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(54) **Organic light emitting diode display device and method of fabricating the same**

Organische LED-Anzeigevorrichtung und Verfahren zu ihrer Herstellung

Dispositif d'affichage à diode électroluminescente organique et son procédé de fabrication

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Description

1. Field of the Invention

[0001] The present invention relates to a method of fabricating an organic light emitting diode (OLED) display device.

2. Description of the Related Art

[0002] Recently, as interest in information displays has been on the rise and demand for the use of portable information media has been increased, lightweight flat panel displays (FPDs) substituting cathode ray tubes (CRTs) as existing display devices have been actively researched and commercialized.

[0003] In the FPD fields, a liquid crystal display (LCD) device, which is lighter and consumes less power, has been spotlighted; however, since an LCD device is a light receiving device, rather than a light emitting device, having shortcomings of brightness, contrast ratio, and a viewing angle, and the like, so a development of a new display device that may overcome such drawbacks has been actively made.

[0004] An LED display device, one of new display devices, is a self-luminous type device, which thus is excellent in a viewing angle and contrast ratio, is lighter and thinner because it does not need a backlight, and is advantageous in terms of power consumption, relative to an LCD device. In addition, an OLED display device can be driven by a DC and at a low voltage, has a fast response speed, and is especially advantageous in terms of fabrication costs.

[0005] Unlike an LCD device or a plasma display panel (PDP), deposition and encapsulation are the whole of a fabrication process of an OLED display device, so the fabrication process is very simple. Also, when the OLED display device is driven according to an active matrix scheme in which each pixel has a thin film transistor (TFT) as a switching element, the same luminance can be obtained although a low current is applied, so, advantageously, the OLED display device consumes low power, has a high pitch (or high definition or high resolution), and can be increased in size.

[0006] Hereinafter, a basic structure and operational characteristics of an OLED display device will be described in detail with reference to the accompanying drawings.

[0007] FIG. 1 is a diagram illustrating a light emission principle of a general OLED display device.

[0008] As shown in FIG. 1, a general OLED display device includes an OLED. The OLED includes organic compound layers 301, 30b, 30c, 30d, and 30e formed between an anode 18 as a pixel electrode and a cathode 28 as a common electrode.

[0009] Here, the organic compound layers 30a, 30b, 30c, 30d, and 30e include a hole injection layer 30a, a hole transport layer 30b, an emission layer 30c, an electron transport layer 30d, and an electron injection layer 30e.

[0010] When a driving voltage is applied to the anode 18 and the cathode 28, holes which have passed through the hole transport layer 30b and electrons which have passed through the electron transport layer 30e move to the light emission layer 30c to form excitons, and as a result, the light emission layer 30c emits visible light.

[0011] In the OLED display device, the pixels each having the OLED having the foregoing structure are arranged in a matrix form and selectively controlled by a data voltage and a scan voltage to display an image.

[0012] The OLED display device is divided into a passive matrix type OLED display device and an active matrix type display device using TFTs as switching elements. Among them, in the active matrix type OLED display device, TFTs as active elements are selectively turned on to select pixels and emitting of pixels is maintained by a voltage maintained in a storage capacitor.

[0013] FIG. 2 is an equivalent circuit diagram of a pixel in a general OLED display device. Namely, FIG. 2 illustrates an example of an equivalent circuit diagram of a pixel having a general 2T1C (including two transistors and one capacitor) in an active matrix type OLED display device.

[0014] Referring to FIG. 2, a pixel of an active matrix type OLED display device includes an OLED, a data line DL and a gate line GL crossing each other, a switching TFT SW, a driving TFT DR, and a storage capacitor Cst.

[0015] Here, the switching TFT SW is turned on in response to a scan pulse from the gate line GL to conduct a current path between a source electrode and a drain electrode thereof. During an ON-time period of the switching TFT SW, a data voltage from the data line DL is applied to a gate electrode of the driving TFT DR and the storage capacitor Cst by way of the source electrode and drain electrode of the switching TFT SW.

[0016] Here, the driving TFT DR controls a current flowing in the OLED according to the data voltage applied to the gate electrode thereof. The storage capacitor Cst stores a voltage between the data voltage and a low potential power source voltage VSS and uniformly maintains it during one frame period.

[0017] In order to form the several organic compound layers constituting the OLED display device, a vacuum evaporation method is largely used.

[0018] Here, in order to use the vacuum evaporation method, a mask (or a shadow mask) or a fine metal mask (FMM) having a plurality of openings corresponding to a plurality of pixel regions is used. However, this method has a limitation in that it is not easy to cope with a fine pitch of patterns for increasing a size of a substrate and implementing a high resolution display

[0019] Namely, FMM is fabricated by forming holes as a pattern intended for deposition on a thin metal plate and stretching the same. Thus, there is a limitation in forming a pattern having a small size, making it difficult to reduce the size of an OLED. Also, when a fine metal mask is increased in size in order to increase a size of a panel, warpage occurs due to the characteristics of the fine metal mask, distort the pattern to degrade a production yield.

[0020] WO 2008/038588 A1 discloses a method for manufacturing an organic material apparatus. Herein, a sacrifice layer formed of an inorganic material is formed on a first organic material layer provided on a substrate. A photo resist is formed in an area on the substrate including the top of the sacrifice layer. Then, the photo resist is exposed and developed to form a predetermined pattern having the sacrifice layer just provided under the photo resist part. A second material layer is formed on the substrate after the development, and the sacrifice layer, the photo resist and the sacrifice layer just under the photo resist is removed by a lift-off process to pattern the second material layer.

[0021] US 2008/124824 A1 discloses a method for forming electronic devices by using protecting layers. Herein, a first light emitting layer and a first protecting layer are formed on a substrate. Next, a first photoresist layer is formed above the first protecting layer and is then selectively exposed and developed to form a first photoresist pattern, by use of which the first light emitting layer and the first protecting layer are removed,
such that the first light emitting layer remains in the areas where the first photoresist pattern is formed. Thereafter, the first photoresist pattern is removed and the same process steps are repeated twice to from a second and a third light emitting layer. Finally, a cathode layer is formed above the first, second and third light emitting layers.

[0022] JP 2008 147072 A deals with a manufacturing method of an organic electroluminescent element. The manufacturing method comprises forming an organic electroluminescent layer including a luminous layer on a substrate on which at least a first electrode layer is formed. A photoresist layer is formed on the organic electroluminescent layer and patterned by exposure and development of the photoresist layer. The organic electroluminescent layer is then removed in the area in which the photoresist layer is removed. Finally, a second electrode layer is formed on the organic electroluminescent layer exposed after the removal process.

[0023] US 2005/153058 A1 discloses a production method for an electroluminescent element. Herein, a first light emitting layer is formed on a substrate on which at least an electrode layer is formed in a pattern. A first peeling layer is formed on the first light emitting layer and a first photoresist layer is formed on the first peeling layer. The first photoresist layer is patterned, by exposing and developing the first photoresist layer, so that the first photoresist layer remains only in an area where the first light emitting part will be formed. Then, the first light emitting layer is removed in an area where the first photoresist layer has been removed. These process steps are repeated twice to form a second light emitting layer and a third light emitting layer.

SUMMARY OF THE INVENTION

[0024] It is an object of the present invention to provide a method for fabricating an organic light emitting diode (OLED) display device having a simplified fabrication process and increased efficiency.

[0025] This object is solved by the method for fabricating an organic light emitting diode (OLED) display device according to claim 1. Embodiments of the invention are characterized by the subclaims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026]

FIG. 1 is a diagram illustrating a light emission principle of a general organic light emitting diode (OLED) display device.

FIG. 2 is an equivalent circuit diagram of a pixel in a general OLED display device.

FIGS. 3A through 3L are sequential sectional views illustrating a method for fabricating an OLED display device not representing the present invention.

FIGS. 4A through 4H are sequential sectional views illustrating a method for fabricating an OLED display device according to an embodiment of the present invention.

FIGS. 5A through 5G are sequential sectional views illustrating a method for fabricating an OLED display device not representing the present invention.

FIG. 6 is a graph showing a state in which a life span of a device is shortened after a photolithography process is performed.

FIGS. 7A through 7K are sequential sectional views illustrating a method for fabricating an OLED display device not representing the present invention.

FIG. 8 is a sectional view showing another example of an OLED display device not representing the present invention illustrated in FIGS. 7A through 7K.

FIG. 9 is a sectional view showing another example of an OLED display device not representing the present invention illustrated in FIGS. 7A through 7K.

FIGS. 10A through 10H are sequential sectional views illustrating a method for fabricating an OLED display device not representing the present invention.

FIGS. 11A through 11H are sequential sectional views illustrating a method for fabricating an OLED display device not representing the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0027] Hereinafter, a method for fabricating an organic light emitting diode (OLED) display device according to an embodiment of the present invention shown in figures 4A - 4H and according to embodiments not relating to the present invention shown in figures 3A - 3L, 5A - 5G, 7A - 7K, 8, 8, 10A - 10H and 11A - 11H will be described in detail with reference to the accompanying drawings such that they can be easily implemented by a person skilled in the art. The present invention may be implemented in various forms according to the appended claims without being limited to the explicit embodiment described herein. Patterning of a large area with respect to an organic compound layer of an OLED display device cannot be handled by an existing method using a fine metal mask due to sagging of a substrate and a mask, so various large area patterning methods have been researched. Among them, the present invention proposes a patterning method through a photolithography process (referred to as a 'photo process', hereinafter), and here, the photo process is advantageous in that it is available for large area patterning and obtaining a fine pitch, and available for an application of a solution process.

[0028] FIGS. 3A through 3L are sequential sectional views illustrating a method for fabricating an OLED display device not representing the present invention, in which a method for fabricating an OLED diode with respect to some pixels is taken as an example.

[0029] Here, a method for fabricating an OLED with respect to a pixel including 2T1C (two transistors and one capacitor) is taken as an example for the description purpose.

[0030] First, although not shown, in an OLED display device , a gate line including a first gate electrode and a storage electrode including a second gate electrode may be formed on a substrate 110 made of an insulating material such as transparent glass, plastic, or the like.

[0031] A gate insulating layer made of silicon nitride (SiNx), silicon oxide (SiO_2), or the like, may be formed on the gate line including the first gate electrode and the storage electrode including the second electrode.

[0032] A first active layer and a second active layer, made of semiconductor, may be formed on the gate insulating layer. The first active layer and the second active layer may be positioned on the first gate electrode and the second gate electrode, respectively.

[0033] A data line, a driving voltage line, a first source/drain electrode, and a second source/drain electrode may be formed on an upper portion of the first active layer and the second active layer.

[0034] A predetermined passivation layer may be formed on the substrate 110 on which the data line, the driving voltage line, the first source/drain electrode, and the second source/drain electrode have been formed.

[0035] As shown in FIG. 3A, a pixel electrode 120 and a connecting electrode (not shown) may be formed on the substrate 110 with the passivation film formed thereon. The pixel electrode 120 and the connecting electrode may be made of a transparent conductive material such as indium tin oxide (ITO) or a reflective conductive material such as aluminum, silver, or an alloy thereof.

[0036] The pixel electrode 120 as an anode may be electrically connected to the second drain electrode through a second contact hole, and the connecting electrode may electrically connect the first drain electrode and the second gate electrode through a first contact hole and a third contact hole.

[0037] A partition (not shown) may be formed on the substrate 110 with the pixel electrode 120 formed thereon. Here, the partition may encompass the edges of the pixel electrode 120, like a bank, to define an opening, and may be made of an organic insulating material or an inorganic insulating material.

[0038] An organic compound layer may be formed on the substrate 110.

[0039] Here, the organic compound layer may have a multilayer structure including an auxiliary layer in order to enhance luminous efficiency of a light emitting layer that emits light, besides the light emitting layer. The auxiliary layer may include an electron transport layer and a hole transport layer for balancing electrons and holes and an electron injection layer and a hole injection layer for strengthening injection of electrons and holes.

[0040] The organic compound layer may be formed through a photo process and a lift-off process, and to this end, as shown in FIG. 3B, a first organic film 151 is deposited on the substrate 110.

[0041] Here, the first organic film 151 may be deposited after the hole injection layer and the hole transport layer are formed on the substrate 110, and here, the first organic film 151 may be deposited to form a red, green, or blue light emitting layer.

[0042] The hole injection layer may facilitate injection of holes from the pixel electrode 120, and the hole transport layer serves to allow holes to be transported to the light emitting layer.

[0043] Thereafter, as shown in FIG. 3C, a photosensitive resin (or photoresist) is coated on the entire surface of the substrate 110 with the first organic film 151 deposited thereon, to form a first photosensitive resin layer 191.

[0044] Ultraviolet rays are selectively irradiated (exposure) to the first photosensitive resin layer 191 through a certain mask (not shown).

[0045] Thereafter, when the first photosensitive resin layer 191 exposed through the mask is developed, a first photosensitive resin pattern 190a made of the photosensitive resin remains only at a position where a first light emitting layer is to be formed as shown in FIG. 3D.

[0046] A photosensitive resin developing solution is used for the developing operation, and here, any developing solution may be used as long as it does not dissolve a material of the light emitting layer. For example, a generally used organic alkali-based developing solution may be used, or an inorganic alkali-based developing solution or an aqueous solution capable of developing resist may be used.

[0047] Thereafter, as shown in FIG. 3E, a partial region of the first organic film formed under the first photosensitive resin pattern 190a is selectively etched by using the first photosensitive resin pattern 190a as a mask, to form a first light emitting layer 150a formed of the first organic film on the substrate 110 (first photo process).

[0048] Here, for example, the first light emitting layer 150a may be a red light emitting layer, and the etching may include wet etching as well as dry etching. However, the present invention is not limited thereto and the first light emitting layer 150a may be a red or blue light emitting layer.

[0049] Thereafter, as shown in FIG. 3F, with the first photosensitive resin pattern 190a remaining, a second organic film 152 is deposited thereon.

[0050] A follow-up process is substantially the same as the first photo process for forming the first light emitting layer 150a. Namely, as shown in FIG. 3G, a photosensitive resin is coated on the entire surface of the substrate 110 with the second organic film 152 formed thereon, to form a second photosensitive resin layer 192.

[0051] Thereafter, UV rays are selectively irradiated to the second photosensitive resin layer 192 through a certain mask (not shown).

[0052] Thereafter, when the second photosensitive resin layer 192 exposed through the mask is developed, a second photosensitive resin pattern 190b made of the photosensitive resin remains only at a position where a second light emitting layer is to be formed as shown in FIG. 3H.

[0053] Thereafter, as shown in FIG. 3I, a partial region of the first organic film formed under the second photosensitive resin pattern 190b is selectively etched by using the second photosensitive resin pattern 190b as a mask, to form a second light emitting layer 150b formed of the second organic film on the substrate 110 (second photo process).

[0054] Here, for example, the second emitting layer 150b may be a green light emitting layer, and the etching may include wet etching as well as dry etching. However, the present example is not limited thereto and when the first light emitting layer 150a is a red light emitting layer, the second light emitting layer 150b may be a blue light emitting layer, other than a green light emitting layer.

[0055] Thereafter, as shown in FIG. 3J, with the first photosensitive resin pattern 190a and the second photosensitive resin pattern 190b remaining, a third organic film 153 is deposited thereon.

[0056] As a follow-up process, a lift-off process, rather than a photo process such as the first and second photo processes as described above, is used. Namely, as shown in FIG. 3K, the first photosensitive resin pattern and the second photosensitive resin pattern are removed through a lift-off process, and here, the third organic film remaining on upper portions of the first light emitting layer 150a and the second light emitting layer 150b is removed along with the first photosensitive resin pattern and the second photosensitive resin pattern.

[0057] As a result, a third light emitting layer 150c formed of the third organic film is formed between the first light emitting layer 150a and the second light emitting layer 150b.

[0058] Here, for example, when the first light emitting layer 150a is a red light emitting layer and the second light emitting layer 150b is a green light emitting layer, the third light emitting layer 150c may be a blue light emitting layer. Also, when the first light emitting layer 150a is a red light emitting layer and the second light emitting layer 150b is a blue light emitting layer, the third light emitting layer 150c may be a green light emitting layer. However, the present example is not limited thereto and the first light emitting layer 150a, the second light emitting layer 150b, and the third light emitting layer 150c may be configured as red, green, and blue light emitting layers irrespective of order.

[0059] Thereafter, as shown in FIG. 3L, a common electrode 180 as a cathode may be formed on the first light emitting layer 150a, the second light emitting layer 150b, and the third light emitting layer 150c. Here, the common electrode, which receives a common voltage, may be made of a reflective conductive material including calcium (Ca), barium (Ba), magnesium (Mg), aluminum (Al), silver (Ag), or the like, or a transparent conductive material such as ITO, IZO, or the like.

[0060] Here, the foregoing common electrode 180 may be formed after the electron transport layer and the electron injection layer are formed on the substrate 110.

[0061] The electron injection layer facilitates injection of electrons from the common electrode 180, and the electron transport layer serves to allow electrons to move to the light emitting layers 150a, 150b, and 150c.

[0062] In this manner, in the case of the present example, since a single photo process, namely, a single photosensitive resin coating, exposing, developing, and etching process (a total of four processes) may be omitted, and thus, the process can be simplified. Also, since OLED pixels are patterned through the photo process, large patterning can be performed and high pitch can be obtained, and in addition, a solution process can be performed.

[0063] In the OLED display device configured as described above, the first gate electrode connected to the gate line and the first source electrode and the first drain electrode connected to the data line may constitute a first switching thin film transistor (TFT) along with the first active layer. Also, the second gate electrode connected to the first drain electrode, the second source electrode connected to the driving voltage line, and the second drain electrode connected to the pixel electrode 120 may constitute a driving TFT along with the second active layer.

[0064] Also, the pixel electrode 120, the light emitting layers 150a, 150b, and 150c, and the common electrode 180 may constitute an OLED, and the mutually overlapping storage electrode and driving voltage line may constitute a storage capacitor.

[0065] However, as mentioned above, when the organic compound layer is patterned through the photo process, the organic compound layer may be likely to be damaged by a photosensitive resin, a developing solution, and a strip solution, which may result in a degradation of efficiency and a life span.

[0066] Thus, in case of an embodiment of the inventive method, a buffer layer made of metal oxide is formed on an upper portion of the organic compound layer to protect the organic compound layer against a photo process. This will be described in detail with reference to the accompanying drawings.

[0067] FIGS. 4A through 4H are sequential sectional views illustrating a method for fabricating an OLED display device according to an embodiment of the present invention, in which a method for fabricating an OLED diode with respect to some pixels is taken as an example.

[0068] Although not shown, as mentioned above, in a method for fabricating an OLED display device according to the present embodiment of the present invention, a gate line including a first gate electrode and a storage electrode including a second gate electrode may be formed on a substrate 210 made of an insulating material such as transparent glass, plastic, or the like.

[0069] A gate insulating layer made of silicon nitride (SiNx), silicon oxide (SiO_2), or the like, may be formed on the gate line including the first gate electrode and the storage electrode including the second electrode.

[0070] A first active layer and a second active layer, made of semiconductor, may be formed on the gate insulating layer. The first active layer and the second active layer may be positioned on the first gate electrode and the second gate electrode, respectively.

[0071] A data line, a driving voltage line, a first source/drain electrode, and a second source/drain electrode may be formed on an upper portion of the first active layer and the second active layer.

[0072] A predetermined passivation layer may be formed on the substrate 210 on which the data line, the driving voltage line, the first source/drain electrode, and the second source/drain electrode have been formed.

[0073] As shown in FIG. 4A, a pixel electrode 220 is and a connecting electrode (not shown) may be formed on the substrate 210 with the passivation film formed thereon. The pixel electrode 220 and the connecting electrode may be made of a transparent conductive material such as indium tin oxide (ITO) or a reflective conductive material such as aluminum, silver, or an alloy thereof.

[0074] The pixel electrode 220 as an anode may be electrically connected to the second drain electrode through a second contact hole, and the connecting electrode may electrically connect the first drain electrode and the second gate electrode through a first contact hole and a third contact hole.

[0075] A partition (not shown) may be formed on the substrate 210 with the pixel electrode 220 formed thereon. Here, the partition may encompass the edges of the pixel electrode 220, like a bank, to define an opening, and may be made of an organic insulating material or an inorganic insulating material.

[0076] An organic compound layer is formed on the substrate 210.

[0077] Here, the organic compound layer has a multilayer structure including an auxiliary layer in order to enhance luminous efficiency of a light emitting layer that emits light, besides the light emitting layer. The auxiliary layer includes an electron transport layer and a hole transport layer for balancing electrons and holes and an electron injection layer and a hole injection layer for strengthening injection of electrons and holes.

[0078] Namely, as shown in FIG. 4A, a thin film 231 for a first hole injection layer, a thin film 241 for a first hole transport layer, a first organic film 251, a thin film 261 for a first electron transport layer, and a thin film 271 for a first buffer layer are sequentially deposited on the substrate 210 with the pixel electrode 220 formed thereon.

[0079] Here, the thin film 261 for a first electron transport layer may include a thin film for a first electron injection layer, and the thin film 271 for a first buffer layer is made of a metal oxide and may be made of a 1-2 Group and 12-16 Group metal oxide or 3-12 Group transition metal oxide.

[0080] Thereafter, as shown in FIG. 4B, a photosensitive resin is coated on the entire surface of the substrate 210 on which the thin film 231 for a first hole injection layer, the thin film 241 for a first hole transport layer, the first organic film 251, the thin film 261 for a first electron transport layer, and the thin film 271 for a first buffer layer are deposited, in order to form a first photosensitive resin layer 291.

[0081] UV light is selectively irradiated to the first photosensitive resin layer 291 through a certain mask (not shown).

[0082] Thereafter, when the first photosensitive resin layer 291 exposed through the mask is developed, a first photosensitive resin pattern 290a made of the photosensitive resin remains only at a position where a first light emitting layer is to be formed as shown in FIG. 4C.

[0083] Thereafter, as shown in FIG. 4D, partial regions of the thin film for a first hole injection layer, the thin film for a first hole transport layer, the first organic film, the thin film for a first electron transport layer, and the thin film for a first buffer layer formed under the first photosensitive resin pattern 290a are selectively etched by using the first photosensitive resin pattern 290a as a mask, in order to form a first hole injection layer 230a, a first hole transport layer 240a, a first light emitting layer 250a, a first electron transport layer 260a, and a first buffer layer 270a formed of the thin film for a first hole injection layer, the thin film for a first hole transport layer, the first organic film, the thin film for a first electron transport layer, and the thin film for a first buffer layer, respectively, on the substrate 210 (first photo process).

[0084] In this manner, since the first buffer layer 270a is positioned on the upper portion of the organic compound layer, namely, on the first electron transport layer 260a, the organic compound layer, in particular, the first electron transport layer 260a, is prevented from being degraded, thus preventing a degradation of the device.

[0085] Also, since the first buffer layer 270a of metal oxide is applied, an energy barrier between the first electron transport layer 260a and the common electrode can be lowered, enhancing efficiency and a life span.

[0086] Here, for example, the first light emitting layer 250a may be a red light emitting layer, and the etching may include wet etching, as well as dry etching. However, the present invention is not limited thereto and the first light emitting layer 250a may be a green or blue light emitting layer.

[0087] Thereafter, as shown in FIG. 4E, the first photosensitive resin pattern is removed.

[0088] Thereafter, as shown in FIG. 4F, a second hole injection layer 230b, a second hole transport layer 240b, a second light emitting layer 250b, a second electron transport layer 260b, and a second buffer layer 270b, which are formed of a thin film for a second hole injection layer, a thin film for a second hole transport layer, a second organic film, a thin film for a second electron transport layer, and a thin film for a second buffer layer made of metal oxide, respectively, are formed on the substrate 210 through a second photo process which is substantially the same as the first photo process as mentioned above.

[0089] Here, for example, the second light emitting layer 250b may be a green light emitting layer. However, the present invention is not limited thereto and when the first light emitting layer 250a is a red light emitting layer, the second light emitting layer 250b may be a blue light emitting layer, other than a green light emitting layer.

[0090] Thereafter, as shown in FIG. 4G, a third hole injection layer 230c, a third hole transport layer 240c, a third light emitting layer 250c, a third electron transport layer 260c, and a third buffer layer 270c, which are formed of a thin film for a third hole injection layer, a thin film for a third hole transport layer, a third organic film, a thin film for a third electron transport layer, and a thin film for a third buffer layer made of metal oxide, respectively, are formed on the substrate 210 through a third photo process which is substantially the same as the first and second photo processes as mentioned above.

[0091] Here, for example, when the first light emitting layer 250a is a red light emitting layer and the second light emitting layer 250b is a green light emitting layer, the third light emitting layer 250c may be a blue light emitting layer. Also, when the first light emitting layer 250a is a red light emitting layer and the second light emitting layer 250b is a blue light emitting layer, the third light emitting layer 250c may be a green light emitting layer. However, the present invention is not limited thereto and the first light emitting layer 250a, the second light emitting layer 250b, and the third light emitting layer 250c may be configured as red, green, and blue light emitting layers irrespective of order.

[0092] Thereafter, as shown in FIG. 4H, common electrodes 280a, 280b, and 280c as cathodes are formed on the first buffer layer 270a, the second buffer layer 270b, and the third buffer layer 270c. Here, the common electrodes 280a, 280b, and 280c, which receive a common voltage, may be made of a reflective conductive material including calcium (Ca), barium (Ba), magnesium (Mg), aluminum (Al), silver (Ag), or the like, or a transparent conductive material such as ITO, IZO, or the like.

[0093] In the OLED display device configured as described above, the first gate electrode connected to the gate line and the first source electrode and the first drain electrode connected to the data line may constitute a first switching thin film transistor (TFT) along with the first active layer. Also, the second gate electrode connected to the first drain electrode, the second source electrode connected to the driving voltage line, and the second drain electrode connected to the pixel electrode 220 may constitute a driving TFT along with the second active layer.

[0094] Also, the pixel electrode 220, the light emitting layers 250a, 250b, and 250c, and the common electrodes 280a, 280b, and 280c may constitute an OLED, and the mutually overlapping storage electrode and driving voltage line may constitute a storage capacitor.

[0095] FIGS. 5A through 5G are sequential sectional views illustrating a method for fabricating an OLED display device according to an example not representing the present invention, in which a method for fabricating an OLED diode with respect to some pixels is taken as an example.

[0096] Although not shown, as mentioned above, in an OLED display device, a gate line including a first gate electrode and a storage electrode including a second gate electrode may be formed on a substrate 310 made of an insulating material such as transparent glass, plastic, or the like.

[0097] A gate insulating layer made of silicon nitride (SiNx), silicon oxide (SiO_2), or the like, may be formed on the gate line including the first gate electrode and the storage electrode including the second electrode.

[0098] A first active layer and a second active layer, made of semiconductor, may be formed on the gate insulating layer. The first active layer and the second active layer may be positioned on the first gate electrode and the second gate electrode, respectively.

[0099] A data line, a driving voltage line, a first source/drain electrode, and a second source/drain electrode may be formed on an upper portion of the first active layer and the second active layer.

[0100] A predetermined passivation layer may be formed on the substrate 310 on which the data line, the driving voltage line, the first source/drain electrode, and the second source/drain electrode have been formed.

[0101] As shown in FIG. 5A, a pixel electrode 320 and a connecting electrode (not shown) may be formed on the substrate 310 with the passivation film formed thereon. The pixel electrode 320 and the connecting electrode may be made of a transparent conductive material such as indium tin oxide (ITO) or a reflective conductive material such as aluminum, silver, or an alloy thereof.

[0102] The pixel electrode 320 as an anode may be electrically connected to the second drain electrode through a second contact hole, and the connecting electrode may electrically connect the first drain electrode and the second gate electrode through a first contact hole and a third contact hole.

[0103] A partition (not shown) may be formed on the substrate 310 with the pixel electrode 320 formed thereon. Here, the partition may encompass the edges of the pixel electrode 320, like a bank, to define an opening, and may be made of an organic insulating material or an inorganic insulating material.

[0104] An organic compound layer may be formed on the substrate 310. Here, in the case of the present example, the organic compound layer is formed through a lift-off process.

[0105] Namely, as shown in FIG. 5A, a photosensitive resin is coated on the entire surface of the substrate 310 with the pixel electrode 320 formed thereon, to form a first photosensitive resin layer 391.

[0106] UV light is selectively irradiated to the first photosensitive resin layer 391 through a certain mask (not shown).

[0107] Thereafter, when the first photosensitive resin layer 391 exposed through the mask is developed, a first photosensitive resin pattern 390a made of the photosensitive resin remains only at a position other than a position where a first light emitting layer is to be formed as shown in FIG. 5B.

[0108] Thereafter, as shown in FIG. 5C, with the first photosensitive resin pattern 390a remaining, a thin film 331 for a first hole injection layer, a thin film 341 for a first hole transport layer, a first inorganic film 351, a thin film 361 for a first electron transport layer, and a thin film 371 for a first buffer layer are deposited on the first photosensitive resin pattern 390a.

[0109] Here, the thin film 361 for a first electron transport layer may include a thin film for a first electron injection layer, and the thin film 371 for a first buffer layer may be made of a 1-2 Group and 12-16 Group metal oxide or 3-12 Group transition metal oxide.

[0110] Thereafter, as shown in FIG. 5D, the first photosensitive resin pattern 390a is removed through a first lift-off process. Here, the thin film for a first hole injection layer, the thin film for a first hole transport layer, the first organic film, the thin film for the first electron transport layer, and the thin film for a first buffer layer remaining on the upper portion of the first photosensitive resin pattern 390a are also removed together with the first photosensitive resin pattern 390a.

[0111] As a result, a first hole injection layer 330, a first hole transport layer 340a, a first light emitting layer 350a, a first electron transport layer 360a, and a first buffer layer 370a, which are formed of the thin film for a first hole injection layer, the thin film for a first hole transport layer, the first organic film, the thin film for the first electron transport layer, and the thin film for a first buffer layer, respectively, are formed on the substrate 310.

[0112] Here, for example, the first light emitting layer 350a may be a red light emitting layer. However, the present example is not limited thereto and the first light emitting layer 350a may be a green or blue light emitting layer.

[0113] Thereafter, as shown in FIG. 5E, a second hole injection layer 330b, a second hole transport layer 340b, a second light emitting layer 350b, a second electron transport layer 360b, and a second buffer layer 370b, which are formed of a thin film for a second hole injection layer, a thin film for a second hole transport layer, a second organic film, a thin film for a second electron transport layer, and a thin film for a second buffer layer, respectively, are formed on the substrate 310 through a second lift-off process which is substantially the same as the first lift-off process as mentioned above.

[0114] Here, for example, the second light emitting layer 350b may be a green light emitting layer. However, the present light emitting layer is not limited thereto and when the first light emitting layer 350a is a red light emitting layer, the second light emitting layer 350b may be a blue light emitting layer, other than a green light emitting layer.

[0115] Thereafter, as shown in FIG. 5F, a third hole injection layer 330c, a third hole transport layer 340c, a third light emitting layer 350c, a third electron transport layer 360c, and a third buffer layer 370c, which are formed of a thin film for a third hole injection layer, a thin film for a third hole transport layer, a third organic film, a thin film for a third electron transport layer, and a thin film for a third buffer layer, respectively, are formed on the substrate 310 through a third lift-off process which is substantially the same as the first and second lift-off processes as mentioned above.

[0116] Here, for example, when the first light emitting layer 350a is a red light emitting layer and the second light emitting layer 350b is a green light emitting layer, the third light emitting layer 350c may be a blue light emitting layer. Also, when the first light emitting layer 350a is a red light emitting layer and the second light emitting layer 350b is a blue light emitting layer, the third light emitting layer 350c may be a green light emitting layer. However, the present example is not limited thereto and the first light emitting layer 350a, the second light emitting layer 350b, and the third light emitting layer 350c may be configured as red, green, and blue light emitting layers irrespective of order.

[0117] Thereafter, as shown in FIG. 5G, common electrodes 380a, 380b, and 380c as cathodes may be formed on the first light emitting layer 350a, the second light emitting layer 350b, and the third light emitting layer 350c. Here, the common electrodes 380a, 380b, and 380c, which receive a common voltage, may be made of a reflective conductive material including calcium (Ca), barium (Ba), magnesium (Mg), aluminum (Al), silver (Ag), or the like, or a transparent conductive material such as ITO, IZO, or the like.

[0118] In the OLED display device configured as described above, the first gate electrode connected to the gate line and the first source electrode and the first drain electrode connected to the data line may constitute a first switching thin film transistor (TFT) along with the first active layer. Also, the second gate electrode connected to the first drain electrode, the second source electrode connected to the driving voltage line, and the second drain electrode connected to the pixel electrode 320 may constitute a driving TFT along with the second active layer.

[0119] Also, the pixel electrode 320, the light emitting layers 350a, 350b, and 350c, and the common electrodes 380a, 380b, and 380c may constitute an OLED, and the mutually overlapping storage electrode and driving voltage line may constitute a storage capacitor.

[0120] Meanwhile, organic substances whose efficiency and life span are rapidly reduced after the photo process is performed are included in the organic compound layer. For example, in the case of a blue light emitting layer, device efficiency tends to be reduced from about 5.3 cd/A to 2.0 cd/A after a photo process based on 1000 nit.

[0121] For example, referring to FIG. 6, there is an organic substance whose life span is rapidly reduced after a photo process exists, which leads to a reduction in efficiency and life span of the LED display device.

[0122] Thus, in case of a fourth embodiment not representing the present invention, two pixels among red, green, and blue pixels are patterned through a lift-off process, while the other remaining one pixel is deposited to be formed without patterning, to thus simplify the process and increase efficiency. This will be described in detail with reference to the accompanying drawings.

[0123] FIGS. 7A through 7K are sequential sectional views illustrating a method for fabricating an OLED display device according to a fourth embodiment not representing the present invention, in which a method for fabricating an OLED diode with respect to some pixels is taken as an example.

[0124] Although not shown, as mentioned above, in an OLED display device according to a fourth embodiment not representing the present invention, a gate line including a first gate electrode and a storage electrode including a second gate electrode may be formed on a substrate 410 made of an insulating material such as transparent glass, plastic, or the like.

[0125] A gate insulating layer made of silicon nitride (SiNx), silicon oxide (SiO_2), or the like, may be formed on the gate line including the first gate electrode and the storage electrode including the second electrode.

[0126] A first active layer and a second active layer, made of semiconductor, may be formed on the gate insulating layer. The first active layer and the second active layer may be positioned on the first gate electrode and the second gate electrode, respectively.

[0127] A data line, a driving voltage line, a first source/drain electrode, and a second source/drain electrode may be formed on an upper portion of the first active layer and the second active layer.

[0128] A predetermined passivation layer may be formed on the substrate 410 on which the data line, the driving voltage line, the first source/drain electrode, and the second source/drain electrode have been formed.

[0129] As shown in FIG. 7A, a pixel electrode 420 and a connecting electrode (not shown) may be formed on the substrate 410 with the passivation film formed thereon. The pixel electrode 420 and the connecting electrode may be made of a transparent conductive material such as indium tin oxide (ITO) or a reflective conductive material such as aluminum, silver, or an alloy thereof.

[0130] The pixel electrode 420 as an anode may be electrically connected to the second drain electrode through a second contact hole, and the connecting electrode may electrically connect the first drain electrode and the second gate electrode through a first contact hole and a third contact hole.

[0131] A partition (not shown) may be formed on the substrate 410 with the pixel electrode 420 formed thereon. Here, the partition may encompass the edges of the pixel electrode 420, like a bank, to define an opening, and may be made of an organic insulating material or an inorganic insulating material.

[0132] An organic compound layer may be formed on the substrate 410. Here, in the case of the fourth embodiment not representing the present invention, two pixels among red, green, and blue pixels are patterned through a lift-off process, while the other remaining one pixel is deposited to be formed without patterning, to form the organic compound layer.

[0133] Namely, as shown in FIG. 7A, a hole injection layer 430 and a hole transport layer 440 are formed on the substrate 410 with the pixel electrode 420 formed thereon.

[0134] As mentioned above, the hole injection layer 430 may facilitate injection of holes from the pixel electrode 420, and the hole transport layer 440 serves to allow holes to be transported to the light emitting layer.

[0135] Thereafter, as shown in FIG. 7B, a photosensitive resin is coated on the entire surface of the substrate 410 with the hole injection layer 430 and the hole transport layer 440 formed thereon, to form a first photosensitive resin layer 491.

[0136] UV light is selectively irradiated to the first photosensitive resin layer 491 through a certain mask (not shown).

[0137] Thereafter, when the first photosensitive resin layer 491 exposed through the mask is developed, a first photosensitive resin pattern 490a made of the photosensitive resin remains only at a position other than a position where a first light emitting layer is to be formed as shown in FIG. 7C.

[0138] Thereafter, as shown in FIG. 7D, with the first photosensitive resin pattern 490a remaining, a first organic film 451 is deposited thereon.

[0139] Thereafter, as shown in FIG. 7E, the first photosensitive resin pattern 490a is removed through a first lift-off process. Here, the first organic film 451 remaining on the upper portion of the first photosensitive resin pattern 490a is also removed together with the first photosensitive resin pattern 490a.

[0140] As a result, a first light emitting layer 450a formed of the first organic film is formed on the substrate 410.

[0141] Here, for example, the first light emitting layer 450a may be a red light emitting layer. However, the first light emitting layer 450a may be a green or blue light emitting layer.

[0142] As shown in FIG. 7F, a second photosensitive resin layer 492 may be formed by applying a photosensitive resin to the entire surface of the substrate 410 with the first light emitting layer 450a formed thereon in the substantially same manner.

[0143] And then, UV light is selectively irradiated to the second photosensitive resin layer 492 through a certain mask (not shown).

[0144] Thereafter, when the second photosensitive resin layer 492 exposed through the mask is developed, a second photosensitive resin pattern 490b made of the photosensitive resin remains only at a position other than a position where a second light emitting layer is to be formed as shown in FIG. 7G.

[0145] Thereafter, as shown in FIG. 7H, with the second photosensitive resin pattern 490b remaining, a second organic film 452 is deposited thereon.

[0146] Thereafter, as shown in FIG. 7I, the second photosensitive resin pattern 490b is removed through second first lift-off process. Here, the second organic film 452 remaining on the upper portion of the second photosensitive resin pattern 490b is also removed together with the second photosensitive resin pattern 490b.

[0147] As a result, a second light emitting layer 450b formed of the second organic film is formed on the substrate 410.

[0148] Here, for example, the second emitting layer 450b may be a green light emitting layer. However, when the first light emitting layer 450a is a red light emitting layer, the second light emitting layer 450b may be a blue light emitting layer, other than a green light emitting layer.

[0149] As shown in FIG. 7J, a third organic film is deposited on the entire surface of the substrate 410 with the first light emitting layer 450a and the second light emitting layer 450b formed thereon, to form a third light emitting layer 450c.

[0150] Here, the third light emitting layer 450c may be formed with a certain thickness on upper portions of the first light emitting layer 450a and the second light emitting layer 450b as well as between the first light emitting layer 450a and the second light emitting layer 450b.

[0151] Here, for example, when the first light emitting layer 450a is a red light emitting layer and the second light emitting layer 450b is a green light emitting layer, the third light emitting layer 450c may be a blue light emitting layer. Also, when the first light emitting layer 450a is a red light emitting layer and the second light emitting layer 450b is a blue light emitting layer, the third light emitting layer 450c may be a green light emitting layer. However, the first light emitting layer 450a, the second light emitting layer 450b, and the third light emitting layer 450c may be configured as red, green, and blue light emitting layers irrespective of order.

[0152] Thereafter, as shown in FIG. 7K, an electron transport layer 460 and a common electrode 480 as a cathode are formed on the substrate 410 on which the first light emitting layer 450a, the second light emitting layer 450b, and the third light emitting layer 450c have been formed.

[0153] Here, the electron transport layer 460 may include an electron injection layer. The common electrode 480, which receives a common voltage, may be made of a reflective conductive material including calcium (Ca), barium (Ba), magnesium (Mg), aluminum (Al), silver (Ag), or the like, or a transparent conductive material.

[0154] In the OLED display device configured as described above, the first gate electrode connected to the gate line and the first source electrode and the first drain electrode connected to the data line may constitute a first switching thin film transistor (TFT) along with the first active layer. Also, the second gate electrode connected to the first drain electrode, the second source electrode connected to the driving voltage line, and the second drain electrode connected to the pixel electrode 220 may constitute a driving TFT along with the second active layer.

[0155] Also, the pixel electrode 420, the light emitting layers 450a, 450b, and 450c, and the common electrode 480 may constitute an OLED, and the mutually overlapping storage electrode and driving voltage line may constitute a storage capacitor.

[0156] In this manner, for example, when the first light emitting layer 450a, the second light emitting layer 450b, and the third light emitting layer 450c are a red light emitting layer, a green light emitting layer, and a blue light emitting layer, respectively, the red light emitting layer and the green light emitting layer are patterned through a lift-off process and the blue light emitting layer may be commonly formed on the entire surface.

[0157] However, the present example is not limited thereto. Namely, the green light emitting layer and the blue light emitting layer may be patterned through a lift-off process while the red light emitting layer may be commonly formed on the entire surface, or the red light emitting layer and the blue light emitting layer may be patterned through a lift-off process while the green light emitting layer may be commonly formed on the entire surface.

[0158] FIG. 8 is a sectional view showing another example of an OLED display device fabricated according to the fourth embodiment not representing the present invention illustrated in FIGS. 7A through 7K, in which a first organic film is deposited on the entire surface of the substrate 410 with the second light emitting layer 450b and the third light emitting layer 450c formed thereon, to from the first light emitting layer 450a.

[0159] Here, the first light emitting layer 450a is formed with a certain thickness even on upper portions of the second light emitting layer 450b and the third light emitting layer 450c, as well as between the second light emitting layer 450b and the third light emitting layer 450c.

[0160] FIG. 9 is a sectional view showing another example of an OLED display device fabricated according to the fourth embodiment not representing the present invention illustrated in FIGS. 7A through 7K, in which a second inorganic film is deposited on the entire surface of the substrate 410 with the first light emitting layer 450a and the third light emitting layer 450c formed thereon, to form the second light emitting layer 450b.

[0161] Here, the second light emitting layer 450b is formed with a certain thickness even on upper portions of the first light emitting layer 450a and the third light emitting layer 450c, as well as between the first light emitting layer 450a and the third light emitting layer 450c.

[0162] Meanwhile, damage to an organic compound layer due to a photo process may be prevented according to other methods than those of the embodiment of the present invention. Namely, an organic compound layer may be protected against a photo process by patterning the organic compound layer by using a cathode as a mask. This will be described in detail according to fifth and sixth embodiments not representing the present invention.

[0163] FIGS. 10A through 10H are sequential sectional views illustrating a method for fabricating an OLED display device according to a fifth embodiment not representing the present invention.

[0164] Although not shown, in an OLED display device according to a fifth embodiment not representing the present invention, a gate line including a first gate electrode and a storage electrode including a second gate electrode may be formed on a substrate 510 made of an insulating material such as transparent glass, plastic, or the like.

[0165] A gate insulating layer made of silicon nitride (SiNx), silicon oxide (SiO_2), or the like, may be formed on the gate line including the first gate electrode and the storage electrode including the second electrode.

[0166] A first active layer and a second active layer, made of semiconductor, may be formed on the gate insulating layer. The first active layer and the second active layer may be positioned on the first gate electrode and the second gate electrode, respectively.

[0167] A data line, a driving voltage line, a first source/drain electrode, and a second source/drain electrode may be formed on an upper portion of the first active layer and the second active layer.

[0168] A predetermined passivation layer may be formed on the substrate 510 on which the data line, the driving voltage line, the first source/drain electrode, and the second source/drain electrode have been formed.

[0169] As shown in FIG. 10A, a pixel electrode 520 and a connecting electrode (not shown) may be formed on the substrate 510 with the passivation film formed thereon. The pixel electrode 520 and the connecting electrode may be made of a transparent conductive material such as indium tin oxide (ITO) or a reflective conductive material such as aluminum, silver, or an alloy thereof.

[0170] The pixel electrode 520 as an anode may be electrically connected to the second drain electrode through a second contact hole, and the connecting electrode may electrically connect the first drain electrode and the second gate electrode through a first contact hole and a third contact hole.

[0171] A partition (not shown) may be formed on the substrate 510 with the pixel electrode 520 formed thereon. Here, the partition may encompass the edges of the pixel electrode 520, like a bank, to define an opening, and may be made of an organic insulating material or an inorganic insulating material.

[0172] An organic compound layer may be formed on the substrate 510.

[0173] Here, the organic compound layer may have a multilayer structure including an auxiliary layer in order to enhance luminous efficiency of a light emitting layer that emits light, besides the light emitting layer. The auxiliary layer may include an electron transport layer and a hole transport layer for balancing electrons and holes and an electron injection layer and a hole injection layer for strengthening injection of electrons and holes.

[0174] Namely, as shown in FIG. 10B, a thin film 531 for a first hole injection layer, a thin film 541 for a first hole transport layer, a first organic film 551, a thin film 561 for a first electron transport layer, and a first conductive film 581 are sequentially deposited on the substrate 510 with the pixel electrode 520 formed thereon.

[0175] Here, the thin film 561 for a first electron transport layer may include a thin film for a first electron injection layer, and the first conductive film 581 may be made of a reflective conductive material including calcium (Ca), barium (Ba), magnesium (Mg), aluminum (Al), silver (Ag), or the like, or a transparent conductive material such as ITO, IZO, or the like.

[0176] Thereafter, as shown in FIG. 10C, a photosensitive resin is coated on the entire surface of the substrate 510, on which the thin film 531 for a first hole injection layer, the thin film 541 for a first hole transport layer, the first organic film 551, the thin film 561 for a first electron transport layer, and the first conductive film 581 have been deposited, to form a first photosensitive resin layer 591.

[0177] Thereafter, UV rays are selectively irradiated to the first photosensitive resin layer 591 through a certain mask M.

[0178] Thereafter, when the first photosensitive resin layer 591 exposed through the mask M is developed, a first photosensitive resin pattern 590a made of the photosensitive resin remains only at a position where a first light emitting layer is to be formed as shown in FIG. 10D.

[0179] Here, the first photosensitive resin pattern 590a may be patterned to have at least the same width as that of the underlying pixel electrode 520 in consideration of an alignment error of the mask M and other processing errors.

[0180] Thereafter, as shown in FIG. 10E, when a partial region of first conductive film formed under the first photosensitive resin pattern 590a is selectively etched by using the first photosensitive resin pattern 590a as a mask, a first common electrode 580a formed of the first conductive film is formed at a position where the first light emitting layer is to be formed.

[0181] Here, the etching may include wet etching as well as dry etching.

[0182] Thereafter, as shown in FIG. 10F, a remnant of the first photosensitive resin pattern is removed through ashing, stripping, or the like, and here, as partial regions of the thin film for a first hole injection layer, the thin film for a first hole transport layer, the first organic film, and the thin film for a first electron transport layer exposed thereunder are selectively removed by using the first common electrode 580a as a mask, a first hole injection layer 530a, a first hole transport layer 540a, a first light emitting layer 550a, and a first electron transport layer 560a, which are formed of the thin film for a first hole injection layer, the thin film for a first hole transport layer, the first organic film, and the thin film for a first electron transport layer, respectively, are formed (a first photo process).

[0183] In this manner, since the first common electrode 580a is positioned as a barrier layer on an upper portion of the organic compound layer, namely, on the first electron transport layer 560a, the organic compound layer, in particular, the first electron transport layer 560a, can be prevented from being degraded during the photo process, thus preventing a degradation of the device.

[0184] Here, the first light emitting layer 550a may be a red light emitting layer, but the present invention is not limited thereto and the first light emitting layer 550a may be a green or blue light emitting layer.

[0185] Next, as shown in FIG. 10G, a second hole injection layer 530b, a second hole transport layer 540b, a second light emitting layer 550b, a second electron transport layer 560b, and a second common electrode 580b, which are formed of a thin film for a second hole injection layer, a thin film for a second hole transport layer, a second organic film, a thin film for a second electron transport layer, and a second conductive film, respectively, are formed on the substrate 510 through a second photo process which is substantially the same as the first photo process as mentioned above.

[0186] Here, the second conductive film may be made of a reflective conductive material including calcium (Ca), barium (Ba), magnesium (Mg), aluminum (Al), silver (Ag), or the like, or a transparent conductive material such as ITO, IZO, or the like.

[0187] Here, for example, the second light emitting layer 550b may be a green light emitting layer. However, the present embodiment is not limited thereto and when the first light emitting layer 550a is a red light emitting layer, the second light emitting layer 550b may be a blue light emitting layer, other than a green light emitting layer.

[0188] Thereafter, as shown in FIG. 10H, a third hole injection layer 530c, a third hole transport layer 540c, a third light emitting layer 550c, a third electron transport layer 560c, and a third common electrode 580c, which are formed of a thin film for a third hole injection layer, a thin film for a third hole transport layer, a third organic film, a thin film for a third electron transport layer, and a third conductive film, respectively, are formed on the substrate 510 through a third photo process which is substantially the same as the first and second photo processes as mentioned above.

[0189] Here, the third conductive film may be made of a reflective conductive material including calcium (Ca), barium (Ba), magnesium (Mg), aluminum (Al), silver (Ag), or the like, or a transparent conductive material such as ITO, IZO, or the like.

[0190] Here, for example, when the first light emitting layer 550a is a red light emitting layer and the second light emitting layer 550b is a green light emitting layer, the third light emitting layer 550c may be a blue light emitting layer. Also, when the first light emitting layer 550a is a red light emitting layer and the second light emitting layer 550b is a blue light emitting layer, the third light emitting layer 550c may be a green light emitting layer. However, the first light emitting layer 550a, the second light emitting layer 550b, and the third light emitting layer 550c may be configured as red, green, and blue light emitting layers irrespective of order.

[0191] In the OLED display device configured as described above, the first gate electrode connected to the gate line and the first source electrode and the first drain electrode connected to the data line may constitute a first switching thin film transistor (TFT) along with the first active layer. Also, the second gate electrode connected to the first drain electrode, the second source electrode connected to the driving voltage line, and the second drain electrode connected to the pixel electrode 520 may constitute a driving TFT along with the second active layer.

[0192] Also, the pixel electrode 520, the light emitting layers 550a, 550b, and 550c, and the common electrodes 580a, 580b, and 580c may constitute an OLED, and the mutually overlapping storage electrode and driving voltage line may constitute a storage capacitor.

[0193] Here, in the OLED display device according to the fifth embodiment not representing the present invention, the organic compound layer and the common electrodes are patterned at intervals between neighboring pixels.

[0194] FIGS. 11A through 11H are sequential sectional views illustrating a method for fabricating an OLED display device according to a sixth embodiment not representing the present invention, in which a method for fabricating an OLED diode with respect to some pixels is taken as an example.

[0195] In this case, the OLED display device according to a sixth embodiment not representing the present invention has the same configuration as that of the fifth embodiment, except that the organic compound layer and the common electrodes are patterned to be in contact with each other between neighboring pixels.

[0196] Although not shown, in an OLED display device according to the sixth embodiment, a gate line including a first gate electrode and a storage electrode including a second gate electrode may be formed on a substrate 610 made of an insulating material such as transparent glass, plastic, or the like.

[0197] A gate insulating layer made of silicon nitride (SiNx), silicon oxide (SiO_2), or the like, may be formed on the gate line including the first gate electrode and the storage electrode including the second electrode.

[0198] A first active layer and a second active layer, made of semiconductor, may be formed on the gate insulating layer. The first active layer and the second active layer may be positioned on the first gate electrode and the second gate electrode, respectively.

[0199] A data line, a driving voltage line, a first source/drain electrode, and a second source/drain electrode may be formed on an upper portion of the first active layer and the second active layer.

[0200] A predetermined passivation layer may be formed on the substrate 610 on which the data line, the driving voltage line, the first source/drain electrode, and the second source/drain electrode have been formed.

[0201] As shown in FIG. 11A, a pixel electrode 620 and a connecting electrode (not shown) may be formed on the substrate 610 with the passivation film formed thereon. The pixel electrode 620 and the connecting electrode may be made of a transparent conductive material such as indium tin oxide (ITO) or a reflective conductive material such as aluminum, silver, or an alloy thereof.

[0202] The pixel electrode 620 as an anode may be electrically connected to the second drain electrode through a second contact hole, and the connecting electrode may electrically connect the first drain electrode and the second gate electrode through a first contact hole and a third contact hole.

[0203] A partition (not shown) may be formed on the substrate 610 with the pixel electrode 620 formed thereon. Here, the partition may encompass the edges of the pixel electrode 620, like a bank, to define an opening, and may be made of an organic insulating material or an inorganic insulating material.

[0204] An organic compound layer may be formed on the substrate 610.

[0205] Here, the organic compound layer may have a multilayer structure including an auxiliary layer in order to enhance luminous efficiency of a light emitting layer that emits light, besides the light emitting layer. The auxiliary layer may include an electron transport layer and a hole transport layer for balancing electrons and holes and an electron injection layer and a hole injection layer for strengthening injection of electrons and holes.

[0206] Namely, as shown in FIG. 11B, a thin film 631 for a first hole injection layer, a thin film 641 for a first hole transport layer, a first organic film 651, a thin film 661 for a first electron transport layer, and a first conductive film 681 are sequentially deposited on the substrate 610 with the pixel electrode 620 formed thereon.

[0207] Here, the thin film 661 for a first electron transport layer may include a thin film for a first electron injection layer, and the first conductive film 681 may be made of a reflective conductive material including calcium (Ca), barium (Ba), magnesium (Mg), aluminum (Al), silver (Ag), or the like, or a transparent conductive material such as ITO, IZO, or the like.

[0208] Thereafter, as shown in FIG. 11C, a photosensitive resin is coated on the entire surface of the substrate 610, on which the thin film 631 for a first hole injection layer, the thin film 641 for a first hole transport layer, the first organic film 651, the thin film 661 for a first electron transport layer, and the first conductive film 681 have been deposited, to form a first photosensitive resin layer 691.

[0209] Thereafter, UV rays are selectively irradiated to the first photosensitive resin layer 691 through a certain mask M.

[0210] Thereafter, when the first photosensitive resin layer 691 exposed through the mask M is developed, a first photosensitive resin pattern 690a made of the photosensitive resin remains only at a position where a first light emitting layer is to be formed as shown in FIG. 11D.

[0211] Here, the first photosensitive resin pattern 690a may be patterned such that the organic compound layer and a common electrode are patterned to be in contact with each other between neighboring pixels.

[0212] Thereafter, as shown in FIG. 11E, when a partial region of first conductive film formed under the first photosensitive resin pattern 690a is selectively etched by using the first photosensitive resin pattern 690a as a mask, a first common electrode 680a formed of the first conductive film is formed at a position where the first light emitting layer is to be formed.

[0213] Here, the etching may include wet etching as well as dry etching.

[0214] Thereafter, as shown in FIG. 11F, a remnant of the first photosensitive resin pattern is removed through ashing, stripping, or the like, and here, as partial regions of the thin film for a first hole injection layer, the thin film for a first hole transport layer, the first organic film, and the thin film for a first electron transport layer exposed thereunder are selectively removed by using the first common electrode 680a as a mask, a first hole injection layer 630a, a first hole transport layer 640a, a first light emitting layer 650a, and a first electron transport layer 660a, which are formed of the thin film for a first hole injection layer, the thin film for a first hole transport layer, the first organic film, and the thin film for a first electron transport layer, respectively, are formed (a first photo process).

[0215] In this manner, since the first common electrode 680a is positioned as a barrier layer on an upper portion of the organic compound layer, namely, on the first electron transport layer 660a, the organic compound layer, in particular, the first electron transport layer 660a, can be prevented from being degraded during the photo process, thus preventing a degradation of the device.

[0216] Here, the first light emitting layer 650a may be a red light emitting layer, but the present invention is not limited thereto and the first light emitting layer 650a may be a green or blue light emitting layer.

[0217] Next, as shown in FIG. 11G, a second hole injection layer 630b, a second hole transport layer 640b, a second light emitting layer 650b, a second electron transport layer 660b, and a second common electrode 680b, which are formed of a thin film for a second hole injection layer, a thin film for a second hole transport layer, a second organic film, a thin film for a second electron transport layer, and a second conductive film, respectively, are formed on the substrate 610 through a second photo process which is substantially the same as the first photo process as mentioned above.

[0218] Here, the second conductive film may be made of a reflective conductive material including calcium (Ca), barium (Ba), magnesium (Mg), aluminum (Al), silver (Ag), or the like, or a transparent conductive material such as ITO, IZO, or the like.

[0219] Here, for example, the second light emitting layer 650b may be a green light emitting layer. However, the present example is not limited thereto and when the first light emitting layer 650a is a red light emitting layer, the second light emitting layer 650b may be a blue light emitting layer, other than a green light emitting layer.

[0220] Thereafter, as shown in FIG. 11H, a third hole injection layer 630c, a third hole transport layer 640c, a third light emitting layer 650c, a third electron transport layer 660c, and a third common electrode 680c, which are formed of a thin film for a third hole injection layer, a thin film for a third hole transport layer, a third organic film, a thin film for a third electron transport layer, and a third conductive film, respectively, are formed on the substrate 610 through a third photo process which is substantially the same as the first and second photo processes as mentioned above.

[0221] Here, the third conductive film may be made of a reflective conductive material including calcium (Ca), barium (Ba), magnesium (Mg), aluminum (Al), silver (Ag), or the like, or a transparent conductive material such as ITO, IZO, or the like.

[0222] Here, for example, when the first light emitting layer 650a is a red light emitting layer and the second light emitting layer 650b is a green light emitting layer, the third light emitting layer 650c may be a blue light emitting layer. Also, when the first light emitting layer 650a is a red light emitting layer and the second light emitting layer 650b is a blue light emitting layer, the third light emitting layer 650c may be a green light emitting layer. However, the first light emitting layer 650a, the second light emitting layer 650b, and the third light emitting layer 650c may be configured as red, green, and blue light emitting layers irrespective of order.

[0223] In the OLED display device configured as described above, the first gate electrode connected to the gate line and the first source electrode and the first drain electrode connected to the data line may constitute a first switching thin film transistor (TFT) along with the first active layer. Also, the second gate electrode connected to the first drain electrode, the second source electrode connected to the driving voltage line, and the second drain electrode connected to the pixel electrode 620 may constitute a driving TFT along with the second active layer.

[0224] Also, the pixel electrode 620, the light emitting layers 650a, 650b, and 650c, and the common electrodes 680a, 680b, and 680c may constitute an OLED, and the mutually overlapping storage electrode and driving voltage line may constitute a storage capacitor.

Claims

1. A method for fabricating an organic light emitting diode (OLED) display device, the method comprising:

> forming a plurality of first electrodes (220) on a substrate (210);
> forming, sequentially, a first hole injection layer (230a), a first hole transport layer (240a), a first light emitting layer (250a), a first electron transport layer (260a), and a first buffer layer (270a) in a laminated manner on the substrate (210) to cover first ones of the first electrodes (220) through a first photo process;
> forming, sequentially, a second hole injection layer (230b), a second hole transport layer (240b), a second light emitting layer (250b), a second electron transport layer (260b), and a second buffer layer (270b) in a laminated manner on the substrate (210) to cover second ones of the first electrodes (220) through a second photo process;
> forming, sequentially, a third hole injection layer (230c), a third hole transport layer (240c), a third light emitting layer (250c), a third electron transport layer (260c), and a third buffer layer (270c) in a laminated manner on the substrate to cover third ones of the first electrodes (220) through a third photo process; and
> forming a second electrode on the first, second, and third buffer layers (270a, 270b, 270c),
> wherein the first, second, and third buffer layers (270a, 270b, 270c) are made of a metal oxide,

wherein the forming of the first hole injection layer (230a), the first hole transport layer (240a), the first light emitting layer (250a), the first electron transport layer (260a), and the first buffer layer (270a) comprises:

> depositing, sequentially, a thin film (231) for a first hole injection layer (230a), a thin film (241) for a first hole transport layer (240a), a first or-

ganic film (251), a thin film (261) for a first electron transport layer (260a), and a thin film (271) for a first buffer layer (270a) on the substrate (210);
applying a photosensitive resin to the entire surface of the substrate (210) with the thin film (231) for a first hole injection layer (230a), the thin film (241) for a first hole transport layer (240a), the first organic film (251), the thin film (261) for a first electron transport layer (260a), and the thin film (271) for a first buffer layer (270a) deposited thereon to form a first photosensitive resin layer (291);
exposing and developing the first photosensitive resin layer (291) to form a first photosensitive resin pattern (290a) made of the photosensitive resin at a position where a first light emitting layer is to be formed; followed by
selectively etching the thin film (231) for a first hole injection layer (230a), the thin film (241) for a first hole transport layer (240a), the first organic film (251), the thin film (261) for a first electron transport layer (260a), and the thin film (271) for a first buffer layer (270a) by using the first photosensitive resin pattern as a mask to form the first hole injection layer (230a), the first hole transport layer (240a), the first light emitting layer (250a), the first electron transport layer (260a), and the first buffer layer (270a), which are formed of thin film (231) for a first hole injection layer (230a), the thin film (241) for a first hole transport layer (240a), the first organic film (251), the thin film (261) for a first electron transport layer (260a), and the thin film (271) for a first buffer layer (270a), respectively, on the substrate (210).

2. The method of claim 1, wherein the forming of the second hole injection layer (230b), the second hole transport layer (240b), the second light emitting layer (250b), the second electron transport layer (260b), and the second buffer layer (270b) comprises:

depositing, sequentially, a thin film for a second hole injection layer (230b), a thin film for a second hole transport layer (240b), a second organic film, a thin film for a second electron transport layer (260b), and a thin film for a second buffer layer (270b) on the substrate;
applying a photosensitive resin to the entire surface of the substrate (210) with the thin film for a second hole injection layer (230b), the thin film for a second hole transport layer (240b), the second organic film, the thin film for a second electron transport layer (260b), and the thin film for a second buffer layer (270b) deposited thereon to form a second photosensitive resin layer;
exposing and developing the second photosensitive resin layer to form a second photosensitive resin pattern made of the photosensitive resin at a position where a second light emitting layer is to be formed; followed by
selectively etching the thin film for a second hole injection layer (230b), the thin film for a second hole transport layer (240b), the second organic film, the thin film for a second electron transport layer (260b), and the thin film for a second buffer layer (270b) by using the second photosensitive resin pattern as a mask to form the second hole injection layer (230b), the second hole transport layer (240b), the second light emitting layer, the second electron transport layer (260b), and the second buffer layer (270b), which are formed of thin film for a second hole injection layer (230b), the thin film for a second hole transport layer (240b), the second organic film, the thin film for a second electron transport layer (260b), and the thin film for a second buffer layer (270b), respectively, on the substrate (210).

3. The method of claim 1, wherein the forming of the third hole injection layer (230c), the third hole transport layer (240c), the third light emitting layer (250c), the third electron transport layer (260c), and the third buffer layer (270c) comprises:

depositing, sequentially, a thin film for a third hole injection layer (230c), a thin film for a third hole transport layer (240c), a third organic film, a thin film for a third electron transport layer (260c), and a thin film for a third buffer layer (270c) on the substrate (210);
applying a photosensitive resin to the entire surface of the substrate (210) with the thin film for a third hole injection layer (230c), the thin film for a third hole transport layer (240c), the third organic film, the thin film for a third electron transport layer (260c), and the thin film for a third buffer layer (270c) deposited thereon to form a third photosensitive resin layer;
exposing and developing the third photosensitive resin layer to form a third photosensitive resin pattern made of the photosensitive resin at a position where a third light emitting layer is to be formed; followed by
selectively etching the thin film for a third hole injection layer (230c), the thin film for a third hole transport layer (240c), the third organic film, the thin film for a third electron transport layer (260c), and the thin film for a third buffer layer (270c) by using the third photosensitive resin pattern as a mask to form the third hole injection layer (230c), the third hole transport layer (240c), the third light emitting layer, the third electron transport layer (260c), and the third buffer layer (270c), which are formed of thin film

for a third hole injection layer (230c), the thin film for a third hole transport layer (230c), the third organic film, the thin film for a third electron transport layer (260c), and the thin film for a third buffer layer (270c), respectively, on the substrate (210).

4. The method of claim 1, wherein the first, second, and third buffer layers (270a, 270b, 270c) are made of a 1-2 Group and 12-16 Group metal oxide or 3-12 Group transition metal oxide.

Patentansprüche

1. Verfahren zum Herstellen einer Anzeigevorrichtung mit organischen Leuchtdioden (OLED-Anzeigevorrichtung), wobei das Verfahren Folgendes umfasst:

Bilden mehrerer erster Elektroden (220) auf einem Substrat (210);
aufeinanderfolgendes Bilden einer ersten Lochinjektionsschicht (230a), einer ersten Lochtransportschicht (240a), einer ersten lichtemittierenden Schicht (250a), einer ersten Elektronentransportschicht (260a) und einer ersten Pufferschicht (270a) auf eine geschichtete Weise auf dem Substrat (210), derart, dass erste der ersten Elektroden (220) abgedeckt werden, durch einen ersten Photoprozess;
aufeinanderfolgendes Bilden einer zweiten Lochinjektionsschicht (230b), einer zweiten Lochtransportschicht (240b), einer zweiten lichtemittierenden Schicht (250b), einer zweiten Elektronentransportschicht (260b) und einer zweiten Pufferschicht (270b) auf eine geschichtete Weise auf dem Substrat (210), derart, dass zweite der ersten Elektroden (220) abgedeckt werden, durch einen zweiten Photoprozess;
aufeinanderfolgendes Bilden einer dritten Lochinjektionsschicht (230c), einer dritten Lochtransportschicht (240c), einer dritten lichtemittierenden Schicht (250c), einer dritten Elektronentransportschicht (260c) und einer dritten Pufferschicht (270c) auf eine geschichtete Weise auf dem Substrat, derart, dass dritte der ersten Elektroden (220) abgedeckt werden, durch einen dritten Photoprozess; und
Bilden einer zweiten Elektrode auf der ersten, der zweiten und der dritten Pufferschicht (270a, 270b, 270c),
wobei die erste, die zweite und die dritte Pufferschicht (270a, 270b, 270c) aus einem Metalloxid hergestellt sind,
wobei das Bilden der ersten Lochinjektionsschicht (230a), der ersten Lochtransportschicht (240a), der ersten lichtemittierenden Schicht (250a), der ersten Elektronentransportschicht (260a) und der ersten Pufferschicht (270a) Folgendes umfasst:

aufeinanderfolgendes Ablagern einer Dünnschicht (231) für eine erste Lochinjektionsschicht (230a), einer Dünnschicht (241) für eine erste Lochtransportschicht (240a), eines ersten organischen Films (251), einer Dünnschicht (261) für eine erste Elektronentransportschicht (260a) und einer Dünnschicht (271) für eine erste Pufferschicht (270a) auf dem Substrat (210);
Aufbringen eines lichtempfindlichen Harzes auf die gesamte Oberfläche des Substrats (210), auf der die Dünnschicht (231) für eine erste Lochinjektionsschicht (230a), die Dünnschicht (241) für eine erste Lochtransportschicht (240a), der erste organische Film (251), die Dünnschicht (261) für eine erste Elektronentransportschicht (260a) und die Dünnschicht (271) für eine erste Pufferschicht (270a) abgelagert sind, um eine erste lichtempfindliche Harzschicht (291) zu bilden;
Belichten und Entwickeln der ersten lichtempfindlichen Harzschicht (291), um eine erste lichtempfindliche Harzstruktur (290a), die aus dem lichtempfindlichen Harz gebildet ist, an einer Position, an der eine erste lichtemittierende Schicht gebildet werden soll, zu bilden; gefolgt von
selektivem Ätzen der Dünnschicht (231) für eine erste Lochinjektionsschicht (230a), der Dünnschicht (241) für eine erste Lochtransportschicht (240a), des ersten organischen Films (251), der Dünnschicht (261) für eine erste Elektronentransportschicht (260a) und der Dünnschicht (271) für eine erste Pufferschicht (270a) unter Verwendung der ersten lichtempfindlichen Harzstruktur als eine Maske, um die erste Lochinjektionsschicht (230a), die erste Lochtransportschicht (240a), die erste lichtemittierenden Schicht (250a), die erste Elektronentransportschicht (260a) und die erste Pufferschicht (270a) zu bilden, die aus der Dünnschicht (231) für eine erste Lochinjektionsschicht (230a) bzw. der Dünnschicht (241) für eine erste Lochtransportschicht (240a) bzw. dem ersten organische Film (251) bzw. der Dünnschicht (261) für eine erste Elektronentransportschicht (260a) bzw. der Dünnschicht (271) für eine erste Pufferschicht (270a) auf dem Substrat (210) gebildet sind.

2. Verfahren nach Anspruch 1, wobei das Bilden der zweiten Lochinjektionsschicht (230b), der zweiten

Lochtransportschicht (240b), der zweiten lichtemittierenden Schicht (250b), der zweiten Elektronentransportschicht (260b) und der zweiten Pufferschicht (270b) Folgendes umfasst:

aufeinanderfolgendes Ablagern einer Dünnschicht für eine zweite Lochinjektionsschicht (230b), einer Dünnschicht für eine zweite Lochtransportschicht (240b), eines zweiten organischen Films, einer Dünnschicht für eine zweite Elektronentransportschicht (260b) und einer Dünnschicht für eine zweite Pufferschicht (270b) auf dem Substrat;
Aufbringen eines lichtempfindlichen Harzes auf die gesamte Oberfläche des Substrats (210), auf der die Dünnschicht für eine zweite Lochinjektionsschicht (230b), die Dünnschicht für eine zweite Lochtransportschicht (240b), der zweite organische Film, die Dünnschicht für eine zweite Elektronentransportschicht (260b) und die Dünnschicht für eine zweite Pufferschicht (270b) abgelagert sind, um eine zweite lichtempfindliche Harzschicht zu bilden;
Belichten und Entwickeln der zweiten lichtempfindlichen Harzschicht, um eine zweite lichtempfindliche Harzstruktur, die aus dem lichtempfindlichen Harz gebildet ist, an einer Position, an der eine zweite lichtemittierende Schicht gebildet werden soll, zu bilden; gefolgt von
selektivem Ätzen der Dünnschicht für eine zweite Lochinjektionsschicht (230b), der Dünnschicht für eine zweite Lochtransportschicht (240b), des zweiten organischen Films, der Dünnschicht für eine zweite Elektronentransportschicht (260b) und der Dünnschicht für eine zweite Pufferschicht (270b) unter Verwendung der zweiten lichtempfindlichen Harzstruktur als eine Maske, um die zweite Lochinjektionsschicht (230b), die zweite Lochtransportschicht (240b), die zweite lichtemittierenden Schicht (250b), die zweite Elektronentransportschicht (260b) und die zweite Pufferschicht (270b) zu bilden, die aus der Dünnschicht für eine zweite Lochinjektionsschicht (230b) bzw. der Dünnschicht für eine zweite Lochtransportschicht (240b) bzw. dem zweiten organische Film bzw. der Dünnschicht für eine zweite Elektronentransportschicht (260b) bzw. der Dünnschicht für eine zweite Pufferschicht (270b) auf dem Substrat (210) gebildet sind.

3. Verfahren nach Anspruch 1, wobei das Bilden der dritten Lochinjektionsschicht (230c), der dritten Lochtransportschicht (240c), der dritten lichtemittierenden Schicht (250c), der dritten Elektronentransportschicht (260c) und der dritten Pufferschicht (270c) Folgendes umfasst:

aufeinanderfolgendes Ablagern einer Dünnschicht für eine dritte Lochinjektionsschicht (230c), einer Dünnschicht für eine dritte Lochtransportschicht (240c), einer dritten organischen Films, einer Dünnschicht für eine dritte Elektronentransportschicht (260c) und einer Dünnschicht für eine dritte Pufferschicht (270c) auf dem Substrat (210);
Aufbringen eines lichtempfindlichen Harzes auf die gesamte Oberfläche des Substrats (210), auf der die Dünnschicht für eine dritte Lochinjektionsschicht (230c), die Dünnschicht für eine dritte Lochtransportschicht (240c), der dritte organische Film, die Dünnschicht für eine dritte Elektronentransportschicht (260c) und die Dünnschicht für eine dritte Pufferschicht (270c) abgelagert sind, um eine dritte lichtempfindliche Harzschicht zu bilden;
Belichten und Entwickeln der dritten lichtempfindlichen Harzschicht, um eine dritte lichtempfindliche Harzstruktur, die aus dem lichtempfindlichen Harz gebildet ist, an einer Position, an der eine dritte lichtemittierende Schicht gebildet werden soll, zu bilden; gefolgt von
selektivem Ätzen der Dünnschicht für eine dritte Lochinjektionsschicht (230c), der Dünnschicht für eine dritte Lochtransportschicht (240c), des dritten organischen Films, der Dünnschicht für eine dritte Elektronentransportschicht (260c) und der Dünnschicht für eine dritte Pufferschicht (270c) unter Verwendung der dritten lichtempfindlichen Harzstruktur als eine Maske, um die dritte Lochinjektionsschicht (230c), die dritte Lochtransportschicht (240c), die dritte lichtemittierenden Schicht (250c), die dritte Elektronentransportschicht (260c) und die dritte Pufferschicht (270c) zu bilden, die aus der Dünnschicht für eine dritte Lochinjektionsschicht (230c) bzw. der Dünnschicht für eine dritte Lochtransportschicht (240c) bzw. dem dritten organische Film bzw. der Dünnschicht für eine dritte Elektronentransportschicht (260c) bzw. der Dünnschicht für eine dritte Pufferschicht (270c) auf dem Substrat (210) gebildet sind.

4. Verfahren nach Anspruch 1, wobei die erste, zweite und dritte Pufferschicht (270a, 270b, 270c) aus einem Metalloxid der Gruppe 1-2 und der Gruppe 12-16 oder einem Übergangsmetalloxid der Gruppe 3-12 hergestellt sind.

Revendications

1. Procédé pour fabriquer un dispositif d'affichage à diodes électroluminescentes organiques (OLED), le procédé comportant les étapes consistant à :

former une pluralité de premières électrodes (220) sur un substrat (210) ;
former, séquentiellement, une première couche d'injection de trous (230a), une première couche de transport de trous (240a), une première couche électroluminescente (250a), une première couche de transport d'électrons (260a) et une première couche tampon (270a) d'une manière stratifiée sur le substrat (210) pour recouvrir des premières électrodes parmi les premières électrodes (220) via un premier processus de photolithographie ;
former, séquentiellement, une deuxième couche d'injection de trous (230b), une deuxième couche de transport de trous (240b), une deuxième couche électroluminescente (250b), une deuxième couche de transport d'électrons (260b) et une deuxième couche tampon (270b) d'une manière stratifiée sur le substrat (210) pour recouvrir des deuxièmes électrodes parmi les premières électrodes (220) via un deuxième processus de photolithographie ;
former, séquentiellement, une troisième couche d'injection de trous (230c), une troisième couche de transport de trous (240c), une troisième couche électroluminescente (250c), une troisième couche de transport d'électrons (260c) et une troisième couche tampon (270c) d'une manière stratifiée sur le substrat pour recouvrir des troisième électrodes parmi les premières électrodes (220) via un troisième processus de photolithographie ; et
former une seconde électrode sur les première, deuxième et troisième couches tampon (270a, 270b, 270c),
dans lequel les première, deuxième et troisième couches tampon (270a, 270b, 270c) sont constituées d'un oxyde de métal,
dans lequel la formation de la première couche d'injection de trous (230a), de la première couche de transport de trous (240a), de la première couche électroluminescente (250a), de la première couche de transport d'électrons (260a) et de la première couche tampon (270a) comporte les étapes consistant à :

déposer, séquentiellement, un film mince (231) pour une première couche d'injection de trous (230a), un film mince (241) pour une première couche de transport de trous (240a), un premier film organique (251), un film mince (261) pour une première couche de transport d'électrons (260a), et un film mince (271) pour une première couche tampon (270a) sur le substrat (210) ;
appliquer une résine photosensible sur la surface complète du substrat (210) avec le film mince (231) pour une première couche d'injection de trous (230a), le film mince (241) pour une première couche de transport de trous (240a), le premier film organique (251), le film mince (261) pour une première couche de transport d'électrons (260a), et le film mince (271) pour une première couche tampon (270a) déposés sur celui-ci pour former une première couche de résine photosensible (291) ;
exposer et développer la première couche de résine photosensible (291) pour former un premier motif de résine photosensible (290a) constitué de la résine photosensible à une position où une première couche électroluminescente doit être formée ; suivi de l'étape consistant à
graver sélectivement le film mince (231) pour une première couche d'injection de trous (230a), le film mince (241) pour une première couche de transport de trous (240a), le premier film organique (251), le film mince (261) pour une première couche de transport d'électrons (260a), et le film mince (271) pour une première couche tampon (270a) en utilisant le premier motif de résine photosensible comme un masque pour former la première couche d'injection de trous (230a), la première couche de transport de trous (240a), la première couche électroluminescente (250a), la première couche de transport d'électrons (260a) et la première couche tampon (270a), qui sont formées du film mince (231) pour une première couche d'injection de trous (230a), du film mince (241) pour une première couche de transport de trous (240a), du premier film organique (251), du film mince (261) pour une première couche de transport d'électrons (260a) et du film mince (271) pour une première couche tampon (270a), respectivement, sur le substrat (210).

2. Procédé selon la revendication 1, dans lequel la formation de la deuxième couche d'injection de trous (230b), de la deuxième couche de transport de trous (240b), de la deuxième couche électroluminescente (250b), de la deuxième couche de transport d'électrons (260b) et de la deuxième couche tampon (270b) comporte les étapes consistant à :

déposer, séquentiellement, un film mince pour une deuxième couche d'injection de trous (230b), un film mince pour une deuxième couche de transport de trous (240b), un deuxième film organique, un film mince pour une deuxième couche de transport d'électrons (260b), et un film mince pour une deuxième couche tampon

(270b) sur le substrat ;
appliquer une résine photosensible sur la surface complète du substrat (210) avec le film mince pour une deuxième couche d'injection de trous (230b), le film mince pour une deuxième couche de transport de trous (240b), le deuxième film organique, le film mince pour une deuxième couche de transport d'électrons (260b) et le film mince pour une deuxième couche tampon (270b) déposés sur celui-ci pour former une deuxième couche de résine photosensible ;
exposer et développer la deuxième couche de résine photosensible pour former un deuxième motif de résine photosensible constitué de la résine photosensible à une position où une deuxième couche électroluminescente doit être formée ; suivi de l'étape consistant à
graver sélectivement le film mince pour une deuxième couche d'injection de trous (230b), le film mince pour une deuxième couche de transport de trous (240b), le deuxième film organique, le film mince pour une deuxième couche de transport de trous (260b), et le film mince pour une deuxième couche tampon (270b) en utilisant le deuxième motif de résine photosensible comme un masque pour former la deuxième couche d'injection de trous (230b), la deuxième couche de transport de trous (240b), la deuxième couche électroluminescente, la deuxième couche de transport d'électrons (260b) et la deuxième couche tampon (270b), qui sont formées du film mince pour une deuxième couche d'injection de trous (230b), du film mince pour une deuxième couche de transport de trous (240b), du deuxième film organique, du film mince pour une deuxième couche de transport d'électrons (260b) et du film mince pour une deuxième couche tampon (270b), respectivement, sur le substrat (210).

3. Procédé selon la revendication 1, dans lequel la formation de la troisième couche d'injection de trous (230c), de la troisième couche de transport de trous (240c), de la troisième couche électroluminescente (250c), de la troisième couche de transport d'électrons (260c) et de la troisième couche tampon (270c) comporte les étapes consistant à :

déposer, séquentiellement, un film mince pour une troisième couche d'injection de trous (230c), un film mince pour une troisième couche de transport de trous (240c), un troisième film organique, un film mince pour une troisième couche de transport d'électrons (260c), et un film mince pour une troisième couche tampon (270c) sur le substrat (210) ;
appliquer une résine photosensible sur la surface complète du substrat (210) avec le film mince pour une troisième couche d'injection de trous (230c), le film mince pour une troisième couche de transport de trous (240c), le troisième film organique, le film mince pour une troisième couche de transport d'électrons (260c) et le film mince pour une troisième couche tampon (270c) déposés sur celui-ci pour former une troisième couche de résine photosensible ;
exposer et développer la troisième couche de résine photosensible pour former un troisième motif de résine photosensible constitué de la résine photosensible à une position où une troisième couche électroluminescente doit être formée ; suivi de l'étape consistant à
graver sélectivement le film mince pour une troisième couche d'injection de trous (230c), le film mince pour une troisième couche de transport de trous (240c), le troisième film organique, le film mince pour une troisième couche de transport de trous (260c), et le film mince pour une troisième couche tampon (270c) en utilisant le troisième motif de résine photosensible comme un masque pour former la troisième couche d'injection de trous (230c), la troisième couche de transport de trous (240c), la troisième couche électroluminescente, la troisième couche de transport d'électrons (260c) et la troisième couche tampon (270c), qui sont formées du film mince pour une troisième couche d'injection de trous (230c), du film mince pour une troisième couche de transport de trous (230c), du troisième film organique, du film mince pour une troisième couche de transport d'électrons (260c) et du film mince pour une troisième couche tampon (270c), respectivement, sur le substrat (210).

4. Procédé selon la revendication 1, dans lequel les première, deuxième et troisième couches tampon (270a, 270b, 270c) sont constituées d'un oxyde de métal des groupes 1 à 2 et des groupes 12 à 16 ou d'un oxyde de métal de transition des groupes 3 à 12.

FIG. 1

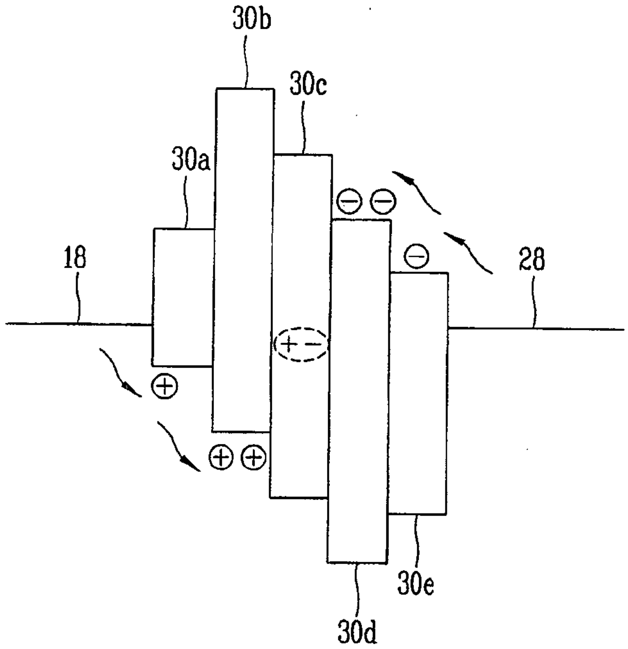


FIG. 2

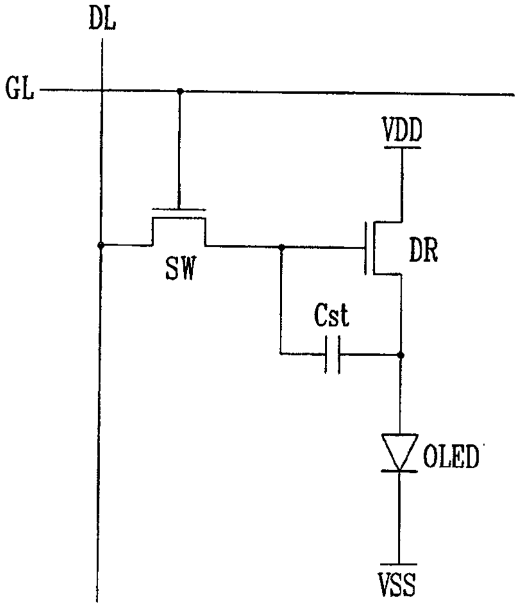


FIG. 3A

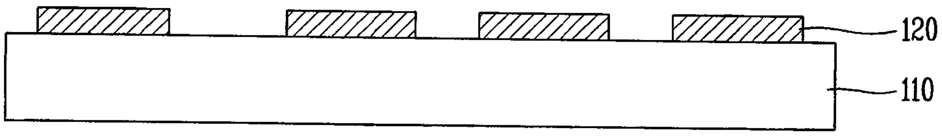


FIG. 3B

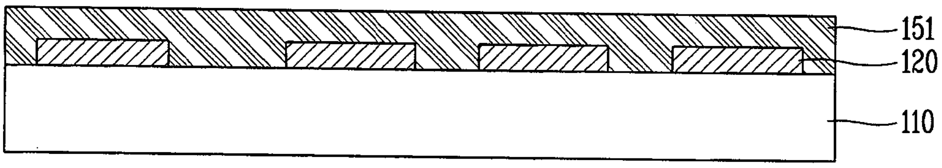


FIG. 3C

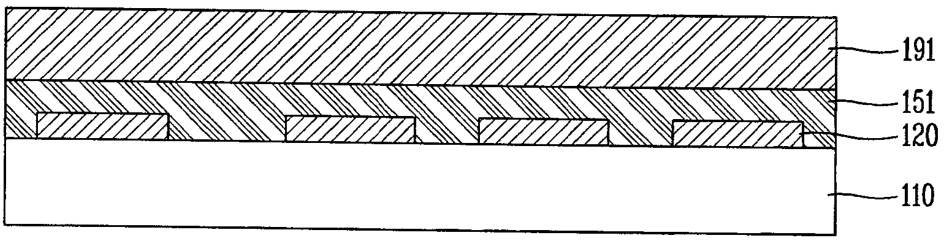


FIG. 3D

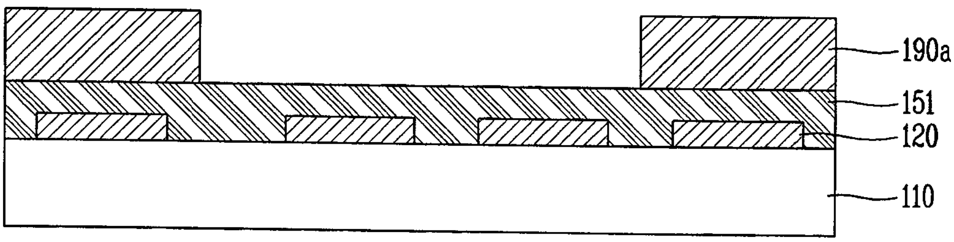


FIG. 3E

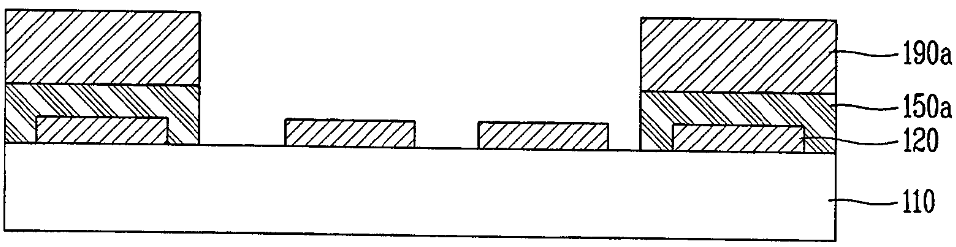


FIG. 3F

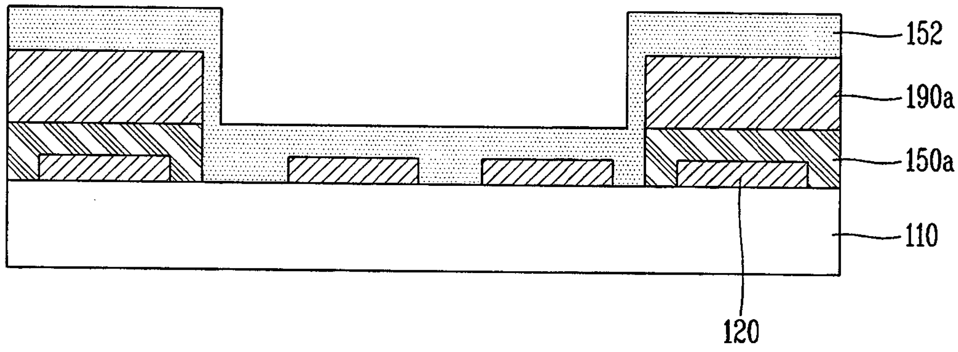


FIG. 3G

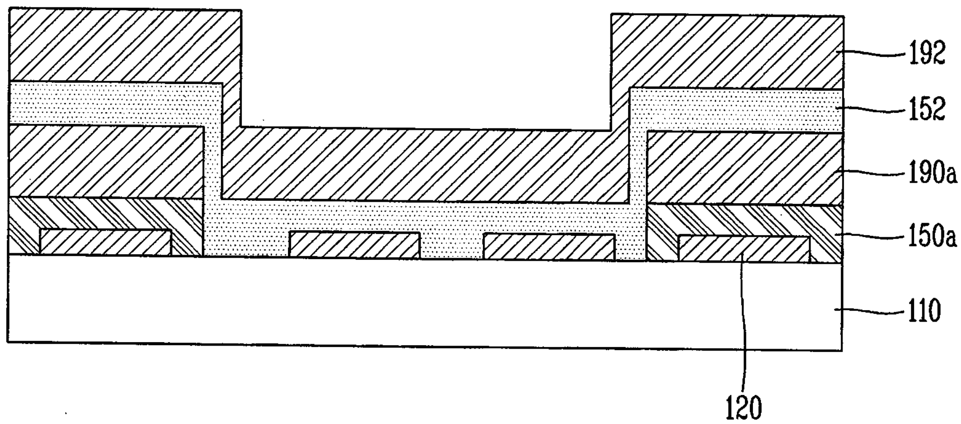


FIG. 3H

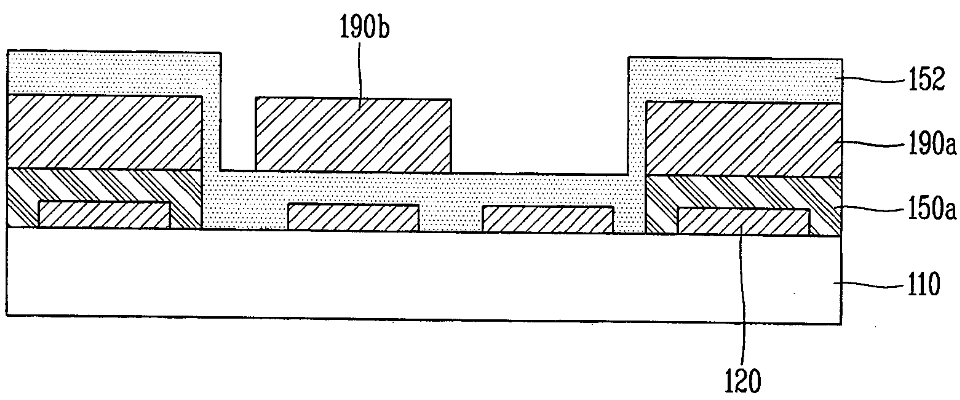


FIG. 3I

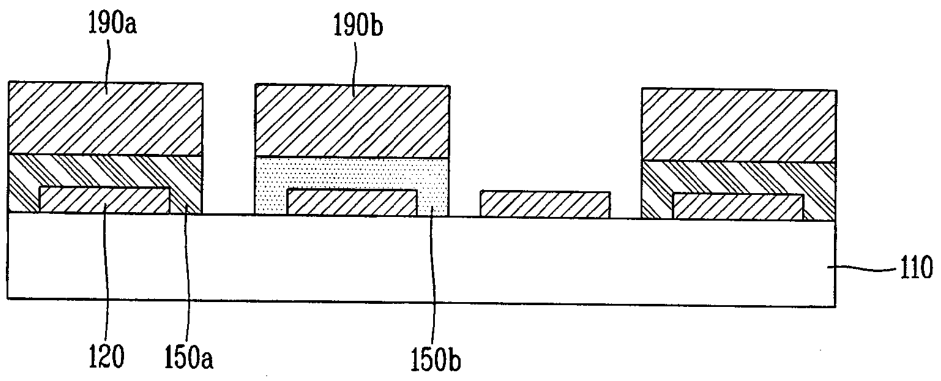


FIG. 3J

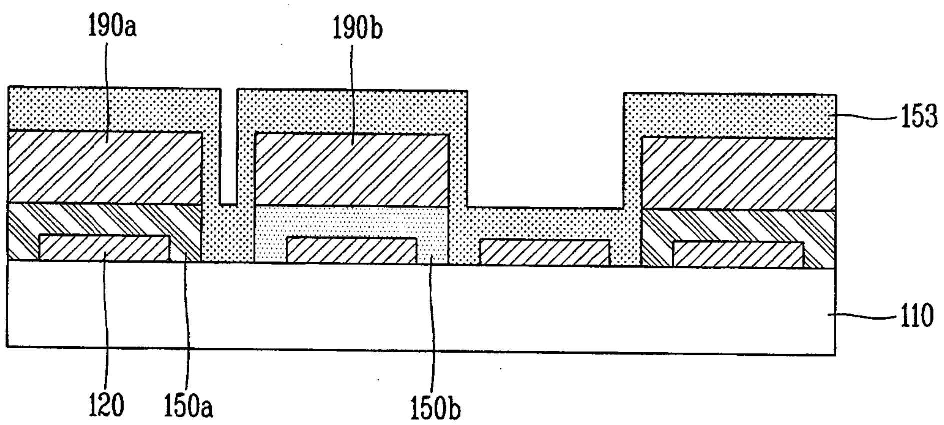


FIG. 3K

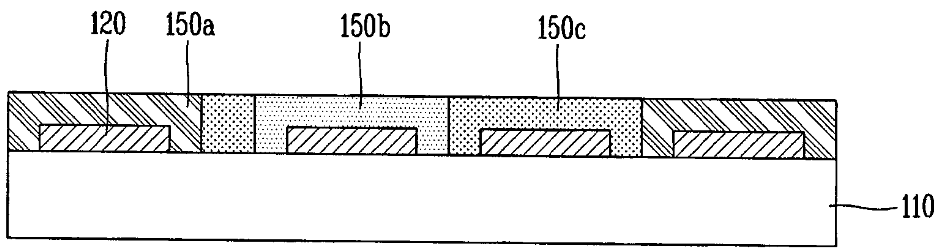


FIG. 3L

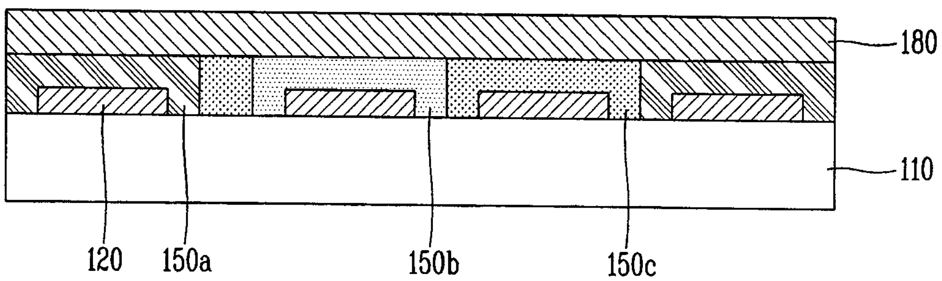


FIG. 4A

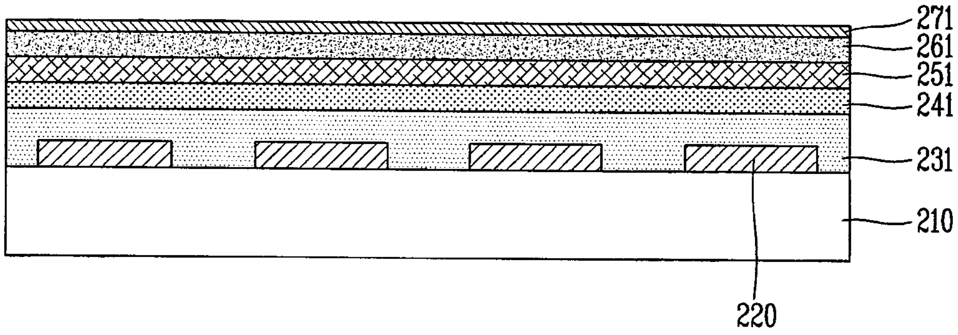


FIG. 4B

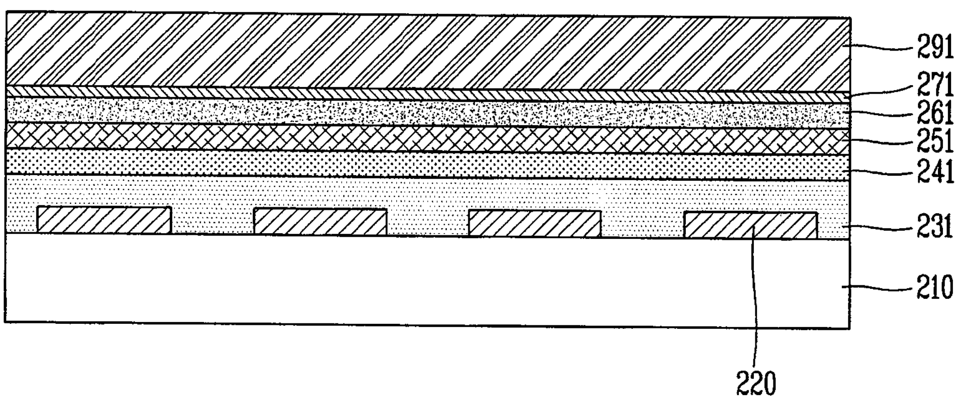


FIG. 4C

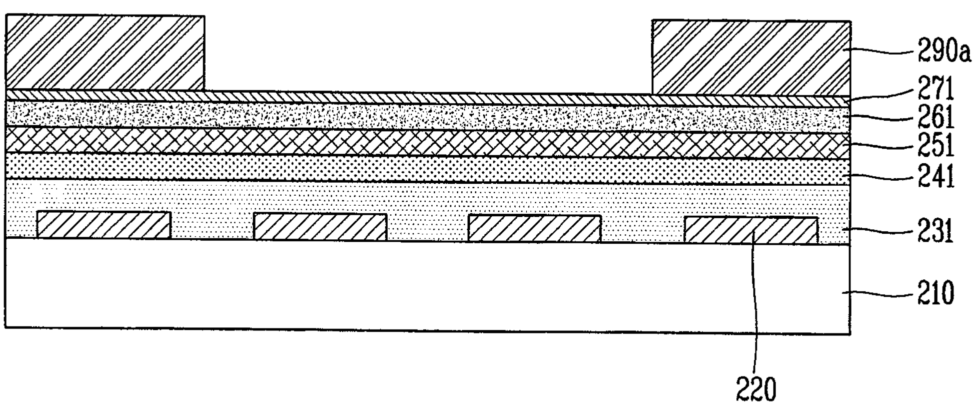


FIG. 4D

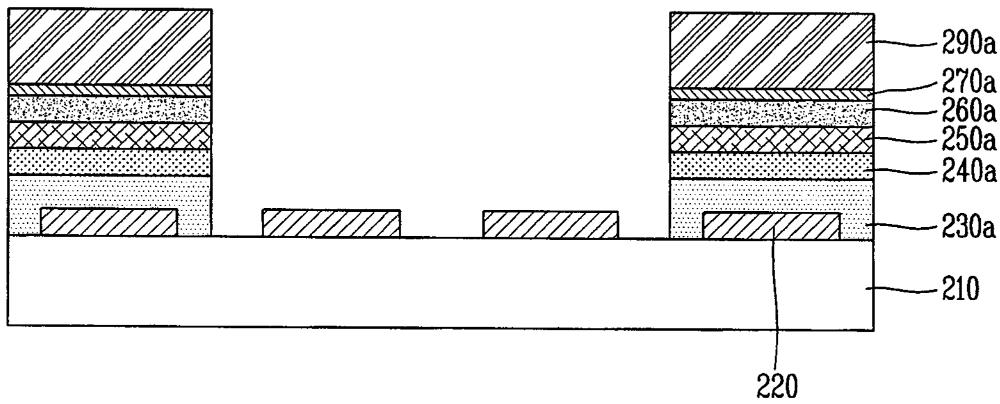


FIG. 4E

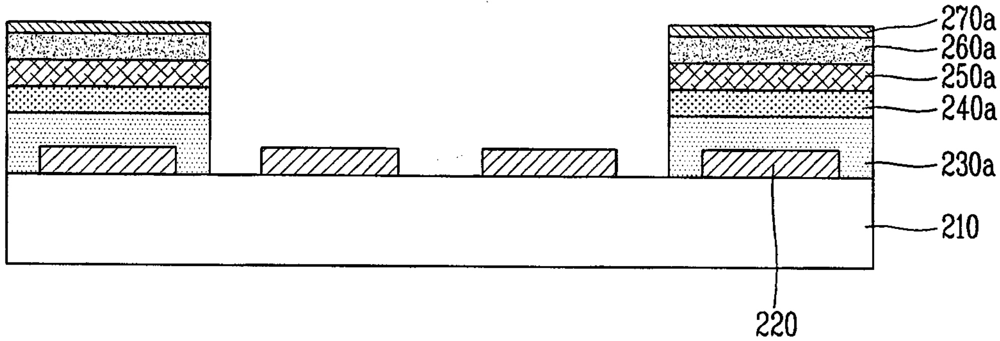


FIG. 4F

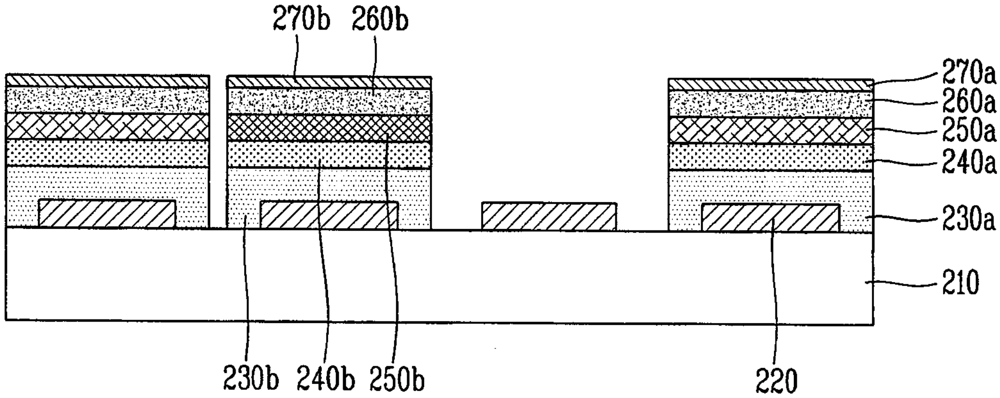


FIG. 4G

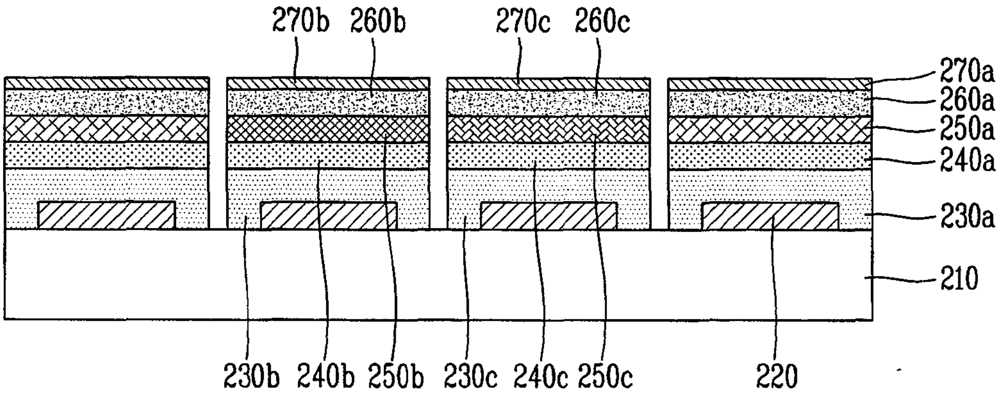

270b 260b 270c 260c
270a
260a
250a
240a
230a
210
230b 240b 250b 230c 240c 250c 220

FIG. 4H

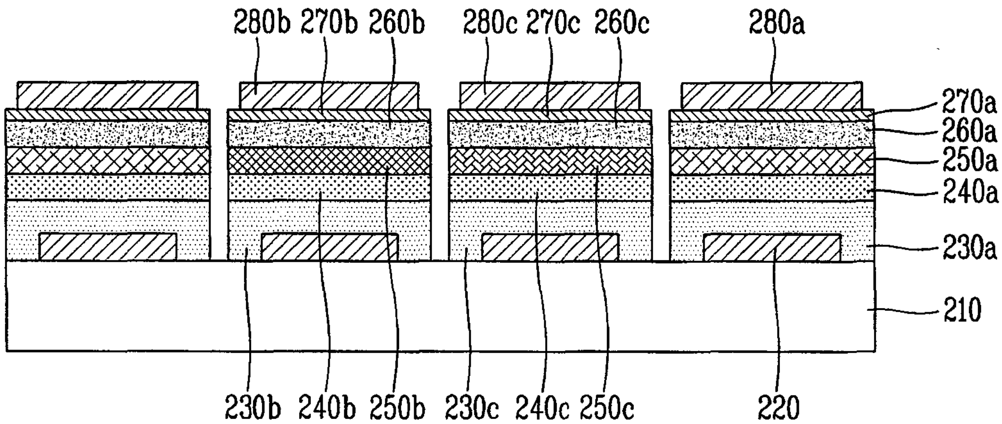

280b 270b 260b 280c 270c 260c 280a
270a
260a
250a
240a
230a
210
230b 240b 250b 230c 240c 250c 220

FIG. 5A

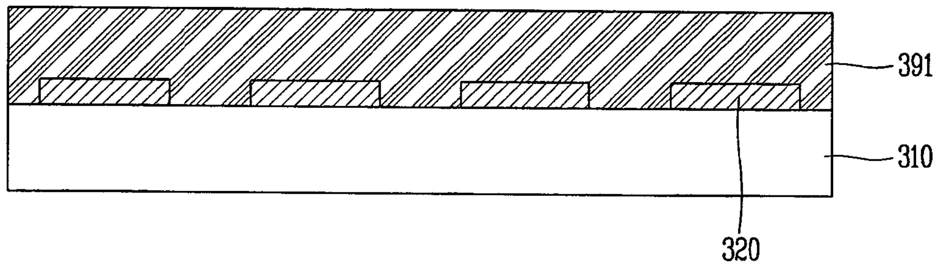


FIG. 5B

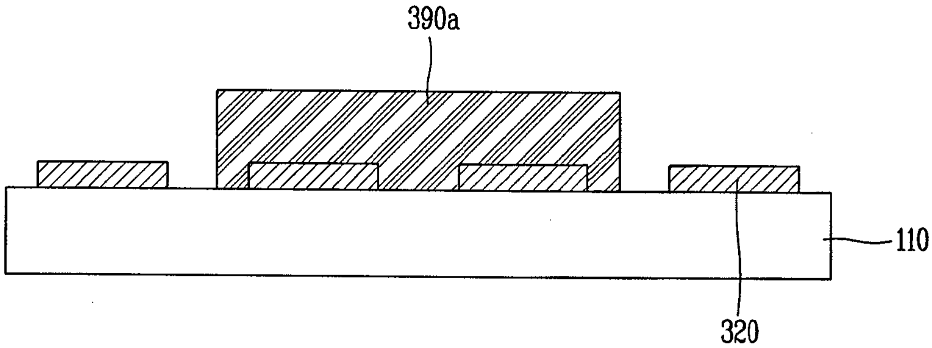


FIG. 5C

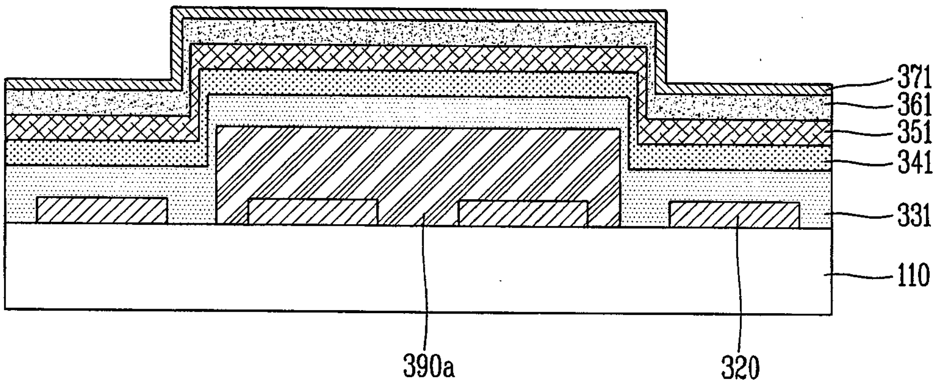


FIG. 5D

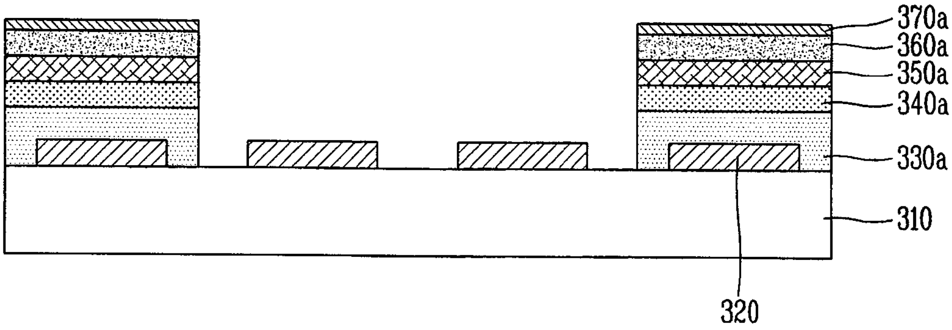


FIG. 5E

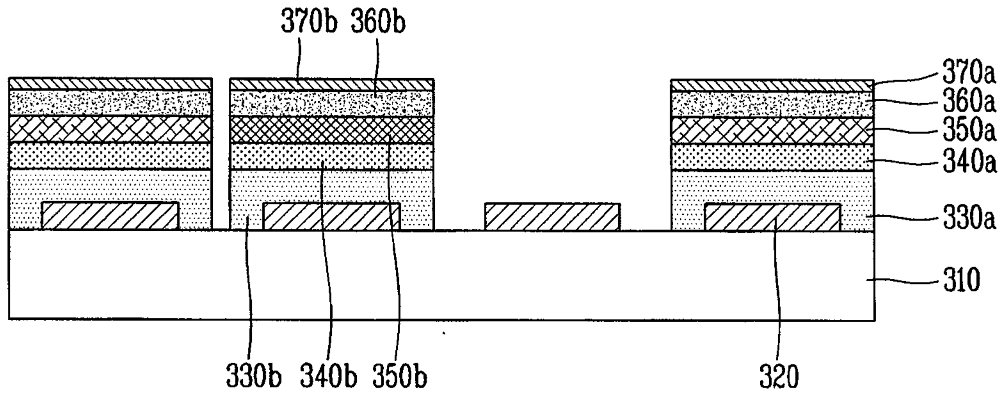


FIG. 5F

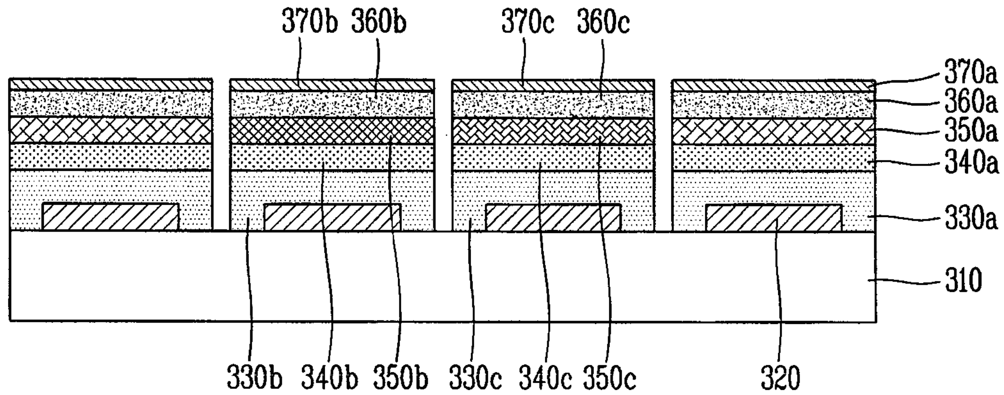


FIG. 5G

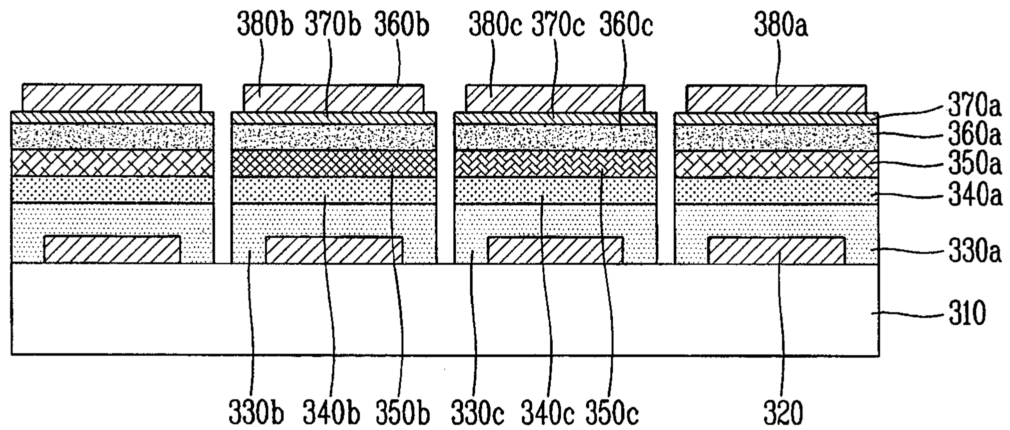
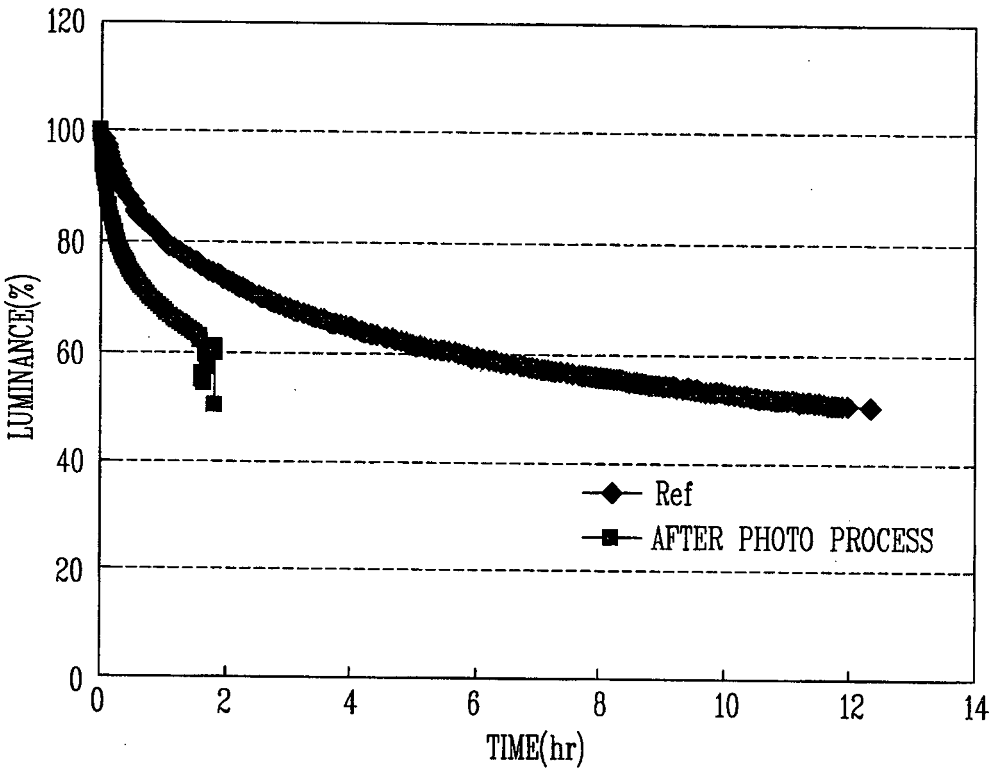


FIG. 6



120
100
80
60
40
20
0
LUMINANCE(%)
0
2
4
6
8
10
12
14
TIME(hr)
Ref
AFTER PHOTO PROCESS

FIG. 7A

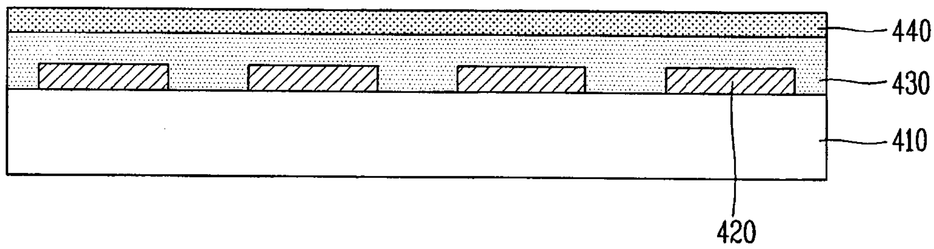


FIG. 7B

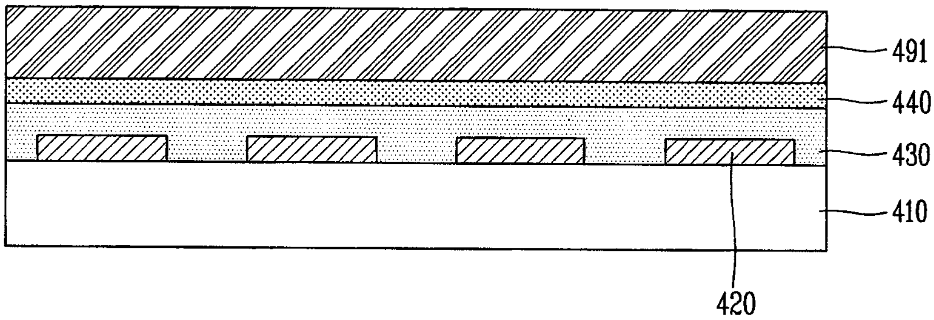


FIG. 7C

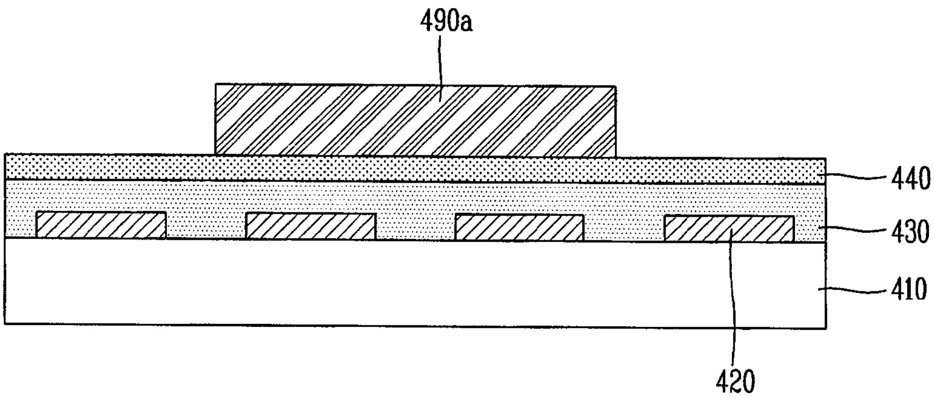


FIG. 7D

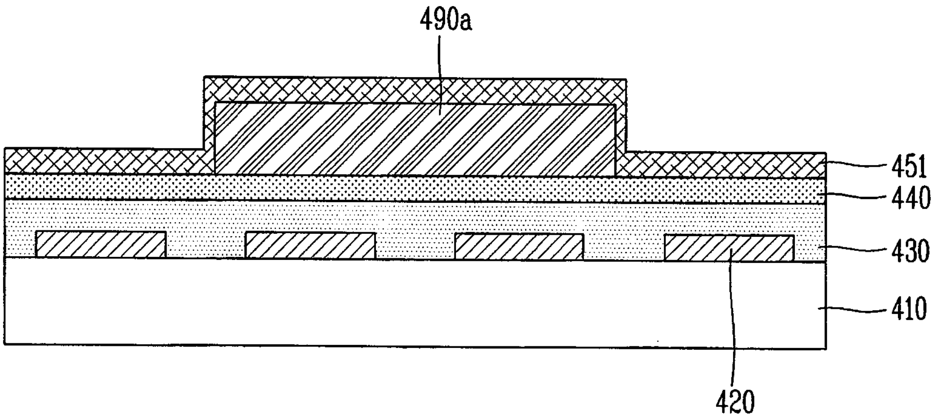


FIG. 7E

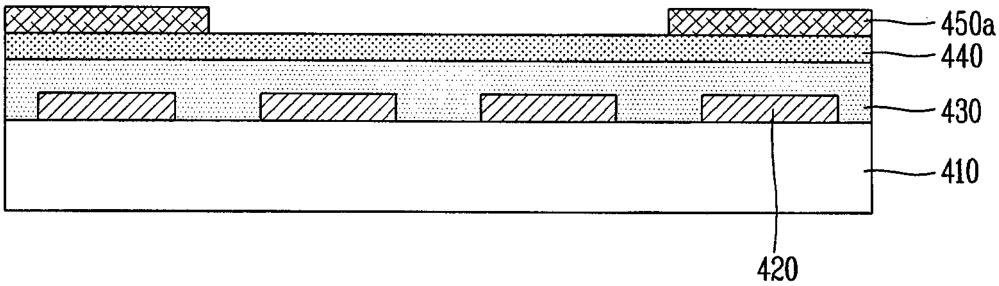


FIG. 7F

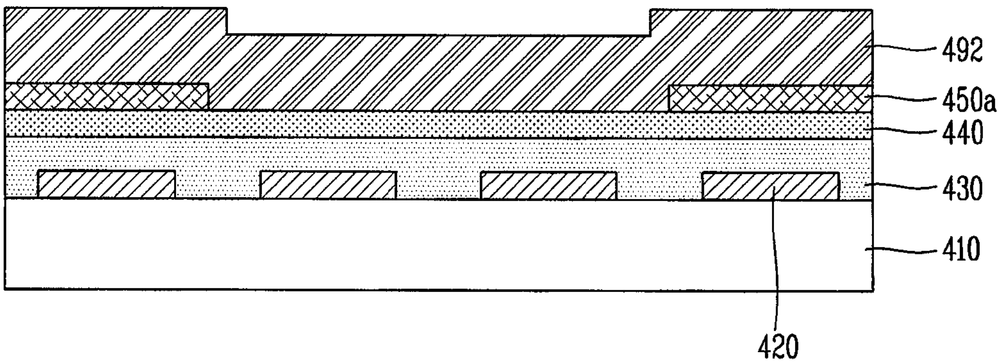


FIG. 7G

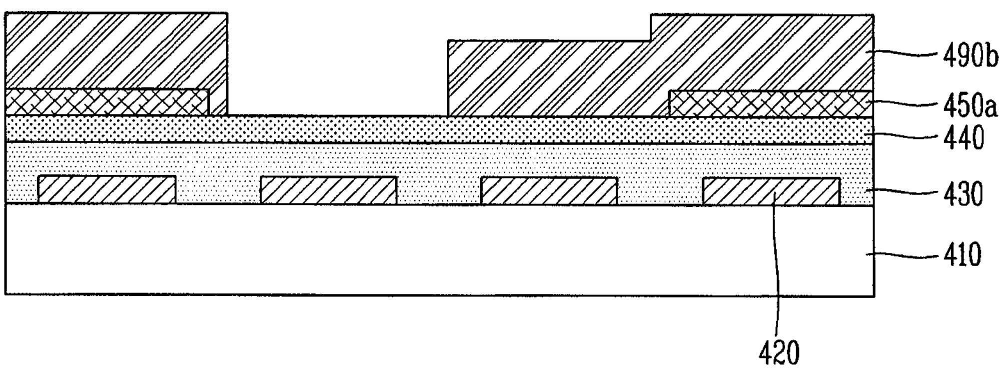


FIG. 7H

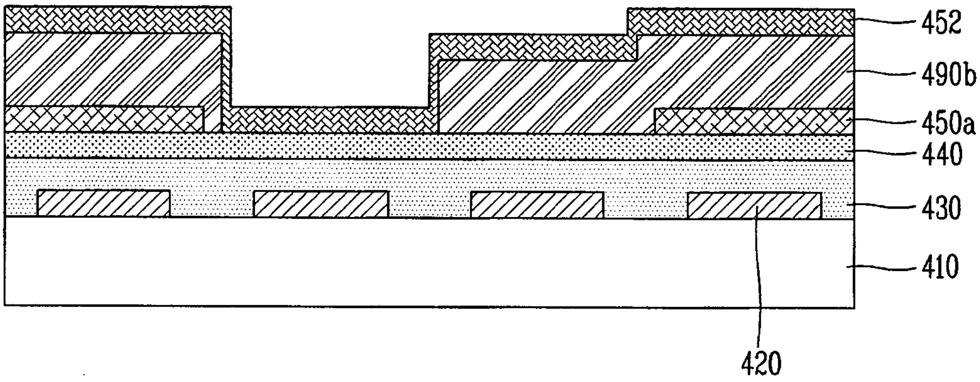


FIG. 7I

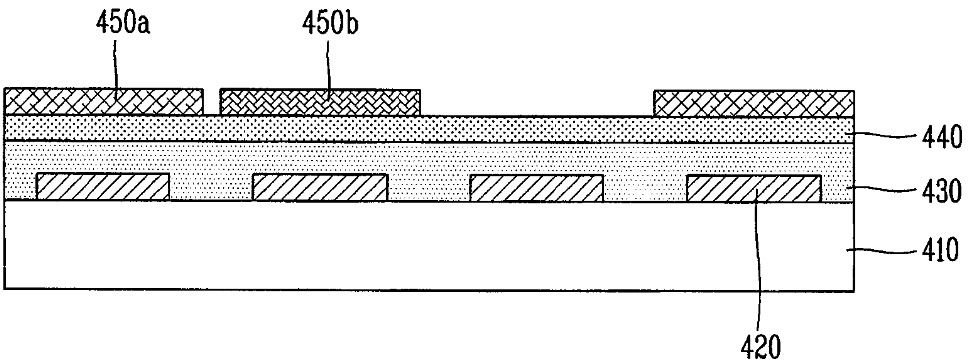


FIG. 7J

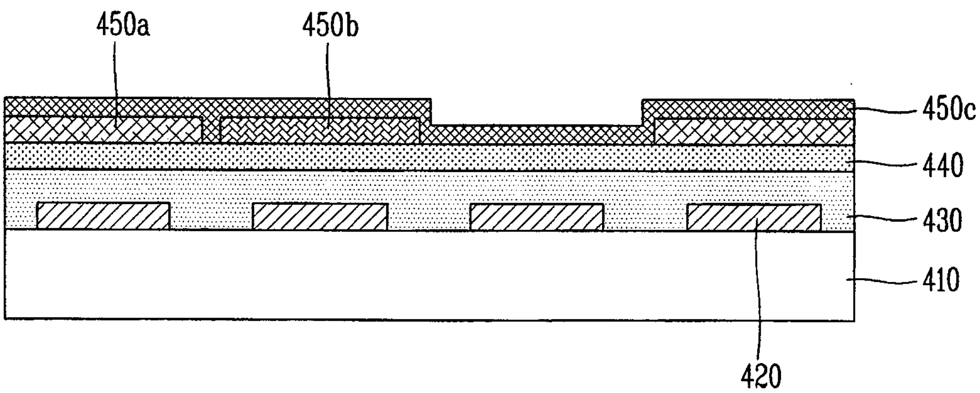


FIG. 7K

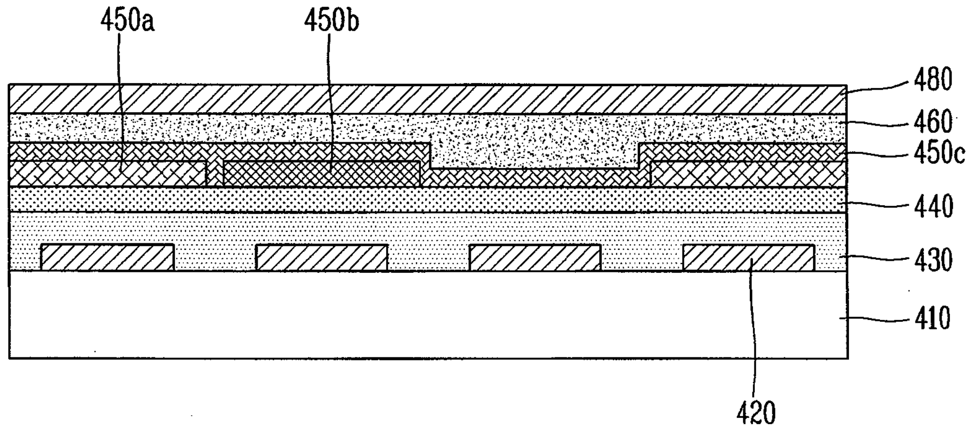


FIG. 8

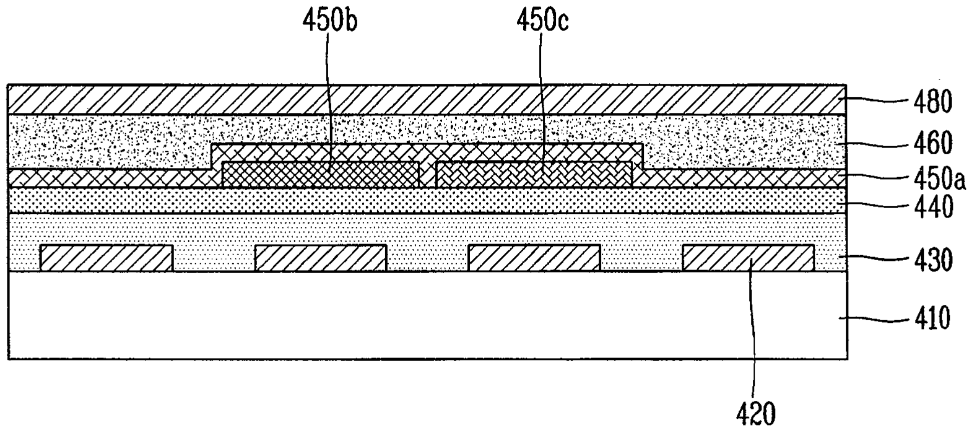


FIG. 9

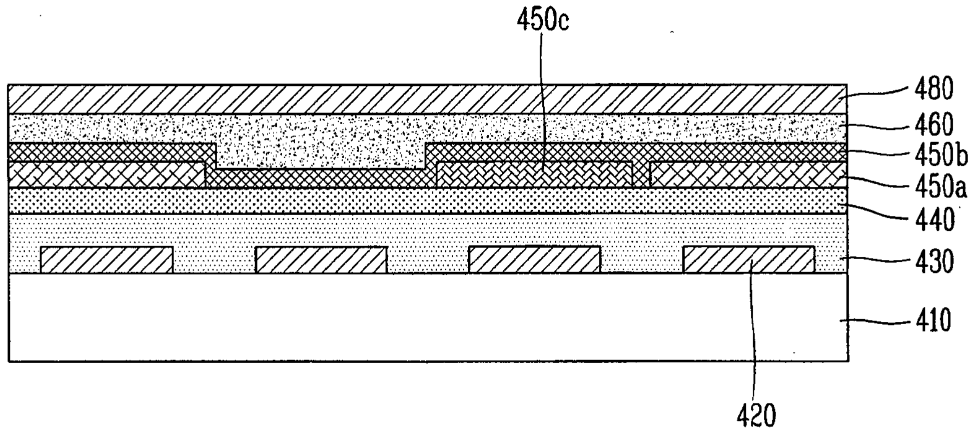


FIG. 10A

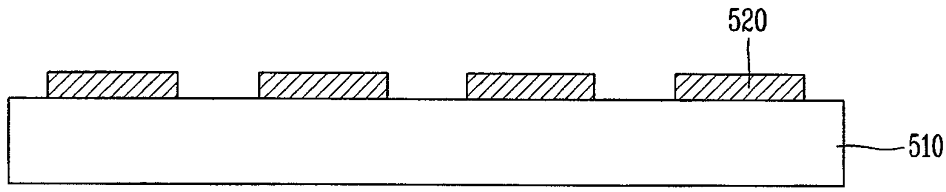


FIG. 10B

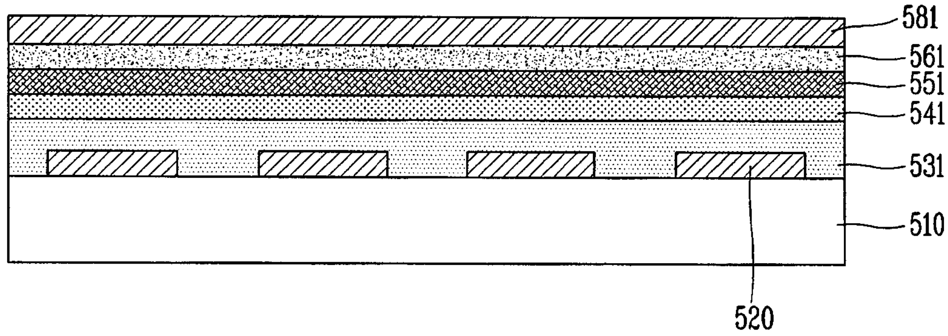


FIG. 10C

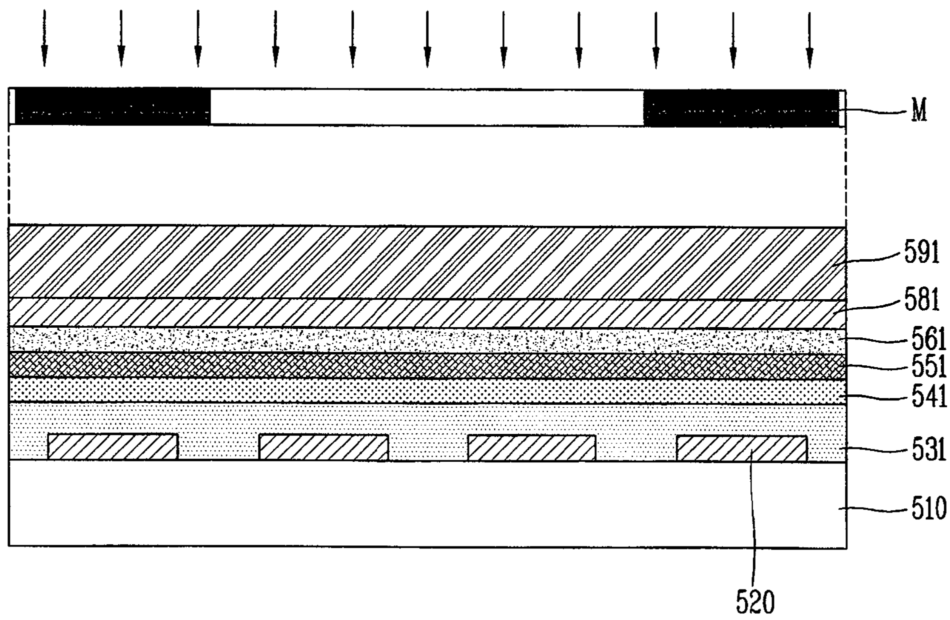


FIG. 10D

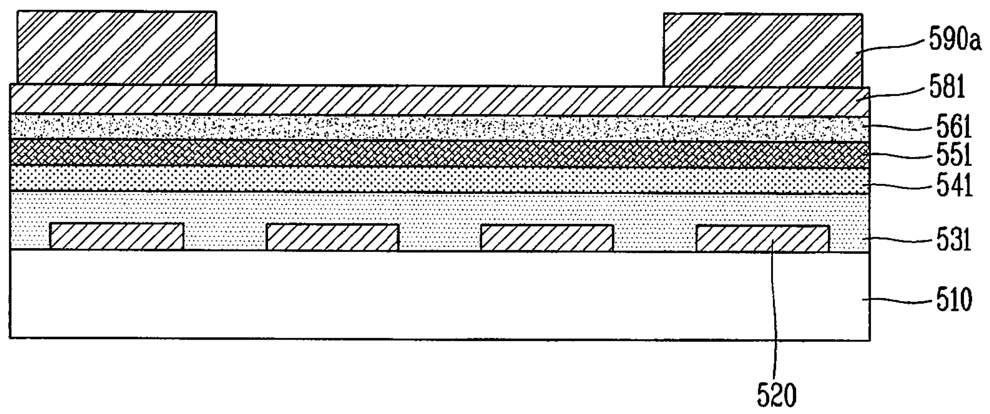


FIG. 10E

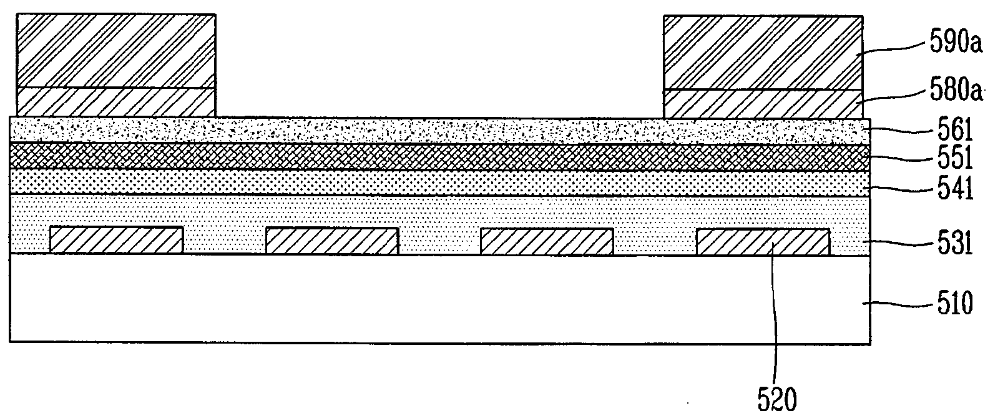


FIG. 10F

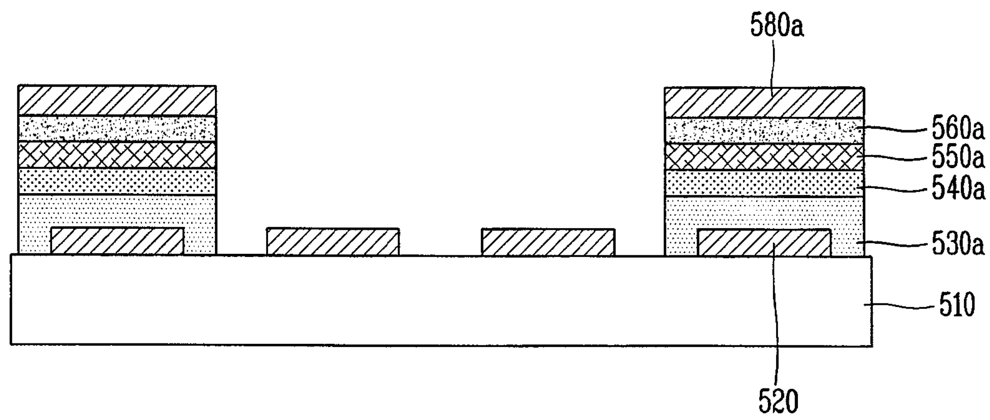


FIG. 10G

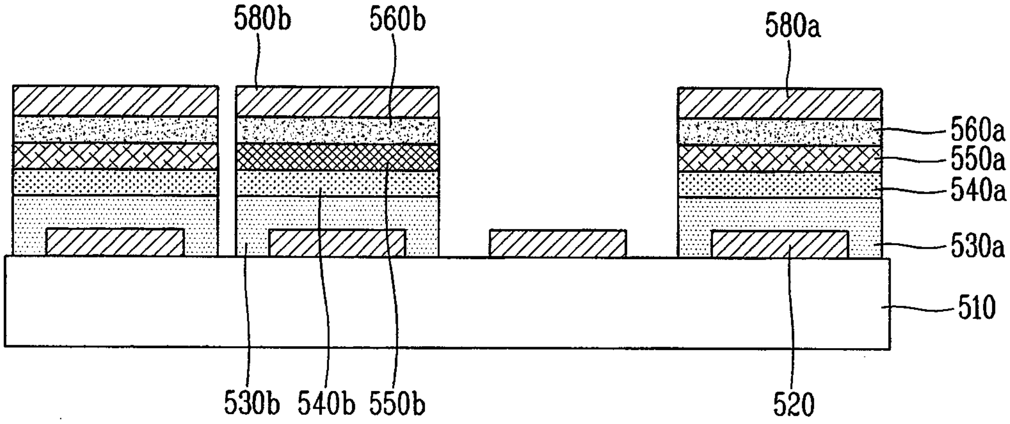


FIG. 10H

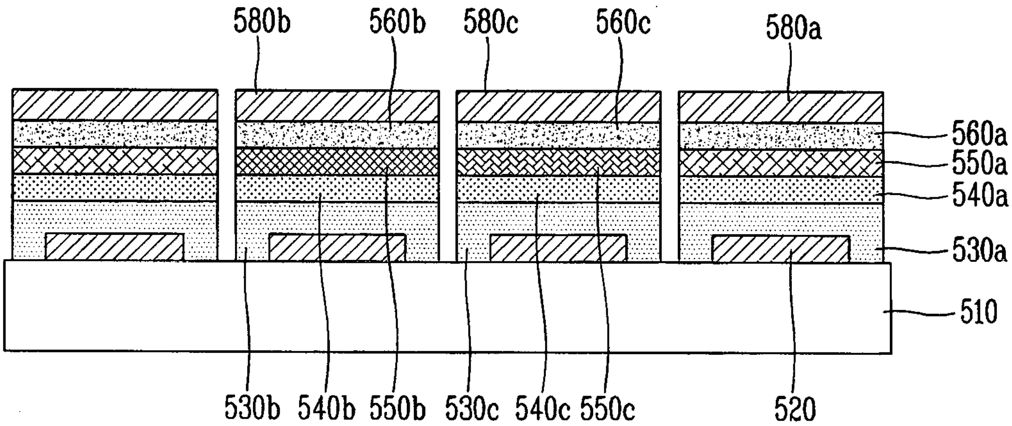


FIG. 11A

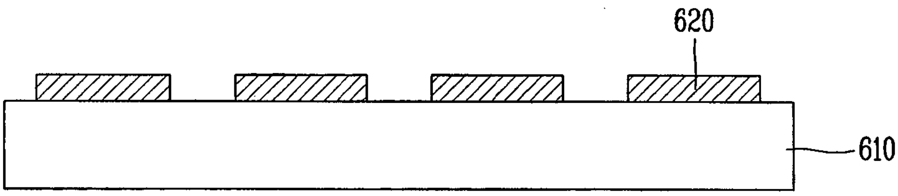


FIG. 11B

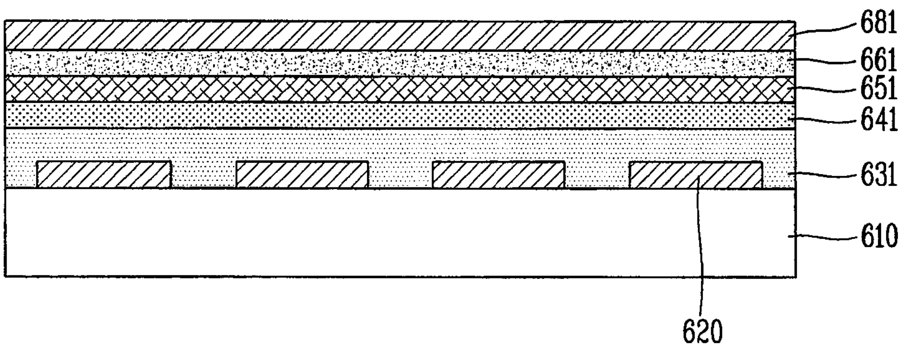


FIG. 11C

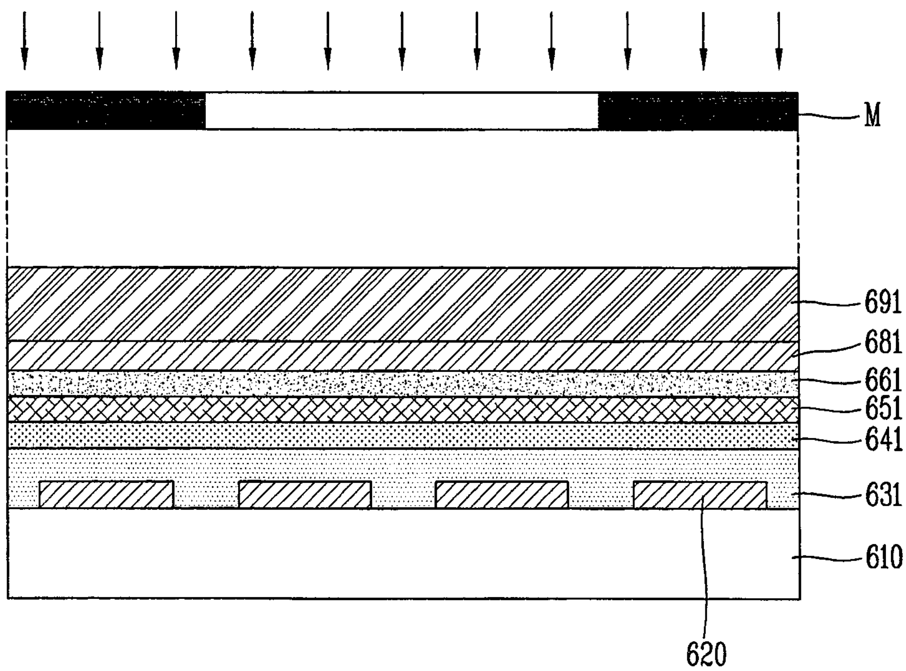


FIG. 11D

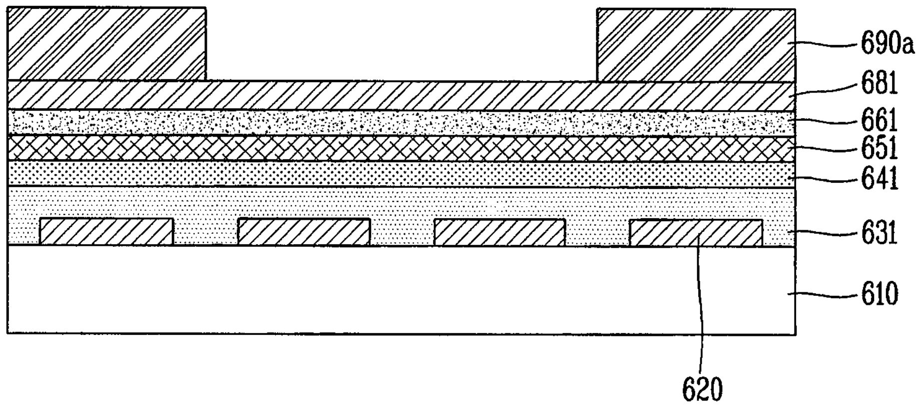


FIG. 11E

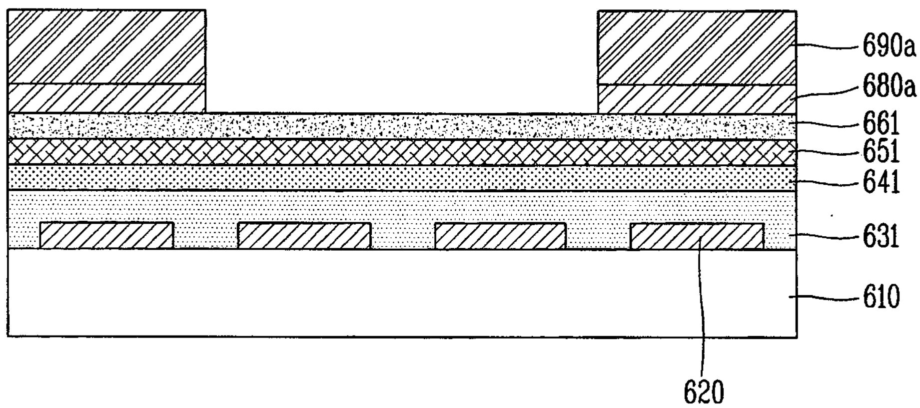


FIG. 11F

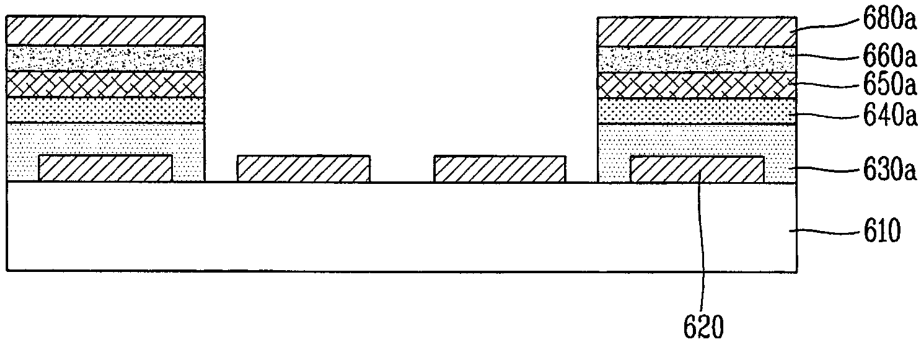


FIG. 11G

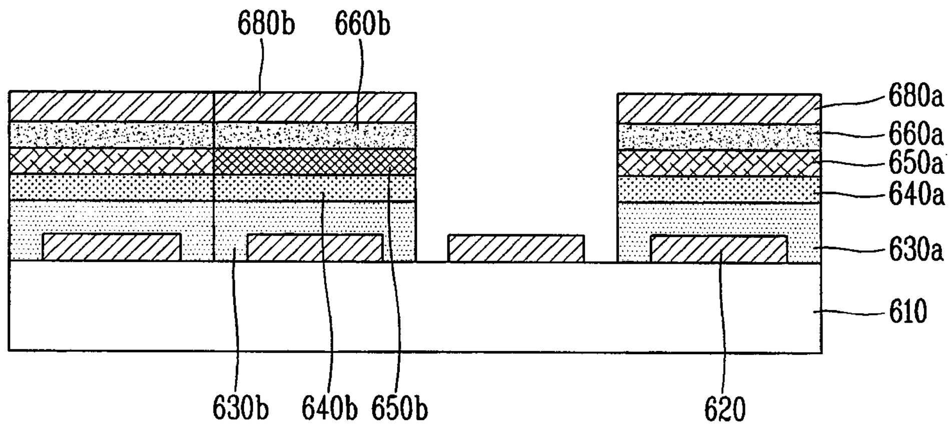
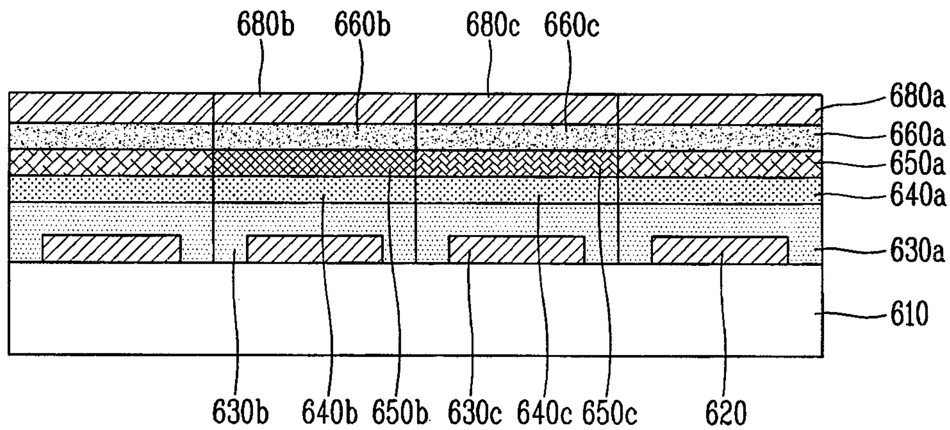


FIG. 11H



REFERENCES CITED IN THE DESCRIPTION

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- JP 2008147072 A **[0022]**
- US 2005153058 A1 **[0023]**