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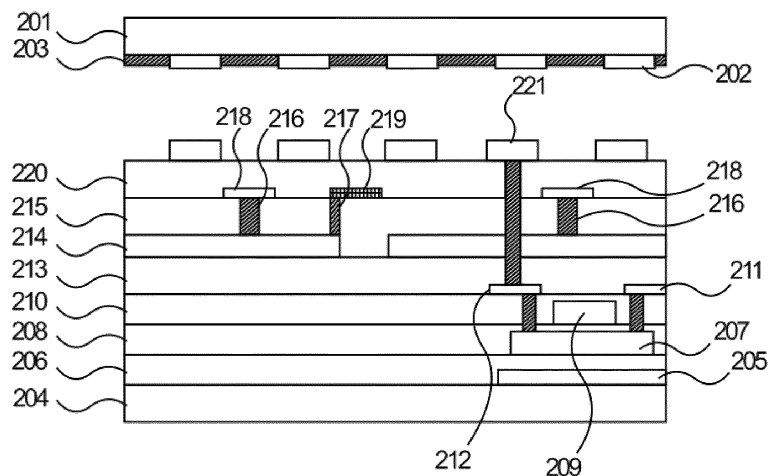
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(54) **EMBEDDED TOUCH SCREEN**

(57) An embedded touch screen, comprising an array substrate; a metal (219, 319) is added in a gap between common electrode plates (214, 314) of the array substrate; the metal (219, 319) is connected to the common electrode plates (214, 314) and forms, together with

pixel electrodes (221, 321), an electric field, so as to drive liquid crystal molecules in a region corresponding to the gap of the common electrode plates to be flipped normally, such that the region has the same display effect as other display regions.



**FIG. 2**

## Description

### TECHNICAL FIELD

**[0001]** The present disclosure relates to the technical field of liquid crystal displays, and more particularly to an in-cell touch screen.

### BACKGROUND OF DISCLOSURE

**[0002]** Touch screens are used as a kind of input medium, which are a simple, convenient, and a natural way of human-computer interaction. Liquid crystals are increasingly used in display panels due to good electrical controllability. Therefore, touch screens are usually integrated in liquid crystal display panels so as to form a variety of electronic products, such as mobile phones, laptops, MP3/MP4, and so on.

**[0003]** A conventional in-cell touch screen achieves a touch sensing by sharing a common electrode with a display. Fig. 1 is a structural schematic diagram of the conventional in-cell touch screen including a color filter substrate and an array substrate. The color filter substrate includes a first glass substrate 101, a color resist layer 102, and a black matrix 103. The array substrate includes a second glass substrate 104, a buffer layer 105, a gate insulating layer 106, an interlayer insulating layer 107, a planarization layer 108, a common electrode layer, a dielectric layer 109, sensing electrode wires 110, a passivation layer 111, and a pixel electrode 114, all of which are stacked in sequence. The sensing electrode wires are connected with the common electrode layer through vias 112. The common electrode layer is patterned to form a number of electrode plates 113. A gap between the electrode plates 113 is formed and located directly below the black matrix 103. No electrode layer is between the electrode plates 113, and accordingly, no electrical field is in an area corresponding to the gap between the neighboring electrode plates. Therefore, a rotational direction of the liquid crystals at a location with no electrical field is inconsistent with a rotational direction of the liquid crystals in other places thereby inducing display brightness in the location with no electrical field to be inconsistent with display brightness in other places, and a display problem appears. Although the location with no electrical field is shielded by the black matrix 103, a display difference can still be viewed at a large oblique angle. Specifically, a bright line pattern or a dark line pattern is shown specifically, and a display effect is affected.

**[0004]** Further, horizontal light shielding strips in the black matrix 103 are used to shield thin film transistors and scan lines, where width of the horizontal light shielding strips is greater than width of vertical light shielding strips used to shield data lines. Therefore, the display problem of the bright line pattern or the dark line pattern appearing is mainly shown in an area corresponding to the vertical light shielding strips.

**[0005]** As mentioned above, since the conventional in-

cell touch screen has no common electrode in a shielding area of the array substrate corresponding to the black matrix 103 so that liquid crystal molecules corresponding to the shielding area are flipped abnormally, the brightness in the shielding area is different from brightness in other areas. Therefore, the bright line pattern or the dark line pattern appears in the liquid crystal display panels when viewed from a large viewing angle, and a viewing effect is affected.

### SUMMARY OF THE DISCLOSURE

#### TECHNICAL PROBLEMS

**[0006]** The present disclosure provides an in-cell touch screen which enables liquid crystal molecules corresponding to a shielding area of a black matrix to rotate normally so as to have a normal display effect in the area. Therefore, the technical problems that, since the conventional in-cell touch screen has no common electrode in a shielding area of the array substrate corresponding to the black matrix so that liquid crystal molecules corresponding to the shielding area are flipped abnormally and brightness in the shielding area is different from brightness in other areas, such that the liquid crystal display panels, when viewed from a large viewing angle, have the bright line pattern or the dark line pattern appear and a viewing effect is affected, can be solved.

#### SOLUTIONS OF PROBLEMS

#### TECHNICAL SOLUTIONS

**[0007]** In order to solve the above problems, a technical solution of the present disclosure is provided as follows:

**[0008]** The present disclosure provides an in-cell touch screen including:

a color filter substrate comprising a color resist layer and a black matrix, wherein the black matrix comprises a plurality of horizontal light shielding strips configured to shield scan lines and a plurality of vertical light shielding strips configured to shield data lines; and

an array substrate disposed and facing the color filter substrate, wherein the array substrate comprises:

a substrate;

a buffer layer disposed on a surface of the substrate;

a gate insulating layer disposed on a surface of the buffer layer;

a first interlayer insulating layer disposed on a

surface of the gate insulating layer;

a planarization layer disposed on a surface of the first interlayer insulating layer;

a common electrode layer disposed on a surface of the planarization layer, wherein a patterning process is performed on the common electrode layer to form a number of common electrode plates distributed in an array; wherein horizontal gaps and vertical gaps are formed between the neighboring common electrode plates, wherein the horizontal gaps are shielded by the horizontal light shielding strips, and the vertical gaps are shielded by the vertical light shielding strips;

a second interlayer insulating layer disposed on a surface of the common electrode layer, wherein a plurality of first metal vias and a plurality of second metal vias are formed in the second interlayer insulating layer, and the second metal vias are formed and closely fitting to edges of the common electrode plates;

a plurality of sensing electrode wires distributed on a surface of the second interlayer insulating layer, wherein the sensing electrode wires are parallel to each other and are connected with the common electrode plates through the first metal vias; and

a plurality of sensing electrode sub-wires distributed on the surface of the second interlayer insulating layer and connected with the common electrode plates through the second metal vias, wherein,

the sensing electrode sub-wires and the sensing electrode wires are parallel to each other, and one of the sensing electrode sub-wires is located between one of the vertical light shielding strips and the corresponding vertical gap.

**[0009]** According to a preferred embodiment of the present disclosure, a passivation layer is disposed on a surface of the second interlayer insulating layer, a number of pixel electrodes distributed in an array are disposed on a surface of the passivation layer, and the sensing electrode sub-wires together with the pixel electrodes form an electric field configured to drive liquid crystal molecules to tilt.

**[0010]** According to a preferred embodiment of the present disclosure, one of the sensing electrode sub-wires is correspondingly disposed in the vertical gap between the common electrode plates in two neighboring columns, and the sensing electrode sub-wire is connected with one of the common electrode plates in the two columns.

**[0011]** According to a preferred embodiment of the present disclosure, the vertical gap between the common electrode plates in two neighboring columns corresponds to the plurality of sensing electrode sub-wires distributed vertically and spaced apart from each other, an interval distance between the two neighboring sensing electrode sub-wires is identical to a width of the horizontal gap, and one of the sensing electrode sub-wires is connected with one of the common electrode plates located on a side of the sensing electrode sub-wire.

**[0012]** According to a preferred embodiment of the present disclosure, each of the second metal vias has an aperture less than an aperture of each of the first metal vias.

**[0013]** The present disclosure provides an in-cell touch screen including:

a color filter substrate comprising a color resist layer and a black matrix, wherein the black matrix comprises a plurality of horizontal light shielding strips configured to shield scan lines and a plurality of vertical light shielding strips configured to shield data lines; and

an array substrate disposed and facing the color filter substrate, wherein the array substrate comprises:

a substrate;

a buffer layer disposed on a surface of the substrate;

a gate insulating layer disposed on a surface of the buffer layer;

a first interlayer insulating layer disposed on a surface of the gate insulating;

a planarization layer disposed on a surface of the first interlayer insulating layer;

a common electrode layer disposed on a surface of the planarization layer, wherein a patterning process is performed on the common electrode layer to form a number of common electrode plates distributed in an array; wherein horizontal gaps and vertical gaps are formed between the neighboring common electrode plates, wherein the horizontal gaps are shielded by the horizontal light shielding strips, and the vertical gaps are shielded by the vertical light shielding strips;

a second interlayer insulating layer disposed on a surface of the common electrode layer, wherein a plurality of first metal vias and a plurality of second metal vias are formed in the second interlayer insulating layer;

a plurality of sensing electrode wires distributed on a surface of the second interlayer insulating layer, wherein the sensing electrode wires are parallel to each other and are connected with the common electrode plates through the first metal vias; and

a plurality of sensing electrode sub-wires distributed on the surface of the second interlayer insulating layer and connected with the common electrode plates through the second metal vias, wherein,

the sensing electrode sub-wires and the sensing electrode wires are parallel to each other, and one of the sensing electrode sub-wires is located between one of the vertical light shielding strips and the corresponding vertical gap.

**[0014]** According to a preferred embodiment of the present disclosure, a passivation layer is disposed on a surface of the second interlayer insulating layer, a number of pixel electrodes distributed in an array are disposed on a surface of the passivation layer, and the sensing electrode sub-wires together with the pixel electrodes form an electric field configured to drive liquid crystal molecules to tilt.

**[0015]** According to a preferred embodiment of the present disclosure, one of the sensing electrode sub-wires is correspondingly disposed in the vertical gap between the common electrode plates in two neighboring columns, and the sensing electrode sub-wire is connected with one of the common electrode plates in the two columns.

**[0016]** According to a preferred embodiment of the present disclosure, the vertical gap between the common electrode plates in two neighboring columns corresponds to the plurality of sensing electrode sub-wires distributed vertically and spaced apart from each other, an interval distance between the two neighboring sensing electrode sub-wires is identical to a width of the horizontal gap, and one of the sensing electrode sub-wires is connected with one of the common electrode plates located on a side of the sensing electrode sub-wire.

**[0017]** According to a preferred embodiment of the present disclosure, each of the second metal vias has an aperture less than an aperture of each of the first metal vias.

**[0018]** According to the above purpose of the present disclosure, an in-cell touch screen is further provided, including:

a color filter substrate comprising a color resist layer and a black matrix, wherein the black matrix comprises a plurality of horizontal light shielding strips configured to shield scan lines and a plurality of vertical light shielding strips configured to shield data lines; and

an array substrate disposed and facing the color filter substrate, wherein the array substrate comprises:

a substrate;

a buffer layer disposed on a surface of the substrate;

a gate insulating layer disposed on a surface of the buffer layer;

a first interlayer insulating layer disposed on a surface of the gate insulating layer;

a planarization layer disposed on a surface of the first interlayer insulating layer;

a common electrode layer disposed on a surface of the planarization layer, wherein a patterning process is performed on the common electrode layer to form a number of common electrode plates distributed in an array; wherein horizontal gaps and vertical gaps are formed between the neighboring common electrode plates, wherein the horizontal gaps are shielded by the horizontal light shielding strips, and the vertical gaps are shielded by the vertical light shielding strips;

a second interlayer insulating layer disposed on a surface of the common electrode layer, wherein a plurality of first metal vias are formed in the second interlayer insulating layer;

a plurality of sensing electrode wires distributed on a surface of the second interlayer insulating layer, wherein the sensing electrode wires are parallel to each other and are connected with the common electrode plates through the first metal vias;

a passivation layer disposed on the surface of the second interlayer insulating layer, wherein a number of second metal vias pass through the passivation layer and the second interlayer insulating layer;

a transparent electrode layer disposed on a surface of the passivation layer, wherein a patterning process is performed on the transparent electrode layer to form a number of pixel electrodes in an array, and a gap is between two neighboring pixel electrodes; and

a plurality of pixel sub-electrodes distributed on the surface of the passivation layer and connected with the common electrode plates through the second metal vias, wherein one of the pixel sub-electrodes is located between one of the

vertical light shielding strips and the corresponding vertical gap.

**[0019]** According to a preferred embodiment of the present disclosure, the pixel sub-electrode is located between the two neighboring pixel electrodes, and the pixel sub-electrode together with the pixel electrodes located at two sides of the pixel sub-electrode form an electric field configured to drive liquid crystal molecules to tilt.

**[0020]** According to a preferred embodiment of the present disclosure, the pixel sub-electrode in a column is correspondingly disposed in the vertical gap between the common electrode plates in two neighboring columns, and the pixel sub-electrode is connected with one of the common electrode plates in the two columns.

**[0021]** According to a preferred embodiment of the present disclosure, in the pixel sub-electrodes are located in a same column, an interval distance between the two neighboring pixel sub-electrodes is identical to a width of the horizontal gap.

**[0022]** According to a preferred embodiment of the present disclosure, each of the second metal vias has an aperture less than an aperture of each of the first metal vias.

#### BENEFICIAL EFFECTS OF DISCLOSURE

##### BENEFICIAL EFFECTS

**[0023]** The beneficial effects of the present disclosure are that: in comparison with a conventional in-cell touch screen, an in-cell touch screen provided by the present disclosure which enables liquid crystal molecules corresponding to a shielding area of a black matrix to rotate normally by disposing a metal on a shielding position of the black matrix, so as to have a normal display effect in the area. Therefore, the technical problems that, since the conventional in-cell touch screen has no common electrode in a shielding area of the array substrate corresponding to the black matrix so that liquid crystal molecules corresponding to the shielding area are flipped abnormally and brightness in the shielding area is different from the brightness in other areas, such that the liquid crystal display panels, when viewed from a large viewing angle, have bright line patterns or dark line patterns appear and a viewing effect is affected, can be solved.

#### BRIEF DESCRIPTION OF DRAWINGS

##### DESCRIPTION OF DRAWINGS

**[0024]** In order to more clearly describe embodiments of the present disclosure or technical solutions in a conventional technology, drawings required to be used for the embodiments or descriptions of the conventional technology are simply described hereinafter. Apparently, the drawings described below only illustrate some embodiments of the present disclosure. Those skilled in the

art can obtain other drawings based on these drawings disclosed herein without creative effort.

Fig. 1 is a structural diagram of a film layer of a conventional in-cell touch screen.

Fig. 2 is a structural diagram of a film layer of an in-cell touch screen of Embodiment 1 of the present disclosure.

Fig. 3 is a structural diagram of a film layer of an in-cell touch screen of Embodiment 2 of the present disclosure.

#### 15 BEST EMBODIMENT FOR CARRYING OUT DISCLOSURE

##### BEST EMBODIMENT OF DISCLOSURE

**[0025]** The following description of the embodiments with reference to the appended drawings is used for illustrating specific embodiments which may be used for carrying out the present disclosure. The directional terms described by the present disclosure, such as "upper", "lower", "front", "back", "left", "right", "inner", "outer", "side", etc., are only directions by referring to the accompanying drawings. Thus, the used directional terms are used to describe and understand the present disclosure, but the present disclosure is not limited thereto. In the figures, elements with similar structures are indicated by the same numbers.

**[0026]** The present disclosure is focused on the technical problems that, since the conventional in-cell touch screen has no common electrode in a shielding area of the array substrate corresponding to the black matrix so that liquid crystal molecules corresponding to the shielding area are flipped abnormally and brightness in the shielding area is different from brightness in other areas, such that liquid crystal display panels, when viewed from a large viewing angle, have bright line patterns or dark line patterns appear and a viewing effect is affected. The present embodiments can solve the defects.

**[0027]** An in-cell touch screen provided by the present disclosure includes: a color filter substrate, an array substrate disposed and facing the color filter substrate, and a liquid crystal layer located between the color filter substrate and the array substrate.

**[0028]** The color filter substrate includes a color resist layer and a black matrix. The black matrix comprises a plurality of horizontal light shielding strips configured to shield scan lines and a plurality of vertical light shielding strips configured to shield data lines.

**[0029]** The array substrate includes: a substrate, a buffer layer, a gate insulating layer, a first interlayer insulating layer, a planarization layer, a common electrode layer, a second interlayer insulating layer, and a plurality of sensing electrode wires. A patterning process is performed on the common electrode layer to form a number

of common electrode plates distributed in an array. Horizontal gaps and vertical gaps are formed between the neighboring common electrode plates. The horizontal gaps are shielded by the horizontal light shielding strips, and the vertical gaps are shielded by the vertical light shielding strips.

**[0030]** The array substrate further includes: a plurality of sensing electrode sub-wires or a plurality of pixel sub-electrodes. One of the sensing electrode sub-wires or one of the pixel sub-electrodes is located between one of the vertical light shielding strips and the corresponding vertical gap. The sensing electrode sub-wires or the pixel sub-electrodes are connected with the common electrode plates through metal vias. The sensing electrode sub-wires together with pixel electrodes or the pixel sub-electrodes together with the pixel electrodes form an electric field so as to drive liquid crystal molecules in an area corresponding to the vertical light shielding strips to tilt normally, such that the area and other display areas have an identical display effect.

#### Embodiment 1

**[0031]** As shown in Fig. 2, an embodiment of the present disclosure provides an in-cell touch screen including: a color filter substrate including: a first glass substrate 201, a color resist layer 202, and a black matrix 203, wherein the black matrix 203 includes a plurality of horizontal light shielding strips configured to shield scan lines and a plurality of vertical light shielding strips configured to shield data lines; and an array substrate disposed and facing the color filter substrate, wherein the array substrate includes a film layer structure as follows:

a second glass substrate 204; a metal light shielding layer 205 having thin film transistors and disposed on a surface of the second glass substrate 204;

a buffer layer 206 disposed on the surface of the second glass substrate 204; an active layer 207 having thin film transistors and disposed on a surface of the buffer layer 206, wherein the active layer 207 includes a channel, a source electrode ion-doped region located at one side of the channel, and a drain electrode ion-doped region located at another side of the channel;

a gate insulating layer 208 disposed on the surface of the buffer layer 206; a gate electrode 209 having thin film transistor and disposed on a surface of the gate insulating layer 208; a gate wire disposed on the surface of the gate insulating layer 208 and connected with the gate electrode 209;

a first interlayer insulating layer 210 disposed on the surface of the gate insulating layer 208; a source electrode metal wire 211 and a drain electrode metal

wire 212 disposed on a surface of the first interlayer insulating layer 210, wherein the source electrode metal wire 211 is connected with the source electrode ion-doped region through a via, and the drain electrode metal wire 212 is connected with the drain electrode ion-doped region through another via;

a planarization layer 213 disposed on the surface of the first interlayer insulating layer 210;

a common electrode layer disposed on a surface of the planarization layer 213, wherein a patterning process is performed on the common electrode layer to form a number of common electrode plates 214 distributed in an array, wherein horizontal gaps and vertical gaps are formed between the neighboring common electrode plates 214, wherein the horizontal gaps are shielded by the horizontal light shielding strips, and the vertical gaps are shielded by the vertical light shielding strips;

a second interlayer insulating layer 215 disposed on a surface of the common electrode layer, wherein a plurality of first metal vias 216 and a plurality of second metal vias 217 are formed in the second interlayer insulating layer 215;

a plurality of sensing electrode wires 218 distributed on a surface of the second interlayer insulating layer 215, wherein the sensing electrode wires 218 are parallel to each other, and one of the sensing electrode wires 218 is connected with one of the common electrode plates 214 through one of the first metal via 216; and

a plurality of sensing electrode sub-wires 219 distributed on the surface of the second interlayer insulating layer 215 and connected with the common electrode plates 214 through the second metal vias 217, wherein the sensing electrode sub-wires 219 and the sensing electrode wires 218 are parallel to each other, and one of the sensing electrode sub-wires 219 is located between one of the vertical light shielding strips and the corresponding vertical gap. The second metal vias 217 are formed and closely fitting to edges of the common electrode plates 214, so as to decrease width of the sensing electrode sub-wires 219 for ensuring a pixel aperture ratio.

**[0032]** The sensing electrode sub-wires 219 are made of a same material as the sensing electrode wires 218, and the sensing electrode sub-wires 219 and the sensing electrode wires 218 are formed using a same mask.

**[0033]** A width of the sensing electrode sub-wires 219 is greater than a width of the vertical gaps so as to enable the sensing electrode sub-wires 219 to cover the vertical gaps and reserve a part of the width for connecting with the common electrode plates 214.

**[0034]** A passivation layer 220 is disposed on the surface of the second interlayer insulating layer 215, and a number of pixel electrodes 221 in an array are disposed on a surface of the passivation layer 220.

**[0035]** Electric current is provided for the sensing electrode sub-wires 219 by the common electrode plates 214 being connected with the sensing electrode sub-wires 219. An electric field is formed by the sensing electrode sub-wires 219 and the pixel electrodes 221 close thereto, so as to drive the liquid crystal molecules, which correspond to a gap between the two common electrode plates 214 disposed horizontally, to have a consistency for a rotational angle with liquid crystal molecules in other areas, so as to eliminate poor display in which bright line patterns and dark line patterns appear in a liquid crystal display when viewed from a large viewing angle.

**[0036]** In order to ensure an open area of pixels as much as possible, the second metal via 217 has an aperture less than an aperture of the first metal via 216, so as to minimize the width of the sensing electrode sub-wires 219 for ensuring the opening area of the pixels.

**[0037]** One of the sensing electrode sub-wires 219 can be correspondingly disposed in the vertical gap between the common electrode plates 214 in two neighboring columns, and the sensing electrode sub-wire 219 is connected with one of the common electrode plates 214 in the two columns. As for the sensing electrode sub-wire 219 formed using the above structure, a mask designing structure is relatively simple in a fabricating process to form the sensing electrode sub-wire 219 corresponding to one of the vertical gaps. A mask corresponding position is merely required to design a slit, and only one second metal via 217 for connecting with the common electrode plate 214 is required, so as to require a relatively low mask accuracy and the yield is improved.

**[0038]** As another example, the vertical gap between the common electrode plates 214 in two neighboring columns can correspond to the plurality of sensing electrode sub-wires distributed vertically and spaced apart from each other, an interval distance between the two neighboring sensing electrode sub-wires 219 is identical to a width of the horizontal gap, and one of the sensing electrode sub-wires 219 is connected with one of the common electrode plates 214 located on a side of the sensing electrode sub-wire 219. As for the sensing electrode sub-wires 219 formed using the above structure, the plurality of sensing electrode sub-wires 219 are correspondingly disposed in one of the vertical gaps. Each of the sensing electrode sub-wires 219 is connected with one of the common electrode plates 214. Electric circuit inputted into each of the sensing electrode sub-wires 219 is relatively stable. Therefore, an unstable electric circuit of the sensing electrode sub-wires 219, induced by an enlarged resistance due to the relatively long sensing electrode sub-wires 219, is avoided. Further, the plurality of sensing electrode sub-wires 219 are independent from each other. When a portion of the common electrode plates is damaged, other sensing electrode sub-wires

219 corresponding to a same vertical gap will not be affected and are used normally.

#### Embodiment 2

**[0039]** As shown in Fig. 3, another embodiment of the present disclosure provides an in-cell touch screen including: a color filter substrate including: a first glass substrate 301, a color resist layer 302, and a black matrix 303, wherein the black matrix 303 includes a plurality of horizontal light shielding strips configured to shield scan lines and a plurality of vertical light shielding strips configured to shield data lines; and an array substrate disposed and facing the color filter substrate, wherein the array substrate includes a film layer structure as follows:

a second glass substrate 304; a metal light shielding layer 305 having thin film transistors and disposed on a surface of the second glass substrate 304;

a buffer layer 306 disposed on the surface of the second glass substrate 304; an active layer 307 having thin film transistors and disposed on a surface of the buffer layer 306, wherein the active layer 307 includes a channel, a source electrode ion-doped region located at one side of the channel, and a drain electrode ion-doped region located at another side of the channel;

a gate insulating layer 308 disposed on the surface of the buffer layer 306; a gate electrode 309 having thin film transistors and disposed on a surface of the gate insulating layer 308; a gate wire disposed on the surface of the gate insulating layer 308 and connected with the gate electrode 309;

a first interlayer insulating layer 310 disposed on the surface of the gate insulating layer 308; a source electrode metal wire 311 and a drain electrode metal wire 312 disposed on a surface of the first interlayer insulating layer 310, wherein the source electrode metal wire 311 is connected with the source electrode ion-doped region through a metal via, and the drain electrode metal wire 312 is connected with the drain electrode ion-doped region through another metal via;

a planarization layer 313 disposed on the surface of the first interlayer insulating layer 310;

a common electrode layer disposed on a surface of the planarization layer 313, wherein a patterning process is performed on the common electrode layer to form a number of common electrode plates 314 distributed in an array, wherein horizontal gaps and vertical gaps are formed between the neighboring common electrode plates 314, wherein the horizon-

tal gaps are shielded by the horizontal light shielding strips, and the vertical gaps are shielded by the vertical light shielding strips;

a second interlayer insulating layer 315 disposed on a surface of the common electrode layer, wherein a plurality of first metal vias 316 are formed in the second interlayer insulating layer 315;

a plurality of sensing electrode wires 318 distributed on a surface of the second interlayer insulating layer 315, wherein the sensing electrode wires 318 are parallel to each other, and one of the sensing electrode wires 318 is connected with one of the common electrode plates 314 through one of the first metal via 316;

a passivation layer 320 is disposed on the surface of the second interlayer insulating layer 315, wherein a number of second metal vias 317 pass through the passivation layer 320 and the second interlayer insulating layer 315; and

a transparent electrode layer disposed on a surface of the passivation layer 320, wherein a patterning process is performed on the transparent electrode layer to form a number of pixel electrodes 321 in an array, and a gap is between the two neighboring pixel electrodes 321.

**[0040]** The array substrate further includes: a plurality of pixel sub-electrodes 319 distributed on the surface of the passivation layer 320 and connected with the common electrode plates 314 through the second metal vias 317, wherein one of the pixel sub-electrodes 319 is located between one of the vertical light shielding strips and the corresponding vertical gap.

**[0041]** Electric current is provided for the pixel sub-electrodes 319 by the common electrode. An electric field is formed by the pixel sub-electrodes 319 and the pixel electrodes 321 close thereto, so as to drive the liquid crystal molecules, which correspond to a gap between the two common electrode plates 314 disposed horizontally, to have a consistency for a rotational angle with liquid crystal molecules in other areas, so as to eliminate poor display in which bright line patterns and dark line patterns appear in a liquid crystal display panel when viewed from a large viewing angle.

**[0042]** A working principle of the touch screen of the Embodiment 2 is similar to a working principle of the touch screen of the Embodiment 1. Specifically, reference can be made to the working principle of the Embodiment 1, and will not be described here again.

**[0043]** The beneficial effects of the present disclosure are that: in comparison with a conventional in-cell touch screen, an in-cell touch screen provided by the present disclosure which enables liquid crystal molecules corresponding to a shielding area of a black matrix to rotate

normally by disposing a metal on a shielding position of the black matrix, so as to have a normal display effect in the area. Therefore, the technical problems that, since the conventional in-cell touch screen has no common electrode in a shielding area of the array substrate corresponding to the black matrix so that liquid crystal molecules corresponding to the shielding area are flipped abnormally and brightness in the shielding area is different from brightness in other areas, such that the liquid crystal display panels, when viewed from a large viewing angle, have bright line patterns or dark line patterns appear and a viewing effect is affected, can be solved.

**[0044]** As described above, although the present disclosure has been described in preferred embodiments, they are not intended to limit the disclosure. One of ordinary skill in the art, without departing from the spirit and scope of the disclosure within, can make various modifications and variations, so the range of the scope of the disclosure is defined by the claims.

## Claims

1. An in-cell touch screen, comprising:

a color filter substrate comprising a color resist layer and a black matrix, wherein the black matrix comprises a plurality of horizontal light shielding strips configured to shield scan lines and a plurality of vertical light shielding strips configured to shield data lines; and  
an array substrate disposed and facing the color filter substrate, wherein the array substrate comprises:

a substrate;  
a buffer layer disposed on a surface of the substrate;  
a gate insulating layer disposed on a surface of the buffer layer;  
a first interlayer insulating layer disposed on a surface of the gate insulating layer;  
a planarization layer disposed on a surface of the first interlayer insulating layer;  
a common electrode layer disposed on a surface of the planarization layer, wherein a patterning process is performed on the common electrode layer to form a number of common electrode plates distributed in an array; wherein horizontal gaps and vertical gaps are formed between the neighboring common electrode plates, wherein the horizontal gaps are shielded by the horizontal light shielding strips, and the vertical gaps are shielded by the vertical light shielding strips; a second interlayer insulating layer disposed on a surface of the common electrode layer, wherein a plurality of first

- metal vias and a plurality of second metal vias are formed in the second interlayer insulating layer, and the second metal vias are formed and closely fit to edges of the common electrode plates;
- 5 a plurality of sensing electrode wires distributed on a surface of the second interlayer insulating layer, wherein the sensing electrode wires are parallel to each other and are connected with the common electrode plates through the first metal vias; and
- 10 a plurality of sensing electrode sub-wires distributed on the surface of the second interlayer insulating layer and connected with the common electrode plates through the second metal vias, wherein the sensing electrode sub-wires and the sensing electrode wires are parallel to each other, and one of the sensing electrode sub-wires is located between one of the vertical light shielding strips and the corresponding vertical gap.
2. The in-cell touch screen according to Claim 1, wherein a passivation layer is disposed on a surface of the second interlayer insulating layer, a number of pixel electrodes distributed in an array are disposed on a surface of the passivation layer, and the sensing electrode sub-wires together with the pixel electrodes form an electric field configured to drive liquid crystal molecules to tilt.
  3. The in-cell touch screen according to Claim 1, wherein one of the sensing electrode sub-wires is correspondingly disposed in the vertical gap between the common electrode plates in two neighboring columns, and the sensing electrode sub-wire is connected with one of the common electrode plates in the two columns.
  4. The in-cell touch screen according to Claim 1, wherein the vertical gap between the common electrode plates in two neighboring columns corresponds to the plurality of sensing electrode sub-wires distributed vertically and spaced apart from each other, an interval distance between the two neighboring sensing electrode sub-wires is identical to a width of the horizontal gap, and one of the sensing electrode sub-wires is connected with one of the common electrode plates located on a side of the sensing electrode sub-wire.
  5. The in-cell touch screen according to Claim 4, wherein each of the second metal vias has an aperture less than an aperture of each of the first metal vias.
  6. An in-cell touch screen, comprising:

a color filter substrate comprising a color resist layer and a black matrix, wherein the black matrix comprises a plurality of horizontal light shielding strips configured to shield scan lines and a plurality of vertical light shielding strips configured to shield data lines; and an array substrate disposed and facing the color filter substrate, wherein the array substrate comprises:

- a substrate;
  - a buffer layer disposed on a surface of the substrate;
  - a gate insulating layer disposed on a surface of the buffer layer;
  - a first interlayer insulating layer disposed on a surface of the gate insulating layer;
  - a planarization layer disposed on a surface of the first interlayer insulating layer;
  - a common electrode layer disposed on a surface of the planarization layer, wherein a patterning process is performed on the common electrode layer to form a number of common electrode plates distributed in an array; wherein horizontal gaps and vertical gaps are formed between the neighboring common electrode plates, wherein the horizontal gaps are shielded by the horizontal light shielding strips, and the vertical gaps are shielded by the vertical light shielding strips;
  - a second interlayer insulating layer disposed on a surface of the common electrode layer, wherein a plurality of first metal vias and a plurality of second metal vias are formed in the second interlayer insulating layer;
  - a plurality of sensing electrode wires distributed on a surface of the second interlayer insulating layer, wherein the sensing electrode wires are parallel to each other and are connected with the common electrode plates through the first metal vias; and
  - a plurality of sensing electrode sub-wires distributed on the surface of the second interlayer insulating layer and connected with the common electrode plates through the second metal vias, wherein the sensing electrode sub-wires and the sensing electrode wires are parallel to each other, and one of the sensing electrode sub-wires is located between one of the vertical light shielding strips and the corresponding vertical gap.
7. The in-cell touch screen according to Claim 6, wherein a passivation layer is disposed on a surface of the second interlayer insulating layer, a number of pixel electrodes distributed in an array are disposed on a

surface of the passivation layer, and the sensing electrode sub-wires together with the pixel electrodes form an electric field configured to drive liquid crystal molecules to tilt.

8. The in-cell touch screen according to Claim 6, wherein one of the sensing electrode sub-wires is correspondingly disposed in the vertical gap between the common electrode plates in two neighboring columns, and the sensing electrode sub-wire is connected with one of the common electrode plates in the two columns.

9. The in-cell touch screen according to Claim 6, wherein the vertical gap between the common electrode plates in two neighboring columns corresponds to the plurality of sensing electrode sub-wires distributed vertically and spaced apart from each other, an interval distance between the two neighboring sensing electrode sub-wires is identical to a width of the horizontal gap, and one of the sensing electrode sub-wires is connected with one of the common electrode plates located on a side of the sensing electrode sub-wire.

10. The in-cell touch screen according to Claim 9, wherein each of the second metal vias has an aperture less than an aperture of each of the first metal vias.

11. An in-cell touch screen, comprising:  
a color filter substrate comprising a color resist layer and a black matrix, wherein the black matrix comprises a plurality of horizontal light shielding strips configured to shield scan lines and a plurality of vertical light shielding strips configured to shield data lines; and  
an array substrate disposed and facing the color filter substrate, wherein the array substrate comprises:

- a substrate;
- a buffer layer disposed on a surface of the substrate;
- a gate insulating layer disposed on a surface of the buffer layer;
- a first interlayer insulating layer disposed on a surface of the gate insulating layer;
- a planarization layer disposed on a surface of the first interlayer insulating layer;
- a common electrode layer disposed on a surface of the planarization layer, wherein a patterning process is performed on the common electrode layer to form a number of common electrode plates distributed in an array; wherein horizontal gaps and vertical gaps are formed between the neighboring common electrode plates, wherein

the horizontal gaps are shielded by the horizontal light shielding strips, and the vertical gaps are shielded by the vertical light shielding strips; a second interlayer insulating layer disposed on a surface of the common electrode layer, wherein a plurality of first metal vias are formed in the second interlayer insulating layer;  
a plurality of sensing electrode wires distributed on a surface of the second interlayer insulating layer, wherein the sensing electrode wires are parallel to each other and are connected with the common electrode plates through the first metal vias;  
a passivation layer disposed on the surface of the second interlayer insulating layer, wherein a number of second metal vias pass through the passivation layer and the second interlayer insulating layer;  
a transparent electrode layer disposed on a surface of the passivation layer, wherein a patterning process is performed on the transparent electrode layer to form a number of pixel electrodes in an array, and a gap is between the two neighboring pixel electrodes; and  
a plurality of pixel sub-electrodes distributed on the surface of the passivation layer and connected with the common electrode plates through the second metal vias, wherein one of the pixel sub-electrodes is located between one of the vertical light shielding strips and the corresponding vertical gap.

12. The in-cell touch screen according to Claim 11, wherein the pixel sub-electrode is located between the two neighboring pixel electrodes, and the pixel sub-electrode together with the pixel electrodes located at two sides of the pixel sub-electrode form an electric field configured to drive liquid crystal molecules to tilt.

13. The in-cell touch screen according to Claim 11, wherein the pixel sub-electrode in a column is correspondingly disposed in the vertical gap between the common electrode plates in two neighboring columns, and the pixel sub-electrode is connected with one of the common electrode plates in the two columns.

14. The in-cell touch screen according to Claim 11, wherein, in the pixel sub-electrodes located in a same column, an interval distance between the two neighboring pixel sub-electrodes is identical to a width of the horizontal gap.

15. The in-cell touch screen according to Claim 14,

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wherein each of the second metal vias has an aperture less than an aperture of each of the first metal vias.

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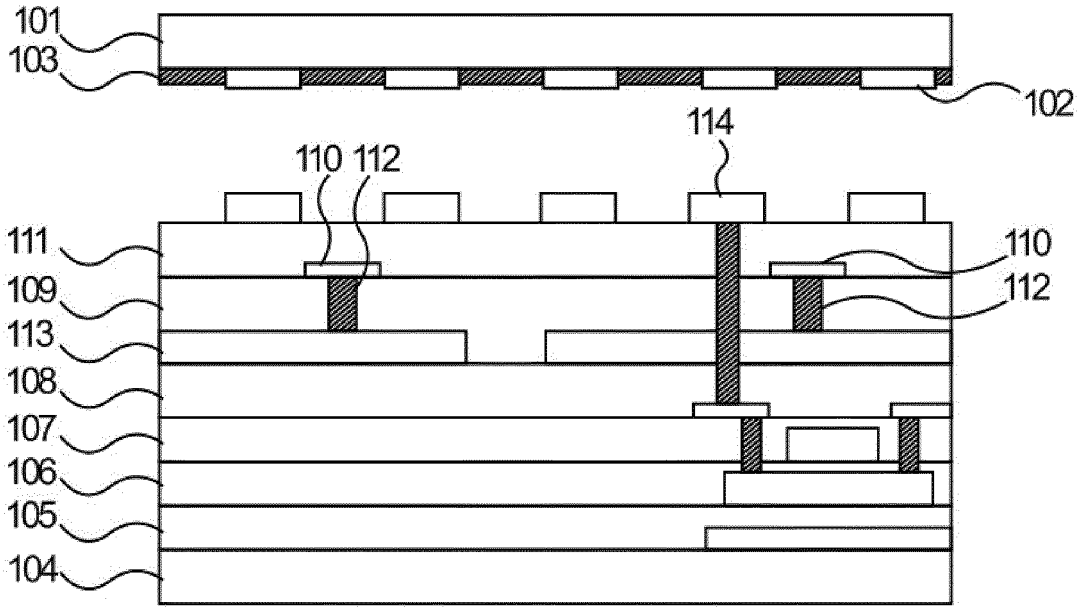


FIG. 1

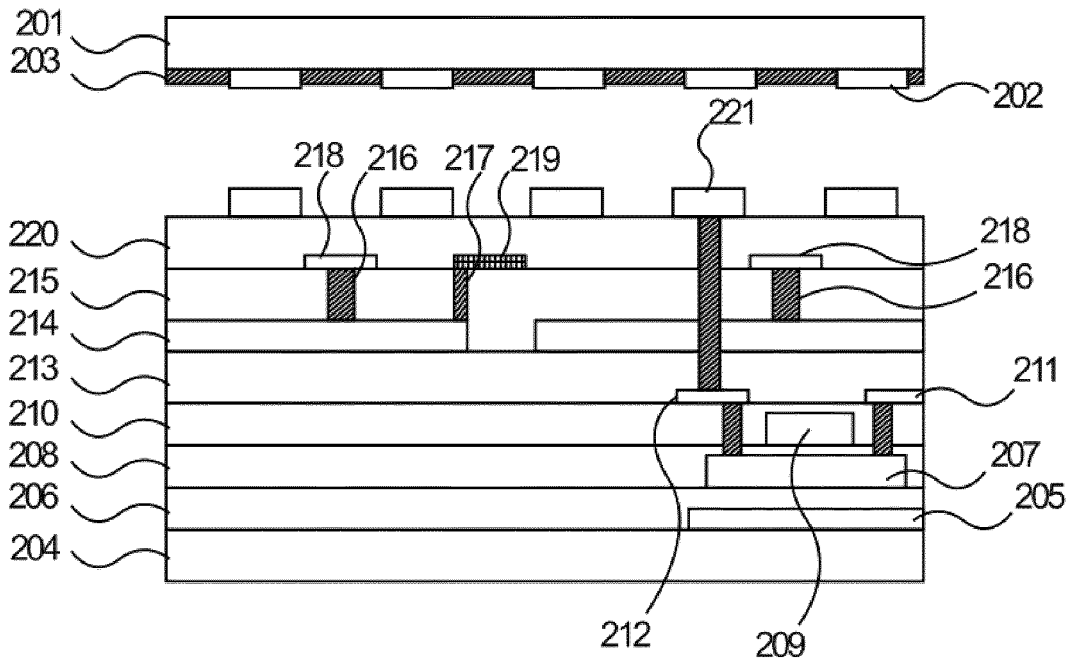


FIG. 2

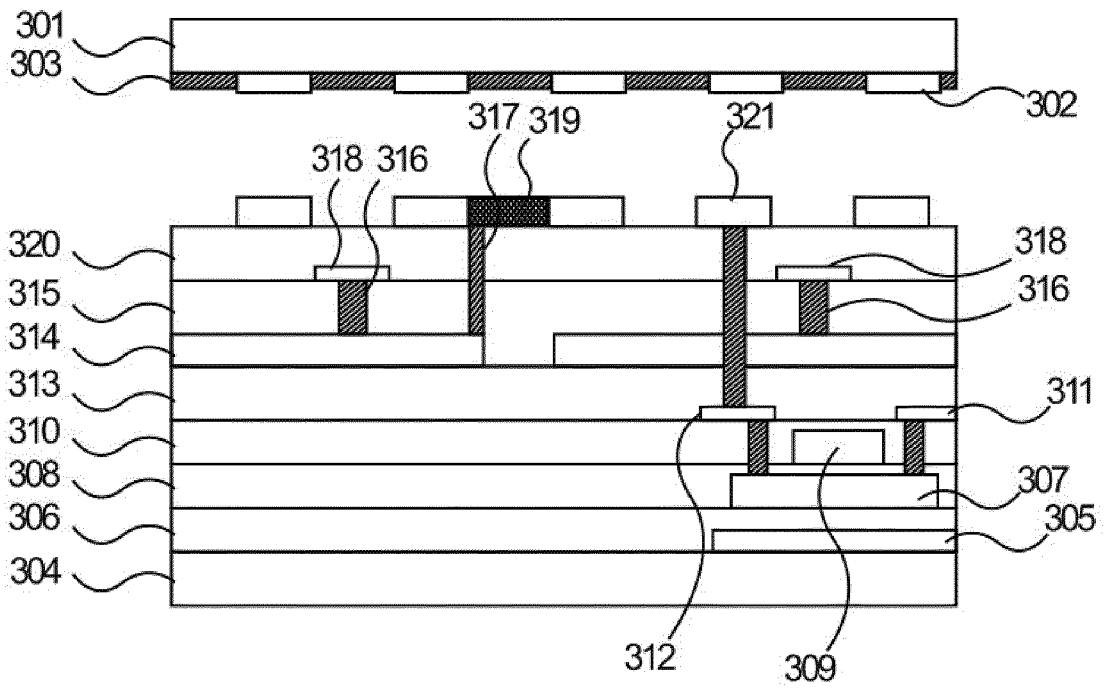


FIG. 3

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/CN2017/096387

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## A. CLASSIFICATION OF SUBJECT MATTER

G02F 1/1362 (2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

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## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G02F 1/-

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNPAT, CNKI, WPI, EPODOC: 触控, 触摸, 屏内, 内嵌, 集成, 黑矩阵, 光阻, 阻光, 遮挡, 遮光, 挡光, 液晶, 像素, 公共, 电极, 感应, touch, in cell, intergrate, block, BM, black matrix, liquid crystal, common, electorde, sense, induction

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## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 104777692 A (XIAMEN TIANMA MICROELECTRONICS CO. LTD. et al.), 15 July 2015 (15.07.2015), description, paragraphs [0032]-[0053], and figure 2	1-15
A	CN 102955635 A (BEIJING BOE OPTOELECTRONICS TECHNOLOGY CO., LTD.), 06 March 2013 (06.03.2013), entire document	1-15
A	CN 102937845 A (BEIJING BOE OPTOELECTRONICS TECHNOLOGY CO., LTD.), 20 February 2013 (20.02.2013), entire document	1-15
A	CN 106896961 A (XIAMEN TIANMA MICROELECTRONICS CO. LTD.), 27 June 2017 (27.06.2017), entire document	1-15
A	US 2016048048 A1 (SAMSUNG DISPLAY CO., LTD.), 18 February 2016 (18.02.2016), entire document	1-15
A	US 7495713 B2 (HANNSTAR DISPLAY CORP.), 24 February 2009 (24.02.2009), entire document	1-15

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 Further documents are listed in the continuation of Box C.
  See patent family annex.

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* Special categories of cited documents:	“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
“A” document defining the general state of the art which is not considered to be of particular relevance	“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
“E” earlier application or patent but published on or after the international filing date	“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
“L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	“&” document member of the same patent family
“O” document referring to an oral disclosure, use, exhibition or other means	
“P” document published prior to the international filing date but later than the priority date claimed	

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Date of the actual completion of the international search 07 March 2018	Date of mailing of the international search report 27 March 2018
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Name and mailing address of the ISA State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No. (86-10) 62019451	Authorized officer  SHI, Minfeng  Telephone No. (86-10) 53962413
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Form PCT/ISA/210 (second sheet) (July 2009)

**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

International application No.  
PCT/CN2017/096387

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Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
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		US 2016328058 A1	10 November 2016
		DE 102015113639 A1	10 November 2016
CN 102955635 A	06 March 2013	CN 102955635 B	11 November 2015
		JP 2014081935 A	08 May 2014
		KR 101520546 B1	21 May 2015
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		US 9081223 B2	14 July 2015
		EP 2720124 A2	16 April 2014
CN 102937845 A	20 February 2013	CN 102937845 B	02 December 2015
CN 106896961 A	27 June 2017	None	
US 2016048048 A1	18 February 2016	US 9202949 B2	01 December 2015
		US 2013341651 A1	26 December 2013
		KR 20130143407 A	31 December 2013
US 7495713 B2	24 February 2009	US 2008030633 A1	07 February 2008

Form PCT/ISA/210 (patent family annex) (July 2009)

专利名称(译)	嵌入式触摸屏		
公开(公告)号	<a href="#">EP3647864A1</a>	公开(公告)日	2020-05-06
申请号	EP2017915590	申请日	2017-08-08
[标]申请(专利权)人(译)	武汉华星光电技术有限公司		
申请(专利权)人(译)	中国武汉恒星光电科技有限公司.		
当前申请(专利权)人(译)	中国武汉恒星光电科技有限公司.		
[标]发明人	HUANG YAOLI HE XINGLONG		
发明人	HUANG, YAOLI HE, XINGLONG		
IPC分类号	G02F1/1362		
CPC分类号	G02F1/133345 G02F1/13338 G02F1/134309 G02F1/134363		
优先权	201710523600.X 2017-06-30 CN		
外部链接	<a href="#">Espacenet</a>		

摘要(译)

一种嵌入式触摸屏，包括阵列基板；在阵列基板的公共电极板（214、314）之间的间隙中添加金属（219、319）。金属（219、319）连接到公共电极板（214、314），并与像素电极（221、321）一起形成电场，以驱动与间隙相对应的区域中的液晶分子。通常，使公共电极板的第二显示区域正常翻转，使得该区域具有与其他显示区域相同的显示效果。

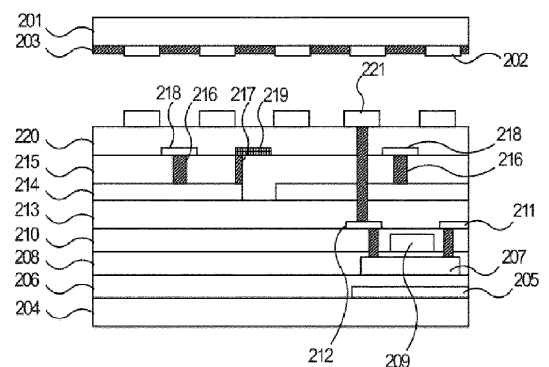


FIG. 2