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**Jeon et al.**

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(54) **LIQUID CRYSTAL DISPLAY AND  
MANUFACTURING METHOD THEREOF**

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(57) **ABSTRACT**

Exemplary embodiments of the present invention disclose a liquid crystal display (LCD) and a method of manufacturing the same. The LCD may have a display area and a peripheral area. An organic layer of the peripheral area may be patterned using a half-tone mask, and a protrusion member may be formed in the peripheral area. Accordingly, the thin film transistor array panel and the corresponding substrate may be prevented from being temporary adhered in the peripheral area such that the density of the liquid crystal molecules filled in the peripheral area may be uniformly maintained and the display quality of the liquid crystal display may be improved.

**6 Claims, 8 Drawing Sheets**

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**G02F 1/1333** (2006.01)

(52) **U.S. Cl.**  
USPC ..... 349/122; 349/106; 349/110

(58) **Field of Classification Search**  
USPC ..... 349/106, 110, 122, 156, 160; 345/88  
See application file for complete search history.

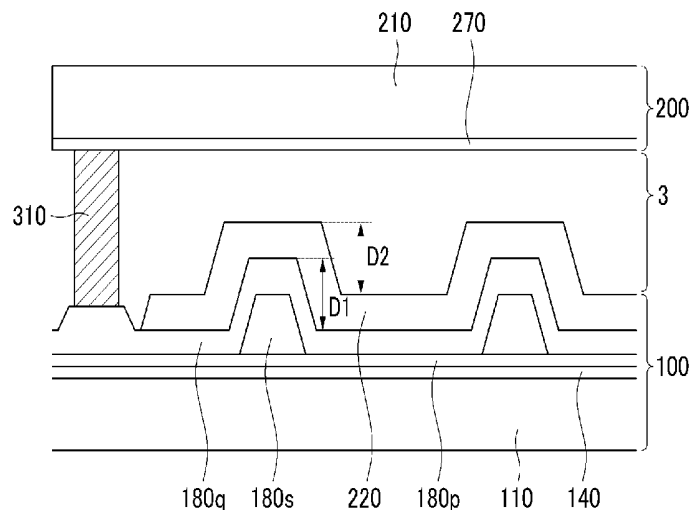


FIG.1

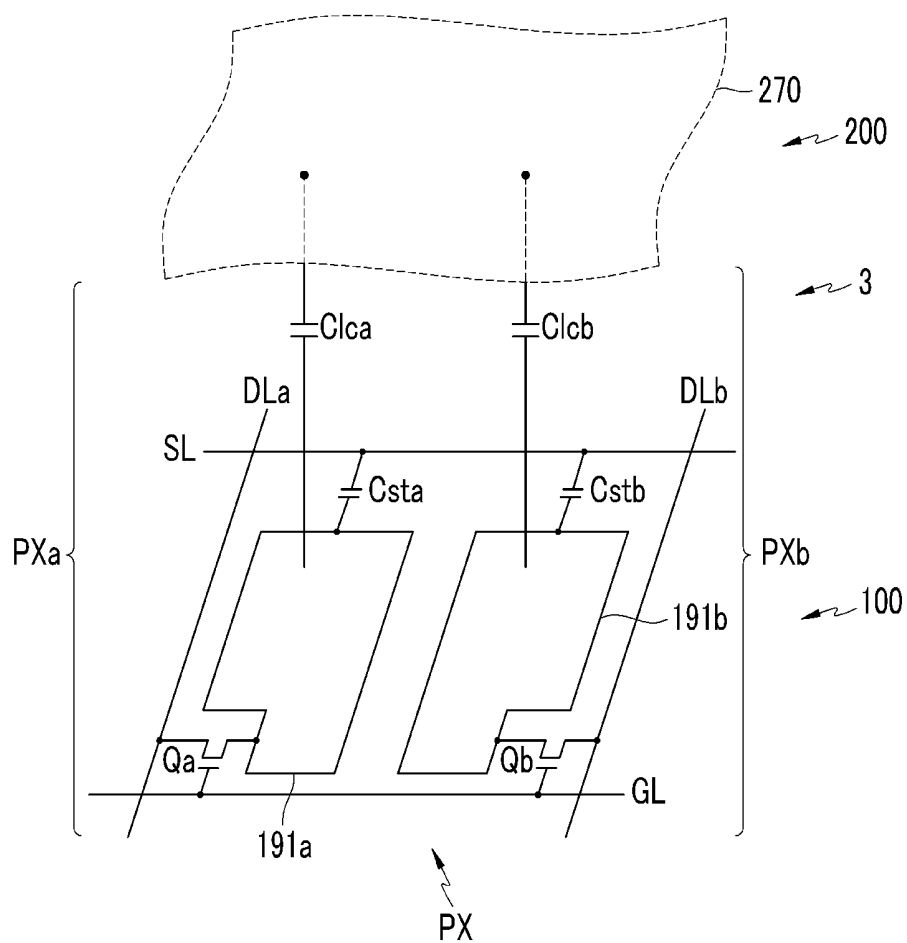
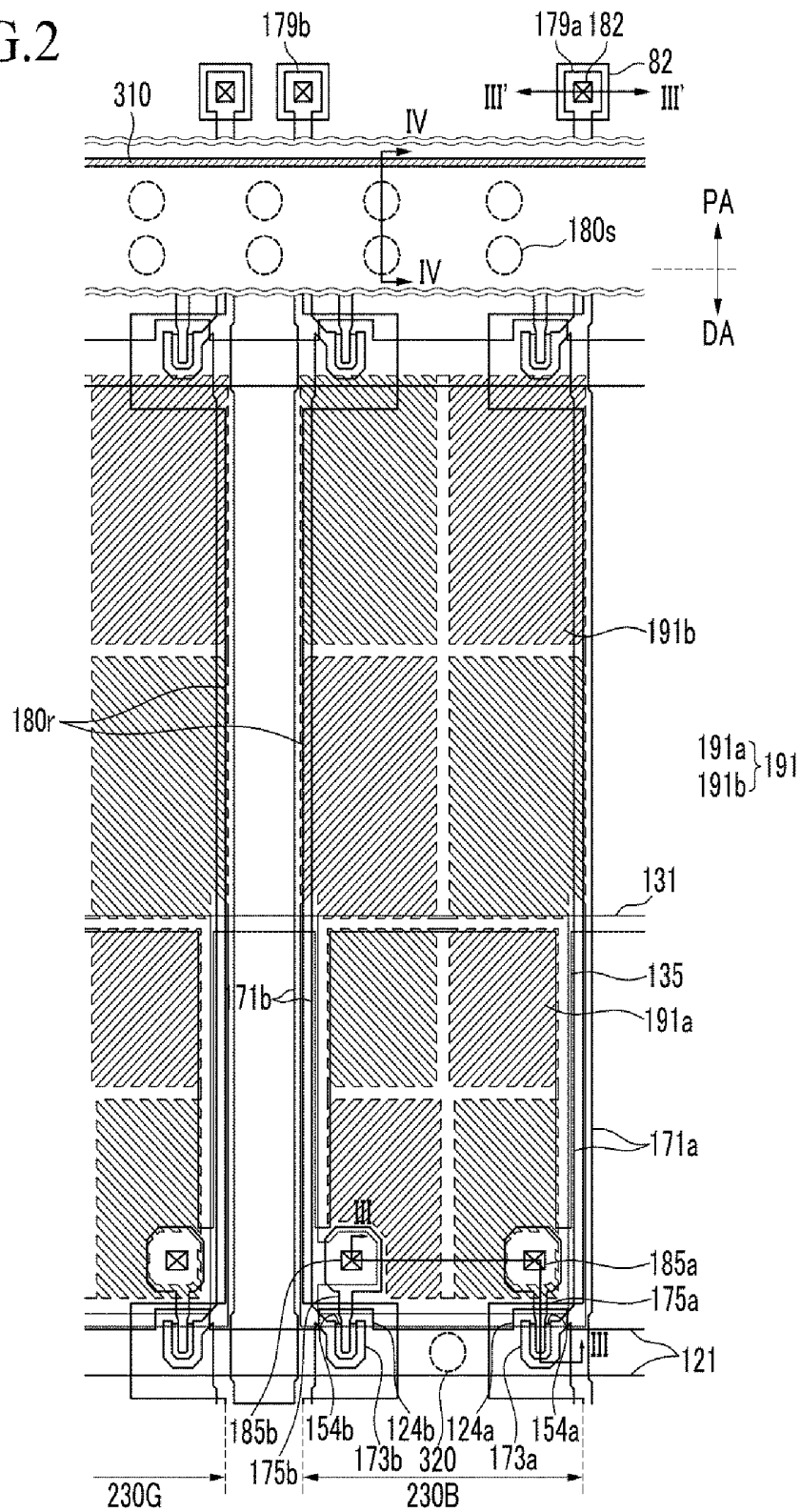


FIG.2





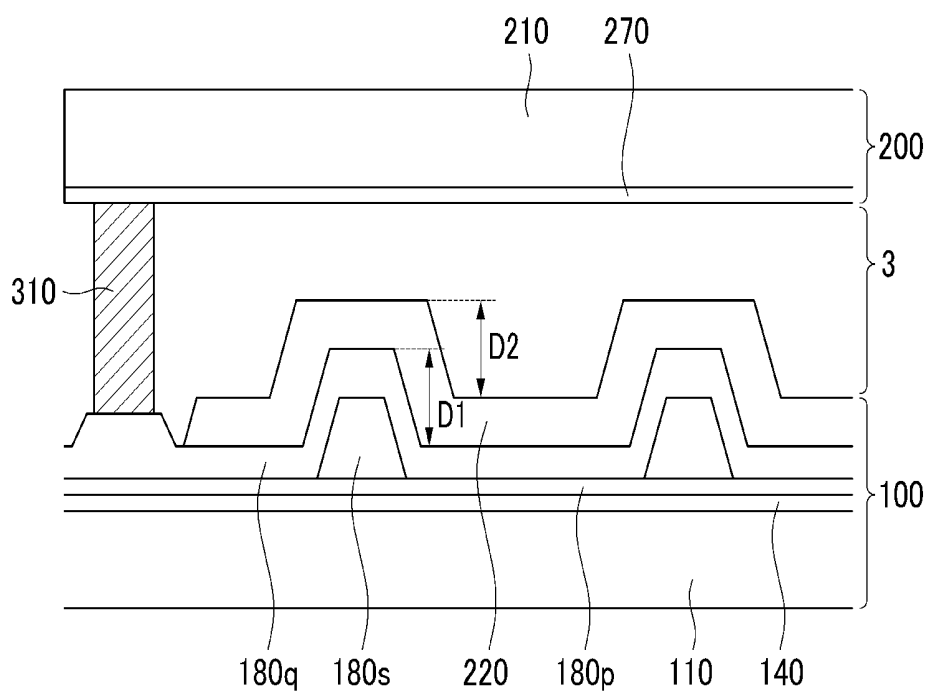


FIG.5

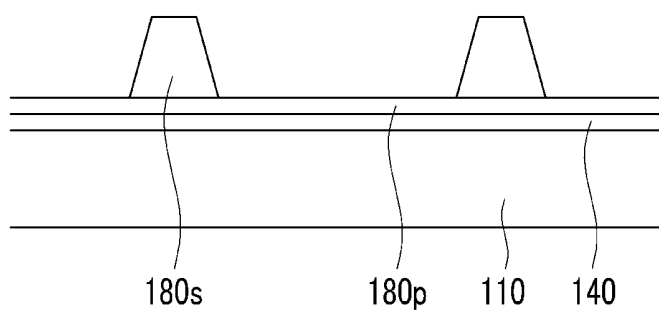


FIG.6

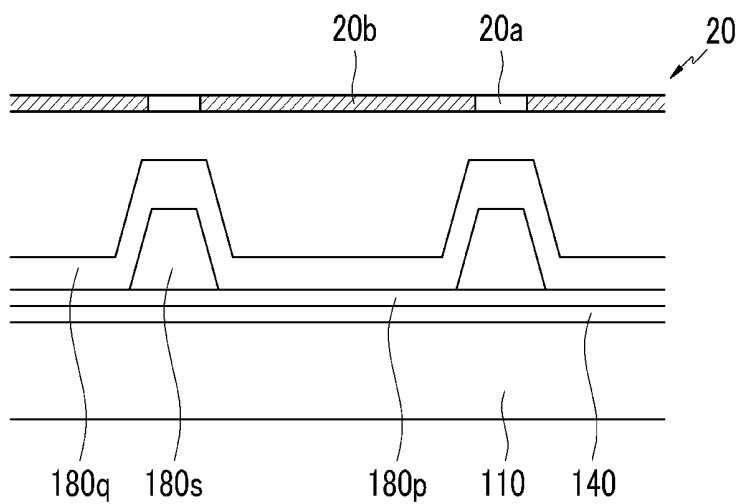


FIG.7

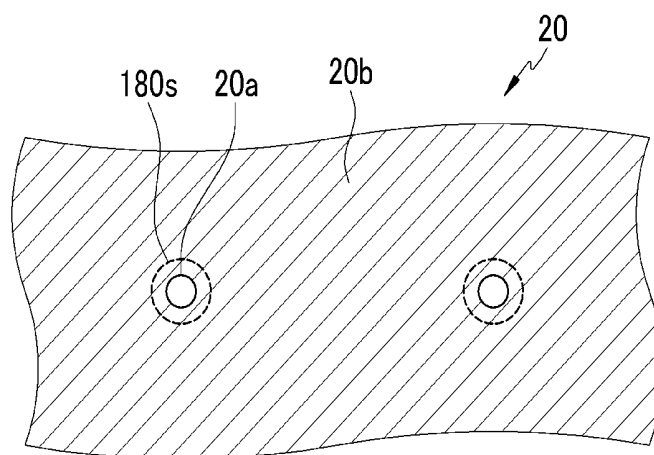


FIG.8

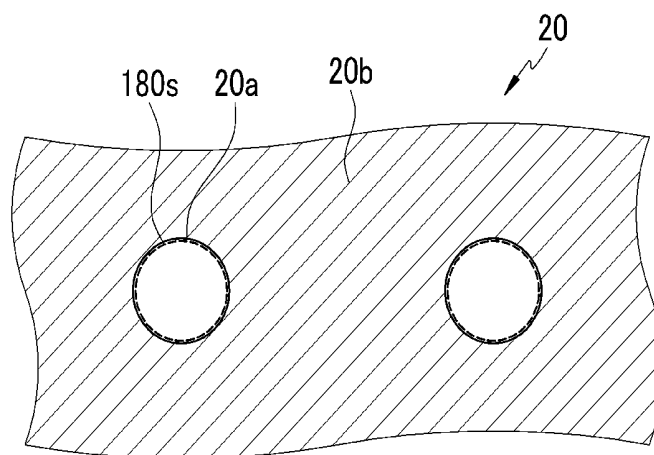


FIG. 9

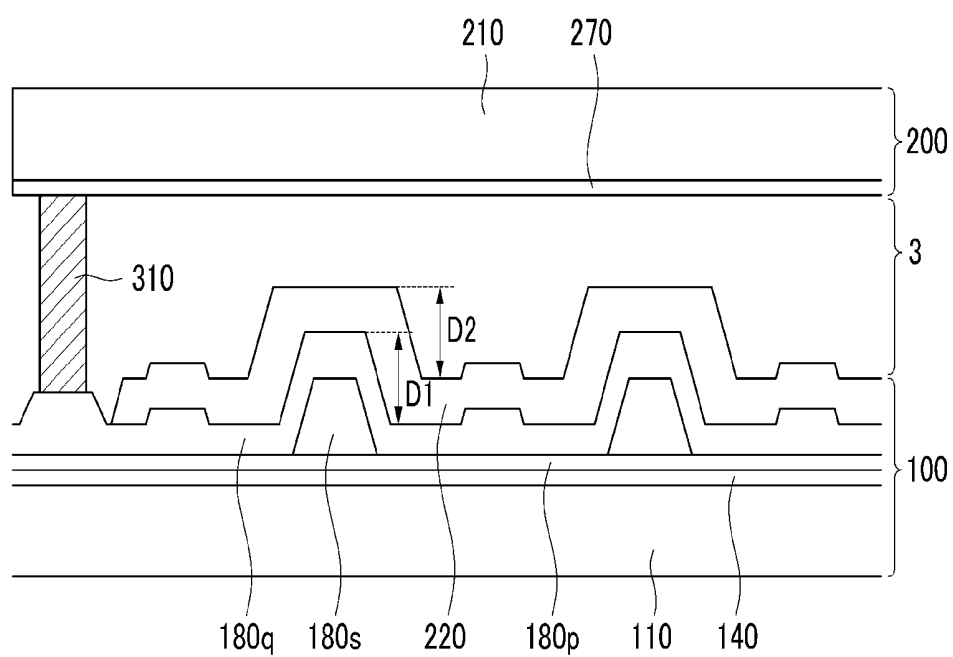


FIG.10

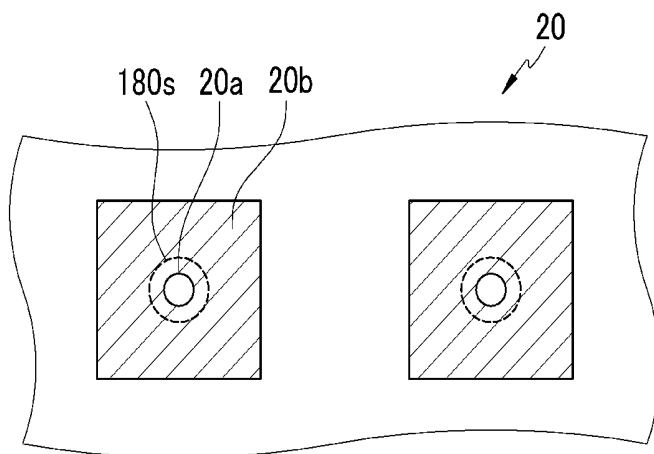
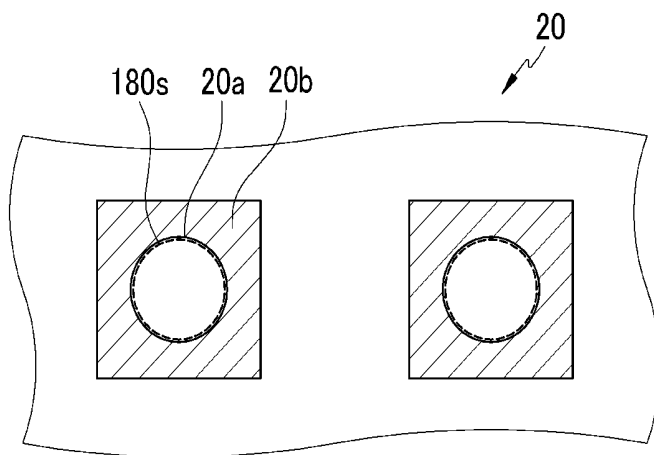


FIG.11



# LIQUID CRYSTAL DISPLAY AND MANUFACTURING METHOD THEREOF

## CROSS REFERENCE TO RELATED APPLICATION

This application claims priority from and the benefit of Korean Patent Application No. 10-2009-0054561, filed on Jun. 18, 2009, which is hereby incorporated by reference for all purposes as if fully set forth herein.

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

Exemplary embodiments of the present invention relate to a liquid crystal display and manufacturing methods of the same.

### 2. Description of the Background

A liquid crystal display (LCD) is one of the most widely used flat panel displays (FPD), and may be composed of two display panels on which field generating electrodes, such as pixel electrodes and a common electrode, are formed. A liquid crystal layer may be interposed between the two display panels. In the LCD, voltages may be applied to the field generating electrodes to generate an electric field over the liquid crystal layer. Liquid crystal molecules of the liquid crystal layer may be aligned according to the electric field. The polarization of incident light may thereby be controlled to display images.

A LCD may include a display panel formed with a thin film transistor (TFT). The TFT array panel may be formed by patterning several layers such as electrodes and semiconductors. A mask may generally be used in the patterning process.

The LCD may be divided into a display area and a peripheral area. Liquid crystal molecules of the liquid crystal layer may fill the display area and the peripheral area. However, when a size of the liquid crystal display is relatively large, a filling deterioration of the liquid crystal molecules disposed on the peripheral area may lead to a deterioration of the filling density of the liquid crystal molecule of the display area. Accordingly, the display quality of the liquid crystal display may be deteriorated.

The above information disclosed in this Background section is only for enhancement of understanding of the background of the invention and therefore it may contain information that does not form the prior art that is already known in this country to a person of ordinary skill in the art.

## SUMMARY OF THE INVENTION

Exemplary embodiments of the present invention provide a liquid crystal display and manufacturing methods of the same.

Additional features 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.

Exemplary embodiments of the present invention disclose a liquid crystal display including a substrate, a protrusion member, and an organic layer. The substrate includes a display area and a peripheral area. The protrusion member is disposed in the peripheral area. The organic layer is disposed in the peripheral area. A height of a first region of the organic layer is higher than a height of a second region of the organic layer of the peripheral area by more than about 1.5  $\mu\text{m}$ . The first region of the organic layer is a region where the organic layer overlaps the protrusion member. The second region of

the organic layer being a region where the organic layer and the protrusion member pattern do not overlap each other.

Exemplary embodiments of the present invention also disclose a liquid crystal display including a substrate, a protrusion member, and an organic layer. The substrate includes a display area and a peripheral area. The protrusion member pattern is disposed in the peripheral area. The organic layer is disposed in the peripheral area. The organic layer includes a recess region. The recess region is a recess portion enclosing the protrusion member pattern.

Exemplary embodiments of the present invention also disclose a liquid crystal display including a substrate, a protrusion member, a partition pattern, and at least one color filter. The substrate includes a display area and a peripheral area. The protrusion member pattern is disposed in the peripheral area and has a column shape. The partition pattern is disposed in the display area. The partition pattern includes the same material as the protrusion member pattern. The partition pattern is disposed at the same layer as the protrusion member pattern. The at least one color filter is disposed in a region defined by the partition pattern.

Exemplary embodiments of the present invention also disclose a manufacturing method of a liquid crystal display. The method includes disposing a protrusion member pattern in the peripheral area on a substrate. The substrate includes a display area and a peripheral area. The method includes disposing an organic layer on the protrusion member pattern by using a mask having different light transmittance. The light transmittance varies according to positions in the mask. The mask includes a translucent region corresponding to a region of the organic layer not overlapping the protrusion member pattern.

## BRIEF DESCRIPTION OF THE DRAWINGS

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 exemplary embodiments of the invention, and together with the description serve to explain the principles of the invention.

FIG. 1 is an equivalent circuit diagram of one pixel in a liquid crystal display according to exemplary embodiments of the present invention.

FIG. 2 is a layout view of a liquid crystal display according to exemplary embodiments of the present invention.

FIG. 3 is a cross-sectional view taken along the lines III-III and III'-III' of the liquid crystal display shown in FIG. 2 according to exemplary embodiments of the present invention.

FIG. 4 is a cross-sectional view taken along the line IV-IV of the liquid crystal display shown in FIG. 2 according to exemplary embodiments of the present invention.

FIG. 5 and FIG. 6 are schematic diagrams showing a method to manufacture a liquid crystal display according to exemplary embodiments of the present invention.

FIG. 7 is a top plan view of a mask used in FIG. 6 according to exemplary embodiments of the present invention.

FIG. 8 is a top plan view of a mask used in a manufacturing process of a thin film transistor array panel according to exemplary embodiments of the present invention.

FIG. 9 is a cross-sectional view of a liquid crystal display according to exemplary embodiments of the present invention.

FIG. 10 is a top plan view of a mask used for a manufacturing process of the liquid crystal display shown in FIG. 9 according to exemplary embodiments of the present invention.

FIG. 11 is a top plan view of a mask used in a manufacturing process of a thin film transistor array panel according to exemplary embodiments of the present invention.

#### DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

The invention is described more fully hereinafter with reference to the accompanying drawings, in which exemplary embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the exemplary embodiments set forth herein. Rather, these exemplary embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. In the drawings, the size and relative sizes of layers and regions may be exaggerated for clarity.

It will be understood that when an element or layer is referred to as being "on", "connected to" or "coupled to" another element or layer, it can be directly on, connected or coupled to the other element or layer or intervening elements or layers may be present. In contrast, when an element is referred to as being "directly on", "directly connected to" or "directly coupled to" another element or layer, there are no intervening elements or layers present. Like numbers refer to like elements throughout. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items.

It will be understood that, although the terms first, second, third etc. may be used herein to describe various elements, components, regions, layers and/or sections, these elements, components, regions, layers and/or sections should not be limited by these terms. These terms are only used to distinguish one element, component, region, layer or section from another region, layer or section. Thus, a first element, component, region, layer or section discussed below could be termed a second element, component, region, layer or section without departing from the teachings of the present invention.

Spatially relative terms, such as "beneath", "below", "lower", "above", "upper" and the like, may be used herein for ease of description to describe one element or feature's relationship to another element(s) or feature(s) as illustrated in the figures. It will be understood that the spatially relative terms are intended to encompass different orientations of the device in use or operation in addition to the orientation depicted in the figures. For example, if the device in the figures is turned over, elements described as "below" or "beneath" other elements or features would then be oriented "above" the other elements or features. Thus, the exemplary term "below" can encompass both an orientation of above and below. The device may be otherwise oriented (rotated 90 degrees or at other orientations) and the spatially relative descriptors used herein interpreted accordingly.

The terminology used herein is for the purpose of describing particular exemplary embodiments only and is not intended to be limiting of the invention. As used herein, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprises" and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the

presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

Exemplary embodiments of the invention are described herein with reference to cross-section illustrations that are schematic illustrations of idealized embodiments (and intermediate structures) of the invention. As such, variations from the shapes of the illustrations as a result, for example, of manufacturing techniques and/or tolerances, are to be expected. Thus, exemplary embodiments of the invention should not be construed as limited to the particular shapes of regions illustrated herein but are to include deviations in shapes that result, for example, from manufacturing. For example, an implanted region illustrated as a rectangle will, typically, have rounded or curved features and/or a gradient of implant concentration at its edges rather than a binary change from implanted to non-implanted region. Likewise, a buried region formed by implantation may result in some implantation in the region between the buried region and the surface through which the implantation takes place. Thus, the regions illustrated in the figures are schematic in nature and their shapes are not intended to illustrate the actual shape of a region of a device and are not intended to limit the scope of the invention.

Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

Hereinafter, exemplary embodiments of the present invention are described below in detail with reference to the drawings.

A liquid crystal display according to exemplary embodiments of the present invention will be described with reference to FIG. 1, FIG. 2, FIG. 3, and FIG. 4.

FIG. 1 is an equivalent circuit diagram of one pixel in a liquid crystal display according to exemplary embodiments of the present invention. FIG. 2 is a layout view of a liquid crystal display according to exemplary embodiments of the present invention. FIG. 3 is a cross-sectional view taken along the line III-III of the liquid crystal display shown in FIG. 2, according to exemplary embodiments of the present invention. FIG. 4 is a cross-sectional view taken along the line IV-IV of the liquid crystal display shown in FIG. 2, according to exemplary embodiments of the present invention.

Referring to FIG. 1, an LCD may include a thin film transistor (TFT) array panel 100, a corresponding panel 200, and a liquid crystal layer 3 interposed between the TFT array panel 100 and the corresponding panel 200. The TFT array panel 100 may include signal lines including a plurality of gate lines GL, a plurality of pairs of data lines DL<sub>a</sub> and DL<sub>b</sub>, and a plurality of storage electrode lines SL, and a plurality of pixels PX connected to the signal lines.

A pixel PX may include a pair of subpixels PX<sub>a</sub> and PX<sub>b</sub>. Subpixels PX<sub>a</sub> and PX<sub>b</sub> may include switching elements Q<sub>a</sub> and Q<sub>b</sub>, liquid crystal capacitors Cl<sub>ca</sub> and Cl<sub>cb</sub>, and storage capacitors C<sub>sta</sub> and C<sub>stb</sub>, respectively.

A switching element Q<sub>a</sub>/Q<sub>b</sub> may be a three-terminal element, such as a TFT, provided on the lower panel 100, and may include a control terminal connected to the gate line GL, an input terminal connected to the data line DL<sub>a</sub>/DL<sub>b</sub>, and an output terminal connected to the liquid crystal capacitor Cl<sub>ca</sub>/Cl<sub>cb</sub> and the storage capacitor C<sub>sta</sub>/C<sub>stb</sub>.

The liquid crystal capacitor *C<sub>lca</sub>/C<sub>lcb</sub>* may have one terminal connected to a subpixel electrode *191a/191b* and another terminal connected to a common electrode *270*. The liquid crystal layer *3* disposed between the electrodes *191a/191b* and common electrode *270* may be a dielectric material.

The storage capacitor *C<sub>sta</sub>/C<sub>stb</sub>* may be coupled to the liquid crystal capacitor *C<sub>lca</sub>/C<sub>lcb</sub>*, the storage electrode line *SL* provided on the panel *100*, and a subpixel electrode *191a/191b* overlapped with an insulator interposed therebetween. A predetermined voltage, such as a common voltage *V<sub>com</sub>*, may be applied to the storage capacitor *C<sub>sta</sub>/C<sub>stb</sub>*.

Referring to FIG. 1 and FIG. 2, a plurality of gate lines *121* and a plurality of storage electrode lines *131* and *135* may be formed on an insulating substrate *110*. The insulating substrate *110* may include glass or plastic. The gate lines *121* may transmit gate signals and may extend substantially in the transverse direction. Each gate line *121* may include a plurality of first and second gate electrodes *124a* and *124b* protruding upward.

The storage electrode lines *131* and *135* include a stem *131* arranged substantially parallel to the gate lines *121*, and a plurality of storage electrodes *135* extended from the stem *131*. The storage electrode lines *131* and *135* may be provided in various forms, shapes, and arrangements. In some cases, the storage electrode line *131* and the storage electrode *135* may be omitted.

A gate insulating layer *140* may be formed on the gate lines *121* and the storage electrode lines *131* and *135*. The gate insulating layer *140* may include silicon nitride (*SiN<sub>x</sub>*) and/or silicon oxide (*SiO<sub>x</sub>*).

A plurality of semiconductors *154a* and *154b* may be formed on the gate insulating layer *140*, and may include hydrogenated amorphous silicon (amorphous silicon is referred to as a-Si) or polysilicon. It should be understood that the gate insulating layer *140* and the plurality of semiconductors *154a* and *154b* may include any suitable material, and are not limited to the materials noted above.

A plurality of pairs of ohmic contacts *161a* and *161b*, *163a* and *163b*, and *165a* and *165b* may be formed on the semiconductors *154a* and *154b*, and may include a material, such as, for example, metal silicide or n<sup>+</sup>-hydrogenated amorphous silicon in which an n-type impurity may be doped with a high concentration.

A plurality of data line pairs *171a* and *171b*, a plurality of first and second drain electrodes *175a* and *175b*, and end portions *179a* and *179b* of the data lines *171a* and *171b* may be formed on the ohmic contacts *161a*, *161b*, *163a*, *163b*, *165a*, and *165b*, and on the gate insulating layer *140*.

The data lines *171a* and *171b* may transmit data signals, may extend substantially in the longitudinal direction, and may cross the gate lines *121* and the stems *131* of the storage electrode lines. A data line *171a/171b* may include a plurality of first/second source electrodes *173a/173b* extending toward the first/second gate electrodes *124a/124b*, and may be curved in a "U" shape. The first/second source electrodes *173a/173b* may be formed opposite to the first/second drain electrodes *175a/175b* with respect to the first/second gate electrodes *124a/124b*.

A first/second gate electrode *124a/124b*, a first/second source electrode *173a/173b*, a first/second drain electrode *175a/175b*, and a first/second semiconductor *154a/154b* may form a first/second TFT *Qa/Qb*, respectively. The channel of the TFT *Qa/Qb* may be formed in the first and the second semiconductors *154a* and *154b* between the first and second source electrodes *173a* and *173b* and the first and second drain electrodes *175a* and *175b*. The first and second drain

electrodes *175a* and *175b* may be connected to pixel electrodes *191a* and *191b* of the LCD.

The ohmic contacts *163b* and *165b* may be interposed between the underlying semiconductor islands *154a* and *154b*, and the overlying data lines *171a* and *171b* and/or drain electrodes *175a* and *175b*.

Three layers, including the first and second semiconductors *154a* and *154b* except the channel portion, the ohmic contacts *161a*, *161b*, *163a*, *163b*, *165a*, and *165b*, and the data lines *171a* and *171b* including the first and second source electrodes *173a* and *173b* and the first and second drain electrodes *175a* and *175b*, may have substantially the same plane shape. The three layers may be formed using one mask. The first and second semiconductors *154a* and *154b* and the ohmic contacts *161a*, *161b*, *163a*, *163b*, *165a*, *165b* may have an island-type shape. It should be understood that the three layers and their components may be implemented in various shapes and sizes and are not limited to the description noted above.

An inorganic insulating layer *180p* may include silicon nitride or silicon oxide and may be formed on the data lines *171a* and *171b*, the drain electrodes *175a* and *175b*, and the exposed semiconductors *154a* and *154b*. In some cases, the inorganic insulating layer *180p* may not be included in the LCD.

A partition pattern *180r* and a protrusion member pattern *180s* may be formed at the same layer on the inorganic insulating layer *180p*, and may include the same material.

The partition pattern *180r* may be disposed in the display area *DA*, extending in the column direction, and overlapping the data lines *171a* and *171b*. The partition pattern *180r* may overlap the TFTs *Qa* and *Qb*. The partition pattern *180r* may have contact holes *185a* and *185b* and may overlap the drain electrodes *175a* and *175b*. The partition pattern *180r* may serve as a barrier separating a blue color filter *230B*, a green color filter *230G*, and a red color filter (not shown). That is, each of the color filters *230B* and *230G* may be formed using an Inkjet method in the region defined by the partition pattern *180r*. The partition pattern *180r* may have a thickness of about 3 μm, and a height higher than that of the color filters *230B* and *230G*.

The protrusion member pattern *180s* may be disposed in the peripheral area *PA*, and may protrude in an approximate planar and column shape. It should be understood that the protrusion member pattern *180s* may be formed in various shapes such as, for example, in approximately a circular, an octagonal, a quadrangular, a triangular, or a stripe shape. A plurality of protrusion member patterns *180s* may be disposed at substantially uniform intervals to enclose the display area *DA*. Also, a plurality of protrusion member patterns *180s* may be disposed to enclose a circumference of the display area *DA* with one or more folds. A thickness of the protrusion member pattern *180s* may be substantially equal to the thickness of the partition pattern *180r*. The partition pattern *180r* and the protrusion member pattern *180s* may be formed simultaneously using the same process, and in some cases, may be formed of the same material. The partition pattern *180r* and the protrusion member pattern *180s* may include a transparent organic material, a photosensitive material, and/or a material functioning as a light blocking member having optical density of more than about 4.0. In general, any suitable material(s) may be used to form the partition pattern *180r* and the protrusion member pattern *180s*.

A blue color filter *230B*, a green color filter *230G*, and a red color filter (not shown) may be formed on the inorganic insulating layer *180p*. Each of the color filters *230B* and *230G* may be disposed between the partition patterns *180r* and may

have a band shape. The color filters **230B** and **230G** may be printed using an Inkjet process. In some cases, the color filters **230B** and **230G** may be formed on the corresponding panel **200** instead of the TFT array panel **100**.

An organic layer **180q** may be formed on the color filters **230B** and **230G**. The organic layer **180q** may include silicon oxide, silicon nitride, and/or a photosensitive organic material. The organic layer **180q** disposed in the display area DA may planarize the TFT array panel **100**.

A portion (not in the protrusion member pattern **180s**) in the organic layer **180q** that is disposed in the peripheral area PA may be removed and formed to a predetermined thickness by using a half-tone mask **20**. The half-tone mask may be a mask including regions with different light transmittance. For example, the half-tone mask may include a transmissive region transmitting all light, a light blocking region blocking all light, and a translucent region transmitting a portion of the light. The translucent region may include several closely disposed slits, or a thin metal layer to control an amount of light exposure.

A difference D1 between a first region of the organic layer **180q** overlapping the protrusion member pattern **180s** and a second region of the organic layer **180q** that does not overlap the protrusion member pattern **180s** may be more than about 1.5  $\mu\text{m}$ . Accordingly, the first region of the organic layer **180q** overlapping the protrusion member pattern **180s** may function as a spacer of the peripheral area PA along with the protrusion member pattern **180s**. Furthermore, when the difference D1 of the heights is more than about 2  $\mu\text{m}$ , the first region of the organic layer **180q** overlapping the protrusion member pattern **180s** may function as a better spacer in the peripheral area PA.

The organic layer **180q** may be formed in the peripheral area PA without use of the half-tone mask. Although a partition is disposed under the organic layer **180q**, a step of the organic layer **180q** may be generated at less than about 0.6  $\mu\text{m}$  of the partition due to the planarization effect of the organic layer **180q**. Accordingly, it may be difficult for the organic layer **180q** to function as a spacer.

A plurality of pixel electrodes **191** and connecting members **82** may be formed on the organic layer **180q**. A connecting member **82** may contact an end portion **179a** of the data line **171a** through a contact hole **182**. The pixel electrodes **191** and the connecting members **82** may include the same material such as, for example, ITO or IZO, and may be simultaneously formed using the same method.

Each pixel electrode **191** may include first and second subpixel electrodes **191a** and **191b** that are separated from each other with a gap **91**.

The overall shape of the first and second subpixel electrodes **191a** and **191b** may be a quadrangle. An area occupied by the second subpixel electrode **191b** may be relatively larger than an area occupied by the first subpixel electrode **191a** in the whole pixel electrode **191**.

A first/second subpixel electrode **191a/191b** may be physically and electrically connected to the first/second drain electrode **175a/175b** through the contact hole **185a/185b**, and may receive data voltages from the first/second drain electrode **175a/175b**.

A light blocking member **220** may be formed on the pixel electrode **191**. The light blocking member **220** positioned in the display area DA may be arranged parallel to the data lines **171a** and **171b** in the column direction. The light blocking member **220** may include protrusions covering the first and second TFTs Qa and Qb. The light blocking member **220** may also cover regions between the color filters **230B** and **230G** thereby preventing light leakage. The light blocking member

**220** positioned in the peripheral area PA may cover the peripheral area with an approximately uniform thickness. Further, in some cases, the light blocking member **220** may be formed in the corresponding panel **200** instead of the TFT array panel **100**.

The height D2 of the light blocking member **220** near the protrusion member pattern **180s** may be more than about 0.7  $\mu\text{m}$ . That is, a height of a first region of the light blocking member **220** where the light blocking member **220** and the protrusion member pattern **180s** overlap each other may be more than about 0.7  $\mu\text{m}$ . A height of a second region of the light blocking member **220** where the light blocking member **220** and the protrusion member pattern **180s** do not overlap each other (in the peripheral area) may be more than about 0.7  $\mu\text{m}$ . Due to the height difference D2, the TFT array panel **100** and the corresponding panel **200** may be prevented from being temporarily adhered in the peripheral area PA. The density of the liquid crystal molecules filling the peripheral area PA may be uniformly maintained thereby improving the display quality of the LCD. Furthermore, the difference of height between the light blocking member **220** in the first region and the light blocking member **220** in the second region may be more than about 1  $\mu\text{m}$ , thereby further improving the display quality of the liquid crystal display.

Without using the half-tone mask to form the organic layer **180q**, the entire peripheral area may be planarized to less than about 0.6  $\mu\text{m}$ . Accordingly, it can be difficult to prevent adhesion between the panels **100** and **200** in the peripheral area.

A spacer **320** may be formed, in some cases, on the pixel electrode **191** in the same layer as the light blocking member **220**, and in some cases, in a different layer from the light blocking member **220**. The spacer **320** may maintain a gap between the two panels **100** and **200** where the liquid crystal layer **3** is situated, and may be a column spacer. The column spacer **320** may be positioned between the first and second TFTs Qa and Qb.

The light blocking member **220** and the column spacer **320** may include the same material, and may be formed with different thicknesses by using the half-tone mask.

A lower alignment layer **11** may be formed on the pixel electrodes **191** and the connecting members **82**.

A sealant **310** may seal and enclose the display area DA. The sealant **310** may be formed on the organic layer **180q** in the peripheral area PA. The region corresponding to the organic layer **180q** overlapping the sealant **310** may correspond to the translucent region of the mask. Accordingly, a thickness of the organic layer **180q** overlapping the sealant **310** may be the same as a thickness of the organic layer **180q** near the protrusion member pattern **180s**.

In some cases, the region corresponding to the organic layer **180q** overlapping the sealant **310** may correspond to the transmissive region or the light blocking region of the mask. In these cases, a thickness of the organic layer **180q** overlapping the sealant **310** may be greater than a thickness of the organic layer **180q** near the protrusion member pattern **180s**.

Next, a manufacturing method of the LCD shown in FIG. 1 to FIG. 4 will be described with reference to FIG. 5 to FIG. 7. Descriptions of components already described with reference to FIG. 1 to FIG. 4 may be omitted.

FIG. 5 and FIG. 6 are schematic diagrams showing a manufacturing process of a LCD. FIG. 7 is a top plan view of the mask used in FIG. 6.

A gate line **121** and storage electrode lines **131** and **135** may be formed on a substrate **110**.

Next, a gate insulating layer **140** may be formed on the gate line **121** and the storage electrode lines **131** and **135**.

Three layers of semiconductors **154a** and **154b**, ohmic contacts **161a**, **161b**, **163b**, **163b**, **165a**, and **165b**, and data lines **171a** and **171b** and drain electrodes **175a** and **175b** (not shown) may be sequentially deposited and formed through a photolithography process on the gate insulating layer **140**.

Next, an inorganic insulating layer **180p** may be disposed on the three layers. The inorganic insulating layer **180p** may include an opening. Contact holes **185a** and **185b** may be formed with an opening of the organic layer **180q**. The opening of the inorganic insulating layer **180p** may be the same size as an opening of the organic layer **180q**. The opening of the organic layer **180q** may be used as a mask to etch the inorganic insulating layer **180p** and form the opening of the inorganic insulating layer **180p**.

Referring to FIG. 2 and FIG. 5, a partition pattern **180r** and a protrusion member pattern **180s** may be formed simultaneously on the inorganic insulating layer **180p** in the peripheral area PA.

Referring to FIG. 2 and FIG. 6, an organic layer **180q** may be formed on the partition pattern **180r** and the protrusion member pattern **180s**. If the organic layer **180q** includes a negative photosensitive organic material, a region of the organic layer **180q** that does not overlap the protrusion member pattern **180s** in the peripheral area PA may be formed to a uniform thickness by using the half-tone mask **20**. That is, referring to FIG. 6 and FIG. 7, the half-tone mask **20** may include a transmissive region **20a** transmitting all light, a translucent region **20b** partially transmitting light, and a light blocking region (not shown) blocking all light. The translucent region **20b** may be a slit pattern, a lattice pattern, or a thin film having intermediate transmittance or an intermediate thickness. The boundary between the transmissive region **20a** and the translucent region **20b** may be formed within the circumference of the protrusion member pattern **180s**.

As a result, if the mask **20** is properly aligned and the exposure and developing processes are executed, a thickness of the organic layer **180q** corresponding to the translucent region **20b** may be the height difference D1 as noted above. In some cases, the height difference D1 may be more than 1.5  $\mu\text{m}$ . When the organic layer **180q** includes a positive photosensitive organic material, the transmissive region **20a** of the half-tone mask **20** may be used as a light blocking region.

Next, a pixel electrode **191** and a connecting member **82** may be formed on the organic layer **180q**.

Next, a light blocking member **220** and a spacer **320** may be formed simultaneously on the pixel electrode **191** and the connecting member **82**. The height difference D2 between the light blocking member **220** of the first region and the light blocking member **220** of the second region may be more than about 0.7  $\mu\text{m}$  as noted above. In some cases, the height difference D2 may be more than 1.0  $\mu\text{m}$ .

Next, a lower alignment layer **11** may be formed on the pixel electrode **191**, the light blocking member **220**, and the spacer **320**. A liquid crystal layer **3** may then be disposed on the lower alignment layer **11**.

On the corresponding substrate **210**, a common electrode **270** may be formed. An upper alignment layer (not shown) may be formed on the common electrode **270**.

The corresponding panel **200** may be aligned such that the common electrode **270** formed on the corresponding substrate **210** may contact the liquid crystal layer **3**, and then the TFT array panel **100** and the corresponding panel **200** may be combined.

In some cases, when the liquid crystal layer **3** is formed on the common electrode **270** of the corresponding substrate **210**, the corresponding panel **200** may be aligned such that the spacer **320** of the TFT array panel **100** contacts the liquid

crystal layer **3**, and then the TFT array panel **100** and the corresponding panel **200** may be combined.

Methods for forming the TFT and the electrode may include thin film deposition and patterning by photolithography.

Using the manufacturing method described above with reference to FIG. 5 to FIG. 7, the thickness of the protrusion member pattern **180s** may be about 3.0  $\mu\text{m}$ , the thickness of the organic layer **180q** may be about 2.5  $\mu\text{m}$ , and the thickness of the light blocking member **220** may be about 4.0  $\mu\text{m}$ . Accordingly, the height difference D1 of the organic layer **180q** may be about 2.12  $\mu\text{m}$ , and the height difference D2 of the light blocking member **220** may be about 1.32  $\mu\text{m}$ .

Hereinafter, another manufacturing method of an LCD will be described with reference to FIG. 8. Descriptions of processes and components already described with reference to FIG. 1 to FIG. 7 may be omitted.

FIG. 8 is a top plan view of a mask used in a manufacturing process of a TFT array panel according to exemplary embodiments of the present invention.

The above-described description of FIG. 5, FIG. 6, and FIG. 7 may be similarly applied according to this method except that the boundary line of the transmissive region **20a** and the translucent region **20b** may be disposed outside the protrusion member pattern **180s** circumference, or substantially along the circumference of the protrusion member pattern **180s**.

Accordingly, by using the boundaries illustrated in FIG. 8, the thickness of the protrusion member pattern **180s** may be about 3.0  $\mu\text{m}$ , the thickness of the organic layer **180q** may be about 2.5  $\mu\text{m}$ , and the thickness of the light blocking member **220** may be about 4.0  $\mu\text{m}$ . Accordingly, the height difference D1 of the organic layer **180q** may be about 2.07  $\mu\text{m}$ , and the height difference D2 of the light blocking member **220** may be about 1.25  $\mu\text{m}$ .

Next, another manufacturing method of an LCD according to exemplary embodiments of the present invention will be described with reference to FIG. 9 and FIG. 10. Descriptions of processes and components already described with reference to FIG. 1 to FIG. 7 may be omitted.

FIG. 9 is a cross-sectional view of an LCD according to exemplary embodiments of the present invention, and FIG. 10 is a top plan view of a mask used for a manufacturing process of the LCD shown in FIG. 9.

The description of the above-described LCD of FIG. 1 to FIG. 4, and the manufacturing method of the liquid crystal display of FIG. 5 to FIG. 7 may be similarly applied except that the translucent region **20b** of the mask **20** may be positioned in the region less than 0.1 mm from a center of the protrusion member pattern **180s**. The translucent region **20b** may have a quadrangular shape enclosing the transmissive region **20a**. It should be understood that the translucent region **20b** and outer circumference thereof may have any suitable dimensions or shape, including, for example, circular, octagonal, triangular, or quadrangular. The inner boundary of the translucent region **20b** may be positioned along the circumference of the protrusion member pattern **180s** and the boundary of the transmissive region **20a**.

When using a mask of FIG. 10 for forming the organic layer **180q**, as shown in FIG. 9, a third region of the organic layer **180q** may be formed according to the shape of the translucent region **20b** and a shape of a recess portion on the circumference of the protrusion member pattern **180s**. The height difference D1 between the first region of the organic layer overlapping the protrusion member pattern **180s** and the third region of the organic layer may be more than 1  $\mu\text{m}$ .

## 11

A light blocking member **220** may be formed on the organic layer **180q**. The height difference **D2** between the portion of the light blocking member **220** overlapping the protrusion member pattern **180s** and the portion of the light blocking member **220** overlapping the third region of the organic layer may be more than 0.7  $\mu\text{m}$ . In some cases, the height difference **D2** may be more than 1.0  $\mu\text{m}$ . Accordingly, the display quality of the LCD may be further improved.

FIG. **11** is a top plan view of another mask used in a manufacturing process of a TFT array panel according to exemplary embodiments of the present invention.

The above-described description of FIG. **8** and FIG. **9** may be similarly applied except that the boundary inside the translucent region **20b** may be disposed outside the circumference of the protrusion member pattern **180s**, or along the circumference of the protrusion member pattern **180s**.

It will be apparent to those skilled in the art that various modifications and variations can be made in 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. A liquid crystal display, comprising:

a substrate comprising a display area and a peripheral area;  
a protrusion member pattern disposed in the peripheral area; and

an organic layer disposed in the peripheral area and the display area,

wherein a height of a first region of the organic layer in the peripheral area is higher than a height of a second region of the organic layer in the peripheral area by more than about 1.5  $\mu\text{m}$ , the first region of the organic layer being a region where the organic layer overlaps the protrusion member pattern, the second region of the organic layer being a region where the organic layer and the protrusion member pattern do not overlap each other, and

## 12

wherein a thickness of the first region of the organic layer in the peripheral area is larger than a thickness of the second region of the organic layer in the peripheral area.

2. The liquid crystal display of claim 1, further comprising: a light blocking member disposed on the organic layer,

wherein a height of a first region of the light blocking member in the peripheral area is higher than a height of a second region of the light blocking member in the peripheral area by more than about 0.7  $\mu\text{m}$ , the first region of the light blocking member being a region where the light blocking member overlaps the protrusion member pattern, the second region of the light blocking member being a region where the light blocking member and the protrusion member pattern do not overlap each other.

3. The liquid crystal display of claim 2, wherein the height of the first region of the light blocking member is higher than the height of the second region of the light blocking member by more than 1.0  $\mu\text{m}$ , and

wherein the protrusion member pattern has a column shape.

4. The liquid crystal display of claim 1, further comprising: an inorganic insulating layer disposed below the organic layer.

5. The liquid crystal display of claim 4, wherein an opening of the organic layer in the peripheral area corresponds to an opening of the inorganic insulating layer in the peripheral area.

6. The liquid crystal display of claim 5, further comprising: a partition pattern disposed in the display area, the partition pattern comprising the same material as the protrusion member pattern, and the partition pattern formed at the same layer as the protrusion member pattern; and a color filter disposed in a region defined by the partition pattern.

\* \* \* \* \*

|                |                                                                                                                        |         |            |
|----------------|------------------------------------------------------------------------------------------------------------------------|---------|------------|
| 专利名称(译)        | 液晶显示器及其制造方法                                                                                                            |         |            |
| 公开(公告)号        | <a href="#">US8564748</a>                                                                                              | 公开(公告)日 | 2013-10-22 |
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| 其他公开文献         | US20100321617A1                                                                                                        |         |            |
| 外部链接           | <a href="#">Espacenet</a> <a href="#">USPTO</a>                                                                        |         |            |

#### 摘要(译)

本发明的示例性实施例公开了一种液晶显示器 ( LCD ) 及其制造方法。LCD可以具有显示区域和外围区域。可以使用半色调掩模来图案化外围区域的有机层, 并且可以在外围区域中形成突出构件。因此, 可以防止薄膜晶体管阵列面板和相应的基板临时粘附在周边区域中, 使得可以均匀地保持填充在周边区域中的液晶分子的密度和液晶显示器的显示质量。可能会有所改善。

