US 20060033863A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2006/0033863 A1**

Lan et al. (43) **Pub. Date: Feb. 16, 2006**

(54) COLOR LIQUID CRYSTAL DISPLAY

(75) Inventors: **Chih-Chieh Lan**, Taipei (TW); **Hung-Yi Hung**, Taipei (TW); **Yu-Fang Wang**, Taipei (TW)

Correspondence Address:
THE WEBB LAW FIRM, P.C.
700 KOPPERS BUILDING
436 SEVENTH AVENUE
PITTSBURGH, PA 15219 (US)

(73) Assignee: **HannStar Display Corporation**, Taipei (TW)

(21) Appl. No.: **11/256,801**

(22) Filed: **Oct. 24, 2005**

Related U.S. Application Data

(62) Division of application No. 10/457,966, filed on Jun. 10, 2003, now Pat. No. 6,958,792.

(30) **Foreign Application Priority Data**

Nov. 26, 2002 (TW) 91134380

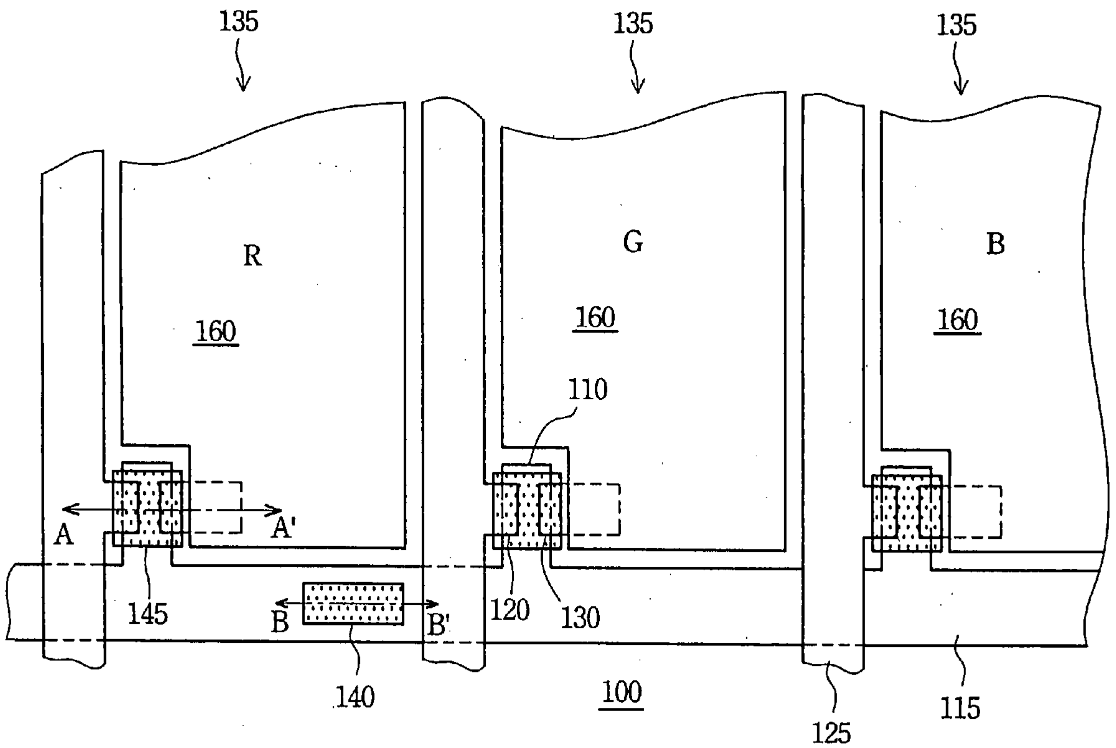
Publication Classification

(51) **Int. Cl.**
G02F 1/1333 (2006.01)

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

(57) **ABSTRACT**

A color liquid crystal display includes a control circuit located on a first transparent substrate. The control circuit includes control devices and a chessboard-like circuit with supporting areas. A passivation layer is located on the control circuit and has contact windows to expose electrodes of the control devices. A color filter layer is located on the passivation layer and pixel electrodes are located on the color filter layer. The pixel electrodes are electrically connected to the electrodes of the control devices through the contact windows. First photoresist layers are located on the supporting areas and the control devices, and second photoresist layers are located on the first photoresist layers. A common electrode is located on a surface of a second transparent substrate that faces the first transparent substrate. A liquid crystal layer is located between the first and the second transparent substrates.



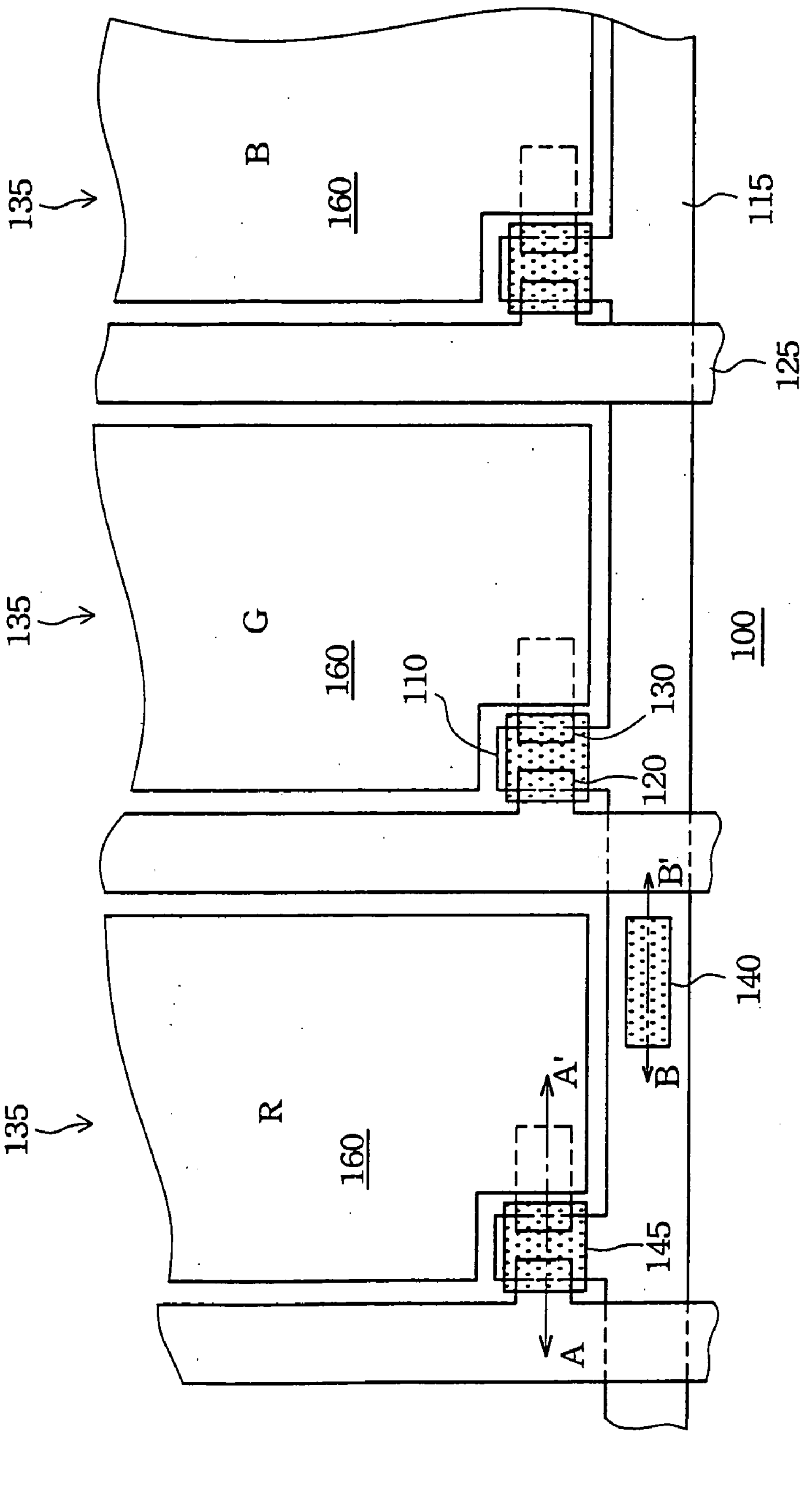


Fig. 1

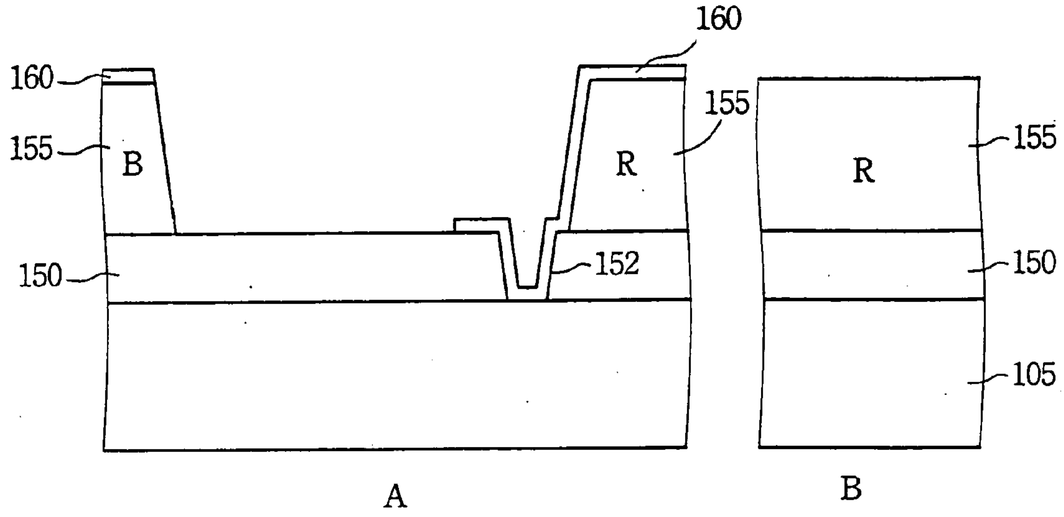

160
160
155
155
B
R
R
155
152
150
150
105
A
B

Fig. 2

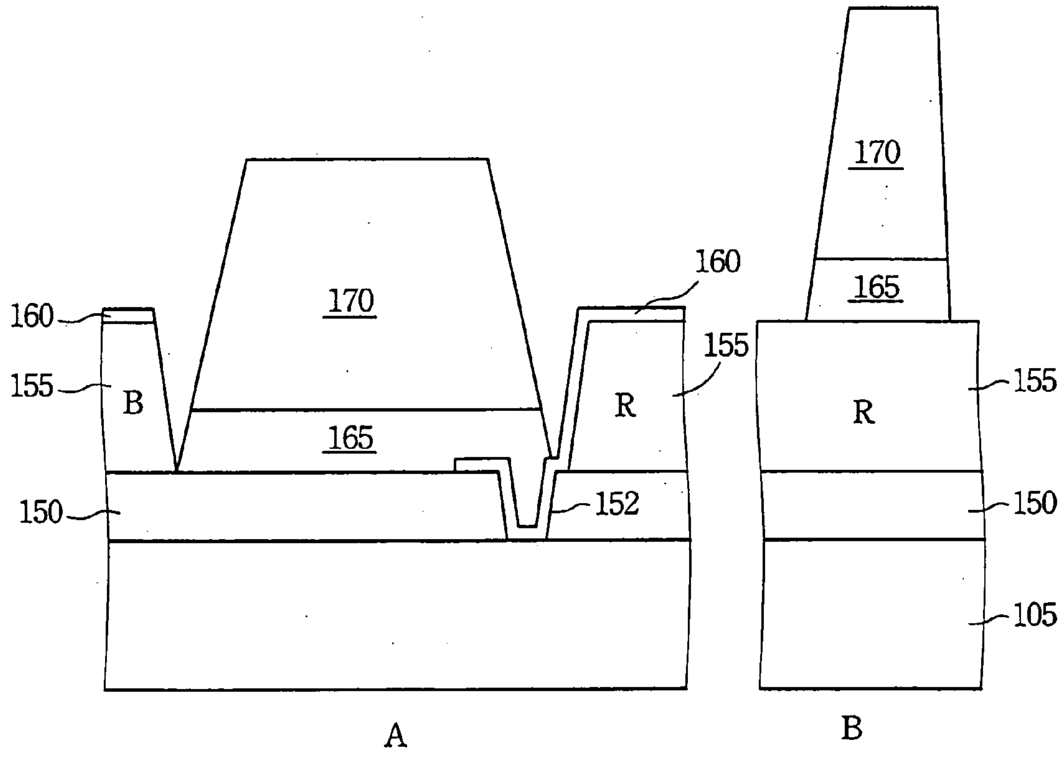

170
170
165
165
160
160
155
155
B
R
R
155
152
150
150
105
A
B

Fig. 3

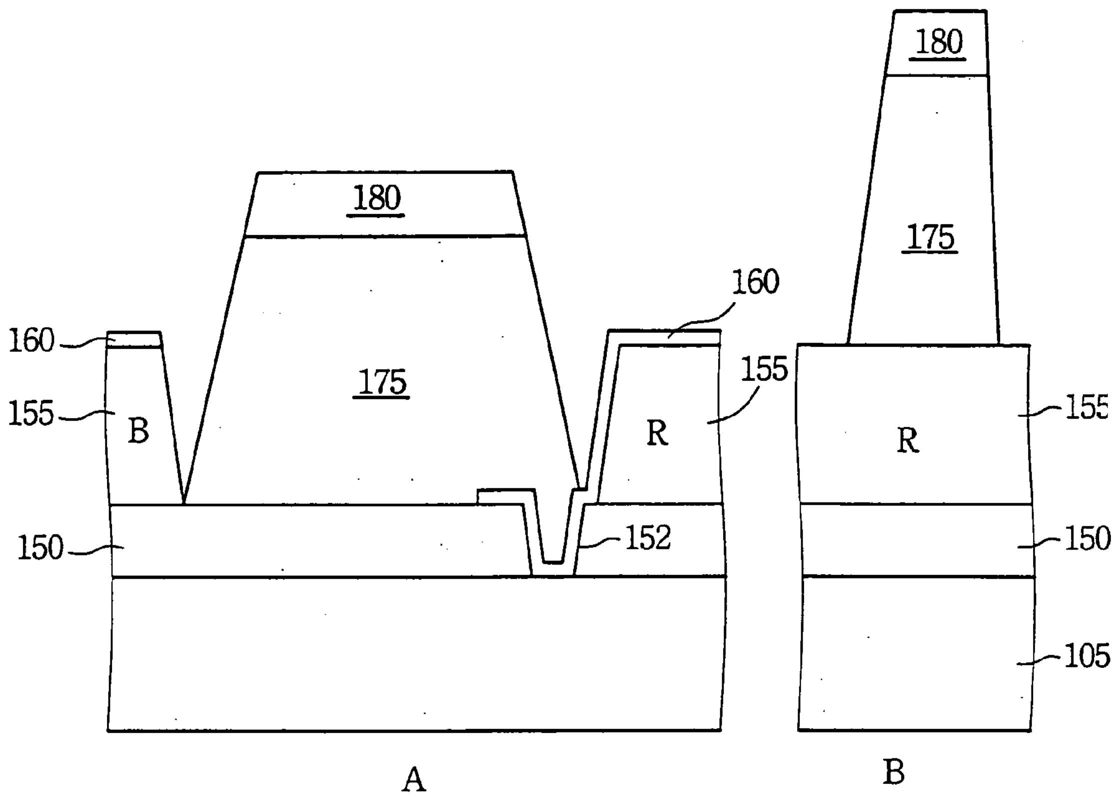


Fig. 4

COLOR LIQUID CRYSTAL DISPLAY

BACKGROUND OF THE INVENTION

[0001] 1. Field of Invention

[0002] The present invention relates to a structure of a color liquid crystal display (LCD) and a method of producing the same. More particularly, the present invention relates to a method of utilizing dual-layer photoresist to form black matrixes and spacers on a control circuit substrate and the LCD structure fabricated by the same method.

[0003] 2. Description of Related Art

[0004] Liquid crystal is a material having properties between those of crystal and liquid. The alignment of the liquid crystal molecules varies with external stimulation such as an electrical field generated by an applied voltage. Hence, this feature of the liquid crystal molecules can be utilized to create a display unit.

[0005] Liquid crystal material was discovered in 1888, and applications thereof first appeared in 1963. However, the value of the commercial application was not proved until Sharp in Japan developed a liquid crystal display applied in a calculator. Japanese companies have continued to develop the technology and improve the product's function. Development and improvement have made the liquid crystal display widely applicable.

[0006] The thin-film-transistor (TFT) array substrate and the color filter substrate are fabricated separately and then are assembled in current technology for producing a color thin film transistor liquid crystal display (TFT-LCD). As a result of the limitations of assembling precision, the aperture ratio of the TFT-LCD cannot be effectively increased. Based on the limitations described above, the latest developments have led to a color filter layer being formed on a TFT array substrate by photolithography to form a color filter on array (COA) substrate. The subsequent process is only to assemble the COA substrate and a transparent indium tin oxide (ITO) substrate, with no precision limit on the assembling step. Therefore, the aperture ratio of the TFT-LCD can be greatly increased to decrease the power consumption. This is the application trend for future portable products.

[0007] The black matrixes and photoresist spacers have to be separately formed by two photolithography steps for a TFT-LCD made by the COA technique described above. If the black matrixes and the photoresist spacers are formed by only one photolithography step, only black resin of the negative photosensitive type can be used and the thickness of black resin needed is at least 5 μm. However, the light transmittance and the photosensitivity of the black resin are reduced and the required exposure dose is about 250 mj/cm^2. In comparison with black resin, the required exposure dose is only about 19 mj/cm^2 for a common transparent photoresist. Therefore, a very long exposure time is needed for patterning the black resin to form an ideal pattern, and the throughput of the stepper is seriously affected. Moreover, spacers are in charge of maintaining the distance between two transparent substrates; hence certain requirements exist on the shape and the height of the spacers. Consequently, the process margin for developing the black resin of the negative photosensitive type is very narrow.

SUMMARY OF THE INVENTION

[0008] It is therefore an objective of the present invention to pattern the black resin and the transparent photoresist by only one photo mask to form black matrixes and spacers simultaneously.

[0009] It is another objective of the present invention to provide a method of forming black matrixes and spacers on a control circuit substrate by double layers of photoresist to increase the throughput of products.

[0010] It is still another objective of the present invention to provide a method of forming black matrixes and spacers on a control circuit substrate by dual-layer photoresist to increase the process margin.

[0011] It is also another objective of the present invention to provide a color LCD made by the method mentioned above.

[0012] In accordance with the foregoing and other objectives of the present invention, a method of utilizing dual-layer photoresist to form black matrixes and spacers on a control circuit substrate is provided. A control circuit, made of control devices and a chessboard-like circuit having supporting areas, is located on a control circuit substrate. A passivation layer is located on the control circuit, and contact windows are formed therein to expose electrodes of the control devices, respectively. This method comprises the following steps. A color filter layer and pixel electrodes are sequentially formed on the control circuit substrate. The pixel electrodes electrically connect to the electrodes of the control devices through the contact windows, respectively. A first photoresist is formed on the control circuit substrate and then is soft-baked. The thickness of the first photoresist is large enough to make the optical density of the first photoresist be greater than 3. A second photoresist is formed on the first photoresist and then is soft-baked. Next, the second photoresist and the first photoresist are patterned to form spacers, respectively on the supporting areas, and black matrixeses, respectively on the control devices. The second photoresist and the first photoresist are hard-baked.

[0013] According to a preferred embodiment of the present invention, the first photoresist is black resin and the second photoresist is transparent photoresist. When the first photoresist is non-photosensitive black resin, the second photoresist is positive or negative photosensitive photoresist. The thickness of the non-photosensitive black resin is about 0.2-1.5 μm to let the optical density of the black resin be greater than 3. The method of patterning the first and the second photoresist comprises the following steps. The second photoresist is exposed and then is developed by a developer solution. The developer solution is also used to remove the first photoresist uncovered by the second photoresist during developing the second photoresist.

[0014] According to another preferred embodiment of the present invention, the first photoresist is a black resin and the second photoresist is a transparent photoresist. When the first photoresist is a negative photosensitive black resin, the second photoresist is negative photosensitive transparent photoresist. The thickness of the negative photosensitive black resin is about 1-2 μm to let the optical density of the black resin be greater than 3. The second and the first photoresist are patterned by photolithography.

[0015] In accordance with the foregoing and other objectives of the present invention, a method of utilizing dual-layer photoresist to form black matrixes and spacers on a control circuit substrate is provided. A control circuit, made of control devices and a chessboard-like circuit having supporting areas, is located on a control circuit substrate. A passivation layer is located on the control circuit, and contact windows are formed therein to expose electrodes of the control devices, respectively. This method comprises the following steps. A color filter layer and pixel electrodes are sequentially formed on the control circuit substrate. The pixel electrodes electrically connect to the electrodes of the control devices through the contact windows, respectively. A first photoresist is formed on the control circuit substrate and then is soft-baked. A second photoresist is formed on the first photoresist and then is soft-baked. The thickness of the second photoresist is large enough to make the optical density of the second photoresist be greater than 3. Next, the second photoresist and the first photoresist are patterned to form spacers, respectively on the supporting areas, and black matrixeses, respectively on the control devices, by photolithography. The second photoresist and the first photoresist are hard-baked.

[0016] According to another preferred embodiment of the present invention, the first photoresist is transparent photoresist and the second photoresist is black resin. When the second photoresist is a negative photosensitive black resin, the first photoresist is negative photosensitive transparent photoresist. The thickness of the negative photosensitive black resin is about 1-2 μm to let the optical density of the black resin be greater than 3.

[0017] In accordance with the foregoing and other objectives of the present invention, a color liquid crystal display is provided. The color liquid crystal display comprises a first transparent substrate, a control circuit, a passivation layer, a color filter layer, pixel electrodes, first photoresist layers, second photoresist layers, a second transparent substrate, a common electrode, and a liquid crystal layer. The control circuit, made of control devices and a chessboard-like circuit having supporting areas, is located on the first transparent substrate. A passivation layer is located on the control circuit, and contact windows are located therein to expose electrodes of the control devices, respectively. A color filter layer and pixel electrodes are sequentially located on the control circuit substrate. The pixel electrodes electrically connect to the electrodes of the control devices through the contact windows, respectively. The first photoresist layers are respectively located on the supporting areas and the control devices. The second photoresist layers are respectively located on the first photoresist layers. The common electrode is on a surface, which faces the first transparent substrate, of the second transparent substrate. The liquid crystal layer is located between the first and the second transparent substrates.

[0018] According to a preferred embodiment of the present invention, the first photoresist is black resin and the second photoresist is transparent photoresist. When the first photoresist is non-photosensitive black resin, the second photoresist is positive or negative photosensitive photoresist. The thickness of the non-photosensitive black resin is about 0.2-1.5 μm to let the optical density of the black resin be greater than 3. The method of patterning the first and the second photoresist comprises the following steps. The second photoresist is exposed and then is developed by a developer solution. The developer solution is also used to remove the first photoresist uncovered by the second photoresist during developing the second photoresist.

[0019] According to another preferred embodiment of the present invention, the first photoresist is a black resin and the second photoresist is a transparent photoresist. When the first photoresist is a negative photosensitive black resin, the second photoresist is negative photosensitive transparent photoresist. The thickness of the negative photosensitive black resin is about 1-2 μm to let the optical density of the black resin be greater than 3. The second and the first photoresist are patterned by photolithography.

[0020] According to this preferred embodiment of the present invention, the first photoresist is transparent photoresist and the second photoresist is black resin. When the second photoresist is a negative photosensitive black resin, the first photoresist is negative photosensitive transparent photoresist. The thickness of the negative photosensitive black resin is about 1-2 μm to let the optical density of the black resin be greater than 3.

[0021] In the foregoing, the invention utilizes the much-improved light transmittance and photosensitivity properties of the transparent photoresist rather than those of the black resin to decrease the thickness needed by black resin used in the prior arts. Hence, the exposure time needed for the black resin used in the prior arts can be greatly reduced to increase greatly the product throughput.

[0022] It is to be understood that both the foregoing general description and the following detailed description are examples, and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] The accompanying drawings are included to provide a further understanding of the invention, and are incorporated in and constitute a part of this specification. The drawings illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention. In the drawings,

[0024] **FIG. 1** is a vertical view of a control circuit substrate according to one preferred embodiment of this invention;

[0025] **FIGS. 2 and 3** are cross-sectional diagrams of utilizing dual-layer photoresist to form black matrixes and spacers on a control circuit substrate in **FIG. 1** according to a preferred embodiment of this invention; and

[0026] **FIGS. 2 and 4** are cross-sectional diagrams of utilizing dual-layer photoresist to form black matrixes and spacers on a control circuit substrate in **FIG. 1** according to another preferred embodiment of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0027] Reference will now be made in detail to the present preferred embodiments of the invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers are used in the drawings and the description to refer to the same or like parts.

[0028] As stated above, this invention provides a method of utilizing dual-layer photoresist to form black matrixes and spacers on a control circuit substrate and the LCD structure fabricated by the same method to increase greatly the product throughput.

[0029] **FIG. 1** is a vertical view of a control circuit substrate according to one preferred embodiment of this invention. In **FIG. 1**, a control circuit, such as a thin film transistor (TFT) array, is formed on a transparent substrate **100**. Each TFT in the TFT array comprises gate **110**, source **120** and drain **130**. Each gate **110** electrically connects to a gate line **115** made by a first metal layer. Each source **120** electrically connects to a data line **125** made by a second metal layer. The data lines **125** cross over the gate lines **115** to define pixels **135**. Red (R), green (G) and blue (B) color filters are respectively formed on each pixel **135** later, and each TFT is respectively formed in a corner of each pixel **135**. Hence, a control circuit substrate is formed.

[0030] The black matrixeses are formed on the areas **145** above the TFTs to prevent photocurrent occurring during the "off" state of the TFTs. The spacers are formed on opaque areas such as supporting areas **140** on the gate lines **115**. The material of the gate lines **115** and the data lines **125** is metal, which is an opaque material. Therefore, black matrixeses need not be formed on the gate lines **115** and the data lines **125** to compartment adjacent pixels **135**. In **FIG. 1**, the relative positions of the pixel electrodes **190** formed later and the TFT are also displayed. The subsequent processes are described in the following embodiments 1-2.

EMBODIMENT 1

[0031] **FIGS. 2 and 3** are cross-sectional diagrams of utilizing dual-layer photoresist to form black matrixes and spacers on a control circuit substrate in **FIG. 1** according to a preferred embodiment of this invention. The labels A and B in **FIGS. 2 and 3** indicate the cross-sectional views of the cross-sectional lines M' and BB', respectively. The TFT structures are not drawn in the Parts A in **FIGS. 2 and 3** to simplify the pictures.

[0032] In **FIG. 2**, a passivation layer **150** such as a silicon nitride layer is formed by, for example, chemical vapor deposition (CVD) on the control circuit substrate **105** (i.e. the transparent substrate **100** having the control circuit thereon as shown in **FIG. 1**). The control circuit substrate **105** comprises, for example, a TFT array substrate. Next, the passivation layer **180** is patterned by, for example, photolithography and etching to form contact windows **152** therein to expose drains **130** (not shown in **FIG. 2**) of the TFT, respectively.

[0033] A color filter layer **155** is formed on the control circuit substrate **105**. The color filter is made of red, green and blue colors color filters respectively on pixels **135** (as shown in **FIG. 1**). In general, the red, green and blue photoresist are respectively patterned by three photolithography steps to form the red, green and blue colors color filters and thus the color filter layer **155**.

[0034] A transparent conductive layer is formed and then is patterned to form pixel electrodes **160** by, for example, photolithography and etching. The pixel electrodes **160** electrically connect to the drains **130** (not shown in **FIG. 2**) of the control devices through the contact windows **152**, respectively. A material of the pixel electrodes **160** includes indium tin oxide or indium zinc oxide.

[0035] In **FIG. 3**, a black resin is formed on the control circuit **105** having the color filter layer **155** and the pixel electrodes **160** located thereon. Then, the black resin is soft-baked. A transparent photoresist is formed on the black resin and then is soft-baked. Next, the transparent photoresist and the black resin are patterned and hard-baked to form black resin layers **165** and transparent photoresist layers **170**. Consequently, black matrixes is formed by stacking the black resin layers **165** and the transparent photoresist layers **170** on Part A, and spacers are formed by stacking the black resin layers **165** and the transparent photoresist layers **170** on Part B.

[0036] According to a preferred embodiment of this invention, when a material of the black resin layers **165** is non-photosensitive black resin, the material of the transparent photoresist layers **170** is positive or negative photosensitive transparent photoresist. The thickness of the non-photosensitive black resin is about 0.2-1.5 μm so that the optical density of the black resin is greater than 3 to shield the control devices from external light. Moreover, the total thickness of the black resin layers **165** and the transparent photoresist layers **170** is equal to the required spacing between the two transparent substrates of a liquid crystal display.

[0037] The method of patterning the black resin and the transparent photoresist comprises the following steps. The transparent photoresist is exposed and then is developed by a developer solution. The developer solution is also used to remove the black resin uncovered by the transparent photoresist during developing the transparent photoresist. Since the needed exposure dose for exposing the transparent photoresist is less than that for exposing the black resin, the exposure dose required for the transparent photoresist is much less than that for the black resin alone in the exposure step. In the subsequent developing step, the insoluble transparent photoresist **170** can protect the black resin **165** lying below by being insoluble in the developer solution. Therefore, only one photo mask, i.e. one photolithography process, is needed to form the black matrixes and the spacers simultaneously.

[0038] According to another preferred embodiment, when a material of the black resin layers **165** is a negative photosensitive black resin, the material of the transparent photoresist layers **170** is also a negative photosensitive transparent photoresist. Therefore, the black resin and the transparent photoresist can be simultaneously patterned by conventional photolithography.

[0039] The thickness of the non-photosensitive black resin is about 1-2 μm so that the optical density of the black resin is greater than 3 to shield the control devices from external light. Moreover, the total thickness of the black resin layers **165** and the transparent photoresist layers **170** is equal to the required spacing between the two transparent substrates of a liquid crystal display. Similarly, since the exposure dose required for exposing the transparent photoresist is less than that for the black resin, the exposure dose required for the transparent photoresist and the black resin is much less than that for the black resin alone in the exposure step. In the subsequent developing step, the unexposed black resin and the transparent photoresist can be simultaneously dissolved in the developer solution. Therefore, only one photo mask, i.e. one photolithography process, is needed to form the black matrixes and the spacers simultaneously.

[0040] The subsequent fabrication processes are well known by persons skilled in the art. Hence, the cross-sectional diagrams of the fabrication processes are omitted here, and subsequent fabrication processes are described verbally, only.

[0041] Next, another transparent conductive layer is formed on another transparent substrate as a common electrode. These two transparent substrates are parallel assembled, and the pixel electrodes **160** and the common electrode face each other. The periphery of the two transparent substrates is sealed, and only one opening is left for pouring liquid crystal into the space between the two transparent substrates. After pouring in the liquid crystal to fill the space between the two transparent substrates, the opening is sealed to accomplish the fabrication process of a TFT LCD.

EMBODIMENT 2

[0042] **FIGS. 2 and 4** are cross-sectional diagrams of utilizing dual-layer photoresist to form black matrixes and spacers on a control circuit substrate in **FIG. 1** according to another preferred embodiment of this invention. The labels A and B in **FIGS. 2 and 4** indicate the cross-sectional views of the cross-sectional lines AA' and BB', respectively. The TFT structures are not drawn on the Parts A in **FIGS. 2 and 4** to simplify the pictures. Besides, a detailed description of **FIG. 2** has been given above, and hence is omitted here.

[0043] In **FIG. 4**, a transparent photoresist is formed on the control circuit **105** having the color filter layer **155** and the pixel electrodes **160** located thereon. Then, the transparent photoresist is soft-baked. A black resin is formed on the black resin and then is soft-baked. Next, the black resin and the transparent photoresist are patterned and hard-baked to form transparent photoresist layers **175** and black resin layers **180**. Consequently, black matrixes is formed by stacking the transparent photoresist layers **175** and the black resin layers **180** on Part A, and spacers are formed by stacking the transparent photoresist layers **175** and the black resin layers **180** on Part B.

[0044] According to another preferred embodiment, when a material of the black resin layers **180** is a negative photosensitive black resin, the material of the transparent photoresist layers **175** is also a negative photosensitive transparent photoresist. Therefore, the black resin and the transparent photoresist can be pattered by conventional photolithography simultaneously.

[0045] The thickness of the non-photosensitive black resin is about 1-2 μm so that the optical density of the black resin is greater than 3 to shield the control devices from external light. Moreover, the total thickness of the black resin layers **165** and the transparent photoresist layers **170** is equal to the required spacing between the two transparent substrates of a liquid crystal display. Similarly, since the exposure dose required for the transparent photoresist is less than that for the black resin, the exposure dose required for the transparent photoresist and the black resin is much less than that for the black resin alone in the exposure step. In the subsequent developing step, the unexposed black resin and the transparent photoresist can be simultaneously dissolved in the developer solution. Therefore, only one photo mask, i.e. one photolithography process, is needed to form the black matrixes and the spacers simultaneously.

[0046] The subsequent fabrication processes are well known by persons skilled in the art. Hence, the cross-sectional diagrams of the fabrication processes are omitted here, and subsequent fabrication processes are described verbally, only.

[0047] Next, another transparent conductive layer is formed on another transparent substrate as a common electrode. These two transparent substrates are parallel assembled, and the pixel electrodes **160** and the common electrode face each other. The periphery of the two transparent substrates is sealed, and only one opening is left for pouring liquid crystal into the space between the two transparent substrates. After pouring in the liquid crystal to fill the space between the two transparent substrates, the opening is sealed to accomplish the fabrication process of a TFT LCD.

[0048] In light of foregoing, the function of the black matrixes is achieved by black resin having a thickness that makes the optical density of the black resin greater than 3. The function of the spacers is achieved by the transparent photoresist to maintain the required spacing between the two transparent substrates of a LCD. Therefore, the transparent photoresist having much improved properties of light transmittance and photosensitivity can be used to replace most of the black resin to greatly reduce the required thickness of a single black resin layer. Therefore, utilizing this invention can not only decrease the required exposure time but also increase the process margin, and thus the product throughput is greatly increased.

[0049] It will be apparent to those skilled in the art that various modifications and variations can be made to the structure of the present invention without departing from the scope or spirit of the invention. In view of the foregoing, it is intended that the present invention cover modifications and variations of this invention provided they fall within the scope of the following claims and their equivalents.

The invention claimed is:

1. A color liquid crystal display, comprising:

a first transparent substrate;

a control circuit located on the first transparent substrate, the control circuit being constituted by control devices and a chessboard-like circuit and the chessboard-like circuit having supporting areas;

a passivation layer located on the control circuit and having contact windows to expose electrodes of the control devices, respectively;

a color filter layer located on the passivation layer;

pixel electrodes located on the color filter layer, and the pixel electrodes electrically connecting to the electrodes of the control devices through the contact windows, respectively;

first photoresist layers respectively located on the supporting areas and the control devices;

second photoresist layers respectively located on the first photoresist layers;

a second transparent substrate;

a common electrode located on a surface facing the first transparent substrate of the second transparent substrate; and

a liquid crystal layer located between the first and the second transparent substrates.

2. The color liquid crystal display of claim 1, wherein the first photoresist layers are black resin layers and the second photoresist layers are transparent photoresist layers.

3. The color liquid crystal display of claim 1, wherein the optical density of the black resin layers is greater than 3.

4. The color liquid crystal display of claim 2, wherein the black resin layers are non-photosensitive black resin layers.

5. The color liquid crystal display of claim 4, wherein a thickness of the non-photosensitive black resin layers is about 0.2-1.5 μm.

6. The color liquid crystal display of claim 4, wherein the transparent photoresist layers are positive photosensitive in type.

7. The color liquid crystal display of claim 4, wherein the transparent photoresist layers are negative photosensitive in type.

8. The color liquid crystal display of claim 2, wherein the transparent photoresist layers are negative photosensitive in type while the black resin layers are negative photosensitive black resin layers.

9. The color liquid crystal display of claim 8, wherein a thickness of the black resin layers is about 1-2 μm.

10. The color liquid crystal display of claim 1, wherein the first photoresist layers are transparent photoresist layers and the second photoresist layers are black resin layers.

11. The color liquid crystal display of claim 10, wherein the transparent photoresist layers are negative photosensitive in type while the black resin layers are negative photosensitive black resin layers.

12. The color liquid crystal display of claim 11, wherein a thickness of the black resin layers is about 1-2 μm.

* * * * *

patsnap

专利名称(译)	彩色液晶显示器		
公开(公告)号	US20060033863A1	公开(公告)日	2006-02-16
申请号	US11/256801	申请日	2005-10-24
[标]申请(专利权)人(译)	瀚宇彩晶股份有限公司		
申请(专利权)人(译)	瀚宇彩晶股份有限公司		
当前申请(专利权)人(译)	瀚宇彩晶股份有限公司		
[标]发明人	LAN CHIH CHIEH HUNG HUNG YI WANG YU FANG		
发明人	LAN, CHIH-CHIEH HUNG, HUNG-YI WANG, YU-FANG		
IPC分类号	G02F1/1333 G02F1/1339 G02F1/1362		
CPC分类号	G02F1/136209 G02F1/13394		
优先权	091134380 2002-11-26 TW		
外部链接	Espacenet USPTO		

摘要(译)

彩色液晶显示器包括位于第一透明基板上的控制电路。控制电路包括控制装置和具有支撑区域的棋盘式电路。钝化层位于控制电路上并具有接触窗口以暴露控制装置的电极。滤色器层位于钝化层上，像素电极位于滤色器层上。像素电极通过接触窗电连接到控制装置的电极。第一光刻胶层位于支撑区域和控制装置上，第二光刻胶层位于第一光刻胶层上。公共电极位于第二透明基板的面对第一透明基板的表面上。液晶层位于第一和第二透明基板之间。