US 20070153201A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2007/0153201 A1

Lee et al. (43) Pub. Date: Jul. 5, 2007

(54) ARRAY SUBSTRATE FOR IN-PLANE SWITCHING MODE LIQUID CRYSTAL DISPLAY DEVICE AND METHOD OF FABRICATING THE SAME

(75) Inventors: **Do-Young Lee**, Seoul (KR); **Byoung-Ho Lim**, Gyeongbuk (KR); **Hyun-Kyu Lee**, Seoul (KR); **Do-Sung Kim**, Gyeongsangbuk-do (KR); **Byung-Koo Kang**, Gyeongbuk (KR); **Eui-Tae Kim**, Seoul (KR)

Correspondence Address:
MORGAN LEWIS & BOCKIUS LLP
1111 PENNSYLVANIA AVENUE NW
WASHINGTON, DC 20004

(73) Assignee: **LG.Philips LCD Co., Ltd.**

(21) Appl. No.: **11/642,590**

(22) Filed: **Dec. 21, 2006**

(30) **Foreign Application Priority Data**

Dec. 29, 2005 (KR) 2005-0133555

Publication Classification

(51) **Int. Cl.**
G02F 1/1343 (2006.01)

(52) **U.S. Cl.** **349/141**

(57) **ABSTRACT**

An array substrate for an IPS mode LCD device includes a gate line in a first direction on a substrate and a data line in a second direction over the substrate; a metal and a common lines in the second direction on the substrate and includes a plurality of first and second protruding portions in the first direction, respectively; a TFT connected to the gate and data lines; an insulating layer over the metal and common lines; a common electrode over the insulating layer and including a first common portion in the second direction and a plurality of second common portions in the first direction; and a pixel electrode over the insulating layer and including a first pixel portion in the second direction and a plurality of second pixel portions in the first direction, wherein the plurality of second common and pixel portions are alternately arranged.

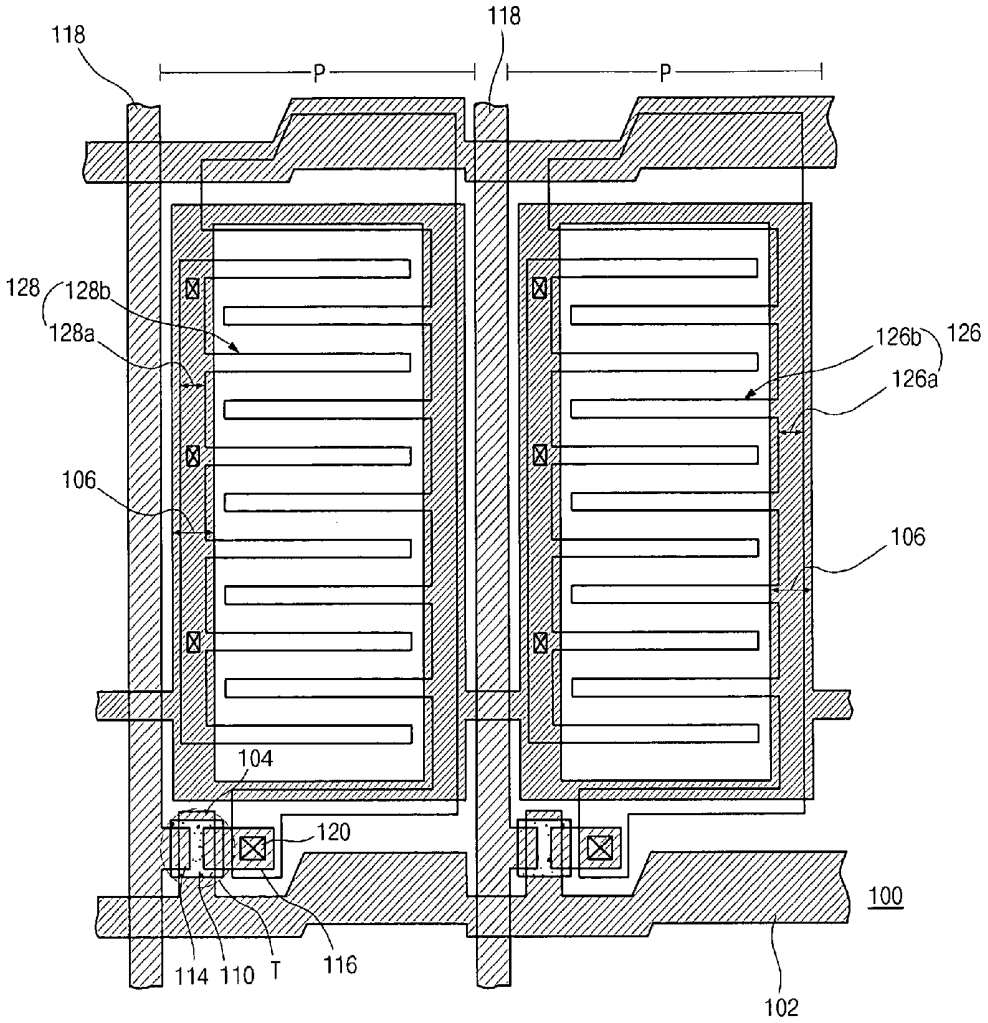


FIG. 1
Related Art

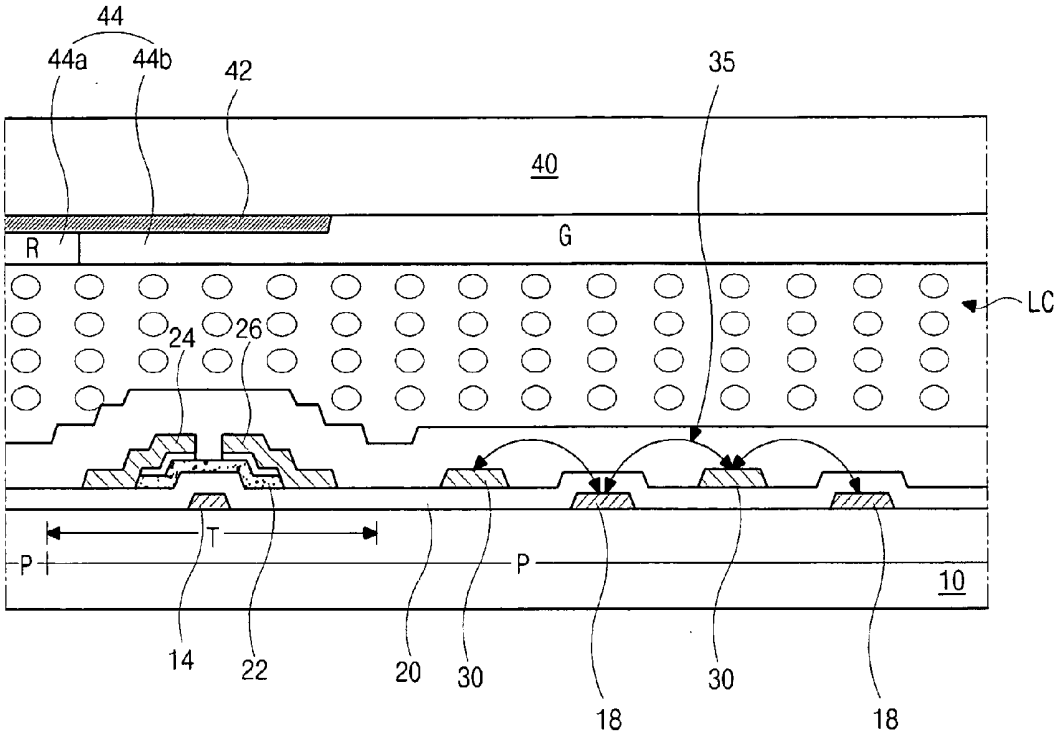


FIG. 2
Related Art

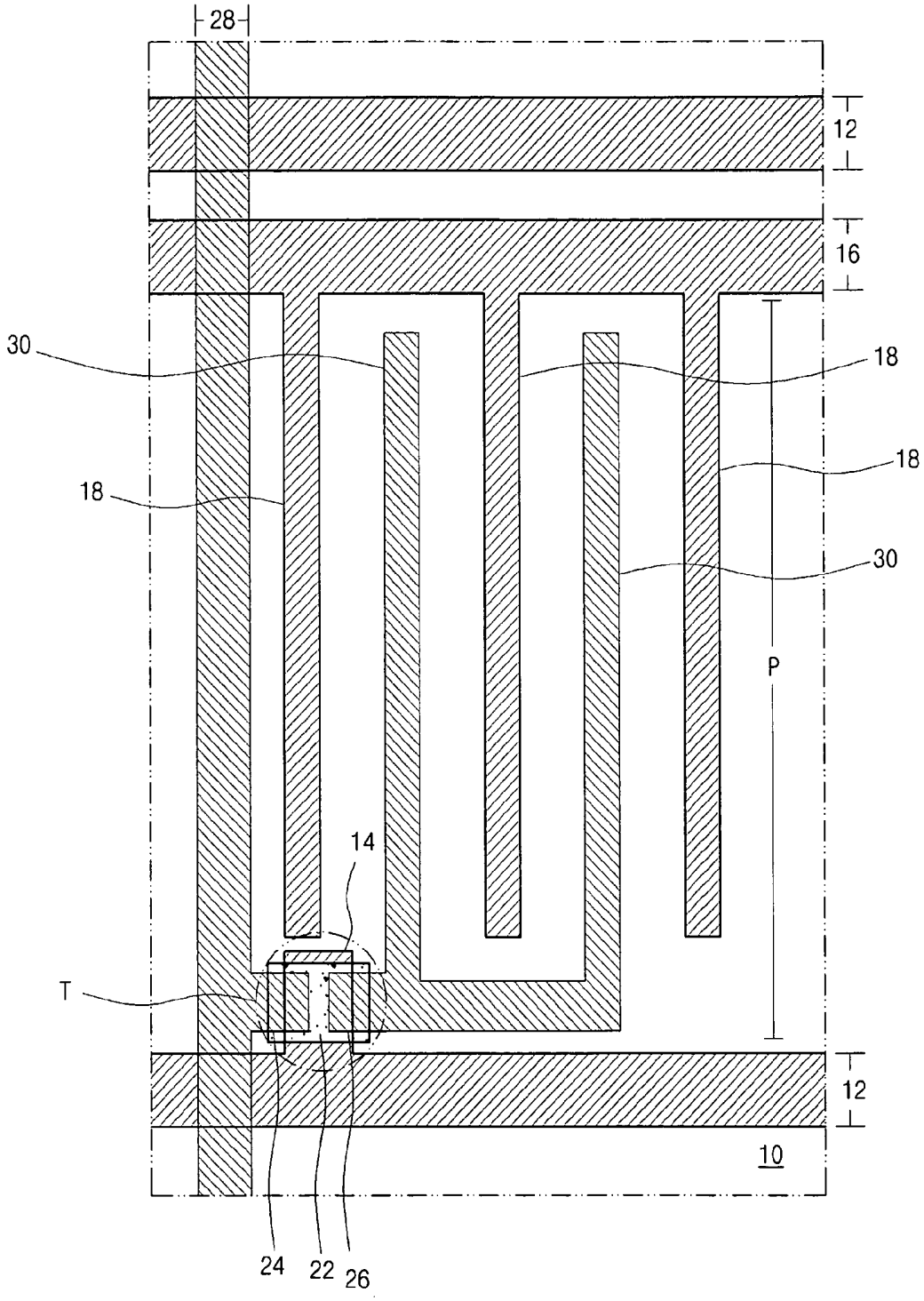


FIG. 3
Related Art

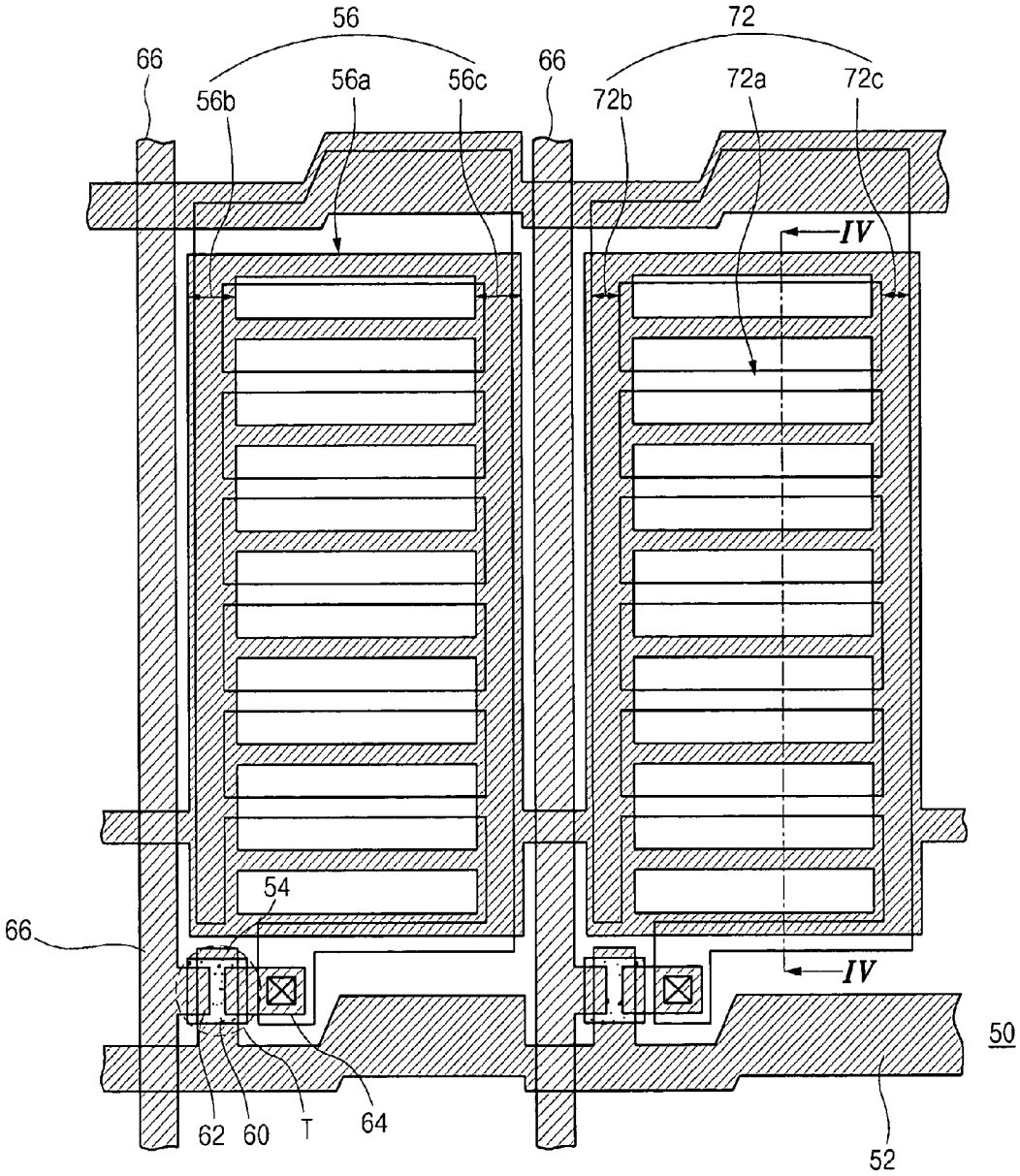


FIG. 4
Related Art

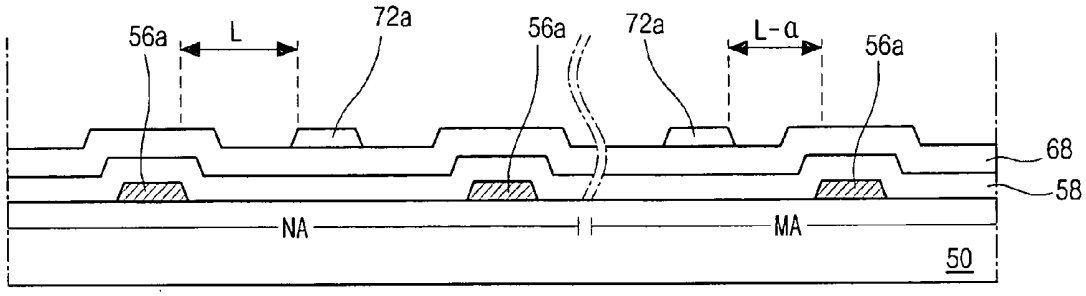


FIG. 5

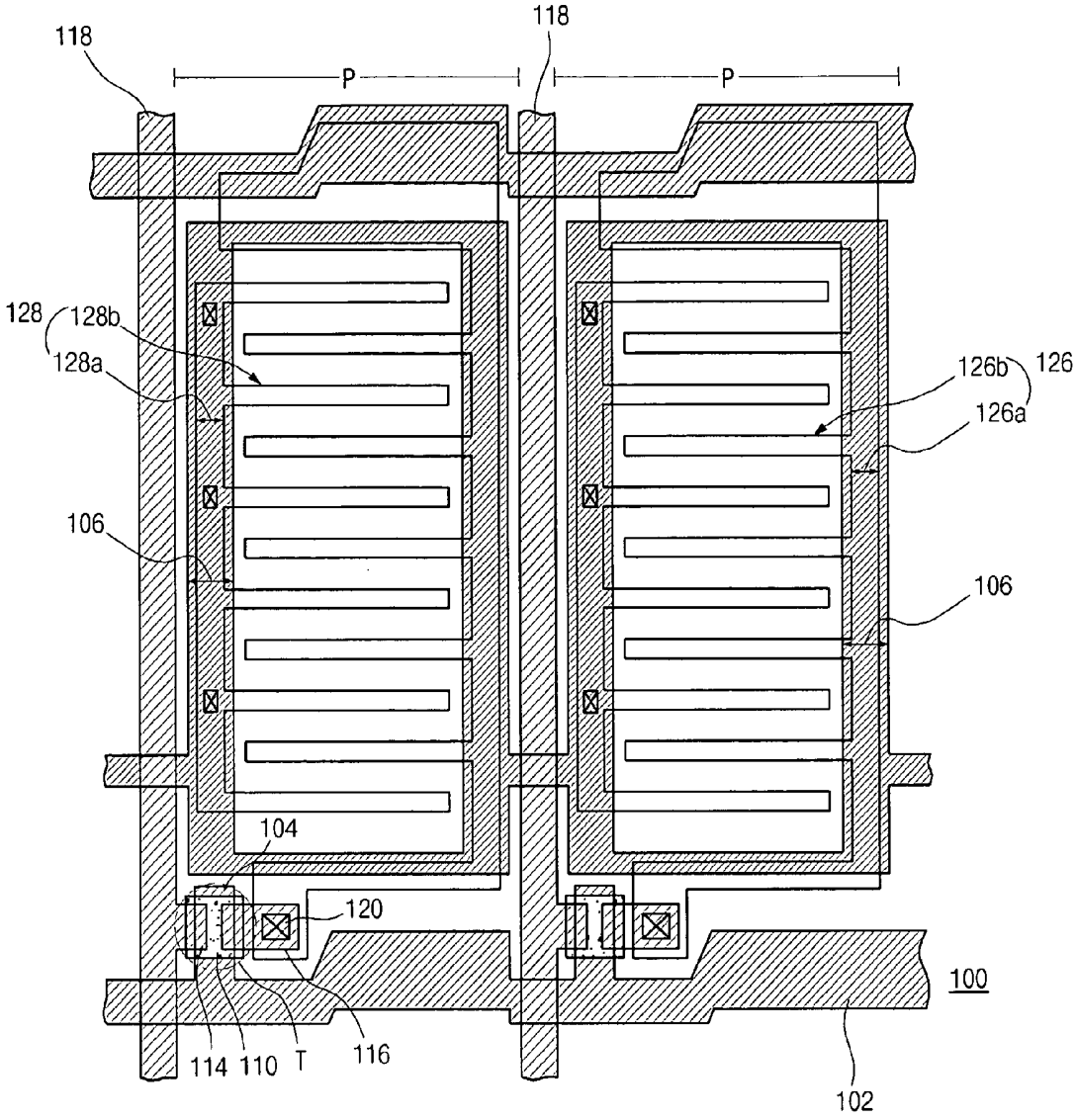

118
118
P
P
128
128b
128a
126b
126
126a
106
106
104
120
100
114
110
T
116
102

FIG. 6

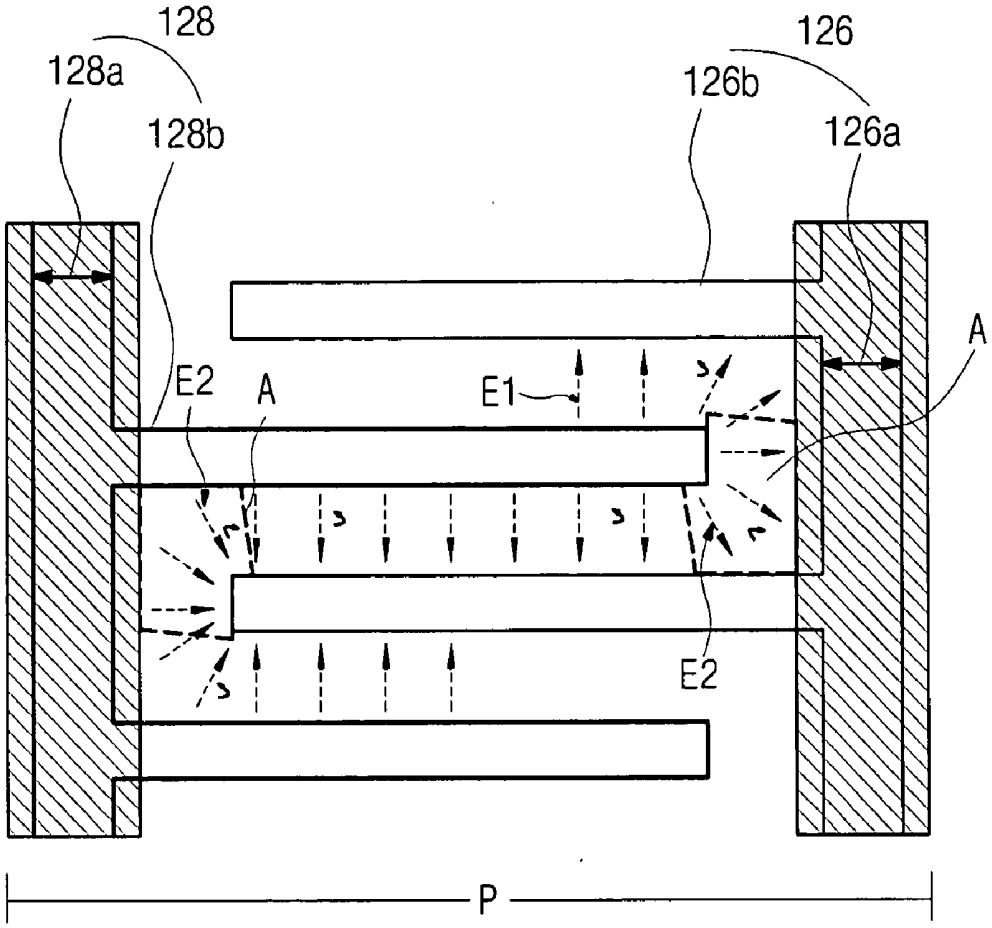


FIG. 7

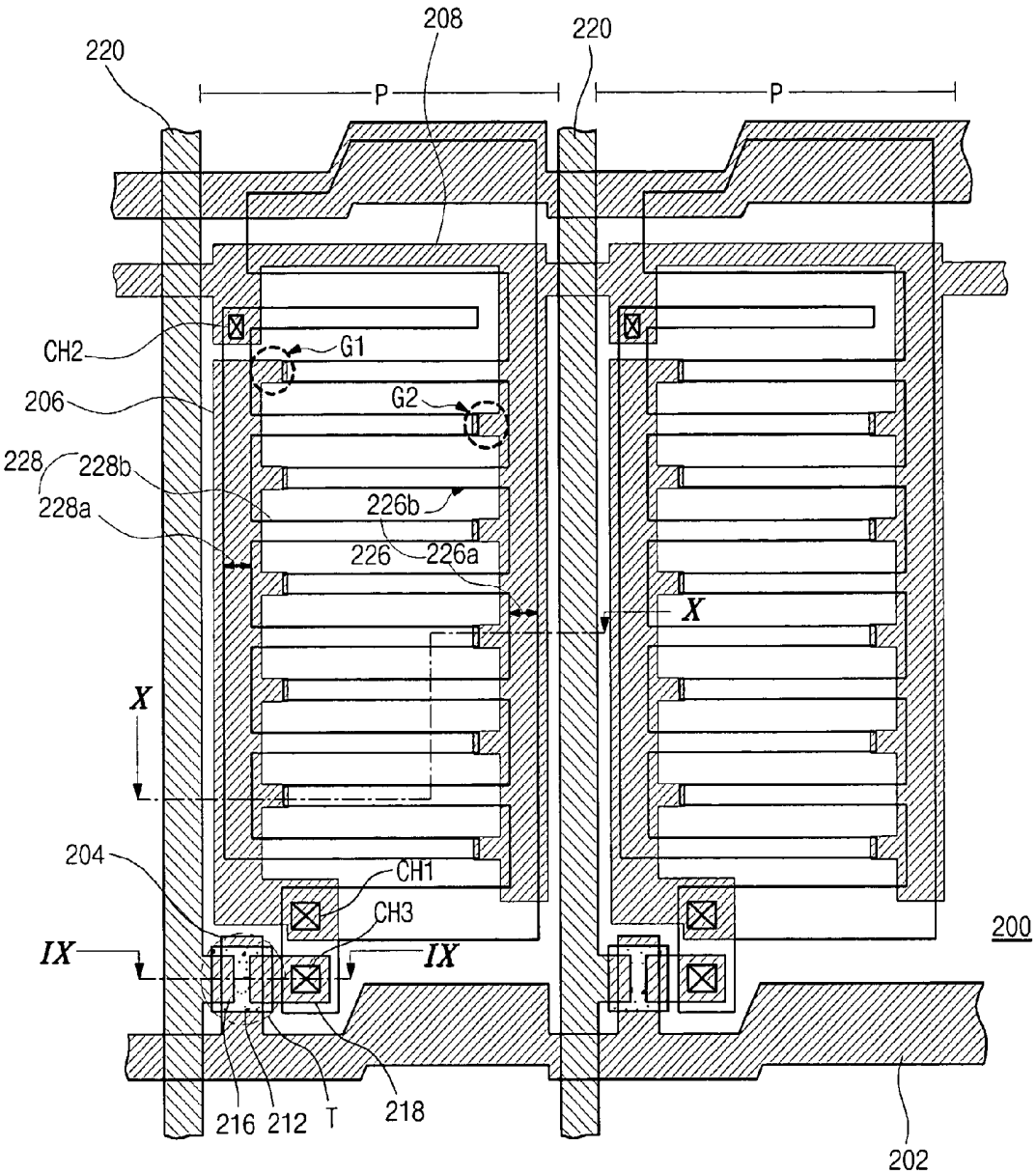

208
220
220
P
P
CH2
G1
206
G2
228
228b
228a
226b
226
226a
X
X
204
CH1
CH3
200
IX
IX
216
212
T
218
202

FIG. 8

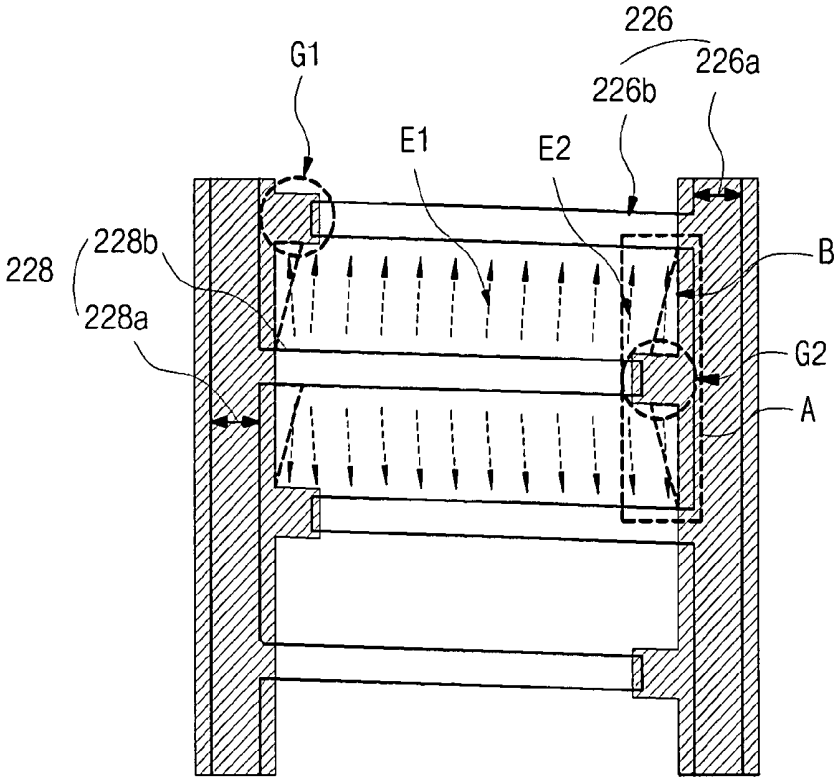

226
G1
226a
226b
E1
E2
228b
228
B
228a
G2
A

FIG. 9A

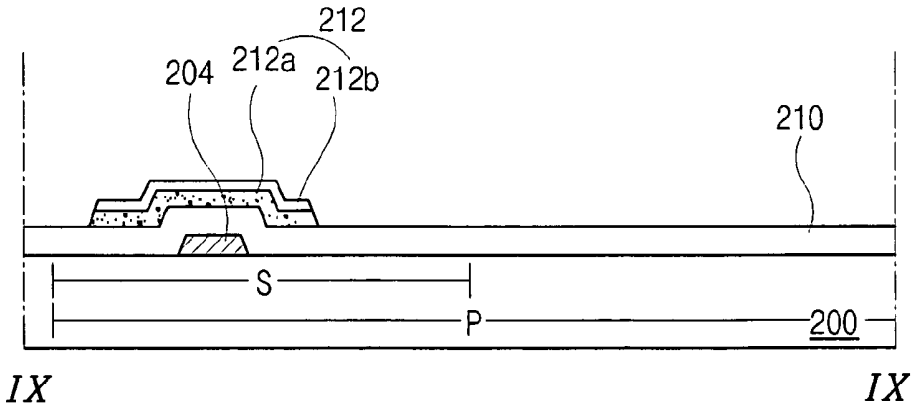

212
204
212a
212b
210
S
P
200
IX
IX

FIG. 9B

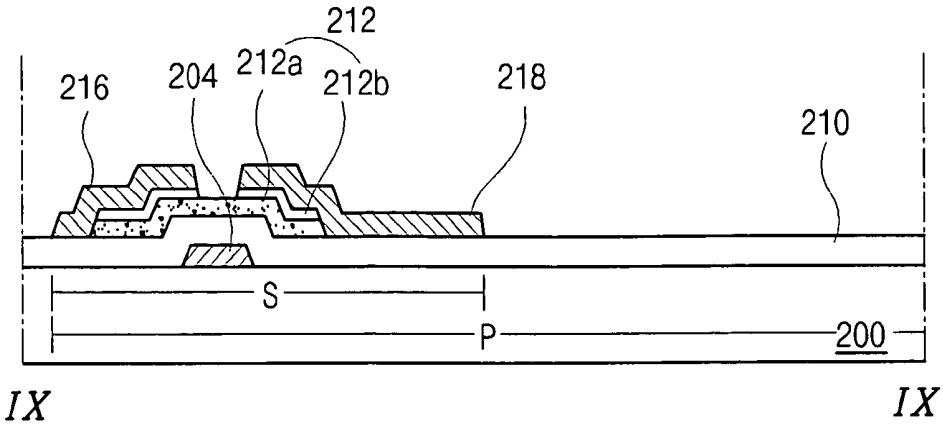


FIG. 9C

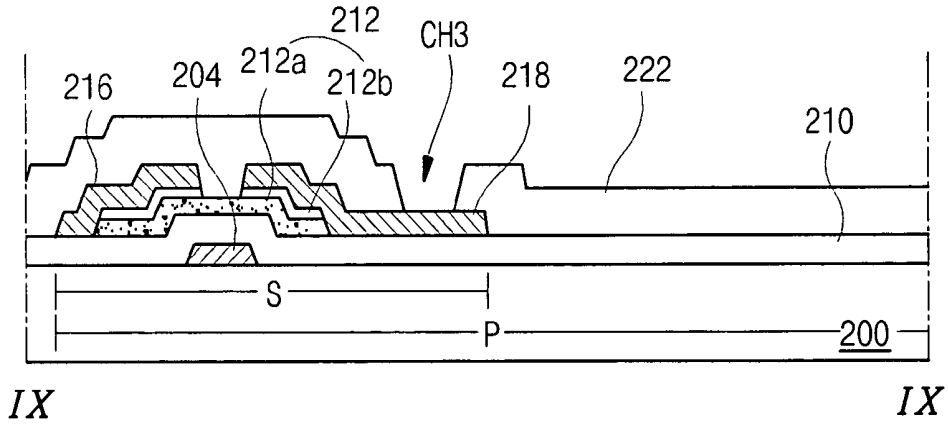


FIG. 9D

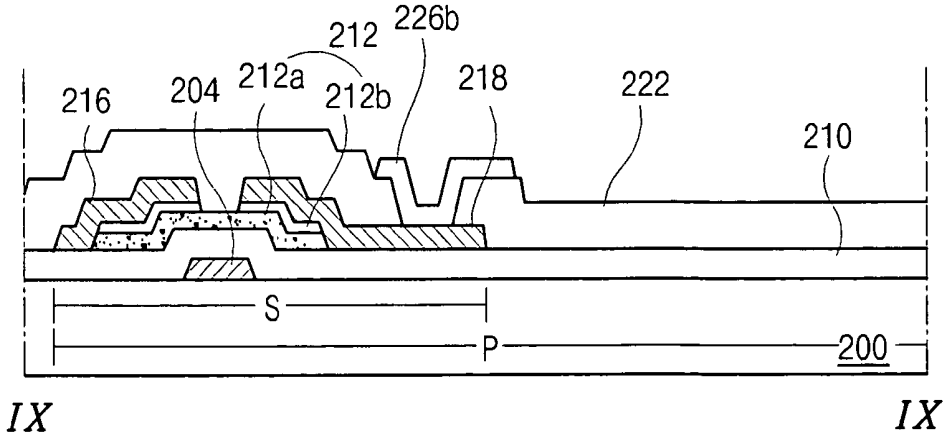


FIG. 10A

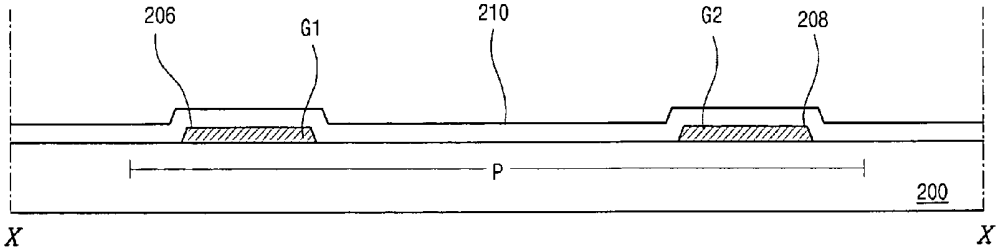


FIG. 10B

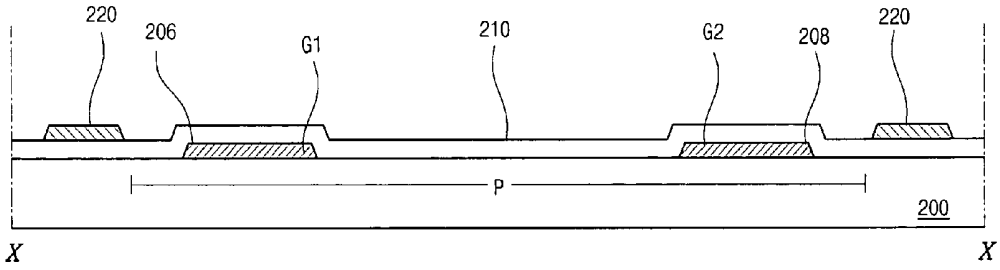


FIG. 10C

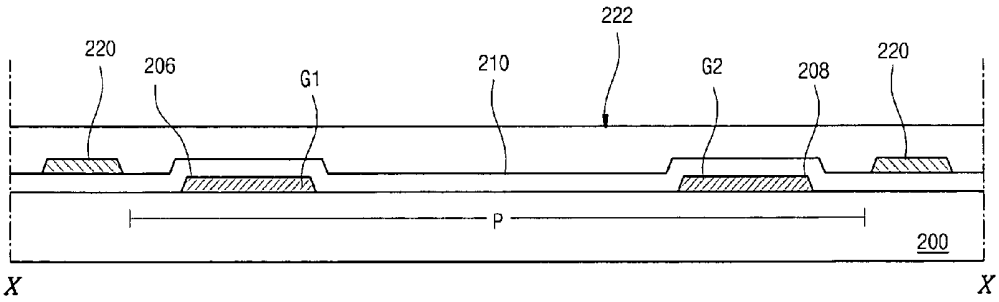
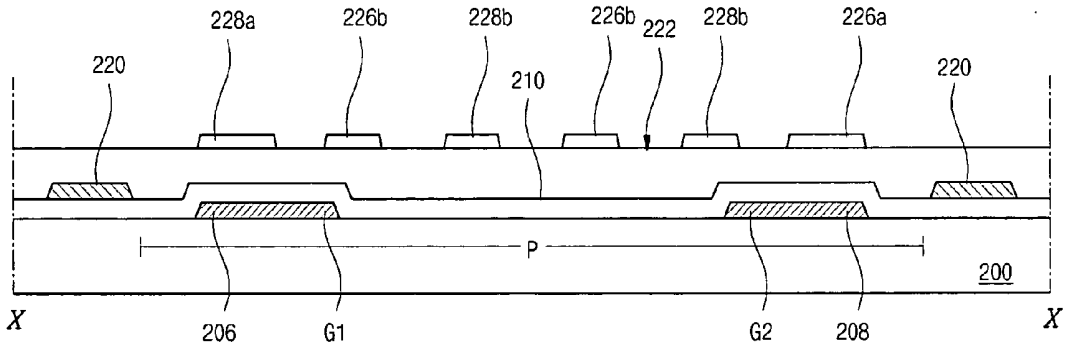


FIG. 10D


228a
226b
228b
226b
222
228b
226a
220
210
220
P
200
X
206
G1
G2
208
X

ARRAY SUBSTRATE FOR IN-PLANE SWITCHING MODE LIQUID CRYSTAL DISPLAY DEVICE AND METHOD OF FABRICATING THE SAME

[0001] The present application claims the benefit of Korean Patent Application No. 2005-0133555 filed in Korea on Dec. 29, 2005, which is hereby incorporated by reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to a liquid crystal display (LCD) device, and more particularly, to an array substrate for an In-Plane Switching (IPS) mode LCD device that has an increased luminance and method of fabricating such IPS mode LCD device.

[0004] 2. Disscussion of the Related Art

[0005] The liquid crystal molecules for the LCD device have unique characteristics, such that an arrangement direction (i.e., orientation) of the liquid crystal molecules can be controlled by applying a desired level of an electrical field to them. As a result, the liquid crystal molecules become aligned to transmit light, and images can be displayed on the screen. Thus, the LCD device displays images by controlling magnitudes of the electric field applied to the liquid crystal molecules. In addition, the LCD device is sometimes referred to as an active matrix LCD (AM-LCD) device that includes an improved resolution and improved displaying features (i.e., faster response time while displaying the moving images).

[0006] Generally, most LCD devices include a thin film transistor (TFT) as a switching element. Further, a related art LCD device includes a first substrate and a second substrate that are facing each other and a liquid crystal layer interposed between the two substrates. The first substrate includes a pixel electrode, and the second substrate includes a color filter layer and a common electrode. The related art LCD device displays images by generating a vertical electric field between the pixel and common electrodes. The related art LCD device using the vertical electric field has an increased light transmittance and an increased aperture ratio. However, the related art LCD device has several problems, such as a narrow viewing angle, low contrast ratio, and other problems. To resolve the above-mentioned problems, an in-plane switching (IPS) mode LCD device having a wide viewing angle is suggested.

[0007] FIG. **1** is a cross-sectional view of a related art IPS mode LCD device. As shown in FIG. **1**, the related art IPS mode LCD device includes first and second substrates **10** and **40** that are facing each other, and a liquid crystal layer LC interposed between the two substrates. The first and second substrates **10** and **40** may be referred to as an array substrate and a color filter substrate, respectively.

[0008] A pixel region P is defined on the first substrate **10**. A thin film transistor (TFT) T, a common electrode **18** and a pixel electrode **30** are formed on the first substrate **10** in the pixel region P. The TFT T includes a gate electrode **14** on the first substrate **10**, a gate insulating layer **20** over the gate electrode **14**, a semiconductor layer **22** over the gate insulating layer **20**, and source and drain electrodes **24** and **26** over the semiconductor layer **22**. The source and drain electrodes **24** and **26** are separated from each other. The common electrodes **18** and the pixel electrodes **30** are arranged alternating each other and also arranged parallel to each other. The common electrode **18** is formed of a same layer and a same material as the gate electrode **14**. The pixel electrode **30** is formed of a same layer and a same material as the source and drain electrodes **24** and **26**. The pixel electrode **30** is connected to the TFT T. The liquid crystal layer LC is controlled by a horizontal electric field generated between the common electrode **18** and the pixel electrode **30**.

[0009] Although not shown in FIG. **1**, gate and data lines are formed on the first substrate **10** to define the pixel region P, and a common line is formed on the first substrate **10** to apply voltage to the common electrode **18**. The second substrate **40** includes a black matrix **42** and a color filter **44**. The black matrix **42** corresponds to the gate line (not shown), the data line (not shown) and the TFT T. The color filter **44** includes sub-color filters **44***a* and **44***b* and corresponds to the pixel region P. Each of the sub-color filters **44***a* and **44***b* includes one of red R, green G and blue B (not shown) color.

[0010] FIG. **2** is a plane view of an array substrate for the related art IPS mode LCD device. As shown in FIG. **2**, the gate line **12** and data line **28** are formed on the first substrate **10** to define the pixel region P, and a common line **16** is formed parallel to the gate line **12**. The TFT T is formed in the pixel region P and connected to the gate and data lines **12** and **28**. The TFT T includes the gate electrode **14**, the gate insulating layer **20** (of FIG. **1**), the semiconductor layer **22** and the source and drain electrodes **24** and **26**. The source and drain electrodes **24** and **26** are separated from each other. The gate electrode **14** extends from the gate line **12** and the source electrode **24** extends from the data line **28**. Moreover, the common electrode **18** and the pixel electrode **30** are formed in a comb shape in the pixel region P. The pixel electrode **30** is connected to the TFT T and the combs of the pixel electrode **30** are arranged alternately with the combs of the common electrode **18**. The common electrode **18** extends from the common line **16** such that the common electrode **18** is perpendicular to the common line **16**. The common and pixel electrodes **18** and **30** are parallel to each other.

[0011] The related art IPS mode LCD device including the array substrate of FIG. **2** has an improved viewing angle in the left and right sides. However, the viewing angle in the upper and lower sides, and along the diagonal direction are not improved. To resolve the above problem, another related art IPS mode LCD device (shown in FIG. **3**) is suggested. The common and pixel electrodes are aligned in a length-wise direction and a width-wise direction to increase the viewing angle in the upper and lower sides.

[0012] FIG. **3** is a plane view of an array substrate for another related art IPS mode LCD device. As shown in FIG. **3**, the gate lines **52** and data lines **66** are formed on the substrate **50** to define the pixel region P. The TFT T is formed in the pixel region P and connected to the gate and data lines **52** and **66**. The TFT T includes the gate electrode **54**, the gate insulating layer (not shown), the semiconductor layer **60** and the source and drain electrodes **62** and **64**. The source and drain electrodes **62** and **64** are separated from each other. The gate electrode **54** extends from the gate line **52** and the source electrode **62** extends from the data line **66**.

Further, the common and pixel electrodes **56** and **72** are formed in the pixel region P. The pixel electrode **72** is connected to the TFT T.

[0013] The common electrode **56** is formed of a same layer and a same material as the gate electrode **54**. The pixel electrode **72** is formed of a transparent conductive material to increase an aperture ratio. However, the pixel electrode **72** may be formed of a same layer and a same material as the source and drain electrodes **62** and **64**. The gate insulating layer (not shown) and a passivation layer (not shown) are disposed between the common electrode **56** and the pixel electrode **72** to prevent the two electrodes from contacting each other.

[0014] The common electrode **56** includes a plurality of first common portions **56***a*, second common portions **56***b*, and third common portions **56***c*. As shown in FIG. **3**, the plurality of first common portions **56***a* are disposed in a width-wise direction, and the second and third common portions **56***b* and **56***c* are disposed in a length-wise direction. In other words, the plurality of first common portions **56***a* are disposed parallel to the gate line **52**, and the second and third common portions **56***b* and **56***c* are disposed parallel to the data line **66**. Similarly, the pixel electrode **72** includes a plurality of first pixel portions **72***a*, second pixel portions **72***b*, and third pixel portions **72***c*. The plurality of first pixel portions **72***a* are disposed in the width-wise direction, and the second and third pixel portions **72***b* and **72***c* are disposed in the length-wise direction. The plurality of first pixel portions **72***a* are parallel to the plurality of first common portion **56***a*, and the second and third pixel portions **72***b* and **72***c* are parallel to the first and second common portions **56***b* and **56***c*.

[0015] Since the common and pixel electrodes **56** and **72** are disposed in the width-wise and length-wise directions, the viewing angle in the upper and lower sides is improved. Moreover, when the plurality of first common and pixel portions **56***a* and **72***a* are parallel to the gate and data lines **52** and **66**, the viewing angle along the diagonal direction is improved.

[0016] However, since the common and pixel electrodes **56** and **72** are formed of different layers, a misalignment of layers may result. FIG. **4** is a cross-sectional view taken along line IV-IV of FIG. **3**. As shown in FIG. **4**, the plurality of first common portions **56***a* are formed on the substrate **50**. The gate insulating layer **58** is formed over the plurality of common portions **56***a* and the passivation layer **68** is formed over the gate insulating layer **58**. The plurality of first pixel portions **72***a* are formed on the passivation layer **68** and are alternately arranged with the plurality of first common portions **56***a*. Accordingly, since the plurality of first common portions **56***a* are formed on the substrate **50** before the plurality of first pixel portions **72***a* are formed, misalignment is generated during formation of the plurality of first common and first pixel portions **56***a* and **72***a*.

[0017] The plurality of first common and first pixel portions **56***a* and **72***a* are formed by a mask process (not shown) and the misalignment is generated during the mask process. As shown in FIG. **4**, a distance between the first common and pixel portions **56***a* and **72***a* is "L" in a normal area NA. However, a distance between the first common and pixel portions **56***a* and **72***a* becomes "L-a" in a misalignment area MA. And, "L-a" is less than the "L".

[0018] The related art IPS mode LCD device having the above problems includes decreased image display quality. Further, the array substrate of FIG. **3** includes the common electrode **56** formed of a same opaque material as the gate electrode **54**, thus decreasing the luminance.

SUMMARY OF THE INVENTION

[0019] Accordingly, the present invention is directed to an array substrate for an IPS mode LCD device and method of fabricating the same that substantially obviates one or more of the problems due to limitations and disadvantages of the related art.

[0020] An object of the present invention is to provide an IPS mode LCD device that improves a viewing angle and an aperture ratio.

[0021] Additional features and advantages of the invention will be set forth in the description which follows, and in part will be apparent from the description, or may be learned by practice of the invention. The objectives and other advantages of the invention will be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

[0022] To achieve these and other advantages and in accordance with the purpose of the present invention, as embodied and broadly described, an array substrate for an In-Plane Switch (IPS) mode liquid crystal display (LCD) device includes a gate line in a first direction on a substrate and a data line in a second direction over the substrate; a metal line in the second direction on the substrate and including a plurality of first protruding portions in the first direction; a common line in the second direction on the substrate and including a plurality of second protruding portions in the first direction; a thin film transistor (TFT) connected to the gate and data lines; an insulating layer over the metal line and the common line; a common electrode over the insulating layer and including a first common portion in the second direction and a plurality of second common portions in the first direction; and a pixel electrode over the insulating layer and including a first pixel portion in the second direction and a plurality of second pixel portions in the first direction, wherein the plurality of second common portions are alternately arranged with the plurality of second pixel portions.

[0023] In another aspect, a method of fabricating an array substrate for an In-Plane Switch (IPS) mode liquid crystal display (LCD) device includes forming a gate line, a gate electrode, a metal line, and a common line on a substrate, wherein the gate line is formed in a first direction, the gate electrode extends from the gate line in a second direction, and the metal and common lines are formed in the second direction, the second direction perpendicular to the first direction, the metal line separated from the common line, and the metal line includes a plurality of first protruding portions and the common line includes a plurality of second protruding portions; forming an gate insulating layer over the gate line, the gate electrode, the metal line and the common line; forming a semiconductor layer over the gate insulating layer at a portion corresponding to the gate electrode; forming source and drain electrodes and a data line over the semiconductor layer, wherein the data line is formed in the second direction, the source electrode extends from the data line, and the source electrode is separated from the drain electrode; forming a passivation layer over the source and drain electrodes and the data line, and first to third contact holes defined through the passivation layer,

wherein the first contact hole exposes the metal line, the second contact holes expose the common line, and the third contact hole exposes the drain electrode; and forming a common electrode and a pixel electrode over the passivation layer, the common electrode includes a first common portion in the second direction and a plurality of second common portions extending from the first common portion, and the pixel electrode includes a first pixel portion in the second direction and a plurality of second pixel portions extending from the first pixel portion, wherein the plurality of second common portions are alternately arranged with the plurality of second pixel portions.

[0024] In another aspect, an array substrate for an In-Plane Switch (IPS) mode liquid crystal display (LCD) device includes a substrate; a gate line in a first direction on the substrate; a data line in a second direction over the substrate; a common line in the second direction on the substrate; a thin film transistor (TFT) connected to the gate and data lines; an insulating layer on the common line; a common electrode over the insulating layer and including a first common portion in the second direction and a plurality of second common portions in the first direction, and the plurality of second common portions extend from the first common portion; and a pixel electrode over the insulating layer and including a first pixel portion in the second direction and a plurality of second pixel portions in the first direction, and the plurality of second pixel portions extend from the first pixel portion, wherein the first pixel portion is separated from the first common portion, and the plurality of second pixel portions are alternately arranged with the plurality of second common portions.

[0025] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and together with the description serve to explain the principles of the invention. In the drawings:

[0027] FIG. **1** is a cross-sectional view of a related art IPS mode LCD device;

[0028] FIG. **2** is a plane view of an array substrate for the related art IPS mode LCD device of FIG. **1**;

[0029] FIG. **3** is a plane view of an array substrate for another related art IPS mode LCD device;

[0030] FIG. **4** is a cross-sectional view taken along line IV-IV of FIG. **3**;

[0031] FIG. **5** is a plane view of an array substrate for an exemplary IPS-mode LCD device according to a first exemplary embodiment of the present invention;

[0032] FIG. **6** is a plane view illustrating a distorted electric field phenomenon in a pixel region of an array substrate for the exemplary IPS-mode LCD device of FIG. **5**;

[0033] FIG. **7** is a plane view of an array substrate for an exemplary IPS-mode LCD device according to a second exemplary embodiment of the present invention;

[0034] FIG. **8** is a plane view illustrating a distorted electric field phenomenon in a pixel region of an array substrate for the exemplary IPS-mode LCD device of FIG. **7**;

[0035] FIGS. **9**A to **9**D are cross-sectional views taken along line IX-IX of FIG. **7** showing exemplary fabricating processes of the second exemplary embodiment of the present invention; and

[0036] FIGS. **10**A to **10**D are cross-sectional views taken along line X-X of FIG. **7** showing the exemplary fabricating processes of the second exemplary embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0037] Reference will now be made in detail to the preferred embodiments, examples of which are illustrated in the accompanying drawings.

[0038] FIG. **5** is a plane view of an array substrate for an exemplary IPS-mode LCD device according to a first exemplary embodiment of the present invention. As shown in FIG. **5**, the gate line **102**, the data line **118**, and the common line **106** are formed on the substrate **100** to define the pixel region P. The TFT T is formed in the pixel region P and connected to the gate and data lines **102** and **118**. The TFT T includes a gate electrode **104**, a gate insulating layer (not shown), a semiconductor layer **110** and a source electrode **114** and a drain electrode **116**. The gate electrode **104** extends from the gate line **102** and the source electrode **114** extends from the data lines **102**. The source and drain electrodes **114** and **116** are separated from each other. The common line **106** is formed of a same layer as the gate line **102**. As shown in FIG. **5**, common lines **106** formed adjacent to each other (i.e., one common line **106** in one pixel region P and another common line **106** in an adjacent pixel region P) may be connected with each other.

[0039] The common electrode **128** and pixel electrode **126** are formed in the pixel region P. The common electrode **128** is connected to the common line **106** through a common contact hole **108**, and the pixel electrode **126** is connected to the TFT T through a drain contact hole **120**.

[0040] The common electrode **128** includes a first common portion **128***a* and a plurality of second common portions **128***b*. The first common portion **128***a* is aligned in the length-wise direction. The plurality of second common portions **128***b* are aligned in the width-wise direction and formed extending from the first common portion **128***a*. The first common portion **128***a* is parallel to the data line **118**, and the plurality of second common portions **128***b* are perpendicular to the first common portion **128***a*. Similarly, the pixel electrode **126** includes a first pixel portion **126***a* and a plurality of second pixel portions **126***b*. The first pixel portion **126***a* is aligned in the length-wise direction. The plurality of second pixel portions **126***b* are aligned in the width-wise direction and formed extending from the first pixel portion **126***a*. The first pixel portion **126***a* is parallel to the data line **118**, and the plurality of second pixel portions **126***b* are perpendicular to the first pixel portion **126***a*. In addition, the common and pixel electrodes **128** and **126** are formed of a same layer and formed of a same transparent conductive material.

[0041] Since the common and pixel electrodes **128** and **126** are formed of a same layer, misalignment of two layers can be prevented. And, a distance between the pixel and

common electrodes **128** and **126** can be maintained equal at all time. Further, since the common and pixel electrodes **128** and **126** are formed of a transparent conductive material, luminance is improved.

[0042] FIG. **6** is a plane view illustrating a distorted electric field phenomenon in a pixel region of the exemplary array substrate of FIG. **5**. As shown in FIG. **6**, forming the common and pixel electrodes **128** and **126** with a same layer creates gaps between the first common portion **128***a* and each second pixel portion **126***b*, between the first pixel portion **126***a* and each second common portion **128***b*, and between the second common portions **128***b* and the second pixel portions **126***b*. Accordingly, the electric field is induced between the plurality of second common and pixel portions **128***b* and **126***b*, between the first common portion **128***a* and each second pixel portion **128***b*, and between the first pixel portion **126***a* and each second common portion **128***b*.

[0043] As shown in FIG. **6**, the first common portion **128***a* and the plurality of second common portions **128***b* extending from the first common portion **128***a* are formed in the pixel region P. Similarly, the first pixel portion **126***a* and the plurality of second pixel portions **126***b* extending from the first pixel portion **126***a* are formed in the pixel region P. As mentioned earlier, the common and pixel electrode **128** and **126**, hence portions **128***a*, **126***a*, **128***b*, and **126***b* are formed of the same layer and the same transparent conductive material.

[0044] In addition, the plurality of second common portions **128***b* and pixel portions **126***b* are arranged parallel to each other having gaps formed therebetween. Accordingly, a first electric field E**1** is induced between the plurality of second common and pixel portions **128***b* and **126***b*. The plurality of second common portions **128***b* are separated from and perpendicular to the first pixel portion **126***a*. Similarly, the plurality of second pixel portions **126***b* are separated from and perpendicular to the first common portion **128***a*. Accordingly, a second electric field E**2** is generated in a region A. And, the first and second electric fields E**1** and E**2** have different shapes. In more detail, the first electric field E**1** is formed in the length-wise direction. However, the second electric field E**2** is formed along the width-wise direction having a fan shape. And, the second electric field E**2** deteriorates the image quality of the IPS mode LCD device. Accordingly, another exemplary array substrate for an IPS mode LCD device is proposed to solve above problem.

[0045] FIG. **7** is a plane view of an array substrate for an IPS-mode LCD device according to a second exemplary embodiment of the present invention. As shown in FIG. **7**, a gate line **202**, a data line **220**, and a common line **208** are formed on the substrate **200** to define the pixel region P. The TFT T is formed in the pixel region P and connected to the gate and data lines **202** and **220**. The TFT T includes a gate electrode **204**, a gate insulating layer (not shown), a semiconductor layer **212**, and source and drain electrodes **216** and **218**. The gate electrode extends from the gate line **202** and the source electrode **216** extends from the data line **220**. The source and drain electrodes **216** and **218** are separated from each other.

[0046] The common line **208** is formed of a same layer as the gate line **202**. The common lines **208** formed adjacent to each other (i.e., one common line **208** in one pixel region P and another common line **208** in an adjacent pixel region P) may be integrated with each other. The common lines **208** in adjacent pixel regions P is integrated such that a same voltage is applied to them. A metal line **206** having a shape symmetrical with respect to the common line **208** is formed. The common line **208** is formed of a same layer and with a same material as the metal line **206**. As shown in FIG. **10**D, the common electrode **228** is formed over the metal line **206** and the pixel electrodes **226** is formed over the common line **208**. The gate insulating layer **210** and the passivation layer **222** are disposed between the common electrode **228** and the metal line **206**, and between the pixel electrode **226** and the common line **208**.

[0047] In detail, the common electrode **228** includes the first common portion **228***a* and the plurality of second common portions **228***b*. The first common portion **228***a* is formed over the metal line **206** in the length-wise direction. The plurality of second common portions **228***b* extend from the first common portion **228***a* and are perpendicular to the first common portion **228***a*. Similarly, the pixel electrode **226** includes the first pixel portion **226***a* and the plurality of second pixel portions **226***b*. The first pixel portion **226***a* is formed over the common line **208** in the length-wise direction. The plurality of second pixel portions **226***b* extend from the first pixel portion **226***a* and are perpendicular to the first pixel portion **228***a*.

[0048] The first common portion **228***a* is separated from the first pixel portion **226***a* and they are parallel to each other. The plurality of second common portions **228***b* are alternatively arranged with the plurality of pixel portions **226***b*. The metal line **206** is connected to the pixel electrode **226** within a first contact hole CH**1**, the common line **208** is connected to the common electrode **228** within a second contact hole CH**2**, and the pixel electrode **226** is connected to the drain electrode **218** of the TFT T within a third contact hole CH**3**. The metal line **206** may be directly connected to the drain electrode **218** within a third contact hole CH**3**.

[0049] A plurality of first protruding portions G**1** extend perpendicularly from the metal line **206** and are parallel to the plurality of second pixel portions **226***b*. Similarly, a plurality of second protruding portions G**2** extend perpendicularly from the common line **208** and are parallel to the plurality of second common portions **228***b*. In addition, the plurality of first protruding portions G**1** partially overlap the plurality of second pixel portions **226***b*, and the plurality of second protruding portions G**2** partially overlap the plurality of second common portions **228***b*. Accordingly, as shown in FIG. **8**, distortion of the electric field between the first common portion **228***a* and each second pixel portion **226***b* and between the first pixel portion **226***a* and each second common portion **228***b* are prevented.

[0050] FIG. **8** is a plane view illustrating a distorted electric field phenomenon in a pixel region of the exemplary array substrate of FIG. **7**. As shown in FIG. **8**, the first electric field E**1** is induced between the plurality of second common and pixel portions **228***b* and **226***b*, and the second electric field E**2** is generated in a rectangular region A between the first pixel portion **226***a* and each second common portion **228***b*. Similarly, the second electric filed E**2** is generated between the first common portion **228***a* and each second pixel portion **226***b*. In a triangular region B, where the first and second protruding portions G**1** and G**2** meet the metal line **206** and common line **208**, respectively, the second electric field E**2** is lightly distorted. However, the first and second electric fields E**1** and E**2** have a substantially

same shape. Accordingly, image deterioration discussed in the first exemplary embodiment is prevented.

[0051] FIGS. **9**A to **9**D are cross-sectional views taken along line IX-IX of FIG. **7** showing exemplary fabricating processes of the second exemplary embodiment of the present invention. FIGS. **10**A to **10**D are cross-sectional views taken along line X-X of FIG. **7** showing the exemplary fabricating processes of the second exemplary embodiment of the present invention. As shown in FIGS. **9**A, the gate electrode **204** and the gate line **202** (of FIG. **7**, not shown) are formed on the substrate **200** by depositing and patterning a first metal layer (not shown). The gate line **202** (of FIG. **7**) extends from the gate electrode **204**. At the same time, the metal line **206**, the common line **208** and the plurality of first and second protruding portions G**1** and G**2** are formed on the substrate **200** in the pixel region P (FIG. **10**A). The metal line **206** is formed at one side of the pixel region P, and the common line **208** is formed at an opposite end of the pixel region P. The plurality of first protruding portions G**1** extend from the metal line **206** towards the common line **208**, and the plurality of second protruding portions G**2** extend from the common line **208** toward the metal line **206**. A switching region S, where the TFT T is formed, is defined in the pixel region P.

[0052] Next, the gate insulating layer **210** is formed over the gate electrode **204**, the metal line **206**, the common line **208** and the plurality of first and second protruding portions G**1** and G**2** by depositing an inorganic insulating material, such as silicon oxide (SiO2) and silicon nitride (SiNx). Next, the semiconductor layer **212** including an active layer **212***a* and an ohmic contact layer **212***b* are formed on the gate insulating **210** over the gate electrode **204** by depositing and patterning an intrinsic amorphous silicon (a-Si:H) and an impurity-doped amorphous silicon (n+a-Si:H). The active layer **212***a* and the ohmic contact layer **212***b* are formed of intrinsic amorphous silicon (a-Si:H) and impurity-doped amorphous silicon (n+a-Si:H).

[0053] Next, as shown in FIGS. **9**B and **10**B, the source and drain electrodes **216** and **218** are formed on the semiconductor layer **212** and the data lines **220** are formed on the gate insulating layer **210** by depositing and patterning a second metal layer (not shown). The second metal layer (not shown) includes at least one of aluminum (Al), aluminum alloy (AlNd), chromium (Cr), tungsten (W), molybdenum (Mo), Titanium (Ti), and moly-tungsten (MoW). The source electrode **216** extends from the data line **220** and is separated from the drain electrode **218**. And, the data line **220** crosses the gate line **202** (of FIG. **7**) perpendicularly to define the pixel region P. While patterning the second metal layer (not shown), the ohmic contact layer **212***b* between the source and drain electrodes **216** and **218** is also patterned.

[0054] Next, as shown in FIGS. **9**C and **10**C, the passivation layer **222** is formed over the source and drain electrodes **216** and **218** and the data line **220** by depositing and patterning one of an inorganic insulating material and an organic insulating material. The inorganic insulating material includes at least one of silicon oxide (SiO2) and silicon nitride (SiNx), and the organic insulating material includes at least one of benzocyclobutane (BCB) and acrylic resin. While patterning the desired materials, the first to third contact holes CH**1**, CH**2**, and CH**3** (of FIG. **7**) are defined through the passivation layer **222**. The first contact hole CH**1** exposes the metal line **206**, the second contact hole CH**2** exposes the common line **208**, and the third contact hole CH**3** exposes the drain electrode **218**.

[0055] Next, as shown in FIGS. **9**D and **10**D, the pixel electrode **226** and the common electrode **228** are formed on the passivation layer **222** by depositing and patterning a transparent conductive material. The transparent conductive material includes one of indium-tin-oxide (ITO) and indium-zinc-oxide (IZO). At this point, the pixel electrode **226** is connected to the metal line **206** and the drain electrode **218** within the first and third contact holes CH**1** and CH**3**, respectively. The common electrode **228** is connected to the common line **208** within the second contact hole CH**2**. The plurality of second pixel portions **226***b* partially overlap the plurality of first protruding portions G**1**, and the plurality of second common portions **228***b* partially overlap the plurality of second protruding portions G**2**. Accordingly, the exemplary array substrate for the IPS-LCD device according to the second exemplary embodiment of the present invention is manufactured by the processes shown in FIGS. **9**A to **9**D and FIGS. **10**A to **10**D.

[0056] It will be apparent to those skilled in the art that various modifications and variations can be made in the array substrate for IPS mode LCD device and method of fabricating the same of the present invention without departing from the spirit or scope of the invention. Thus, it is intended that the present invention cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

What is claimed is:

1. An array substrate for an In-Plane Switch (IPS) mode liquid crystal display (LCD) device, comprising:

a gate line in a first direction on a substrate and a data line in a second direction over the substrate;

a metal line in the second direction on the substrate and including a plurality of first protruding portions in the first direction;

a common line in the second direction on the substrate and including a plurality of second protruding portions in the first direction;

a thin film transistor (TFT) connected to the gate and data lines;

an insulating layer over the metal line and the common line;

a common electrode over the insulating layer and including a first common portion in the second direction and a plurality of second common portions in the first direction; and

a pixel electrode over the insulating layer and including a first pixel portion in the second direction and a plurality of second pixel portions in the first direction, wherein the plurality of second common portions are alternately arranged with the plurality of second pixel portions.

2. The substrate according to claim **1**, wherein the first common portion and the first pixel portion correspond to the metal line and the common line, respectively.

3. The substrate according to claim **1**, wherein the metal line and the common line are formed of a same layer and a same material as the gate line.

4. The substrate according to claim **1**, wherein the common and pixel electrodes are formed of a same layer.

5. The substrate according to claim **1**, wherein the common and pixel electrodes are formed of one of indium-tin-oxide (ITO) and indium-zinc-oxide (IZO).

6. The substrate according to claim 1, wherein the common electrode is connected to the common line.

7. The substrate according to claim 1, wherein the pixel electrode is connected to the thin film transistor (TFT) and the metal line.

8. The substrate according to claim 1, wherein each of the plurality of second pixel portions partially overlaps each of the plurality of first protruding portions.

9. The substrate according to claim 1, wherein each of the plurality of second common portions partially overlaps each of the second protruding portions.

10. A method of fabricating an array substrate for an In-Plane Switch (IPS) mode liquid crystal display (LCD) device, comprising:

forming a gate line, a gate electrode, a metal line, and a common line on a substrate, wherein the gate line is formed in a first direction, the gate electrode extends from the gate line in a second direction, and the metal and common lines are formed in the second direction, the second direction perpendicular to the first direction, the metal line separated from the common line, and the metal line includes a plurality of first protruding portions and the common line includes a plurality of second protruding portions;

forming an gate insulating layer over the gate line, the gate electrode, the metal line and the common line;

forming a semiconductor layer over the gate insulating layer at a portion corresponding to the gate electrode;

forming source and drain electrodes and a data line over the semiconductor layer, wherein the data line is formed in the second direction, the source electrode extends from the data line, and the source electrode is separated from the drain electrode;

forming a passivation layer over the source and drain electrodes and the data line, and first to third contact holes defined through the passivation layer, wherein the first contact hole exposes the metal line, the second contact holes expose the common line, and the third contact hole exposes the drain electrode; and

forming a common electrode and a pixel electrode over the passivation layer, the common electrode includes a first common portion in the second direction and a plurality of second common portions extending from the first common portion, and the pixel electrode includes a first pixel portion in the second direction and a plurality of second pixel portions extending from the first pixel portion, wherein the plurality of second common portions are alternately arranged with the plurality of second pixel portions.

11. The method according to claim 10, wherein the first common portion corresponds to the metal line and the first pixel portion corresponds to the common line.

12. The method according to claim 10, wherein the common and pixel electrodes are formed of one of indium-tin-oxide (ITO) and indium-zinc-oxide (IZO).

13. The method according to claim 10, wherein the common electrode is connected to the common line within the second contact hole, and the pixel electrode is connected to the metal line and the drain electrode within the first and third contact holes, respectively.

14. The method according to claim 10, wherein each of the plurality of second pixel portions partially overlaps each of the plurality of first protruding portions, and each of the plurality of second common portions partially overlaps each of the plurality of second protruding portions.

15. An array substrate for an In-Plane Switch (IPS) mode liquid crystal display (LCD) device, comprising:

a substrate;

a gate line in a first direction on the substrate;

a data line in a second direction over the substrate;

a common line in the second direction on the substrate;

a thin film transistor (TFT) connected to the gate and data lines;

an insulating layer on the common line;

a common electrode over the insulating layer and including a first common portion in the second direction and a plurality of second common portions in the first direction, and the plurality of second common portions extend from the first common portion; and

a pixel electrode over the insulating layer and including a first pixel portion in the second direction and a plurality of second pixel portions in the first direction, and the plurality of second pixel portions extend from the first pixel portion, wherein the first pixel portion is separated from the first common portion, and the plurality of second pixel portions are alternately arranged with the plurality of second common portions.

16. The substrate according to claim 15, wherein the common and pixel electrodes are formed of a same layer.

17. The substrate according to claim 15, wherein the common and pixel electrodes are formed of one of indium-tin-oxide (ITO) and indium-zinc-oxide (IZO).

18. The substrate according to claim 15, wherein the first common portion is connected to the common line and the first pixel portion is connected to the thin film transistor (TFT).

* * * * *

专利名称(译)	用于面内切换模式液晶显示装置的阵列基板及其制造方法		
公开(公告)号	US20070153201A1	公开(公告)日	2007-07-05
申请号	US11/642590	申请日	2006-12-21
[标]申请(专利权)人(译)	乐金显示有限公司		
申请(专利权)人(译)	LG.PHILIPS LCD CO.，LTD.		
当前申请(专利权)人(译)	LG DISPLAY CO.，LTD.		
[标]发明人	LEE DO YOUNG LIM BYOUNG HO LEE HYUN KYU KIM DO SUNG KANG BYUNG KOO KIM EUI TAE		
发明人	LEE, DO-YOUNG LIM, BYOUNG-HO LEE, HYUN-KYU KIM, DO-SUNG KANG, BYUNG-KOO KIM, EUI-TAE		
IPC分类号	G02F1/1343		
CPC分类号	G02F1/134363 G02F2201/40 G02F1/136286 G02F1/1362		
优先权	1020050133555 2005-12-29 KR		
其他公开文献	US7751012		
外部链接	Espacenet USPTO		

摘要(译)

用于IPS模式LCD器件的阵列基板包括在基板上沿第一方向的栅极线和沿基板上的第二方向的数据线;在基板上沿第二方向的金属和公共线，并且分别包括在第一方向上的多个第一和第二突出部分; TFT连接到栅极线和数据线;金属和公共线上的绝缘层;绝缘层上的公共电极，包括沿第二方向的第一公共部分和沿第一方向的多个第二公共部分;绝缘层上方的像素电极，包括第二方向上的第一像素部分和第一方向上的多个第二像素部分，其中多个第二公共像素部分和像素部分交替排列。