag, and Au, or a mixture thereof, and the transparent inorganic electrode may be an inorganic material selected from a group comprising, for example, ITO, IZO, and ITZO, or a mixture thereto.

[0108] The reflective layer **507** and protective film **509***b* may be formed on the surface of the non-pixel region **620**. If the protective film **509***b* is allowed to be formed in the procedure where the anode electrode **509***a* is formed, it can be formed without additional process steps and mask. In a case where the protective film **509***b* and anode electrode **509***a* are formed of the inorganic electrode material, it should be separated from the anode electrode **509***a* for the electrical isolation between the scan line **504***b* and data line **506***c* and the anode electrode **509***a*.

[0109] A laser beam and/or infrared ray is irradiated under a condition where the encapsulation substrate **700** is attached onto the substrate **600**, such that the frit **720** is fused and bonded to the substrate **600**.

[0110] A manufacturing method of an organic electroluminescence display device configured as above will be described below with reference to FIGS. **14***a* through **14***h* and FIGS. **15***a* and **15***b* in accordance with yet another embodiment.

[0111] Referring to FIGS. **14***a* and **15***a*, firstly, a substrate **600** is prepared, on which a pixel region **610** and a non-pixel region **620** are defined. The non-pixel region **620** may be defined as a region surrounding the pixel region **610** or a peripheral region of the pixel region **610**.

[0112] A buffer layer **501** is formed on the pixel region **610** and non-pixel region **620** of the substrate **600**. The buffer layer **501**, which serves to inhibit the damage to the substrate **600** due to heat and isolate diffusion of ions from the substrate **600** to the outside, is formed as an insulating film such as silicon oxide film SiO2 and/or silicon nitride film SiNx.

[0113] Referring to FIG. **14***b*, a semiconductor layer **501**, which provides an active layer, is formed on the buffer layer **502** of the pixel region **610**, and then a gate insulating film **502** is formed on the upper surface of the pixel region **610** and non-pixel region **620** including the semi conductor layer **503**. The semiconductor layer **502** provides a source and drain regions and a channel region for a thin film transistor.

[0114] Referring to FIG. **14***c*, a gate electrode **504***a* is formed on the gate insulating film **502** placed on the upper side of the semiconductor layer **503**. At this time, on the pixel region **610** is formed a scan line connected to the gate electrode **504***a* and on the non-pixel region **620** are formed a scan line **504***b* extended from the scan line **504***b* of the pixel region **610** and a pad **504***c* to receive signals from the exterior. The gate electrode **504***a*, scan line **504***b* and pad **504***c* are made of metals such as Mo, W, Ti, Al, or alloy thereof, and formed as a stacking structure. The non-pixel region **620** of FIG. **14***c* is a sectional surface of a part formed with the scan line **504***b*.

[0115] Referring to FIG. **14***d*, a between-layer insulating film **505** is formed on the upper surface of the pixel region **610** including the gate electrode **504***a*. Contact holes are formed through which parts of the semiconductor layer **503** are exposed by patterning the between-layer insulating film **505** and gate insulating film **502**, and a source electrode **506***a* and a drain electrode **506***b* are formed to be connected through the contact holes to the semiconductor layer **502**. On the pixel region **610** is formed a data line **506***c* connected to the source and drain electrodes **506***a*, **506***b* and on the non-pixel region **620** are formed a data line **506***c* extended from the data line **506***c* of the pixel region **610** and a pad **506***d* to receive signals from the exterior. The source and drain electrodes **506***a* and **506***b*, data line **506***c* and pad **506***d* are made of metals such as Mo, W, Ti, Al, or alloy thereof, and formed as a stacking structure. The non-pixel region **620** of FIG. **14***d* is a sectional surface of a part formed with the data line **506***c*.

[0116] Referring to FIGS. **14***e* and **14***f*, the reflective layer **507** is formed on the upper surface of the non-pixel region **620** including the scan line **504***b* and data line **506***c*.

Although most metals can reflect light, this embodiment employs a single layer or stacking structure of metals having low heat absorption ratio and high reflectivity, for example, such as metals selected from a group comprising Cu, Au, Al, Ag, etc, or an alloy of the metals. For the reference, the reflectivity of Cu, Au, Al, and Ag is Cu (0.976), Au (0.986), Al (0.868), and Ag (0.969), respectively. The non-pixel region **620** of FIG. **14***e* is a sectional surface of a part formed with the scan line **504***b*, and the non-pixel region **620** of FIG. **14***f* is a sectional surface of a part formed with the data line **506***c*.

[0117] Referring to FIGS. **14***g* and **15***b*, a flattened layer **508** is formed on the upper surface of the pixel region **610** to flatten the surface. A via hole is formed through which parts of the source or drain electrode **506***a* or **506***b* are exposed by patterning the flattened layer **508** of the pixel region **610**. An electrode material layer made of an inorganic material is formed on the upper side of the pixel region **610** and non-pixel region **620**. Patterning is made so that on the pixel region **610** is formed the anode electrode **509***a*, which is connected through the via hole to the source or drain electrode **506***a* or **506***b*, and on the non-pixel region **620** is formed the protective film **509***b*.

[0118] The electrode material layer made of an inorganic material may be made of an opaque inorganic material or a mixture of inorganic materials in the case of front surface light emitting type, and a transparent inorganic material or a mixture of inorganic materials in the case of back surface light emitting type. The opaque inorganic material or mixture of inorganic materials may be selected from a group comprising, for example, ACX (alloy of Al), Ag, and Au, and the transparent inorganic or mixture of inorganic materials may be selected from a group comprising, for example, ITO, IZO, and ITZO.

[0119] Although this embodiment causes the protective film **509***b* to be formed during the procedure when the anode electrode **509***a* is formed, so that additional processes and mask will not required, it is also possible to form the anode electrode **509***a* and the protective film **509***b* through separate processes. However, in a case where the anode electrode **509***a* and the protective film **509***b* are formed of an inorganic electrode material in the same process steps, the anode electrode **509***a* and the protective film **509***b* are preferably separated from each other for the electrical isolation between the scan line **504***b* and data line **506***c* and the anode electrode **509***a*.

[0120] Referring to FIG. **14***h*, a pixel definition film **510** is formed on the flattened layer **508** so that a part of the anode electrode **509***a* is exposed, and then an organic thin film **511** is formed on the exposed anode electrode **509***a* and a cathode electrode **511** is formed on the pixel definition film **510** including the organic thin film layer **512**.

[0121] This embodiment suggested a construction where the scan line **504***b*, data line **506***c* and power supply line are not exposed by the reflective layer **507** and protective film **509***b*. Although a construction is suggested where the reflective layer **507** and protective film **509***b* are formed on the surface of the non-pixel region **620** including the scan line **504***b*, data line **506***c* and power supply line, it is also possible to implement a construction where the reflective layer **507** and protective film **509***b* are formed only on the scan line **504***b*, data line **506***c* and power supply line of the non-pixel region **620**.

[0122] Turning again to FIGS. **12***a* and **12***b*, a encapsulation substrate **700** is provided whose size is such an extent that a part of the pixel region **610** is superposed to a part of the non-pixel region **620**. A substrate made of a transparent material such as glass is employed as the encapsulation substrate **700**, and preferably a substrate made of silicon oxide SiO2 is employed.

[0123] The frit **720** is formed along the surrounding of the encapsulation substrate **700**. The frit **720** encapsulates the pixel region **610** to inhibit oxygen and moisture from being penetrated therein, which is formed to surround a part of the non-pixel region **620** including the pixel region **610**. The frit **720** is in one embodiment a powder-type glass material. In other embodiments a paste state of frit, which includes a laser or infrared light absorber, an organic binder, a filler for reducing the thermal expansion coefficient, etc., is cured after a firing process. For example, a frit may include at least one kind of transition metal dopant.

[0124] Referring to FIG. **16**, the encapsulation substrate **700** is arranged on the upper side of the substrate **600** manufactured through processes shown and described with respect to FIGS. **14***a* through **12***h*. The frit **720** is attached to the substrate **700** by irradiating a laser beam and/or infrared ray along the frit **720** under a condition where the encapsulation substrate **700** is arranged on the upper side of the substrate **600** to be superposed to the pixel region **610** and a part of the non-pixel region **620**. The laser beam or infrared ray is absorbed to the frit **720**, which in turn generates heat, and thereby the frit **720** is fused and attached to the substrate **600**.

[0125] In one embodiment using the laser, the laser beam is irradiated on the order of power of 36 W to 38 W, and is moved at a substantially constant speed along the frit **720** so as to sustain a substantially constant fusion temperature and adhesive strength. In one embodiment, movement speed of the laser or infrared ray is on the order of 10 to 30 mm/sec, and preferably, approximately 20 mm/sec.

[0126] On the other hand, although this embodiment has been described with respect to a case where the frit **720** is formed to seal only the pixel region **610**, it is not limited thereto, but may be formed to include the scan driver **810**. In that embodiment, the size of the encapsulation substrate **700** should also be changed. In addition, a case has been described where the frit **720** is formed on the encapsulation substrate **700**, it is not limited thereto, but may also be formed on the substrate **600**.

[0127] The organic electroluminescence display device according to this embodiment forms the reflective layer **507** and the protective film **509***b* to have a stacking structure on the metal wirings such as the scan line **504***b*, data line **506***c* and power supply line of the non-pixel region **620**. Therefore, when a laser beam and/or infrared ray are irradiated to fuse and attach the frit **720** to the substrate **600**, the metal wirings **504***b*, **506***c* of a lower side of the frit **720** and a part intersecting the frit **720** are less directly exposed to heat due to the laser beam or infrared ray as shown in FIGS. **17***a* and **17***b*. The protective film **509***b* made of an inorganic electrode material reflects laser beam or infrared ray to inhibit heat from being absorbed. The reflective layer **507** made of a metal having low absorption ratio and high reflectivity reflects a part of laser beam or infrared ray passing through the protective film **509***b* and screen heat from being transferred from the protective film **509***b* to the metal wirings **504***b*, **506***c*.

[0128] Reflectivity of the metals generally used as electrodes or wirings is Cr (0.632), Mo (0.550), Ti (0.557), and W (0.500) in the wavelength bandwidth of infrared(IR) ray, but reflectivity of the opaque inorganic electrode materials used for the embodiment is relatively high such as Al (0.868), Ag (0.969), Au (0.986), etc. Accordingly, since heat absorption ratio is low due to the high reflectivity, the amount of heat transferred to the metal wirings of the lower side may be significantly lowered. In addition, the transparent inorganic electrode materials (ITO, IZO, ITZO, etc.) used in certain embodiments, which are metal oxide, have even lower heat conductivity compared to metallic materials, and thus may serve to isolate heat transferred to the metal wirings of the lower side and may serve as a buffer layer, thus making it possible to significantly reduce damage to the metal wiring due to heat. Accordingly, heat transfer is effectively interrupted by the reflective layer **507** and the protective film **509***b* formed as a double structure and thus possible damage to the metal wirings **504***b*, **506***c* due to heat is reduced, which in turn inhibits the cracking of the metal wirings or substantial variations of self resistance and electrical properties, thereby making it possible to sustain electrical property and reliability of elements.

[0129] In addition, since the second protective film **509***b* is formed of an inorganic material having outstanding adhesive strength with the frit on the metal wirings **504***b*, **506***c* of the non-pixel region **620** during the procedure of forming the anode electrode **509***a* without addition of separate processes or mask, it is possible to give even more prominent adhesive strength than the case where the frit is attached directly to the metal wirings **504***b*, **506***c*. Thus, the adhesive strength is enhanced between the frit **720** and substrate, which in turn inhibits the penetration of oxygen or moisture effectively, thereby improving reliability of the display device.

[0130] Although embodiments of the invention have been shown and described, it would be appreciated by those skilled in the art that changes can be made in these embodiments without departing from the principles and spirit of the invention, the scope of which is defined in the claims and their equivalents.

1. An organic electroluminescence display device comprising:

a first substrate formed with an organic electroluminescence element,

a metal wiring for conducting signals to the organic electroluminescence element,

a second substrate arranged on an upper side of the first substrate,

a frit provided between the first substrate and the second substrate, and

a reflective layer formed between the metal wiring and the frit.

2. The organic electroluminescence display device as claimed in claim 1, wherein at least either one of the first substrate and the second substrate comprises a transparent material.

3. The organic electroluminescence display device as claimed in claim 1, wherein the metal wiring comprises a scan line, a data line, and a power supply line.

4. The organic electroluminescence display device as claimed in claim 1, wherein the reflective layer is further formed on a remaining region excluding a region formed with the organic electroluminescence element.

5. The organic electroluminescence display device as claimed in claim 1, wherein the reflective layer is formed of one or more selected from a group consisting of Cu, Au, Al, and Ag.

6. The organic electroluminescence display device as claimed in claim 1, wherein the frit comprises at least one dopant made of transition metal.

7. The organic electroluminescence display device as claimed in claim 1, further comprising a transistor for controlling the operation of the organic electroluminescence element.

8. The organic electroluminescence display device as claimed in claim 1, further comprising a protective film formed on the reflective layer.

9. The organic electroluminescence display device as claimed in claim 1, wherein the frit comprises one or more materials selected from the group consisting of magnesium oxide (MgO), calcium oxide (CaO), barium oxide (BaO), lithium oxide (Li2O), sodium oxide (Na2O), potassium oxide (K2O), boron oxide (B2O3), vanadium oxide (V2O5), zinc oxide (ZnO), tellurium oxide (TeO2), aluminum oxide (Al2O3), silicon dioxide (SiO2), lead oxide (PbO), tin oxide (SnO), phosphorous oxide (P2O5), ruthenium oxide (Ru2O), rubidium oxide (Rb2O), rhodium oxide (Rh2O), ferrite oxide (Fe2O3), copper oxide (CuO), titanium oxide (TiO2), tungsten oxide (WO3), bismuth oxide (Bi2O3), antimony oxide (Sb2O3), lead-borate glass, tin-phosphate glass, vanadate glass, and borosilicate.

10. A manufacturing method of an organic electroluminescence display device, method comprising:

providing an organic electroluminescence element on a pixel region of a first substrate and providing a wiring connected to the organic electroluminescence element on a non-pixel region of the first substrate,

providing a reflective layer on an upper surface of the non-pixel region including the wiring,

forming a frit along a surrounding of the second substrate, and

arranging the second substrate on an upper side of the first substrate and attaching the frit to the first substrate.

11. The manufacturing method of an organic electroluminescence display device as claimed in claim 10, further comprising:

providing a first electrode on the first substrate of the pixel region,

providing an insulating film on an upper side of the pixel region,

patterning the insulating film so that at least a part of the first electrode is exposed to define a pixel,

providing an organic thin film layer on the exposed first electrode, providing a separation film on the upper side of the pixel region and patterning the separation film so that the organic thin film layer is at least partially exposed, and

providing a second electrode on the organic thin film layer.

12. The manufacturing method of an organic electroluminescence display device as claimed in claim 10, wherein the wiring is formed of one or more selected from a group consisting of Cr, Mo, Ti and ITO.

13. The manufacturing method of an organic electroluminescence display device as claimed in claim 10, further comprising:

after providing the reflective layer, patterning so that the reflective layer remains substantially only on the wiring.

14. The manufacturing method of an organic electroluminescence display device as claimed in claim 10, wherein the frit is fused and attached to the first substrate by irradiation with at least one of a laser beam and infrared ray.

15. The manufacturing method of an organic electroluminescence display device as claimed in claim 10, wherein the frit comprises at least one dopant comprising at least one transition metal.

16. The manufacturing method of an organic electroluminescence display device as claimed in claim 10, further comprising providing a transistor for controlling the organic electroluminescence element.

17. The manufacturing method of an organic electroluminescence display device as claimed in claim 15, further comprising:

providing a buffer layer on a first substrate including a pixel region and a non-pixel region,

providing a semiconductor layer on the buffer layer of the pixel region and providing a gate insulating film on the upper surface of the pixel region including the semiconductor layer,

providing a gate electrode and a first metal wiring on the gate insulating film of the pixel region and providing on the buffer layer of the non-pixel region the first metal wiring extended from the first metal wiring of the pixel region,

providing a between-layer insulating film on the upper surface of the pixel region including the gate electrode,

providing on the between-layer insulating film of the pixel region a source and drain electrodes and a second metal wiring connected to the semiconductor layer and providing on the buffer layer of the non-pixel region the second metal wiring extended from the second metal wiring of the pixel region,

providing a flattened layer on the upper surface of the pixel region, and

providing on the flattened layer the organic electroluminescence element comprising a first electrode, an organic thin film layer and a second electrode connected to the source and drain electrodes.

18. An organic electroluminescence display device comprising:

a first substrate formed with an organic electroluminescence element comprising a first electrode, an organic thin film layer and a second electrode and a metal wiring for conducting signals to the organic electroluminescence element,

a second substrate arranged at a upper side of the first substrate,

a frit provided between the first substrate and the second substrate,

a reflective layer provided between the metal wiring and the frit, and

a protective film formed on the reflective film.

19. The organic electroluminescence display device as claimed in claim 18, wherein the protective film is formed of a first electrode material and separated from the first electrode.

20. The organic electroluminescence display device as claimed in claim 18, further comprising a transistor for controlling the organic electroluminescence element.

21. A manufacturing method of an organic electroluminescence display device comprising:

providing a buffer layer on a first substrate including a pixel region and a non-pixel region,

providing a semiconductor layer on the buffer layer of the pixel region and providing a gate insulating film on the upper surface of the non-pixel region,

providing a gate electrode and a first metal wiring on the gate insulating film of the pixel region and providing on the gate insulating film of the non-pixel region the first metal wiring extended from the first metal wiring of the pixel region,

providing a between-layer insulating film on the upper surface of the pixel region and providing a contact hole so that a portion of the semiconductor layer is exposed,

providing on the between-layer insulating film of the pixel region a source and drain electrodes and a second metal wiring connected through the contact hole to the semiconductor layer and providing on the gate insulating film of the non-pixel region the second metal wiring extended from the second metal wiring of the pixel region,

providing a reflective layer on the upper surface of the non-pixel region including the first and second metal wirings,

providing a flattened layer on the upper surface of the pixel region and providing a via hole so that the source and drain electrodes are exposed,

providing an inorganic electrode layer on the upper surface of the pixel region and non-pixel region and then patterning the inorganic electrode layer, with a first electrode formed on the pixel region, the first electrode connected through the via hole to the source or drain electrode, and with a protective film formed on the non-pixel region,

providing an organic thin film layer and a second electrode on the first electrode,

forming a frit along a surrounding of the second substrate, and

arranging the second substrate on an upper surface of the first substrate and then attaching the frit to the first substrate.

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专利名称(译)	有机电致发光显示装置及其制造方法		
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摘要(译)

有机电致发光显示装置及其制造方法。一种有机电致发光显示装置，包括：第一基板，形成有有机电致发光元件，所述有机电致发光元件具有第一电极，有机薄膜层和第二电极;金属布线，用于将信号传输到所述有机电致发光元件;第二基板，布置在上侧第一基板的第一基板，设置在第一基板和第二基板之间的玻璃料，反射层和设置在金属布线和玻璃料之间的保护膜，其中第一基板和第二基板通过玻璃料彼此附接。