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(54) ORGANIC LIGHT EMITTING DIODE DISPLAY

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Oct. 30, 2008 (KR) 10-2008-0107320

(51) **Int. Cl.**
H05B 33/04 (2006.01)

(52) **U.S. Cl.** **313/512**; 313/504; 445/25

(58) **Field of Classification Search** 313/504, 313/506, 512; 445/24, 25
See application file for complete search history.

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(57) **ABSTRACT**

An organic light emitting diode (OLED) display is provided. The OLED display includes a substrate, a subpixel on the substrate, and a multi-layered protective layer covering the subpixel. The multi-layered protective layer has a structure in which organic layers and inorganic layers are alternately stacked in a repeated manner and at least one moisture absorbing layer is interposed in the multi-layered protective layer.

8 Claims, 9 Drawing Sheets

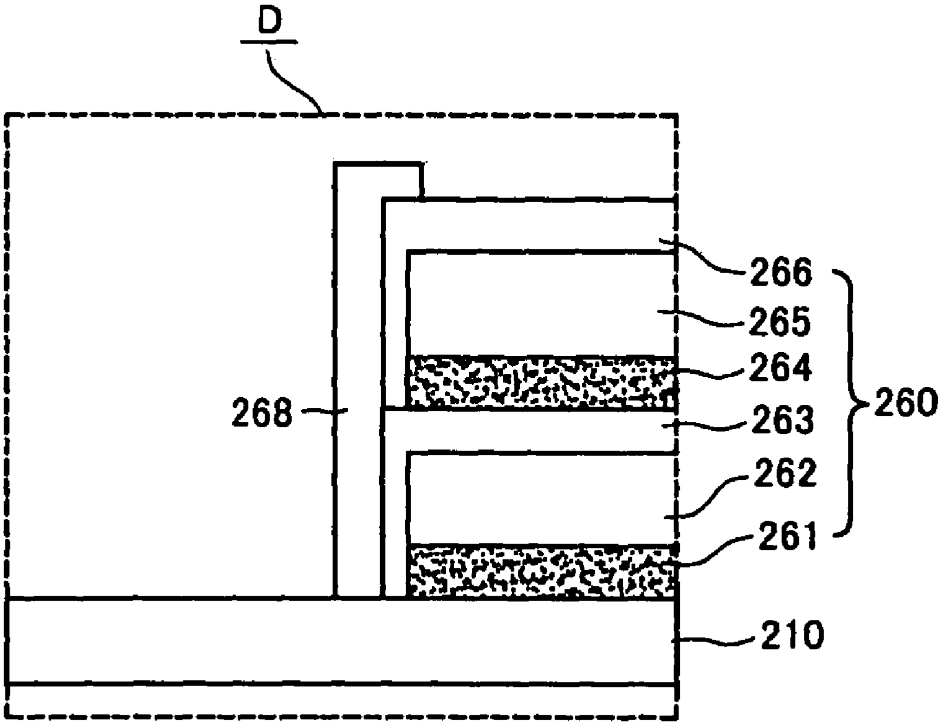
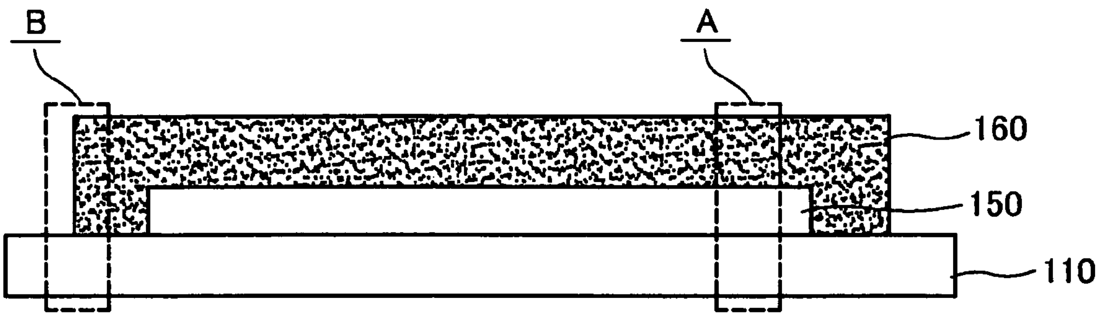
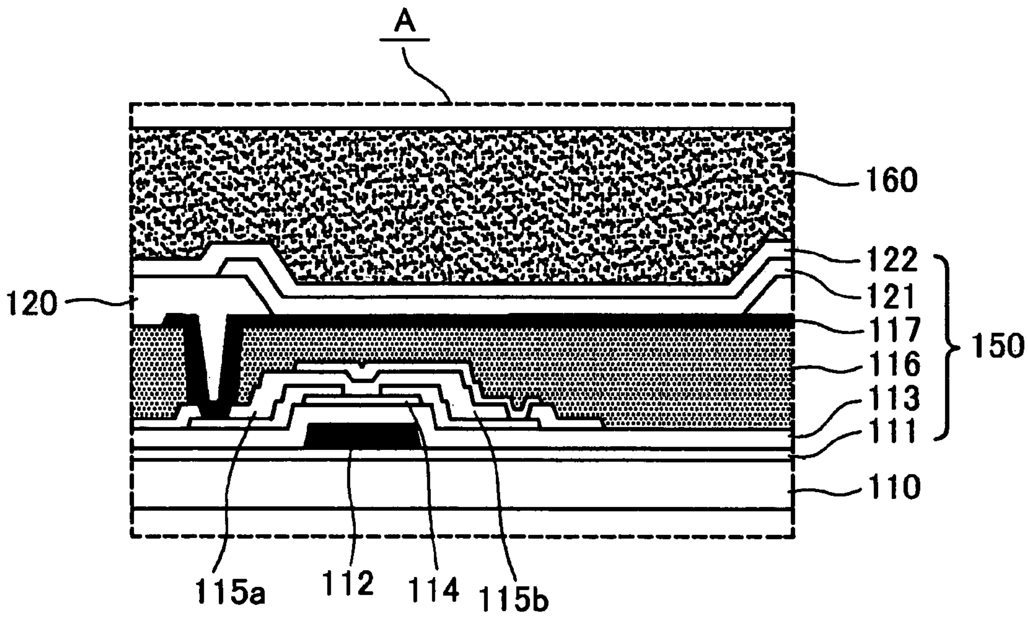


FIG. 1



B
A
160
150
110

FIG. 2



A
160
122
121
120
117
116
113
111
150
110
115a
112
114
115b

FIG. 3

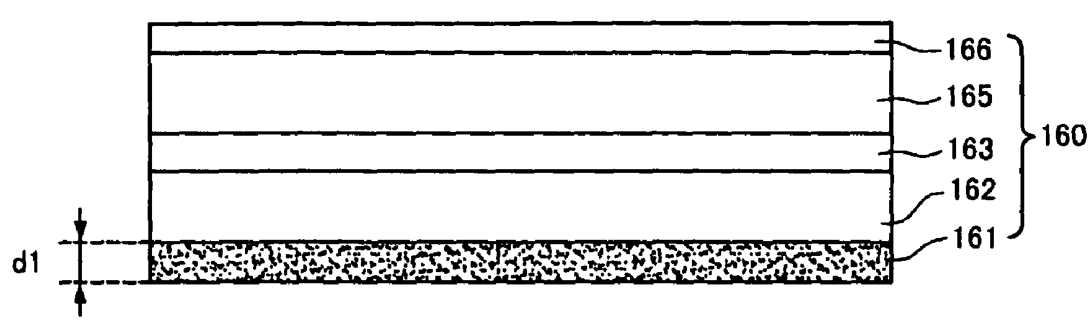


FIG. 4

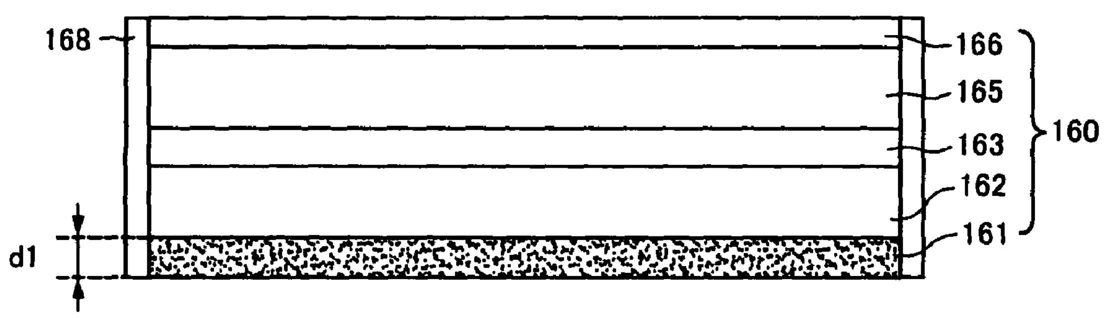


FIG. 5

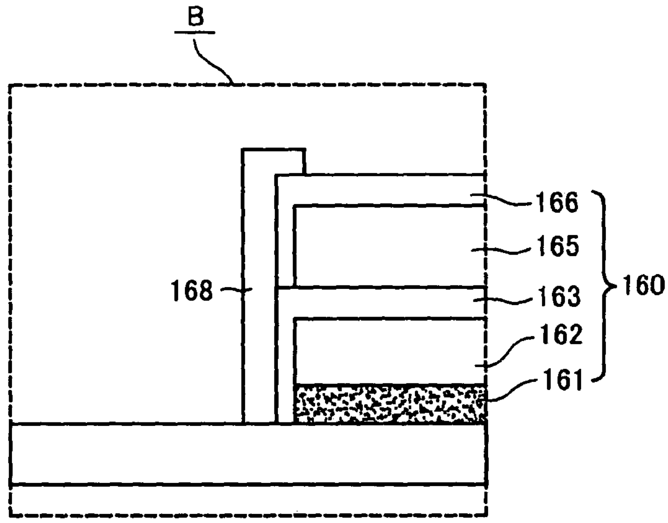


FIG. 6

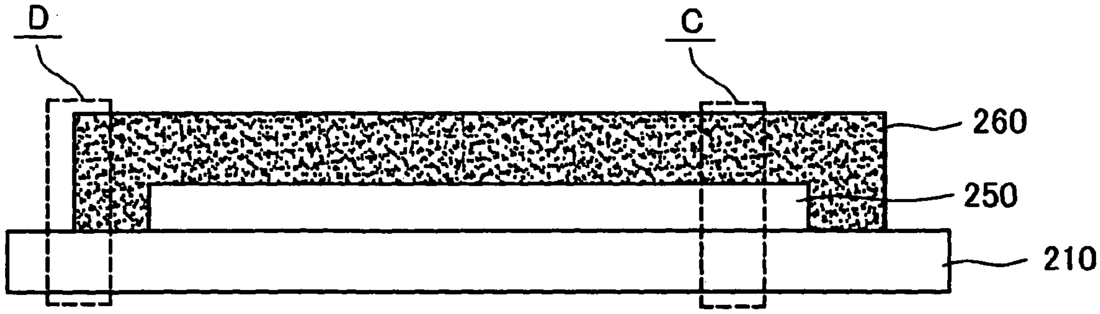


FIG. 7

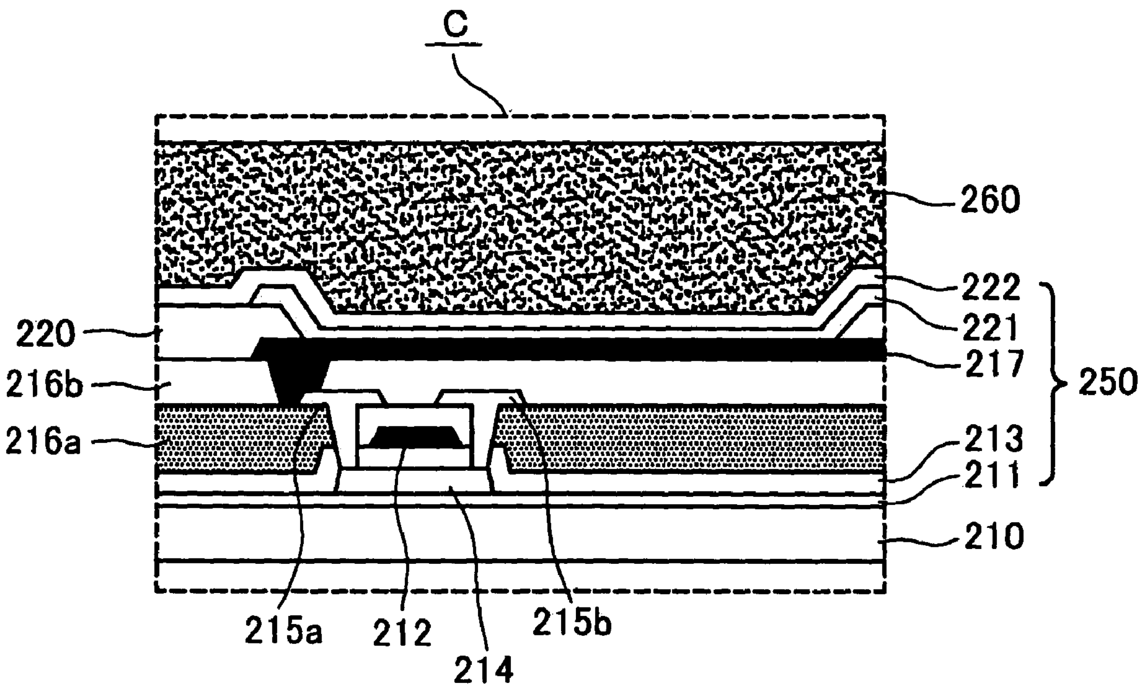

C
260
222
221
217
250
213
211
210
220
216b
216a
215a
212
214
215b

FIG. 8

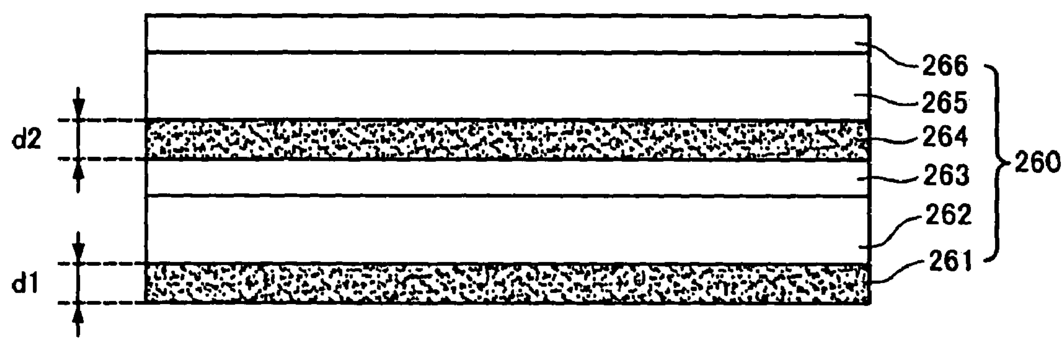

d2
d1
266
265
264
263
262
261
260

FIG. 9

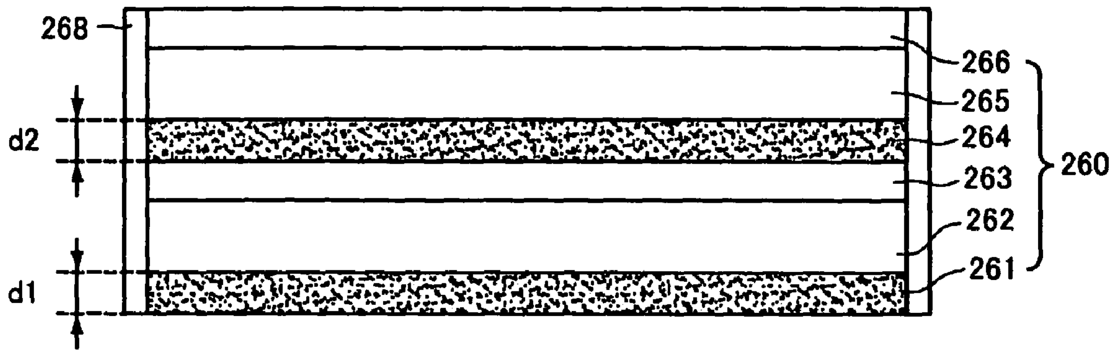

268
266
265
d2
264
263
260
262
d1
261

FIG. 10

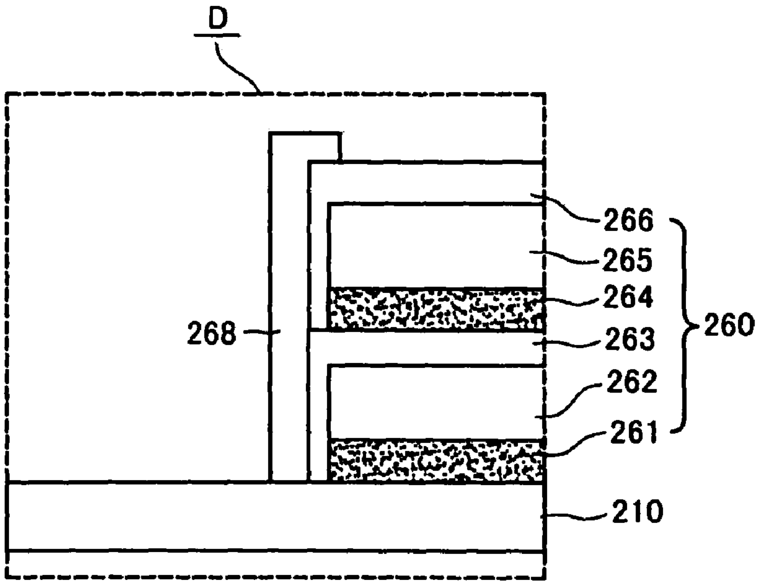

D
266
265
264
268
263
260
262
261
210

FIG. 11

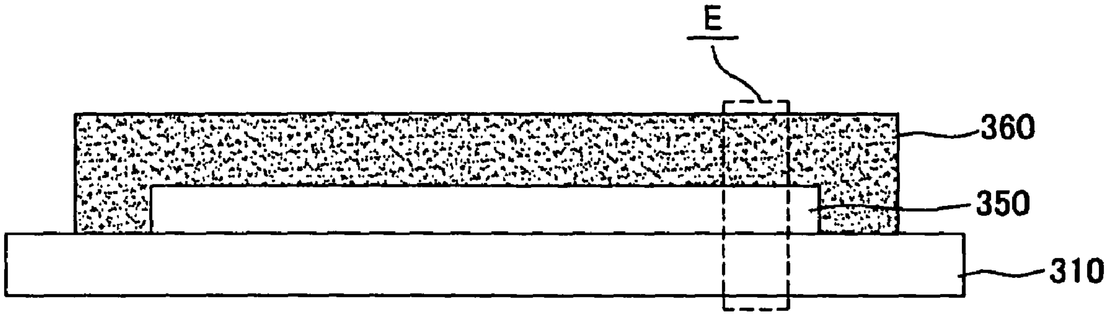

E
360
350
310

FIG. 12

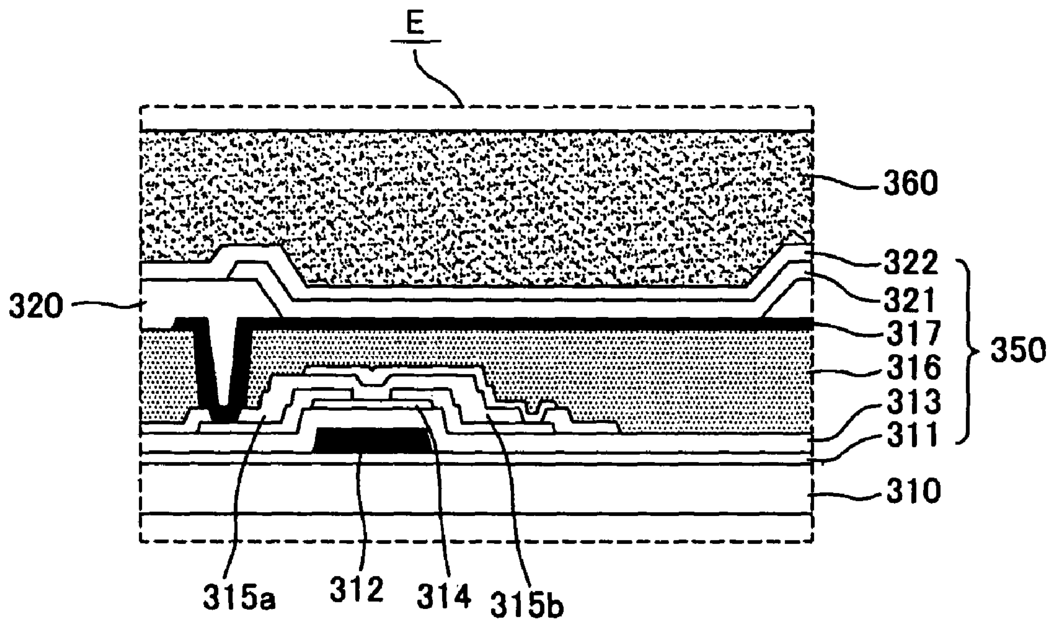

E
360
322
321
320
317
316
313
311
350
310
315a
312
314
315b

FIG. 13

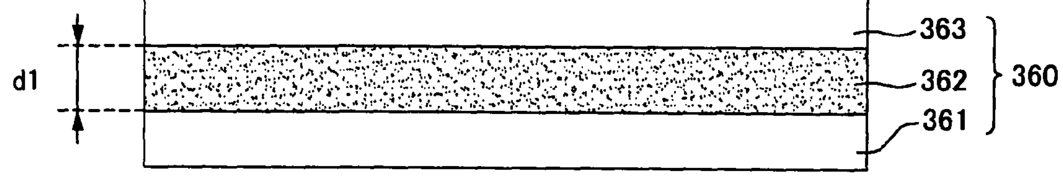


FIG. 14

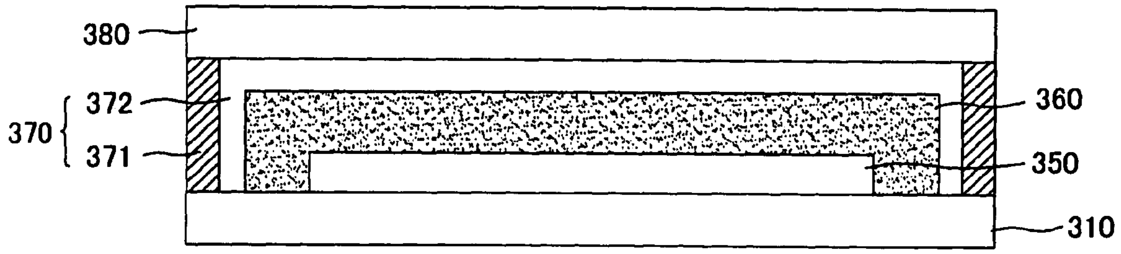


FIG. 15

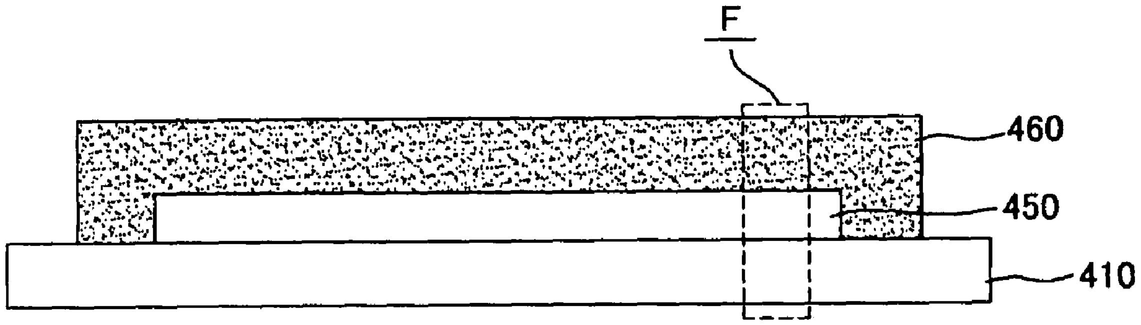

F
460
450
410

FIG. 16

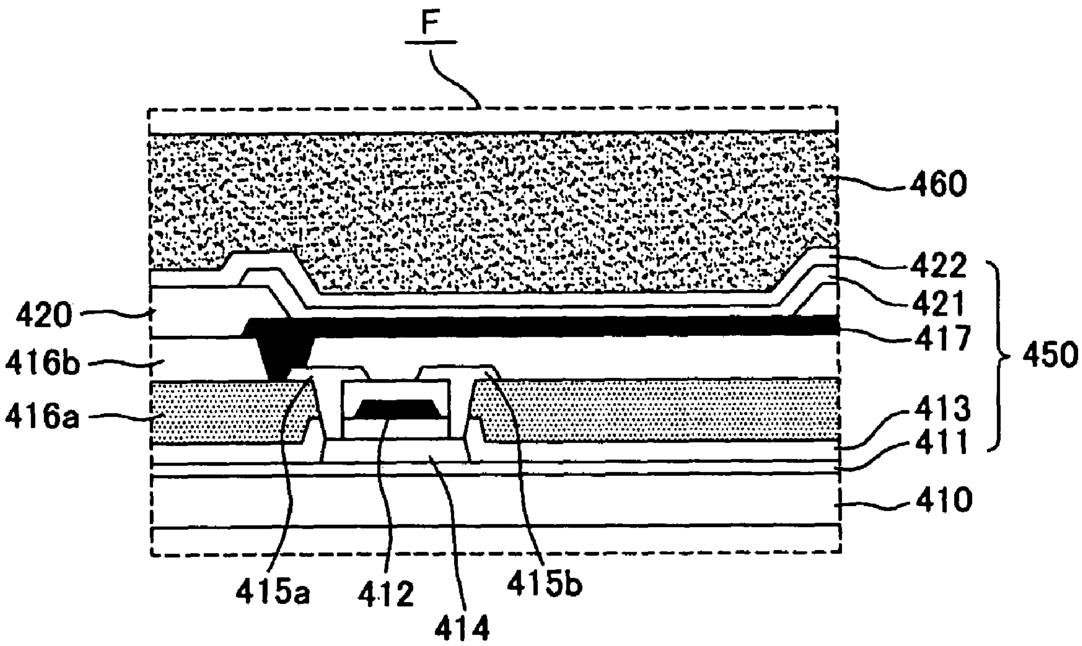

F
460
422
421
417
450
413
411
410
420
416b
416a
415a
412
414
415b

FIG. 17

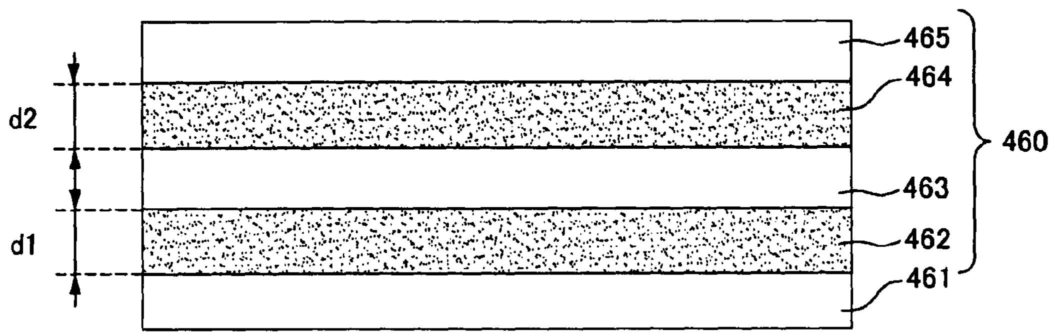
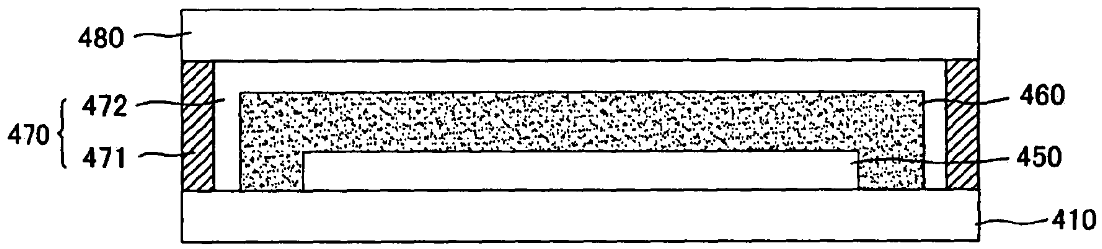


FIG. 18



ORGANIC LIGHT EMITTING DIODE DISPLAY

This application claims the benefit of Korean Patent Application Nos. 10-2008-048798 and 10-2008-107320 respectively filed on May 26, 2008 and Oct. 30, 2008, the entire contents of which is hereby incorporated by reference.

BACKGROUND

1. Field of the Invention

This document relates to an organic light emitting diode (OLED) display.

2. Discussion of Related Art

An organic light emitting element used in an organic light emitting diode (OLED) display has a self-emission structure in which a light emitting layer is formed between two electrodes on a substrate.

The OLED display may be classified into a top emission type OLED display, a bottom emission type OLED display, and a dual emission type OLED display depending on an emitting direction of light. The OLED display may be classified into a passive matrix type OLED display and an active matrix type OLED display depending on a driving manner.

A subpixel of the OLED display includes a switching transistor, a drive transistor, a capacitor, an anode electrode, a cathode electrode, and an organic light emitting layer. Because the subpixel having the above-described structure is weak in moisture or oxygen, a multi-layered protective layer having several dozen layers is formed on the subpixel.

In a related art, a multi-layered protective layer on a subpixel is disadvantageous in a mass production aspect. However, the multi-layered protective layer can reduce the generation of a pin hole and can lengthen a traveling path of penetrating moisture to increase penetration time of moisture into a cathode electrode and an organic light emitting layer of the OLED display. In other words, the moisture penetration is delayed. Hence, life span of the related OLED display can increase.

The related art multi-layered protective layer can delay the moisture penetration, but cannot hinder the penetration of moisture. Hence, the multi-layered protective layer is not advantageous in the mass production and the life span.

SUMMARY

Accordingly, the present invention is directed to organic light emitting diode display that substantially obviates one or more of the problems due to limitations and disadvantages of the related art.

Additional features and advantages of the invention will be set forth in the description which follows, and in part will be apparent from the description, or may be learned by practice of the invention. The objectives and other advantages of the invention will be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

To achieve these and other advantages and in accordance with the purpose of the present invention, as embodied and broadly described, an organic light emitting diode (OLED) display including a substrate, a subpixel on the substrate, and a multi-layered protective layer covering the subpixel, the multi-layered protective layer having a structure in which organic layers and inorganic layers are alternately stacked in a repeated manner and at least one moisture absorbing layer is interposed in the multi-layered protective layer.

In another aspect, there is an organic light emitting diode (OLED) display including a substrate, a subpixel on the substrate, and a multi-layered protective layer covering the subpixel, the multi-layered protective layer having a structure in which at least one moisture absorbing layer is interposed between inorganic layers.

It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompany drawings, which are included to provide a further understanding of the invention and are incorporated on and constitute a part of this specification illustrate embodiments of the invention and together with the description serve to explain the principles of the invention. In the drawing:

FIG. **1** is a cross-sectional view sequentially illustrating an organic light emitting diode (OLED) display according to a first exemplary embodiment of the invention;

FIG. **2** is an enlarged view of a portion “A” of FIG. **1**;

FIG. **3** illustrates an exemplary structure of a multi-layered protective layer;

FIG. **4** illustrates another exemplary structure of a multi-layered protective layer;

FIG. **5** is an enlarged view of a portion “B” of FIG. **1**;

FIG. **6** is a cross-sectional view sequentially illustrating an OLED display according to a second exemplary embodiment of the invention;

FIG. **7** is an enlarged view of a portion “C” of FIG. **6**;

FIG. **8** illustrates an exemplary structure of a multi -layered protective layer;

FIG. **9** illustrates another exemplary structure of a multi-layered protective layer;

FIG. **10** is an enlarged view of a portion “D” of FIG. **6**;

FIG. **11** is a cross-sectional view sequentially illustrating an OLED display according to a third exemplary embodiment of the invention;

FIG. **12** is an enlarged view of a portion “E” of FIG. **11**;

FIG. **13** illustrates an exemplary structure of a multi-layered protective layer;

FIG. **14** illustrates another exemplary structure of a multi-layered protective layer;

FIG. **15** is a cross-sectional view sequentially illustrating an OLED display according to a fourth exemplary embodiment of the invention;

FIG. **16** is an enlarged view of a portion “F” of FIG. **15**;

FIG. **17** illustrates an exemplary structure of a multi-layered protective layer; and

FIG. **18** illustrates another exemplary structure of a multi-layered protective layer.

DETAILED DESCRIPTION

Reference will now be made in detail embodiments of the invention examples of which are illustrated in the accompanying drawings.

First Exemplary Embodiment

As shown in FIG. **1**, an organic light emitting diode (OLED) display according to a first exemplary embodiment of the invention may include a substrate **110**, a subpixel **150** on the substrate **110**, and a multi-layered protective layer **160** covering the subpixel **150**. The multi-layered protective layer **160** may have a structure in which organic layers and inorganic layers are alternately stacked in a repeated manner and at least one moisture absorbing layer is interposed in the multi-layered protective layer **160**.

The substrate **110** may be formed of a material that has mechanical strength or excellent dimensional stability for forming elements. The substrate **110** may be a glass substrate, a metal substrate, a ceramic substrate, or a plastic substrate. The plastic substrate may be formed of polycarbonate resin, acrylic resin, vinyl chloride resin, polyethyleneterephthalate resin, polyimide resin, polyester resin, epoxy resin, silicon resin, and fluorine resin. Other materials may be used for the substrate **110**.

The subpixel **150** may include a transistor including a switching transistor, a drive transistor, and a capacitor and an organic light emitting diode on the transistor.

The subpixel **150** is described in detail below with reference to FIG. **2**.

As shown in FIG. **2**, a buffer layer **111** may be positioned on the substrate **110**. The buffer layer **111** prevents impurities (e.g., alkali ions discharged from the substrate **110**) from being introduced during formation of the transistor in a succeeding process. The buffer layer **111** may be formed using silicon oxide (SiO_2), silicon nitride (SiN_x), or using other materials.

A gate **112** may be positioned on the buffer layer **111**. The gate **112** may be formed of molybdenum (Mo), aluminum (Al), chromium (Cr), gold (Au), titanium (Ti), nickel (Ni), neodymium (Nd) or copper (Cu), or a combination thereof. The gate **112** may have a multi-layered structure formed of Mo, Al, Cr, Au, Ti, Ni, Nd or Cu, or a combination thereof. For example, the gate **112** may have a double-layered structure including Mo/Al—Nd or Mo/Al.

A first insulating layer **113** may be positioned on the gate **112**. The first insulating layer **113** may be formed of silicon oxide (SiO_x), silicon nitride (SiN_x), or a multi-layered structure or a combination thereof, but is not limited thereto.

An active layer **114** may be positioned on the first insulating layer **113**. The active layer **114** may be formed of amorphous silicon or crystallized polycrystalline silicon. Although it is not shown, the active layer **114** may include a channel region, a source region, and a drain region. The source region and the drain region of the active layer **114** may be doped with p-type or n-type impurities. The active layer **114** may include an ohmic contact layer for reducing a contact resistance.

A source **115*a*** and a drain **115*b*** may be positioned on the active layer **114**. The source **115*a*** and the drain **115*b*** may have a single-layered structure or a multi-layered structure. When the source **115*a*** and the drain **115*b*** have the single-layered structure, the source **115*a*** and the drain **115*b*** may be formed of Mo, Al, Cr, Au, Ti, Ni, Nd or Cu, or a combination thereof. When the source **115*a*** and the drain **115*b*** have the multi-layered structure, the source **115*a*** and the drain **115*b*** may have a double-layered structure including Mo/Al—Nd or a triple-layered structure including Mo/Al/Mo or Mo/Al—Nd/Mo.

A second insulating layer **116** may be positioned on the source **115*a*** and the drain **115*b***. The second insulating layer **116** may be formed of silicon oxide (SiO_x), silicon nitride (SiN_x), or a multi-layered structure or a combination thereof. Other materials may be used. The second insulating layer **116** may be a passivation layer.

So far, the explanation of a bottom gate type transistor was given of an example of the transistor on the substrate **110**. The organic light emitting diode on the transistor will be described in detail below.

A first electrode **117** may be positioned on the second insulating layer **116**. The first electrode **117** may be an anode electrode and may be formed of transparent Indium-Tin-oxide (ITO) or Indium-Zinc-Oxide (IZO). Other materials may be used for the first electrode **117**.

A bank layer **120** may be positioned on the first electrode **117**. The bank layer **120** may be formed of an organic material such as benzocyclobutene (BCB)-based resin, acrylic resin, or polyimide resin. The bank layer **120** has an opening on the first electrode **117**.

An organic light emitting layer **121** may be positioned inside the opening of the bank layer **120**. The organic light emitting layer **121** may have a structure to emit one of red, green, and blue light depending on the subpixel **150**.

A second electrode **122** may be positioned on the organic light emitting layer **121**. The second electrode **122** may be a cathode electrode and may be formed of aluminum (Al). Other materials may be used for the second electrode **122**.

The multi-layered protective layer **160** is positioned on the subpixel **150** to cover the subpixel **150**.

The multi-layered protective layer **160** is described in detail below with reference to FIGS. **3** and **4**.

As shown in FIG. **3**, the multi-layered protective layer **160** has a structure in which organic layers **162** and **165** and inorganic layers **163** and **166** are alternately stacked in a repeated manner and at least one moisture absorbing layer **161** is interposed in the multi-layered protective layer **160**. The moisture absorbing layer **161** may be formed through a deposition method using a mask inside a vacuum chamber. Other methods may be used.

A thickness d**1** of the moisture absorbing layer **161** may be 30 □ to 500 □. When the thickness d**1** of the moisture absorbing layer **161** is equal to or greater than 30 □, the moisture absorbing layer **161** can absorb moisture penetrating into the organic layers **162** and **165** and the inorganic layers **163** and **166** positioned outside the moisture absorbing layer **161**. Hence, the moisture absorbing layer **161** can prevent the degradation of the subpixel **150** and a reduction in life span of the OLED display. When the thickness d**1** of the moisture absorbing layer **161** is equal to or smaller than 500 □, the moisture absorbing layer **161** can more efficiently absorb moisture penetrating into the organic layers **162** and **165** and the inorganic layers **163** and **166** to the extent that a transmittance of light coming from the subpixel **150** is not reduced.

The moisture absorbing layer **161** may be formed of lithium (Li), calcium (Ca), magnesium (Mg), barium (Ba), strontium (Sr), yttrium (Y), or cesium (Cs). Other materials capable of absorbing moisture may be used.

When the moisture absorbing layer **161** is formed of Ca, the following reaction formula between Ca and moisture (i.e., H_2O) is obtained: $2Ca+O_2+H_2O \rightarrow Ca(OH)_2+CaO$. It can be seen from the above reaction formula that a transparent material is produced through a reaction between the moisture absorbing layer **161** and H_2O. Therefore, the transmittance of light coming from the subpixel **150** is not reduced.

The organic layers **162** and **165** on the moisture absorbing layer **161** may be formed of a deposition material. It is advantageous that a deposition material having a close molecule structure is used so that there is little pin hole after performing a deposition process.

The inorganic layers **163** and **166** on the organic layers **162** and **165** may be formed of Al_2O_3, SiNx, SiO_2, SiON, or SiC. Other materials may be used.

As shown in FIG. **4**, an edge portion of the multi-layered protective layer **160** may be sealed with an inorganic barrier rib **168**. The inorganic barrier rib **168** may be formed of the same material as the inorganic layers **163** and **166**, for example, Al_2O_3, SiNx, SiO_2, SiON, or SiC. Other materials may be used. The inorganic barrier rib **168** may prevent moisture from penetrating into the side of the multi-layered protective layer **160**, which is relatively thinner than other portions of the multi-layered protective layer **160**.

As shown in FIGS. **3** and **4**, thicknesses of the organic layers **162** and **165** may be greater than thicknesses of the inorganic layers **163** and **166** or the thickness d**1** of the moisture absorbing layer **161**. Hence, a penetration path of moisture may lengthen while maintaining a flexibility of the OLED display.

As shown in FIG. **5**, an edge portion of the moisture absorbing layer **161** may be positioned more inward than edge portions of the inorganic layers **163** and **166**. Because the edge portion of the multi-layered protective layer **160** is thinner than an upper portion of the multi-layered protective layer **160**, the edge portion of the moisture absorbing layer **161** is positioned more inward than the edge portions of the inorganic layers **163** and **166** so that the thin edge portion of the multi-layered protective layer **160** is strengthened.

FIG. **5** shows that a length of edge portions of the organic layers **162** and **165** is similar to a length of the edge portion of the moisture absorbing layer **161**. However, the organic layers **162** and **165** may be positioned more outwardly than the moisture absorbing layer **161**.

FIG. **5** shows that the inorganic barrier rib **168** sealing the edge portion of the multi-layered protective layer **160** covers and seals a portion of the inorganic layer **166** positioned at an uppermost location of the multi-layered protective layer **160**. However, the inorganic barrier rib **168** may cover and seal a portion of any one layer included in the multi-layered protective layer **160**.

Second Exemplary Embodiment

As shown in FIG. **6**, an OLED display according to a second exemplary embodiment of the invention may include a substrate **210**, a subpixel **250** on the substrate **210**, and a multi-layered protective layer **260** covering the subpixel **250**. The multi-layered protective layer **260** may have a structure in which organic layers and inorganic layers are alternately stacked in a repeated manner and at least one moisture absorbing layer is interposed in the multi-layered protective layer **260**.

The substrate **210** may be formed of a material that has mechanical strength or excellent dimensional stability for forming elements. The substrate **210** may be a glass substrate, a metal substrate, a ceramic substrate, or a plastic substrate. The plastic substrate may be formed of polycarbonate resin, acrylic resin, vinyl chloride resin, polyethyleneterephthalate resin, polyimide resin, polyester resin, epoxy resin, silicon resin, and fluorine resin. Other materials may be used for the substrate **210**.

The subpixel **250** may include a transistor including a switching transistor, a drive transistor, and a capacitor and an organic light emitting diode on the transistor.

The subpixel **250** is described in detail below with reference to FIG. **7**.

As shown in FIG. **7**, a buffer layer **211** may be positioned on the substrate **210**. The buffer layer **211** prevents impurities (e.g., alkali ions discharged from the substrate **210**) from being introduced during formation of the transistor in a succeeding process. The buffer layer **211** may be formed using silicon oxide (SiO_2), silicon nitride (SiN_x), or using other materials.

An active layer **214** may be positioned on the buffer layer **211**. The active layer **214** may be formed of amorphous silicon or crystallized polycrystalline silicon. Although it is not shown, the active layer **214** may include a channel region, a source region, and a drain region. The source region and the drain region of the active layer **214** may be doped with p-type or n-type impurities. The active layer **214** may include an ohmic contact layer for reducing a contact resistance.

A first insulating layer **213** may be positioned on the active layer **214**. The first insulating layer **213** may be formed of silicon oxide (SiO_x), silicon nitride (SiN_x), or a multi-layered structure or a combination thereof, but is not limited thereto.

A gate **212** may be positioned on the first insulating layer **213**. The gate **212** may be formed of molybdenum (Mo), aluminum (Al), chromium (Cr), gold (Au), titanium (Ti), nickel (Ni), neodymium (Nd) or copper (Cu), or a combination thereof. The gate **212** may have a multi-layered structure formed of Mo, Al, Cr, Au, Ti, Ni, Nd, or Cu, or a combination thereof. For example, the gate **212** may have a double-layered structure including Mo/Al—Nd or Mo/Al.

A second insulating layer **216*a*** may be positioned on the gate **212**. The second insulating layer **216*a*** may be formed of silicon oxide (SiO_x), silicon nitride (SiN_x), or a multi-layered structure or a combination thereof. Other materials may be used. The second insulating layer **216*a*** may be a passivation layer.

A source **215*a*** and a drain **215*b*** contacting the active layer **214** may be positioned on the second insulating layer **216*a***. The source **215*a*** and the drain **215*b*** may have a single-layered structure or a multi-layered structure. When the source **215*a*** and the drain **215*b*** have the single-layered structure, the source **215*a*** and the drain **215*b*** may be formed of Mo, Al, Cr, Au, Ti, Ni, Nd, or Cu, or a combination thereof. When the source **215*a*** and the drain **215*b*** have the multi-layered structure, the source **215*a*** and the drain **215*b*** may have a double-layered structure including Mo/Al—Nd or a triple-layered structure including Mo/Al/Mo or Mo/Al—Nd/Mo.

A third insulating layer **216*b*** may be positioned on the source **215*a*** and the drain **215*b***. The third insulating layer **116*b*** may be formed of an organic material or an inorganic material. The third insulating layer **116*b*** may be a planarization layer for increasing a planarization level.

So far, the transistor on the substrate **210** was described. The organic light emitting diode on the transistor will be described in detail below.

A first electrode **217** connected to the source **215*a*** and the drain **215*b*** may be positioned on the third insulating layer **216*b***. The first electrode **217** may be an anode electrode and may be formed of transparent Indium-Tin-oxide (ITO) or Indium-Zinc-Oxide (IZO). Other materials may be used for the first electrode **217**.

A bank layer **220** may be positioned on the first electrode **217**. The bank layer **220** may be formed of an organic material such as benzocyclobutene (BCB)-based resin, acrylic resin, or polyimide resin. The bank layer **220** has an opening on the first electrode **217**.

An organic light emitting layer **221** may be positioned inside the opening of the bank layer **220**. The organic light emitting layer **221** may have a structure to emit one of red, green, and blue light in which depending on the subpixel **250**.

A second electrode **222** may be positioned on the organic light emitting layer **221**. The second electrode **222** may be a cathode electrode and may be formed of aluminum (Al). Other materials may be used for the second electrode **222**.

The multi-layered protective layer **260** is positioned on the subpixel **250** to cover the subpixel **250**.

The multi-layered protective layer **260** is described in detail below with reference to FIGS. **8** and **9**.

As shown in FIG. **8**, the multi-layered protective layer **260** may have a structure in which a moisture absorbing layer **261**, an organic layer **262**, an inorganic layer **263**, a moisture absorbing layer **264**, an organic layer **265**, and an inorganic layer **266** are stacked in the order named. The moisture absorbing layers **261** and **264** may be formed through a deposition method using a mask inside a vacuum chamber. Other methods may be used.

Thicknesses d**1** and d**2** of the moisture absorbing layers **261** and **264** may be 30 Å to 500 Å. When the thicknesses d**1** and d**2** of the moisture absorbing layers **261** and **264** are equal to or greater than 30 Å, the moisture absorbing layers **261** and **264** can absorb moisture penetrating into the organic layers **262** and **265** and the inorganic layers **263** and **266** positioned outside the moisture absorbing layers **261** and **264**. Hence, the moisture absorbing layers **261** and **264** can prevent the degradation of the subpixel **250** and a reduction in life span of the OLED display. When the thicknesses d**1** and d**2** of the moisture absorbing layers **261** and **264** are equal to or smaller than 500 Å, the moisture absorbing layers **261** and **264** can more efficiently absorb moisture penetrating into the OLED display through the organic layers **262** and **265** and the inorganic layers **263** and **266** to the extent that a transmittance of light coming from the subpixel **250** is not reduced.

The moisture absorbing layers **261** and **264** may be formed of lithium (Li), calcium (Ca), magnesium (Mg), barium (Ba), strontium (Sr), yttrium (Y), or cesium (Cs). Other materials capable of absorbing moisture may be used.

When the moisture absorbing layers **261** and **264** is formed of Ca, the following reaction formula between Ca and moisture (i.e., H_2O) is obtained: $2Ca+O_2+H_2O \rightarrow Ca(OH)_2+CaO$. It can be seen from the above reaction formula that a transparent material is produced through a reaction between the moisture absorbing layers **261** and **264** and H_2O. Therefore, the transmittance of light coming from the subpixel **250** is not reduced.

The organic layers **262** and **265** on the moisture absorbing layers **261** and **264** may be formed of a deposition material. It is advantageous that a deposition material having a close molecule structure is used so that there is little pin hole after performing a deposition process.

The inorganic layers **263** and **266** on the organic layers **262** and **265** may be formed of Al_2O_3, SiNx, SiO_2, SiON, or SiC. Other materials may be used.

As shown in FIG. **9**, in the multi-layered protective layer **260**, the moisture absorbing layer **261**, the organic layer **262**, the inorganic layer **263**, the moisture absorbing layer **264**, the organic layer **265**, and the inorganic layer **266** are stacked in the order named. An edge portion of the multi-layered protective layer **260** may be sealed with an inorganic barrier rib **268**. The inorganic barrier rib **268** may prevent moisture from penetrating into the side of the multi-layered protective layer **260**, which is relatively thinner than other portions of the multi-layered protective layer **260**. The inorganic barrier rib **268** may be formed of the same material as the inorganic layers **263** and **266**, for example, Al_2O_3, SiNx, SiO_2, SiON, or SiC. Other materials may be used.

As shown in FIGS. **8** and **9**, thicknesses of the organic layers **262** and **265** may be greater than thicknesses of the inorganic layers **263** and **266** or the thicknesses d**1** and d**2** of the moisture absorbing layers **261** and **264**. Hence, a penetration path of moisture may lengthen while maintaining a flexibility of the OLED display.

The thickness d**1** of the moisture absorbing layer **261** may be different from the thickness d**2** of the moisture absorbing layer **264**. For example, the thickness d**1** of the moisture absorbing layer **261** may be smaller than the thickness d**2** of the moisture absorbing layer **264** so as to increase a transmittance of light coming from the subpixel **250**. The thickness d**2** of the moisture absorbing layer **264** may be smaller than the thickness d**1** of the moisture absorbing layer **261**, if necessary.

As shown in FIG. **10**, edge portions of the moisture absorbing layers **261** and **264** may be positioned more inward than edge portions of the inorganic layers **263** and **266**. Because the edge portion of the multi-layered protective layer **260** is thinner than an upper portion of the multi-layered protective layer **260**, the edge portions of the moisture absorbing layers **261** and **264** are positioned more inward than the edge portions of the inorganic layers **263** and **266** so that the thin edge portion of the multi-layered protective layer **260** is strengthened.

FIG. **10** shows that a length of edge portions of the organic layers **262** and **265** is similar to a length of the edge portions of the moisture absorbing layers **261** and **264**. However, the organic layers **262** and **265** may be positioned more outwardly than the moisture absorbing layers **261** and **264**.

FIG. **10** shows that the inorganic barrier rib **268** sealing the edge portion of the multi-layered protective layer **260** covers and seals a portion of the inorganic layer **266** positioned at an uppermost location of the multi-layered protective layer **260**. However, the inorganic barrier rib **268** may cover and seal a portion of any one layer included in the multi-layered protective layer **260**.

Third Exemplary Embodiment

As shown in FIG. **11**, an OLED display according to a third exemplary embodiment of the invention may include a substrate **310**, a subpixel **350** on the substrate **310**, and a multi-layered protective layer **360** covering the subpixel **350**. The multi-layered protective layer **360** may have a structure in which at least one moisture absorbing layer is interposed between inorganic layers.

The subpixel **350** may include a transistor including a switching transistor, a drive transistor, and a capacitor and an organic light emitting diode on the transistor.

Since a structure of the subpixel **350** shown in FIG. **12** is substantially the same as the subpixel **150** shown in FIG. **2**, a further description may be briefly made or may be entirely omitted. The multi-layered protective layer **360** is positioned on the subpixel **350** to cover the subpixel **350**.

The multi-layered protective layer **360** is described in detail below with reference to FIGS. **13** and **14**.

As shown in FIG. **13**, the multi-layered protective layer **360** has a structure in which at least one or more moisture absorbing layer **362** is interposed between inorganic layers **361** and **363**. The moisture absorbing layer **362** may be formed using one of a dipping method, a spin coating method, a spray coating method, a dispensing method, and a screen printing method depending on a formation material of the moisture absorbing layer **362**. Other methods may be used.

A thickness d**1** of the moisture absorbing layer **362** may be 0.05 μm to 1,000 μm When the thickness d**1** of the moisture absorbing layer **362** is equal to or greater than 0.05 μm the moisture absorbing layer **362** can absorb moisture or oxygen penetrating into the inorganic layers **361** and **363** surrounding the moisture absorbing layer **362**. Hence, the moisture absorbing layer **362** can prevent the degradation of the subpixel **350** and a reduction in life span of the OLED display. When the thickness d**1** of the moisture absorbing layer **362** is equal to or smaller than 1,000 m the moisture absorbing layer **362** can more efficiently absorb moisture or oxygen penetrating into the inorganic layers **361** and **363** surrounding the moisture absorbing layer **362** to the extent that a transmittance of light coming from the subpixel **350** is not reduced.

The moisture absorbing layer **362** may be formed of polyvinyl alcohol or an organic metal compound. If the moisture absorbing layer **362** contains an adhesive material, the moisture absorbing layer **362** may be attached to the inorganic layer **361** using the adhesive material. If the moisture absorbing layer **362** does not contain an adhesive material, the moisture absorbing layer **362** may be attached to the inorganic layer **361** by applying heat to the moisture absorbing layer **362** and drawing the moisture absorbing layer **362**.

When the moisture absorbing layer **362** is formed of the organic metal compound, the organic metal compound may be a compound expressed by the following formula: M(OR1)a. In the above formula, M is one of group I, III, and IV elements, R1 is one of substituted or non-substituted mono-valent chain hydrocarbon group, mono-valent alicyclic hydrocarbon group, and monocyclic or polycyclic mono-valent aromatic or hetero aromatic hydrocarbon group, "a" is 2 when M is a group II element, "a" is 3 when M is a group III element, and "a" is 4 when M is a group IV element.

In a process for forming the moisture absorbing layer **362**, when an organic metal compound solution is deposited on the subpixel and then a condensing agent is produced using at least one of heat or ultraviolet rays, the moisture absorbing layer **362** may contain at least one of the following (1) and (2). (1) may include at least one of zeolite capable of absorbing H_2O, silica, alumina, alkali metal oxide, alkaline earth metal oxide, nickel zinc cadmium oxide, chloride, perchlorate, sulfate, epoxide, luis, a compound for producing positive carbon ions, alkoxide, and acyl halide. (2) may include at least one of alkali metal capable of absorbing O_2, alkaline earth metal, iron oxide, tin oxide, copper oxide, manganese oxide, phosphit, salt having negative phosphit ions, phenol, secondary aromatic amine. thioethers, and aldehyde. Each of particles of metal included in (1) or (2) has the size of 10 nm to 500 nm.

In the process for forming the moisture absorbing layer **362** using the organic metal compound solution, a base material (i.e., moisture transfer layer) of an organic binder may use at least one of polyacrylate, polymethacrylate, polyether imide (PEI), polyamide (PA), cellulose acetate (CA), cellulose triacetate (TCA), polysiloxane, polyvinyl alcohol (PVA), polyethylene oxide (PEO), polyethylene glycol (PEG), polypropylene glycol (PPG), polyvinyl acetate (PVAC), polyoxymethylene (POM), poly (ethylene vinyl alcohol) copolymer (EVAL, EVOH), poly (amide-ekylene oxide) copolymer (PA-PEO), poly (urethane-ethylene oxide) copolymer (PUR-PEO), poly (ekylene-vinyl acetate) copolymer (EVA, EVAC). A solvent may use a polar solvent such as an alcohol-based solvent and a ketone-based solvent, or a non-polar solvent such as aromatic hydrocarbon, alicyclic hydrocarbon, and alicyclic hydrocarbon-based organic solvent.

As described above, in the process for forming the moisture absorbing layer **362** using the organic metal compound solution, a thermal process is performed on a coated thin film to produce a condensing agent. The condensing agent may perform a stress reduction and absorption and removal of an external gas.

The inorganic layers **361** and **363** may be formed on the subpixel **350** using one of a chemical vapor deposition (CVD) method, a sputtering method, and an evaporation method depending on a material of the inorganic layers **361** and **363**. Other methods may be used. The inorganic layers **361** and **363** may be formed of inorganic oxide or inorganic nitride. For example, the inorganic layers **361** and **363** may be formed of one of SiO_2, SiOxNy, SiNx, SiOxCy, Al_2O_3, ITO, ZnOx, and Al—ZnOx. Other materials may be used.

As shown in FIG. **14**, the OLED display thus formed may further include a sealing substrate **380** for sealing the subpixel **350**. The sealing substrate **380** may be positioned opposite the substrate **310** to be spaced apart from the substrate **310**. The substrate **310** and the sealing substrate **380** may be sealed with an adhesive member **370**. The adhesive member **370** may include a first adhesive member **371** positioned outside the substrate **310** and the sealing substrate **380** and a second adhesive member **372** that is positioned more inward than the first adhesive member **371** in front of the substrate **310** and the sealing substrate **380**. An edge sealant may be used as the first adhesive member **371**, and a transparent front sealant may be used as the second adhesive member **372**. Other materials may be used for the first and second adhesive members **371** and **372**.

Fourth Exemplary Embodiment

As shown in FIG. **15**, an OLED display according to a fourth exemplary embodiment of the invention may include a substrate **410**, a subpixel **450** on the substrate **410**, and a multi-layered protective layer **460** covering the subpixel **450**. The multi-layered protective layer **460** may have a structure in which at least one or more moisture absorbing layer is interposed between inorganic layers. The multi-layered protective layer **460** may include at least two inorganic layers and at least two moisture absorbing layers.

The subpixel **450** may include a transistor including a switching transistor, a drive transistor, and a capacitor and an organic light emitting diode on the transistor.

Since a structure of the subpixel **450** shown in FIG. **16** is substantially the same as the subpixel **250** shown in FIG. **7**, a further description may be briefly made or may be entirely omitted. The multi-layered protective layer **460** is positioned on the subpixel **450** to cover the subpixel **450**.

The multi-layered protective layer **460** is described in detail below with reference to FIGS. **17** and **18**.

As shown in FIG. **17**, the multi-layered protective layer **460** has a structure in which the inorganic layers and the moisture absorbing layers are alternately stacked in a repeated manner. More specifically, the multi-layered protective layer **460** has a structure in which an inorganic layer **461**, a moisture absorbing layer **462**, an inorganic layer **463**, a moisture absorbing layer **464**, and an inorganic layer **465** are stacked in the order named.

The moisture absorbing layers **462** and **464** may be formed using one of a dipping method, a spin coating method, a spray coating method, a dispensing method, and a screen printing method depending on a formation material. Other methods may be used.

Thicknesses d**1** and d**2** of the moisture absorbing layers **462** and **464** may be 0.05 μm to 1,000 μm When the thicknesses d**1** and d**2** of the moisture absorbing layers **462** and **464** are equal to or greater than 0.05 μm the moisture absorbing layer **462** can absorb moisture or oxygen penetrating into the inorganic layers **461**, **463**, and **465** surrounding the moisture absorbing layers **462** and **464**. Hence, the moisture absorbing layers **462** and **464** can prevent the degradation of the subpixel **450** and a reduction in life span of the OLED display. When the thicknesses d**1** and d**2** of the moisture absorbing layers **462** and **464** are equal to or smaller than 1,000 μm the moisture absorbing layer **462** can more efficiently absorb moisture or oxygen penetrating into the inorganic layers **461**, **463**, and **465** surrounding the moisture absorbing layers **462** and **464** to the extent that a transmittance of light coming from the subpixel **450** is not reduced.

The moisture absorbing layers **462** and **464** may be formed of polyvinyl alcohol or an organic metal compound. If the moisture absorbing layers **462** and **464** contain an adhesive material, the moisture absorbing layers **462** and **464** may be attached to the inorganic layers **461** and **463** using the adhesive material. If the moisture absorbing layers **462** and **464** do not contain an adhesive material, the moisture absorbing layers **462** and **464** may be attached to the inorganic layers **461** and **463** by applying heat to the moisture absorbing layers **462** and **464** and drawing the moisture absorbing layers **462** and **464**.

The thickness d1 of the moisture absorbing layer **462** may be equal to or different from the thickness d2 of the moisture absorbing layer **464**. For example, the thickness d1 of the moisture absorbing layer **462** may be smaller than the thickness d2 of the moisture absorbing layer **464** in consideration of an amount of moisture or oxygen penetrating from the outside.

When the moisture absorbing layers **462** and **464** are formed of the organic metal compound, the organic metal compound may be a compound expressed by the following formula: M(OR1)a. In the above formula, M is one of group I, III, and IV elements, R1 is one of substituted or non-substituted mono-valent chain hydrocarbon group, mono-valent alicyclic hydrocarbon group, and monocyclic or polycyclic mono-valent aromatic or hetero aromatic hydrocarbon group, "a" is 2 when M is a group II element, "a" is 3 when M is a group III element, and "a" is 4 when M is a group IV element.

a process for forming the moisture absorbing layers **462** and **464**, when an organic metal compound solution is deposited on the subpixel and then a condensing agent is produced using at least one of heat or ultraviolet rays, the moisture absorbing layers **462** and **464** may contain at least one of the following (1) and (2). (1) may include at least one of zeolite capable of absorbing H_2O, silica, alumina, alkali metal oxide, alkaline earth metal oxide, nickel zinc cadmium oxide, chloride, perchlorate, sulfate, epoxide, luis, a compound for producing positive carbon ions, alkoxide, and acyl halide. (2) may include at least one of alkali metal capable of absorbing O_2, alkaline earth metal, iron oxide, tin oxide, copper oxide, manganese oxide, phosphit, salt having negative phosphit ions, phenol, secondary aromatic amine, thioethers, and aldehyde. Each of particles of metal included in (1) or (2) has the size of 10 nm to 500 nm.

In the process for forming the moisture absorbing layers **462** and **464** using the organic metal compound solution, a base material (i.e., a moisture transfer layer) of an organic binder may use at least one of polyacrylate, polymethacrylate, polyether imide (PEI), polyamide (PA), cellulose acetate (CA), cellulose triacetate (TCA), polysiloxane, polyvinyl alcohol (PVA), polyethylene oxide (PEO), polyethylene glycol (PEG), polypropylene glycol (PPG), polyvinyl acetate (PVAC), polyoxymethylene (POM), poly (ethylene vinyl alcohol) copolymer (EVAL, EVOH), poly (amide-ekylene oxide) copolymer (PA-PEO), poly (urethane-ethylene oxide) copolymer (PUR-PEO), poly ekylene-vinyl acetate) copolymer (EVA, EVAC). A solvent may use a polar solvent such as an alcohol-based solvent and a ketone-based solvent, or a non-polar solvent such as aromatic hydrocarbon, alicyclic hydrocarbon, and alicyclic hydrocarbon-based organic solvent.

As described above, in the process for forming the moisture absorbing layer **462** using the organic metal compound solution, a thermal process is performed on a coated thin film

to produce a condensing agent. The condensing agent may perform a stress reduction and absorption and removal of an external gas.

The inorganic layers **461**, **463**, and **465** may be formed on the subpixel **450** using one of a CVD method, a sputtering method, and an evaporation method depending on a formation material of the inorganic layers **461**, **463**, and **465**. Other methods may be used. The inorganic layers **461**, **463**, and **465** may be formed of inorganic oxide or inorganic nitride. For example, the inorganic layers **461**, **463**, and **465** may be formed of one of SiO_2, SiOxNy, SiNx, SiOxCy, Al_2O_3, ITO, ZnOx, and Al—ZnOx. Other materials may be used.

As described above, in the OLED display according to the embodiments of the invention, the degradation of elements of the OLED display can be prevented and life span of the OLED display can increase through the multi-layered protective layer including the moisture absorbing layer. Furthermore, the OLED display according to the embodiments of the invention can achieve mass production as well as an increase in the life span. The OLED display according to the embodiments of the invention can minimize a generation percentage of particles capable of causing a defect of the OLED display during a manufacturing process and can provide a flexibility.

Any reference in this specification to "one embodiment," "an embodiment," "example embodiment," etc., means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the invention. The appearances of such phrases in various places in the specification are not necessarily all referring to the same embodiment. Further, when a particular feature, structure, or characteristic is described in connection with any embodiment, it is submitted that it is within the purview of one skilled in the art to effect such feature, structure, or characteristic in connection with other ones of the embodiments.

Although embodiments have been described with reference to a number of illustrative embodiments thereof, it should be understood that numerous other modifications and embodiments can be devised by those skilled in the art that will fall within the spirit and scope of the principles of this disclosure. More particularly, various variations and modifications are possible in the component parts and/or arrangements of the subject combination arrangement within the scope of the disclosure, the drawings and the appended claims. In addition to variations and modifications in the component parts and/or arrangements, alternative uses will also be apparent to those skilled in the art.

What is claimed is:

1. An organic light emitting diode (OLED) display comprising:

a substrate;

a subpixel on the substrate;

a multi-layered protective layer covering the subpixel, the multi-layered protective layer having a structure in which organic layers and inorganic layers are alternately stacked in a repeated manner and at least one moisture absorbing layer is interposed in the multi-layered protective layer; and

an inorganic barrier rib formed only at an edge portion of the substrate to cover an edge portion of the multi-layered protective layer,

wherein the multi-layered protective layer has a structure in which a first moisture absorbing layer, a first organic layer, a first inorganic layer, a second moisture absorbing layer, a second organic layer, and a second inorganic layer are stacked in the order named, wherein a thickness of the moisture absorbing layer is 30 Å to 500 Å,

wherein thicknesses of the two moisture absorbing layers are different from each other,

wherein a thickness of the organic layer is greater than a thickness of the inorganic layer or a thickness of the moisture absorbing layer.

2. The OLED display of claim **1**, wherein the moisture absorbing layer is formed of lithium (Li), calcium (Ca), magnesium (Mg), barium (Ba), strontium (Sr), yttrium (Y), or cesium (Cs).

3. The OLED display of claim **1**, wherein the inorganic layers are formed of $Al2O3$, SiNx, SiO2, SiON, or SiC.

4. The OLED display of claim **1**, wherein an edge portion of the moisture absorbing layer is positioned more inward than edge portions of the inorganic layers.

5. The OLED display of claim **1**, wherein the moisture absorbing layer is formed through a deposition method using a mask inside a vacuum chamber.

6. An organic light emitting diode (OLED) display comprising:

a substrate;

a subpixel on the substrate;

a multi-layered protective layer covering the subpixel, the multi-layered protective layer having a structure in which at least one moisture absorbing layer is interposed between inorganic layers,

an inorganic barrier rib formed only at an edge portion of the substrate to cover an edge portion of the multi-layered protective layer; and

a sealing substrate for covering the multi-layered protective layer, the sealing substrate being positioned opposite the substrate to be spaced apart from the substrate,

wherein the substrate and the sealing substrate are sealed with an adhesive member,

wherein the adhesive member includes a first adhesive member positioned outside the substrate and the sealing substrate and a second adhesive member that is positioned more inward than the first adhesive member in front of the substrate and the sealing substrate,

wherein the multi-layered protective layer has a structure in which a first inorganic layer, a first moisture absorbing layer, a second inorganic layer, a second moisture absorbing layer, and a third inorganic layer are stacked in the order named,

wherein a thickness of the moisture absorbing layer is 0.05 μm to 1,000 μm,

wherein the moisture absorbing layer is formed of polyvinyl alcohol or an organic metal compound,

wherein the organic metal compound is a compound expressed by the following formula: M(OR1)a,

wherein M is one of group II, III, and IV elements,

R1 is one of substituted or non-substituted mono-valent chain hydrocarbon group, mono-valent alicyclic hydrocarbon group, and monocyclic or polycyclic mono-valent aromatic or hetero aromatic hydrocarbon group,

"a" is 2 when M is a group II element, "a" is 3 when M is a group III element, and "a" is 4 when M is a group IV element.

7. The OLED display of claim **6**, wherein the inorganic layers are formed of one of SiO2, SiOxNy, SiNx, SiOxCy, Al2O3, indium-tin-oxide (ITO), ZnOx, and Al—ZnOx.

8. The OLED display of claim **6**, wherein the moisture absorbing layer is formed using one of a dipping method, a spin coating method, a spray coating method, a dispensing method, and a screen printing method.

* * * * *

专利名称(译)	有机发光二极管显示器		
公开(公告)号	US8053984	公开(公告)日	2011-11-08
申请号	US12/453740	申请日	2009-05-20
[标]申请(专利权)人(译)	李载允 YOO CHOONGKEUN KIM JONGSUNG 爱敬全度 LEE JONGKYUN		
申请(专利权)人(译)	李载允 YOO CHOONGKEUN KIM JONGSUNG 爱敬全度 LEE JONGKYUN		
当前申请(专利权)人(译)	LG DISPLAY CO. , LTD.		
[标]发明人	LEE JAEYOON YOO CHOONGKEUN KIM JONGSUNG JEON AEKYUNG LEE JONGKYUN		
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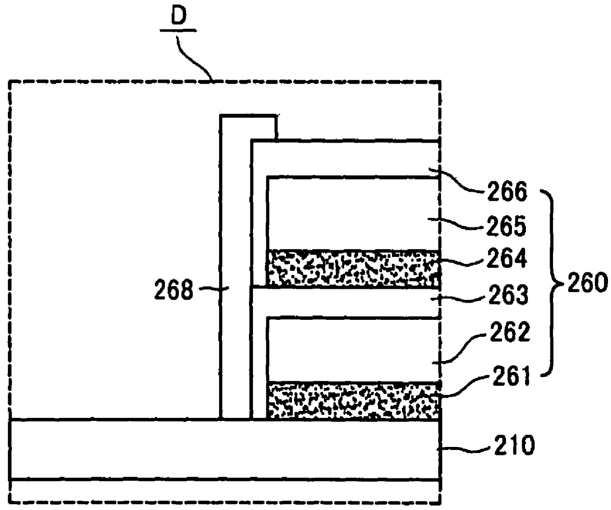
IPC分类号	H05B33/04		
CPC分类号	H01L51/5256 H01L27/3244		
优先权	1020080048798 2008-05-26 KR 1020080107320 2008-10-30 KR		
其他公开文献	US20090289549A1		
外部链接	Espacenet USPTO		

摘要(译)

提供有机发光二极管（OLED）显示器。OLED显示器包括基板，基板上的子像素和覆盖子像素的多层保护层。多层保护层具有这样的结构，其中有机层和无机层以重复的方式交替堆叠，并且在多层保护层中插入至少一个吸湿层。



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