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(54) **TOUCH DISPLAY APPARATUS AND METHOD FOR MANUFACTURING SAME**

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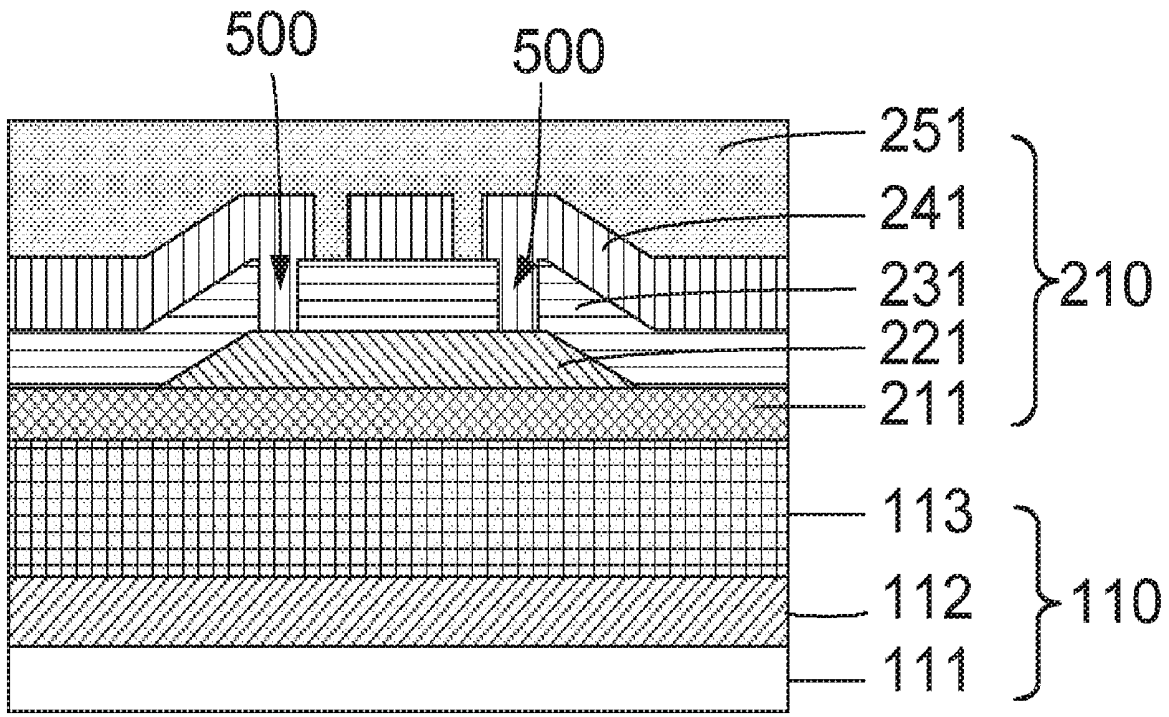
(57) **ABSTRACT**

A touch display apparatus is provided. The touch display apparatus includes an organic light emitting diode display panel, which includes a thin film transistor back plate, a light emitting layer, an encapsulation layer, and a substrate layer disposed on the encapsulation layer. First electrode strings disposed on the substrate layer along a first direction, each of the first electrode strings includes a plurality of first electrode units. Second electrode strings disposed on the substrate layer along a second direction and insulated from the first electrode strings, each of the second electrode strings includes a plurality of second electrode units. The first electrode strings and the second electrode strings are disposed on the same layer. A first bridging structure is electrically connected to two adjacent first electrode units or two adjacent second electrode units for increasing touch sensing areas. A method for manufacturing the touch display apparatus is also provided.



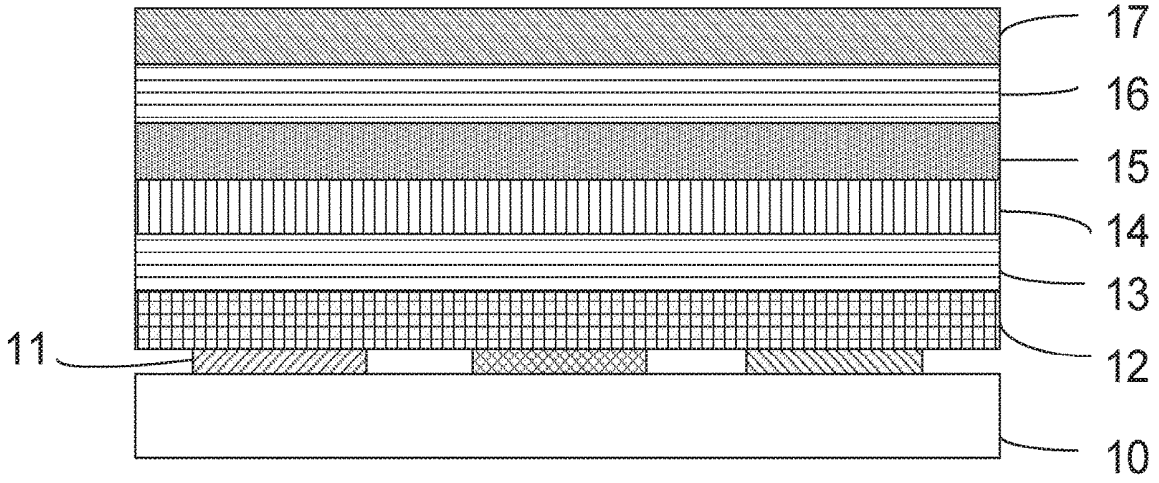


FIG. 1

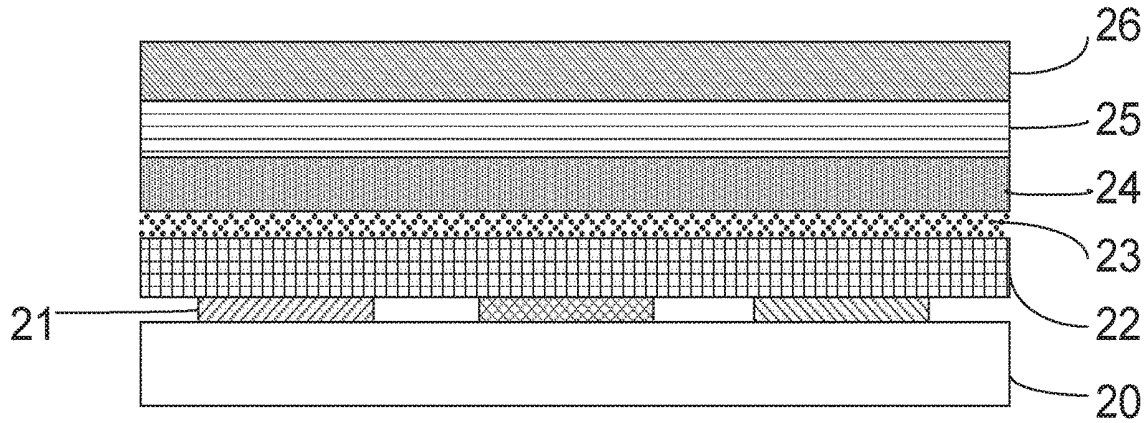


FIG. 2

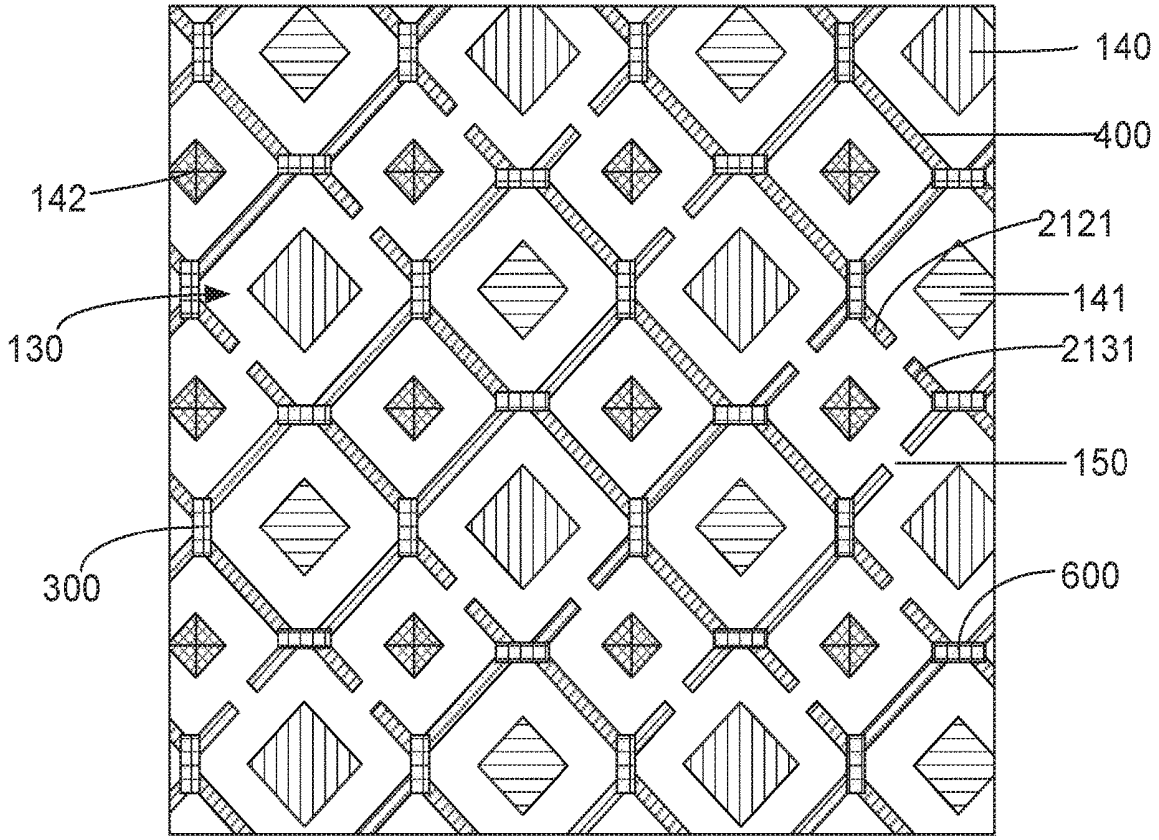


FIG. 3

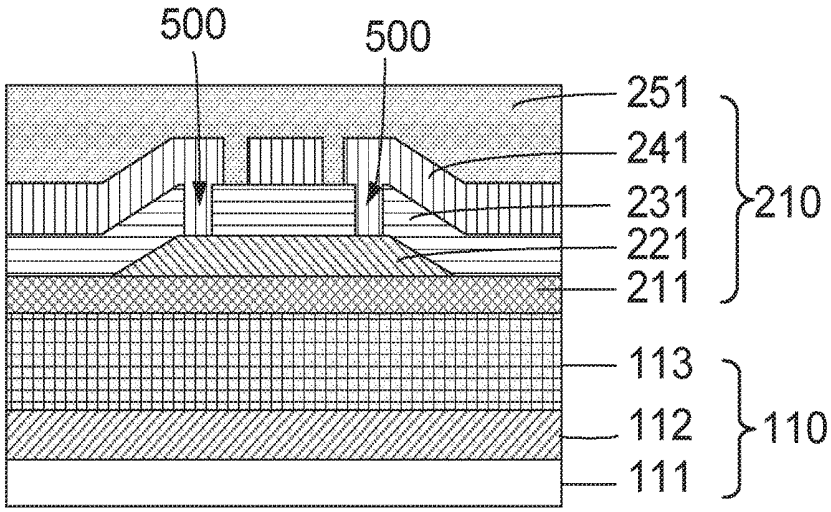

500
500
251
241
231
221
211
210
113
112
111
110

FIG. 4

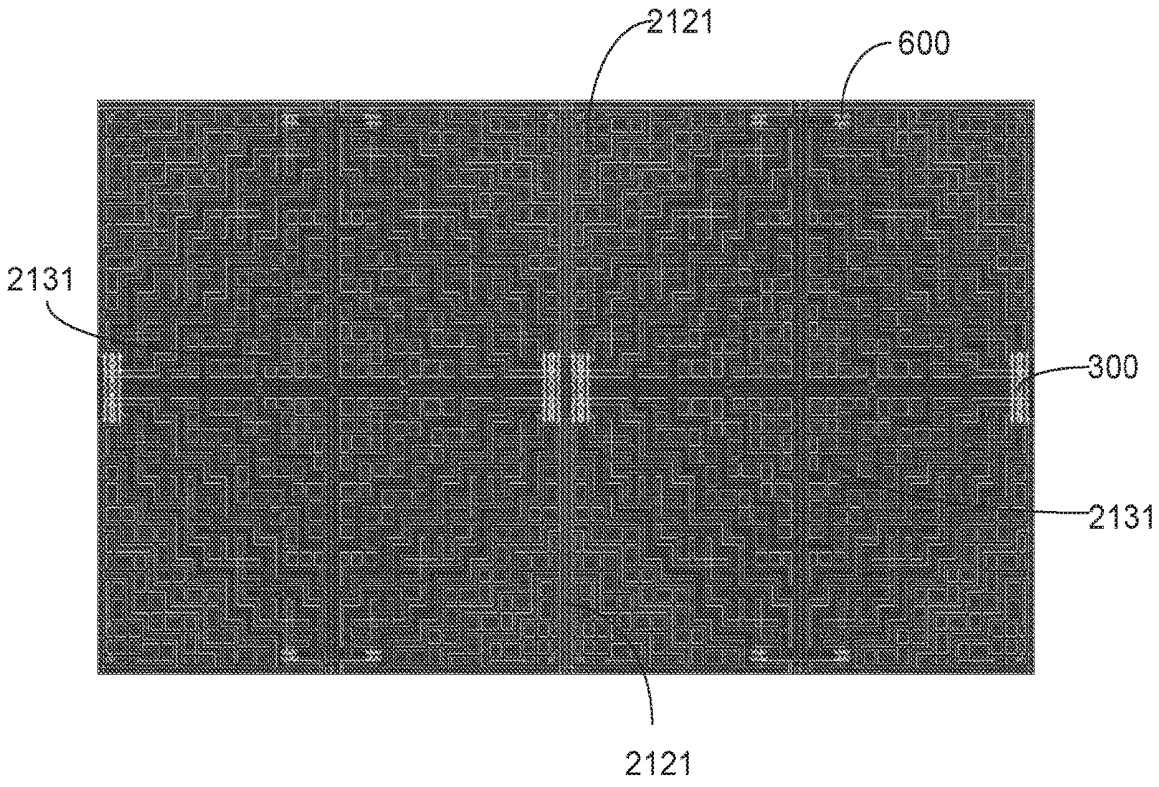

2121
600
2131
300
2131
2121

FIG. 5

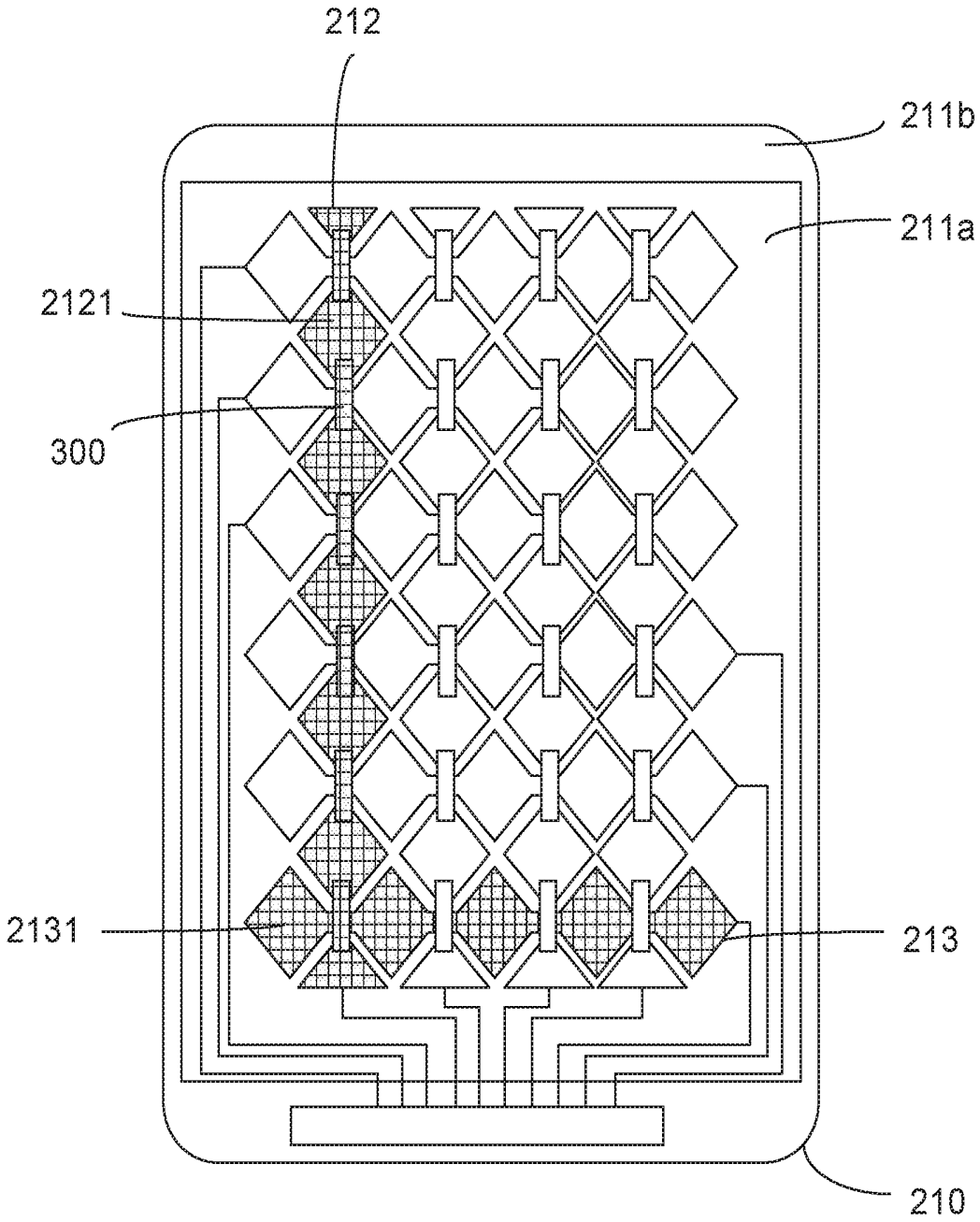


FIG. 6

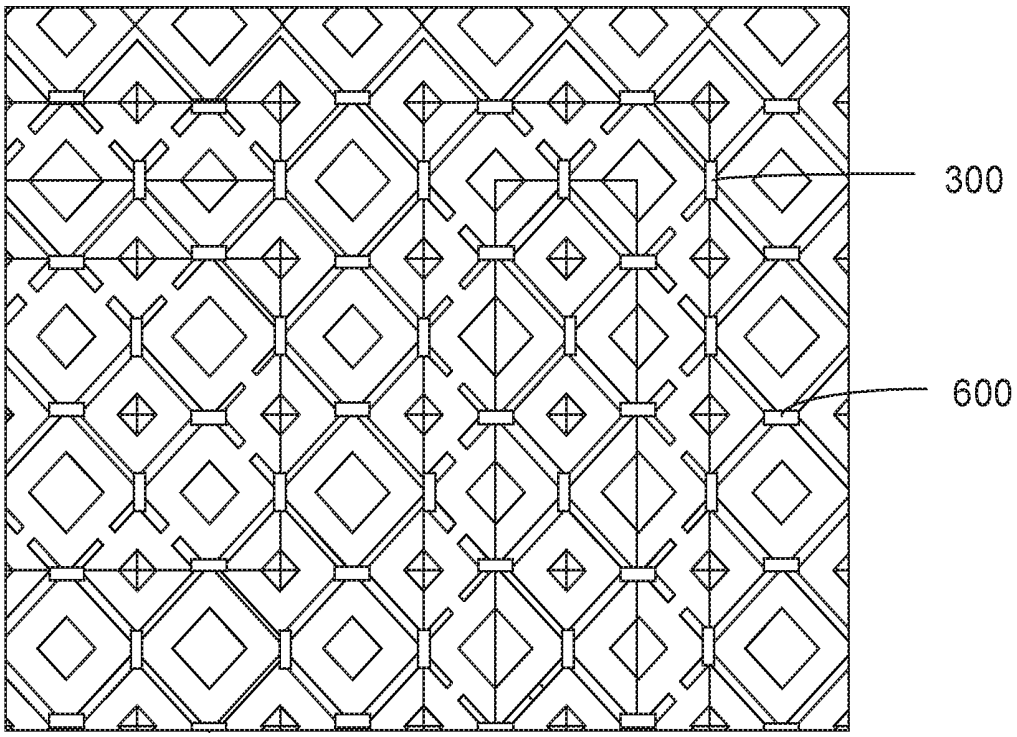


FIG. 7

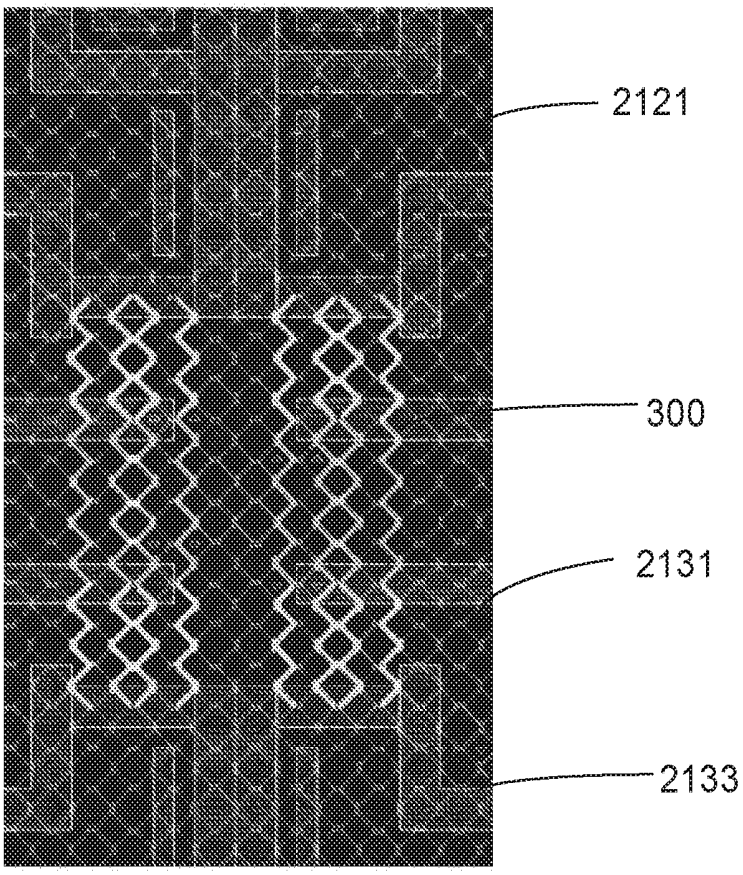


FIG. 8

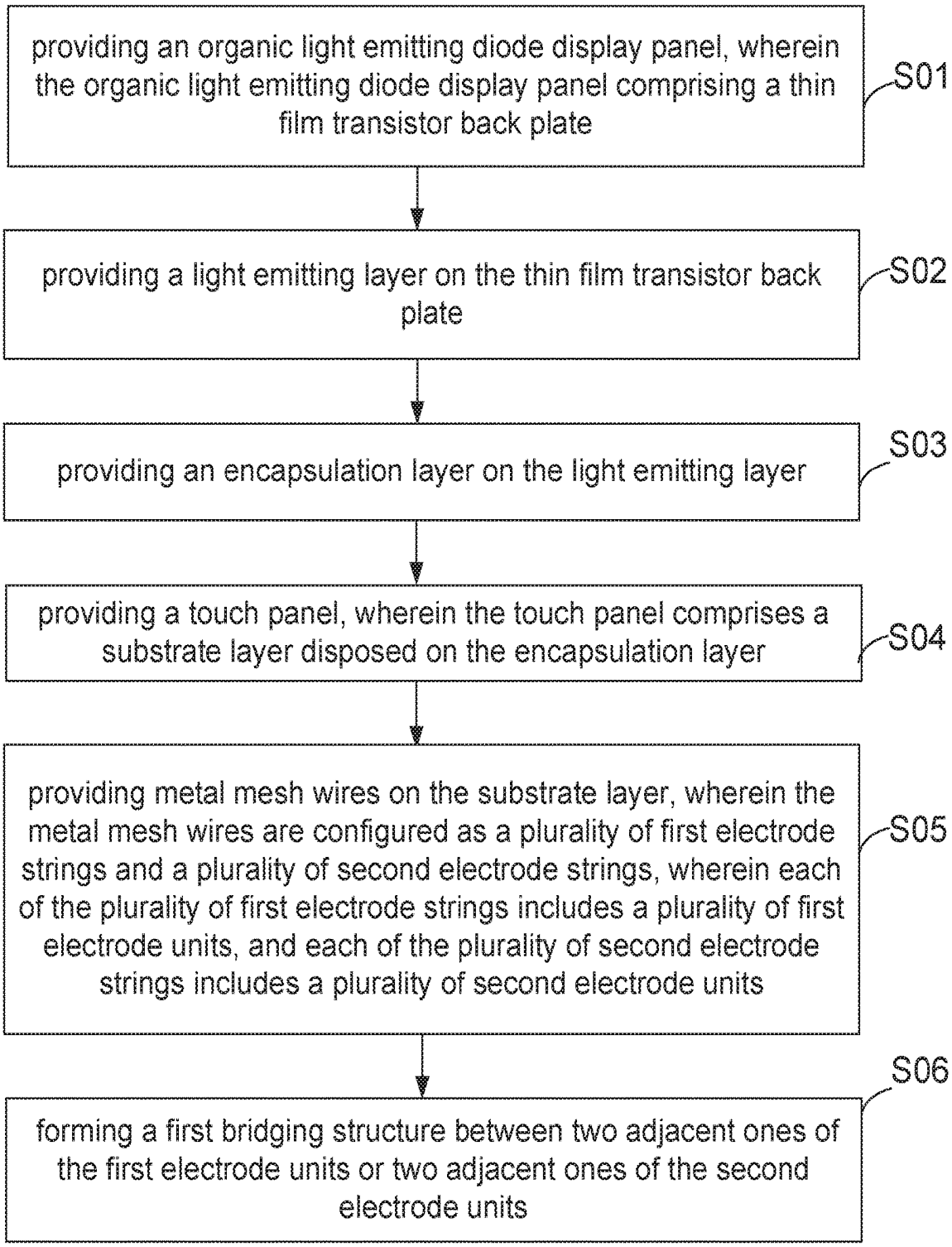

providing an organic light emitting diode display panel, wherein the organic light emitting diode display panel comprising a thin film transistor back plate
S01
providing a light emitting layer on the thin film transistor back plate
S02
providing an encapsulation layer on the light emitting layer
S03
providing a touch panel, wherein the touch panel comprises a substrate layer disposed on the encapsulation layer
S04
providing metal mesh wires on the substrate layer, wherein the metal mesh wires are configured as a plurality of first electrode strings and a plurality of second electrode strings, wherein each of the plurality of first electrode strings includes a plurality of first electrode units, and each of the plurality of second electrode strings includes a plurality of second electrode units
S05
forming a first bridging structure between two adjacent ones of the first electrode units or two adjacent ones of the second electrode units
S06

FIG. 9

TOUCH DISPLAY APPARATUS AND METHOD FOR MANUFACTURING SAME

FIELD OF INVENTION

[0001] This disclosure relates to touch display technology, and more particularly, to a touch display apparatus and a method for manufacturing the touch display apparatus.

BACKGROUND OF INVENTION

[0002] In recent years, active matrix organic light-emitting diode (AMOLED) display technology has developed rapidly, and the corresponding touch technology has also been followed up. Currently, touch technology with active matrix organic light-emitting diode display mainly includes add-on touch film bonding technology and glass encapsulation rigid in-cell touch panel technology. In the add-on touch film bonding technology or the glass encapsulation rigid in-cell touch panel technology, there is a problem of increasing a thickness of products and affecting a narrow-frame design. As shown in FIG. **1**, a display panel manufactured by the add-on touch film bonding technology includes a TFT (Thin-Film Transistor) substrate **10**, an optical medium layer **11**, a thin film encapsulation layer **12**, an optical adhesive layer **13**, a touch film layer **14**, a polarizer **15**, an optical adhesive layer **16**, and a cover glass **17**. The touch film layer **14** and the active matrix organic light emitting diode display panel are bonded together through the optical adhesive layer **13**. The touch film layer **14** can be disposed above or below the polarizer **15** according to requirements. Since a number of bonding times is increased, fitting tolerances are generally greater than 0.1 mm, and use of the add-on touch film bonding technology will increase the thickness of a product and is disadvantageous to a narrow-frame design of the product.

[0003] As shown in FIG. **2**, a display panel manufactured by the glass encapsulation rigid in-cell touch panel technology includes a TFT substrate **20**, an optical medium layer **21**, an encapsulating glass layer **22**, a touch wires layer **23**, a polarizer **24**, an optical adhesive layer **25**, and a cover glass **26**. A touch sensing circuit is formed on the encapsulating glass layer **22** of the display panel, and then one side of the encapsulating glass layer **22** is bonded to an organic light-emitting diode (OLED) panel through glass glue, and there is no need to bond an add-on touch film. However, this structure is only suitable for manufacturing rigid active matrix organic light emitting diode displays, and an overall thickness of the display is thick, which is not suitable for a development direction of current products. In addition, directly forming a touch panel on the OLED panel may be interfered by signals of a lower OLED panel, and touch sensitivity is poor.

[0004] Therefore, it is necessary to provide a touch display apparatus and a manufacturing method thereof, which solve drawbacks of increasing the thickness of the product and the poor sensitivity of the touch panel in the conventional technology.

SUMMARY OF INVENTION

[0005] In the conventional touch display, the use of the add-on touch film bonding technology will increase the thickness of a product and is not conducive to the narrow-frame design of the product. Moreover, directly forming the touch panel on the OLED panel may be interfered by signals of a lower OLED panel, and thus a touch sensing is insensitivity.

[0006] The object of this disclosure is to provide a touch display apparatus. The touch display apparatus comprises an organic light emitting diode display panel. The organic light emitting diode display panel comprises a thin film transistor back plate, a light emitting layer disposed on the thin film transistor back plate, an encapsulation layer disposed on the light emitting layer, a substrate layer disposed on the encapsulation layer, a plurality of first electrode strings disposed on the substrate layer along a first direction, and each of the plurality of first electrode strings includes a plurality of first electrode units, and a plurality of second electrode strings disposed on the substrate layer along a second direction and insulated from the plurality of first electrode strings, each of the plurality of second electrode strings includes a plurality of second electrode units. The plurality of first electrode strings and the plurality of second electrode strings are disposed on the same layer, and a first bridging structure is electrically connected to two adjacent ones of the first electrode units or two adjacent ones of the second electrode units.

[0007] When the first bridging structure is electrically connected to the two adjacent ones of the first electrode units, the second electrode unit further includes a third electrode disposed inside the second electrode unit, and the first bridging structure is electrically connected to the third electrode and the first electrode unit.

[0008] When the first bridging structure is electrically connected to the two adjacent ones of the second electrode units, the first electrode unit further includes a fourth electrode disposed inside the first electrode unit, and the first bridging structure is electrically connected to the fourth electrode and the second electrode unit.

[0009] According to an embodiment of the touch display apparatus of the disclosure, a second bridging structure is electrically connected the fourth electrode with the second electrode unit.

[0010] According to an embodiment of the touch display apparatus of the disclosure, the second electrode unit further comprises a third electrode disposed inside the second electrode unit, and a second bridging structure is electrically connected to the third electrode and the first electrode unit.

[0011] According to an embodiment of the touch display apparatus of the disclosure, the first electrode unit and the second electrode unit respectively comprise an insulating layer disposed on the first bridging structure or the second bridging structure, and a through hole disposed above the first bridging structure or the second bridging structure, and a metal layer disposed on the insulating layer, and the metal layer electrically connected to the first bridging structure or the second bridging structure through the through hole.

[0012] According to an embodiment of the touch display apparatus of the disclosure, the third electrode is disposed in an inner region of the second electrode unit, the fourth electrode is disposed in an inner region of the first electrode unit, and the first bridging structure and the second bridging structure are respectively formed by sequentially laminating a first conductive layer, an intermediate metal layer and a second conductive layer.

[0013] According to an embodiment of the touch display apparatus of the disclosure, the first electrode unit and the second electrode unit respectively comprise an insulating

layer disposed on the first bridging structure or the second bridging structure, and a through hole disposed above the first bridging structure or the second bridging structure, and a metal layer disposed on the insulating layer, the metal layer electrically connected to the first bridging structure or the second bridging structure through the through hole.

[0014] According to an embodiment of the touch display apparatus of the disclosure, the third electrode is disposed in an inner region of the second electrode unit, the fourth electrode is disposed in an inner region of the first electrode unit, and the first bridging structure and the second bridging structure are respectively formed by sequentially laminating a first conductive layer, an intermediate metal layer and a second conductive layer.

[0015] According to an embodiment of the touch display apparatus of the disclosure, the organic light emitting diode display panel further includes a protective layer disposed on the substrate layer, the protective layer completely covering the plurality of first electrode strings, the plurality of second electrode strings, the first bridging structure, and the second bridging structure.

[0016] Accor ding to an embodiment of the touch display apparatus of the disclosure, the first electrode unit is a driving electrode, and the second electrode unit is a sensing electrode.

[0017] The disclosure further provides a touch display apparatus. The touch display apparatus comprises an organic light emitting diode display panel. The organic light emitting diode display panel comprises a thin film transistor back plate, a light emitting layer disposed on the thin film transistor back plate, an encapsulation layer disposed on the light emitting layer, a substrate layer disposed on the encapsulation layer, a plurality of first electrode strings disposed on the substrate layer along a first direction, and each of the plurality of first electrode strings includes a plurality of first electrode units, and a plurality of second electrode strings disposed on the substrate layer along a second direction and insulated from the plurality of first electrode strings, each of the plurality of second electrode strings includes a plurality of second electrode units. The plurality of first electrode strings and the plurality of second electrode strings are disposed on the same layer, and a first bridging structure is electrically connected to two adjacent ones of the first electrode units or two adjacent ones of the second electrode units.

[0018] According to an embodiment of the touch display apparatus of the disclosure, the first bridging structure is electrically connected to two adjacent ones of the first electrode units, the second electrode unit further includes a third electrode disposed inside the second electrode unit, the first bridging structure is electrically connected to the third electrode and the first electrode unit, the first electrode unit further includes a fourth electrode disposed inside the first electrode unit, and a second bridging structure is electrically connected to the fourth electrode and the second electrode unit.

[0019] According to an embodiment of the touch display apparatus of the disclosure, the first bridging structure is electrically connected to two adjacent ones of the second electrode units, the first electrode unit further includes a fourth electrode disposed inside the first electrode unit, the first bridging structure is electrically connected to the fourth electrode and the second electrode unit, the second electrode unit further includes a third electrode disposed inside the second electrode unit, and a second bridging structure is electrically connected to the third electrode and the first electrode unit.

[0020] According to an embodiment of the touch display apparatus of the disclosure, the first electrode unit and the second electrode unit respectively comprise an insulating layer disposed on the first bridging structure or the second bridging structure, and a through hole disposed above the first bridging structure or the second bridging structure, and a metal layer disposed on the insulating layer, the metal layer electrically connected to the first bridging structure or the second bridging structure through the through hole.

[0021] According to an embodiment of the touch display apparatus of the disclosure, the third electrode is disposed in an inner region of the second electrode unit, and the fourth electrode is disposed in an inner region of the first electrode unit.

[0022] According to an embodiment of the touch display apparatus of the disclosure, the first bridging structure and the second bridging structure are respectively formed by sequentially laminating a first conductive layer, an intermediate metal layer and a second conductive layer.

[0023] According to an embodiment of the touch display apparatus of the disclosure, the organic light emitting diode display panel further includes a protective layer disposed on the substrate layer, the protective layer completely covering the plurality of first electrode strings, the plurality of second electrode strings, the first bridging structure, and the second bridging structure.

[0024] Accor ding to an embodiment of the touch display apparatus of the disclosure, the first electrode unit is a driving electrode, and the second electrode unit is a sensing electrode.

[0025] The disclosure further provides a method of manufacturing a touch display apparatus. The method comprises the step of: providing an organic light emitting diode display panel, wherein the organic light emitting diode display panel comprising a thin film transistor back plate; providing a light emitting layer on the thin film transistor back plate; providing an encapsulation layer on the light emitting layer; providing a substrate layer on the encapsulation layer; providing metal mesh wires on the substrate layer, wherein the metal mesh wires are configured as a plurality of first electrode strings and a plurality of second electrode strings, wherein each of the plurality of first electrode strings includes a plurality of first electrode units, and each of the plurality of second electrode strings includes a plurality of second electrode units; and forming a first bridging structure between two adjacent ones of the first electrode units or two adjacent ones of the second electrode units.

[0026] According to an embodiment of the touch display apparatus of the disclosure, the first bridging structure is electrically connected to two adjacent ones of the second electrode units, the first electrode unit further includes a fourth electrode disposed inside the first electrode unit, the first bridging structure is electrically connected to the fourth electrode and the second electrode unit, the second electrode unit further includes a third electrode disposed inside the second electrode unit, and a second bridging structure is electrically connected to the third electrode and the first electrode unit.

[0027] According to an embodiment of the touch display apparatus of the disclosure, the first bridging structure is electrically connected to two adjacent ones of the second

electrode units, the first electrode unit further includes a fourth electrode disposed inside the first electrode unit, the first bridging structure is electrically connected to the fourth electrode and the second electrode unit, the second electrode unit further includes a third electrode disposed inside the second electrode unit, and a second bridging structure is electrically connected to the third electrode and the first electrode unit.

[0028] Advantageous effects of the disclosure are as follows. The disclosure provides a touch display apparatus and a method for manufacturing the touch display apparatus. A flexible active matrix organic light emitting diode display manufactured by the in-cell touch panel technology is realized by forming metal grid touch sensing wires on a thin film encapsulation layer of the flexible active matrix organic light emitting diode display. Compared with conventional technology, a thickness of the display panel can be effectively reduced, and the use of the metal grid as the touch sensing wires can make the display panel have good bending resistance characteristics and realize flexible display touch. Furthermore, a metal grid touch structure of the disclosure can effectively reduce the number of bonding times of the touch display device in a manufacturing process, reduce the thickness of the display panel, and connect touch electrodes and peripheral sensing electrodes by using different bridging structures. This design effectively enhances touch sensing signals and expands touch sensing areas, thereby improving the sensitivity of the touch sensing.

DESCRIPTION OF DRAWINGS

[0029] FIG. **1** is a side cross-sectional schematic diagram of a structure of a conventional display panel manufactured by add-on touch film bonding technology.

[0030] FIG. **2** is a side cross-sectional schematic diagram of a structure of a conventional display panel manufactured by glass encapsulation rigid in-cell touch panel technology.

[0031] FIG. **3** is a top schematic diagram of a touch panel of a touch display apparatus according to the present disclosure.

[0032] FIG. **4** is a side cross-sectional schematic diagram of the touch display apparatus of the present disclosure.

[0033] FIG. **5** is a schematic diagram of metal grid wires of the touch display apparatus according to the present disclosure.

[0034] FIG. **6** is a schematic diagram of the touch panel of the touch display apparatus according to the present disclosure.

[0035] FIG. **7** is a structural schematic diagram of a first bridging structure of the touch display apparatus according to the present disclosure.

[0036] FIG. **8** is a structural schematic diagram of a second bridging structure of the touch display apparatus according to the present disclosure.

[0037] FIG. **9** is a flowchart of a method for manufacturing the touch display apparatus according to the present disclosure.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0038] This description of the exemplary embodiments is intended to be read in connection with the accompanying drawings, which are to be considered part of the entire written description. In the description, terms such as "lower", "upper", "horizontal", "vertical", "above", "below", "up", "down", "top", and "bottom", as well as derivatives thereof, should be construed to refer to the orientation as then described or as shown in the drawing under discussion. These terms are for convenience of description and do not require that the apparatus be constructed or operated in a particular orientation, and do not limit the scope of the disclosure. Referring to the drawings of the disclosure, similar components are labeled with the same number.

[0039] In order to more clearly describe the embodiments of the disclosure, the description is used to make a simple introduction of the drawings used in the following embodiments.

[0040] Referring to FIGS. **3-6**, in which a top schematic diagram, a side cross-sectional schematic diagram of a touch panel of a touch display apparatus, and a schematic diagram of the touch panel of the touch display apparatus according to the present disclosure are shown. In an embodiment of the present disclosure, a touch display apparatus is provided. The touch display apparatus comprises an organic light emitting diode display panel **110** and a touch panel **210**. The organic light emitting diode display panel **110** comprises a thin film transistor back plate **111**, a light emitting layer **112** disposed on the thin film transistor back plate **111**, and an encapsulation layer **113** disposed on the light emitting layer **112**. The touch panel **210** comprises a substrate layer **211** disposed on the encapsulation layer **113**, a plurality of first electrode strings **212** disposed on the substrate layer **211** along a first direction, each of the plurality of first electrode strings **212** includes a plurality of first electrode units **2121**, and a plurality of second electrode strings **213** disposed on the substrate layer along a second direction and insulated from the plurality of first electrode strings **212**, each of the plurality of second electrode strings **213** includes a plurality of second electrode units **2131**. The plurality of first electrode strings **212** are interlaced with the plurality of second electrode strings **213**. The plurality of first electrode strings **212** and the plurality of second electrode strings **213** are disposed on the same layer. A first bridging structure **300** is electrically connected to two adjacent ones of the first electrode units **2121** or two adjacent ones of the second electrode units **2131**. In the embodiment of FIG. **6**, the first bridging structure **300** is electrically connected to the adjacent first electrode units **2121**. Further, in the embodiment of FIG. **6**, the first direction is a horizontal direction and the second direction is a vertical direction, but is not limited thereto.

[0041] The substrate layer **211** of the touch panel **210** comprises a display area **211***a* and a non-display area **211***b*. The touch panel **210** includes a plurality of electrode regions. The electrode regions are divided into a plurality of first electrode strings **212** arranged in an array in the display area **211***a*, and a plurality of second electrode strings **213** disposed around the plurality of first electrode strings **212** arranged in an array. The plurality of first electrode strings **212** and the plurality of second electrode strings **213** have the same shape and area, but the shape or area of floating electrodes or virtual electrodes (will be described later) disposed in the first electrode string **212** and the second electrode string **213** are not the same.

[0042] In some embodiments, the first electrode unit **2121** is a driving electrode, and the second electrode unit **2131** is a sensing electrode. In other embodiments, the first electrode

unit **2121** is a sensing electrode, and the second electrode unit **2131** is a driving electrode. Material of the first electrode unit **2121** and the second electrode unit **2131** include a transparent conductive material, such as indium tin oxide (ITO), indium zinc oxide (IZO), fluorine doped tin oxide (FTO), aluminum doped zinc oxide (AZO), gallium doped zinc oxide (GZO), or other light-transmitting conductive materials, such as a metal mesh, and a silver nano-wire (SNW), etc.

[0043] Referring to FIG. **3**, touch sensing wires of the plurality of first electrode strings **212** and the plurality of second electrode strings **213** are formed by metal-mesh metal grid technology, and a plurality of metal mesh wires **400** constituting the touch sensing wires are not disposed in a pixel emitting region **130** of the organic light emitting diode display panel **110** and traces are arranged in an intermediate portion of adjacent pixels **140**, **141**, and **142** (e.g., pixels of different color lights). The plurality of first electrode units **2121** and the plurality of second electrode unit **2131** are formed in the same layer, and the plurality of first electrode units **2121** and the plurality of second electrode units **2131** are separated by openings **150** generated by the metal-mesh metal grid technology. A distance between two ones of the openings **150** is not greater than a distance between two adjacent pixel emitting regions. One of the plurality of first electrode units **2121** and the plurality of second electrode units **2131** are connected by a bridging structure, which will be described in detail later.

[0044] The plurality of first electrode strings **212** and the plurality of second electrode strings **213** are spatially isolated from each other.

[0045] Specifically, the second electrode unit **2131** comprises a third electrode **2133** disposed inside the second electrode unit **2131**. In this embodiment, there is a gap between the second electrode unit and the third electrode, that is, the second electrode unit **2131** and the third electrode **2133** are not electrically connected to each other. A capacitance value is effectively controlled, and other noise capacitors can be shielded. The first electrode unit **2121** comprises a fourth electrode **2123** disposed inside the first electrode unit **2121**. There is a gap between the first electrode unit **2121** and the fourth electrode **2123**, and the first electrode unit **2121** and the fourth electrode **2123** are not electrically connected to each other. In the present embodiment, the third electrode **2133** and the fourth electrode **2123** are disposed inside the first electrode unit **2121** and the second electrode unit **2131**, respectively.

[0046] In an embodiment of the present disclosure, when the first bridging structure **300** is electrically connected to two adjacent ones of the first electrode units **2121**, the second electrode unit **2131** further includes a third electrode **2133** disposed inside the second electrode unit **2131** (such as the aforementioned floating electrodes or virtual electrodes). The first bridging structure **300** is electrically connected to the third electrode **2133** and the first electrode unit **2121**. The first electrode unit **2121** further includes a fourth electrode **2123** (such as the aforementioned floating electrodes or virtual electrodes) disposed inside the first electrode unit **2121**, and a second bridging structure **600** is electrically connected to the fourth electrode **2133** and the second electrode unit **2131**.

[0047] In this embodiment, the first bridging structure **300** is respectively disposed at both ends of the first electrode unit **2121**. The first bridging structure **300** connects two adjacent first electrode units **2121** with each other to achieve effective communication of signals. The first bridging structure **300** conducts the third electrode **2133** inside the second electrode unit **2131** and the first electrode unit **2121** to realize the increase of a sensing area of the first electrode unit **2121** and enhance an interaction ability between a touch driving area and a sensing area. As shown in FIG. **7**, two of the adjacent first electrode units **2121** isolated from each other are conducted by the plurality of zigzag-shaped first bridging structures **300**, and at the same time the third electrode **2133** inside the second electrode unit **2131** is electrically conducted with the first electrode unit **2121**. Thus, the sensing area of the first electrode unit **2121** and the second electrode unit **2131** is expanded to enhance the touch sensing effect.

[0048] In this embodiment, the second bridging structure **600** is disposed at an outermost periphery of the second electrode unit **2131**, and the fourth electrode **2123** inside the first electrode unit **2121** is conducted with the second electrode unit **2131**. The sensing area of the second electrode unit **2131** is enlarged, and the touch sensing area between the second electrode unit **2131** and the first electrode unit **2121** is increased, thereby effectively increasing the touch sensing effect and sensitivity.

[0049] In another embodiment of the present disclosure, the first bridging structure **300** is electrically connected an adjacent second electrode units **2131** instead of electrically connected an adjacent first electrode units **2121**. The first electrode unit **2121** further includes a fourth electrode **2123** disposed inside the first electrode unit **2121**, the first bridge structure **300** is electrically connected to the fourth electrode **2123** and the second electrode unit **2131**. The second electrode unit **2131** further includes a third electrode **2133** disposed inside the second electrode unit **2131**. The second bridging structure **600** is electrically connected to the third electrode **2133** and the first electrode unit **2121**.

[0050] That is to say, the first bridging structure **300** is disposed at both ends of the second electrode unit **2131**, that is, the first bridging structure **300** is disposed between two adjacent second electrode units **2131**. The first bridging structure **300** connects two adjacent second electrode units **2131** with each other to achieve effective communication of signals. The first bridging structure **300** conducts the fourth electrode **2123** with the second electrode unit **2131** disposed inside the first electrode unit **2121** to realize an increase of the sensing area of the second electrode unit **2131**, and enhance an interaction ability between the touch driving area and the sensing area.

[0051] In this embodiment, the second bridging structure **600** is disposed at the outermost periphery of the first electrode unit **2121**. The third electrode **2133** inside the second electrode unit **2131** is conducted with the first electrode unit **2121**. The sensing area of the first electrode unit **2121** is enlarged, and a touch sensing area between the first electrode unit **2121** and the second electrode unit **2131** is increased, thereby effectively increasing touch sensing effect and sensitivity, as shown in FIG. **8**.

[0052] As shown in FIG. **4**, the substrate layer is disposed on the encapsulation layer **113**. The substrate layer **211** is preferably made of silicon nitride, but is not limited thereto. An electrode metal layer (not shown) in a form of a metal mesh wire **400** is formed on the substrate layer **211**. The electrode metal layer includes a plurality of first electrode strings **212** and a plurality of second electrode strings **213**.

More specifically, a first metal layer **221** is disposed on the encapsulation layer **113**, and the first metal layer **221** acts as the first bridging structure **300**. In addition, an insulating layer **231** is disposed on the first bridging structure **300**, and a through hole **500** is disposed on the insulating layer **231** corresponding to the first bridging structure **300**. A second metal layer **241** is disposed on the insulating layer **231**. The second metal layer **241** is electrically connected to the first bridging structure **300** through the through hole **500**. The second metal layer **241** is configured to include a touch electrode pattern of the first electrode unit **2121** and the second electrode unit **2131**, that is, to form metal mesh wires **400**. The first bridging structure **300** conducts the first electrode unit **2121** and the second electrode unit **2131** which are isolated from each other through the through hole **500** in the insulating layer **231**, thereby realizing a mutual capacitance sensing function, as shown in FIG. **4**. The touch panel further includes a protective layer **251** disposed on the substrate layer **211** to completely cover the plurality of first electrode strings **212**, the plurality of second electrode strings **213**, the first bridge structure **300**, and the second bridge structure **600**.

[0053] The first bridging structure **300** and the second bridging structure **600** are respectively formed by sequentially laminating of a first conductive layer, an intermediate metal layer, and a second conductive layer. More specifically, the metal of the first bridging structure **300** and the second bridging structure **600** is formed by sequentially laminating of metals such as titanium-aluminum-titanium or molybdenum-aluminum-molybdenum. The second metal layer constituting the metal mesh wires **400** is formed by a titanium-aluminum-titanium three-layered composite metal structure, which can prevent metal oxidation and enhance the folding resistance of touch sensing wires. Preferably, the metal mesh wires **400** have a line width in a range of 0.5 microns to 5 microns.

[0054] Referring to FIG. **9** accompanying with FIG. **4**, a flowchart of a method for manufacturing the touch display apparatus according to the present disclosure is shown. The disclosure further provides a method of manufacturing a touch display apparatus. The method comprises following steps. In a step S**01**, an organic light emitting diode display panel is provided. The organic light emitting diode display panel **110** comprising a thin film transistor back plate **111**. In a step S**02**, a light emitting layer **112** is provided on the thin film transistor back plate **111**. In a step S**03**, an encapsulation layer is provided on the light emitting layer. In a step S**04**, a touch panel **210** is provided. The touch panel **210** comprises a substrate layer **211** disposed on the encapsulation layer **113**. In a step S**05**, metal mesh wires **400** are provided on the substrate layer **211**. The metal mesh wires **400** are configured as a plurality of first electrode strings **212** and a plurality of second electrode strings **213**. Each of the plurality of first electrode strings **212** includes a plurality of first electrode units **2121**, and each of the plurality of second electrode strings **213** includes a plurality of second electrode units **2131**. In a step S**06**, a first bridging structure **300** is formed between two adjacent ones of the first electrode units **2121** or two adjacent ones of the second electrode units **2131**.

[0055] In some embodiments, the first electrode unit **2121** is a driving electrode, and the second electrode unit **2131** is a sensing electrode. In other embodiments, the first electrode unit **2121** is a sensing electrode, and the second electrode unit **2131** is a driving electrode. Material of the first electrode unit **2121** and the second electrode unit **2131** include a transparent conductive material, such as indium tin oxide (ITO), indium zinc oxide (IZO), fluorine doped tin oxide (FTO), aluminum doped zinc oxide (AZO), gallium doped zinc oxide (GZO), or other light-transmitting conductive materials, such as a metal mesh, and a silver nano-wire (SNW), etc.

[0056] Specifically, the metal mesh wires **400** are formed by a metal-mesh metal grid technology. The metal mesh wires **400** are not disposed in a pixel emitting region of the organic light emitting diode display panel **110** and traces of the metal mesh wires are arranged in an intermediate portion of adjacent pixels. The metal mesh wires **400** have a line width in a range of 0.5 microns to 5 microns. Specifically, the substrate layer **211** is formed on the encapsulation layer **113**. The substrate layer **211** is preferably made of a silicon nitride material, and then a first metal layer is formed on the substrate layer **211** as a bridging structure **300**. An insulating layer **231** is formed on the first bridging structure **300**, and a plurality of through holes **500** are formed above the first bridging structure **300** by an etching process. Then a second metal layer **241** is formed on the insulating layer **231**. The second metal layer **241** is etched to form a touch electrode pattern including the first electrode unit **2121** and the second electrode unit **2131**. The first bridging structure **300** conducts the first electrode unit **2121** and the second electrode unit **2131** which are isolated from each other through the through hole **500** in the insulating layer **231**, thereby realizing a mutual capacitance sensing function.

[0057] Additionally, the second bridging structure **600** is disposed at the outermost periphery of the first electrode unit **2121** or the second electrode unit **2131**. When the first bridging structure **300** is electrically connected to two adjacent ones of the first electrode units **2121**, the second electrode unit **2131** further includes a third electrode **2133** disposed inside the second electrode unit **2131** (such as the aforementioned floating electrodes or virtual electrodes). The first bridging structure **300** is electrically connected to the third electrode **2133** and the first electrode unit **2121**. The first electrode unit **2121** further includes a fourth electrode **2123** (such as the aforementioned floating electrodes or virtual electrodes) disposed inside the first electrode unit **2121**, and the second bridging structure **600** is electrically connected to the fourth electrode **2133** and the second electrode unit **2131**.

[0058] In this embodiment, the second bridging structure **600** is disposed at the outermost periphery of the second electrode unit **2131**, and the fourth electrode **2123** inside the first electrode unit **2121** is conducted with the second electrode unit **2131**. The sensing area of the second electrode unit **2131** is enlarged, and the touch sensing area between the second electrode unit **2131** and the first electrode unit **2121** is increased, thereby effectively increasing the touch sensing effect and sensitivity.

[0059] In another embodiment of the present disclosure, when the first bridging structure **300** is electrically connected to two adjacent ones of the second electrode units **2131**, the first electrode unit **2121** further includes a fourth electrode **2123** disposed inside the first electrode unit **2121**. The first bridging structure **300** is electrically connected to the fourth electrode **2123** and the second electrode units **2131**. The second electrode units **2131** further includes a third electrode **2133** disposed inside the second electrode

units **2131**, and a second bridging structure **600** is electrically connected to the third electrode **2133** and the first electrode unit **2121**.

[0060] That is to say, the first bridging structure **300** is disposed at both ends of the second electrode unit **2131**, that is, the first bridging structure **300** is disposed between two adjacent second electrode units **2131**. The first bridging structure **300** connects two adjacent second electrode units **2131** with each other to achieve effective communication of signals. The first bridging structure **300** conducts the fourth electrode **2123** with the second electrode unit **2131** disposed inside the first electrode unit **2121** to realize the increase of the sensing area of the second electrode unit **2131**, and enhance an interaction ability between the touch driving area and the sensing area.

[0061] In this embodiment, the second bridging structure **600** is disposed at the outermost periphery of the first electrode unit **2121**. The third electrode **2133** inside the second electrode unit **2131** is conducted with the first electrode unit **2121**. The sensing area of the first electrode unit **2121** is enlarged, and a touch sensing area between the first electrode unit **2121** and the second electrode unit **2131** is increased, thereby effectively increasing touch sensing effect and sensitivity.

[0062] The fourth electrode **2123** (floating electrodes/virtual electrodes) disposed inside the first electrode unit **2121** is electrically conducted with the second electrode unit **2131**. Alternatively, the third electrode **2133** (floating electrodes/virtual electrodes) disposed inside the second electrode unit **2131** is conducted with the first electrode unit **2121**, so that the touch sensing area of the first electrode unit **2121** and the second electrode unit **2131** can be enlarged, and the touch sensing area of the first electrode unit **2121** and the second electrode unit **2131** effectively increase, thereby effectively increasing the touch sensing signal.

[0063] The disclosure provides a touch display apparatus and a method for manufacturing the touch display apparatus. A flexible active matrix organic light emitting diode display manufactured by the in-cell touch panel technology is realized by forming metal grid touch sensing wires on a thin film encapsulation layer of the flexible active matrix organic light emitting diode display. Compared with conventional technology, a thickness of the display panel can be effectively reduced, and use of the metal grid as the touch sensing wires can make the display panel have good bending resistance characteristics and realize flexible display touch. Furthermore, a metal grid touch structure of the disclosure can effectively reduce the number of bonding times of the touch display device in a manufacturing process, reduce the thickness of the display panel, and connect touch electrodes and peripheral sensing electrodes by using different bridging structures. This design effectively enhances touch sensing signals and expands touch sensing areas, thereby improving the sensitivity of the touch sensing.

[0064] This disclosure has been described with preferred embodiments thereof, and it is understood that many changes and modifications to the described embodiment can be carried out without departing from the scope and the spirit of the invention.

What is claimed is:

1. A touch display apparatus, comprising:

an organic light emitting diode display panel, the organic light emitting diode display panel comprising:

a thin film transistor back plate;

a light emitting layer disposed on the thin film transistor back plate;

an encapsulation layer disposed on the light emitting layer;

a substrate layer disposed on the encapsulation layer;

a plurality of first electrode strings disposed on the substrate layer along a first direction, wherein each of the plurality of first electrode strings includes a plurality of first electrode units; and

a plurality of second electrode strings disposed on the substrate layer along a second direction and insulated from the plurality of first electrode strings, wherein each of the plurality of second electrode strings includes a plurality of second electrode units;

wherein the plurality of first electrode strings and the plurality of second electrode strings are disposed on the same layer, and a first bridging structure is electrically connected to two adjacent ones of the first electrode units or two adjacent ones of the second electrode units;

wherein when the first bridging structure is electrically connected to the two adjacent ones of the first electrode units, the second electrode unit further includes a third electrode disposed inside the second electrode unit, and the first bridging structure is electrically connected to the third electrode and the first electrode unit;

wherein when the first bridging structure is electrically connected to the two adjacent ones of the second electrode units, the first electrode unit further includes a fourth electrode disposed inside the first electrode unit, and the first bridging structure is electrically connected to the fourth electrode and the second electrode unit.

2. The touch display apparatus according to claim **1**, wherein and a second bridging structure is electrically connected the fourth electrode with the second electrode unit.

3. The touch display apparatus according to claim **1**, wherein the second electrode unit further comprises a third electrode disposed inside the second electrode unit, and a second bridging structure is electrically connected to the third electrode and the first electrode unit.

4. The touch display apparatus according to claim **2**, wherein the first electrode unit and the second electrode unit respectively comprise:

an insulating layer disposed on the first bridging structure or the second bridging structure, and a through hole disposed above the first bridging structure or the second bridging structure; and

a metal layer disposed on the insulating layer, and the metal layer electrically connected to the first bridging structure or the second bridging structure through the through hole.

5. The touch display apparatus according to claim **2**, wherein the third electrode is disposed in an inner region of the second electrode unit, the fourth electrode is disposed in an inner region of the first electrode unit, and the first bridging structure and the second bridging structure are respectively formed by sequentially laminating a first conductive layer, an intermediate metal layer, and a second conductive layer.

6. The touch display apparatus according to claim **3**, wherein the first electrode unit and the second electrode unit respectively comprise:

an insulating layer disposed on the first bridging structure or the second bridging structure, and a through hole disposed above the first bridging structure or the second bridging structure; and

a metal layer disposed on the insulating layer, the metal layer electrically connected to the first bridging structure or the second bridging structure through the through hole.

7. The touch display apparatus according to claim **3**, wherein the third electrode is disposed in an inner region of the second electrode unit, the fourth electrode is disposed in an inner region of the first electrode unit, and the first bridging structure and the second bridging structure are respectively formed by sequentially laminating a first conductive layer, an intermediate metal layer, and a second conductive layer.

8. A touch display apparatus, comprising:

an organic light emitting diode display panel, the organic light emitting diode display panel comprising:

a thin film transistor back plate;

a light emitting layer disposed on the thin film transistor back plate;

an encapsulation layer disposed on the light emitting layer;

a substrate layer disposed on the encapsulation layer;

a plurality of first electrode strings disposed on the substrate layer along a first direction, wherein each of the plurality of first electrode strings includes a plurality of first electrode units; and

a plurality of second electrode strings disposed on the substrate layer along a second direction and insulated from the plurality of first electrode strings, wherein each of the plurality of second electrode strings includes a plurality of second electrode units;

wherein the plurality of first electrode strings and the plurality of second electrode strings are disposed on the same layer, and a first bridging structure is electrically connected to two adjacent ones of the first electrode units or two adjacent ones of the second electrode units.

9. The touch display apparatus according to claim **8**, wherein the first bridging structure is electrically connected to two adjacent ones of the first electrode units, the second electrode unit further includes a third electrode disposed inside the second electrode unit, the first bridging structure is electrically connected to the third electrode and the first electrode unit, the first electrode unit further includes a fourth electrode disposed inside the first electrode unit, and a second bridging structure is electrically connected to the fourth electrode and the second electrode unit.

10. The touch display apparatus according to claim **8**, wherein the first bridging structure is electrically connected to two adjacent ones of the second electrode units, the first electrode unit further includes a fourth electrode disposed inside the first electrode unit, the first bridging structure is electrically connected to the fourth electrode and the second electrode unit, the second electrode unit further includes a third electrode disposed inside the second electrode unit, and a second bridging structure is electrically connected to the third electrode and the first electrode unit.

11. The touch display apparatus according to claim **9**, wherein the first electrode unit and the second electrode unit respectively comprise:

an insulating layer disposed on the first bridging structure or the second bridging structure, and a through hole disposed above the first bridging structure or the second bridging structure; and

a metal layer disposed on the insulating layer, the metal layer electrically connected to the first bridging structure or the second bridging structure through the through hole.

12. The touch display apparatus according to claim **9**, wherein the third electrode is disposed in an inner region of the second electrode unit, and the fourth electrode is disposed in an inner region of the first electrode unit.

13. The touch display apparatus according to claim **9**, wherein the first bridging structure and the second bridging structure are respectively formed by sequentially laminating a first conductive layer, an intermediate metal layer, and a second conductive layer.

14. The touch display apparatus according to claim **10**, wherein the first electrode unit and the second electrode unit respectively comprise:

an insulating layer disposed on the first bridging structure or the second bridging structure, and a through hole disposed above the first bridging structure or the second bridging structure; and

a metal layer disposed on the insulating layer, the metal layer electrically connected to the first bridging structure or the second bridging structure through the through hole.

15. The touch display apparatus according to claim **10**, wherein the third electrode is disposed in an inner region of the second electrode unit, and the fourth electrode is disposed in an inner region of the first electrode unit.

16. The touch display apparatus according to claim **10**, wherein the first bridging structure and the second bridging structure are respectively formed by sequentially laminating a first conductive layer, an intermediate metal layer, and a second conductive layer.

17. A method of manufacturing a touch display apparatus, comprising:

providing an organic light emitting diode display panel, wherein the organic light emitting diode display panel comprising a thin film transistor back plate;

providing a light emitting layer on the thin film transistor back plate;

providing an encapsulation layer on the light emitting layer;

providing a substrate layer on the encapsulation layer;

providing metal mesh wires on the substrate layer, wherein the metal mesh wires are configured as a plurality of first electrode strings and a plurality of second electrode strings, wherein each of the plurality of first electrode strings includes a plurality of first electrode units, and each of the plurality of second electrode strings includes a plurality of second electrode units; and

forming a first bridging structure between two adjacent ones of the first electrode units or two adjacent ones of the second electrode units.

18. The method according to claim **17**, wherein the first bridging structure is electrically connected to two adjacent ones of the second electrode units, the first electrode unit further includes a fourth electrode disposed inside the first electrode unit, the first bridging structure is electrically connected to the fourth electrode and the second electrode

unit, the second electrode unit further includes a third electrode disposed inside the second electrode unit, and a second bridging structure is electrically connected to the third electrode and the first electrode unit.

19. The method according to claim **17**, wherein the first bridging structure is electrically connected to two adjacent ones of the second electrode units, the first electrode unit further includes a fourth electrode disposed inside the first electrode unit, the first bridging structure is electrically connected to the fourth electrode and the second electrode unit, the second electrode unit further includes a third electrode disposed inside the second electrode unit, and a second bridging structure is electrically connected to the third electrode and the first electrode unit.

* * * * *

专利名称(译)	触摸显示设备及其制造方法		
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摘要(译)

提供了一种触摸显示设备。 触摸显示设备包括有机发光二极管显示面板，该有机发光二极管显示面板包括薄膜晶体管背板，发光层，封装层以及设置在封装层上的基板层。 沿着第一方向设置在基板层上的第一电极串，每个第一电极串包括多个第一电极单元。 沿着第二方向设置在基板层上并与第一电极串绝缘的第二电极串，每个第二电极串包括多个第二电极单元。 第一电极串和第二电极串设置在同一层上。 第一桥接结构电连接至两个相邻的第一电极单元或两个相邻的第二电极单元，以增加触摸感测面积。 还提供了一种用于制造触摸显示设备的方法。