US 20210335895A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0335895 A1**

FENG (43) **Pub. Date: Oct. 28, 2021**

(54) **TOUCH DISPLAY PANEL AND ELECTRONIC DEVICE**

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(21) Appl. No.: **16/615,233**

(22) PCT Filed: **May 17, 2019**

(86) PCT No.: **PCT/CN2019/087438**

§ 371 (c)(1),
(2) Date: **Nov. 20, 2019**

(30) **Foreign Application Priority Data**

Apr. 25, 2019 (CN) 201910340721.X

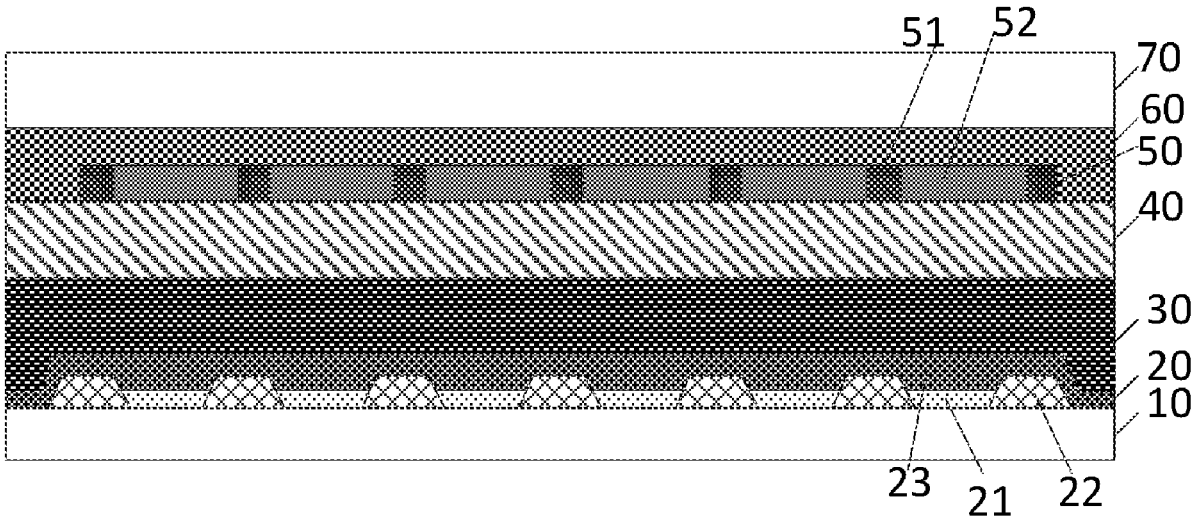
Publication Classification

(51) **Int. Cl.**
H01L 27/32 (2006.01)
G06F 3/041 (2006.01)

(52) **U.S. Cl.**
CPC ***H01L 27/323*** (2013.01); ***G06F 3/0412*** (2013.01)

(57) **ABSTRACT**

A touch display panel and an electronic device are disclosed. The touch display panel includes a base substrate; an organic light-emitting display layer disposed on the base substrate; an encapsulation layer disposed on the organic light-emitting display layer; a touch-control layer disposed on the encapsulation layer and comprising a plurality of first electrodes and a plurality of second electrodes staggered with respect to the first electrodes and insulated from the first electrodes; and a color filter layer disposed on the touch-control layer and comprising a black matrix and a plurality of color filter resists.



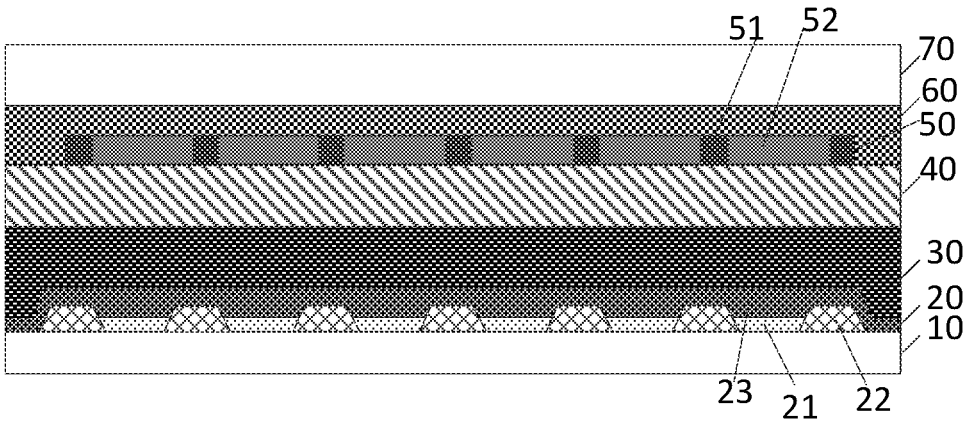


FIG. 1

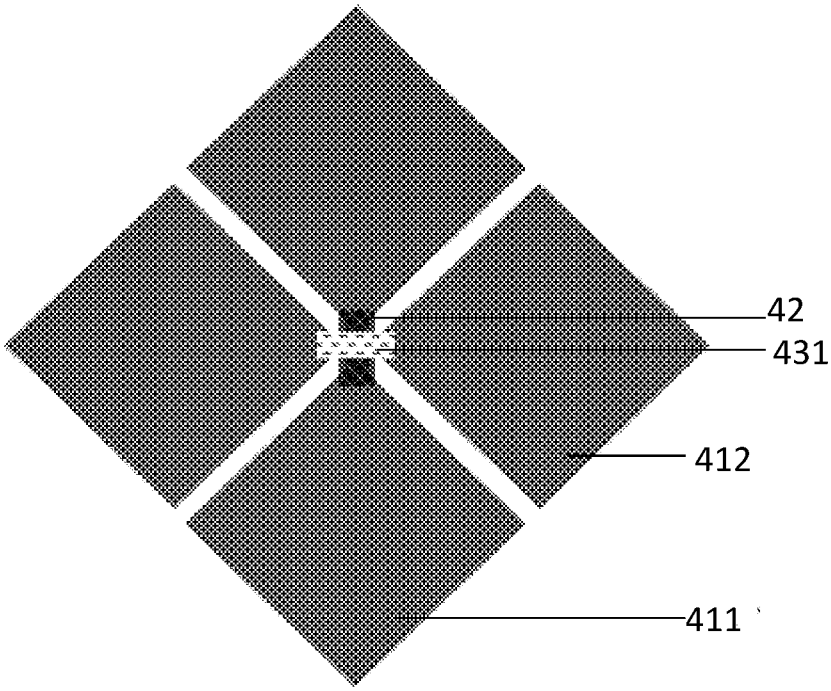


FIG. 2

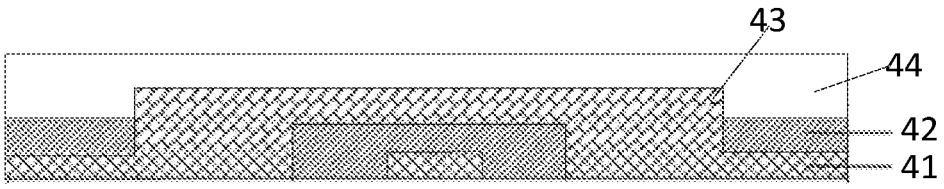


FIG. 3

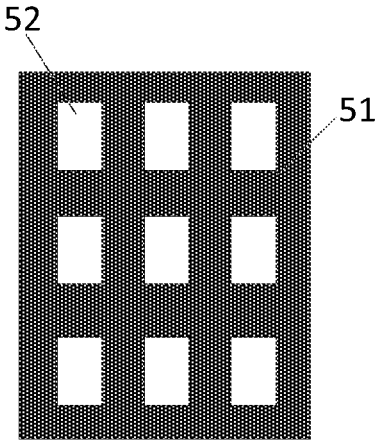


FIG. 4

TOUCH DISPLAY PANEL AND ELECTRONIC DEVICE

BACKGROUND OF INVENTION

1. Field of Invention

[0001] The present invention relates to a display field, and particularly, to a touch display panel and an electronic device.

2. Related Art

[0002] Organic light-emitting diode (OLED) has been regarded as a next generation novel display technology due to advantages of being light in weight, wind viewing angles, quick response times, low temperature resistance, and high luminous efficiency.

[0003] Current touch display panels generally include display panels and touch panels. Display panels generally include organic light-emitting display layers and color filter layers. However, such a structure is configured with display panels and touch panels both manufactured separately, wherein the display panels need to be laminated to the touch panels through adhesive layers, resulting in an increase in thickness of the display panels.

[0004] Therefore, it is imperative to provide a touch display panel and an electronic device to overcome problems existing in current technology.

SUMMARY OF INVENTION

[0005] An object of the present invention is to provide a touch display panel and an electronic device, capable of reducing a thickness of a display panel.

[0006] To achieve the above-mentioned object, the present invention provides a touch display panel, comprising a base substrate; an organic light-emitting display layer disposed on the base substrate; an encapsulation layer disposed on the organic light-emitting display layer; a touch-control layer disposed on the encapsulation layer and comprising a plurality of first electrodes and a plurality of second electrodes staggered with respect to the first electrodes and insulated from the first electrodes; and a color filter layer disposed on the touch-control layer and comprising a black matrix and a plurality of color filter resists.

[0007] The present invention further provides an electronic device comprising the above-mentioned touch display panel.

[0008] A touch display panel and an electronic device of the present invention include an organic light-emitting display layer, an encapsulation layer, a touch-control layer, and a color filter layer all sequentially disposed on a base substrate. Since the touch-control layer is directly disposed between the organic light-emitting display layer and the color filter layer, no glue is required for lamination, thereby reducing an overall thickness of the display panel.

BRIEF DESCRIPTION OF DRAWINGS

[0009] FIG. **1** is a schematic structural view of a touch display panel of the present invention.

[0010] FIG. **2** is an enlarged schematic structural view of first electrodes and second electrodes of the present invention.

[0011] FIG. **3** is a schematic structural view of a touch-control layer of the present invention.

[0012] FIG. **4** is a top plan view of a color filter layer of the present invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

[0013] Hereafter, embodiments of the present invention will be described in detail with reference to the accompanying drawings, wherein same or like reference numerals designate same or like elements or elements having same or like functions throughout the specification. The embodiments described with reference to the accompanying drawings are to be regarded as illustrative to only explain the present invention, but not to be construed as limiting the present invention.

[0014] In the description of the present invention, it is to be understood that the term "center", "longitudinal", "lateral", "length", "width", "thickness", "upper", "lower", "front", "rear", "left", "right", "vertical", "horizontal", "top", "bottom", "inner", "outer", "clockwise", "counterclockwise" and the like indicates orientation or the orientation or positional relationship based on the positional relationship shown in the drawings, for convenience of description only and the present invention is to simplify the description, but does not indicate or imply that the device or element referred to must have a particular orientation in a particular orientation construction and operation, and therefore not be construed as limiting the present invention. In addition, the terms "first", "second" are used to indicate or imply relative importance or the number of technical features specified implicitly indicated the purpose of description and should not be understood. Thus, there is defined "first", "second" features may be explicitly or implicitly including one or more of the features. In the description of the new practice, the meaning of "plurality" is at least two, e.g. two, three, etc., unless explicitly specifically limited.

[0015] In the present invention, unless otherwise explicitly specified or limited, the terms "mounted", "connected", "connected", "fixed" and like terms are to be broadly understood, for example, may be a fixed connection, may be is detachably connected to, or integrally; may be a mechanical connector, may be electrically connected; may be directly connected, can also be connected indirectly through intervening structures, it may be interaction between the two internal communicating elements or two elements. Those of ordinary skill in the art, to be understood that the specific meanings in the present invention in accordance with specific circumstances.

[0016] In the present invention, unless otherwise expressly specified or limited, the first feature being "on" or "lower" the second feature may include direct contact of the first and the second features and may also include that the first and the second features are not in direct contact, but in contact by the additional features therebetween. Also, the first feature being "on", "above", "upper" the second feature may include that the first feature is obliquely upward, directly above the second feature, or simply represent that a level of the first feature is higher than that of the second feature. The first feature being "beneath", "below" and "lower" the second feature may include that the first feature is obliquely downward and right below the second feature, or simply represent that a level of the first feature is less than that of the second feature.

[0017] The following disclosure provides many different embodiments or examples to achieve different structures of

the present invention. To simplify the disclosure of the present invention, the components and configuration of specific examples are described hereinafter. Of course, they are only illustrative, and are not intended to limit the present invention. Further, the present disclosure may repeat reference numerals in different embodiments and/or the reference letters. This repetition is for the purpose of simplicity and clarity, and does not indicate a relationship between the various embodiments and/or set in question. Further, the present invention provides various specific examples of materials and processes, but one of ordinary skill in the art may be appreciated that other processes and applications and/or other materials.

[0018] Please refer to FIGS. **1** to **4**. FIG. **1** is a schematic structural view of a touch display panel of the present invention.

[0019] The touch display panel of the present invention includes a base substrate **10**, an organic light-emitting display layer **20**, an encapsulation layer **30**, a touch-control layer **40**, and a color filter layer **50**. Furthermore, the touch display panel may also include a protective layer **60** and a glass cover **70**.

[0020] The base substrate **10** includes a substrate and a switch array layer disposed on the substrate. The substrate may be a glass substrate or a flexible substrate. The switch array layer includes a plurality of thin-film transistors.

[0021] The organic light-emitting display layer **20** is disposed on the base substrate **10**. The organic light-emitting display layer **20** includes an anode (not shown), an organic light-emitting layer **21**, and a cathode **23**, wherein the organic light-emitting layer **21** is formed by an evaporation process. Furthermore, the organic light-emitting display layer **20** may include a pixel defining layer **22**. The pixel defining layer **22** includes a plurality of pixel defining units spaced apart from each other, wherein the organic light-emitting display layer **21** is located at a gap between two of the pixel defining units. The anode is connected to a drain of the thin-film transistor. The anode is made of indium tin oxide (ITO). The organic light-emitting display layer **20** includes a plurality of organic light-emitting units at a top plan view angle. A color of light emitted by the organic light-emitting units is white.

[0022] The encapsulation layer **30** is disposed on the organic light-emitting display layer **20**. The encapsulation layer **30** includes a first inorganic layer, an organic layer, and a second inorganic layer, wherein the first inorganic layer and the second inorganic layer are configured to block moisture and oxygen. The organic layer is configured to buffer stress from inorganic layers to enhance flexibility of an OLED panel. A preparation process of the first inorganic layer is one or at least a combination of plasma enhanced chemical vapor deposition (PECVD), atomic layer deposition (ALD), and pulse laser deposition (PLD). The first inorganic layer is made of at least one of silicon nitride, silicon oxide, silicon carbide, silicon carbonitride, aluminum oxide, and the like. The organic layer is made of at least one of an epoxy resin, a silicon-based polymer, and polymethyl methacrylate. The second inorganic layer may be made of a material the same as that of the first inorganic layer.

[0023] Please further refer to FIG. **2**. The touch-control layer **40** is disposed on the encapsulation layer **30** and includes a plurality of first electrodes **411** and a plurality of second electrodes **412** staggered with respect to and insulated from the first electrodes **411**, wherein a process temperature of the touch-control layer **40** is less than 90 degrees. Since a heat resistant temperature of an OLED layer material is generally low, damage to the organic light-emitting display layer can be prevented when the touch-control layer **40** is formed through a low temperature process, wherein the touch-control layer **40** may be formed by a low temperature resistant material, for example, a heat resistance temperature of the material of the touch-control layer **40** is less than 90 degrees. Since the touch-control layer is made of a material compatible with the low temperature process, sensitivity of the touch-control layer can be improved, thereby improving accuracy and sensitivity of a touch function.

[0024] Adjacent two of the first electrodes **411** are electrically connected, and adjacent two of the second electrodes **412** are connected by a connecting bridge **431**. In one embodiment, the first electrodes **411** are transmitting electrodes, and the second electrodes **412** are receiving electrodes.

[0025] Please further refer to FIG. **3**. The touch-control layer **40** has a cross-sectional structure including a first electrically conductive layer **41**, an insulating layer **42**, and a second electrically conductive layer **43**, and further including a planarization layer **44**.

[0026] The first electrically conductive layer **41** includes the first electrodes **411** and the second electrodes **412**. That is, the first electrodes **411** and the second electrodes **412** are disposed on the first electrically conductive layer **41**, wherein the first electrically conductive layer **41** is made of ITO.

[0027] The insulating layer **42** is disposed on the first electrically conductive layer **41** and is configured to separate the first electrically conductive layer **41** and the second electrically conductive layer **43**.

[0028] The second electrically conductive layer **43** includes a plurality of connecting bridges **431**. That is, the connecting bridges **431** are disposed on the second electrically conductive layer **43**. In one embodiment, the second electrically conductive layer **43** is disposed on the first electrically conductive layer **42**.

[0029] The planarization layer **44** is disposed above a top of the touch-control layer **40**. For example, the planarization **44** is disposed on the second electrically conductive layer **43** and is made of an organic material.

[0030] In can be understood that in another embodiment, the second electrically conductive layer **43** is disposed below the first electrically conductive layer **41**. In this manner, the planarization layer **44** is disposed on the first electrically conductive layer **41**.

[0031] Please further refer to FIG. **4**. The color filter layer **50** is disposed on the touch-control layer **40** and includes a black matrix **51** and a plurality of color filter resists **52**. The black matrix **51** surrounds peripheries of the color filter resists **52**, wherein the color filter resists **52** include a red color filter, a green color filter, and a blue color filter. A process temperature of the color filter layer **50** is less than 90 degrees

[0032] Please refer back to FIG. **1**. The protective layer **60** is disposed on the color filter layer **50**. In order to improve a lifespan and display performance of a display panel, the protective layer **60** is made of an organic insulating material. In order to prevent damage to the organic light-emitting display layer, a process temperature of the protective layer **60** is less than 90 degrees. That is, the protective layer **60** is fabricated by a low temperature process.

[0033] The glass cover **70** is disposed on the protective layer **60**.

[0034] Since the touch-control layer is directly disposed between the organic light-emitting display layer and the color filter layer, no glue is required to bond the organic light-emitting display layer and the color filter layer, thereby reducing an overall thickness of the display panel. Therefore, a thickness of the touch display panel at the end is reduced to at least one-half of a conventional touch display panel. In addition, since the touch-control layer is directly disposed between the organic light-emitting display layer and the color filter layer, manufacturing processes can be simplified, thereby reducing production cost. Furthermore, since the touch-control layer and the color filter layer are formed by using a low temperature process, damage to the organic light-emitting layer can be avoided, so that a lifespan of the display panel is extended.

[0035] The present invention further provides an electronic device, including the above-mentioned touch display panel. The electronic device may be a device such as a mobile phone or a tablet computer.

[0036] A touch display panel and an electronic device of the present invention include an organic light-emitting display layer, an encapsulation layer, a touch-control layer, and a color filter layer all sequentially disposed on a base substrate. Since the touch-control layer is directly disposed between the organic light-emitting display layer and the color filter layer, no glue is required for lamination, thereby reducing an overall thickness of the display panel.

[0037] Accordingly, although the present invention has been disclosed as a preferred embodiment, it is not intended to limit the present invention. Those skilled in the art without departing from the spirit and scope of the present invention may make various changes or modifications, and thus the scope of the present invention should be after the appended claims and their equivalents.

1. A touch display panel, comprising:

a base substrate;

an organic light-emitting display layer disposed on the base substrate;

an encapsulation layer disposed on the organic light-emitting display layer;

a touch-control layer disposed on the encapsulation layer and comprising a plurality of first electrodes and a plurality of second electrodes staggered with respect to the first electrodes and insulated from the first electrodes; and

a color filter layer disposed on the touch-control layer and comprising a black matrix and a plurality of color filter resists.

2. The touch display panel of claim **1**, wherein touch display panel further comprises a protective layer disposed on the color filter layer, and a glass cover disposed on the protective layer.

3. The touch display panel of claim **2**, wherein the protective layer is made of an organic insulating material.

4. The touch display panel of claim **2**, wherein a process temperature of the protective layer is less than 90 degrees.

5. The touch display panel of claim **1**, wherein process temperatures of the touch-control layer and the color filter layer are both less than 90 degrees.

6. The touch display panel of claim **1**, wherein the touch-control layer has a cross-sectional structure comprising:

a first electrically conductive layer comprising the plurality of first electrodes and the plurality of second electrodes;

an insulating layer disposed on the first electrically conductive layer; and

a second electrically conductive layer comprising a plurality of connecting bridges.

7. The touch display panel of claim **6**, wherein the cross-sectional structure of the touch-control layer further comprises a planarization layer disposed above a top of the touch-control layer.

8. The touch display panel of claim **7**, wherein the planarization layer is made of an organic material.

9. The touch display panel of claim **6**, wherein the second electrically conductive layer is disposed on the first electrically conductive layer.

10. The touch display panel of claim **1**, wherein the touch-control layer is made of a low temperature resistant material.

11. An electronic device, comprising a touch display panel comprising:

a base substrate;

an organic light-emitting display layer disposed on the base substrate;

an encapsulation layer disposed on the organic light-emitting display layer;

a touch-control layer disposed on the encapsulation layer and comprising a plurality of first electrodes and a plurality of second electrodes staggered with respect to the first electrodes and insulated from the first electrodes; and

a color filter layer disposed on the touch-control layer and comprising a black matrix and a plurality of color filter resists.

12. The electronic device of claim **11**, wherein touch display panel further comprises a protective layer disposed on the color filter layer, and a glass cover disposed on the protective layer.

13. The electronic device of claim **12**, wherein the protective layer is made of an organic insulating material.

14. The electronic device of claim **12**, wherein a process temperature of the protective layer is less than 90 degrees.

15. The electronic device of claim **11**, wherein process temperatures of the touch-control layer and the color filter layer are both less than 90 degrees.

16. The electronic device of claim **11**, wherein the touch-control layer has a cross-sectional structure comprising:

a first electrically conductive layer comprising the plurality of first electrodes and the plurality of second electrodes;

an insulating layer disposed on the first electrically conductive layer; and

a second electrically conductive layer comprising a plurality of connecting bridges.

17. The electronic device of claim **16**, wherein the cross-sectional structure of the touch-control layer further comprises a planarization layer disposed above a top of the touch-control layer.

18. The electronic device of claim **17**, wherein the planarization layer is made of an organic material.

19. The electronic device of claim **16**, wherein the second electrically conductive layer is disposed on the first electrically conductive layer.

20. The electronic device of claim **11**, wherein the touch-control layer is made of a low temperature resistant material.

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