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(54) FINGERPRINT SENSING PIXEL WITH A LARGER APERTURE

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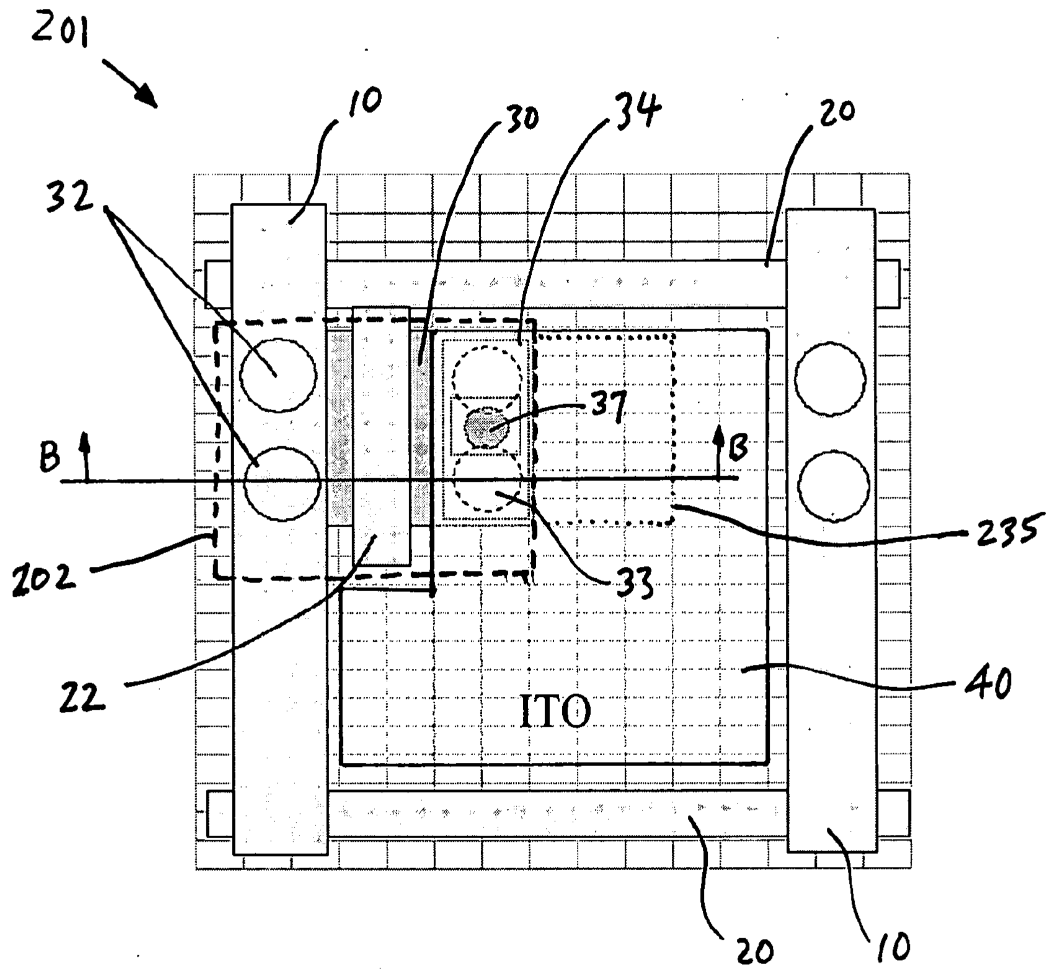
(57) **ABSTRACT**

In a thin film transistor-based resistive-type fingerprinting touch screen panel, the size of the contact metal layer connecting the drain electrode of the TFT and the ITO sensing electrode in each of the pixel regions of the touch screen panel is reduced, thus increasing the aperture of the pixel region. Having a greater aperture, more of the back-lighting from the LCD display panel usually positioned behind the touch screen panel is transmitted through the touch screen panel, making that region brighter.



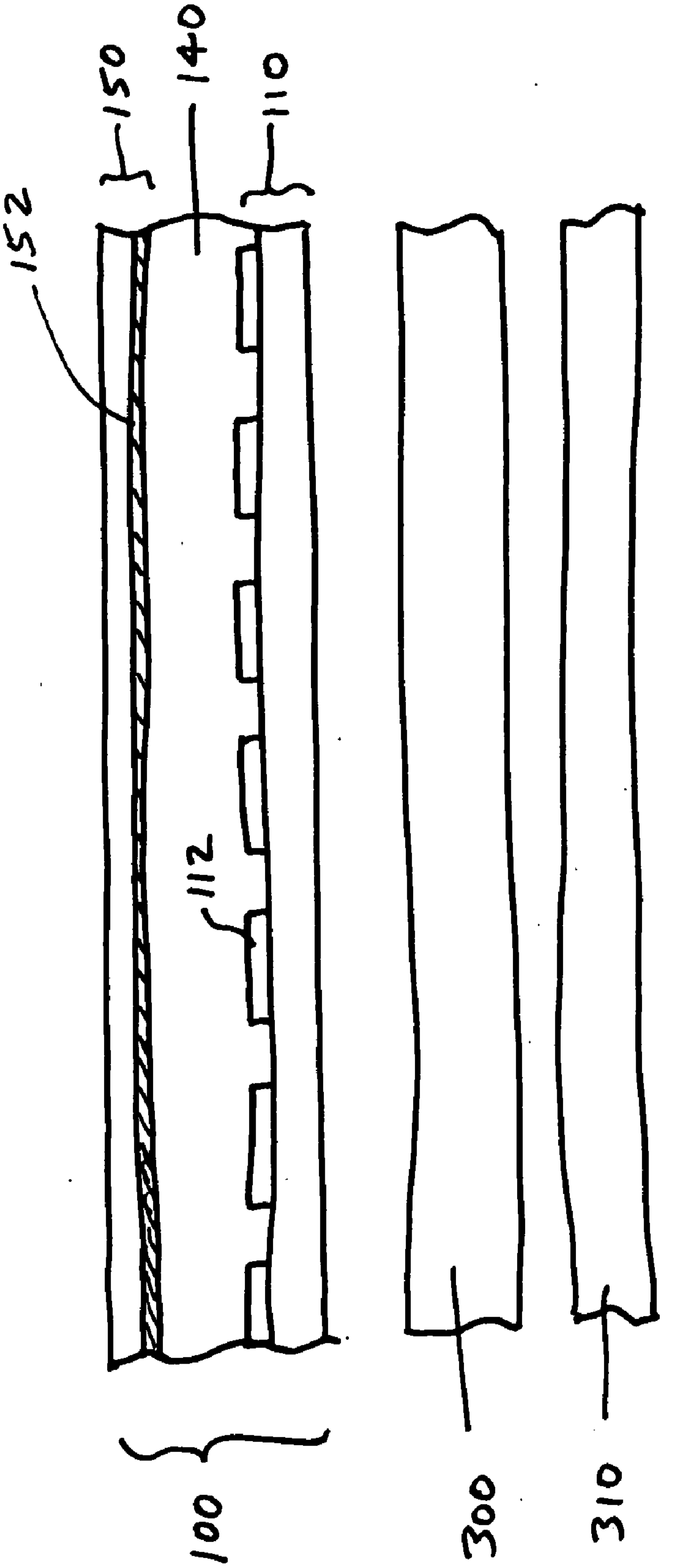


Fig. 1A

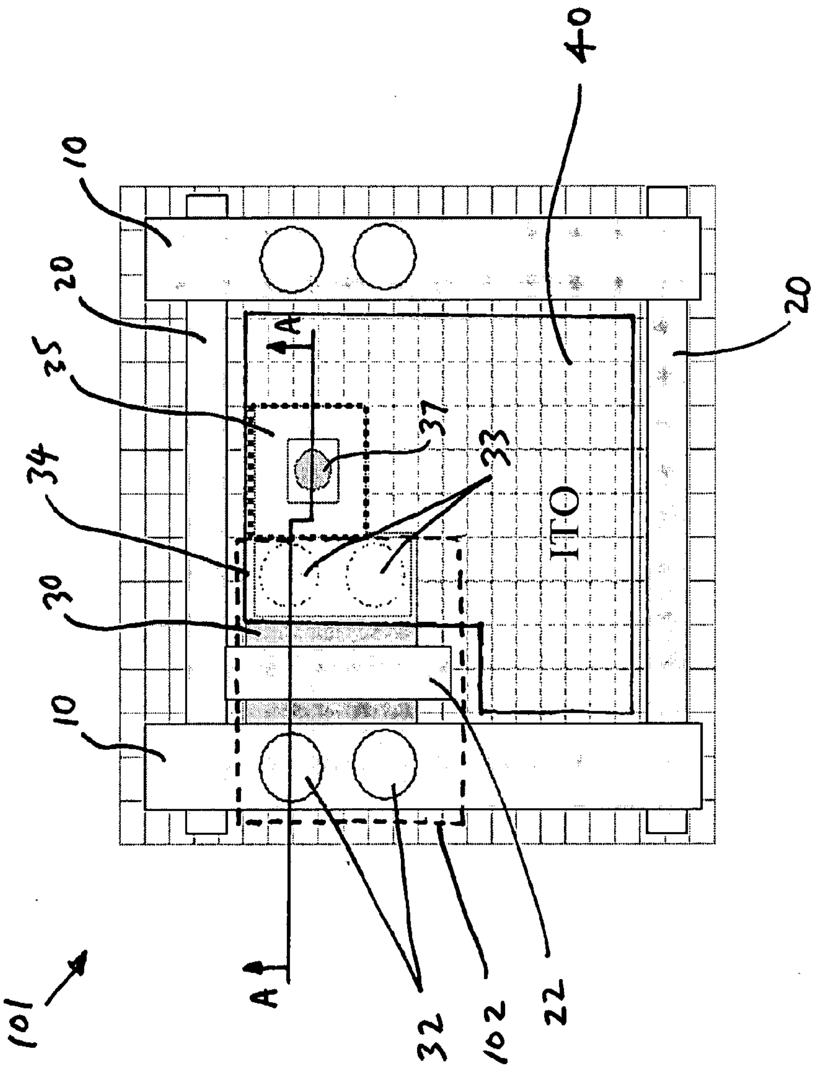


Fig. 1B
(PRIOR ART)

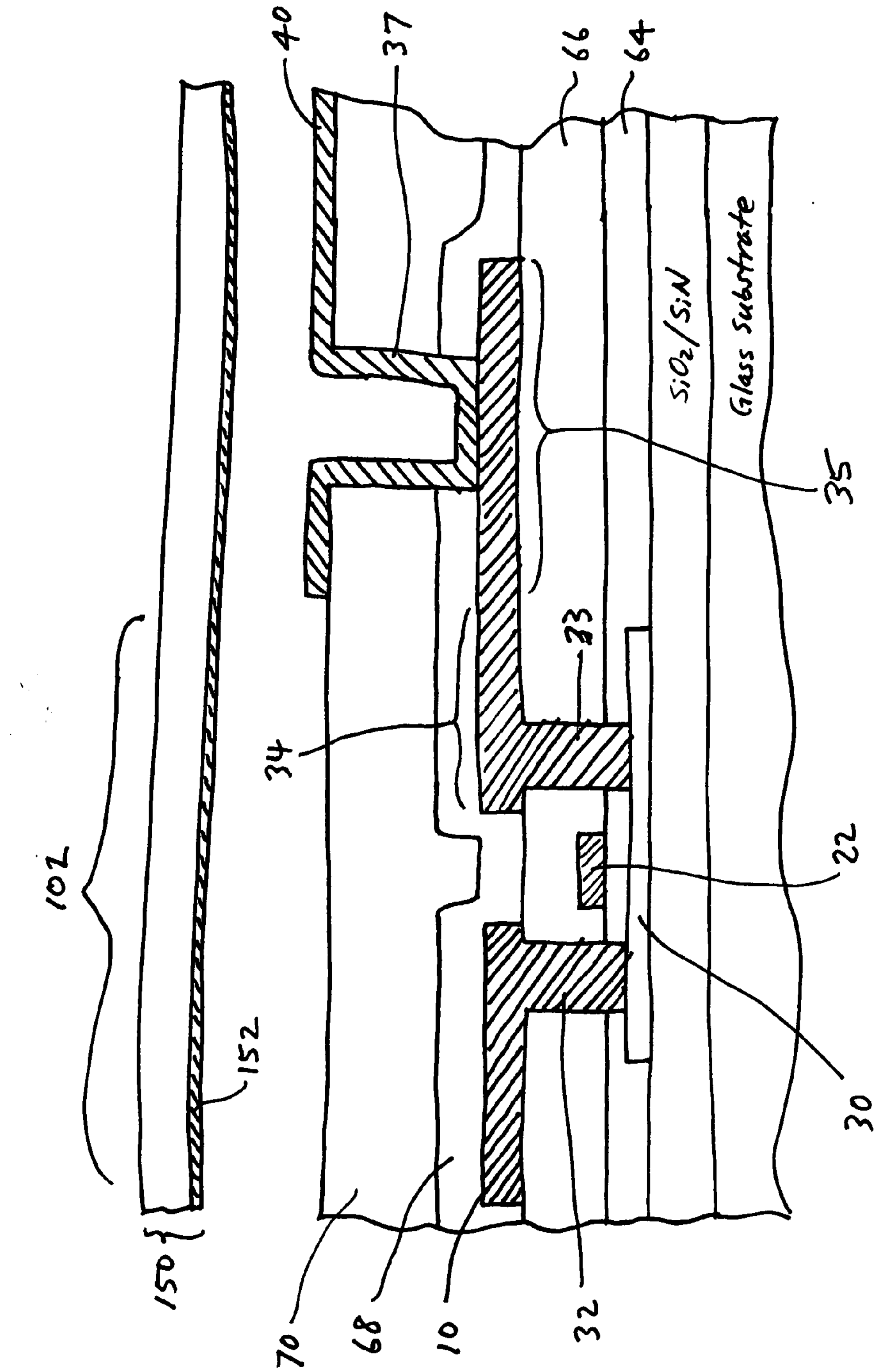


Fig. 1C
(PRIOR ART)

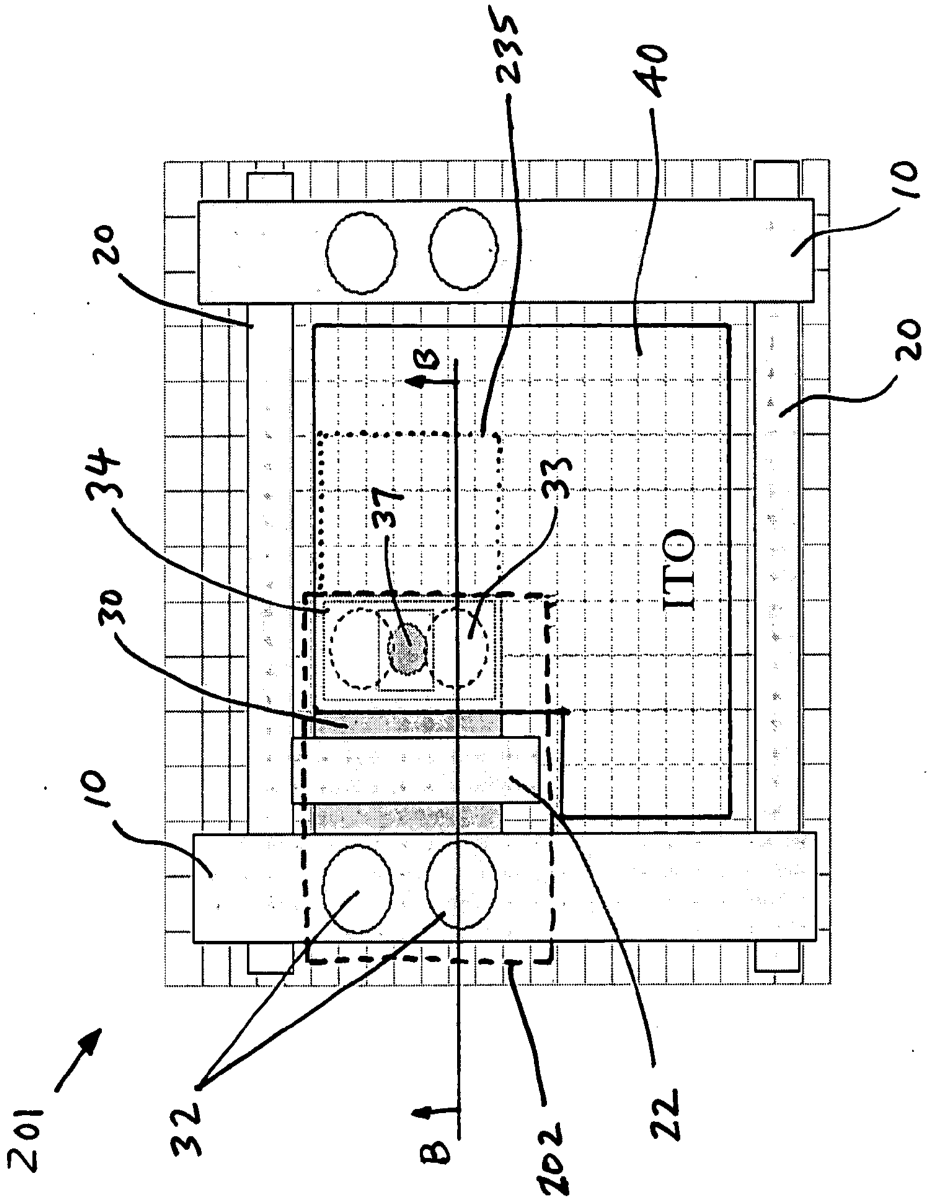


Fig. 2A

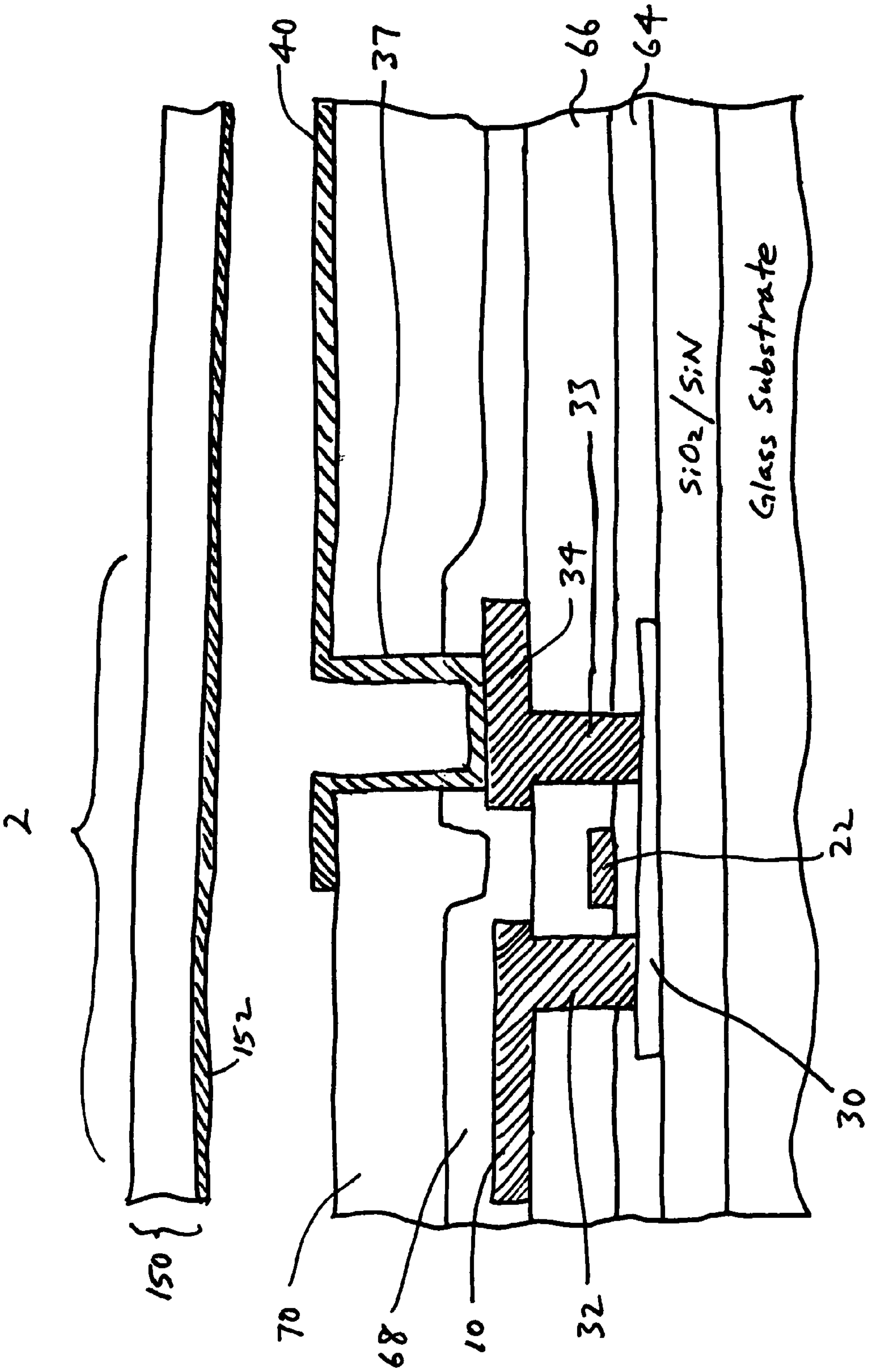

40
37
66
64
2
33
34
22
30
SiO_2/SiN
Glass Substrate
152
150
70
68
10
32

Fig. 2B

FINGERPRINT SENSING PIXEL WITH A LARGER APERTURE

FIELD OF THE INVENTION

[0001] The present invention relates to fingerprinting touch screen panels and more particularly to fingerprinting touch screen panels having high aperture ratio to allow more backlighting to transmit through the touch screen panels.

BACKGROUND OF THE INVENTION

[0002] Touch screen panels are commonly used in combination with liquid crystal display (LCD) devices. In many such applications, the touch screen panels function as contact switches to allow graphically rendered buttons and switches on the LCD screen to function as if they are real buttons and switches. More recent development in the touch screen panel technology has produced touch screen panels for acquiring fingerprint images directly on the touch screen panels. A general description of an example of such fingerprinting touch screen panel is illustrated in **FIGS. 1A-1C**.

[0003] **FIG. 1A** is a cross-sectional view of a thin film transistor-based resistive-type touch screen panel **100** for acquiring fingerprint images. The touch screen panel **100** is usually used in combination with a LCD panel **300** having a backlight system **310**. The touch screen panel **100** is comprised of a lower substrate **110** and an upper substrate **150**. The upper substrate **150** is typically made of a polyethylene terephthalate (PET) film or a thin glass sheet, which is flexible. The underside of the upper substrate **150** is a thin transparent conducting layer of gold **152**. The lower substrate **110** has an array of sensing electrodes (usually made of transparent conductive material, such as, indium-tin-oxide (ITO) or indium-zinc-oxide) **112** for sensing the undulations of a human finger pressing down on the upper substrate **150** to acquire an image of the finger's fingerprint. The lower substrate **110** is positioned beneath the upper substrate **150** and is separated from the upper substrate **150** by a gap of approximately 100 to 300 micrometers. Each of the sensing electrodes **112** is connected to a thin film transistor (TFT), which together comprising a pixel of the touch screen panel, for sensing the fingerprint image. The operational details of this type of fingerprinting touch screen panels are well-known in the touch panel and LCD display industry and need not be discussed here.

[0004] **FIG. 1B** is a plan view schematic illustration of a single fingerprint sensing pixel region **101** of the lower substrate **110**. **FIG. 1C** is a cross-sectional schematic illustration of the pixel region **101** of the lower substrate **110**, along line A-A in **FIG. 1B**, showing the representative structure of a pixel of the conventional touch screen panel **100** used for fingerprinting. Referring to **FIGS. 1B and 1C**, the pixel **101** is comprised of a sensing electrode **40**, usually made of transparent material such as ITO or indium zinc oxide, connected to a TFT device **102**. A grid of source lines **10** and addressing lines **20** is utilized to address a particular pixel in the full array. The source line **10** and the addressing line **20** are typically conducting lines made of a metal such as aluminum. The addressing line **20** is connected to a gate electrode **22** of the TFT device **102**. The source line **10** is connected to source electrodes **32**, whose outlines are shown in this plan view. The source electrodes **32** extends downward through the interlayer dielectric (ILD) **66** and the gate insulation layer **64** and connected to a poly-Si dielectric layer **30** that forms the channel region of the TFT device **102**. On the opposite side of the gate electrode **22**, drain electrodes **33** connect the channel **30** to the same metal layer where the source line **10** is formed. The top ends of the drain electrodes **33** are connected to a drain contact metal pad **34**. The drain contact metal pad **34** has extended portion **35** that extends away from the TFT structures. The source line **10** and the extended portion **35** are both formed on top of the ILD layer. As illustrated in **FIG. 1C**, a passivation layer **68** and an ultra high aperture (UHA) layer **70** are formed over these metal structures. The sensing electrode **40** is formed over an ultra-high-aperture (UHA) layer **70** and is connected to the extended portion **35** through a via **37**.

[0005] Other than the metal features, such as the source and addressing lines **10**, **20**, gate electrode **22**, channel region **30**, source/drain electrodes **32**, **33**, and the extended portion **35**, rest of the lower substrate **110** is made of transparent materials. Thus, each of the pixel **101** allows the backlighting of the LCD display to transmit through the touch screen panel **100**. But, as illustrated in the plan view of **FIG. 1B**, a substantial portion of the pixel area is occupied by the non-transparent metal structures mentioned above. This is generally quantified as an aperture ratio, the ratio of the total pixel area to the transparent area. In a conventional touch screen panel of **FIG. 1B**, the aperture ratio is about 80%.

[0006] Most fingerprinting touch screen panels with their aperture ratio of about 80%, when placed in front of an LCD panel, transmit less backlighting compared to the remaining LCD panel regions where there is no fingerprinting touch screen panel. This results in the fingerprinting touch screen panel region of the LCD display system to appear dimmer than the rest of the LCD display area. Although this has no effect on the functional aspects of the fingerprinting touch screen panel or the LCD display, having a dimmer fingerprinting area on the LCD display screen may not be optimal for some applications for aesthetical reasons. Thus, fingerprinting touch screen panels having greater aperture ratio pixels, allowing more LCD backlighting to transmit through the touch screen panels are desired.

SUMMARY OF THE INVENTION

[0007] According to an aspect of the present invention, an improved sensing pixel of a thin film transistor-based resistive-type fingerprinting touch screen panel comprises a thin film transistor having a poly-Si film layer forming a channel region and at least one drain electrode connecting the poly-Si film layer to a contact metal pad. A sensing electrode of the pixel is connected to the contact metal pad through a via, wherein at least a portion of the via overlaps the poly-Si film layer when viewed through the sensing electrode. The sensing electrode may be made of a transparent material such as indium tin oxide or indium zinc oxide.

[0008] According to another embodiment of the present invention, a thin film transistor-based resistive-type fingerprinting touch screen panel is also disclosed. The touch screen panel comprises an upper substrate and a lower substrate positioned beneath the upper substrate. The upper substrate is usually a flexible PET film having a conductive coating layer on the underside. The lower substrate comprises an array of thin film transistor-based sensing pixels.

Each of the sensing pixels comprises a thin film transistor having a poly-Si film layer forming a channel region and at least one drain electrode connecting the poly-Si film layer to a contact metal pad. A sensing electrode of the pixel is connected to the contact metal pad through a via, wherein at least a portion of the via overlaps the poly-Si film layer when viewed through the sensing electrode. The sensing electrode may be made of a transparent material such as indium tin oxide or indium zinc oxide.

[0009] According to another embodiment of the present invention, a display system having a fingerprinting feature is also disclosed. The display system comprises a LCD panel, a backlight for the LCD panel behind the LCD panel and a thin film transistor-based resistive-type fingerprinting touch screen panel in front of the LCD. The fingerprinting touch screen panel comprises an upper substrate and a lower substrate positioned beneath the upper substrate. The lower substrate comprises an array of thin film transistor-based sensing pixels, each of the sensing pixels comprising a thin film transistor having a poly-Si film layer forming a channel region and at least one drain electrode connecting the poly-Si film layer to a contact metal pad. A sensing electrode of the pixel is connected to the contact metal pad through a via in a manner such that at least a portion of the via overlaps the poly-Si film layer when viewed through the sensing electrode.

BRIEF DESCRIPTION OF THE DRAWING

[0010] **FIG. 1A** is a schematic cross-sectional illustration of a typical LCD display panel with a fingerprinting touch screen panel in front of the LCD panel.

[0011] **FIG. 1B** is a schematic plan view illustration of a pixel region of the fingerprinting touch screen panel of **FIG. 1A**.

[0012] **FIG. 1C** is a schematic cross-sectional illustration of the pixel region of **FIG. 1B**.

[0013] **FIG. 2A** is a schematic plan view illustration of a pixel region of a fingerprinting touch screen panel according to an embodiment of the present invention.

[0014] **FIG. 2B** is a schematic cross-sectional illustration of the pixel region illustrated in **FIG. 2A**.

[0015] The features shown in the above-referenced drawings are schematic only and are not drawn to scale. Like reference numbers represent like elements.

DETAILED DESCRIPTION

[0016] **FIG. 2A** illustrates a plan view of a pixel region **201** of an improved fingerprinting touch screen panel according to an embodiment of the present invention. Comparing this improved structure to the pixel region **101** of the conventional fingerprinting touch screen panel **100** of **FIG. 1C**, the extended portion **35** of the drain contact metal pad **34** has been removed. This is represented by a phantom line **235** showing the outline of where the extended portion **35** would be in a conventional fingerprinting touch screen panel. Thus, in the improved fingerprinting touch screen panel according to an aspect of the present invention, the total area of opaque metalized portion in the pixel region **201** has been reduced. In turn, the transparent region is larger and the aperture ratio of the pixel region **201** is higher than the aperture ration of the pixel region **101**, for example, of the conventional fingerprinting touch screen panel **100**.

[0017] To achieve this improvement, the via **37** connecting the ITO sensing electrode **40** to the drain electrodes **33** of the TFT device **202** has been moved so that at least a portion of the via **37** overlaps the poly-Si film layer **30** when viewed through the sensing electrode **40** as shown in **FIG. 2A**. As illustrated in the plan view **FIG. 2A**, which is a view through the sensing electrode **40**, the via **37**, while contacting the contact metal pad **34**, overlaps the poly-Si layer **30**. Actually, in this example, the via **37** is completely overlaps the poly-Si layer **30**. In a preferred embodiment of the present invention, a substantial portion or all of the via **37** overlaps the outline of the poly-Si film layer **30** when viewed through the sensing electrode **40** so that the size of the contact metal pad **34** is minimized and need not extend beyond the outline of the poly-Si film layer **30**. Of course it should be noted that the via **37** overlapping the poly-Si film layer **30** does not refer to the via **37** and the poly-Si film layer **30** directly contacting each other since these two features are separated by the gate insulation layer **64** and the ILD layer **66**. The overlapping describes the spatial relationship between the via **37** and the poly-Si layer **30** in the vertical direction so that their outlines or footprint overlaps when they are in positional relationship according to a preferred embodiment of the present invention.

[0018] This structure can be seen more clearly in the cross-sectional illustration of **FIG. 2B**. The drain electrodes **33** terminate on top at the contact metal **34**. The via **37** of the ITO sensing electrode **40** is aligned longitudinally with the drain electrodes **33** and contacts the contact metal pad **34**. Unlike the structure of the pixel region **101** of the conventional fingerprinting touch screen panel **100**, the contact metal pad **34** in the improved pixel region **201** does not have the extended portion **35**.

[0019] With the removal of the extended portion **35** of the contact metal pad **34**, the improved pixel region **201** may achieve an aperture ratio greater than about 80%, which is the typical aperture ratio value in the conventional resistive-type fingerprinting touch screen panels.

[0020] While the foregoing invention has been described with reference to the above embodiments, various modifications and changes can be made without departing from the spirit of the invention.

What is claimed is:

1. A sensing pixel of a thin film transistor-based resistive-type fingerprinting touch screen panel, the sensing pixel comprising:

a thin film transistor having a poly-Si film layer forming a channel region and at least one drain electrode connecting the poly-Si film layer to a contact metal pad;

a sensing electrode connected to the contact metal pad through a via, wherein at least a portion of the via overlaps the poly-Si film layer when viewed through the sensing electrode.

2. The sensing pixel of claim 1, wherein a substantial portion of the via overlaps the poly-Si film layer when viewed through the sensing electrode.

3. The sensing pixel of claim 1, wherein the sensing electrode comprises indium tin oxide or indium zinc oxide.

4. The sensing pixel of claim 1, wherein the sensing pixel having an aperture ratio of greater than about 80%.

5. A thin film transistor-based resistive-type fingerprinting touch screen panel comprising:

an upper substrate;

a lower substrate beneath the upper substrate, wherein the lower substrate comprises an array of thin film transistor-based sensing pixels, each of the sensing pixels comprising:

a thin film transistor having a poly-Si film layer forming a channel region and at least one drain electrode connecting the poly-Si film layer to a contact metal pad;

a sensing electrode connected to the contact metal pad through a via, wherein at least a portion of the via overlaps the poly-Si film layer when viewed through the sensing electrode.

6. The touch screen panel of claim 5, wherein a substantial portion of the via overlaps the poly-Si film layer.

7. The touch screen panel of claim 5, wherein the sensing electrode comprises indium tin oxide or indium zinc oxide.

8. The touch screen panel of claim 5, wherein the sensing pixel having an aperture ratio of greater than about 80%.

9. A display system having a fingerprinting feature comprising:

a LCD panel;

a backlight for the LCD panel;

a thin film transistor-based resistive-type fingerprinting touch screen panel over the LCD panel, wherein the thin film transistor-based resistive-type fingerprinting touch screen panel comprises:

an upper substrate;

a lower substrate beneath the upper substrate, wherein the lower substrate comprises an array of thin film transistor-based sensing pixels, each of the sensing pixels comprising:

a thin film transistor having a poly-Si film layer forming a channel region and at least one drain electrode connecting the poly-Si film layer to a contact metal pad;

a sensing electrode connected to the contact metal pad through a via, wherein at least a portion of the via overlaps the poly-Si film layer when viewed through the sensing electrode.

10. The touch screen panel of claim 9, wherein a substantial portion of the via overlaps the poly-Si film layer.

11. The touch screen panel of claim 9, wherein the sensing electrode comprises indium tin oxide or indium zinc oxide.

12. The touch screen panel of claim 9, wherein the sensing pixel having an aperture ratio of greater than 80%.

13. The sensing pixel of claim 1, wherein the sensing electrode is transparent.

14. The touch screen panel of claim 5, wherein the sensing electrode is transparent.

15. The touch screen panel of claim 9, wherein the sensing electrode is transparent.

16. The touch screen panel of claim 5, wherein the upper substrate is made of PET.

17. The touch screen panel of claim 9, wherein the upper substrate is made of PET.

* * * * *

专利名称(译)	指纹感应像素具有更大的光圈		
公开(公告)号	US20050219200A1	公开(公告)日	2005-10-06
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[标]申请(专利权)人(译)	翁CHIEN SEN		
申请(专利权)人(译)	翁CHIEN-SEN		
当前申请(专利权)人(译)	友达光电股份有限公司		
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发明人	WENG, CHIEN-SEN		
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CPC分类号	G02F1/13338 G06F2203/0338 G06F3/03547		
外部链接	Espacenet USPTO		

摘要(译)

在基于薄膜晶体管的电阻型指纹触摸屏面板中，连接TFT的漏电极和触摸屏面板的每个像素区域中的ITO感测电极的接触金属层的尺寸减小，从而增加像素区域的孔径。具有更大的光圈，来自通常位于触摸屏面板后面的LCD显示面板的更多背光通过触摸屏面板传输，使得该区域更亮。