



US008305312B2

(12) **United States Patent**
Kim

(10) **Patent No.:** **US 8,305,312 B2**
(45) **Date of Patent:** **Nov. 6, 2012**

(54) **LIQUID CRYSTAL DISPLAY AND METHOD
FOR MANUFACTURING THE SAME**

(75) Inventor: **Dong-Gyu Kim**, Yongin-si (KR)

(73) Assignee: **Samsung Display Co., Ltd.** (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 762 days.

(21) Appl. No.: **12/368,787**

(22) Filed: **Feb. 10, 2009**

(65) **Prior Publication Data**

US 2010/0001936 A1 Jan. 7, 2010

(30) **Foreign Application Priority Data**

Jul. 2, 2008 (KR) 10-2008-0063973

(51) **Int. Cl.**
G09G 3/36 (2006.01)

(52) **U.S. Cl.** **345/87; 345/88**

(58) **Field of Classification Search** None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,419,991 A 5/1995 Segawa
2006/0033871 A1 2/2006 Kim

FOREIGN PATENT DOCUMENTS

KR 10-0428484 4/2004
KR 1020040048757 6/2004
KR 1020040060042 7/2004
KR 1020070060042 7/2004
KR 1020050011091 1/2005

KR 1020070005923 1/2007
KR 1020070091730 9/2007
KR 1020070106062 11/2007
KR 1020070122158 12/2007

OTHER PUBLICATIONS

English Abstract for KR Pat. Pub. No. 1020040060042, 2 pages.
English Abstract for KR Pat. Pub. No. 1020070091730, 1 page.
English Abstract for KR Pat. Pub. No. 1020070005923, 2 pages.
English Abstract for KR Pat. Pub. No. 1020050011091, 1 page.
English Abstract for KR Pat. Pub. No. 1020070106062, 2 pages.
English Abstract for KR Pat. Pub. No. 1020070122158, 2 pages.
English Abstract for KR Pat. Pub. No. 1020070060042, 2 pages.
English Abstract for KR Pat. Pub. No. 1020040048757, 2 pages.

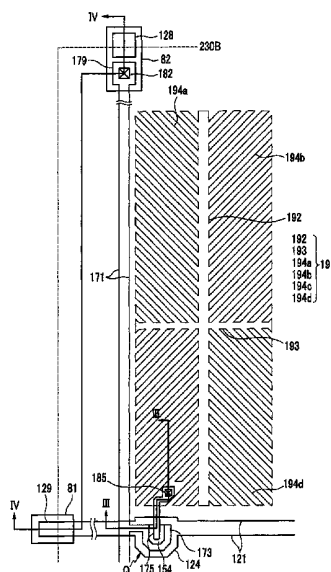
Primary Examiner — Paul Hober

(74) *Attorney, Agent, or Firm* — Innovation Counsel LLP

(57) **ABSTRACT**

A liquid crystal display includes: a substrate; a display region on the substrate, the display region comprising: one or more gate lines overlying the substrate; a gate insulating layer overlying the gate lines; a semiconductor layer overlying the gate insulating layer; one or more pairs of source and drain electrodes overlying the semiconductor layer, each pair being a pair of one source electrode and one corresponding drain electrode facing the source electrode; one or more data lines overlying the semiconductor layer, each data line comprising one or more of the source electrodes, wherein a display area is provided at each intersection of the data lines with the gate lines; a passivation layer overlying the data lines and the drain electrodes and comprising a plurality of contact holes; and one or more color filters overlying the passivation layer and comprising a plurality of through holes. In top view, the semiconductor layer has the same shape as the data lines and the drain electrodes except over each region between each source electrode and the corresponding drain electrode. The contact holes' edges are aligned with the through holes' edges.

16 Claims, 15 Drawing Sheets



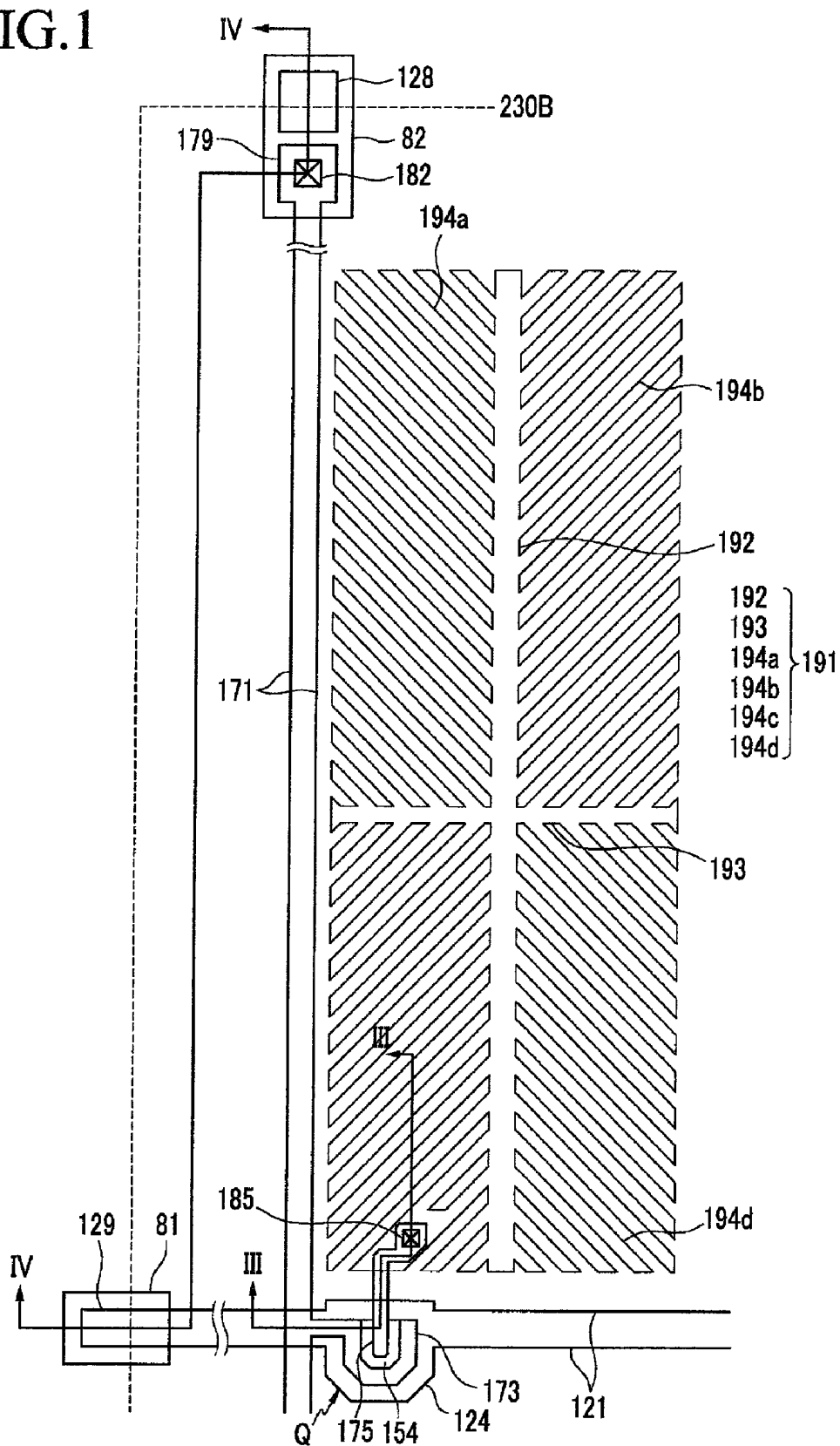


FIG. 2

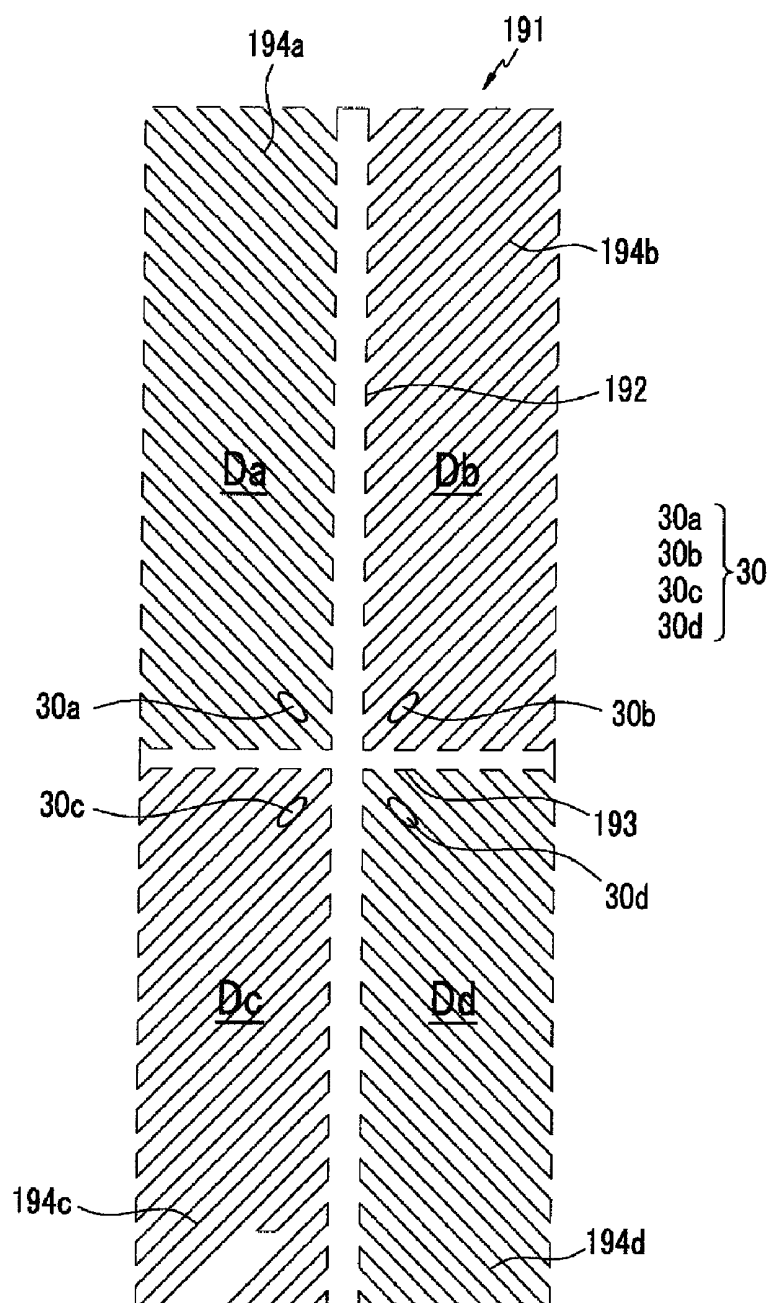


FIG. 3

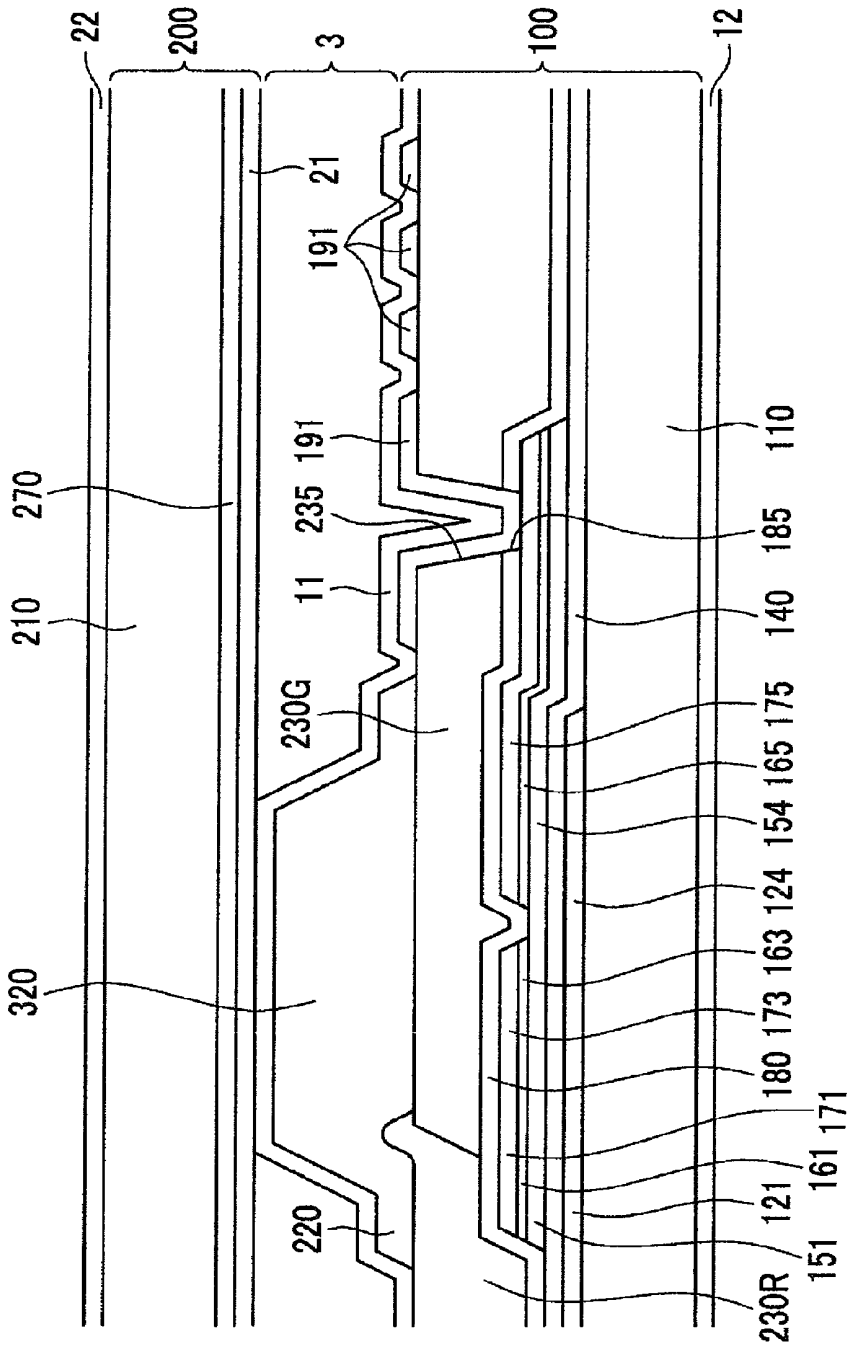


FIG. 4

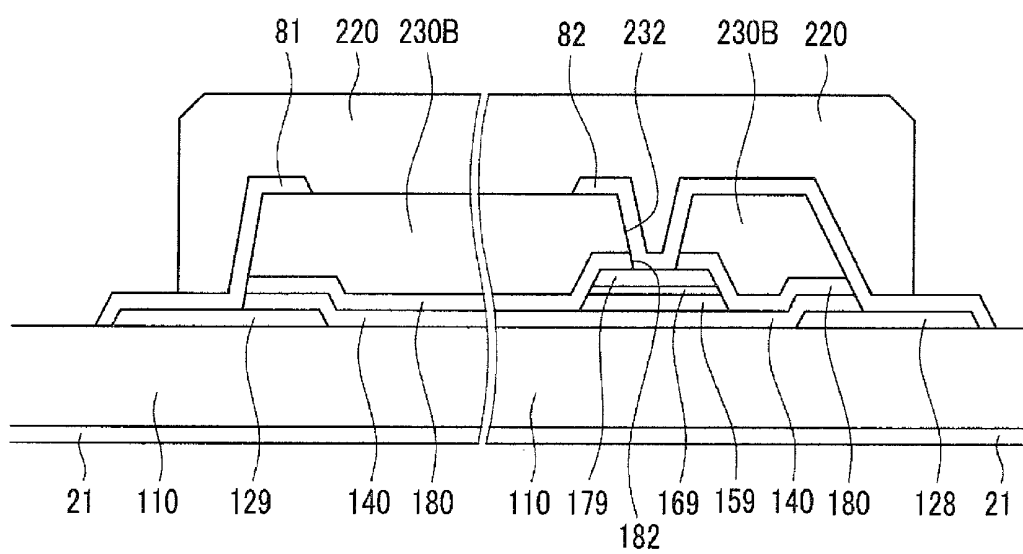


FIG. 5

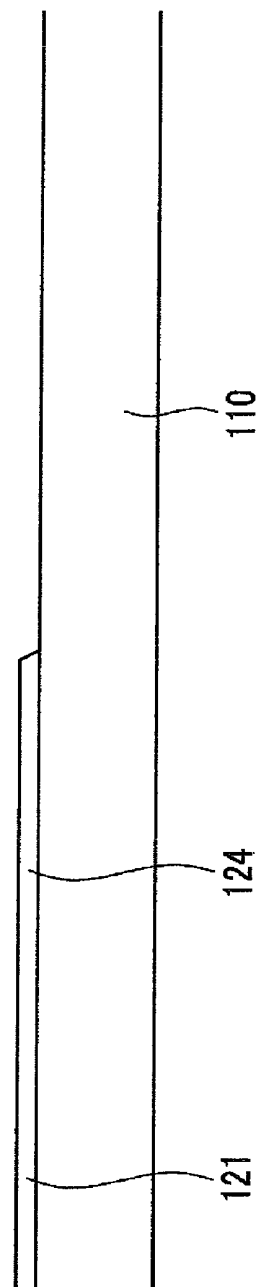


FIG.6

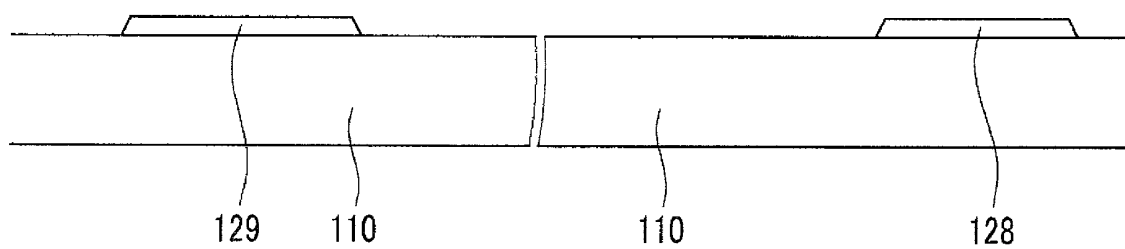


FIG. 7

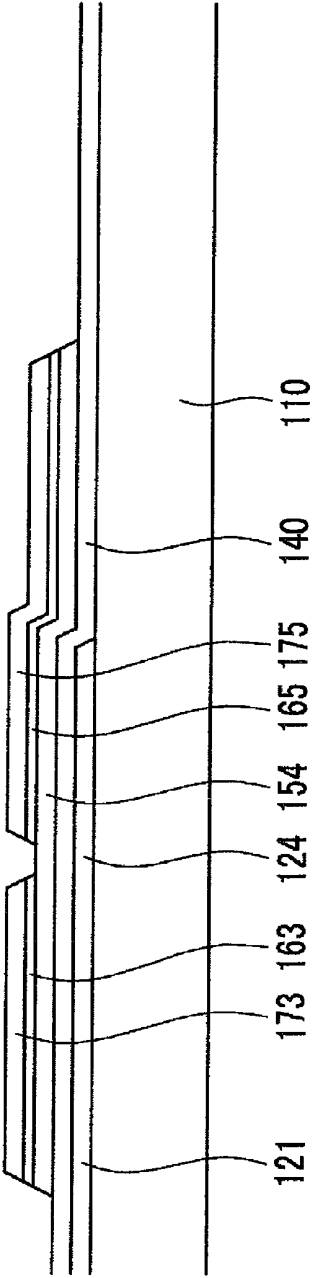


FIG. 8

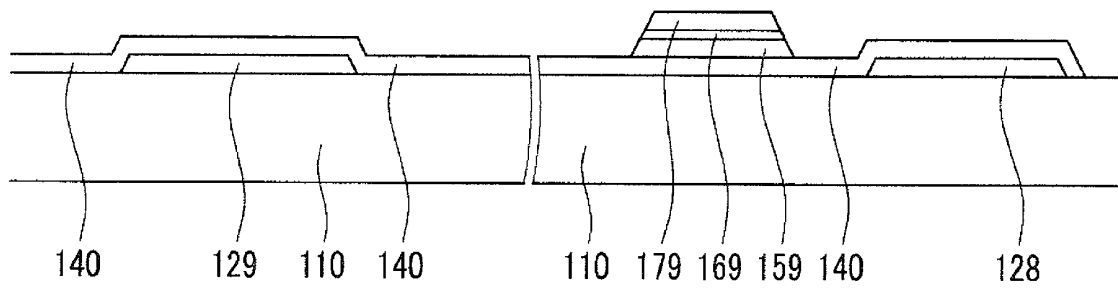


FIG. 9

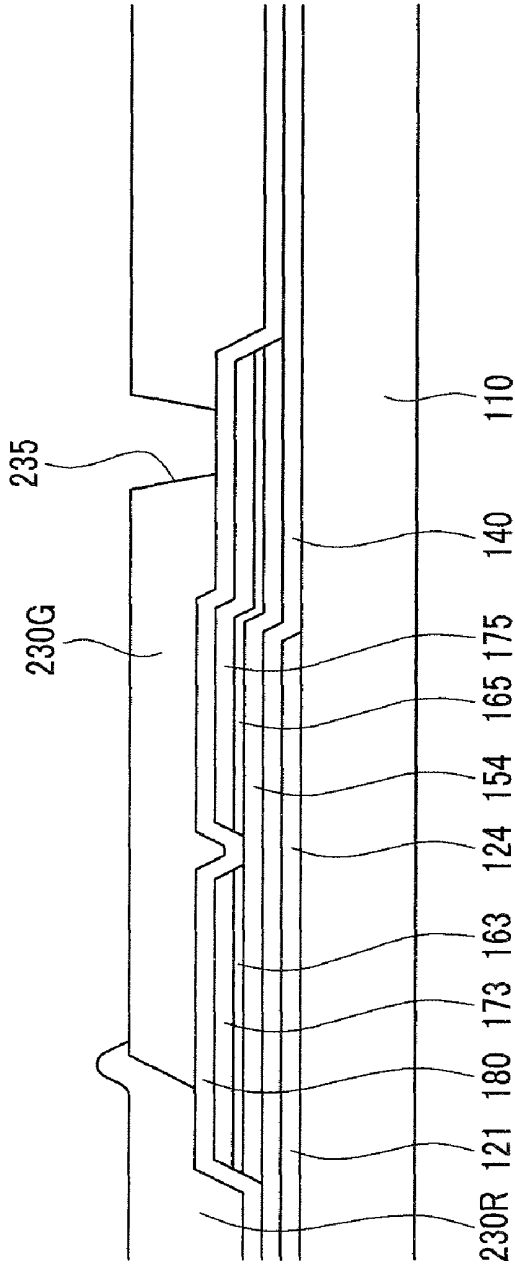


FIG. 10

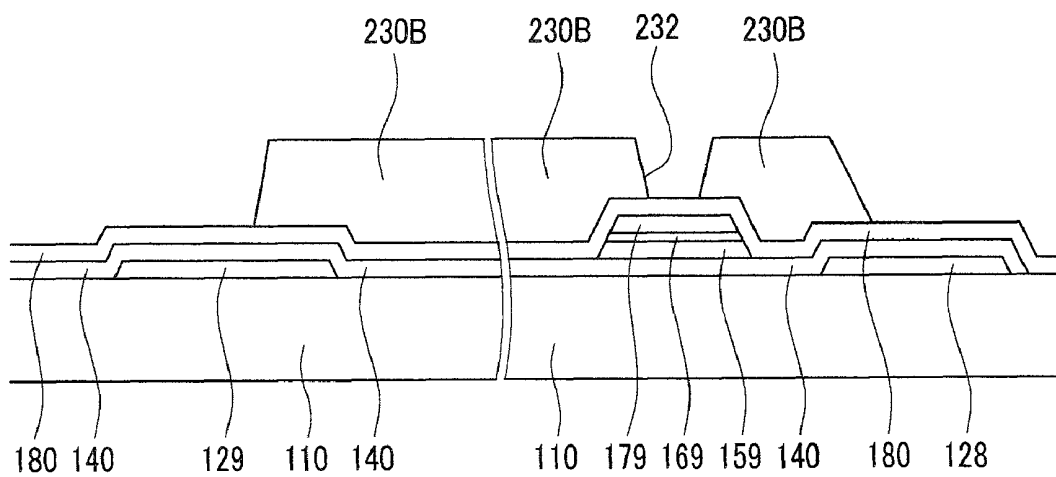


FIG. 11

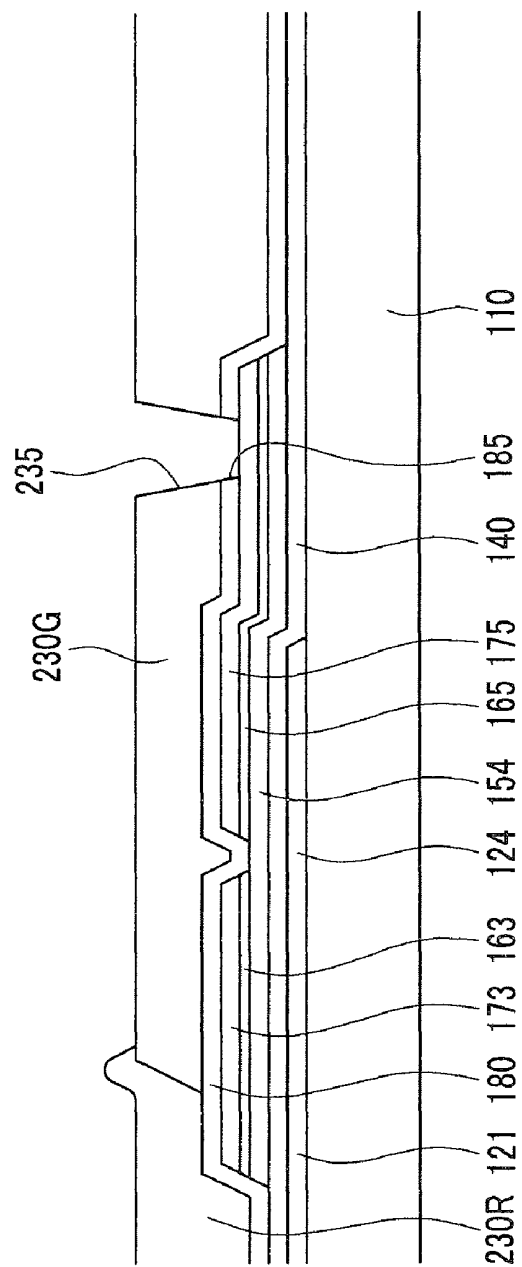


FIG. 12

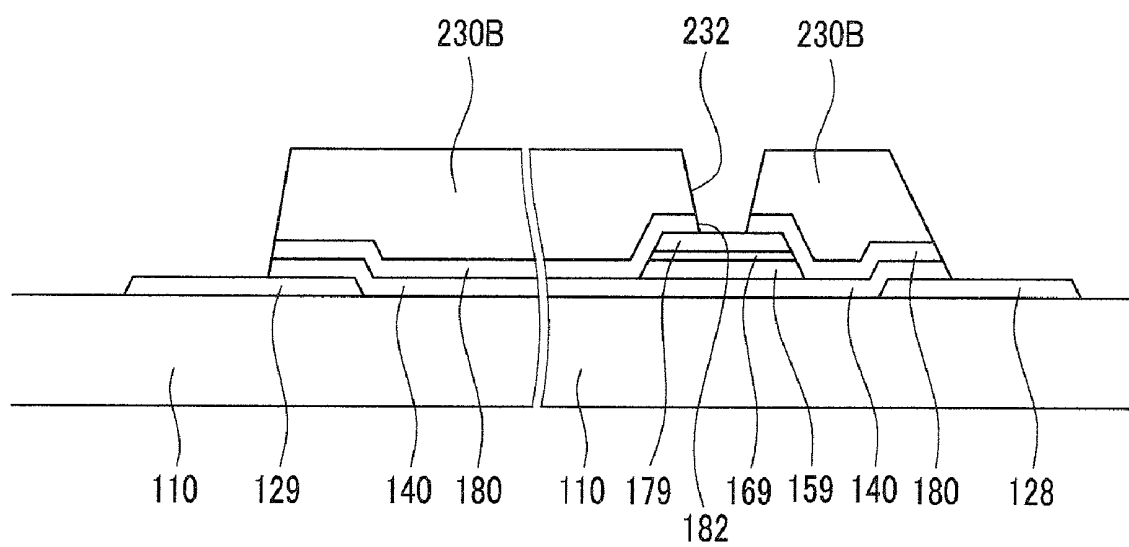


FIG. 13

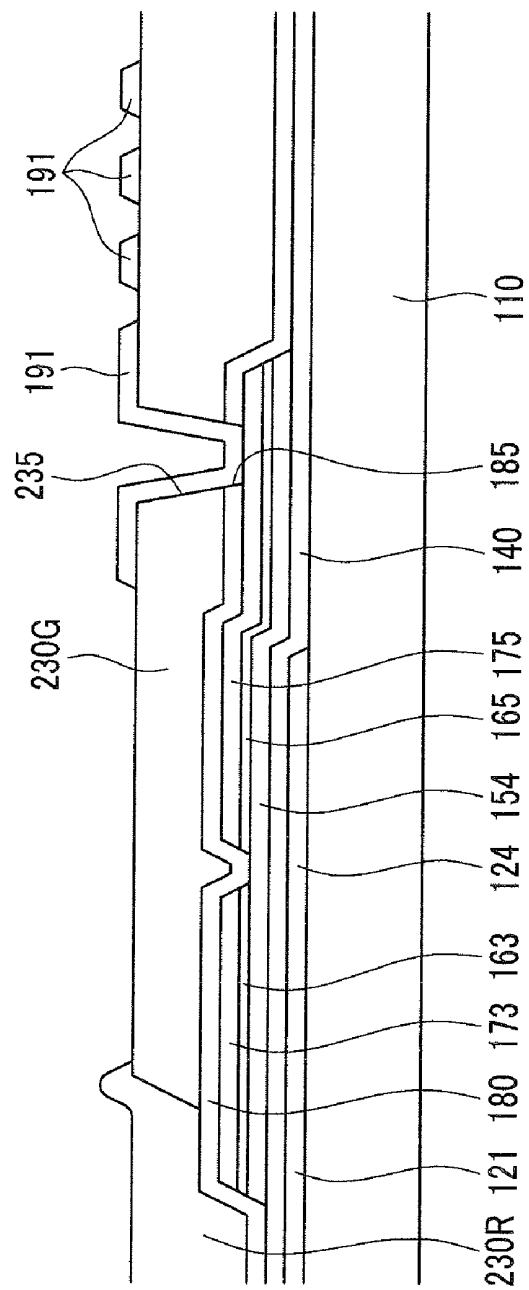


FIG. 14

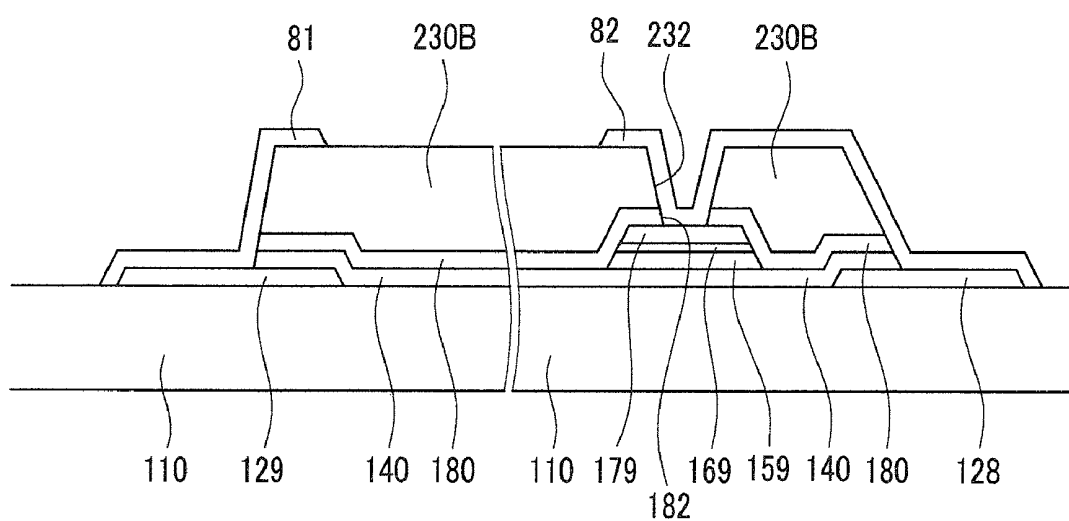
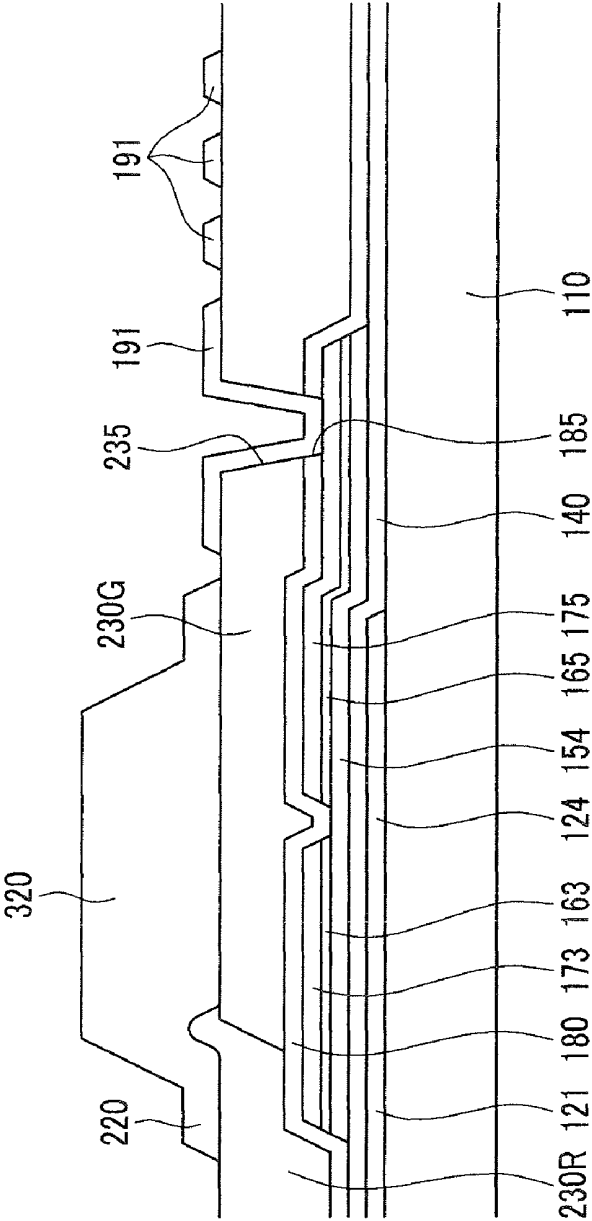


FIG.15



LIQUID CRYSTAL DISPLAY AND METHOD FOR MANUFACTURING THE SAME

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority to and the benefit of Korean Patent Application No. 10-2008-0063973 filed in the Korean Intellectual Property Office on Jul. 2, 2008, the entire contents of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

(a) Field of the Invention

The present invention relates to a liquid crystal display and a manufacturing method thereof.

(b) Description of the Related Art

A liquid crystal display is one of widely used types of flat panel displays. The liquid crystal display includes two display panels containing field generating electrodes such as pixel electrodes and a common electrode. A liquid crystal layer is interposed between the display panels. Voltages are applied to the field generating electrodes to generate an electric field in the liquid crystal layer. The electric field determines the tilt angles of the liquid crystal molecules. The tilt angles control the polarization of incident light so as to form a desired image.

In many liquid crystal displays, the pixel electrodes are located in one of the panels and the common electrode is located in the other panel.

A liquid crystal display may also include color filters made of an organic material containing pigments for color display. If the color filters are located in the different panel than the pixel electrodes, the pixel electrodes may be undesirably misaligned with the color filters. To solve this problem, a color filter on array (CoA) structure has been developed in which the pixel electrodes and the color filters are formed in the same display panel. In addition to the color filters and the pixel electrodes, such display panel contains signal lines (such as gate lines and data lines) used to provide voltages to the pixel electrodes and also contains switching elements for controllably providing these voltages to the pixel electrodes.

Such display panel is formed using a number of thin films including one or more insulating layers, one or more semiconductor layers, and a number of conductive layers for the gate lines and the data lines. These thin films are patterned by photolithographic processes using a number of optical masks. Use of each mask increases the process time and complexity because use of each mask involves photoresist deposition, exposure, developing, and cleaning. Accordingly, it is desirable to reduce the number of masks required.

The above information disclosed in this Background section is only for enhancement of understanding of the background of the invention and may therefore contain information that does not form prior art for this patent application.

SUMMARY

In some embodiments of the present invention, a display panel for a liquid crystal display having a color filter on array structure can be manufactured with a reduced number of masks.

Some embodiments of the present invention provide a liquid crystal display comprising: a substrate; a display region on the substrate, the display region comprising: one or more gate lines overlying the substrate; a gate insulating layer overlying the gate lines; a semiconductor layer overlying the

gate insulating layer; one or more pairs of source and drain electrodes overlying the semiconductor layer, each pair being a pair of one source electrode and one corresponding drain electrode facing the source electrode; one or more data lines overlying the semiconductor layer, each data line comprising one or more of the source electrodes, wherein a display area is provided at each intersection of the data lines with the gate lines; a passivation layer overlying the data lines and the drain electrodes and comprising a plurality of contact holes; and one or more color filters overlying the passivation layer and comprising a plurality of through holes, wherein in said display region, in top view, the semiconductor layer has the same shape as the data lines and the drain electrodes except over each region between each source electrode and the corresponding drain electrode, and the contact holes' edges are aligned with the through holes' edges.

In some embodiments, the contact holes comprise: for each drain electrode, a first contact hole exposing an end portion of the drain electrode; and for each data line a second contact hole exposing an end portion of the data line.

In some embodiments, at least one said color filter is present in a region adjacent to the end portion of one of the gate lines and the end portion of one of the data lines, wherein said region does not overlap with any display area.

In some embodiments, said at least one said color filter overlaps the end portions of the one of the gate lines and the one of the data lines.

In some embodiments, said at least one said color filter is a blue color filter.

Some embodiments further comprise at least one data pad formed of the same material as the gate lines and electrically connected to the end portion of at least one of the data lines.

In some embodiments, said at least one said color filter is a blue color filter overlying the data pad.

Some embodiments further comprise a contact member connecting the end portion of at least one of the data lines to the data pad through the second contact hole and the second through hole.

Some embodiments further comprise one or more pixel electrodes, each pixel electrode being present in a respective one of said display areas, wherein each pixel electrode comprises a plurality of minute branches whose edges include edges extending in different (non-parallel) directions.

In some embodiments, each of the edges of the minute branches forms an angle of 45° or 135° with the gate lines.

Some embodiments further comprise a light blocking member and a column spacer which overlie the pixel electrodes.

In some embodiments, the light blocking member and the column spacer are formed of the same material but their top surfaces are at different heights.

In some embodiments, the light blocking member overlies the end portion of each gate line and of each data line.

In some embodiments, the color filters overlie the end portion of each gate line and of each data line.

In some embodiments, each color filter overlying the end portion of at least one gate line and/or at least one data line is a blue color filter.

Some embodiments provide method for manufacturing a liquid crystal display, the method comprising: forming a gate line and a data pad on a substrate; forming a gate insulating layer over the gate line; sequentially depositing, over the gate insulating layer, an intrinsic silicon layer which is amorphous silicon or polysilicon, then a doped amorphous silicon layer, and then a data metal layer; obtaining a pattern for a patterning operation; patterning the intrinsic silicon layer, the doped amorphous silicon layer, and the data metal layer as defined

by said pattern, to form a patterned intrinsic silicon layer, an ohmic contact layer, and a data line; depositing a passivation layer over the data line; forming over the passivation layer one or more color filters having a plurality of through holes; etching the passivation layer and the gate insulating layer while using the color filters as a mask; and forming a pixel electrode over the color filters.

Some embodiments further comprise forming over the pixel electrode, from a single layer, a light blocking member and a column spacer.

In some embodiments, the light blocking member overlies the end portion of the data line.

In some embodiments, in the etching of the passivation layer and the gate insulating layer while using the color filters as the mask, the data pad and the end portion of the gate line become exposed.

In some embodiments, in the etching of the passivation layer and the gate insulating layer while using the color filters as the mask, a first contact hole is formed exposing the drain electrode, and a second contact hole is formed exposing the end portion of the data line.

In some embodiments, the forming of the pixel electrode comprises forming a contact liner connecting the data pad to the end portion of the data line through the second contact hole.

In some embodiments, the gate line and the data pad are formed of the same layer.

According to some embodiments of the present invention, the color filters are used to etch the passivation layer as an etch mask such that the liquid crystal display may be manufactured with a reduced number of masks, thereby reducing the manufacturing time and cost.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a layout view of a liquid crystal display according to an exemplary embodiment of the present invention.

FIG. 2 is a layout view of a pixel electrode in a liquid crystal display according to an exemplary embodiment of the present invention.

FIG. 3 and FIG. 4 are cross-sectional views of the liquid crystal display shown in FIG. 1 taken along the lines III-III and IV-IV.

FIG. 5, FIG. 7, FIG. 9, FIG. 11, FIG. 13, and FIG. 15 are cross-sectional views showing the liquid crystal display of FIG. 1 along the line III-III at different stages of fabrication.

FIG. 6, FIG. 8, FIG. 10, FIG. 12, and FIG. 14 are cross-sectional views showing the liquid crystal display of FIG. 1 along the line IV-IV at different stages of fabrication.

DESCRIPTION OF SOME REFERENCE NUMERALS IN THE DRAWINGS

3:	liquid crystal layer
11, 21:	alignment layers
21, 22:	polarizers
30:	liquid crystal molecules
100:	lower panel
110, 210:	substrates
121, 129:	gate lines
124:	gate electrodes
128:	data pads
140:	gate insulating layer
151, 154:	semiconductor elements
161, 163, 165:	ohmic contacts
171, 179:	data lines

-continued

173:	source electrodes
175:	drain electrodes
180:	passivation layer
181, 182, 185:	contact hole
191:	pixel electrodes
220:	light blocking member
230R, 230G, 230B:	color filters
231, 232, 235:	through holes
270:	common electrode

DETAILED DESCRIPTION OF SOME EMBODIMENTS

Some embodiments of the present invention will now be described with reference to the accompanying drawings. These embodiments are not limiting. The invention is defined by the appended claims.

In the drawings, the thickness of layers, films, panels, regions, etc., may be exaggerated for clarity. Like reference numerals designate like elements throughout the specification. It will be understood that when an element such as a layer, film, region, or substrate is referred to as being "on" another element, then intervening elements may or may not be present. In contrast, when an element is referred to as being "directly on" another element, then there are no intervening elements.

Firstly, a liquid crystal display according to an exemplary embodiment of the present invention will be described with reference to FIGS. 1 to 4. FIG. 1 is a layout view ("top view" herein) of the liquid crystal display. FIG. 2 is a layout view of a pixel electrode in the liquid crystal display. FIGS. 3 and 4 are cross-sectional views of the liquid crystal display shown in FIG. 1 taken along the lines III-III and IV-IV respectively.

Referring to FIGS. 1 to 4, the liquid crystal panel assembly according to this embodiment includes a lower panel 100 and an upper panel 200 facing each other, a liquid crystal layer 3 interposed therebetween, and a pair of polarizers 12 and 22 attached to the outside surfaces of the display panels 100 and 200 respectively.

In the lower panel 100, gate conductors including gate lines 121 and data pads 128 are formed on an insulating substrate 110 that is preferably made of transparent glass or plastic.

The gate lines 121 transmit gate signals and extend horizontally in the view of FIG. 1. Each of the gate lines 121 includes a plurality of gate electrodes 124 protruding upward and downward, and an end portion 129 having a large area for connection with another layer and/or a gate driving circuit.

A gate insulating layer 140, preferably silicon nitride (SiN_x) or silicon oxide (SiO_x), is formed over the gate lines 121 and the data pads 128.

Semiconductor stripes 151, preferably hydrogenated amorphous silicon or polysilicon, are formed on the gate insulating layer 140. Each of the semiconductor stripes 151 includes a plurality of protrusions 154 and a widened end portion 159.

Ohmic contact stripes 161 and ohmic contact islands 165 are formed on the semiconductor stripes 151. Each of the ohmic contact stripes 161 includes a plurality of protrusions 163 facing the ohmic contact islands 165 above the gate electrodes 124, and has a wide end portion 169 having a large area. The ohmic contacts 161 and 165 may be made of a material such as n+ hydrogenated amorphous silicon heavily doped with an n-type impurity such as phosphorus, or of silicide.

A plurality of data lines **171** and a plurality of drain electrodes **175** are formed on the ohmic contacts **161** and **165** and on the gate insulating layer **140**.

The data lines **171** transmit data voltages and extend in the vertical direction in the view of FIG. 1, intersecting the gate lines **121** and defining display areas (pixel areas). Each of the data lines **171** includes a plurality of U-shaped source electrodes **173** and an end portion **179**.

The drain electrodes **175** are spaced from the data lines **171**. Each drain electrode **175** has one end enclosed by the respective source electrode **173**, and has a widened area at the other end.

A gate electrode **124**, a source electrode **173**, and a drain electrode **175** form a thin film transistor (TFT) along with a protrusion **154** of a semiconductor stripe **151**. The thin film transistor's channel is formed in the protrusion **154** of the semiconductor stripe **151** between the respective source electrode **173** and the respective drain electrode **175**.

The ohmic contacts **163** and **165** are present only between the underlying semiconductor stripes **151** and the overlying data lines **171** and drain electrodes **175**, to reduce contact resistance.

The semiconductor stripes **151** have the same shape in top view (layout view) as the overlying data lines **171** and drain electrodes **175** and the underlying ohmic contacts **161** and **165** except that the semiconductor stripes **151** include portions between the source electrodes **173** and the respective drain electrodes **175**.

A passivation layer **180** is formed on the data lines **171**, the drain electrodes **175**, and the exposed portions of the semiconductor stripes **151**. The passivation layer **180** is made of an inorganic insulator such as silicon nitride or silicon oxide.

The passivation layer **180** has a plurality of first contact holes **185** terminating at the widened areas at the ends of the respective drain electrodes **175**, and a plurality of second contact holes **182** terminating at the end portions **179** of the respective data lines **171**.

The passivation layer **180** and the gate insulating layer **140** are removed over at least parts of the data pads **128** and of the end portions **129** of the gate lines **121** to expose the data pads **128** and the gate lines' end portions **129**.

Red, green, and blue color filters **230R**, **230G**, and **230B** are formed on the passivation layer **180**. The color filters **230R**, **230G**, or **230B** may be formed as monochromatic bands each of which runs between, and parallel to, a respective pair of adjacent data lines **171**. The band may overlap the adjacent data lines. Adjacent monochromatic bands **230R**, **230G**, **230B** overlap with each other. The color filters **230R**, **230G**, and **230B** may be made of a photosensitive organic material containing suitable pigments.

The color filters **230R**, **230G**, and **230B** include first and second through holes **235** and **232** positioned above the respective first and second contact holes **185** and **182** in the passivation layer **180**. Each through hole is aligned with the respective contact hole to have substantially the same size, location and shape (when viewed from the top) as the contact hole.

The color filters **230R**, **230G**, and **230B** are present not only in the pixel areas (defined by the intersection of the gate lines **121** and the data lines **171**) but also in regions outside the pixel areas, e.g. in regions containing the end portions **129** and **179** of the gate lines and the data lines and extending to the edge of the pixel areas and possibly (but not necessarily) into the pixel areas. In these latter regions, no pixels are present and hence no image is displayed. Therefore, the blue color filters **230B** are preferred in these regions because blue is less noticeable (less visible) than red or green. The gate

lines' end portions **129** and the data pads **128** are completely covered by the blue filter region or regions **230B** except for the second through holes **232** and except for some areas from which the passivation layer **180** and the gate insulating layer **140** are removed.

A plurality of pixel electrodes **191** and a plurality of first and second contact liners **81** and **82** are formed on the passivation layer **180**. The first contact liners **81** cover the end portions **129** of the gate lines **121**. The second contact liners **82** are connected to the end portions **179** of the data lines **171** through the second contact holes **182**, and extend to cover the data pads **128**. The first and second contact liners **81** and **82** protect the end portions **129** and **179** and enhance the adhesion of connections of the end portions **129** and **179** to external devices.

Referring to FIG. 2, the overall shape of each pixel electrode **191** is rectangular. Each pixel electrode **191** includes a horizontal (transverse) stem **193**, a vertical (longitudinal) stem **192** intersecting the transverse stem **193**, and a plurality of first to fourth minute branches **194a**, **194b**, **194c**, and **194d**. The pixel electrode **191** is divided into a first sub-region Da, a second sub-region Db, a third sub-region Dc, and a fourth sub-region Dd by the transverse stem **193** and the longitudinal stem **192**. The first, second, third, and fourth minute branches **194a**, **194b**, **194c**, and **194d** belong respectively to the sub-regions Da, Db, Dc, Dd.

Each first minute branch **194a** obliquely extends from the transverse stem **193** or the longitudinal stem **192** in the upper-left direction. Each second minute branch **194b** obliquely extends from the transverse stem **193** or the longitudinal stem **192** in the upper-right direction. Each third minute branch **194c** obliquely extends from the transverse stem **193** or the longitudinal stem **192** in the lower-left direction. Each fourth minute branch **194d** obliquely extends from the transverse stem **193** or the longitudinal stem **192** in the lower-right direction.

Each of the first to fourth minute branches **194a-194d** forms an angle of about 45 degrees or 135 degrees with the gate lines **121** or the transverse stem **193**. The minute branches **194a-194d** of different sub-regions Da-Dd may be perpendicular to each other.

The pixel electrodes **191** are physically and electrically connected to the drain electrodes **175** through the contact holes **185**, and receive data voltages from the drain electrodes **175**. The pixel electrodes **191** (with their data voltages) and a common electrode **270** of the common electrode panel **200** generate an electric field that determines the orientation of liquid crystal molecules of the liquid crystal layer **3** located between the pixel electrodes **191** and the common electrode **270**. The liquid crystal molecules' orientation defines the luminance of the light transmitted through the liquid crystal layer **3**.

The edges of the first to fourth minute branches **194a-194d** distort the electric field, to provide the electric field with horizontal components that change the tilt angles of the liquid crystal molecules **30**. The horizontal components of the electric field are perpendicular to the edges of the first to fourth minute branches **194a-194d**. Accordingly, when viewed from the top (as in FIG. 2), the liquid crystal molecules **30a**, **30b**, **30c**, **30d** are tilted in the direction parallel to the adjacent minute branches **194a-194d**. In the embodiment of FIG. 2, the minute branches **194a-194d** of each pixel PX extend in two different mutually-perpendicular directions (upper-left to bottom right and upper-right to bottom-left). Therefore, the liquid crystal molecules **30** tilt in these two directions. The viewing angle of the liquid crystal display is consequently widened.

A light blocking member **220** and column spacers **320** are formed over the pixel electrodes **191**. The light blocking member **220** may be referred to as a black matrix, and prevents light leakage between the pixel electrodes **191**. The column spacers **320** maintain a gap between the two display panels **100** and **200** to accommodate the liquid crystal layer **3** in this gap. The light blocking member **220** and the column spacers **320** are made of the same photosensitive organic material containing pigments.

An alignment layer **11** is formed over the light blocking member **230** and the column spacers **320**.

Now the upper panel **200** will be described. The common electrode **270** preferably consisting of a transparent conductor such as ITO or IZO is formed on the whole surface of a substrate **210**. An alignment layer **21** is formed on the common electrode **270**.

The two alignment layers **11** and **21** may be vertical alignment layers. The liquid crystal layer **3** between the lower panel **100** and the upper panel **200** includes liquid crystal molecules **30** having negative dielectric anisotropy, and may be oriented such that the major axes of the liquid crystal molecules **30** of the liquid crystal layer **3** are almost perpendicular to the surfaces of the two display panels **100** and **200** when no electric field is applied.

Fabrication of the lower panel of the liquid crystal display shown in FIGS. **1** to **4** will now be described with reference to FIGS. **5** to **14**, which show cross-sectional views of the lower liquid crystal display panel **100** at different stages of fabrication. FIGS. **5**, **7**, **9**, **11**, **13**, and **15** show cross-sections along the line III-III in FIG. **1**. FIGS. **6**, **8**, **10**, **12**, and **14** show cross-sections along the line IV-IV in FIG. **1**.

Firstly, as shown in FIGS. **5** and **6**, a metal layer made of a material such as molybdenum is deposited on the insulating substrate **110** made of transparent glass or plastic. Next, the metal layer is photolithographically patterned to form the gate lines **121** including the gate electrodes **124** and the end portions **129**, and to form the data pads **128**.

As shown in FIGS. **7** and **8**, the gate insulating layer **140** (e.g. silicon nitride (SiNx) or some other suitable material), an intrinsic (undoped) amorphous silicon layer, and an n+ doped amorphous silicon layer **161** are deposited one after another by plasma enhanced chemical vapor deposition (PECVD) over the gate lines **121** and the data pads **128**. The intrinsic amorphous silicon layer can for example be hydrogenated amorphous silicon. The n+ doped amorphous silicon layer **161** can be amorphous silicon heavily doped with phosphorus (P). Alternatively, silicide can be used. Next, a "data" layer (or "data metal" layer), e.g. molybdenum, is formed on the doped amorphous silicon layer **161**. The intrinsic amorphous silicon layer, the doped amorphous silicon layer **161**, and the data layer are then patterned using a single photolithographic step. The data lines **171**, the drain electrodes **175**, and the semiconductor stripes **151** with protrusions **154** and widened ends **159** are formed as a result. The data lines **171** and the drain electrodes **175** have substantially the same shape in top view as the semiconductor stripes **151**.

In this process, the photolithographic step uses a pattern defined by a photoresist layer of non-uniform thickness. The photoresist is thicker over the data lines **171** and drain electrodes **175** than over the channel regions of the thin film transistors. Such photoresist layer may be formed by a number of methods. For example, an optical mask can be used which has clear and opaque areas and in addition has intermediate, "translucent" areas whose light transmittance is lower than for the opaque areas but higher than for the clear areas. The translucent areas can be formed as opaque areas with clear patterns of slits or lattices sized to provide the

intermediate light transmittance (intermediate between that of the opaque and clear areas). Alternatively, the translucent areas can be made using a thin film having an intermediate transmittance or thickness. In case of the slit patterns, it is preferable that the slits or the spaces between the slits be narrower than the resolution of the optical system used for the photoresist exposure. Another possible method involves use of a reflowable photoresist. The reflowable photoresist is first patterned using an optical mask with just clear and opaque areas. In this operation, the photoresist is removed from over the channel regions. Then the photoresist is reflowed to cause some of the photoresist to flow into the areas overlying the channel regions.

Next, as shown in FIGS. **9** and **10**, the passivation layer **180** is formed to cover the protrusions **154** of the semiconductor stripes **151** and also to overlie the data lines **171** and the drain electrodes **175**.

Then the color filters **230R**, **230G**, and **230B** are formed on the passivation layer **180** together with the first and second through holes **235** and **232**. The passivation layer **180** is exposed over the data pads **128** and the end portions **129**.

Next, as shown in FIG. **11** and FIG. **12**, the passivation layer **180** and the gate insulating layer **140** are dry-etched using the color filters **230R**, **230G**, and **230B** as an etch mask to form the first and second contact holes **185** and **182** and expose the data pads **128** and the gate lines' end portions **129**. As a result, the first and second contact holes **185** and **182** are aligned with the respective first and second through holes **235** and **232**. Also, the edges of the blue color filters **230B**, the gate insulating layer **140**, and the passivation layer **180** over the data pads **128** and the gate lines' end portion **129** are aligned with each other.

Next, as shown in FIGS. **13** and **14**, a transparent conductive material such as ITO or IZO is deposited on the passivation layer **180**, and is photolithographically patterned to form the pixel electrodes **191** and the first and second contact liners **81** and **82**.

Then, as shown in FIG. **15** and FIG. **4**, a photosensitive organic layer with pigments is formed on the color filters **230R**, **230G**, and **230B** and the first and second contact liners **81** and **82**, and photolithographically patterned to form the light blocking member **220** and the column spacers **320**. In this process, when exposing the photosensitive organic layer, the exposure dose is varied to obtain a desired non-uniform thickness of the photosensitive organic layer as needed to form the light blocking member **220** and the column spacers **320**. The light blocking member **220** overlies the first and second contact liners **81** and **82** and protects the gate lines **121** and the data lines **171** from being exposed and thus corroded.

In this manufacturing process, since the color filters **230R**, **230G**, and **230B** of the lower panel **100** are used as an etch mask to etch the passivation layer **180** and the gate insulating layer **140**, the thin film transistors and the pixel electrodes may be formed by three masks (not counting the masks used to pattern the color filters **230R**, **230G**, and **230B** and the light blocking member **220**).

The embodiments described above illustrate but do not limit the present invention. Other embodiments and variations are within the scope of the invention as defined by the appended claims.

What is claimed is:

1. A liquid crystal display comprising:
 - a substrate;
 - a pixel region on the substrate, the pixel region comprising:
 - a gate lines disposed on the substrate;
 - a gate insulating layer disposed on the gate line;

9

a semiconductor layer disposed on the gate insulating layer;
 a source electrode disposed on the semiconductor layer;
 a drain electrodes disposed the semiconductor layer, and facing the source electrode;
 a pad region disposed on the substrate, the pad region comprising:
 a data line disposed on the semiconductor layer;
 a passivation layer disposed on the data lines and the drain electrode and comprising a first contact hole in the pixel region and a second contact hole in the pad region; and
 a color filters disposed on the passivation layer and comprising a first through hole in the pixel region and a second through hole in the pad region,
 wherein an edge of the first contact hole is aligned with an edge of the first through hole, and an edge of the second contact hole is aligned with an edge of the second through hole.

2. The liquid crystal display of claim 1, wherein the first contact hole exposes an end portion of the drain electrode; and
 the second contact hole exposes an end portion of the data line.

3. The liquid crystal display of claim 2, wherein the color filter is disposed in a region adjacent to an end portion of the gate line and the end portion of the data line, wherein the region does not overlap with the pixel region.

4. The liquid crystal display of claim 3, wherein said the color filter overlaps the end portions of the gate line and the end portion of the data line.

5. The liquid crystal display of claim 4, wherein the color filter is a blue color filter.

6. The liquid crystal display of claim 1, further comprising a data pad formed of the same material as the gate line and electrically connected to an end portion of the data line.

10

7. The liquid crystal display of claim 6, wherein the color filter is a blue color filter disposed on the data pad.

8. The liquid crystal display of claim 7, further comprising a contact member connecting the end portion of the data line to the data pad through the second contact hole and the second through hole.

9. The liquid crystal display of claim 1, further comprising a pixel electrode disposed in the pixel region,
 wherein the pixel electrode comprises a plurality of minute branches whose edges include edges extending in different (non-parallel) directions.

10. The liquid crystal display of claim 9, wherein each of the edges of the minute branches forms an angle of 45° or 135° with the gate line.

11. The liquid crystal display of claim 1, further comprising a light blocking member and a column spacer which overlie a pixel electrode.

12. The liquid crystal display of claim 11, wherein the light blocking member and the column spacer are formed of the same material but their top surfaces are at different heights.

13. The liquid crystal display of claim 11, wherein the light blocking member overlaps an end portion of the gate line and an end portion of the data line.

14. The liquid crystal display of claim 1, wherein the color filters overlaps an end portion of the gate line and the end portion of an end portion of the data line.

15. The liquid crystal display of claim 14, wherein the color filter overlapping the end portion of the gate line and the end portion of the data line is a blue color filter.

16. The liquid crystal display of claim 1, wherein the semiconductor layer has the same shape as the date line and the drain electrode except over a region between the source electrode and the drain electrode in the pixel region, in a top view.

* * * * *

专利名称(译)	液晶显示器及其制造方法		
公开(公告)号	US8305312	公开(公告)日	2012-11-06
申请号	US12/368787	申请日	2009-02-10
[标]申请(专利权)人(译)	金东GYU		
申请(专利权)人(译)	金东GYU		
当前申请(专利权)人(译)	三星DISPLAY CO. , LTD.		
[标]发明人	KIM DONG GYU		
发明人	KIM, DONG-GYU		
IPC分类号	G09G3/36		
CPC分类号	G02F1/136286 G02F1/1368 G02F1/133514 G02F1/1343 G02F2001/13629 G02F2001/136295		
优先权	1020080063973 2008-07-02 KR		
其他公开文献	US20100001936A1		
外部链接	Espacenet USPTO		

摘要(译)

液晶显示器包括：基板；在基板上的显示区域，显示区域包括：覆盖基板的一条或多条栅极线；栅极绝缘层覆盖栅极线；覆盖栅极绝缘层的半导体层；一对或多对源极和漏极覆盖在半导体层上，每对是一对源极和一个对应的漏极，面对源极；覆盖半导体层的一条或多条数据线，每条数据线包括一个或多个源电极，其中在数据线与栅极线的每个交叉点处提供显示区域；覆盖数据线和漏电极并包括多个接触孔的钝化层；一个或多个滤色器覆盖在钝化层上并包括多个通孔。在俯视图中，除了在每个源电极和对应的漏电极之间的每个区域之外，半导体层具有与数据线和漏电极相同的形状。接触孔的边缘与通孔的边缘对齐。

