US 20140145979A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2014/0145979 A1**

(43) **Pub. Date: May 29, 2014**

Lee

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

(71) Applicant: **SAMSUNG DISPLAY CO., LTD.**, Yongin-City (KR)

(72) Inventor: **Jeong-Yeol Lee**, Yongin-City (KR)

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

(21) Appl. No.: **13/830,519**

(22) Filed: **Mar. 14, 2013**

(30) **Foreign Application Priority Data**

Nov. 29, 2012 (KR) 10-2012-0137334

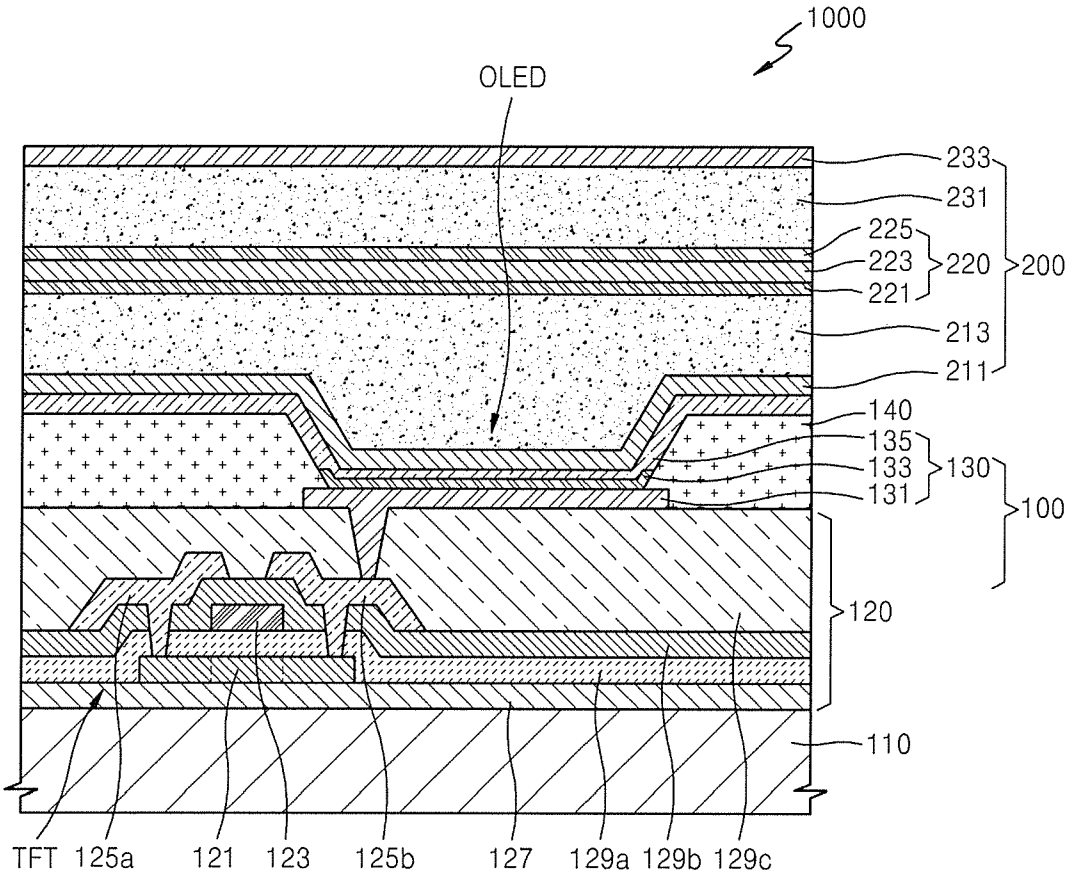
Publication Classification

(51) **Int. Cl.**
G06F 3/041 (2006.01)

(52) **U.S. Cl.**
CPC ***G06F 3/041*** (2013.01)
USPC **345/173**

(57) **ABSTRACT**

An organic light emitting display apparatus including a thin film encapsulation layer having a touch screen structure. The organic light emitting display apparatus includes a substrate; an organic light emitting diode (OLED) layer on the substrate; a thin film encapsulation layer on the OLED layer, and comprising a plurality of inorganic layers and a plurality of organic layers that are alternately stacked; and a touch sensing layer in the thin film encapsulation layer, wherein the touch sensing layer includes: a first touch conductive layer; a touch inorganic layer on the first touch conductive layer; and a second touch conductive layer on the touch inorganic layer, wherein the touch inorganic layer is one of the plurality of inorganic layers included in the thin film encapsulation layer.



BOE v. Samsung IPR2025-01476
Ex-1025

FIG. 1

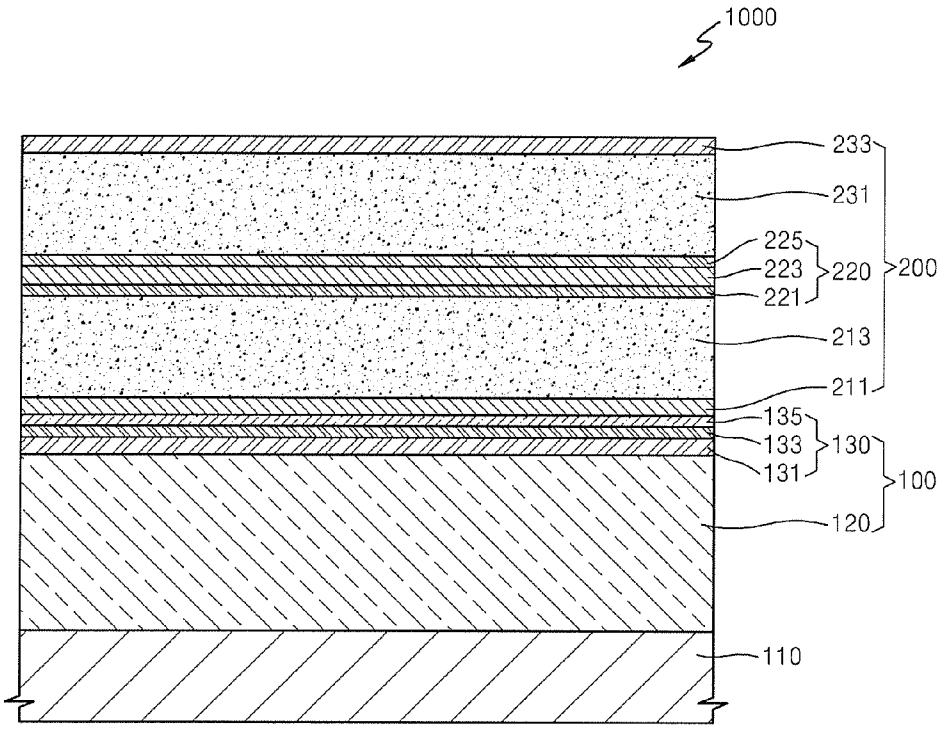

1000
233
231
225
223
221
220
200
213
211
135
133
131
130
100
120
110

FIG. 2

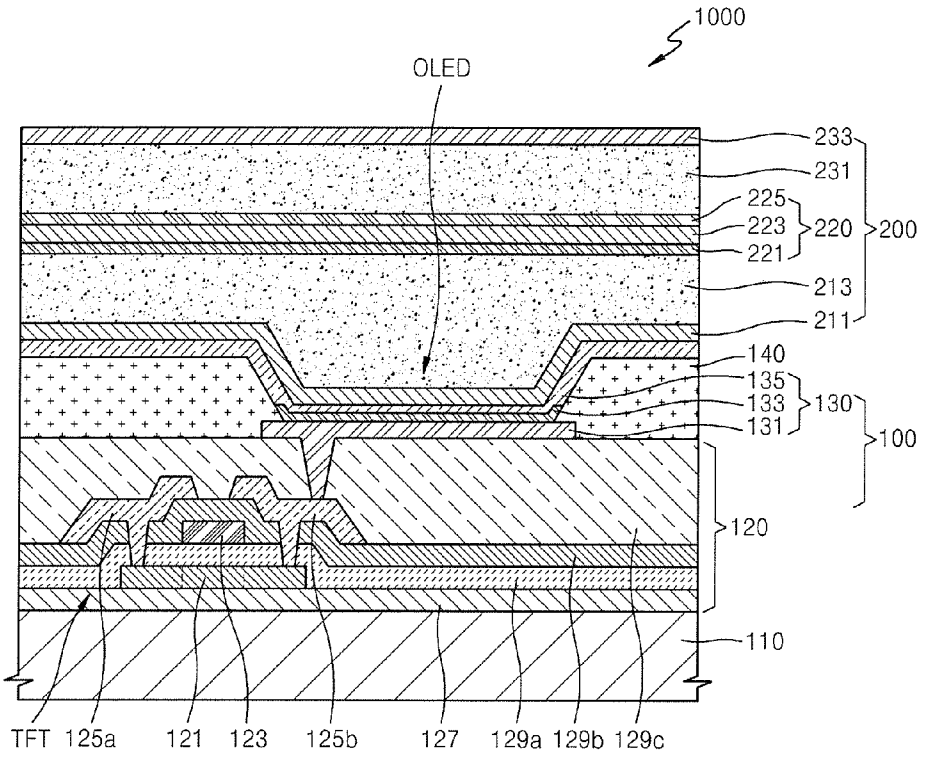

1000
OLED
233
231
225
223
220
221
200
213
211
140
135
133
130
131
100
120
110
TFT
125a
121
123
125b
127
129a
129b
129c

FIG. 3A

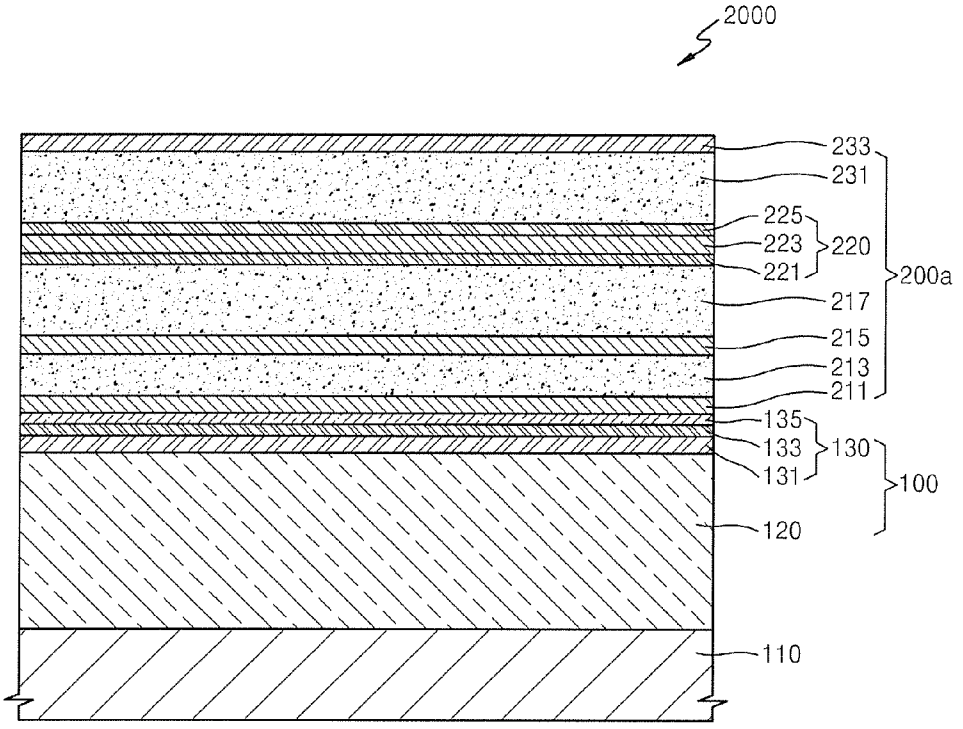

2000
233
231
225
223
221
220
200a
217
215
213
211
135
133
131
130
100
120
110

FIG. 3B

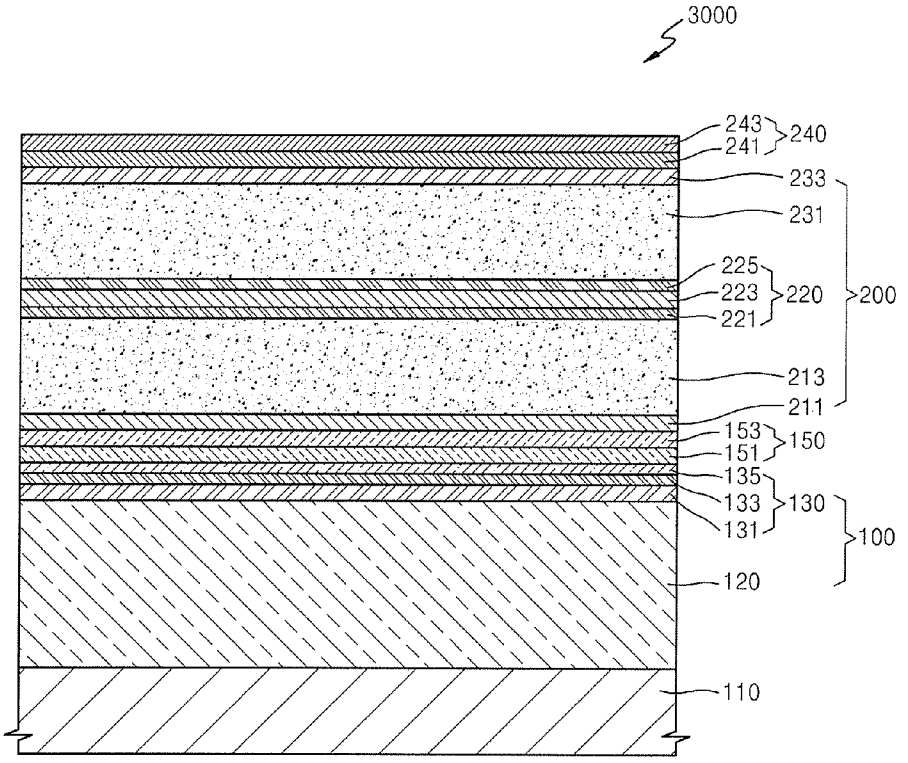

3000
243
241
240
233
231
225
223
221
220
200
213
211
153
151
150
135
133
131
130
100
120
110

FIG. 4A

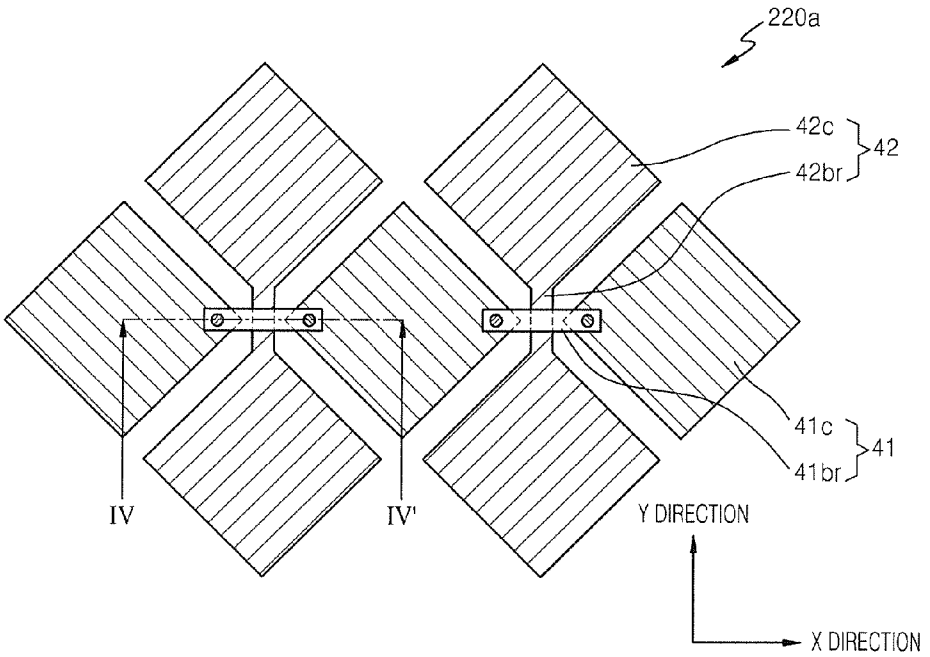

220a
42c
42
42br
41c
41
41br
IV
IV'
Y DIRECTION
X DIRECTION

FIG. 4B

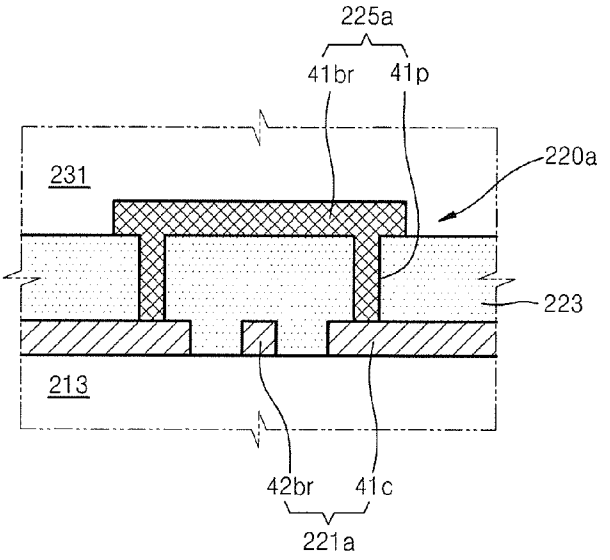

225a
41br
41p
220a
231
223
213
42br
41c
221a

FIG. 4C

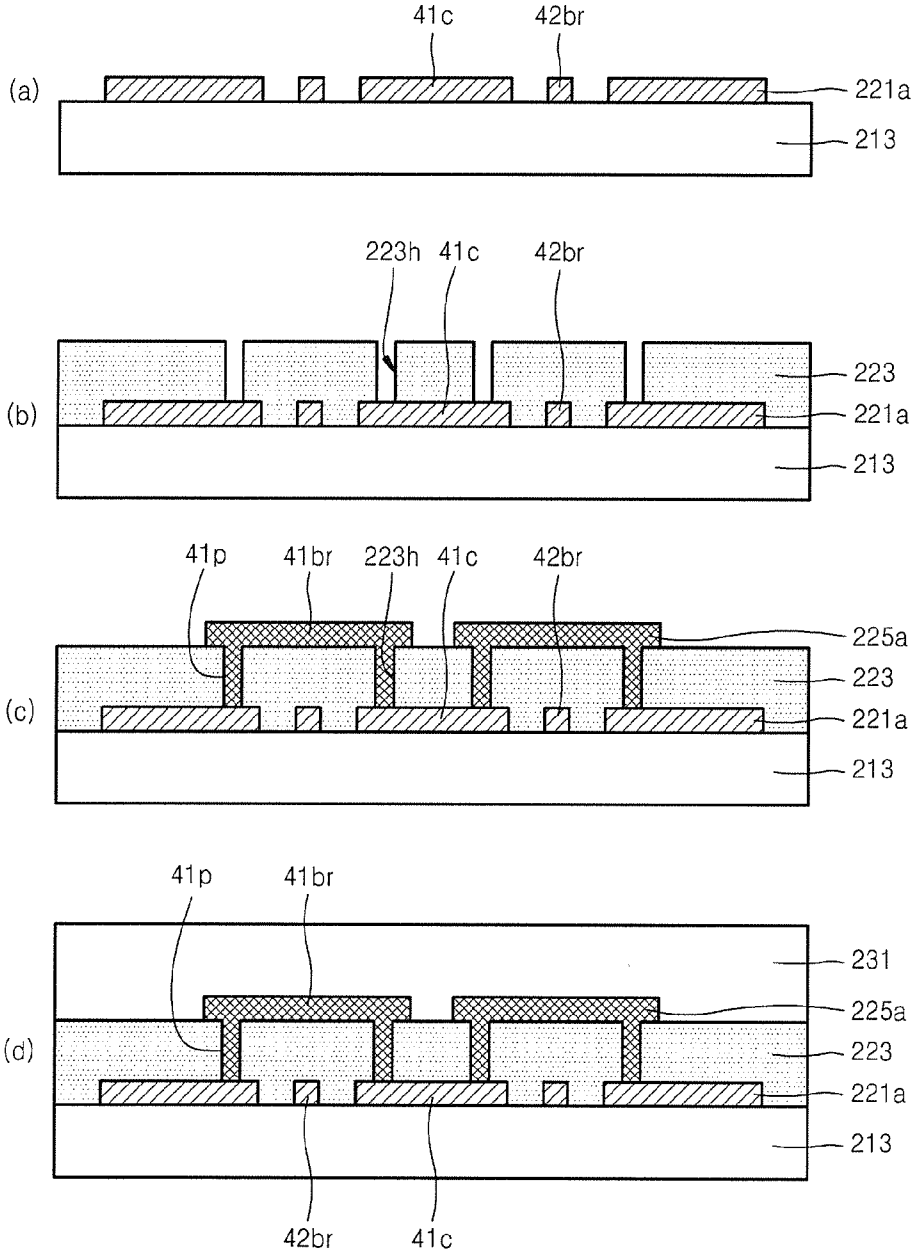

(a)
41c
42br
221a
213
(b)
223h
41c
42br
223
221a
213
(c)
41p
41br
223h
41c
42br
225a
223
221a
213
(d)
41p
41br
231
225a
223
221a
213
42br
41c

FIG. 5A

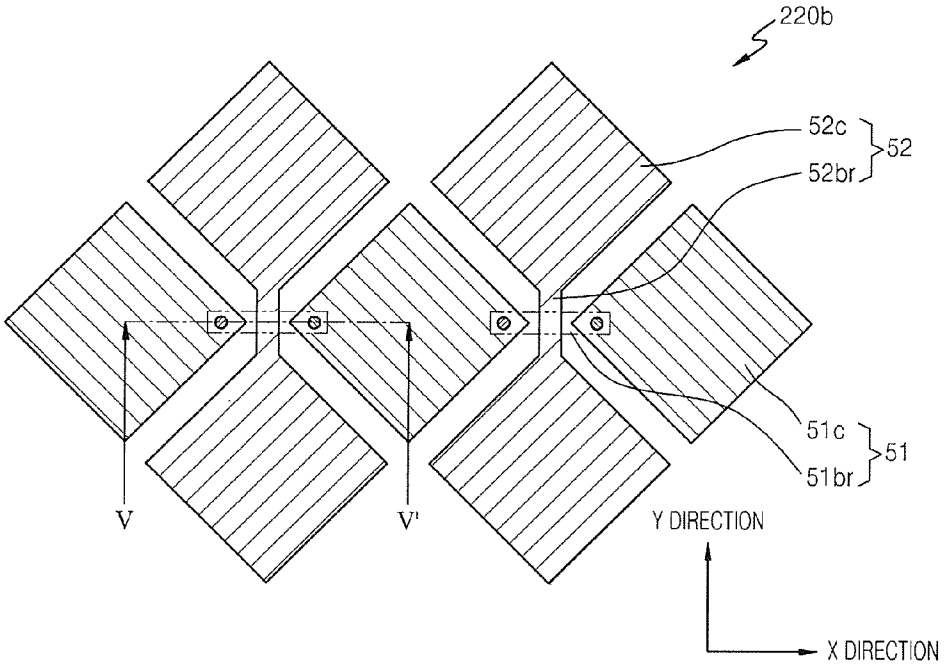

220b
52c
52
52br
51c
51
51br
V
V'
Y DIRECTION
X DIRECTION

FIG. 5B

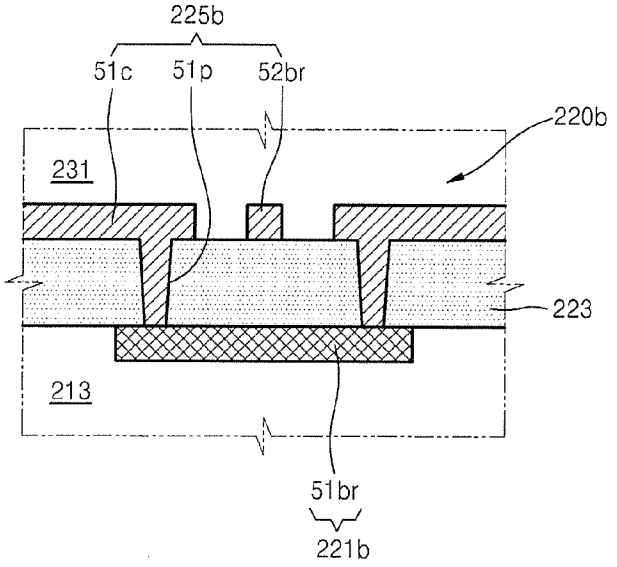
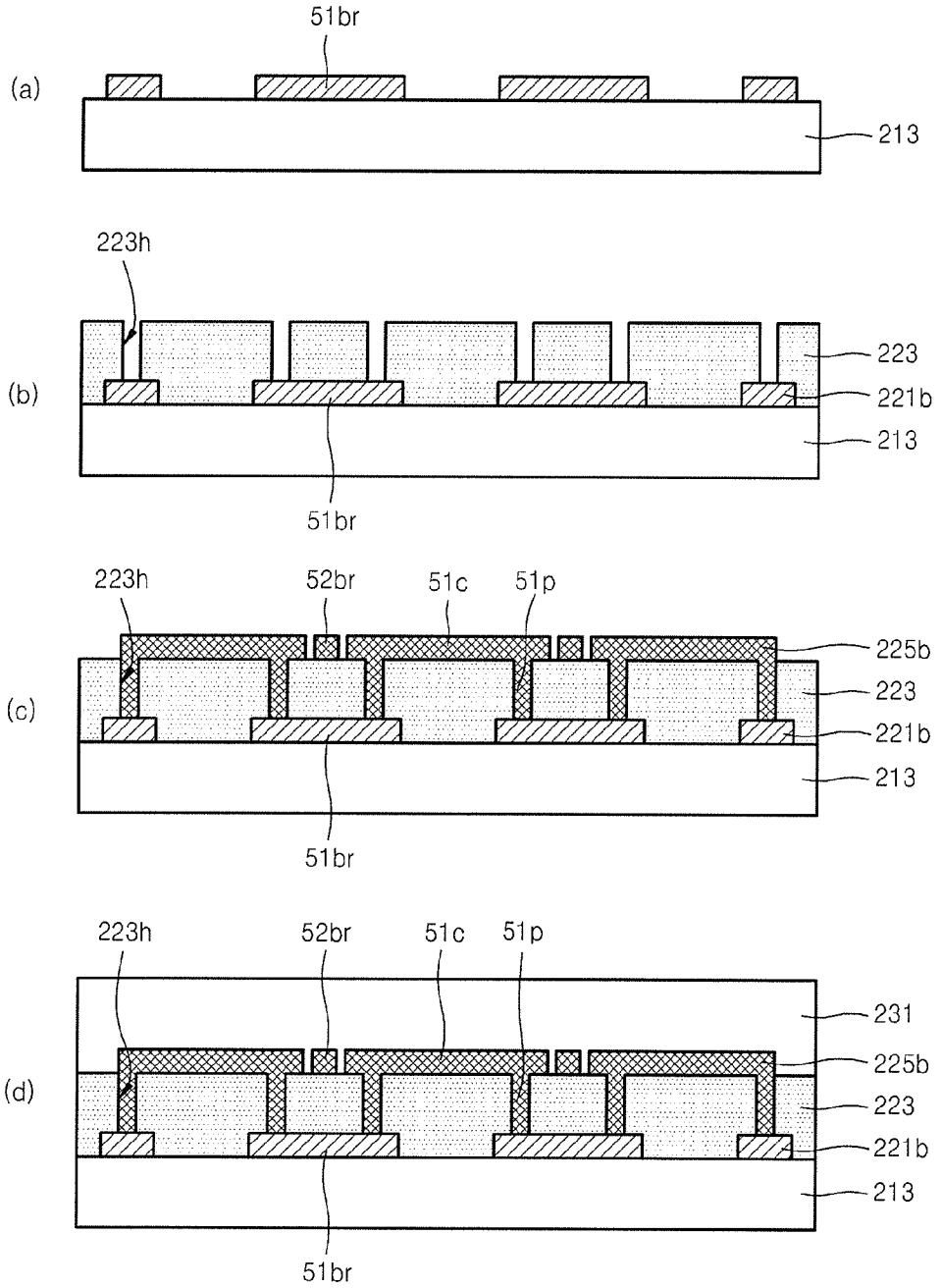

225b
51c
51p
52br
220b
231
223
213
51br
221b

FIG. 5C


(a)
51br
213
(b)
223h
223
221b
213
51br
(c)
223h
52br
51c
51p
225b
223
221b
213
51br
(d)
223h
52br
51c
51p
231
225b
223
221b
213
51br

ORGANIC LIGHT EMITTING DISPLAY APPARATUS AND METHOD OF MANUFACTURING THE SAME

CROSS-REFERENCE TO RELATED PATENT APPLICATION

[0001] This application claims priority to and the benefit of Korean Patent Application No. 10-2012-0137334, filed on Nov. 29, 2012, in the Korean Intellectual Property Office, the disclosure of which is incorporated herein in its entirety by reference.

BACKGROUND

[0002] 1. Field

[0003] Embodiments of the present invention relate to an organic light emitting display apparatus, and more particularly, to an organic light emitting display apparatus including a thin film encapsulation layer having a touch-screen structure and a method of manufacturing the same.

[0004] 2. Description of the Related Art

[0005] An organic light emitting display apparatus is a self-emissive display apparatus, which includes a hole injection electrode, an electron injection electrode, and an organic emission layer disposed between the hole injection electrode and the electron injection electrode, and which emits light when excitons (that are generated by combining holes injected from the hole injection electrode and electrons injected from the electron injection electrode in the organic emission layer) enter a ground state from an excited state.

[0006] Because the organic light emitting display apparatus is a self-emissive display apparatus that does not need an additional light source, the organic light emitting display apparatus may be driven with a low voltage and formed thin with a light weight. Thus, the organic light emitting display apparatus is considered as a next-generation display apparatus due to high-end characteristics, such as, wide viewing angle, high contrast, and fast response speed.

[0007] However, because the organic light emitting display apparatus may degrade due to external moisture and oxygen, the organic light emitting display apparatus may be encapsulated in order to protect the organic light emitting display apparatus against the external moisture and oxygen.

[0008] A thin film encapsulation (TFE) including a plurality of inorganic layers or a plurality of layers including organic layers and inorganic layers may be used for encapsulating the organic light emitting display apparatus in order to achieve thin and/or flexible organic light emitting display apparatuses.

[0009] A touch panel is an input device that may be easily used by intuitive manipulation of buttons displayed on a display panel by touching the buttons with fingers (or another input device). Touch panels are being applied to various fields, such as document issuing devices used in banks or public offices, medical instruments, guide displays for tourists, and traffic monitors.

[0010] A touch panel may be fabricated separately and attached to an organic light emitting display apparatus. However, when the above method is used, a thickness of the display apparatus increases, a process for attaching the touch screen is additionally performed, impurities may infiltrate into the screen during the attaching process, and manufacturing costs increase.

SUMMARY

[0011] Embodiments of the present invention provide an organic light emitting display apparatus including a thin film encapsulation layer in which a touch structure is formed.

[0012] Embodiments of the present invention also provide a method of manufacturing the organic light emitting display apparatus.

[0013] According to an aspect of the present invention, there is provided an organic light emitting display apparatus including: a substrate; an organic light emitting diode (OLED) layer on the substrate; and a thin film encapsulation layer on the OLED layer including: a plurality of inorganic layers; a plurality of organic layers stacked with the inorganic layers; and a touch sensing layer including: a first touch conductive layer; a touch inorganic layer on the first touch conductive layer; and a second touch conductive layer on the touch inorganic layer. Here, the inorganic layers of the thin film encapsulation layer include the touch inorganic layer of the thin film encapsulation layer.

[0014] The OLED layer may include: a pixel electrode on the substrate; an intermediate layer on the pixel electrode including an organic emission layer; and an opposite electrode on the intermediate layer.

[0015] The first touch conductive layer may include: a plurality of first sensing cells arranged along a first direction on the substrate; a plurality of first connecting patterns for connecting the first sensing cells to each other; and a plurality of second sensing cells arranged along a second direction on the substrate, and the second touch conductive layer may include: contact plugs in the touch inorganic layer electrically connected to portions of the second sensing cells; and a plurality of second connecting patterns electrically connecting the second sensing cells to each other via the contact plugs.

[0016] According to an embodiment of the present invention the first touch conductive layer includes a transparent conductive oxide material.

[0017] The second touch conductive layer may include: a plurality of first sensing cells arranged along a first direction on the substrate; a plurality of first connecting patterns electrically connecting the first sensing cells to each other; a plurality of second sensing cells arranged along a second direction on the substrate; and contact plugs in the touch inorganic layer electrically connected to the portions of the second sensing cells, and the first touch conductive layer may include a plurality of second connecting patterns electrically connecting the second sensing cells to each other via the contact plugs.

[0018] According to an embodiment of the present invention, the second touch conductive layer includes a transparent conductive oxide material.

[0019] The thin film encapsulation layer may further include: a first inorganic layer on the OLED layer; a first organic layer on the first inorganic layer; the touch inorganic layer on the first organic layer; a second organic layer on the touch inorganic layer; a second inorganic layer on the second organic layer; and a transparent conductive oxide layer interposed between the touch inorganic layer and the first organic layer or the second organic layer.

[0020] The thin film encapsulation layer may further include: a third inorganic layer on the first organic layer; and the touch inorganic layer on the third inorganic layer.

[0021] The organic layers of the thin film encapsulation layer may include a lower organic layer under the touch inorganic layer and an upper organic layer on the touch inor-

ganic layer, the first touch conductive layer may be directly between the lower organic layer and a bottom surface of the touch inorganic layer, and the second touch conductive layer may be directly between an upper surface of the touch inorganic layer and the upper organic layer.

[0022] According to an embodiment of the present invention the substrate is a flexible substrate.

[0023] The organic light emitting display apparatus may further include a protective layer between the OLED layer and the thin film encapsulation layer.

[0024] The organic light emitting display apparatus may further include an optical member on the thin film encapsulation layer.

[0025] According to an embodiment of the present invention, there is provided a method of manufacturing an organic light emitting display apparatus, the method including: sequentially forming a pixel electrode, an intermediate layer including an organic emission layer, and an opposite electrode on a substrate; and forming a thin film encapsulation layer including a plurality of inorganic layers on the opposite electrode; a plurality of organic layers stacked with the inorganic layers on the opposite electrode; and a touch sensing layer. Here the touch sensing layer includes one of the inorganic layers of the thin film encapsulation layer.

[0026] The sequentially forming the pixel electrode, the intermediate layer including the organic emission layer, and the opposite electrode on the substrate may include: forming the pixel electrode on the substrate; forming a pixel defining layer that defines a pixel region and covers opposite edges of the pixel electrode; forming the intermediate layer including the organic emission layer on a region defined by the pixel defining layer; and forming the opposite electrode so as to cover the intermediate layer and the pixel defining layer.

[0027] The forming of the thin film encapsulation layer may include: forming a first inorganic layer on the opposite electrode; forming a first organic layer on the first inorganic layer; forming the touch sensing layer on the first organic layer; forming a second organic layer on the touch sensing layer; and forming a second inorganic layer on the second organic layer.

[0028] The forming of the touch sensing layer may include: forming a first touch conductive layer; forming a touch inorganic layer on the first touch conductive layer; and forming a second touch conductive layer on the touch inorganic layer. Here, the touch inorganic layer may include one of the inorganic layers of the thin film encapsulation layer.

[0029] According to an embodiment of the present invention, there is provided an organic light emitting display apparatus including: a substrate; an organic light emitting diode (OLED) layer on the substrate; a thin film encapsulation layer on the OLED layer including: a plurality of inorganic layers; a plurality of organic layers stacked with the inorganic layers; and a touch sensing layer including a touch inorganic layer including one of the inorganic layers.

[0030] The touch inorganic layer may be between two successive organic layers among the organic layers.

[0031] The touch sensing layer may further include a first touch conductive layer under the touch inorganic layer, and a second touch conductive layer on the touch inorganic layer.

[0032] At least one of the first touch conductive layer and the second touch conductive layer may include a transparent conductive oxide material, and the thin film encapsulation layer further may include the layer that includes the transparent conductive oxide material.

BRIEF DESCRIPTION OF THE DRAWINGS

[0033] The above and other features and aspects of the present invention will become more apparent by describing in detail exemplary embodiments thereof with reference to the attached drawings in which:

[0034] FIG. **1** is a schematic cross-sectional view of an organic light emitting display apparatus according to an embodiment of the present invention;

[0035] FIG. **2** is a schematic cross-sectional view of a pixel area in the organic light emitting display apparatus of FIG. **1**;

[0036] FIG. **3**A is a schematic cross-sectional view of an organic light emitting display apparatus according to another embodiment of the present invention;

[0037] FIG. **3**B is a schematic cross-sectional view of an organic light emitting display apparatus according to another embodiment of the present invention;

[0038] FIG. **4**A is a schematic plan view of a touch sensing layer of a thin film encapsulation layer according to an embodiment of the present invention;

[0039] FIG. **4**B is a schematic cross-sectional view of the touch sensing layer taken along the line IV-IV' of FIG. **4**A;

[0040] FIG. **4**C depicts schematic cross-sectional views illustrating a method of forming a touch sensing layer disposed in the thin film encapsulation layer, according to an embodiment of the present invention;

[0041] FIG. **5**A is a schematic plan view of a touch sensing layer of a thin film encapsulation layer according to an embodiment of the present invention;

[0042] FIG. **5**B is a schematic cross-sectional view of the touch sensing layer taken along the line V-V' of FIG. **5**A; and

[0043] FIG. **5**C depicts schematic cross-sectional views illustrating a method of forming a touch sensing layer disposed in the thin film encapsulation layer, according to an embodiment of the present invention.

DETAILED DESCRIPTION

[0044] Although a few embodiments of the present invention have been shown and described, it will be appreciated by those skilled in the art that changes may be made in these exemplary embodiments without departing from the spirit of the present invention, the scope of which is defined by the appended claims and their equivalents.

[0045] It will be understood that, although the terms first and second are used herein to describe various elements, these elements should not be limited by these terms. These terms are only used to distinguish one element from another element. Thus, a first element discussed below may be termed a second element, and similarly, a second element may be termed a first element, without departing from the teachings of this disclosure.

[0046] The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. As used herein, the singular forms "a", "an" and "the" may include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprises" and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

[0047] As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items.

Expressions such as "at least one of," when preceding a list of elements, modify the entire list of elements and do not modify the individual elements of the list. Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this inventive concept belongs. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

[0048] FIG. **1** is a schematic cross-sectional view of an organic light emitting display apparatus **1000** according to an embodiment of the present invention. FIG. **2** is a schematic cross-sectional view of a pixel area in the organic light emitting display apparatus **1000** shown in FIG. **1**.

[0049] Referring to FIGS. **1** and **2**, the organic light emitting display apparatus **1000** according to the embodiment of the present invention includes a substrate **110**, a display unit **100** on the substrate **110**, and a thin film encapsulation layer **200** on the display unit **100**. The display unit **100** includes an organic emission device layer **130**. The thin film encapsulation layer **200** includes a plurality of inorganic layers **211**, **223**, and **233** and a plurality of organic layers **213** and **231** that are stacked (e.g., alternately stacked) with each other. The thin film encapsulation layer **200** may include a touch sensing layer **220**. The touch sensing layer **220** may include a second inorganic layer **223**, and a first touch conductive layer **221** and a second touch conductive layer **225** disposed under and above the second inorganic layer **223**, respectively. The second inorganic layer **223** included in the touch sensing layer **220** may be referred to as a touch inorganic layer **223** hereinafter. The touch sensing layer **220** may convert a contact location into an electric signal in order to sense the contact location where a finger of a human being or a touching object directly contacts the organic light emitting display apparatus **1000**. For example, the touch sensing layer **220** may have a touching structure of an electrostatic capacitance type.

[0050] The substrate **110** may be a flexible substrate. The substrate **110** may be formed of a plastic material having excellent heat resistance and durability, for example, polyimide (PI), polyethylene terephthalate (PET), polyethylene napthalate (PEN), polycarbonate (PC), polyarylate (PAR), polyetherimide (PEI), and polyethersulphone (PES). However, the present invention is not limited thereto, and the substrate **110** may be formed of various materials having flexibility such as a metal foil or a thin glass. In one embodiment the substrate **110** may be a rigid substrate, and here, the substrate **110** may be formed of a glass material (e.g., mainly containing SiO_2).

[0051] In an embodiment of the present invention that is of a bottom emission type in which images are displayed toward the substrate **110**, the substrate **110** is formed of a transparent material. However, in an embodiment of the present invention that is of a top emission type in which images are displayed toward a direction opposite the substrate **110**, the substrate **110** may not be formed of a transparent material, for example, the substrate **110** may be formed of metal. When the substrate **110** is formed of metal, the substrate **110** may be formed of one or more selected from the group consisting of carbon, iron, chrome, manganese, nickel, titanium, molybdenum, and stainless steel (SUS); however, the present invention is not limited thereto.

[0052] A display unit **100** may be disposed on an upper surface of the substrate **110**. The term 'display unit **100**' in the present specification generally refers to an organic light emitting diode (OLED) and a thin film transistor (TFT) array, and denotes a part displaying images and a driving part for displaying the images together.

[0053] The display unit **100** includes a plurality of pixels arranged as a matrix. Each of the pixels includes an OLED and an electronic device electrically connected to the OLED. The electronic device may include at least two TFTs including a driving TFT and a switching TFT, and a storage capacitor. The electronic device is electrically connected to wires so as to receive electric signals from an outer driving unit and drives. The arrangement of the electronic devices and wires electrically connected to the OLED is referred to as a TFT array.

[0054] The display unit **100** includes a device/wiring layer **120** including the TFT array, and an OLED layer **130** including an OLED array.

[0055] The device/wiring layer **120** may include a driving TFT for driving an OLED, a switching TFT (not shown), a capacitor (not shown), and wires (not shown) connected to the TFTs and the capacitor. FIG. **2** only shows the driving TFT for driving the OLED for the convenience of description; however, the present invention is not limited thereto, for example, it is well known in the art that a plurality of TFTs, a storage capacitor, and various wires may be further formed.

[0056] A buffer layer **127** may be disposed on an upper surface of the substrate **110** in order to planarize the surface and prevent impurities from infiltrating into the substrate **110**. The buffer layer **127** may include silicon oxide, silicon nitride, and/or silicon oxynitride, and may be formed by various deposition methods such as plasma enhanced chemical vapor deposition (PECVD), atmospheric pressure CVD (APCVD), and low pressure CVD (LPCVD). In an embodiment of the present invention, the buffer layer **127** may be omitted.

[0057] An active layer **121** may be disposed on a region (e.g., a predetermined region) of the buffer layer **127**. The active layer **121** may be formed by depositing an inorganic semiconductor material, such as silicon or semiconductor oxide, or an organic semiconductor on a surface (e.g., an entire surface) of the substrate **110** on the buffer layer **127**, and patterning the semiconductor in a photolithography process and an etching process.

[0058] When the active layer **121** is formed of a silicon material, an amorphous silicon layer may be formed on the entire surface of the substrate **110** and may be crystallized to form a polycrystalline silicon layer, and then, the polycrystalline silicon layer may be patterned and impurities are doped on peripheral regions so as to form the active layer **121** including a source region, a drain region, and a channel region between the source and drain regions.

[0059] On the active layer **121**, a gate insulating layer **129***a* including an insulating material, for example, a silicon oxide material, a silicon nitride material, and/or a silicon oxynitride material may be disposed. A gate electrode **123** may be disposed in a region (e.g., a predetermined region) on the gate insulating layer **129***a*. The gate electrode **123** may be connected to a gate line (not shown) to which a control signal for controlling the TFT is applied.

[0060] An interlayer dielectric **129***b* may be disposed on the gate electrode **123**. The interlayer dielectric **129***b* includes contact holes exposing the source and drain regions of the

active layer **121**, and a source electrode **125***a* and a drain electrode **125***b* may be electrically connected to the source region and the drain region of the active layer **121** via the contact holes of the interlayer dielectric **129***b*. The TFT formed in the above manner may be covered and protected by a passivation layer **129***c*.

[0061] The passivation layer **129***c* may include an inorganic insulating layer and/or an organic insulating layer. Examples of the inorganic insulating layer used in the passivation layer **129***c* may include silicon oxide (SiO_2), silicon nitride (SiNx), silicon oxynitride (SiON), aluminum oxide (Al_2O_3), titanium oxide (TiO_2), tantalum oxide (Ta_2O_5), hafnium oxide (HfO_2), zirconium oxide (ZrO_2), barium strontium titanate (BST), lead zirconate-titanate (PZT). In addition, examples of the organic insulating layer used in the passivation layer **129***c* may include universal polymers (PMMA, PS), polymer derivative having phenol group, acryl-based polymer, imide-based polymer, aryleter-based polymer, amide-based polymer, fluoride-based polymer, p-xylene-based polymer, vinyl alcohol-based polymer, and blends thereof. Otherwise, the passivation layer **129***c* may have a composite stacked structure in which the inorganic insulating layer and the organic insulating layer are stacked.

[0062] An OLED may be disposed on a light emission region on the passivation layer **129***c*.

[0063] The OLED layer **130** may include a pixel electrode **131** formed on the passivation layer **129***c*, an opposite electrode **135** facing the pixel electrode **131**, and an intermediate layer **133** disposed between the pixel electrode **131** and the opposite electrode **135**.

[0064] When a voltage is applied between the pixel electrode **131** and the opposite electrode **135**, the intermediate layer **133** emits light. The intermediate layer **133** may emit, for example, blue light, green light, red light, or white light.

[0065] When the intermediate layer **133** emits white light, the organic light emitting display apparatus may further include blue, green, and red color filters for displaying color images.

[0066] The organic light emitting display apparatus may be classified as a bottom emission type, a top emission type, or a dual emission type according to a light emitting direction thereof. In the bottom emission type organic light emitting display apparatus, the pixel electrode **131** is formed as a light transmitting electrode, and the opposite electrode **135** is formed as a reflective electrode. In the top emission type organic light emitting display apparatus, the pixel electrode **131** is formed as a reflective electrode, and the opposite electrode **135** is formed as a semi-transmissive electrode. By way of example, embodiments of the present invention having the top emission type, in which the OLED emits light toward the thin film encapsulation layer **200**, will be described below.

[0067] The pixel electrode **131** may be a reflective electrode. The pixel electrode **131** may include a stacked structure in which a reflective layer and a transparent (or a semi-transparent) electrode layer having a high work function are stacked. The reflective layer may include Ag, Mg, Al, Pt, Pd, Au, Ni, Nd, Ir, Cr, or an alloy thereof. The transparent or semi-transparent electrode layer may include at least one material selected from transparent conductive oxide materials such as indium tin oxide (ITO), indium zinc oxide (IZO), zinc oxide (ZnO), indium oxide (In_2O_3), indium gallium oxide (IGO), and aluminum zinc oxide (AZO). The pixel electrode **131** may be patterned as an island corresponding to each of the pixels. The pixel electrode **131** may function as an anode.

[0068] A pixel defining layer **140** covering edges of the pixel electrode **131** and having an opening (e.g., a predetermined opening) that exposes a center portion of the pixel electrode **131** may be disposed on the pixel electrode **131**. The intermediate layer **133** including an organic emission layer that emits light may be disposed in the opening. The region at which the intermediate layer **133** is disposed may be referred to as an emission area. When the emission area is formed in the opening of the pixel defining layer **140**, the pixel defining layer **140** is disposed to protrude between adjacent emission areas, and the protruding regions of the pixel defining layer **140** may be defined as a non-emission area because the organic emission layer is not formed on the protruding regions.

[0069] The opposite electrode **135** may be formed of a transmissive electrode. The opposite electrode **135** may be a semi-transparent layer formed of metal such as Li, Ca, LiF/Ca, LiF/Al, Al, Mg, and Ag having a low work function to have a thin thickness. In order to address the high resistance caused by a thin metal semi-transparent layer, a transparent conductive layer formed of a transparent conductive oxide may be stacked on the metal semi-transparent layer. The opposite electrode **135** may be formed on the surface (e.g., the entire surface) of the substrate **110** as a common electrode. The opposite electrode **135** may function as a cathode.

[0070] The pixel electrode **131** and the opposite electrode **135** may have opposite polarities to each other.

[0071] The intermediate layer **133** includes an organic emission layer for emitting light, and the organic emission layer may be formed of a low-molecular weight organic material or a high-molecular weight organic material. When the organic emission layer **133** is formed of the low-molecular weight organic material, a hole transport layer (HTL) and a hole injection layer (HIL) may be stacked on the organic emission layer **133** toward the pixel electrode **131**, and an electron transport layer (ETL) and an electron injection layer (EIL) may be stacked toward the opposite electrode **135**. Other functional layers other than the HIL, HTL, ETL, and EIL may also be included.

[0072] When the organic emission layer is formed of a high molecular weight material, an HTL (e.g., only an HTL) may be formed on the organic emission layer toward the pixel electrode **131**. A high molecular HTL that is formed of poly-(2,4)-ethylene-dihydroxy thiophene (PEDOT) or polyaniline (PANI) may be formed on the pixel electrode **131** in an inkjet printing method or a spin coating method.

[0073] In the present embodiment, the OLED layer **130** is disposed on the device/wiring layer **120** in which the TFT is disposed; however, the present invention is not limited thereto. For example, the pixel electrode **131** of the OLED may be formed at the same layer as the active layer **121** of the TFT, the pixel electrode **131** may be formed at the same layer as the gate electrode **123** of the TFT, or the pixel electrode **131** may be formed at the same layer as the source electrode **125***a* and the drain electrode **125***b*.

[0074] Also, in the present embodiment, the gate electrode **123** of the driving TFT is disposed on the active layer **121**; however, the present invention is not limited thereto, for example, the gate electrode **123** may be disposed under the active layer **121**.

[0075] The thin film encapsulation layer **200** may be disposed on the substrate **110** to cover the display unit **100**. The OLED included in the display unit **100** is formed of an organic material, and thus, degrades due to external moisture or oxygen. Therefore, the display unit **100** is sealed. The thin film encapsulation layer **200** is a unit for sealing the display unit **100** and may have a structure in which a plurality of inorganic layers and a plurality of organic layers are stacked (e.g., alternately stacked).

[0076] In the organic light emitting display apparatus **1000** according to an embodiment of the present invention, the substrate **110** is a flexible substrate and the thin film encapsulation layer **200** is used as the encapsulation unit, and accordingly, the organic light emitting display apparatus **1000** may be manufactured to be flexible and thin.

[0077] As described above, because the display unit **100** is sealed by the thin film encapsulation layer **200** and not by a sealing substrate, the organic light emitting display apparatus **1000** may be formed thin and flexible.

[0078] The thin film encapsulation layer **200** may include a plurality of inorganic layers **211**, **223**, and **233** and a plurality of organic layers **213** and **231**. The inorganic layers **211**, **223**, and **233** and the organic layers **213** and **231** may be alternately stacked.

[0079] The inorganic layers **211**, **223**, and **233** may be formed of a metal oxide, a metal nitride, a metal carbide, or a combination thereof. For example, the inorganic layers **211**, **223**, and **233** may be formed of aluminum oxide, silicon oxide, or silicon nitride. According to another embodiment, the inorganic layers **211**, **223**, and **233** may include a stacked structure of a plurality of inorganic insulating layers. The inorganic layers **211**, **223**, and **233** prevent the external moisture and/or oxygen from infiltrating into the OLED layer **130**.

[0080] The organic layers **213** and **231** may include a high molecular organic compound. For example, the organic layers **213** and **231** may include one of epoxy, acrylate, or urethane acrylate. The organic layers **213** and **231** may lessen internal stress of the inorganic layers **211**, **223**, and **233**, or compensate for defects of the inorganic layers **211**, **223**, and **233** and planarize the inorganic layers **211**, **223**, and **233**.

[0081] According to an embodiment of the present invention, a first touch conductive layer **221** and a second touch conductive layer **225** are disposed in the thin film encapsulation layer **200**, and the first touch conductive layer **221**, the second inorganic layer **223**, and the second touch conductive layer **225** may configure a touch sensing layer **220**.

[0082] The touch sensing layer **220** according to the embodiment of the present invention may include first sensing patterns extending in a first direction and second sensing patterns extending in a second direction. The first direction and the second direction may be perpendicular (or substantially perpendicular) to each other, and the first sensing patterns and the second sensing patterns may overlap each other while being insulated from each other. When a finger of a human being or a touching object contacts the thin film encapsulation layer **200** on the touch sensing layer **220**, capacitance between the first sensing patterns and the second sensing patterns varies. The contact location may be determined by sensing an electric signal corresponding to the variation of the electric capacitance of the first sensing patterns and the second sensing patterns.

[0083] According to an embodiment, the first sensing patterns may be formed in the first touch conductive layer **221**, and the second sensing patterns may be formed in the second touch conductive layer **225**. The second inorganic layer **223** may be disposed between the first touch conductive layer **221** and the second touch conductive layer **225**. In an embodiment of the present invention, the first and second touch conductive layers **221** and **225** may be formed of a transparent conductive oxide material. Examples of the transparent conductive oxide may include ITO, IZO, ZnO, In_2O_3, IGO, and AZO.

[0084] According to an embodiment of the present invention, the first sensing pattern may include first sensing cells and first connecting patterns for connecting the first sensing cells, and the second sensing pattern may include second sensing cells and second connecting patterns for connecting the second sensing cells. The first and second sensing cells may be formed in the first touch conductive layer **221**. The first connecting patterns may be formed in the first touch conductive layer **221**, and the second connecting patterns may be formed in the second touch conductive layer **225**. The first touch conductive layer **221** may be formed of a transparent conductive oxide. The second touch conductive layer **225** may be formed of a low-resistive metal material. This embodiment will be described in detail below with reference to FIGS. **4**A through **4**C.

[0085] According to an embodiment of the present invention, the first sensing pattern may include first sensing cells and first connecting patterns for connecting the first sensing cells, and the second sensing pattern may include second sensing cells and second connecting patterns for connecting the second sensing cells. The first and second sensing cells may be formed on the second touch conductive layer **225**. The first connecting patterns may be formed in the second touch conductive layer **225**, and the second connecting patterns may be formed in the first touch conductive layer **221**. The second touch conductive layer **225** may be formed of a transparent conductive oxide. The first touch conductive layer **221** may be formed of a low-resistive metal material. This embodiment will be described in detail below with reference to FIGS. **5**A through **5**C.

[0086] According to the present embodiment, the thin film encapsulation layer **200** includes the first touch conductive layer **221** and/or the second touch conductive layer **225** that may be formed of a transparent conductive oxide, as well as the inorganic layers **211**, **223**, and **233** and the organic layers **213** and **231**. Therefore, the organic light emitting display apparatus **1000** may have a mechanically firm structure, and may have improved moisture infiltration prevention function and sealing performance. Moreover, one inorganic layer **223** among the plurality of inorganic layers **211**, **223**, and **233** configuring the thin film encapsulation layer **200** is used as the touch sensing layer **220**, and thus, manufacturing processes may be simplified. Also, since the touch screen function may be realized by using the touch sensing layer **220** in the thin film encapsulation layer **200** without using an additional touch panel, the organic light emitting display apparatus **1000** may be formed thin and flexible.

[0087] FIG. **3**A is a cross-sectional view schematically showing an organic light emitting display apparatus **2000** according to an embodiment of the present invention.

[0088] The embodiment illustrated in FIG. **3**A includes elements similar to those described above, the description of these similar elements are given, at least in part, by way of reference to the above description. Differences from the organic light emitting display apparatus **1000** shown in FIGS. **1** and **2**, however, will be described in detail below.

[0089] Referring to FIG. **3**A, the organic light emitting display apparatus **2000** of the present embodiment has the same (or substantially similar) structure as that of the organic light emitting display apparatus **1000** shown in FIGS. **1** and **2**, except for that a thin film encapsulation layer **200***a* further includes an inorganic layer **215** and an organic layer **217**.

[0090] Two inorganic layers **211** and **215** and two organic layers **213** and **217** may be alternately stacked between the display unit **100** and the touch sensing layer **220**. In the present embodiment, the two inorganic layers **211** and **215** and the two organic layers **213** and **217** are stacked under the touch sensing layer **220**; however, the present invention is not limited thereto, for example, more inorganic layers and organic layers may be stacked between the display unit **100** and the touch sensing layer **220**.

[0091] In the present embodiment, one organic layer **231** and one inorganic layer **233** are stacked on the touch sensing layer **220**; however, the present invention is not limited thereto. For example, more inorganic layers and organic layers may be stacked on the touch sensing layer **220**.

[0092] In addition, the stacking order of the inorganic layers **211**, **215**, **223**, and **233** and the organic layers **213**, **217**, and **231** may vary. In the present embodiment, the inorganic layer **211** is stacked on the display unit **100**; however, the present invention is not limited thereto, for example, the organic layer **213** may be stacked on the display unit **100**. Also, in FIG. **3**A, the inorganic layer **233** is the uppermost layer of the thin film encapsulation layer **200***a*; however, the organic layer **231** may be the uppermost layer of the thin film encapsulation layer **200***a*.

[0093] Also, in FIG. **3**A the touch sensing layer **220** is disposed directly on the organic layer **217**; however, the present invention is not limited thereto, and the touch sensing layer **220** may be directly disposed on the inorganic layer **215** or another inorganic layer may be disposed between the touch sensing layer **220** and the organic layer **217**.

[0094] Also, in the present embodiment, the organic layer **231** is disposed directly on the touch sensing layer **220**; however, the present invention is not limited thereto, and the inorganic layer **233** may be directly disposed on the touch sensing layer **220** or another inorganic layer may be disposed between the touch sensing layer **220** and the organic layer **231**.

[0095] FIG. **3**B is a schematic cross-sectional view of an organic light emitting display apparatus **3000** according to an embodiment of the present invention.

[0096] Referring to FIG. **3**B, configurations of the organic light emitting display apparatus **3000** are the same (or substantially the same) as those of the organic light emitting display apparatus **1000** described with reference to FIGS. **1** and **2**, except that a protective layer **150** is disposed between the display unit **100** and the thin film encapsulation layer **200** and an optical member **240** is disposed on the thin film encapsulation layer **200**. These differences are described below in detail.

[0097] The protective layer **150** may include a capping layer **151** and a shielding layer **152**. The capping layer **151** may be formed of an organic material such as a-NPD, NPB, TPD, m-MTDATA, Alq_3, or CuPc. The capping layer **151** protects the OLED layer **130**, and allows light emitted from the OLED layer **130** to be transmitted to outside.

[0098] The shielding layer **152** may be formed of an inorganic material such as LiF, MgF_2, or CaF_2. The shielding layer **152** shields against plasma used to form the thin film encapsulation layer **200**, so that the plasma may not infiltrate into the OLED layer **130** and damage the intermediate layer **133** and the opposite electrode **135**.

[0099] The optical member **240** may be disposed on the thin film encapsulation layer **200**. The optical member **240** may include a phase retarder **241** and a polarization plate **243**. The phase retarder **241** may be a quarter-wave (A/4) plate.

[0100] The optical member **240** of the organic light emitting display apparatus **3000** restrains external light from being reflected, thereby improving visibility and contrast of the organic light emitting display apparatus **3000**.

[0101] FIG. **4**A is a schematic plan view of a touch sensing layer **220***a* disposed in the thin film encapsulation layer **200**, according to an embodiment of the present invention, and FIG. **4**B is a schematic cross-sectional view of the touching sensing layer **220***a* taken along the line IV-IV of FIG. **4**A.

[0102] Referring to FIGS. **4**A and **4**B, the touch sensing layer **220***a* disposed in the thin film encapsulation layer **200** includes first sensing patterns **41** and second sensing patterns **42**.

[0103] The first sensing patterns **41** may extend in a first direction (for example, an X-axis direction). The plurality of first sensing patterns **41** may be arranged along a second direction (for example, a Y-axis direction) crossing the first direction. The first sensing patterns **41** may include a plurality of first sensing cells **41***c* that are spaced from each other at suitable (e.g., predetermined) intervals along the first direction, and first connecting patterns **41***br* connecting the first sensing cells **41***c* to each other. The first connecting patterns **41***br* may be disposed at a different layer from that of the first sensing cells **41***c*, and the first connecting patterns **41***br* may electrically connect the first sensing cells **41***c* to each other as bridges by using contact plugs **41***p* that penetrate through the second inorganic layer **223**.

[0104] The second sensing patterns **42** may extend in the second direction. The plurality of second sensing patterns **42** are arranged along the first direction. The second sensing patterns **42** may include a plurality of second sensing cells **42***c* spaced apart from each other at suitable (e.g., predetermined) intervals in the second direction, and second connecting patterns **42***br* for connecting the second sensing cells **42***c* to each other. The second sensing cells **42***c* may be arranged between the first sensing cells **41***c* so as not to overlap with the first sensing cells **41***c*. The second connecting patterns **42***br* may be disposed at the same layer as that of the second sensing cells **42***c*, and the second connecting patterns **42***br* and the second sensing cells **42***c* may be integrally formed with each other.

[0105] As shown in FIG. **4**A, the first sensing cells **41***c* and the second sensing cells **42***c* may be formed having a lozenge-shaped; however, the present invention is not limited thereto. Also, the first sensing cells **41***c* and the second sensing cells **42***c* may be formed differently from each other.

[0106] The first sensing cells **41***c*, the second sensing cells **42***c*, and the second connecting patterns **42***br* may be disposed on the first organic layer **213**, and configure a first touch conductive layer **221***a*. As described above, the first touch conductive layer **221***a* may be formed of a transparent conductive oxide.

[0107] The first connecting patterns **41***br* and the contact plugs **41***p* may configure a second touch conductive layer **225***a*, and may be formed of a transparent conductive material or a low resistive metal material such as molybdenum (Mo), silver (Ag), titanium (Ti), copper (Cu), aluminum (Al), and

Mo/Al/Mo. The second inorganic layer **223** and the second touch conductive layer **225***a* may be covered by the second organic layer **231**.

[0108] FIG. **4**C depicts schematic cross-sectional views illustrating a method of forming the touch sensing layer **220***a* in the thin film encapsulation layer **200**, according to an embodiment of the present invention.

[0109] Referring to (a) of FIG. **4**C, the first touch conductive layer **221***a* may be formed on the first organic layer **213**. The first touch conductive layer **221***a* may include the first sensing cells **41***c*, the second sensing cells **42***c*, and the second connecting patterns **42***br*. The first touch conductive layer **221***a* may be formed of a transparent conductive material. For example, a transparent conductive material layer may be disposed on the first organic layer **213**. The transparent conductive material layer may be patterned by a photolithography process using a first photo mask (not shown) and an etching process, thereby forming the first sensing cells **41***c*, the second sensing cells **42***c*, and the second connecting patterns **42***br*.

[0110] Referring to (b) of FIG. **4**C, the second inorganic layer **223** may be formed on the first touch conductive layer **221***a*. The second inorganic layer **223** may include contact holes **223***h* exposing upper parts of the first sensing cells **41***c*. As described above, the second inorganic layer **223** may be formed of an inorganic insulating material. For example, an inorganic insulating material layer may be disposed on the first touch conductive layer **221**. The inorganic insulating material layer may be patterned by a photolithography process using a second photo mask (not shown) and an etching process, thereby forming the contact holes **223***h* exposing parts of the upper surface of the first sensing cells **41***c*.

[0111] Referring to (c) of FIG. **4**C, a second touch conductive layer **225***a* may be formed on the second inorganic layer **223**. The second touch conductive layer **225***a* may include the first connecting patterns **41***br*, and contact plugs **41***bp* for burying (or filling) the contact holes **223** of the second inorganic layer **223**. The second touch conductive layer **225***a* may be formed of a low-resistive metal material. For example, a low-resistive metal material layer may be disposed on the second inorganic layer **223** so as to bury (or fill) the contact holes **223***h*. The low-resistive metal material layer may be patterned by a photolithography method using a third photo mask (not shown) and an etching process, thereby forming the first connecting patterns **41***br* and the contact plugs **41***p*.

[0112] Referring to (d) of FIG. **4**C, the second organic layer **231** may be formed on the second inorganic layer **223** and the second touch conductive layer **225***a*. Through the above described processes, the touch sensing layer **220***a* disposed in the thin film encapsulation layer **200** may be formed.

[0113] FIG. **5**A is a schematic plan view of a touch sensing layer **220***b* disposed in the thin film encapsulation layer **200** according to another embodiment of the present invention, and FIG. **5**B is a schematic cross-sectional view of the touch sensing layer **220***b* taken along the line V-V of FIG. **5**A.

[0114] Referring to FIGS. **5**A and **5**B, the touch sensing layer **220***b* disposed in the thin film encapsulation layer **200** includes first sensing patterns **51** and second sensing patterns **52**.

[0115] The first sensing patterns **51** may extend in the first direction (for example, an X-axis direction). The plurality of first sensing patterns **51** may be arranged along the second direction (for example, a Y-axis direction) crossing the first direction. The first sensing patterns **51** may include a plurality of first sensing cells **51***c* spaced apart at suitable (e.g., predetermined) intervals in the first direction, and first connecting patterns **51***br* connecting the first sensing cells **51***c* to each other. The first connecting patterns **51***br* may be disposed at a different layer from that of the first sensing cells **51***c*, and the first sensing cells **51***c* may be electrically connected to the first connecting patterns **51***br* by using contact plugs **51***p* penetrating through the second inorganic layer **223**. The first sensing cells **51***c* arranged in the first direction may be electrically connected to each other via the first connecting patterns **51***br*.

[0116] The second sensing patterns **52** may extend in the second direction. The plurality of second sensing patterns **52** may be arranged along the first direction. The second sensing pattern **52** may include a plurality of second sensing cells **52***c* that are spaced apart at suitable (or predetermined) intervals along the second direction and second connecting patterns **52***br* connecting the second sensing cells **52***c* to each other. The second sensing cells **52***c* may be distributed between the first sensing cells **51***c* so as not to overlap the first sensing cells **51***c*. The second connecting patterns **52***br* may be disposed at the same layer as that of the second sensing cells **52***c*, and the second connecting patterns **52***br* and the second sensing cells **52***c* may be integrally formed with each other.

[0117] The first connecting patterns **51***br* may be disposed on the first organic layer **213**, and may configure the first touch conductive layer **221***b*. The first touch conductive layer **221***b* may be formed of a transparent conductive material, or may be formed of a low-resistive metal material such as Mo, Ag, Ti, Cu, Al, or Mo/Al/Mo.

[0118] The first sensing cells **51***c*, the contact plugs **51***p*, the second sensing cells **52***c*, and the second connecting patterns **52***br* may form (at least part of) the second touch conductive layer **225***b*. The second touch conductive layer **225***b* may be formed of a transparent conductive oxide material. The second inorganic layer **223** and the second touch conductive layer **225***b* may be covered by the second organic layer **231**.

[0119] FIG. **5**C depicts schematic cross-sectional views illustrating a method of forming the touch sensing layer **220***b* disposed in the thin film encapsulation layer according to an embodiment of the present invention.

[0120] Referring to (a) of FIG. **5**C, the first touch conductive layer **221***b* may be formed on the first organic layer **213**. The first touch conductive layer **221***b* may include the first connecting patterns **51***br*. The first touch conductive layer **221***b* may be formed of a low-resistive metal material. For example, a low-resistive metal material layer may be disposed on the first organic layer **213**. The low-resistive metal material layer may be patterned by a photolithography process using a first photo mask (not shown) and an etching process, thereby forming the first connecting patterns **51***br*.

[0121] Referring to (b) of FIG. **5**C, the second inorganic layer **223** may be formed on the first touch conductive layer **221***b*. The second inorganic layer **223** may include the contact holes **223***h* partially exposing upper surfaces of the first connecting patterns **51***br*. As described above, the second inorganic layer **223** may be formed of an inorganic insulating material. In particular, an inorganic insulating material layer may be disposed on the first touch conductive layer **221***b*. The inorganic insulating material layer is patterned by a photolithography process using a second photo mask (not shown) and an etching process, thereby forming the contact holes **223***h* partially exposing the upper surfaces of the first connecting patterns **51***br*.

[0122] Referring to (c) of FIG. **5**C, the second touch conductive layer **225***b* may be formed on the second inorganic layer **223**. The second touch conductive layer **225***b* may include the first sensing cells **51***c*, the contact plugs **51***p* burying (or filling) the contact holes **223***h* of the second inorganic layer **223**, the second sensing cells **52***c*, and the second connecting patterns **52***br*. The second touch conductive layer **225***b* may be formed of a transparent conductive material. For example, a transparent conductive material layer may be disposed on the second inorganic layer **223** so as to bury the contact holes **223***h*. The transparent conductive material layer may be patterned by a photolithography process using a third photo mask (not shown) and an etching process, thereby forming the first sensing cells **51***c*, the contact plugs **51***p*, the second sensing cells **52***c*, and the second connecting patterns **52***br*.

[0123] Referring to (d) of FIG. **5**C, the second organic layer **231** may be formed on the second inorganic layer **223** and the second touch conductive layer **225***b*. Through the above processes, the touch sensing layer **220***b* disposed in the thin film encapsulation layer **200** as shown in FIG. **5**B may be formed.

[0124] According to the organic light emitting display apparatus and the method of manufacturing the organic light emitting display apparatus of embodiments of the present invention, the flexible organic light emitting display apparatus accompanied with the touch screen function may be realized. Moreover, the entire thickness of the display apparatus may be reduced, manufacturing yield may be improved because an attaching process may be omitted, and thus, manufacturing costs may be reduced.

[0125] While the present invention has been particularly shown and described with reference to exemplary embodiments thereof, it will be understood by those of ordinary skill in the art that various changes in form and details may be made therein without departing from the spirit and scope of the present invention as defined by the following claims and their equivalents.

What is claimed is:

1. An organic light emitting display apparatus comprising:
- a substrate;
- an organic light emitting diode (OLED) layer on the substrate; and
- a thin film encapsulation layer on the OLED layer comprising:
  - a plurality of inorganic layers;
  - a plurality of organic layers stacked with the inorganic layers; and
  - a touch sensing layer comprising:
    - a first touch conductive layer;
    - a touch inorganic layer on the first touch conductive layer; and
    - a second touch conductive layer on the touch inorganic layer,
- wherein the inorganic layers of the thin film encapsulation layer comprise the touch inorganic layer of the thin film encapsulation layer.

2. The organic light emitting display apparatus of claim **1**, wherein the OLED layer comprises:
- a pixel electrode on the substrate;
- an intermediate layer on the pixel electrode comprising an organic emission layer; and
- an opposite electrode on the intermediate layer.

3. The organic light emitting display apparatus of claim **1**, wherein the first touch conductive layer comprises:
- a plurality of first sensing cells arranged along a first direction on the substrate;
- a plurality of first connecting patterns for connecting the first sensing cells to each other; and
- a plurality of second sensing cells arranged along a second direction on the substrate, and

wherein the second touch conductive layer comprises:
- contact plugs in the touch inorganic layer electrically connected to portions of the second sensing cells; and
- a plurality of second connecting patterns electrically connecting the second sensing cells to each other via the contact plugs.

4. The organic light emitting display apparatus of claim **3**, wherein the first touch conductive layer comprises a transparent conductive oxide material.

5. The organic light emitting display apparatus of claim **1**, wherein the second touch conductive layer comprises:
- a plurality of first sensing cells arranged along a first direction on the substrate;
- a plurality of first connecting patterns electrically connecting the first sensing cells to each other;
- a plurality of second sensing cells arranged along a second direction on the substrate; and
- contact plugs in the touch inorganic layer electrically connected to portions of the second sensing cells, and

wherein the first touch conductive layer comprises a plurality of second connecting patterns electrically connecting the second sensing cells to each other via the contact plugs.

6. The organic light emitting display apparatus of claim **5**, wherein the second touch conductive layer comprises a transparent conductive oxide material.

7. The organic light emitting display apparatus of claim **1**, wherein the thin film encapsulation layer further comprises:
- a first inorganic layer on the OLED layer;
- a first organic layer on the first inorganic layer;
- the touch inorganic layer on the first organic layer;
- a second organic layer on the touch inorganic layer;
- a second inorganic layer on the second organic layer; and
- a transparent conductive oxide layer interposed between the touch inorganic layer and the first organic layer or the second organic layer.

8. The organic light emitting display apparatus of claim **7**, wherein the thin film encapsulation layer further comprises:
- a third inorganic layer on the first organic layer; and
- the touch inorganic layer on the third inorganic layer.

9. The organic light emitting display apparatus of claim **1**, wherein the organic layers of the thin film encapsulation layer comprise a lower organic layer under the touch inorganic layer and an upper organic layer on the touch inorganic layer,
- wherein the first touch conductive layer is directly between the lower organic layer and a bottom surface of the touch inorganic layer, and
- wherein the second touch conductive layer is directly between an upper surface of the touch inorganic layer and the upper organic layer.

10. The organic light emitting display apparatus of claim **1**, wherein the substrate is a flexible substrate.

11. The organic light emitting display apparatus of claim **1**, further comprising a protective layer between the OLED layer and the thin film encapsulation layer.

12. The organic light emitting display apparatus of claim **1**, further comprising an optical member on the thin film encapsulation layer.

13. A method of manufacturing an organic light emitting display apparatus, the method comprising:

sequentially forming a pixel electrode, an intermediate layer comprising an organic emission layer, and an opposite electrode on a substrate; and

forming a thin film encapsulation layer comprising a plurality of inorganic layers on the opposite electrode; a plurality of organic layers stacked with the inorganic layers on the opposite electrode; and a touch sensing layer,

wherein the touch sensing layer comprises one of the inorganic layers of the thin film encapsulation layer.

14. The method of claim **13**, wherein the sequentially forming the pixel electrode, the intermediate layer comprising the organic emission layer, and the opposite electrode on the substrate comprises:

forming the pixel electrode on the substrate;

forming a pixel defining layer that defines a pixel region and covers opposite edges of the pixel electrode;

forming the intermediate layer comprising the organic emission layer on a region defined by the pixel defining layer; and

forming the opposite electrode so as to cover the intermediate layer and the pixel defining layer.

15. The method of claim **13**, wherein the forming of the thin film encapsulation layer comprises:

forming a first inorganic layer on the opposite electrode;

forming a first organic layer on the first inorganic layer;

forming the touch sensing layer on the first organic layer;

forming a second organic layer on the touch sensing layer; and

forming a second inorganic layer on the second organic layer.

16. The method of claim **13**, wherein the forming of the touch sensing layer comprises:

forming a first touch conductive layer;

forming a touch inorganic layer on the first touch conductive layer; and

forming a second touch conductive layer on the touch inorganic layer,

wherein the touch inorganic layer comprises one of the inorganic layers of the thin film encapsulation layer.

17. An organic light emitting display apparatus comprising:

a substrate;

an organic light emitting diode (OLED) layer on the substrate;

a thin film encapsulation layer on the OLED layer comprising:

a plurality of inorganic layers;

a plurality of organic layers stacked with the inorganic layers; and

a touch sensing layer comprising a touch inorganic layer comprising one of the inorganic layers.

18. The organic light emitting display apparatus of claim **17**, wherein the touch inorganic layer is between two successive organic layers among the organic layers.

19. The organic light emitting display apparatus of claim **17**, wherein the touch sensing layer further comprises a first touch conductive layer under the touch inorganic layer, and a second touch conductive layer on the touch inorganic layer.

20. The organic light emitting display apparatus of claim **19**, wherein at least one of the first touch conductive layer and the second touch conductive layer comprises a transparent conductive oxide material, and the thin film encapsulation layer further comprises the layer that comprises the transparent conductive oxide material.

* * * * *