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(54) **LIQUID CRYSTAL DISPLAY DEVICE AND METHOD OF FABRICATING THE SAME**

(75) Inventors: **Kyung Wook Kim**, Seoul (KR);
Sang-Ki Kwak, Cheonan-si (KR);
Yeo-Geon Yoon, Asan-si (KR);
Hyuk-Jin Kim, Cheonan-si (KR)

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

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G02F 1/1333 (2006.01)

(52) **U.S. Cl.** **349/129; 349/110**

(58) **Field of Classification Search** 349/110,
349/129

See application file for complete search history.

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Primary Examiner — Phu Vu

(74) *Attorney, Agent, or Firm* — Cantor Colburn LLP

(57) **ABSTRACT**

A liquid crystal display (LCD) device and a method of fabricating the same includes a gate line arranged in one direction, a data line arranged in a perpendicular direction to the gate line, a pixel electrode arranged in a pixel region defined by the gate and data lines and having a diagonal side adjacent to a crossing portion of the gate and data lines, and a light blocking pattern arranged in a parallel direction with respect to the diagonal side of the pixel electrode and preventing light leakage.

20 Claims, 8 Drawing Sheets

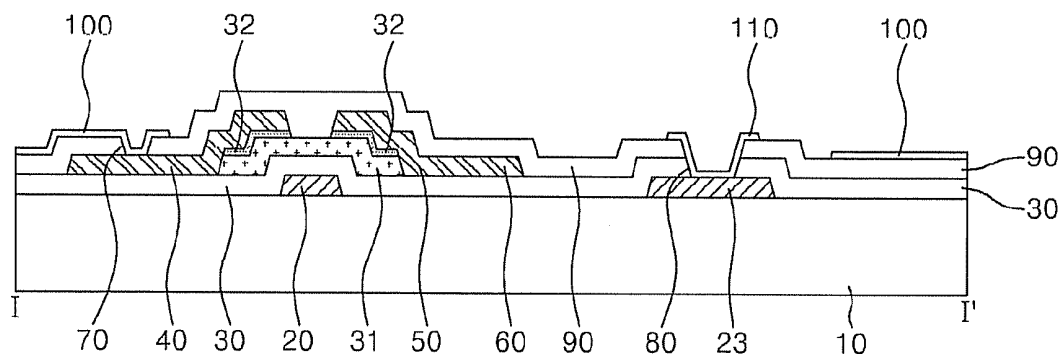


FIG. 1

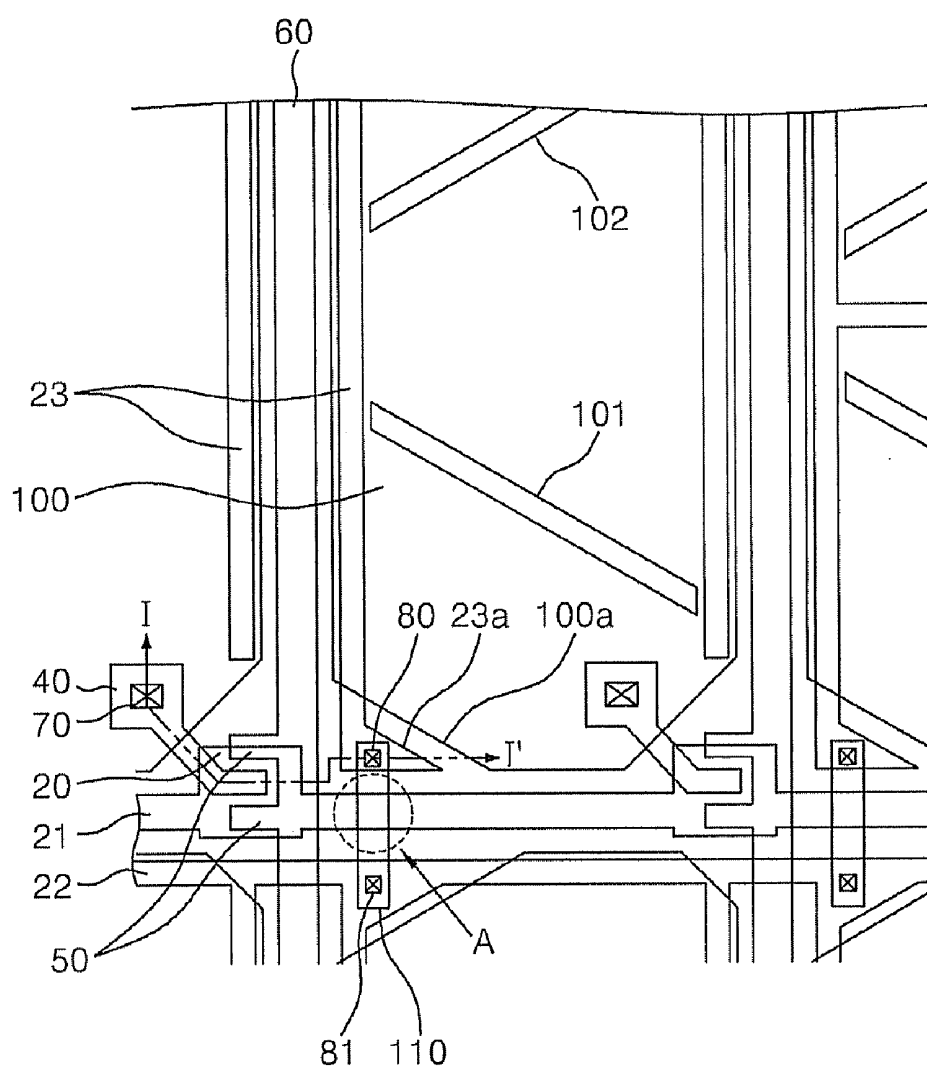


FIG. 2

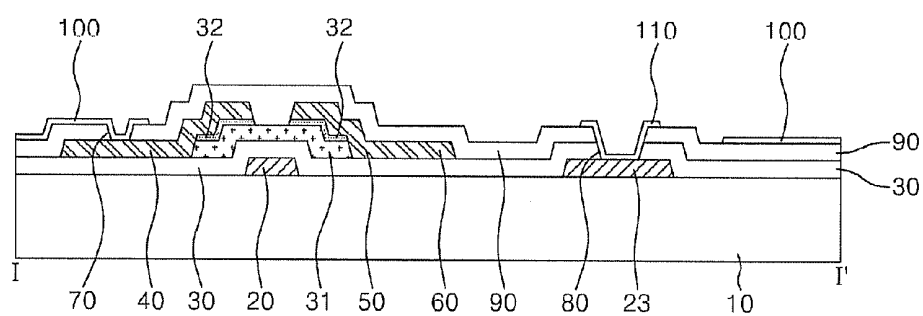


FIG. 3A

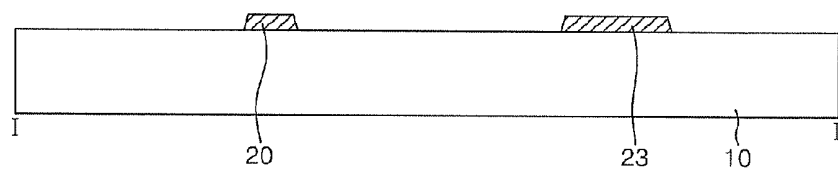


FIG.3B

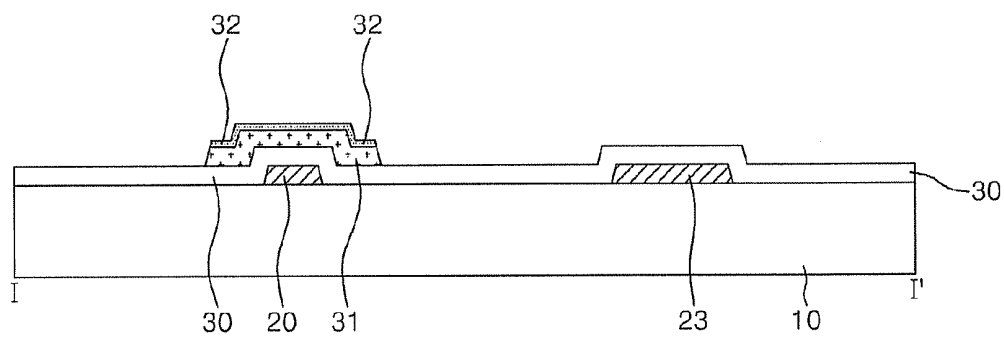


FIG.3C

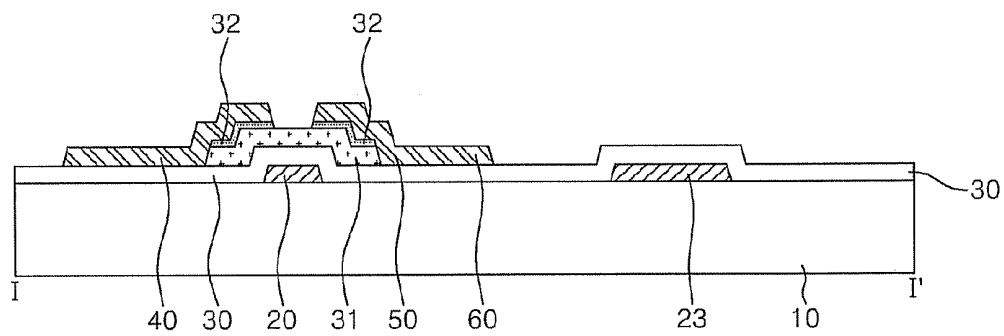


FIG.3D

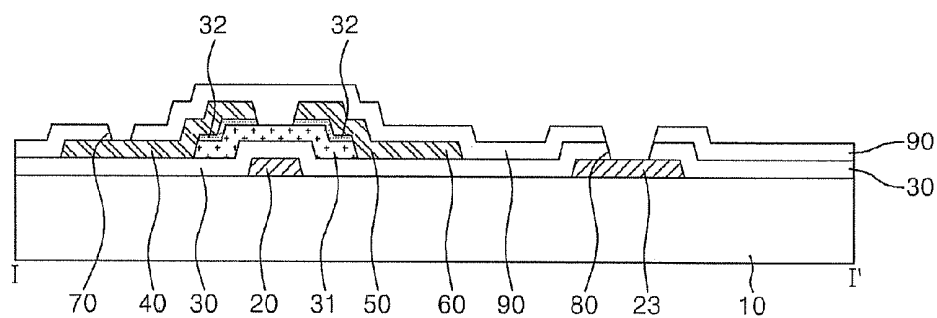


FIG.3E

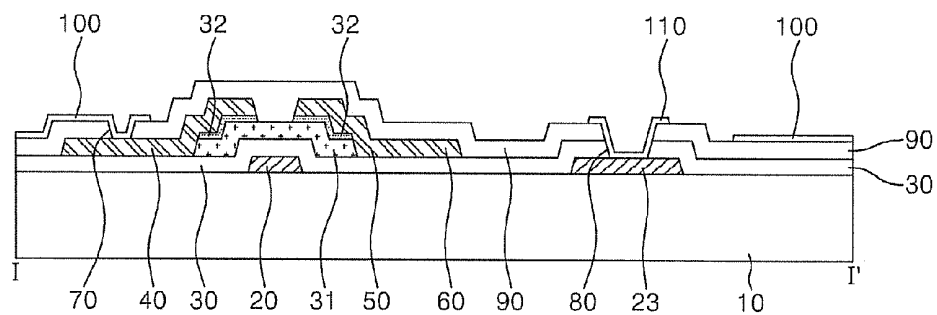


FIG. 4

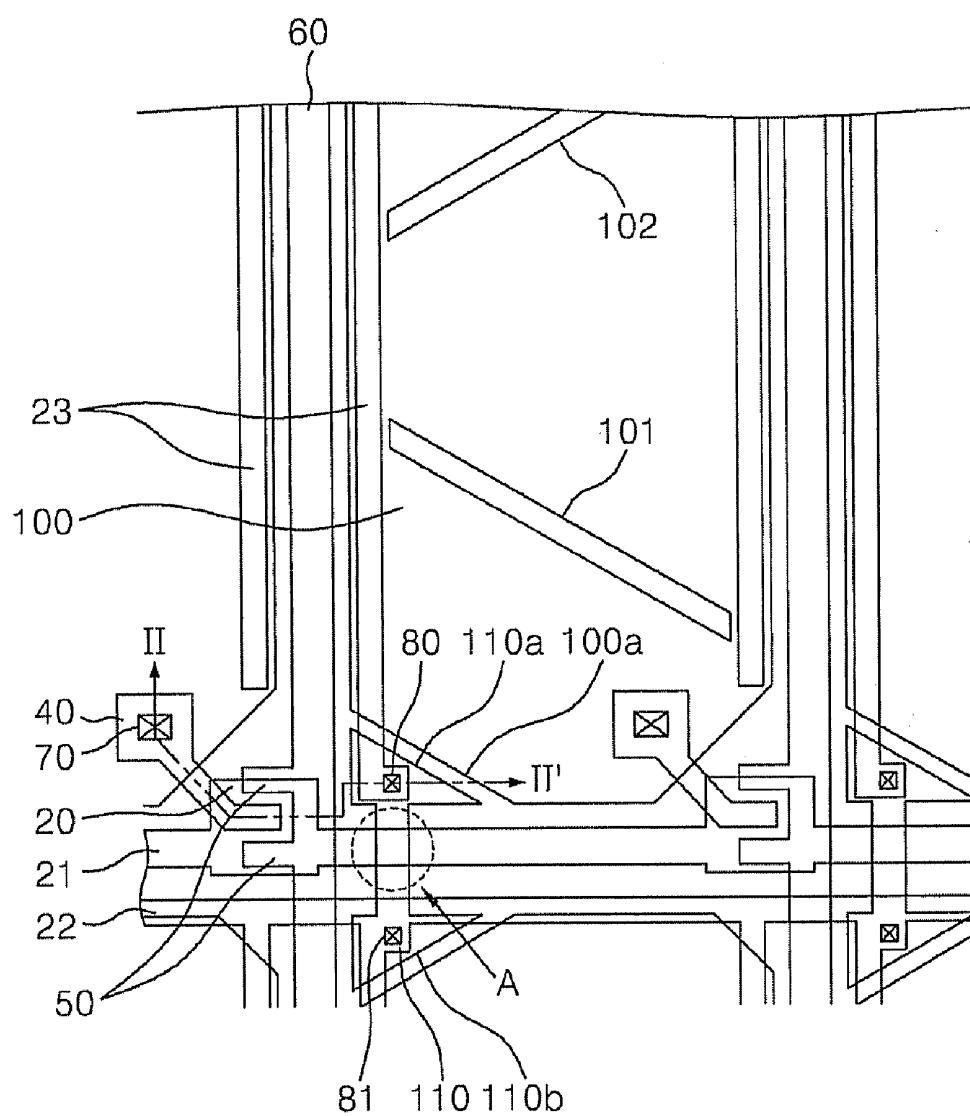


FIG. 5

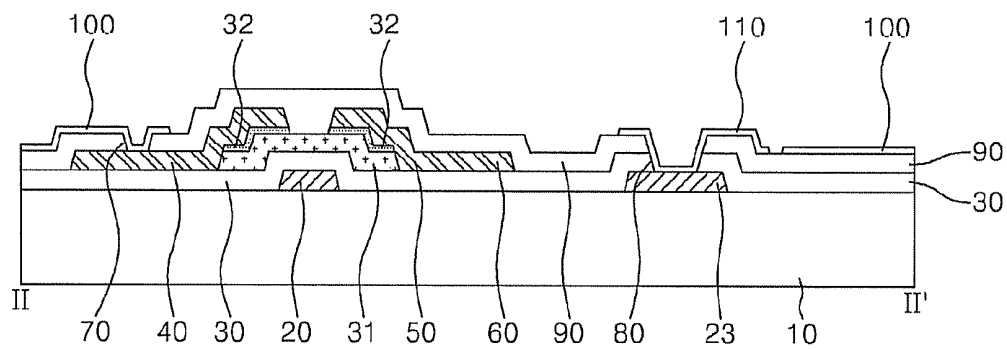


FIG. 6A

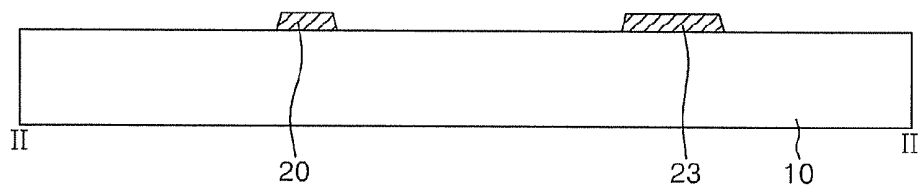


FIG. 6B

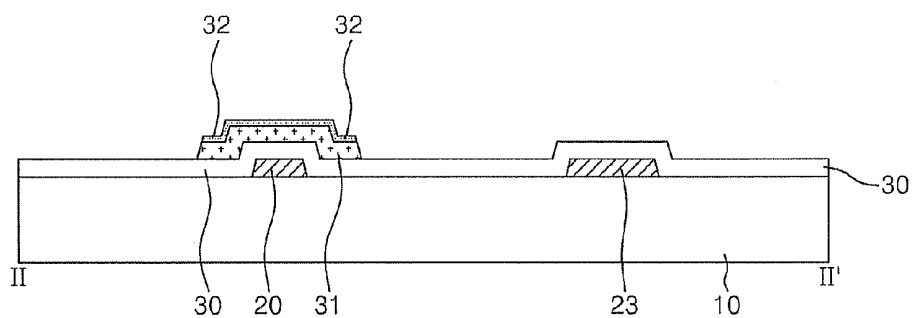


FIG. 6C

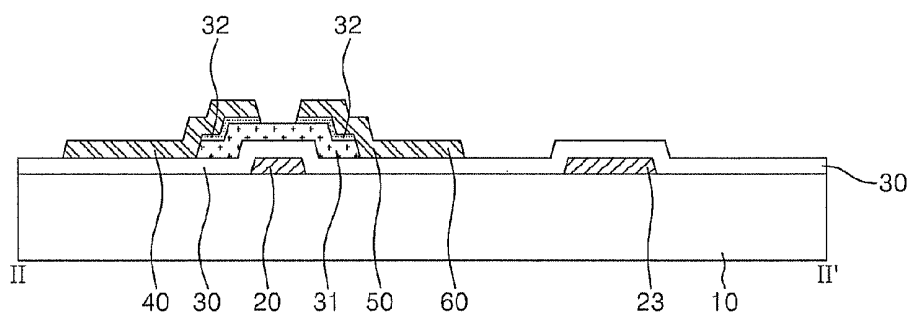


FIG. 6D

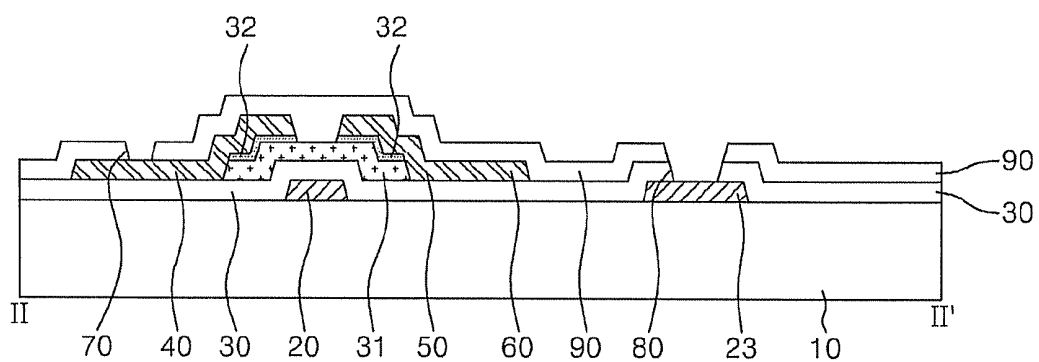
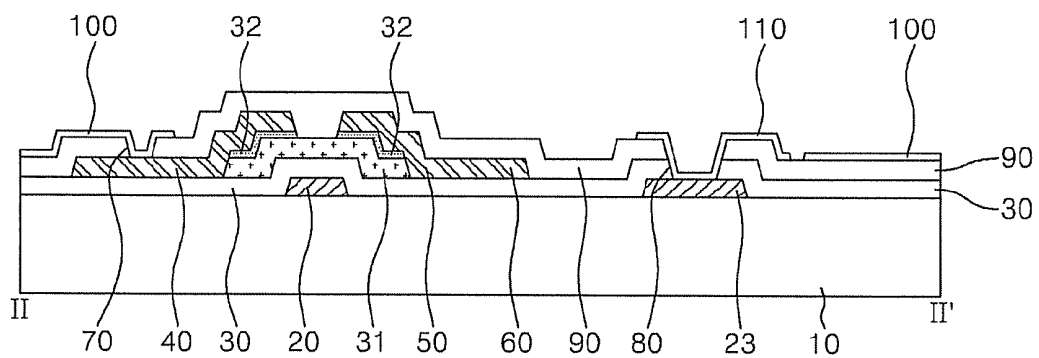


FIG. 6E



LIQUID CRYSTAL DISPLAY DEVICE AND METHOD OF FABRICATING THE SAME

This application is a continuation of U.S. application Ser. No. 11/671,790, filed on Feb. 6, 2007, which claims priority to and the benefit of Korean Patent Application No. 2006-11111, filed Feb. 6, 2006, and all the benefits accruing therefrom under 35 U.S.C. §119, the disclosure of which is incorporated herein by reference in its entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to a liquid crystal display ("LCD") device and, more particularly, to an LCD device in which a display defect resulting from a texture defect occurring around a side of a pixel electrode due to column spacer movement is reduced or effectively prevented, and a method of fabricating the same.

2. Description of the Related Art

An "LCD" device is widely used in products such as cellular phones, computer monitors, televisions, etc., and is increasingly in demand due to its advantages of compact size, light weight, and low power consumption.

A typical LCD device comprises a color filter substrate and a thin film transistor ("TFT") substrate with a liquid crystal layer interposed therebetween. The color filter substrate comprises a common electrode and a color filter, and the TFT substrate comprises a TFT and a pixel electrode. Different electric potentials are applied to the pixel electrode and the common electrode to change the orientation of liquid crystal molecules, so that the transmissivity of light is adjusted to display an image.

Recently, a vertically aligned ("VA") mode LCD device (in which a longitudinal or major axis of a liquid crystal molecule is perpendicular to upper and lower substrates when an electric field is not applied thereto) has attracted attention due to the high contrast ratio and wide viewing angle capabilities thereof.

Presently, there are two known methods of obtaining a wide viewing angle in VA mode LCD device. The first method is to form an incision pattern in an electrode, while the second method is to form a projection in an electrode. Both of the two methods form a fringe field to equally distribute the tilt direction of liquid crystal molecules in four directions to thereby obtain the wide viewing angle. A patterned vertically aligned ("PVA") mode for forming the incision pattern is also used as a wide viewing angle technique in lieu of an in-plane switching ("IPS") mode.

The PVA mode has a relatively fast response characteristic as compared to a twisted nematic ("TN") mode, since there is no torsion in movement of the liquid crystal molecule and the liquid crystal molecule is splayed in a perpendicular direction to an electric field, or moves only by bending elasticity.

However, if an upper substrate including a black matrix and a lower substrate including a TFT are misaligned or moved by an external physical shock or impact, the black matrix is also moved. In this instance, a texture control defect may occur due to light leakage, thereby leading to a display defect in the LCD device. In particular, if a column spacer for maintaining a cell gap between the upper substrate and the lower substrate is formed at a region adjacent to a blue pixel region and the column spacer is shocked or impacted, the texture defect occurs because light leakage is more increased than at other regions due to a movement of the column spacer in the direction of a pixel region. Even where the column spacer is restored to its original position, the text defect of the blue

pixel region is still not cured. As a result, the defect may result in a deterioration of the brightness of the display, and may also result in a horizontal line defect and a yellowish phenomenon.

BRIEF SUMMARY OF THE INVENTION

Aspects of the present invention provide an LCD device in which a display defect is prevented by modifying a shape of a portion of a storage extending portion or a shape of a portion of a bridge electrode for connecting the storage extending portion and a storage line which are located in a region where the column spacer is arranged, and a method of fabricating the same.

One exemplary embodiment of the present invention provides an LCD device, comprising a gate line arranged in one direction, a data line arranged in a perpendicular direction to the gate line, a pixel electrode arranged in a pixel region defined by the gate and data lines and having a diagonal side adjacent to a crossing portion of the gate and data lines, and a light blocking pattern arranged in a parallel direction with respect to the diagonal side of the pixel electrode and preventing light leakage.

In one exemplary embodiment, the light blocking pattern is formed from the same metal on the same plane as the gate line.

In one exemplary embodiment, the light blocking pattern comprises a first storage line arranged in a parallel direction with respect to the gate line to supply a storage voltage, and a storage extending portion arranged in a parallel direction with respect to the data line and extending from the first storage line, wherein the storage extending portion overlaps one side of the pixel electrode.

In one exemplary embodiment, the LCD device further comprises a bridge electrode electrically connecting the storage extending portion of the first storage line with a second storage line.

In one exemplary embodiment, the bridge electrode is formed from the same metal on the same plane as the pixel electrode.

In one exemplary embodiment, the light blocking pattern is formed from the same metal on the same plane as the pixel electrode.

In one exemplary embodiment, the LCD device further comprises a first storage line arranged in a parallel direction with respect to the gate line to supply a storage voltage, and a storage extending portion arranged in a parallel direction with respect to the data line and extending from the first storage line, wherein the storage extending portion overlaps one side of the pixel electrode, and wherein the light blocking pattern electrically connects the storage extending portion to a second storage line and has a diagonal side which is substantially parallel with respect to the diagonal side of the pixel electrode.

In one exemplary embodiment, the light blocking pattern receives a storage voltage.

Another exemplary embodiment of the present invention provides a method of forming an LCD device comprising forming a gate line arranged in one direction and a data line arranged in a perpendicular direction to the gate line, forming a pixel electrode arranged in a pixel region defined by the gate and data lines and having a diagonal side adjacent to a crossing portion of the gate and data lines, and forming a light blocking pattern arranged in a parallel direction with respect to the diagonal side of the pixel electrode.

In one exemplary embodiment, forming the light blocking pattern comprises forming a first storage line arranged in a

parallel direction with respect to the gate line and formed from the same metal on the same plane as the gate line, and forming a storage extending portion arranged in a parallel direction with respect to the data line and extending from the first storage line, wherein the storage extending portion overlaps one side of the pixel electrode.

In one exemplary embodiment, forming the light blocking pattern further comprises forming a part of the storage line to be substantially parallel with respect to the diagonal side of the pixel electrode, and forming one side of an end of the storage extending portion to be substantially parallel with respect to the diagonal side of the pixel electrode.

In one exemplary embodiment, the method further comprises forming a bridge electrode electrically connecting the storage extending portion of the first storage line with a second storage line.

In one exemplary embodiment, forming the bridge electrode comprises forming one side of the bridge electrode to be substantially parallel with respect to the diagonal side of the pixel electrode with the same metal on the same plane as the pixel electrode.

In one exemplary embodiment, the light blocking pattern is formed from the same metal on the same plane as the pixel electrode while forming the pixel electrode.

In one exemplary embodiment, the method further comprises forming a first storage line arranged in a parallel direction with respect to the gate line, forming a storage extending portion arranged in a parallel direction with respect to the data line and extending from the first storage line, and forming the light blocking pattern electrically connecting the storage extending portion to a second storage line.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other aspects, features and advantages of the present invention will be described in reference to certain exemplary embodiments is thereof with reference to the attached drawings in which:

FIG. 1 is a top view illustrating a TFT substrate according to one exemplary embodiment of the present invention;

FIG. 2 is a cross-sectional view taken along line I-I' of FIG. 1;

FIGS. 3A to 3E are cross-sectional views illustrating a process for fabricating the TFT substrate of FIGS. 1 and 2 according to one exemplary embodiment of the present invention;

FIG. 4 is a top view illustrating a TFT substrate according to another exemplary embodiment of the present invention;

FIG. 5 is a cross-sectional view taken along line I-I' of FIG. 4; and

FIGS. 6A to 6E are cross-sectional views illustrating a process for fabricating the TFT substrate of FIGS. 4 and 5 according to another exemplary embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The present invention is described more fully hereinafter with reference to the accompanying drawings, in which exemplary embodiments of the invention are shown. The present 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.

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 "lower" other elements or features would then be oriented "above" or "upper" relative to 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 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.

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, the present invention will be explained in detail with reference to the accompanying drawings.

FIG. 1 is a top view illustrating a TFT substrate according to one exemplary embodiment of the present invention, and FIG. 2 is a cross-sectional view taken along line I-I' of FIG. 1.

Referring to FIGS. 1 and 2, the TFT substrate comprises a gate line 21 arranged in a transverse direction, a data line 60 arranged in a perpendicular direction with respect to the gate line 21, a pixel electrode 100 arranged in a pixel region defined by the gate line 21 and the data line 60, a storage line 22 arranged in a parallel direction with respect to the gate line 21 to supply a storage voltage, and a storage extending portion 23 extending from the storage line 22 and arranged in a parallel direction with respect to the data line 60. The storage line 21 and the storage extending portion 23 constitute a storage electrode. The pixel electrode 100 has a diagonal side 100a adjacent to a crossing point of the gate line 21 and the

data line 60. In other words, the diagonal side 100a of the pixel electrode 100 is formed by a corner cut off from the pixel electrode. The storage extending portion 23 overlaps a side of the pixel electrode 100 adjacent to the data line 60 and also has a diagonal side 23a corresponding to (and generally parallel with) the diagonal side 100a of the pixel electrode 100. The storage line 22 and the storage extending portion 23 constitute a light blocking pattern.

The gate line 21 supplies a scan signal, and the data line 60 supplies an image data signal. A gate insulating layer 30 (FIG. 2) is interposed between the gate line 21 and the data line 60. A TFT connected to the gate line 21 and the data line 60 is formed in the pixel region.

The TFT comprises a gate electrode 20 extending from the gate line 21, a source electrode 50 extending from the data line 60, a drain electrode 40 electrically connected to the pixel electrode 100, and a semiconductor layer 31 which has a channel area between the source and drain electrodes 50 and 40, and which overlaps the gate electrode 20 with the gate insulating layer 30 interposed therebetween. The TFT further comprises an ohmic contact layer 32 for providing ohmic contact between the source and drain electrodes 50 and 40, and the semiconductor layer 31. The TFT transmits the image data signal of the data line 60 to the pixel electrode 100 in response to the scan signal of the gate line 21.

A passivation film 90 is formed over the entire surface of a substrate 10. The pixel electrode 100 is formed on the passivation film 90 and is electrically connected to the drain electrode 40 via a pixel contact hole 70 formed through the passivation film 90. The pixel electrode 100, which has received the image data signal from the TFT drives a liquid crystal layer to vary the transmissivity of light using a voltage difference with respect to the common electrode of the color filter substrate. The pixel electrode 100 comprises at least two slits 101 and 102 to divide the pixel region into a plurality of domains. The two slits 101 and 102 are symmetrically arranged at a predetermined angle on upper and lower portions of the pixel electrode in a transverse axis direction. In an exemplary embodiment, the first and second slits 101 and 102 are perpendicularly arranged with respect to one another. The first and second slits 101 and 102 evenly disperse a direction of the fringe field in multiple directions to form a plurality of domains in a single pixel. The diagonal side 100a of the pixel electrode 100 (arranged adjacent to a crossing point of the gate line 21 and the data line 60) serves to prevent the pixel electrode 100 from overlapping a bridge electrode 110 which connects the storage extending portion 23 and the storage line 22 of the next stage.

The light blocking pattern includes the storage line 22 and the storage extending portion 23. The light blocking pattern overlaps the pixel electrode 100. The storage voltage is applied to the light blocking pattern so as to maintain a data voltage charged to the pixel electrode 100 during one frame.

The storage line 22 is arranged in a parallel direction with respect to the gate line 21 and supplies the storage voltage. The storage extending portion 23, extending from the storage line 22, is arranged in a parallel direction with respect to the data line 60.

The storage extending portion 23 is formed in a parallel direction with to the data line 60 and overlaps one side of the pixel electrode 100 adjacent to the data line 60. An end of the storage extending portion 23 is electrically connected to the storage line 22 of the next stage via the bridge electrode 110. The storage extending portion 23 has a diagonal side 23a substantially parallel to the diagonal side 100a of the pixel electrode 100 so as to prevent light leakage which may occur at an edge region of the pixel electrode 100. In addition, the

storage line 22 has a diagonal side substantially parallel with respect to the diagonal side 110a of the pixel electrode 100 so as to prevent light leakage.

Accordingly, the light blocking pattern prevents light leakage which may occur at an edge region of the pixel electrode 100 due to misalignment of the color filter substrate and the TFT substrate.

Even where a column spacer located in an area "A" in FIG. 1 is caused to move by external shock or impact, light leakage is prevented by the diagonal side 23a of the end of the storage extending portion 23. Therefore, a texture defect which may occur at an edge region of the pixel electrode 100 is prevented. Particularly, even in a case where the column spacer is arranged adjacent to the blue unit pixel, the yellowish phenomenon can be prevented notwithstanding movement of the column spacer. Accordingly, the display quality of the LCD device is improved.

The end of the storage extending portion 23 is electrically connected to the bridge electrode 110 via a first contact hole 80, and the storage line 22 of the next stage is electrically connected to the bridge electrode 110 via a second contact hole 81. Thus, the storage line 22 and the storage extending portion 23 are electrically connected to one another by the bridge electrode 110.

In an exemplary embodiment, the bridge electrode 110 is made of a transparent conductive material such as, for example indium tin oxide ("ITO") or indium zinc oxide ("IZO").

FIGS. 3A to 3E are cross-sectional views illustrating a process for fabricating the TFT substrate of FIGS. 1 and 2 according to one exemplary embodiment of the present invention.

Referring to FIG. 3A, a first conductive pattern group including the gate line 21 (not shown in FIG. 3A), the gate electrode 20, and the light blocking pattern is formed on the substrate 10 by using a first mask process. The light blocking pattern includes the storage line 22 and the storage extending portion 23 having a diagonal side.

More specifically, a first conductive layer is deposited on the substrate 10 using, for example, a sputtering technique. The first conductive layer may be formed from Al (aluminum), Cr (chromium), Cu (copper), Mo (molybdenum), an alloy(s) thereof, or a combination thereof. In addition, the first conductive layer may have a single layer structure or a multi-layer structure. The first conductive layer is patterned by a photolithography process using a first mask and an etching process to form the first conductive pattern group including the gate line 21, the gate electrode 20, the storage line 22, and the storage extending portion 23 having the diagonal side 23a. The storage line 22 has a diagonal side which is substantially parallel with respect to the diagonal side 110a of the pixel electrode 100 so as to prevent light leakage.

Referring to FIG. 3B, the gate insulating layer 30, the semiconductor layer 31, and the ohmic contact layer 32 are then sequentially formed on the substrate 10, having the first conductive pattern group previously formed thereon, by using a second mask process.

More specifically, the gate insulating layer 30, an amorphous silicon layer, and a high-density doped amorphous silicon layer are sequentially formed on the substrate 10 having the first conductive pattern group by using, for example, a plasma enhanced chemical vapor deposition ("PECVD") technique. The amorphous silicon layer and the high-density doped amorphous silicon layer are patterned by a photolithography process using a second mask and an etching process so as to form the semiconductor layer 31 and the ohmic contact

layer **32**. The gate insulating layer **30** is, in an exemplary embodiment, made of an inorganic insulating material, such as SiN_x or SiO_x .

Referring to FIG. 3C, a second conductive pattern group, including the data line **60**, the source electrode **50**, and the drain electrode **40** is formed on the substrate **10**, having the semiconductor layer **31** and the ohmic contact layer **32** previously formed thereon, by using a third mask process.

More specifically, the data line **60** is formed on the gate insulating layer **30** in a parallel direction with respect to the storage extending portion **23**, and the source and drain electrodes **50** and **40** are formed on the gate insulating layer **30** so as to cover both ends of the ohmic contact layer **32**. The source electrode **50** extends from the data line **60**. In order to form the second conductive pattern group, a second conductive layer is deposited over the entire surface of the substrate **10** by using, for example, a sputtering technique and is then patterned by a photolithography process using a third mask and an etching process. The second conductive layer may be formed from, for example, Al, Cr, Cu, Mo, an alloy(s) thereof, or a combination thereof. In addition, the second conductive layer may have a single layer structure or a multi-layer structure.

Referring to FIG. 3D, the passivation film **90** including the pixel contact hole **70** and the first and second contact holes **80** and **81** (contact hole **81** not shown in the cross sectional view of FIG. 3D) is formed over the entire surface of the substrate **10** by using a fourth mask process.

More specifically, the passivation film **90** is formed over the entire surface of the substrate **10** by using a deposition technique such as a PECVD technique or a spin coating technique. The pixel contact hole **70** and the first and second contact holes **80** and **81** are formed in the passivation film **90** by a photolithography process using a fourth mask and an etching process. The pixel contact hole **70** penetrates the passivation film **90** to expose a portion of the drain electrode **40**, while the first contact hole **80** penetrates the gate insulating layer **30** and the passivation film **90** to expose a portion of the end portion of the storage extending portion **23**, and the second contact hole **81** (FIG. 1) penetrates the gate insulating layer **30** and the passivation film **90** to expose a portion of the storage line **22** of the next stage. The passivation film **90** may be made of, for example, an organic insulating material or an inorganic insulating material similar to the gate insulating layer **30**.

Finally, referring to FIG. 3E, the pixel electrode **100** and the bridge electrode **110** are formed on the passivation film **90** by using a fifth mask process.

More specifically, a transparent conductive layer is deposited on the passivation film **90** by a sputtering technique, for example. The transparent conductive layer is patterned by a photolithography process using a fifth mask and an etching process to thereby form the pixel electrode **100** and the bridge electrode **110**. The first and second slits **101** and **102** are also patterned in the pixel electrode **100**. The bridge electrode **110** is patterned so as to connect the end portion of the storage extending portion **23** to the storage line **22** of the next stage. Each corner portion of the pixel electrode **100** has a diagonal side in order to avoid overlapping with the bridge electrode **110**. The transparent conductive layer is made of, for example, a transparent conductive material such as ITO, IZO, and tin oxide (TO). The pixel electrode **100** is electrically connected to the drain electrode **40** via the pixel contact hole **70**, while the bridge electrode **110** is electrically connected to both the storage extending portion **23** and the storage line **22** of the next stage via the first and second contact holes **80** and **81**, respectively.

FIG. 4 is a top view illustrating a TFT array substrate according to another exemplary embodiment of the present invention, and FIG. 5 is a cross-sectional view taken along line I-I' of FIG. 4.

The TFT substrate of the embodiment of FIGS. 4 and 5 includes the same or similar components as the TFT substrate of the embodiment of FIGS. 1 and 2, with the exception the shape of a portion of the bridge electrode **110** which is connected to the end portion of the storage extending portion **23**. Thus, in the following description, identical portions of the description of this embodiment with respect to the earlier embodiments are omitted for purposes of simplicity.

Referring to FIGS. 4 and 5, the TFT array substrate comprises a gate line **21** arranged in a transverse direction, a data line **60** arranged in a perpendicular direction with respect to the gate line **21**, a pixel electrode **100** arranged in a pixel region defined by the gate and data lines **21** and **60**, a storage line **22** arranged in a parallel direction with respect to the gate line **21** to supply a storage voltage, a storage extending portion **23** extending from the storage line **22** and arranged in a parallel direction with respect to the data line **60**, and a bridge electrode **110** which electrically connects the storage extending portion **23** to the storage line **22** of the next stage. The pixel electrode **100** has a diagonal side **100a** adjacent to a crossing point of the gate line **21** and the data line **60**. In other words, the diagonal side **100a** of the pixel electrode **100** is formed by a corner cut off from the pixel electrode **100**. The storage extending portion **23** overlaps a side of the pixel electrode **100** adjacent to the data line **60**. However, in contrast to the embodiment of FIG. 1, the end of the storage extending portion **23** which is connected to the bridge electrode **110** does not have a diagonal portion. Instead, the bridge electrode **110** has at least one diagonal side **110a** which corresponds to (and is substantially parallel to) the diagonal side **100a** of the pixel electrode **100**. In the exemplary embodiment depicted, both ends of the bridge electrode **110** have the diagonal sides **110a** and **110b**. That is, one end of the bridge electrode **110** which is electrically connected to the storage extending portion **23** has the diagonal side **110a**, while the other end of the bridge electrode **110** which is electrically connected to the storage line **22** of the next stage has the diagonal side **110b**. The diagonal sides **110a** and **110b** of the bridge electrode **110** are substantially parallel with respect to the diagonal side **100a** of the pixel electrode **100**, thereby forming a horizontal electric field. The bridge electrode **110** is a light blocking pattern.

In an exemplary embodiment, the bridge electrode **110** is made of the same transparent conductive material as the pixel electrode **100**. As a result of the above-described shape of the bridge electrode **110**, the horizontal electric field is formed between the pixel electrode **100** and the bridge electrode **110**, so that the liquid crystal molecules arranged at the corner portion of the pixel electrode **100** may be controlled. The electric field formed between the diagonal side **110a** of the bridge electrode **110** and the diagonal side **100a** of the pixel electrode **100** is horizontally formed by a fringe field formed therebetween and the liquid crystal molecules are vertically driven, thereby preventing light leakage. Accordingly, a texture defect which may occur by light leakage from an edge region of the pixel electrode **100** is prevented.

In a later process, the column spacer (not shown) is located at the area "A" where the gate line **21** and the bridge electrode **110** overlap. Even where the column spacer is moved by external physical shock or impact, the fringe field formed between the pixel electrode **100** and the bridge electrode **110** prevents the occurrence of abnormal texture, resulting in high display quality. In particular, even in the case where the

column spacer is arranged adjacent to the blue unit pixel, the yellowish phenomenon can be prevented even though the column spacer moves.

FIGS. 6A to 6E are cross-sectional views illustrating a process for fabricating the TFT array substrate of the embodiment of FIGS. 4 and 5 according to another exemplary embodiment of the present invention.

The processes of FIGS. 6A to 6E are similar to or same as those of FIGS. 3A to 3E except that the bridge electrode has the diagonal side, and thus duplicated description is omitted.

Referring to FIG. 6A, a first conductive pattern group including the gate line **21** (not shown in FIG. 6A), the gate electrode **20**, the storage line **22**, and the storage extending portion **23** is formed on the substrate **10** by using a first mask process. In this embodiment, the end of the storage extending portion **23** which is connected to the bridge electrode **110** does not have the diagonal portion.

More specifically, a first conductive layer is deposited on the substrate **10** using, for example, a sputtering technique. The first conductive layer may be formed from, for example, Al, Cr, Cu, Mo, an alloy(s) thereof, or a combination thereof. In addition, the first conductive layer may have a single layer structure or a multi-layer structure. The first conductive layer is patterned by a photolithography process using a first mask and an etching process to form the first conductive pattern group including the gate line **21**, the gate electrode **20**, the storage line **22**, and the storage extending portion **23**.

The processes of FIGS. 6B to 6D are same as those of FIGS. 3B to 3D, and thus duplicative descriptions thereof are omitted.

Referring to FIG. 6E, the pixel electrode **100** and the bridge electrode **110** are formed on the passivation film **90** by using a fifth mask process.

More specifically, a transparent conductive layer is deposited on the passivation film **90** by, for example, a sputtering technique. The transparent conductive layer is patterned by a photolithography process using a fifth mask and etching process to thereby form the pixel electrode **100** and the bridge electrode **110**. The first and second slits **101** and **102** are also patterned in the pixel electrode **100**. The bridge electrode **110** is patterned to connect the end portion of the storage extending portion **23** to the storage line **22** of the next stage. One end of the bridge electrode **110**, which is electrically connected to the storage extending portion **23**, has a diagonal portion **110a**. The other end of the bridge electrode **110**, which is electrically connected to the storage line **22** of the next stage, may also have a diagonal portion **110b**. In an exemplary embodiment, both corner portions of the pixel electrode **100** have the diagonal sides to avoid the overlap with the bridge electrode **110**. As a result of the above described shape of the bridge electrode **110**, the fringe field is formed between the pixel electrode **100** and the bridge electrode **110**. The transparent conductive layer is made of, for example, a transparent conductive material such as ITO, IZO and TO. The pixel electrode **100** is electrically connected to the drain electrode **40** via the pixel contact hole **70**, while the bridge electrode **110** is electrically connected to both the storage extending portion **23** and the storage line **22** of the next stage via the first and second contact holes **80** and **81**, respectively.

As described above, according to the LCD device of the present invention embodiments, at least one of the storage extending portion and the bridge electrode has a diagonal portion corresponding to the diagonal portion of the pixel electrode, so that a fringe field is formed between one of the storage extending portion and the bridge electrode and the pixel electrode, thereby preventing light leakage because the liquid crystal molecules are driven in a vertical direction by

the fringe field. In addition, even where the column spacer is moved by an external physical shock, a texture defect is prevented and the display quality is improved.

Although the present invention has been described with reference to certain exemplary embodiments thereof, it will be understood by those skilled in the art that a variety of modifications and variations may be made to the present invention without departing from the spirit or scope of the present invention defined in the appended claims, and their equivalents.

What is claimed is:

1. A liquid crystal display including a pixel to display an image, the pixel comprising:

- a gate line extending in a first direction;
- a first data line extending in a second direction perpendicular to the first direction;
- a second data line extending in the second direction and spaced apart from the first data line;
- a pixel electrode electrically connected to one of the first and second data lines, and including a diagonal side, the pixel electrode disposed between the first data line and second data line;
- a storage line extending in parallel with the gate line;
- a first storage extending portion extending from the storage line to prevent light leakage of the pixel, the first storage extending portion being adjacent to one of the first and second data lines; and
- a second storage extending portion extending from the storage line to prevent light leakage of the pixel, the second storage extending portion being adjacent to the other one of the first and second data lines and being spaced apart from the first storage extending portion.

wherein the gate line is formed on the same plane as a first storage extending portion and a second storage extending portion, and

wherein the first storage extending portion is defined by a straight-line shaped portion at one end and a light blocking portion at an opposite end, the light blocking portion includes a side parallel with respect to the diagonal side of the pixel electrode, and the side parallel with respect to the diagonal side of the pixel electrode extends entirely to a terminal end defining the opposite terminal end of the first storage extending portion.

2. The liquid crystal display of claim 1, wherein a portion of at least one of the first and second storage extending portions overlaps with at least a portion of the pixel electrode.

3. The liquid crystal display of claim 1, wherein the pixel further comprising a bridge electrode electrically connecting one of the first and second storage extending portions of the pixel with an adjacent storage line of an adjacent pixel.

4. The liquid crystal display of claim 3, wherein the adjacent pixel is arranged along the second direction.

5. The liquid crystal display of claim 3, wherein the bridge electrode is disposed across the gate line.

6. The liquid crystal display of claim 5, wherein the bridge electrode contacts with the one of the first and second storage extending portions of the pixel through a first contact hole and is electrically connected to the adjacent storage line through a second contact hole.

7. The liquid crystal display of claim 6, wherein the pixel further comprising,

- a base substrate, the gate line and the storage line being disposed on the base substrate;
- a first insulating layer disposed on the base substrate, the gate line, and the storage line, the first and second data lines being disposed on the first insulating layer; and

11

a second insulating layer disposed on the first insulating layer and the first and second data lines, the pixel electrode and the bridge electrode being disposed on the second insulating layer.

8. The liquid crystal display of claim 7, wherein the first contact hole is formed through the first and second insulating layers to expose at least a portion of the one of the first and second storage extending portions, and the second contact hole is formed through the first and second insulating layers to expose at least a portion of the adjacent storage line.

9. The liquid crystal display of claim 7, wherein the first and second storage extending portions have a same material as the gate line.

10. The liquid crystal display of claim 7, wherein the bridge electrode has a same material as the pixel electrode.

11. The liquid crystal display of claim 1, wherein the light blocking portion is triangular shape in plain view.

12. The liquid crystal display of claim 1, wherein the pixel electrode includes at least two openings.

13. The liquid crystal display of claim 12, wherein one opening of the at least two openings is elongated in a first direction having a first angle with the storage line, the other opening of the at least two openings is elongated in a second direction having a second angle with the storage line, and the first and second angles are different from each other.

14. The liquid crystal display of claim 13, wherein one of the first and second angles is an acute angle, the other of the first and second angles is an obtuse angle, and the first angle plus the second angle is about 180 degrees.

15. The liquid crystal display of claim 1, wherein the first and second data lines are formed on another plane which is different from the plane the gate line is formed and at least one

12

of the first and second storage extending portions does not overlap with the first and second data lines.

16. The liquid crystal display of claim 11, wherein the pixel further comprising a bridge electrode electrically connecting the light blocking portion with an adjacent storage line of an adjacent pixel, the adjacent pixel is arranged along the second direction.

17. The liquid crystal display of claim 16, wherein the bridge electrode is disposed across the gate line.

18. The liquid crystal display of claim 17, wherein the bridge electrode contacts with the light blocking portion through a first contact hole and the bridge electrode is electrically connected to the adjacent storage line of the adjacent pixel through a second contact hole.

19. The liquid crystal display of claim 18, wherein the pixel further comprising,

a base substrate, the gate line and the storage line being disposed on the base substrate;

a first insulating layer disposed on the base substrate, the gate line, and the storage line, the first and second data lines being disposed on the first insulating layer; and

a second insulating layer disposed on the first insulating layer and the first and second data lines, the pixel electrode and the bridge electrode being disposed on the second insulating layer.

20. The liquid crystal display of claim 19, wherein the first contact hole is formed through the first and second insulating layers to expose at least a portion of the light blocking portion, and the second contact hole is formed through the first and second insulating layers to expose at least a portion of the adjacent storage line.

* * * * *

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[标]申请(专利权)人(译)	三星电子株式会社		
申请(专利权)人(译)	SAMSUNG ELECTRONICS CO. , LTD.		
当前申请(专利权)人(译)	三星DISPLAY CO. , LTD.		
[标]发明人	KIM KYUNG WOOK KWAK SANG KI YOON YEO GEON KIM HYUK JIN		
发明人	KIM, KYUNG WOOK KWAK, SANG-KI YOON, YEO-GEON KIM, HYUK-JIN		
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摘要(译)

液晶显示 (LCD) 装置及其制造方法包括沿一个方向布置的栅极线，沿栅极线垂直方向布置的数据线，布置在由栅极限定的像素区域中的像素电极和数据线具有与栅极线和数据线的交叉部分相邻的对角线侧，以及相对于像素电极的对角线侧沿平行方向布置的光阻挡图案，并防止漏光。

