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(54) **IN-CELL TOUCH PANEL**

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G06F 3/041	(2006.01)

(52) **U.S. Cl.**

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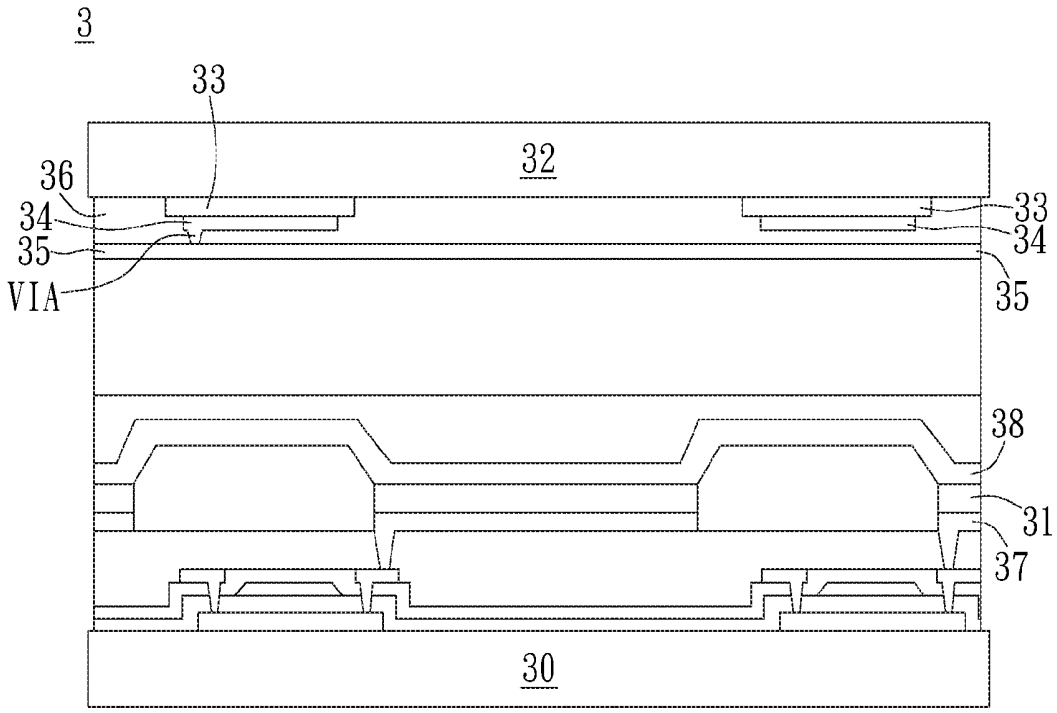
(57) **ABSTRACT**

An in-cell touch panel is disclosed. The in-cell touch panel includes a plurality of pixels. A laminated structure of each pixel includes a substrate, an OLED layer, an encapsulation layer, a light-blocking layer, a first conductive layer and a second conductive layer. The OLED layer is disposed above the substrate. The encapsulation layer is disposed above the OLED layer opposite to the substrate. The first conductive layer is disposed under the light-blocking layer. The second conductive layer is disposed under the encapsulation layer.



1

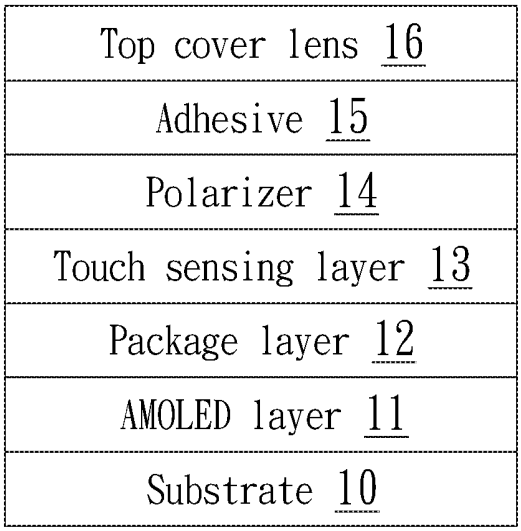


FIG. 1 (PRIOR ART)

2

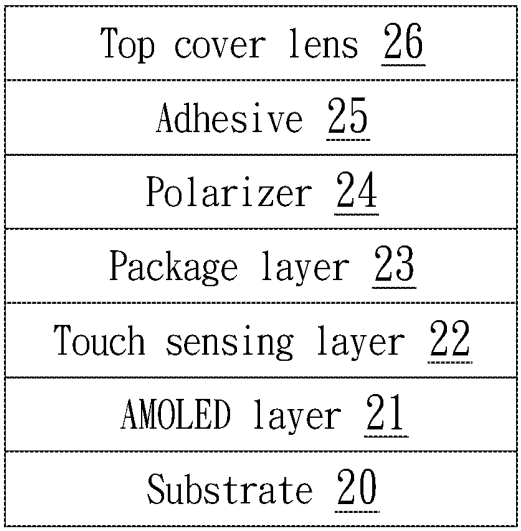
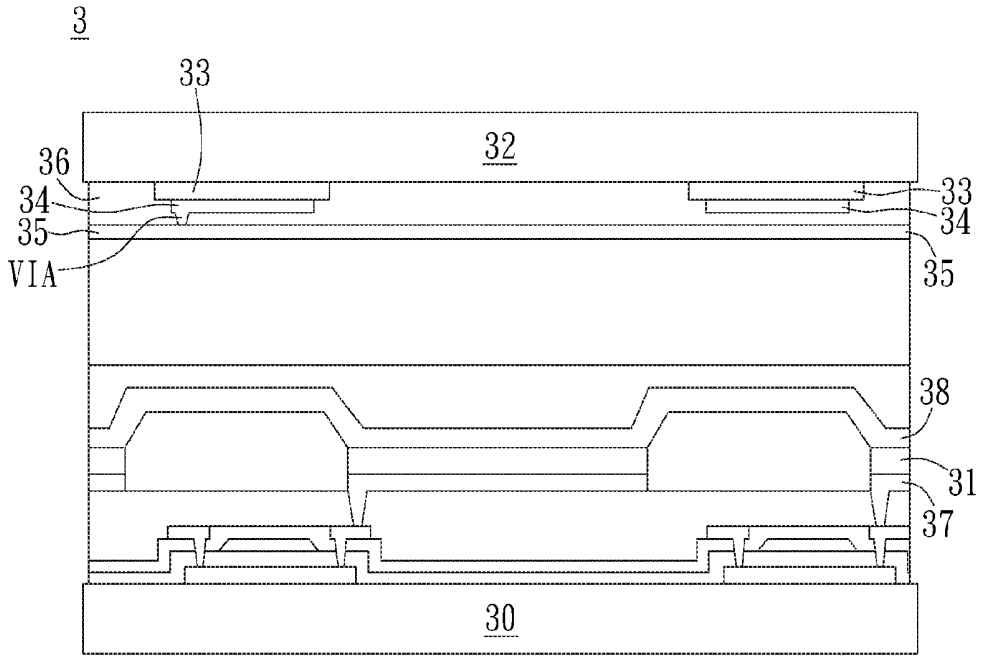


FIG. 2


3
33
32
36
34
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VIA
33
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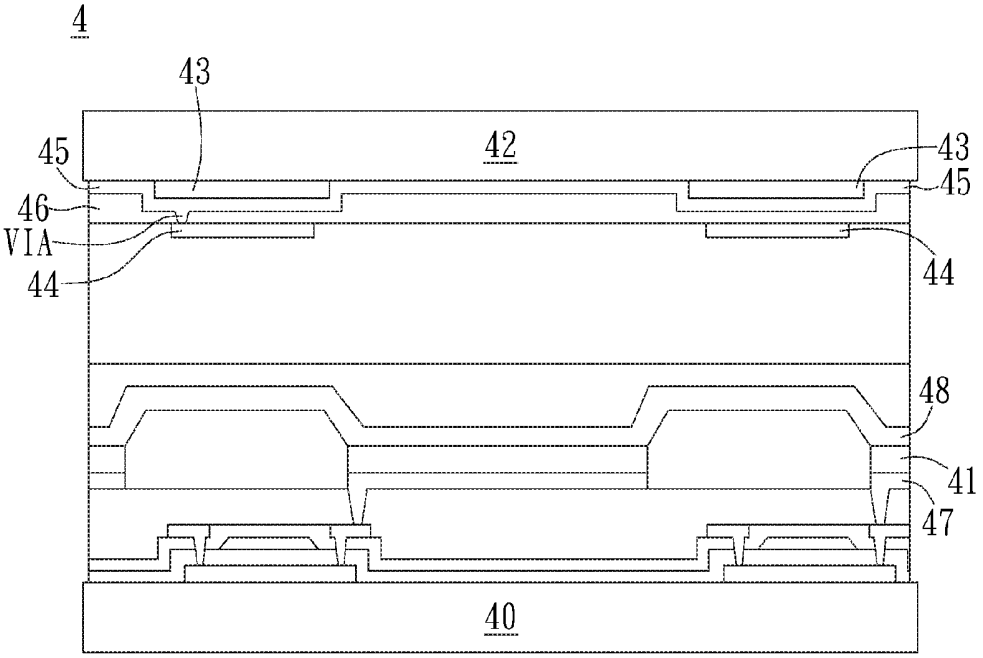
38
31
37
30

FIG. 3


4
43
42
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46
VIA
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40

FIG. 4

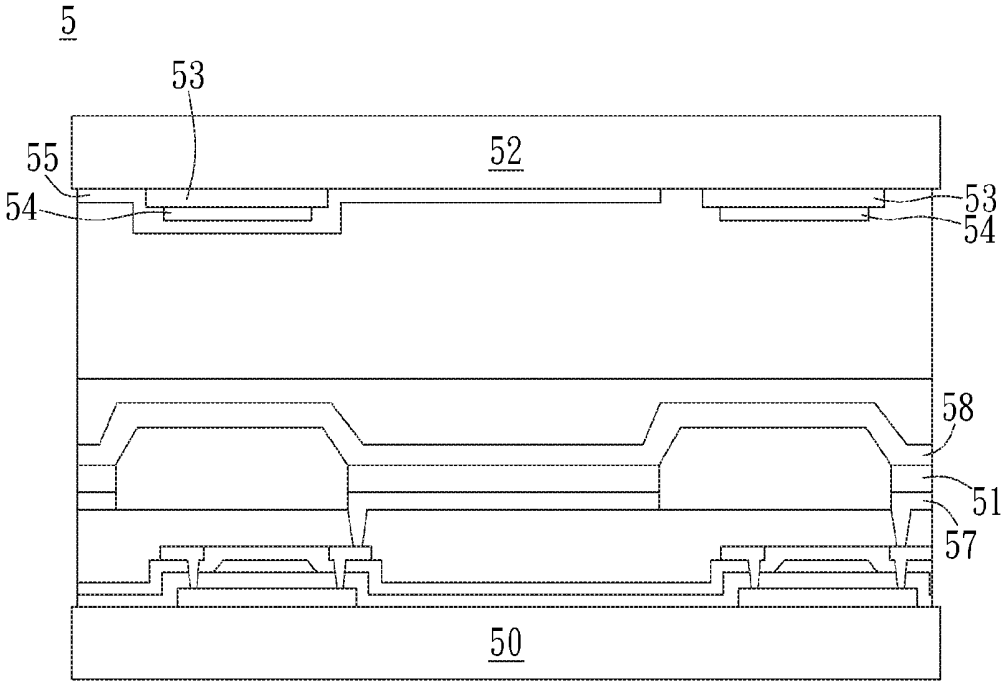

FIG. 5

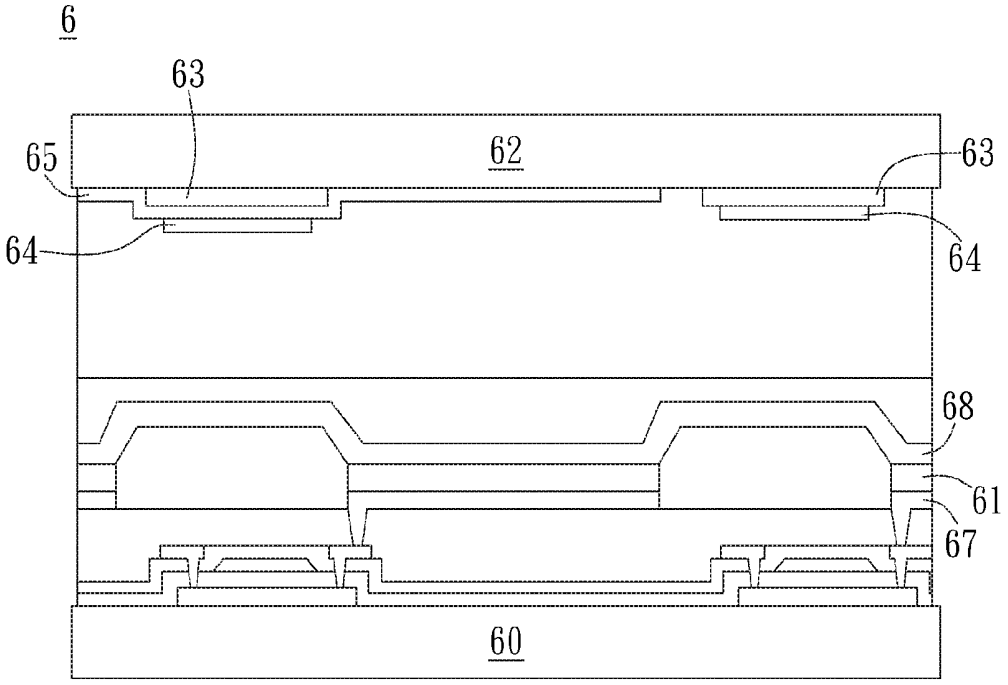

FIG. 6

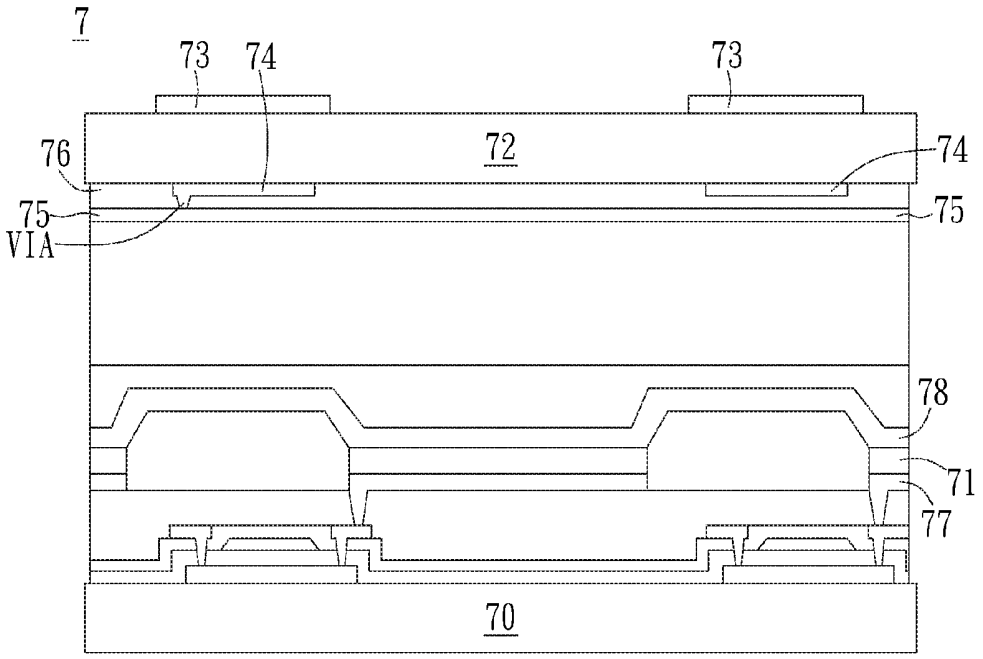

FIG. 7

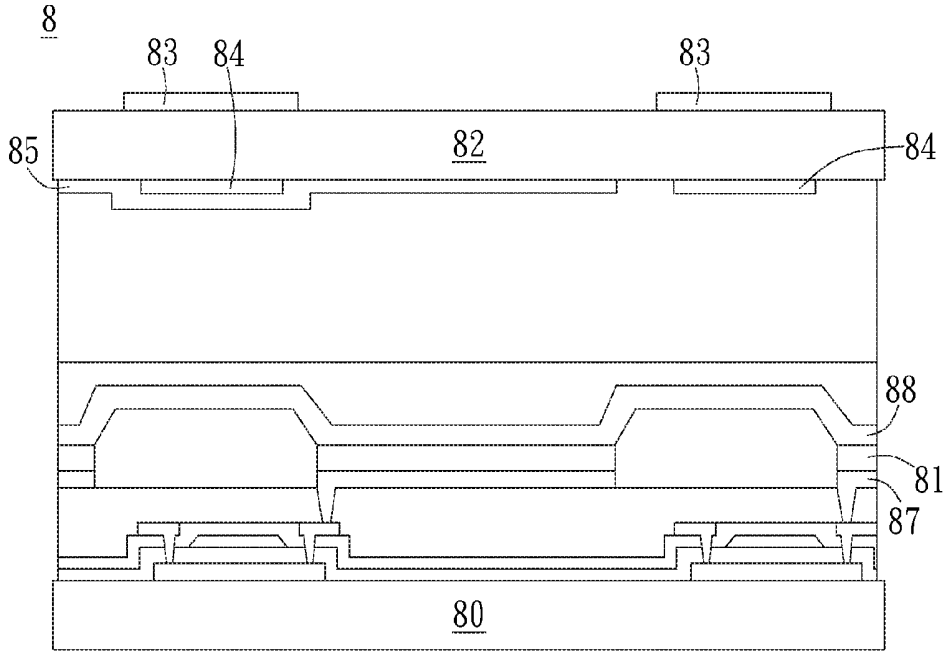

FIG. 8

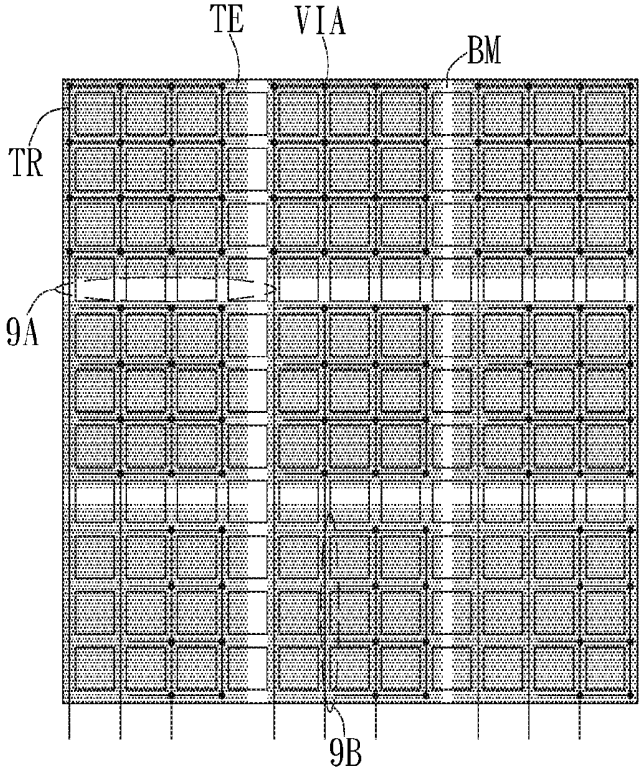

FIG. 9

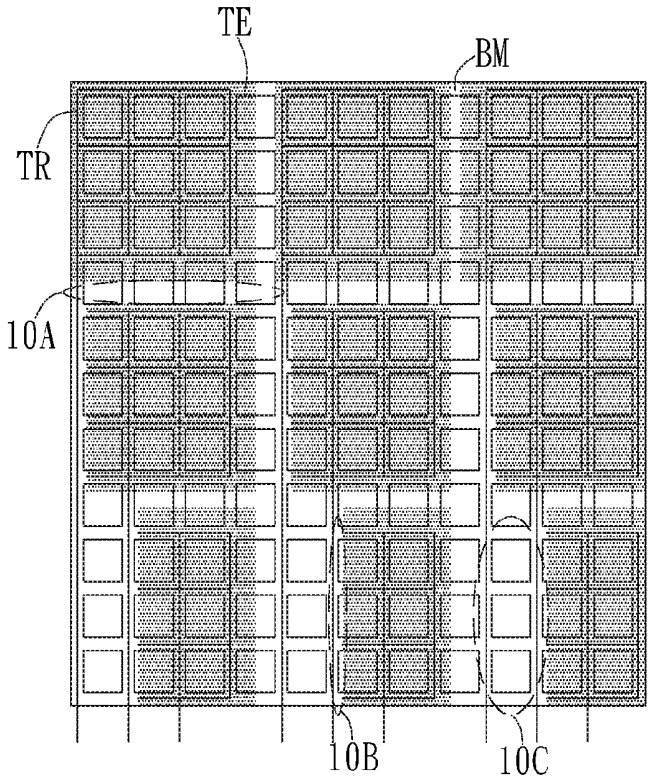

FIG. 10

IN-CELL TOUCH PANEL

BACKGROUND OF THE INVENTION

[0001] Field of the Invention

[0002] This invention relates to a touch panel, especially to an in-cell touch panel.

[0003] Description of the Related Art

[0004] In general, capacitive touch panels using active matrix organic light emitting diode (AMOLED) display technology can be divided into different types based on their different laminated structures, such as in-cell AMOLED capacitive touch panels and on-cell AMOLED capacitive touch panels.

[0005] Please refer to FIG. **1** and FIG. **2**. FIG. **1** and FIG. **2** illuminate schematic diagrams of the laminated structures of the on-cell AMOLED capacitive touch panel and the in-cell AMOLED capacitive touch panel respectively. As shown in FIG. **1**, the laminated structure **1** of the on-cell AMOLED capacitive touch panel includes a substrate **10**, an AMOLED layer **11**, an encapsulation layer **12**, a touch sensing layer **13**, a polarizer **14**, an adhesive **15** and a top cover lens **16** from the bottom up. As shown in FIG. **2**, the laminated structure **2** of the in-cell AMOLED capacitive touch panel includes a substrate **20**, an AMOLED layer **21**, a touch sensing layer **22**, an encapsulation layer **23**, a polarizer **24**, an adhesive **25** and a top cover lens **26** from the bottom up.

[0006] After comparing FIG. **1** with FIG. **2**, it can be found that the touch sensing layer **22** of the in-cell AMOLED capacitive touch panel is disposed under the encapsulation layer **23**, namely the touch sensing layer **22** is disposed in the AMOLED display module; the touch sensing layer **13** of the on-cell AMOLED capacitive touch panel is disposed above the encapsulation layer **12**, namely the touch sensing layer **13** is disposed out of the AMOLED display module. Compared to the conventional one glass solution (OGS) AMOLED capacitive touch panel and the on-cell AMOLED capacitive touch panel, the in-cell AMOLED capacitive touch panel can achieve the thinnest AMOLED touch panel design and it can be widely used in portable electronic products such as cell phones, tablet PCs and notebook PCs.

[0007] Therefore, the invention provides an in-cell touch panel having novel layout to simplify the design of circuit traces and reduce the effects of resistance and parasitic capacitance to enhance the entire performance of the in-cell touch panel and solve the above-mentioned problems.

SUMMARY OF THE INVENTION

[0008] An embodiment of the invention is an in-cell touch panel. In this embodiment, the in-cell touch panel includes a plurality of pixels. A laminated structure of each pixel includes a substrate, an OLED layer, an encapsulation layer, a light-blocking layer, a first conductive layer and a second conductive layer. The OLED layer is disposed above the substrate. The encapsulation layer is disposed above the OLED layer opposite to the substrate. The first conductive layer is disposed under the light-blocking layer. The second conductive layer is disposed under the encapsulation layer.

[0009] In an embodiment, the in-cell touch panel is an in-cell self-capacitive touch panel or an in-cell mutual-capacitive touch panel.

[0010] In an embodiment, the second conductive layer is formed after the first conductive layer.

[0011] In an embodiment, the second conductive layer is formed before the first conductive layer.

[0012] In an embodiment, an insulating layer is formed between the first conductive layer and the second conductive layer.

[0013] In an embodiment, the first conductive layer and the second conductive layer are electrically connected through a via formed in the insulating layer.

[0014] In an embodiment, the first conductive layer and the second conductive layer are electrically connected by direct contact without any insulating layer formed between the first conductive layer and the second conductive layer.

[0015] In an embodiment, the first conductive layer and the second conductive layer are not electrically connected.

[0016] In an embodiment, the light-blocking layer is formed by opaque material and the light-blocking layer is disposed above a non-luminous area of the OLED layer.

[0017] In an embodiment, the second conductive layer is formed by transparent conductive material and the second conductive layer is used to form touch sensing electrodes of the in-cell touch panel.

[0018] In an embodiment, the first conductive layer is electrically connected with the second conductive layer and used as traces of the touch sensing electrodes of the in-cell touch panel.

[0019] In an embodiment, the traces of different touch sensing electrodes of the in-cell touch panel are disconnected.

[0020] In an embodiment, the second conductive layer forming different parts of different touch sensing electrodes of the in-cell touch panel are disconnected.

[0021] In an embodiment, one of the touch sensing electrodes of the in-cell touch panel is electrically connected to a plurality of traces respectively to reduce a resistance of the touch sensing electrode.

[0022] In an embodiment, one touch sensing electrode of the in-cell touch panel and a trace of another touch sensing electrode of the in-cell touch panel are not overlapped.

[0023] Compared with the prior arts, the invention has the following advantages and effects:

[0024] (1) The designs of touch electrodes and their traces are simple.

[0025] (2) The optical effects on the AMOLED touch panel can be effectively reduced by the novel layout method.

[0026] (3) The RC loading of the touch electrodes can be effectively reduced.

[0027] (4) The module thickness of the AMOLED touch panel can be effectively reduced.

[0028] The advantage and spirit of the invention may be understood by the following detailed descriptions together with the appended drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029] So that the manner in which the above recited features of the present invention can be understood in detail, a more particular description of the invention, briefly summarized above, may be had by reference to embodiments, some of which are illustrated in the appended drawings. It is to be noted, however, that the appended drawings illustrate only typical embodiments of this invention and are therefore

not to be considered limiting of its scope, for the invention may admit to other equally effective embodiments.

[0030] FIG. **1** and FIG. **2** illuminate schematic diagrams of the laminated structures of the on-cell AMOLED capacitive touch panel and the in-cell AMOLED capacitive touch panel respectively.

[0031] FIG. **3** illuminates the laminated structure of the pixel of the in-cell touch panel in the first embodiment of the invention.

[0032] FIG. **4** illuminates the laminated structure of the pixel of the in-cell touch panel in the second embodiment of the invention.

[0033] FIG. **5** illuminates the laminated structure of the pixel of the in-cell touch panel in the third embodiment of the invention.

[0034] FIG. **6** illuminates the laminated structure of the pixel of the in-cell touch panel in the fourth embodiment of the invention.

[0035] FIG. **7** and FIG. **8** illuminate different embodiments of the light-blocking layer disposed above the encapsulation layer respectively.

[0036] FIG. **9** and FIG. **10** illuminate different layout methods of the sensing electrodes and their traces of the in-cell touch panel of the invention respectively.

DETAILED DESCRIPTION

[0037] The invention discloses an in-cell touch panel. In practical applications, the in-cell touch panel of the invention can be an in-cell self-capacitive touch panel or an on-cell self-capacitive touch panel without any specific limitations. The in-cell touch panel includes a plurality of pixels. The actual design of the in-cell touch panel can be designed in different ways based on different panels and characteristics.

[0038] At first, please refer to FIG. **3**. FIG. **3** illuminates the laminated structure of the pixel of the in-cell touch panel in the first embodiment of the invention.

[0039] As shown in FIG. **3**, the laminated structure **3** includes a substrate **30**, an OLED layer **31**, an encapsulation layer **32**, a light-blocking layer **33**, a first conductive layer **34**, a second conductive layer **35**, an insulating layer **36**, an anode layer **37** and a cathode layer **38**. The OLED layer **31** is disposed above the substrate **30**. The encapsulation layer **32** is disposed above the OLED layer **31** opposite to the substrate **30**. The first conductive layer **34** is disposed under the light-blocking layer **33**. The second conductive layer **35** is disposed under the encapsulation layer **32**. The anode layer **37** is disposed under the OLED layer **31** and the cathode layer **38** is disposed above the OLED layer **31** respectively.

[0040] It should be noticed that the second conductive layer **35** in this embodiment is formed before the first conductive layer **34**, and there is an insulating layer **36** formed between the first conductive layer **34** and the second conductive layer **35**. The light-blocking layer **33** is formed by opaque material and the light-blocking layer **33** is disposed above a non-luminous area (e.g., gate lines or signal lines) of the OLED layer **31**. The second conductive layer **35** is formed by transparent conductive material and the second conductive layer **35** is used to form touch sensing electrodes of the in-cell touch panel.

[0041] From FIG. **3**, it can be found that the first conductive layer **34** and the second conductive layer **35** can be electrically connected through a via VIA formed in the insulating layer **36**, or the first conductive layer **34** and the second conductive layer **35** are not electrically connected without specific limitations. The first conductive layer **34** can be formed by transparent or opaque conductive material. When the first conductive layer **34** disposed under the light-blocking layer **33** is electrically connected with the second conductive layer **35**, the first conductive layer **34** can be used as traces of the touch sensing electrodes of the in-cell touch panel, but not limited to this.

[0042] Then, please refer to FIG. **4**. FIG. **4** illuminates the laminated structure of the pixel of the in-cell touch panel in the second embodiment of the invention.

[0043] As shown in FIG. **4**, the laminated structure **4** includes a substrate **40**, an OLED layer **41**, an encapsulation layer **42**, a light-blocking layer **43**, a first conductive layer **44**, a second conductive layer **45**, an insulating layer **46**, an anode layer **47** and a cathode layer **48**. The OLED layer **41** is disposed above the substrate **40**. The encapsulation layer **42** is disposed above the OLED layer **41** opposite to the substrate **40**. The first conductive layer **44** is disposed under the light-blocking layer **43**. The second conductive layer **45** is disposed under the encapsulation layer **42**. The anode layer **47** is disposed under the OLED layer **41** and the cathode layer **48** is disposed above the OLED layer **41** respectively.

[0044] It should be noticed that the second conductive layer **45** in this embodiment is formed after the first conductive layer **44**, and there is an insulating layer **46** formed between the first conductive layer **44** and the second conductive layer **45**. The light-blocking layer **43** is formed by opaque material and the light-blocking layer **43** is disposed above a non-luminous area of the OLED layer **41**. The second conductive layer **45** is formed by transparent conductive material and the second conductive layer **45** is used to form touch sensing electrodes of the in-cell touch panel.

[0045] From FIG. **4**, it can be found that the first conductive layer **44** and the second conductive layer **45** can be electrically connected through a via VIA formed in the insulating layer **46**, or the first conductive layer **44** and the second conductive layer **45** are not electrically connected without specific limitations. The first conductive layer **44** can be formed by transparent or opaque conductive material. When the first conductive layer **44** disposed under the light-blocking layer **43** is electrically connected with the second conductive layer **45**, the first conductive layer **44** can be used as traces of the touch sensing electrodes of the in-cell touch panel, but not limited to this.

[0046] Then, please refer to FIG. **5**. FIG. **5** illuminates the laminated structure of the pixel of the in-cell touch panel in the third embodiment of the invention.

[0047] As shown in FIG. **5**, the laminated structure **5** includes a substrate **50**, an OLED layer **51**, an encapsulation layer **52**, a light-blocking layer **53**, a first conductive layer **54**, a second conductive layer **55**, an anode layer **57** and a cathode layer **58**. The OLED layer **51** is disposed above the substrate **50**. The encapsulation layer **52** is disposed above the OLED layer **51** opposite to the substrate **50**. The first conductive layer **54** is disposed under the light-blocking layer **53**. The second conductive layer **55** is disposed under the encapsulation layer **52**. The anode layer **57** is disposed under the OLED layer **51** and the cathode layer **58** is disposed above the OLED layer **51** respectively.

[0048] It should be noticed that the second conductive layer **55** in this embodiment is formed before the first

conductive layer **54**, and there is no insulating layer formed between the first conductive layer **54** and the second conductive layer **55**. From FIG. **5**, it can be found that the first conductive layer **54** and the second conductive layer **55** can be electrically connected in a direct contact way or the first conductive layer **54** and the second conductive layer **55** are not electrically connected without any specific limitations. The light-blocking layer **53** is formed by opaque material and the light-blocking layer **53** is disposed above a non-luminous area of the OLED layer **51**. The second conductive layer **55** is formed by transparent conductive material and the second conductive layer **55** is used to form touch sensing electrodes of the in-cell touch panel. The first conductive layer **54** can be formed by transparent or opaque conductive material. When the first conductive layer **54** disposed under the light-blocking layer **53** is electrically connected with the second conductive layer **55**, the first conductive layer **54** can be used as traces of the touch sensing electrodes of the in-cell touch panel, but not limited to this.

[0049] Afterwards, please refer to FIG. **6**. FIG. **6** illuminates the laminated structure of the pixel of the in-cell touch panel in the fourth embodiment of the invention.

[0050] As shown in FIG. **6**, the laminated structure **6** includes a substrate **60**, an OLED layer **61**, an encapsulation layer **62**, a light-blocking layer **63**, a first conductive layer **64**, a second conductive layer **65**, an anode layer **67** and a cathode layer **68**. The OLED layer **61** is disposed above the substrate **60**. The encapsulation layer **62** is disposed above the OLED layer **61** opposite to the substrate **60**. The first conductive layer **64** is disposed under the light-blocking layer **63**. The second conductive layer **65** is disposed under the encapsulation layer **62**. The anode layer **67** is disposed under the OLED layer **61** and the cathode layer **68** is disposed above the OLED layer **61** respectively.

[0051] It should be noticed that the second conductive layer **65** in this embodiment is formed after the first conductive layer **64**, and there is no insulating layer formed between the first conductive layer **64** and the second conductive layer **65**. From FIG. **6**, it can be found that the first conductive layer **64** and the second conductive layer **65** can be electrically connected in a direct contact way or the first conductive layer **64** and the second conductive layer **65** are not electrically connected without any specific limitations. The light-blocking layer **63** is formed by opaque material and the light-blocking layer **63** is disposed above a non-luminous area of the OLED layer **61**. The second conductive layer **65** is formed by transparent conductive material and the second conductive layer **65** is used to form touch sensing electrodes of the in-cell touch panel. The first conductive layer **64** can be formed by transparent or opaque conductive material. When the first conductive layer **64** disposed under the light-blocking layer **63** is electrically connected with the second conductive layer **65**, the first conductive layer **64** can be used as traces of the touch sensing electrodes of the in-cell touch panel, but not limited to this.

[0052] In addition, it should be noted that the light-blocking layers **33**, **43**, **53** and **63** are all disposed under the encapsulation layers **32**, **42**, **52** and **62** in the first embodiment through the fourth embodiment shown in FIG. **3** through FIG. **6**. However, in practical applications, as shown in FIG. **7** and FIG. **8**, the light-blocking layers **73** and **83** can be disposed above the encapsulation layers **72** and **82** respectively to effectively shelter the first conductive layers **74** and **84** disposed under the encapsulation layers **72** and **82**.

[0053] Except the above-mentioned embodiments, the invention can be practiced in the in-cell touch panels having the laminated structure including white-light OLED and color filtering layer or other laminated structures without any specific limitations.

[0054] Then, the following two embodiments will be used to explain different sensing electrode and trace layouts of the in-cell touch panel.

[0055] In an embodiment, as shown in FIG. **9**, the light-blocking layer BM formed by opaque material is disposed on the encapsulation layer and overlapped above the non-luminous area (e.g., gate lines or signal lines) of the OLED layer. The first conductive layer sheltered by the light-blocking layer BM forms the traces TR of the touch sensing electrodes and the traces TR of different touch sensing electrodes of the in-cell touch panel are disconnected (as shown in the region **9**B in FIG. **9**). The touch sensing electrode TE formed by the transparent second conductive layer (e.g., ITO) can be electrically connected with the touch sensing electrode traces TR through via VIA. And, the resistance can be reduced by electrically connecting with a plurality of touch sensing electrode traces TR through via VIA respectively within the touch sensing electrodes TE.

[0056] As shown in the region **9**A in FIG. **9**, the second conductive layer forming different parts of different touch sensing electrodes of the in-cell touch panel can be disconnected and the traces TR of different touch sensing electrodes of the in-cell touch panel can be also disconnected.

[0057] It should be noticed that the panel layout shown in FIG. **9** can correspond to the laminated structures **3** and **4** of FIG. **3** and FIG. **4**, but not limited to this.

[0058] In another embodiment, as shown in FIG. **10**, the light-blocking layer BM formed by opaque material is disposed on the encapsulation layer and overlapped above the non-luminous area (e.g., gate lines or signal lines) of the OLED layer. The first conductive layer sheltered by the light-blocking layer BM forms the traces TR of the touch sensing electrodes and the traces TR of different touch sensing electrodes of the in-cell touch panel are disconnected (as shown in the region **10**B in FIG. **10**). The touch sensing electrode TE formed by the transparent second conductive layer (e.g., ITO) can be electrically connected with the touch sensing electrode traces TR in a direct contact way. And, the resistance can be reduced by disposing a plurality of touch sensing electrode traces TR within the touch sensing electrodes TE.

[0059] As shown in the region **10**A in FIG. **10**, the second conductive layer forming different parts of different touch sensing electrodes TE of the in-cell touch panel can be disconnected and the traces TR of different touch sensing electrodes of the in-cell touch panel can be also disconnected. The traces TR of different touch sensing electrodes of the in-cell touch panel will not be overlapped.

[0060] As shown in the region **10**C in FIG. **10**, the second conductive layer (e.g., ITO) forming a touch sensing electrode TE and the trace TR of another touch sensing electrode TE will not be overlapped. It should be noticed that the panel layout shown in FIG. **10** can correspond to the laminated structures **5** and **6** of FIG. **5** and FIG. **6**, but not limited to this.

[0061] Compared with the prior arts, the invention has the following advantages and effects:

[0062] (1) The designs of touch electrodes and their traces are simple.

[0063] (2) The optical effects on the AMOLED touch panel can be effectively reduced by the novel layout method.

[0064] (3) The RC loading of the touch electrodes can be effectively reduced.

[0065] (4) The module thickness of the AMOLED touch panel can be effectively reduced.

[0066] With the example and explanations above, the features and spirits of the invention will be hopefully well described. Those skilled in the art will readily observe that numerous modifications and alterations of the device may be made while retaining the teaching of the invention. Accordingly, the above disclosure should be construed as limited only by the metes and bounds of the appended claims.

1. An in-cell touch panel, comprising:

a plurality of pixels, a laminated structure of each pixel comprising:

a substrate;

an OLED layer disposed above the substrate;

an encapsulation layer disposed above the OLED layer opposite to the substrate;

a light-blocking layer;

a first conductive layer disposed under the light-blocking layer; and

a second conductive layer disposed under the encapsulation layer.

2. The in-cell touch panel of claim **1**, wherein the in-cell touch panel is an in-cell self-capacitive touch panel or an in-cell mutual-capacitive touch panel.

3. The in-cell touch panel of claim **1**, wherein the second conductive layer is formed after the first conductive layer.

4. The in-cell touch panel of claim **1**, wherein the second conductive layer is formed before the first conductive layer.

5. The in-cell touch panel of claim **1**, wherein an insulating layer is formed between the first conductive layer and the second conductive layer.

6. The in-cell touch panel of claim **5**, wherein the first conductive layer and the second conductive layer are electrically connected through a via formed in the insulating layer.

7. The in-cell touch panel of claim **1**, wherein the first conductive layer and the second conductive layer are electrically connected by direct contact without any insulating layer formed between the first conductive layer and the second conductive layer.

8. The in-cell touch panel of claim **1**, wherein the first conductive layer and the second conductive layer are not electrically connected.

9. The in-cell touch panel of claim **1**, wherein the light-blocking layer is formed by opaque material and the light-blocking layer is disposed above a non-luminous area of the OLED layer.

10. The in-cell touch panel of claim **1**, wherein the second conductive layer is formed by transparent conductive material and the second conductive layer is used to form touch sensing electrodes of the in-cell touch panel.

11. The in-cell touch panel of claim **10**, wherein the first conductive layer is electrically connected with the second conductive layer and used as traces of the touch sensing electrodes of the in-cell touch panel.

12. The in-cell touch panel of claim **11**, wherein the traces of different touch sensing electrodes of the in-cell touch panel are disconnected.

13. The in-cell touch panel of claim **10**, wherein the second conductive layer forming different parts of different touch sensing electrodes of the in-cell touch panel are disconnected.

14. The in-cell touch panel of claim **10**, wherein one of the touch sensing electrodes of the in-cell touch panel is electrically connected to a plurality of traces respectively to reduce a resistance of the touch sensing electrode.

15. The in-cell touch panel of claim **10**, wherein one touch sensing electrode of the in-cell touch panel and a trace of another touch sensing electrode of the in-cell touch panel are not overlapped.

* * * * *

专利名称(译)	内嵌式触摸屏		
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申请号	US15/170640	申请日	2016-06-01
[标]申请(专利权)人(译)	瑞鼎科技股份有限公司		
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当前申请(专利权)人(译)	RAYDIUM半导体公司		
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发明人	CHIANG, CHANG-CHING LIN, YI-YING LEE, KUN-PEI		
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外部链接	Espacenet USPTO		

摘要(译)

本发明公开了一种内嵌式触摸面板。内嵌式触摸面板包括多个像素。每个像素的层叠结构包括基板，OLED层，封装层，遮光层，第一导电层和第二导电层。OLED层设置在衬底上方。封装层设置在OLED层的与衬底相对的上方。第一导电层设置在光阻挡层下方。第二导电层设置在封装层下方。