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Choi et al.

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(54) **TRANSFLECTIVE LIQUID CRYSTAL DISPLAY DEVICE COMPRISING A PATTERNED SPACER WHEREIN THE BUFFER LAYER AND THE SPACER ARE A SINGLE BODY AND METHOD OF FABRICATING THE SAME**

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(51) **Int. Cl.**

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G02F 1/1333 (2006.01)

(52) **U.S. Cl.** **349/155**; 349/156; 349/114;
349/106; 349/138

(58) **Field of Classification Search** 349/156,
349/107, 114

See application file for complete search history.

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(57) **ABSTRACT**

A color filter substrate for a transfective liquid crystal display device includes a substrate having a plurality of pixel regions, each of the plurality of pixel regions having reflective and transmissive portions, a black matrix on the substrate, a buffer layer on the black matrix having a first open portion corresponding to the transmissive portion of the pixel region and a patterned spacer within the reflective portion of the pixel region, a color filter layer on the buffer layer, the color filter layer having a first thickness within the reflective portion of the pixel region and a second thickness within the transmissive portion of the pixel region, and a common electrode on the color filter layer, wherein the buffer layer and the patterned spacer are a single body.

26 Claims, 13 Drawing Sheets

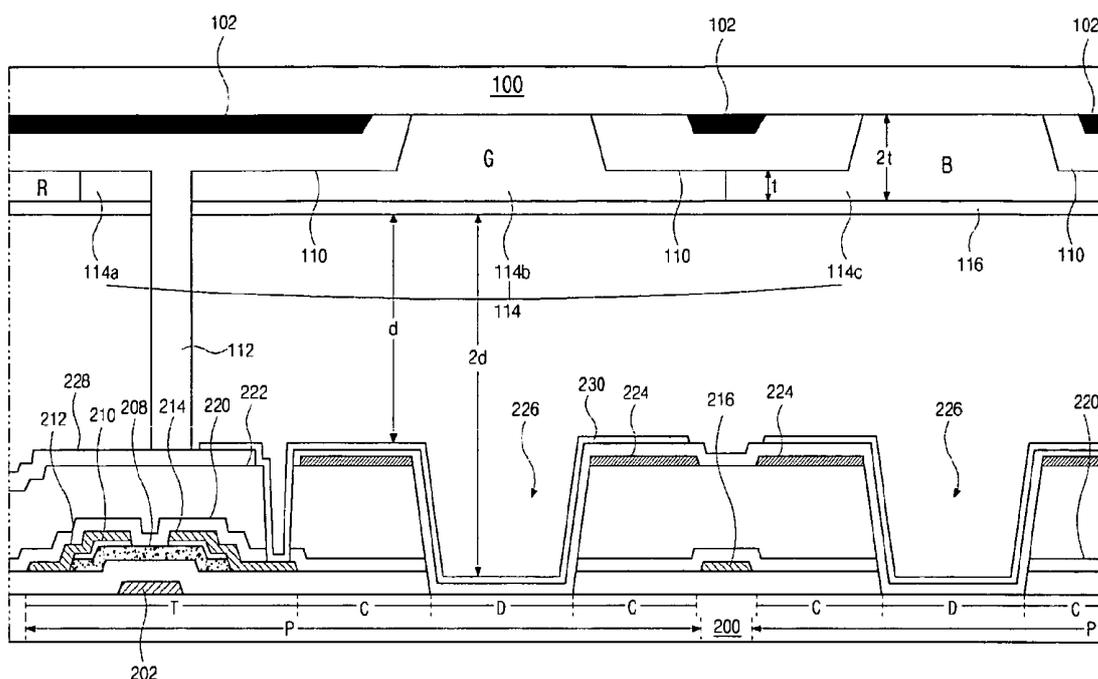


FIG. 1
Related Art

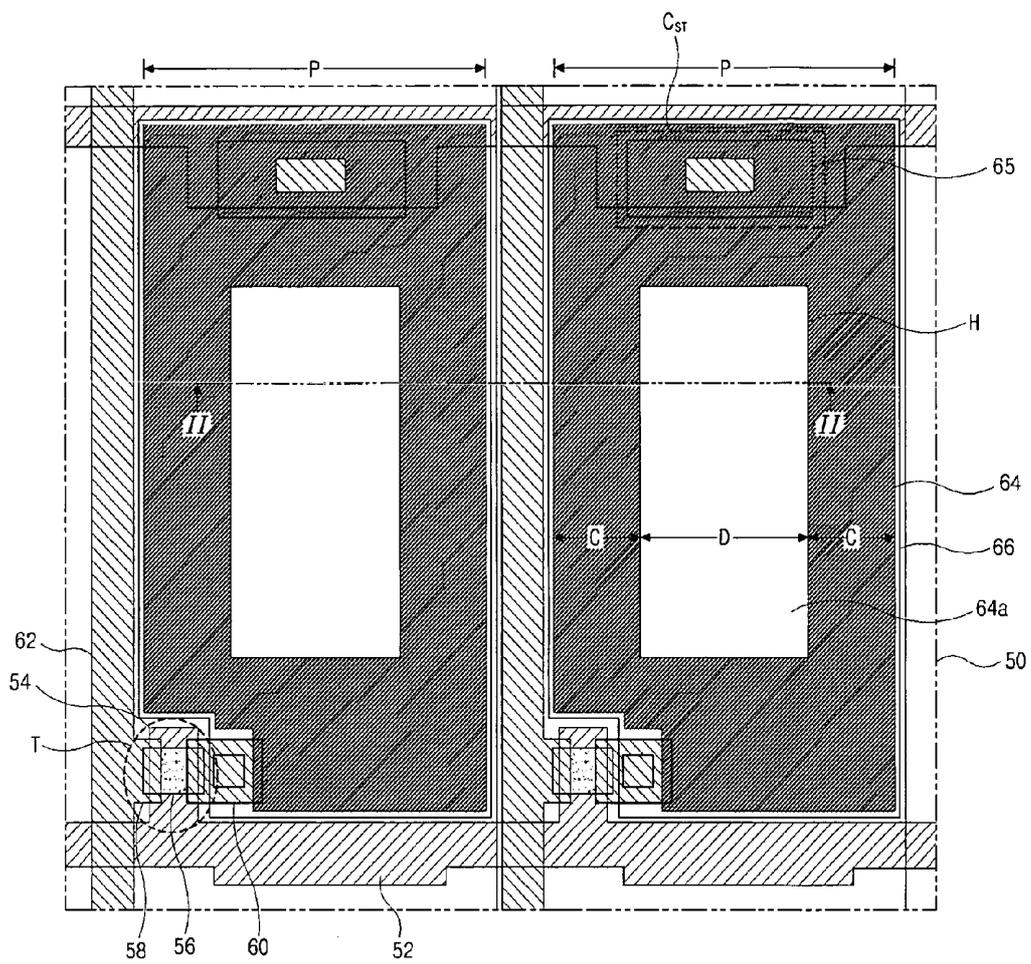


FIG. 4
Related Art

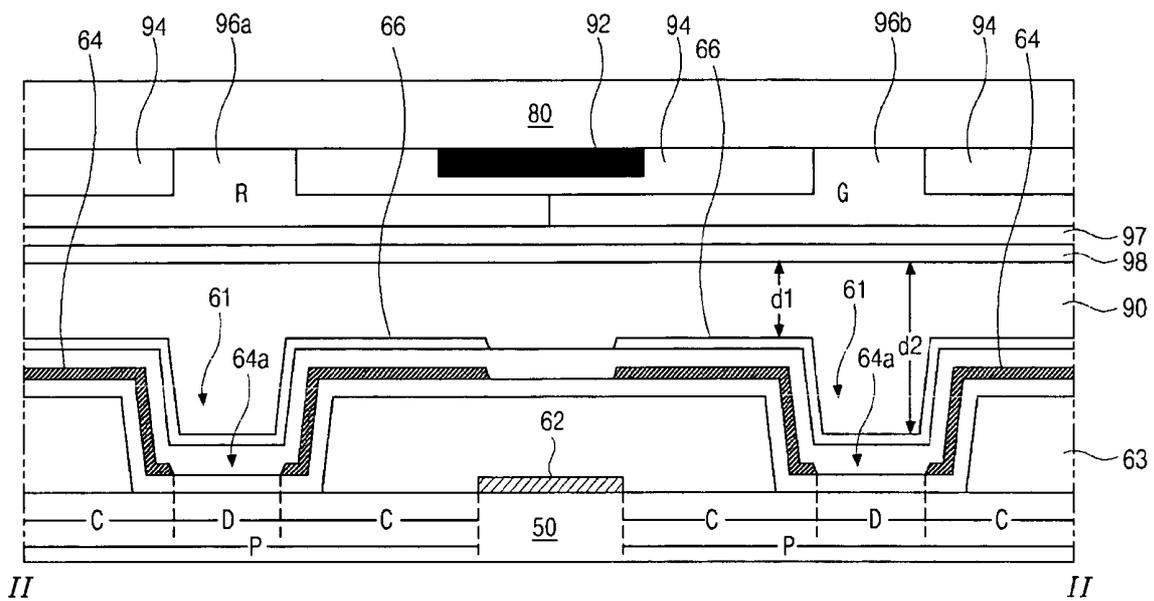


FIG. 5A
Related Art

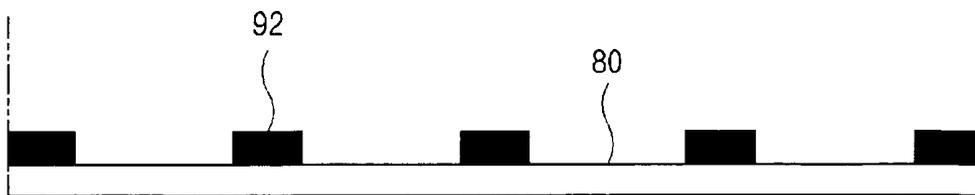


FIG. 5B
Related Art

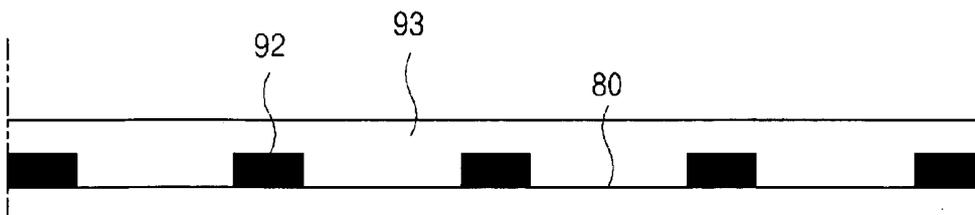


FIG. 5C
Related Art

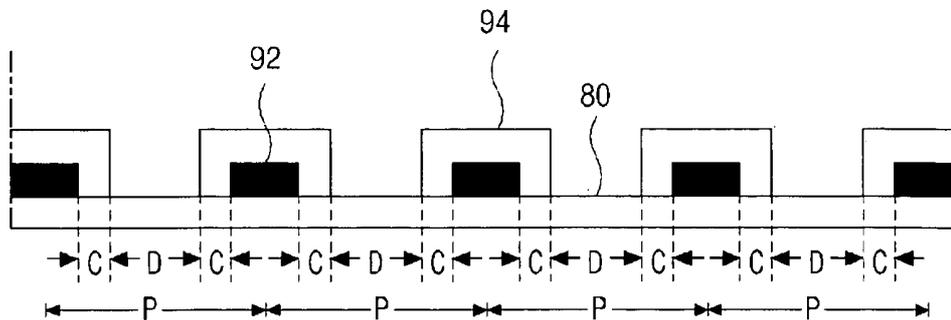


FIG. 5D
Related Art

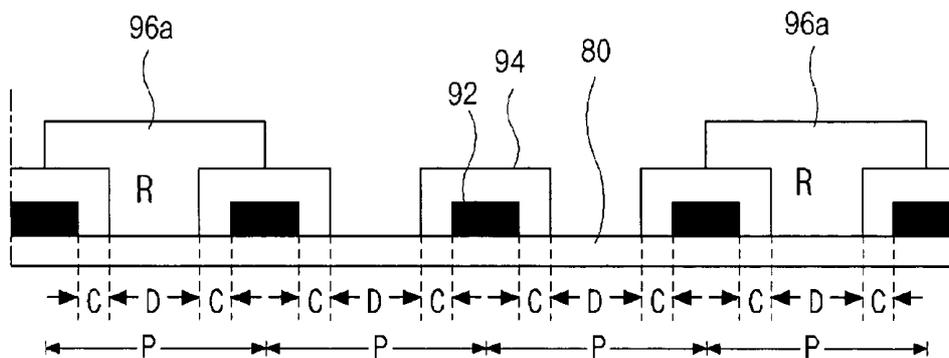


FIG. 5E
Related Art

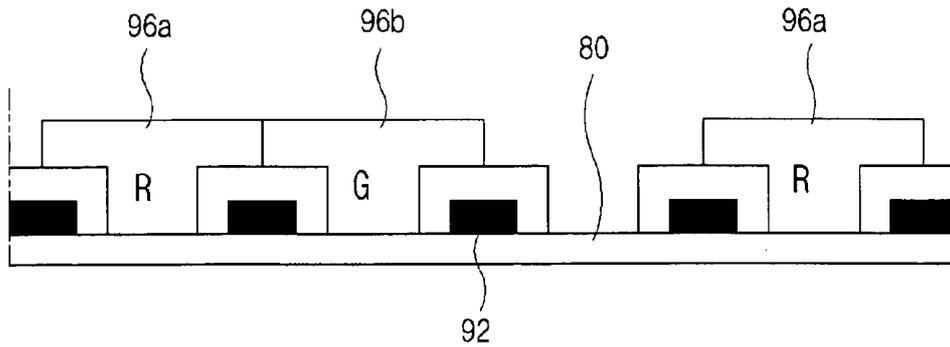


FIG. 5F
Related Art

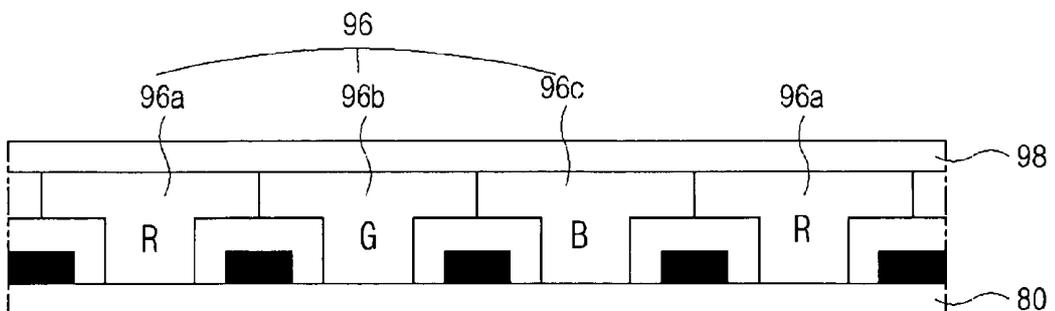


FIG. 6

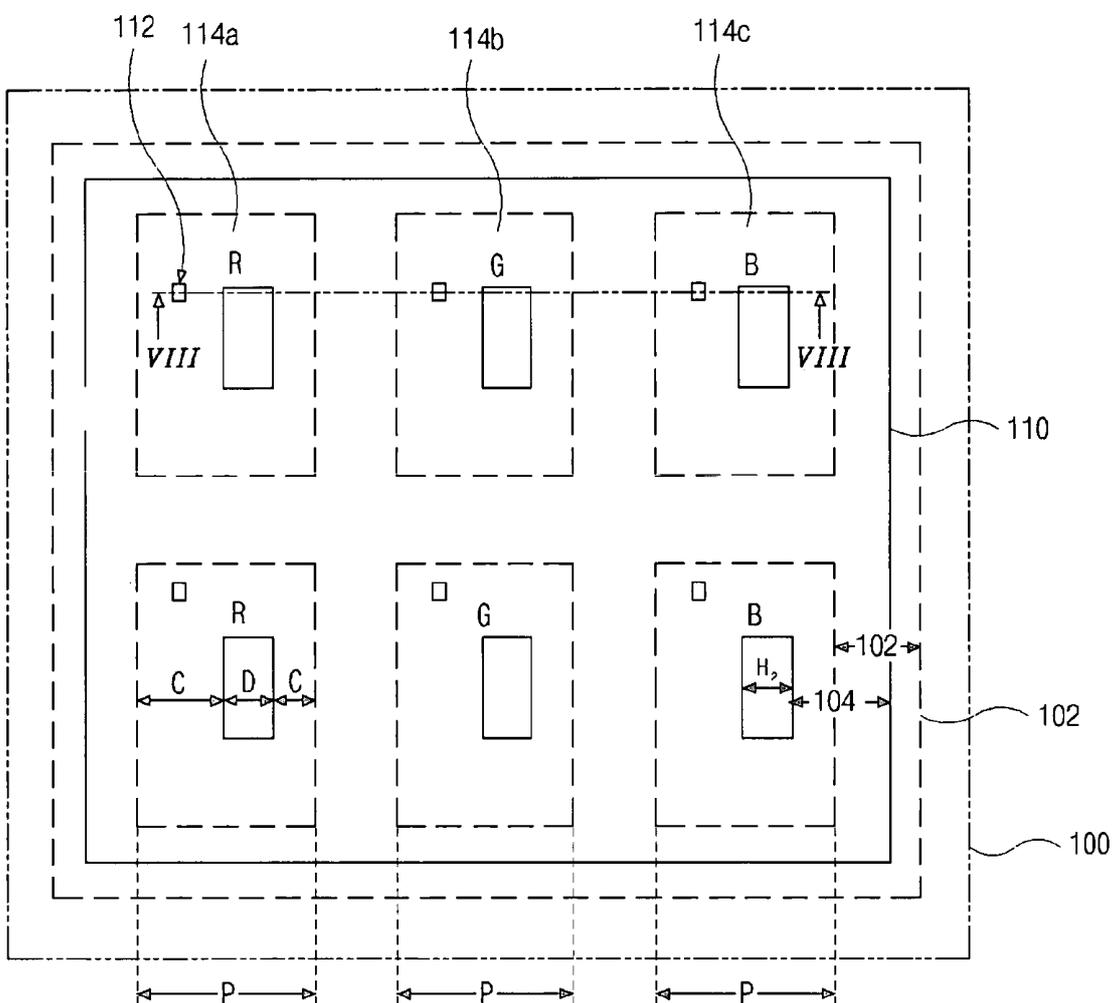


FIG. 7

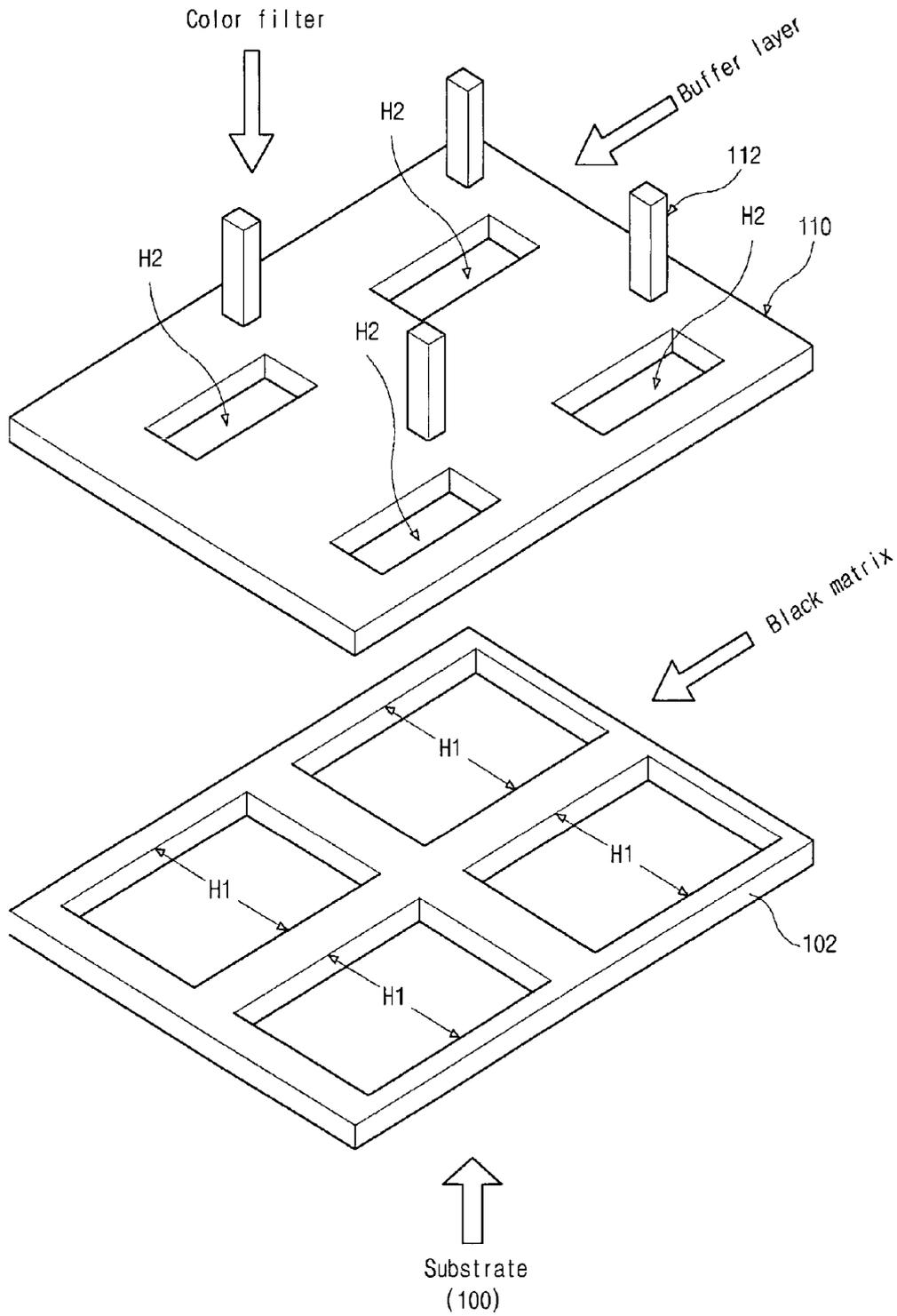


FIG. 8A

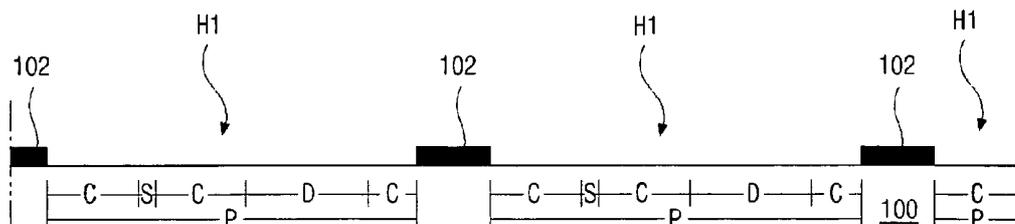


FIG. 8B

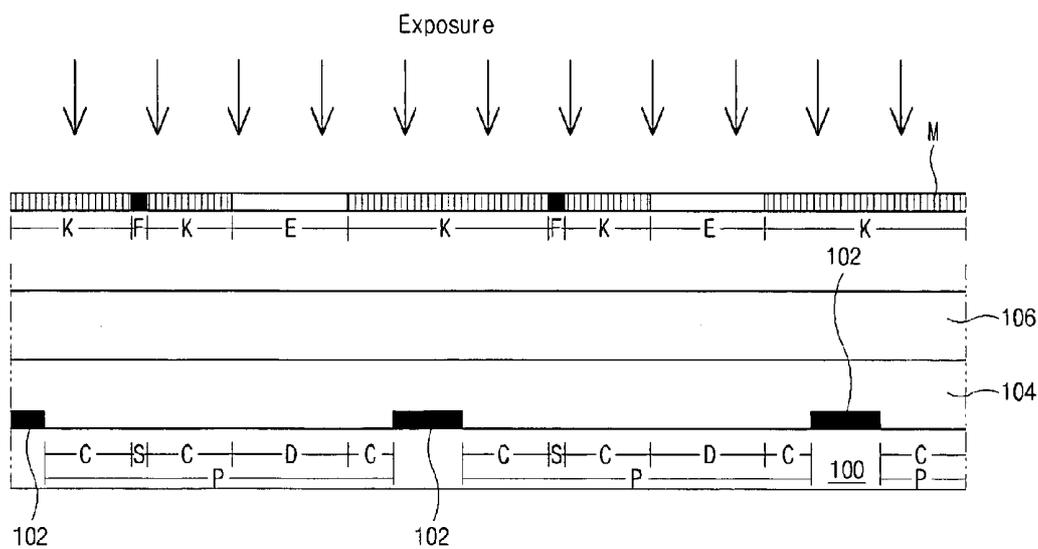


FIG. 8C

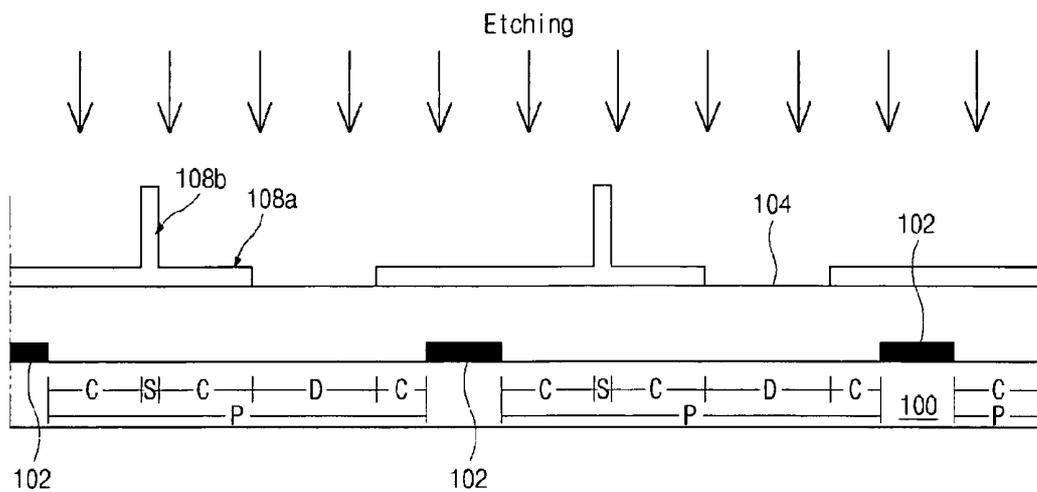


FIG. 8D

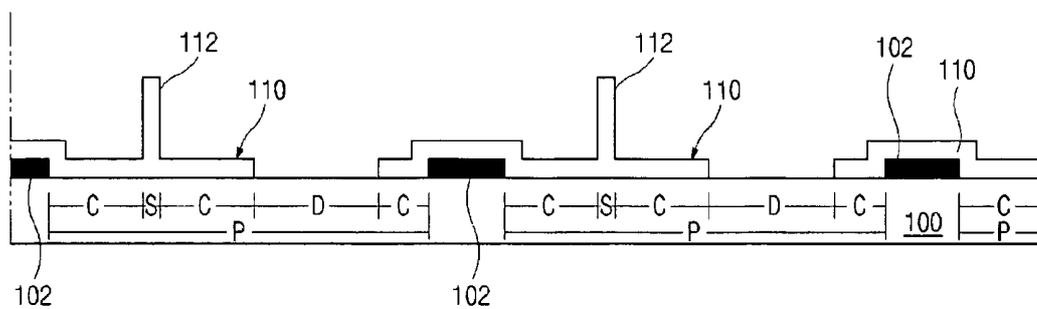


FIG. 8E

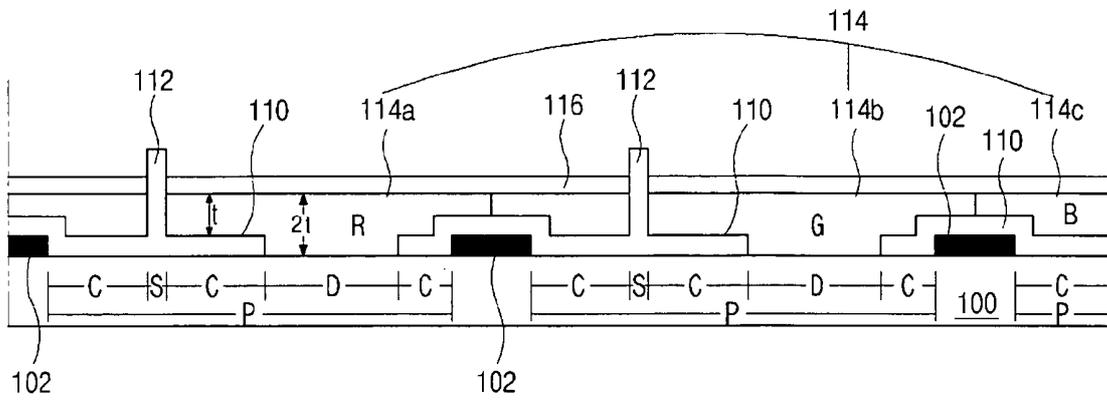
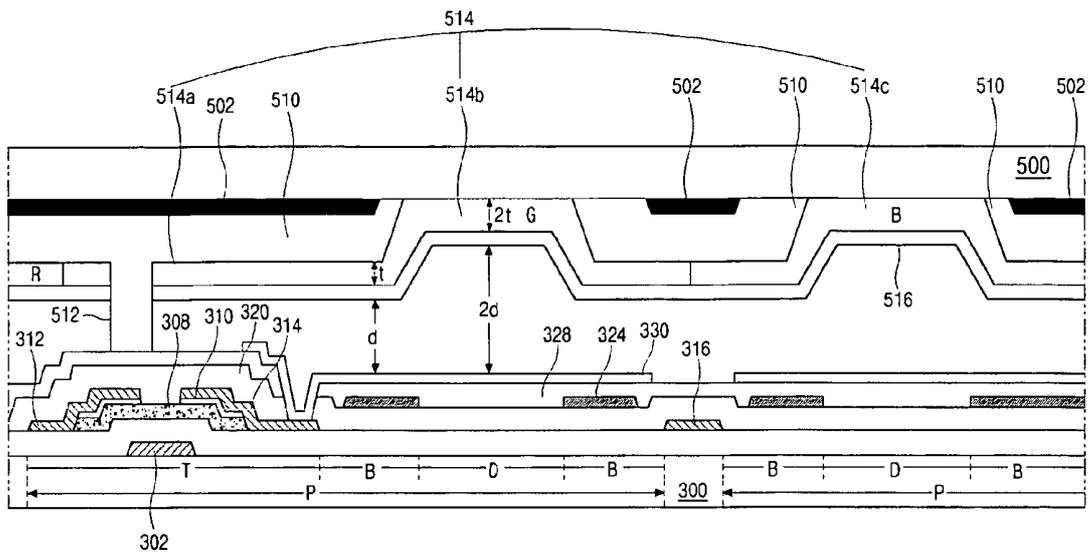


FIG. 10



**TRANSFLECTIVE LIQUID CRYSTAL
DISPLAY DEVICE COMPRISING A
PATTERNED SPACER WHEREIN THE
BUFFER LAYER AND THE SPACER ARE A
SINGLE BODY AND METHOD OF
FABRICATING THE SAME**

The present invention claims the benefit of Korean Patent Application No. 2002-88298, filed in Korea on Dec. 31, 2002, which is hereby incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a liquid crystal display device and a method of fabricating a liquid crystal display device, and more particularly, to a transfective liquid crystal display device and method of fabricating a transfective liquid crystal display device.

2. Discussion of the Related Art

In general, transfective liquid crystal display (LCD) devices function as both transmissive and reflective LCD devices. Accordingly, since the transfective LCD devices can use both a backlight and an exterior natural or artificial light, the transfective LCD devices are usable in more different type of devices, wherein power consumption of transfective LCD devices can be reduced.

FIG. 1 is a schematic plan view of an array substrate for a transfective liquid crystal display device according to the related art. In FIG. 1, a gate line 52 and a data line 62 are formed on a substrate 50, wherein the gate line 52 and the data line 62 cross each other to define a pixel region P. A thin film transistor (TFT) T, which includes a gate electrode 54, an active layer 56, and source and drain electrodes 58 and 60, is disposed at a crossing of the gate line 52 and the data line 62. In addition, the pixel region P includes a reflective portion C and a transmissive portion D, wherein a reflective electrode 64 and a transparent electrode 66 correspond to the reflective portion C and the transmissive portion D, respectively. The reflective electrode 64 having a transmissive hole 64a is formed over the transparent electrode 66, and a metal pattern 65 having an island shape overlaps a portion of the gate line 52 and contacts the reflective electrode 64 or the transparent electrode 66. Accordingly, the metal pattern 65 and the overlapped portion of the gate line 52 constitute a storage capacitor C_{ST} .

FIG. 2 is a schematic cross sectional view along I—I of FIG. 1 according to a first embodiment of the related art, and FIG. 3 is a schematic cross sectional view along I—I of FIG. 1 according to a second embodiment of the related art. In FIGS. 2 and 3, first and second substrates 50 and 80 face each other and are spaced apart from each other, wherein the first and second substrates 50 and 80 include a plurality of pixel regions P and a gate line (not shown) and a data 62 line crossing each other are formed on an inner surface of the first substrate 50. In addition, a red sub-color filter 84a, a green sub-color filter 84b, and a blue sub-color filter (not shown) are formed on an inner surface of the second substrate 80, and a black matrix 82 is formed between the sub-color filters 84a and 84b. A transparent common electrode 86 is formed on the sub-color filters 84a and 84b and the black matrix 82, wherein the pixel region P includes a reflective portion C and a transmissive portion D. Generally, a reflective electrode 64 corresponding to the reflective portion C and a transparent electrode 66 corresponding to the transmissive portion D are formed over an inner surface

of the first substrate 50. The reflective electrode 64 has a transmissive hole 64a formed over or under the transparent electrode 66.

In the transfective LCD device, it is necessary to obtain an equivalent optical efficiency in the reflective and transmissive portions C and D. In FIG. 2, since the light path (i.e., the distance that light transverses when light passes through a liquid crystal layer) in the reflective portion C is different from that in the transmissive portion D, the polarization properties in the reflective and transmissive portions C and D are also different from each other. When light passes through a liquid crystal layer 90 having a thickness d within the transmissive portion D, light passing through the liquid crystal layer 90 in the reflective portion C is reflected at the reflective electrode 64 and then passes through the liquid crystal layer 90 again. Accordingly, light path in the reflective portion C is twice of that within the transmissive portion D. Thus, light has different polarization properties in the reflective and transmissive portions C and D, thereby a difference in light efficiency is generated.

To solve this problem, as shown in FIG. 3, an insulating layer 63 within the transmissive portion D has an open portion 61 so that light path in the reflective portion C can be the same as that in the transmissive portion D. When the liquid crystal layer 90 in the reflective portion C has a first thickness of d, the liquid crystal layer 90 in the transmissive portion D has a second thickness of 2d. In other words, the liquid crystal layer 90 has a dual cell gap.

However, even though light efficiency of the reflective portion C is the same as that of the transmissive portion D due to the dual cell gap, uniform color reproducibility cannot be obtained. The sub-color filters 84a and 84b within the reflective portion C have the same thickness as that in the transmissive portion D. Light passes through the sub-color filters 84a and 84b twice within the reflective portion C, whereas light passes through the sub-color filters 84a and 84b just once in the transmissive portion D. Accordingly, even though light passing through the transmissive portion D is brighter than light reflected from the reflective portion C, light emitted from the reflective portion C has higher color reproducibility than that emitted from the transmissive portion D. To solve this problem, a method that a sub-color filter having a dual thickness in the reflective and transmissive portions is disclosed in Korean Patent Application No. 2000-9979.

FIG. 4 is a schematic cross sectional view along I—I of FIG. 1 according to a third embodiment of the related art. In FIG. 4, first and second substrates 50 and 80 having a pixel region P face each other and are spaced apart from each other, and a liquid crystal layer 90 is interposed therebetween. The pixel region P includes a reflective portion C and a transmissive portion D, wherein a black matrix 92 is formed on an inner surface of the second substrate 80 at a border of the pixel region P. A transparent buffer layer 94 corresponding to the reflective portion C is formed on the black matrix 82, and red and green sub-color filters 96a and 96b are formed on the buffer layer 94 in the pixel region P. A planarization layer 97 and a common electrode 98 are sequentially formed on the red and green sub-color filters 96a and 96b.

A reflective electrode 64 corresponding to the reflective portion C and a transparent electrode 66 corresponding to the transmissive portion D are formed on an inner surface of the first substrate 50. Generally, the reflective electrode 64 has a transmissive hole 64a formed under the transparent electrode 66. Since an insulating layer 63 under the reflective electrode 64 has an open portion 61 corresponding to the

transmissive hole 64a, a first thickness d1 of the liquid crystal layer 90 within the reflective portion C is one-half of a second thickness d2 of the liquid crystal layer 90 within the transmissive portion D. That is, the second thickness d2 of the liquid crystal layer 90 within the transmissive portion D is substantially twice of the first thickness d1 of the liquid crystal layer 90 within the reflective portion C. Each of the sub-color filters 96a and 96b has a thickness ratio of 1:2 within the reflective and transmissive portions C and D due to the buffer layer 94.

FIGS. 5A to 5F are schematic cross sectional views of a fabrication process of a color filter layer according to the related art. In FIG. 5A, a black matrix 92 is formed on a substrate 80 by sequentially depositing and patterning chromium oxide (CrOx) and chromium (Cr), wherein the black matrix 92 is provided for low reflectance of an LCD screen. Since an aperture ratio is directly dependent on a shape of the black matrix 92, the black matrix 92 is formed to cover only a portion corresponding to a switching element (not shown), a gate line (not shown), and a data line (not shown) in order to prevent light leakage due to reflected light and an assembly margin of an attachment process for the upper and lower substrates. As a result, a portion of the color filter substrate within a pixel region is exposed.

In FIG. 5B, a transparent thin film 93 is formed on the black matrix 92 by depositing one of a photopolymeric polymer, an organic insulating material, and an inorganic insulating material.

In FIG. 5C, a buffer layer 94 is formed at a portion corresponding to the reflective portion C through photolithographic processes to eliminate the transparent thin film 93 (in FIG. 5A) corresponding to the transmissive portion D. As a result, the buffer layer 94 is formed on a second substrate 80 corresponding to the reflective portion C.

In FIG. 5D, a red sub-color filter 96a is formed on the buffer layer 94 by coating and patterning color resin including red dye. Since the color resin fills a portion corresponding to the transmissive portion D where the buffer layer 94 is not formed, the red sub-color filter 96a is formed to correspond to one pixel region P including the reflective and transmissive portions C and D.

In FIG. 5E, similar to the red sub-color filter 96a, a green sub-color filter 96b is formed on the buffer layer 94 by coating and patterning color resin including green dye.

In FIG. 5F, similar to the red and green sub-color filters 96a and 96b, a blue sub-color filter 96c is formed on the buffer layer 94 by coating and patterning color resin including blue dye. Accordingly, a color filter layer 96 including red, green, and blue sub-color filters 96a, 96b, and 96c may be formed. In addition, a common electrode 98 is formed on the color filter layer 96 by depositing one of a transparent conductive metallic material group including indium-tin-oxide (ITO) and indium-zinc-oxide (IZO). A planarization layer (not shown) may be formed between the color filter layer 96 and the common electrode 98.

In the transfective LCD devices of FIGS. 2, 3, and 4, ball spacers may be used to maintain a cell gap. Generally, since the ball spacers are randomly spread out between first and second substrates, an inferior alignment layer may be formed due to movement of the ball spacers. Moreover, a light leakage phenomenon may occur at portions adjacent to the ball spacers due to adsorption forces between liquid crystal molecules adjacent to the ball spacers. In addition, since the ball spacers may be formed through an additional process, production costs increase. Accordingly, superior display quality can not be obtained in the transfective LCD device using the ball spacers.

SUMMARY OF THE INVENTION

Accordingly, the present invention is directed to a liquid crystal display device that substantially obviates one or more of the problems due to limitations and disadvantages of the related art.

An object of the present invention is to provide a transfective liquid crystal display device having patterned spacers.

Another object of the present invention is to provide a method of fabricating a transfective liquid crystal display device having patterned spacers.

Another object of the present invention is to provide a transfective liquid crystal display device having patterned spacers simultaneously formed with a buffer layer for a dual color filter layer.

Another object of the present invention is to provide a method of fabricating a transfective liquid crystal display device having patterned spacers simultaneously formed with a buffer layer for a dual color filter layer.

Another object of the present invention is to provide a method of fabricating a transfective liquid crystal display device having simplified fabricating processes.

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

To achieve these and other advantages and in accordance with the purpose of the present invention, as embodied and broadly described, a color filter substrate for a transfective liquid crystal display device includes a substrate having a plurality of pixel regions, each of the plurality of pixel regions having reflective and transmissive portions, a black matrix on the substrate, a buffer layer on the black matrix having a first open portion corresponding to the transmissive portion of the pixel region and a patterned spacer within the reflective portion of the pixel region, a color filter layer on the buffer layer, the color filter layer having a first thickness within the reflective portion of the pixel region and a second thickness within the transmissive portion of the pixel region, and a common electrode on the color filter layer, wherein the buffer layer and the patterned spacer are a single body.

In another aspect, a method of fabricating a color filter substrate for a transfective liquid crystal display device includes forming a black matrix on a substrate having a plurality of pixel regions, each of the plurality of pixel regions having reflective and transmissive portions, forming a buffer layer on the black matrix, the buffer layer having a first open portion corresponding to the transmissive portion of the pixel region and a patterned spacer within the reflective portion of the pixel region, forming a color filter layer on the buffer layer, the color filter layer having a first thickness within the reflective portion of the pixel region and a second thickness within the transmissive portion of the pixel region, and forming a common electrode on the color filter layer.

In another aspect, a transfective liquid crystal display device includes first and second substrates facing each other and spaced apart from each other, a gate line on an inner surface of the first substrate, a data line crossing the gate line to define a pixel region having reflective and transmissive portions, a thin film transistor connected to the gate line and the data line, a passivation layer on the thin film transistor, the gate line, and the data line, wherein the passivation layer

has a groove corresponding to the transmissive portion of the pixel region, a reflective layer within the reflective portion of the pixel region, a transparent electrode within the transmissive portion of the pixel region, wherein the transparent electrode is connected to the thin film transistor, a black matrix on an inner surface of the second substrate, a buffer layer on the black matrix, the buffer layer having a first open portion corresponding to the transmissive portion of the pixel region and a patterned spacer within the reflective portion of the pixel region, a color filter layer on the buffer layer, the color filter layer having a first thickness within the reflective portion of the pixel region and a second thickness within the transmissive portion of the pixel region, a common electrode on the color filter layer, and a liquid crystal layer interposed between the transparent electrode and the common electrode, wherein the buffer layer and the patterned spacer are a single body.

In another aspect, a transmissive liquid crystal display device includes first and second substrates facing each other and spaced apart from each other, a gate line on an inner surface of the first substrate, a data line crossing the gate line to define a pixel region having reflective and transmissive portions, a thin film transistor connected to the gate line and the data line, a reflective layer within the reflective portion of the pixel region, a transparent electrode within the transmissive portion of the pixel region, the transparent electrode being connected to the thin film transistor, a black matrix on an inner surface of the second substrate, a buffer layer on the black matrix, the buffer layer having a first open portion corresponding to the transmissive portion of the pixel region and a patterned spacer within the reflective portion of the pixel region, a color filter layer on the buffer layer, the color filter layer having a first thickness within the reflective portion of the pixel region and a second thickness within the transmissive portion of the pixel region, a common electrode on the color filter layer, and a liquid crystal layer interposed between the transparent electrode and the common electrode, wherein the buffer layer and the patterned spacer are one single body.

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

BRIEF DESCRIPTION OF THE DRAWINGS

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

FIG. 1 is a schematic plan view of an array substrate for a transmissive liquid crystal display device according to the related art;

FIG. 2 is a schematic cross sectional view along I—I of FIG. 1 according to a first embodiment of the related art;

FIG. 3 is a schematic cross sectional view along I—I of FIG. 1 according to a second embodiment of the related art;

FIG. 4 is a schematic cross sectional view along I—I of FIG. 1 according to a third embodiment of the related art;

FIGS. 5A to 5F are schematic cross sectional views of a fabrication process of a color filter layer according to the related art;

FIG. 6 is a schematic plan view of an exemplary color filter substrate for a transmissive liquid crystal display device according to the present invention;

FIG. 7 is a schematic perspective view of an exemplary black matrix and buffer layer of a color filter substrate for a transmissive liquid crystal display device according to the present invention;

FIGS. 8A to 8E are schematic cross sectional views along VIII—VIII of FIG. 6 of an exemplary method of fabricating a color filter substrate for a transmissive liquid crystal display device according to the present invention;

FIG. 9 is a schematic cross sectional view of an exemplary transmissive liquid crystal display device according to the present invention; and

FIG. 10 is a schematic cross sectional view of another exemplary transmissive liquid crystal display device according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference will now be made in detail to the preferred embodiments of the present invention, an example of which is illustrated in the accompanying drawings.

FIG. 6 is a schematic plan view of an exemplary color filter substrate for a transmissive liquid crystal display device according to the present invention, and FIG. 7 is a schematic perspective view of an exemplary black matrix and buffer layer of a color filter substrate for a transmissive liquid crystal display device according to the present invention. In FIGS. 6 and 7, a black matrix 102 having a plurality of first open portions H1 may be formed on a substrate 100, wherein the substrate 100 may have a plurality of pixel regions P and each of the pixel regions P may include reflective and transmissive portions C and D. The plurality of first open portions H1 may correspond to the plurality of pixel regions P. A buffer layer 110 having a plurality of second open portions H2 may be formed on the black matrix 102, wherein the plurality of second open portions H2 may correspond to the transmissive portion D. In addition, the buffer layer 110 may include a plurality of patterned spacers 112 corresponding to the reflective portion C. The plurality of patterned spacers 112 may be simultaneously formed with the buffer layer 110 as a single body. Although not shown, a color filter layer may be formed on the buffer layer 110 using a spin coating method to fill the transmissive portion D.

FIGS. 8A to 8E are schematic cross sectional views along VIII—VIII of FIG. 6 of an exemplary method of fabricating a color filter substrate for a transmissive liquid crystal display device according to the present invention. In FIGS. 8A to 8E, each sub-color filter may extend along a vertical direction. Accordingly, red, green, and blue sub-color filters may extend along a vertical direction and may be alternately disposed along a horizontal direction.

In FIG. 8A, a black matrix 102 having a plurality of first open portions H1 may be formed on a substrate 100, wherein the substrate 100 may have a plurality of pixel regions P and each of the pixel regions P may include reflective portions C, a transmissive portions D, and a spacer portion S adjacent to the reflective portion C. The plurality of first open portions H1 correspond to the plurality of pixel regions P, and a black matrix 102 may be formed of a single layer of chromium (Cr) or a double layer of chromium/chromium oxide (Cr/CrOx) having low reflectance.

In FIG. 8B, a transparent insulating layer 104 may be formed on the black matrix 102 by coating one of a transparent organic insulating material group, for example, benzocyclobutene (BCB) and acrylic resin. In addition, a photoresist (PR) layer 106 may be formed on the transparent

insulating layer **104**, wherein a mask **M** having transmissive regions **E**, shielding regions **F**, and half-transmissive regions **K** may be disposed over the PR layer **106**, wherein the half-transmissive regions **K** may be formed of a slit or a half-transmissive layer. The transmissive regions **E**, the shielding regions **F**, and the half-transmissive regions **K** may correspond to the transmissive portions **D**, the spacer portions **S** and the reflective portions **C**, respectively. After disposing the mask **M** over the PR layer **106**, the PR layer **106** may be exposed to light through the mask **M**, and then developed.

In FIG. **8C**, after developing the PR layer **106**, first and second PR patterns **108a** and **108b** corresponding to the reflective portions **C** and the spacer portions **S**, respectively, may be obtained. The first PR pattern **108a** may have a thickness lower than a thickness of the PR layer **106** (in FIG. **8B**), and the second PR pattern **108b** may have a same thickness as the PR layer **106** (in FIG. **8B**). The transparent insulating layer **104** within the transmissive portions **D** may be exposed to the light since the entire PR layer **106** (in FIG. **8B**) within the transmissive portion **D** may be removed through the exposure and developing steps.

The first and second PR patterns **108a** and **108b** and the transparent insulating layer **104** may be etched until the second PR pattern **108b** is removed. For example, while the transparent insulating layer **104** is etched, the first and second PR patterns **108a** and **108b** may be also etched through a dry etching method.

In FIG. **8D**, after etching the first and second PR patterns **108a** and **108b** (in FIG. **8C**) and the transparent insulating layer **104** (in FIG. **8C**), a plurality of buffer layers **110** corresponding to the reflective portions **C** and patterned spacers **112** corresponding to the spacer portions **S** may be obtained. Each of the buffer layers **110** may have a thickness lower than a thickness of the patterned spacers **112**, and the patterned spacers **112** may have a columnar shape. Portions of the substrate **100** within the transmissive portion **D** may be exposed since the entire transparent insulating layer **104** (in FIG. **8C**) may be removed.

In FIG. **8E**, a color filter layer **114** including red, green, and blue sub-color filters **114a**, **114b**, and **114c** may be formed on the buffer layers **110**. The red, green, and blue sub-color filters **114a**, **114b**, and **114c**, each of which may correspond to the pixel regions **P**, may be sequentially formed through coating and patterning steps. Each of the red, green, and blue sub-color filters **114a**, **114b**, and **114c** may be formed to have a first thickness **t** within the reflective portion **C** and a second thickness **2t** that may be about twice the first thickness **t** within the transmissive portion **D** due to the buffer layers **110**. In addition, a common electrode **116** may be formed on the color filter layer **114**, and may be formed of a transparent conductive metal, such as indium-tin-oxide (ITO) and indium-zinc-oxide (IZO).

FIG. **9** is a schematic cross sectional view of an exemplary transfective liquid crystal display device according to the present invention. In FIG. **9**, first and second substrates **200** and **100** may face each other and may be spaced apart from each other, wherein the first and second substrates **200** and **100** may have a plurality of pixel regions **P** and each of the pixel regions **P** may include reflective and transmissive portions **C** and **D**. A thin film transistor (TFT) **T**, which may include a gate electrode **202**, an active layer **208**, an ohmic contact layer **210**, and source and drain electrodes **212** and **214**, may be formed on an inner surface of the first substrate **200**. A gate line (not shown) and a data line **216** that cross each other may be formed over the inner surface of the first substrate **200**. Accordingly, one of the pixel regions **P** may

be defined by the crossing of the gate line (not shown) and the data line **216**, wherein the data line **216** may be connected to the source electrode **212**.

In FIG. **9**, a first insulating layer **220** of an inorganic material and a second insulating layer **222** of an organic material having a groove **226** corresponding to the transmissive portion **D** may be formed on the TFT **T** and the data line **216** through sequential depositing and patterning steps. In addition, a reflective layer **224** having an open portion corresponding to the transmissive portion **D** may be formed on the second insulating layer **222**, a third insulating layer **228** may be formed on the reflective layer **224**, and a transparent electrode **230** corresponding to the pixel region **P** may be formed on the third insulating layer **228**.

In FIG. **9**, a black matrix **102** may be formed on an inner surface of the second substrate **100**, and may include a plurality of first open portions **H1** (in FIG. **8A**) corresponding to the plurality of pixel regions **P** and a portion of the black matrix **102** may correspond to the TFT **T**. In addition, a transparent buffer layer **110** may be formed on the black matrix **102**, wherein the buffer layer **110** may include a plurality of second open portions **H2** (in FIG. **7**) within the transmissive portion **D** and a patterned spacer **112** corresponding to the reflective portion **C**. The patterned spacer **112** may be simultaneously formed with the buffer layer **110** as a single body.

In FIG. **9**, a color filter layer **114** including red, green, and blue sub-color filters **114a**, **114b**, and **114c** may be formed on the buffer layer **110**. Each of the red, green, and blue sub-color filters **114a**, **114b**, and **114c** may correspond to one of the pixel regions **P**. Due to the buffer layer **110**, the color filter layer **114** may have a first thickness **t** within the reflective portion **C** and a second thickness **2t** within the transmissive portion **D**. For example, the first thickness **t** may be substantially one-half of the second thickness **2t**. Since the first and second insulating layers **220** and **222** may have the grooves **226** corresponding to the transmissive portions **D**, the transfective LCD device may have a first cell gap **d** within the reflective portions **C** and a second cell gap **2d** within the transmissive portions **D**, wherein the first cell gap **d** may be substantially one-half of the second cell gap **2d**.

According to the present invention, the first and second insulating layers **220** and **222** of the first substrate **200** may be patterned to have the grooves **226** for a dual cell gap of the first and second cell gaps **d** and **2d**. Thus, in order to obtain a cell gap ratio of 1:2 in the reflective and transmissive portions **C** and **D**, the organic material for the second insulating layer **222** may be deposited to have a sufficient thickness, and then may be patterned. Accordingly, a cell gap ratio between the reflective and transmissive portions **C** and **D** may be obtained by adjusting the thickness of the second organic insulating layer **222**.

FIG. **10** is a schematic cross sectional view of another exemplary transfective liquid crystal display device according to the present invention. In FIG. **10**, first and second substrates **300** and **500** may face each other and may be spaced apart from each other, wherein the first and second substrates **300** and **500** may have a plurality of pixel regions **P** and each of the pixel regions **P** may include reflective and transmissive portions **C** and **D**. A thin film transistor (TFT) **T**, which may include a gate electrode **302**, an active layer **308**, an ohmic contact layer **310**, and source and drain electrodes **312** and **314**, may be formed on an inner surface of the first substrate **300**. A gate line (not shown) and a data line **316** may be formed over the inner surface of the first substrate **300** to cross each other. One of the pixel regions **P**

may be defined by the crossing of the gate line (not shown) and the data line 316, wherein the data line 316 may be connected to the source electrode 312. In addition, a first insulating layer 320 may be formed on the TFT T, and the data line 316 and a reflective layer 324 may be formed on the first insulating layer 320, wherein the reflective layer 324 may include an open portion 324a that corresponds to the transmissive portion D. A second insulating layer 328 may be formed on the reflective layer 324 and a transparent electrode 330 corresponding to the pixel regions P may be formed on the second insulating layer 328.

In FIG. 10, a black matrix 502 may be formed on an inner surface of the second substrate 500, wherein the black matrix 502 may have a plurality of first open portions H1 (in FIG. 8A) that correspond to the plurality of pixel regions P and a portion of the black matrix 502 may correspond to the TFT T. In addition, a transparent buffer layer 510 may be formed on the black matrix 502 and may include a plurality of second open portions H2 (in FIG. 7) within the transmissive portion D and a patterned spacer 512 corresponding to the reflective portion C. The patterned spacer 512 may be simultaneously formed with the buffer layer 510 as a single body. A color filter layer 514 including red, green, and blue sub-color filters 514a, 514b, and 514c may be formed on the buffer layer 510, wherein each of the red, green, and blue sub-color filters 514a, 514b, and 514c may correspond to one of the pixel regions P.

Due to the buffer layer 510, the color filter layer 514 may have a first thickness t within the reflective portion C and a second thickness $2t$ within the transmissive portion D. For example, the first thickness t may be substantially one-half of the second thickness $2t$. Accordingly, the color filter layer 514 may have a step difference along a border of the reflective and transmissive portions C and D so that the transmissive LCD device can have a first cell gap d within the reflective portion C and a second cell gap $2d$ within the transmissive portion D. Thus, the first cell gap d may be substantially one-half of the second cell gap $2d$. For example, when the buffer layer 510 is formed to have a thickness of about 2.5 μm to about 4.0 μm , top surfaces of the color filter layer 514 within the reflective and transmissive portions C and D may have a step difference of about 2.0 μm to about 2.5 μm . Accordingly, a distance from the inner surface of the second substrate 500 to the top surface of the color filter layer 514 within the reflective portion C may be greater than a distance from the inner surface of the second substrate 500 to the top surface of the color filter layer 514 within the transmissive portion D by about 2.0 μm to about 2.5 μm .

According to the present invention, a cell gap ratio of the transmissive LCD device, as well as a thickness ratio of the color filter layer 514, between the reflective and transmissive portions C and D may be adjusted due to the step difference of the buffer layer 510. Accordingly, an additional step of forming a groove in an insulating layer on the first substrate may be omitted, thereby simplifying fabricating processes.

According to the present invention, since the transmissive LCD device may have a cell gap ratio of 1:2 and a thickness ratio of the color filter layer within the reflective and transmissive portions may be 1:2, an equivalent optical efficiency and an equivalent color reproducibility may be obtained within the reflective and transmissive portions. Accordingly, the transmissive LCD device having high brightness and superior display quality may be obtained. Moreover, since patterned spacers may be simultaneously

formed with the buffer layer, production yield may be improved through process simplification.

It will be apparent to those skilled in the art that various modifications and variations can be made in a transmissive liquid crystal display device and method of fabricating the same of the present invention without departing from the spirit or scope of the invention. Thus, it is intended that the present invention cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

What is claimed is:

1. A color filter substrate for a transmissive liquid crystal display device, comprising:

a substrate having a plurality of pixel regions, each of the plurality of pixel regions having reflective, transmissive, and black matrix portions;

a black matrix on the substrate;

a buffer layer on the black matrix having a first open portion corresponding to the transmissive portion of the pixel region and a patterned spacer within the black matrix portion of the pixel region;

a color filter layer on the buffer layer, the color filter layer having a first thickness within the reflective portion of the pixel region and a second thickness within the transmissive portion of the pixel region; and

a common electrode on the color filter layer,

wherein the buffer layer and the patterned spacer are a single body with the patterned spacer protruding from the buffer layer through the color filter layer and the common electrode.

2. The color filter substrate according to claim 1, wherein the first thickness is substantially one-half of the second thickness.

3. The color filter substrate according to claim 1, wherein the buffer layer includes one of a transparent organic insulating material group including benzocyclobutene (BCB) and acrylic resin.

4. The color filter substrate according to claim 1, wherein the color filter layer has a step difference along a border between the reflective and transmissive portions of the pixel region.

5. The color filter substrate according to claim 4, wherein the buffer layer has a thickness within a range of about 2.5 μm to about 4.0 μm .

6. The color filter substrate according to claim 5, wherein the step difference is within a range of about 2.0 μm to about 2.5 μm .

7. The color filter substrate according to claim 1, wherein the black matrix has a second open portion corresponding to the pixel region.

8. A method of fabricating a color filter substrate for a transmissive liquid crystal display device, comprising:

forming a black matrix on a substrate having a plurality of pixel regions, each of the plurality of pixel regions reflective, transmissive, and black matrix portions;

forming a buffer layer on the black matrix, the buffer layer having a first open portion corresponding to the transmissive portion of the pixel region and a patterned spacer within the black matrix portion of the pixel region;

forming a color filter layer on the buffer layer, the color filter layer having a first thickness within the reflective portion of the pixel region and a second thickness within the transmissive portion of the pixel region; and

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forming a common electrode on the color filter layer, wherein the buffer layer and the patterned spacer are a single body with the patterned spacer protruding from the buffer layer through the color filter layer and the common electrode.

9. The method according to claim 8, wherein the forming of the buffer layer comprises:

forming a transparent insulating layer on the black matrix; forming a photoresist layer on the transparent insulating layer;

disposing a mask having a transmissive region, a shielding region, and a half-transmissive region over the photoresist layer, wherein the transmissive region, the shielding region, and the half-transmissive region correspond to the transmissive portion, a spacer portion within the reflective portion, and the reflective portion, respectively, wherein a first transmittance of the transmissive region is greater than a second transmittance of the half-transmissive region and the second transmittance of the half-transmissive region is greater than a third transmittance of the shielding region;

irradiating the photoresist layer with light through the mask;

developing the photoresist layer to form a photoresist pattern, wherein the transparent insulating layer within the transmissive layer is exposed through the photoresist pattern; and etching the transparent insulating layer and the photoresist pattern.

10. The method according to claim 9, wherein the photoresist pattern has a first thickness within the reflective portion and a second thickness within the spacer portion greater than the first thickness.

11. The method according to claim 8, wherein the first thickness is substantially one-half of the second thickness.

12. The method according to claim 8, wherein the buffer layer includes one of a transparent organic insulating material group including benzocyclobutene (BCB) and acrylic resin.

13. The method according to claim 8, wherein the color filter layer includes red, green, and blue sub-color filters corresponding to the pixel region.

14. A transmissive liquid crystal display device, comprising:

first and second substrates facing each other and spaced apart from each other;

a gate line on an inner surface of the first substrate;

a data line crossing the gate line to define a pixel region having reflective, transmissive, and black matrix portions;

a thin film transistor connected to the gate line and the data line;

a passivation layer on the thin film transistor, the gate line, and the data line, wherein the passivation layer has a groove corresponding to the transmissive portion of the pixel region;

a reflective layer within the reflective portion of the pixel region;

a transparent electrode within the transmissive portion of the pixel region, wherein the transparent electrode is connected to the thin film transistor;

a black matrix on an inner surface of the second substrate; a buffer layer on the black matrix, the buffer layer having a first open portion corresponding to the transmissive portion of the pixel region and a patterned spacer within the black matrix portion of the pixel region;

a color filter layer on the buffer layer, the color filter layer having a first thickness within the reflective portion of

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the pixel region and a second thickness within the transmissive portion of the pixel region;

a common electrode on the color filter layer; and

a liquid crystal layer interposed between the transparent electrode and the common electrode,

wherein the buffer layer and the patterned spacer are a single body with the patterned spacer protruding from the buffer layer through the color filter layer and the common electrode.

15. The device according to claim 14, wherein the patterned spacer contacts a top layer over the first substrate through the liquid crystal layer.

16. The device according to claim 14, wherein the first thickness is substantially one-half of the second thickness.

17. The device according to claim 14, wherein the liquid crystal layer has a third thickness within the reflective portion of the pixel region and a fourth thickness within the transmissive portion of the pixel region, wherein the third thickness is substantially one-half of the fourth thickness.

18. The device according to claim 14, wherein the black matrix has a second open portion corresponding to the pixel region.

19. A transmissive liquid crystal display device, comprising:

first and second substrates facing each other and spaced apart from each other;

a gate line on an inner surface of the first substrate;

a data line crossing the gate line to define a pixel reflective, transmissive, and black matrix portions;

a thin film transistor connected to the gate line and the data line;

a reflective layer within the reflective portion of the pixel region;

a transparent electrode within the transmissive portion of the pixel region, the transparent electrode being connected to the thin film transistor;

a black matrix on an inner surface of the second substrate;

a buffer layer on the black matrix, the buffer layer having a first open portion corresponding to the transmissive portion of the pixel region and a patterned spacer within the black matrix portion of the pixel region;

a color filter layer on the buffer layer, the color filter layer having a first thickness within the reflective portion of the pixel region and a second thickness within the transmissive portion of the pixel region;

a common electrode on the color filter layer; and a liquid crystal layer interposed between the transparent electrode and the common electrode,

wherein the buffer layer and the patterned spacer are one single body with the patterned spacer protruding from the buffer layer through the color filter layer and the common electrode.

20. The device according to claim 19, wherein the patterned spacer contacts a top layer over the first substrate through the liquid crystal layer.

21. The device according to claim 19, wherein the first thickness is substantially one-half of the second thickness.

22. The device according to claim 19, wherein the liquid crystal layer has a third thickness within the reflective portion of the pixel region and a fourth thickness within the transmissive portion of the pixel region, wherein the third thickness is substantially one-half of the fourth thickness.

23. The device according to claim 19, wherein the color filter layer has a step difference along a border between the reflective and transmissive portions of the pixel region.

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24. The device according to claim **23**, wherein the buffer layer has a thickness within a range of about 2.5 μm to about 4.0 μm .

25. The device according to claim **24**, wherein the step difference is within a range of about 2.0 μm to about 2.5 μm .

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26. The device according to claim **19**, wherein the black matrix has a second open portion corresponding to the pixel region.

* * * * *

专利名称(译)	包括图案化间隔物的半透半反液晶显示装置，其中缓冲层和间隔物是单体，以及制造该间隔物的方法		
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[标]申请(专利权)人(译)	乐金显示有限公司		
申请(专利权)人(译)	LG.飞利浦液晶CO., LTD.		
当前申请(专利权)人(译)	LG DISPLAY CO., LTD.		
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摘要(译)

一种用于半透半反液晶显示装置的滤色器基板，包括具有多个像素区域的基板，所述多个像素区域中的每一个具有反射和透射部分，基板上的黑矩阵，黑矩阵上的缓冲层具有对应于像素区域的透射部分的第一开口部分和像素区域的反射部分内的图案化间隔物，缓冲层上的滤色器层，滤色器层在像素区域的反射部分内具有第一厚度在像素区域的透射部分内的第二厚度，以及在滤色器层上的公共电极，其中缓冲层和图案化的间隔物是单体。

