US007515225B2

(12) **United States Patent**
Park

(10) **Patent No.: US 7,515,225 B2**
(45) **Date of Patent: Apr. 7, 2009**

(54) **SUBSTRATE FOR A LIQUID CRYSTAL DISPLAY AND A FABRICATING METHOD THEREOF**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 392 days.

(21) Appl. No.: **11/011,066**

(22) Filed: **Dec. 15, 2004**

(65) **Prior Publication Data**

US 2005/0134788 A1 Jun. 23, 2005

(30) **Foreign Application Priority Data**

Dec. 23, 2003 (KR) 10-2003-0095717

(51) **Int. Cl.**
G02F 1/1335 (2006.01)
G02F 1/1343 (2006.01)

(52) **U.S. Cl.** **349/106**; 349/144

(58) **Field of Classification Search** 349/106–109, 349/110, 139, 143–144, 158
See application file for complete search history.

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(57) **ABSTRACT**

A substrate for a liquid crystal display includes a black matrix on a substrate having first, second, third and fourth sub-pixel regions, wherein the black matrix includes first, second, third and fourth openings corresponding to the first, second, third and fourth sub-pixel regions, respectively, first, second and third color filter patterns corresponding to the first, second and third openings, respectively, a first planarization layer on the first, second and third color filter patterns and filling the fourth opening, and a second planarization layer on the first planarization layer.

12 Claims, 14 Drawing Sheets

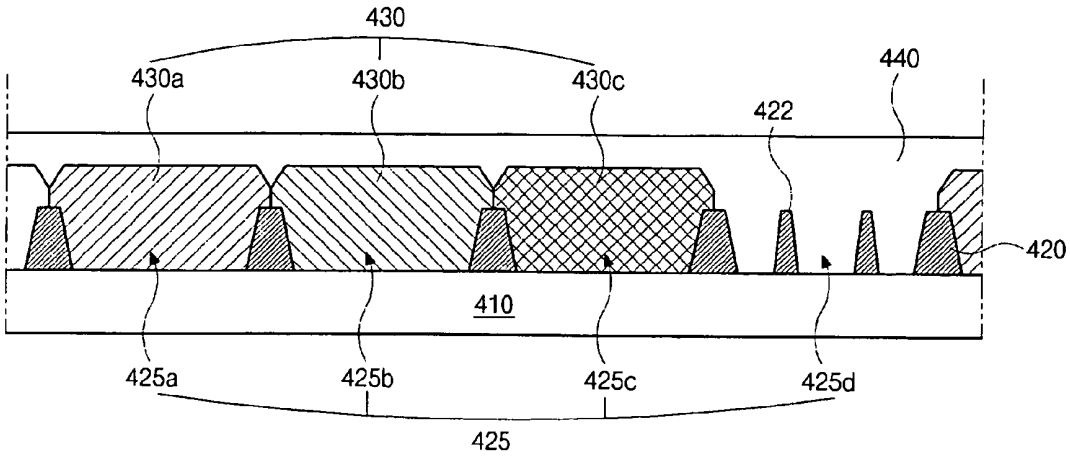


FIG. 1
RELATED ART

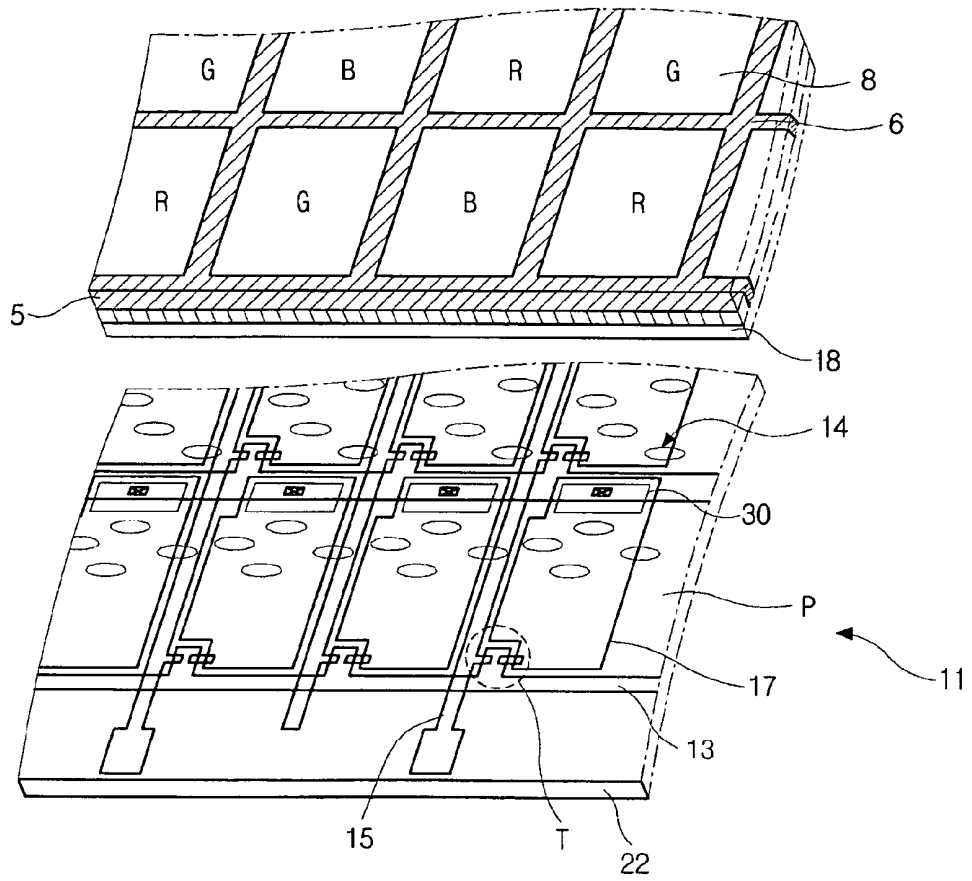


FIG. 2
RELATED ART

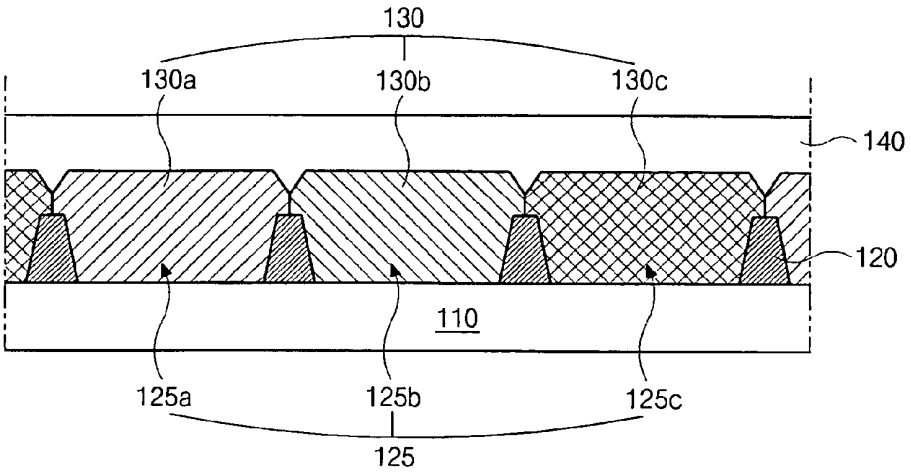


FIG. 3
RELATED ART

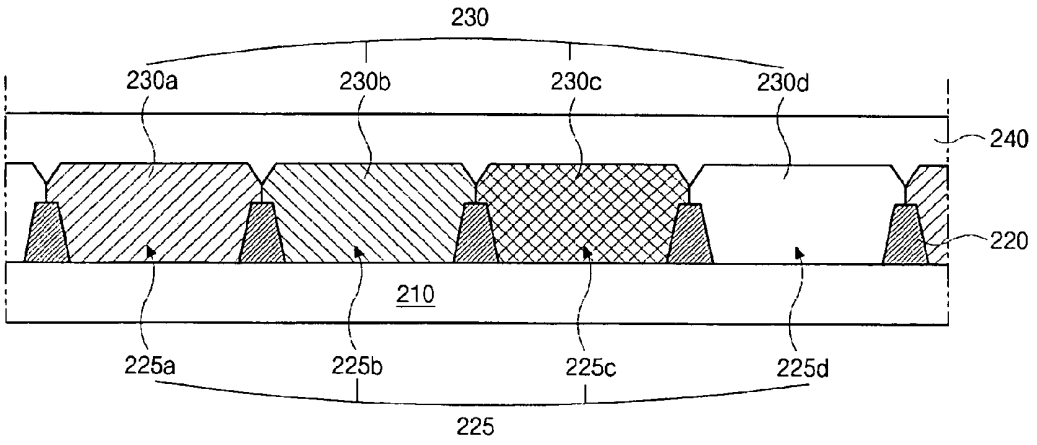


FIG. 4A
RELATED ART

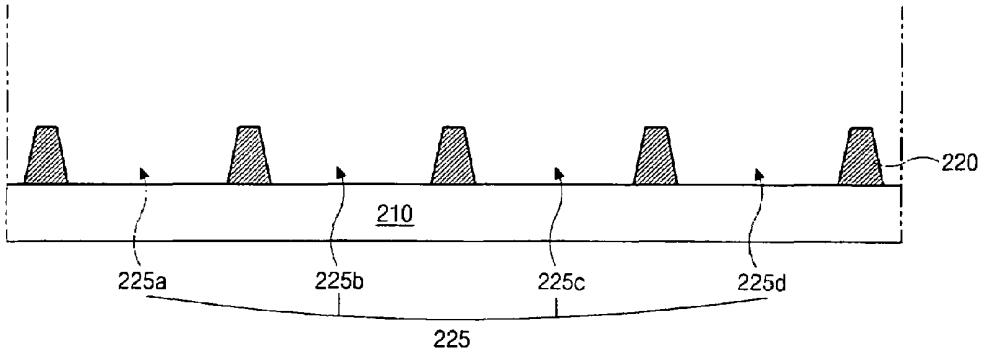


FIG. 4B
RELATED ART

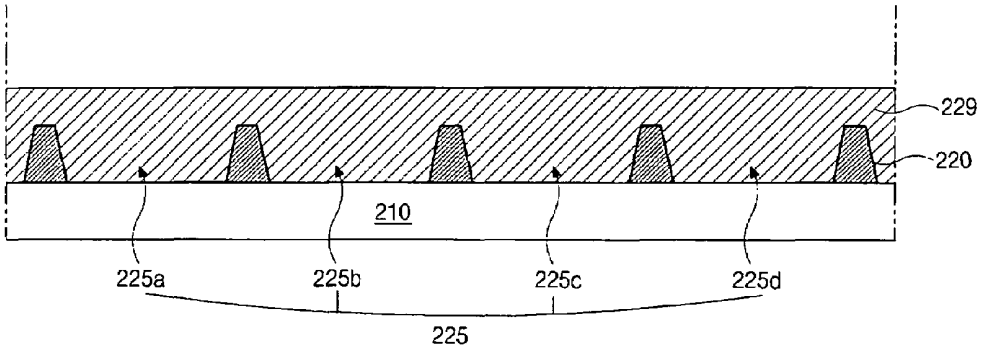


FIG. 4C
RELATED ART

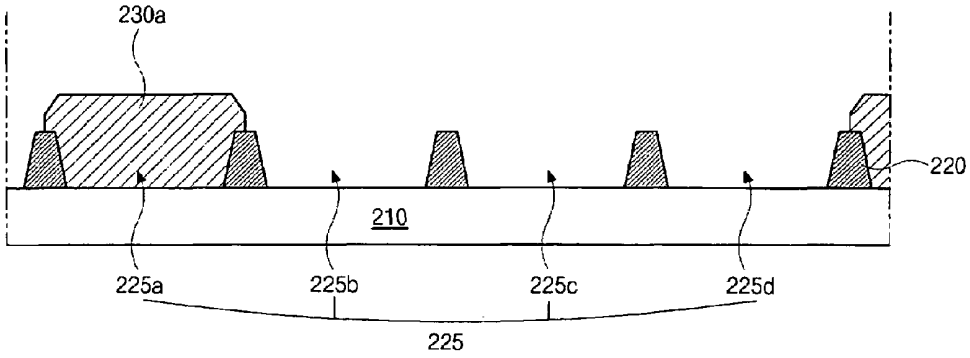


FIG. 4D
RELATED ART

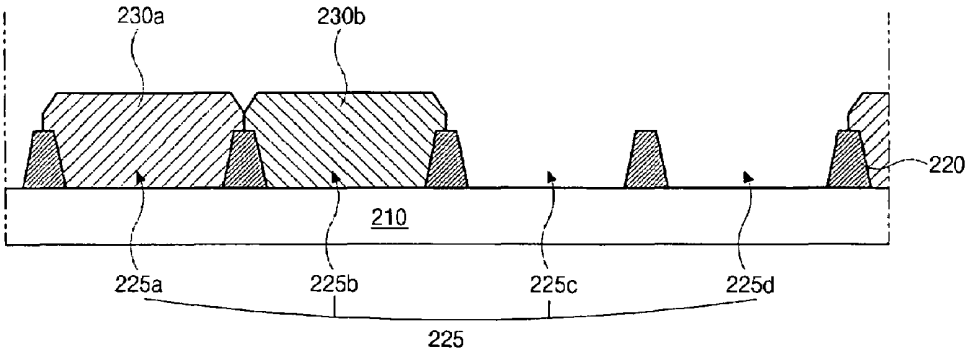


FIG. 4E
RELATED ART

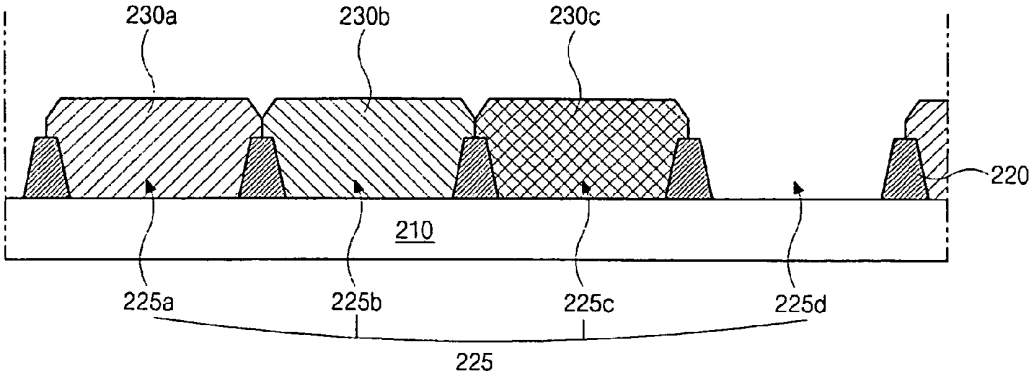


FIG. 4F
RELATED ART

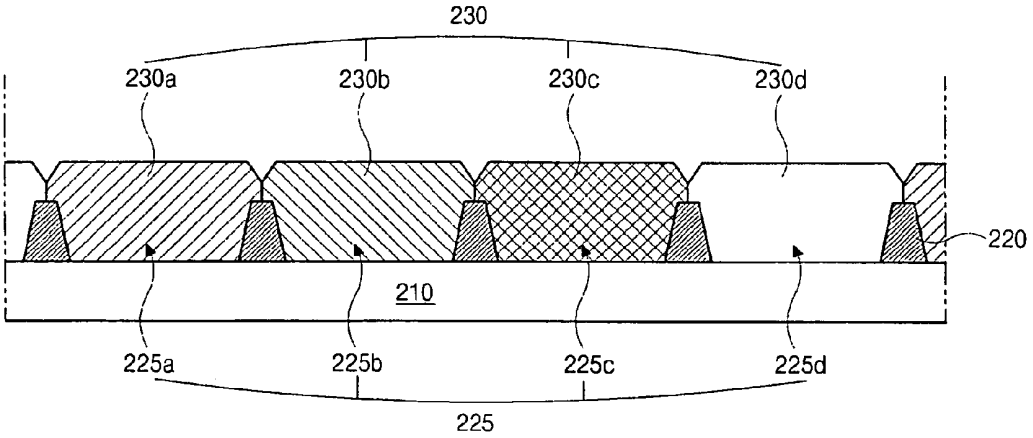


FIG. 4G
RELATED ART

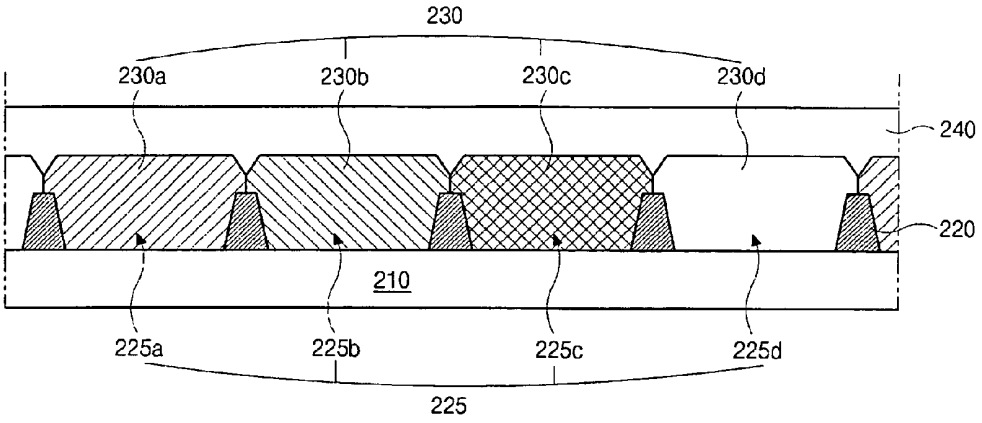


FIG. 5

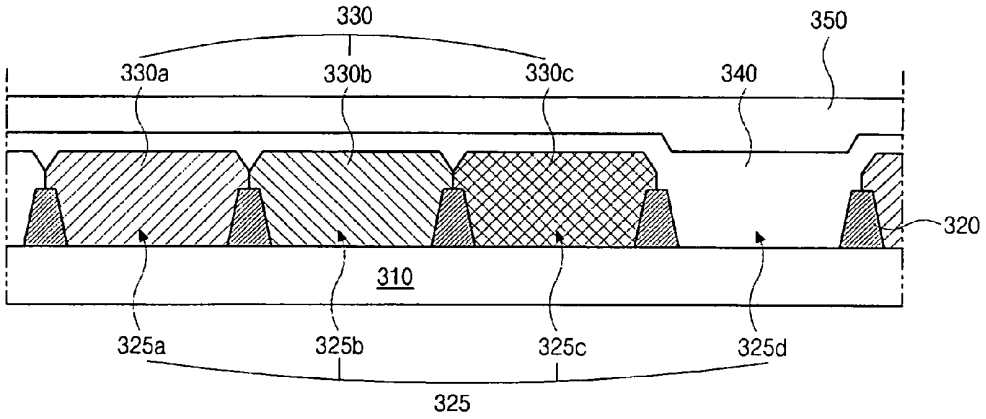

330
350
330a
330b
330c
340
320
310
325a
325b
325c
325d
325

FIG. 6A

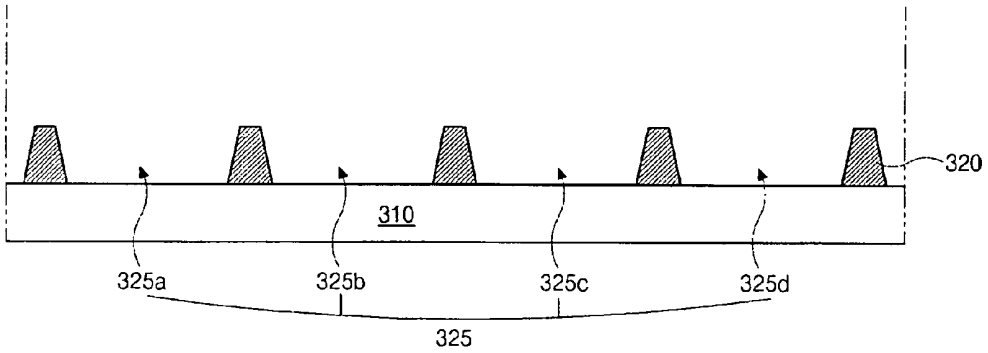

320
310
325a
325b
325c
325d
325

FIG. 6B

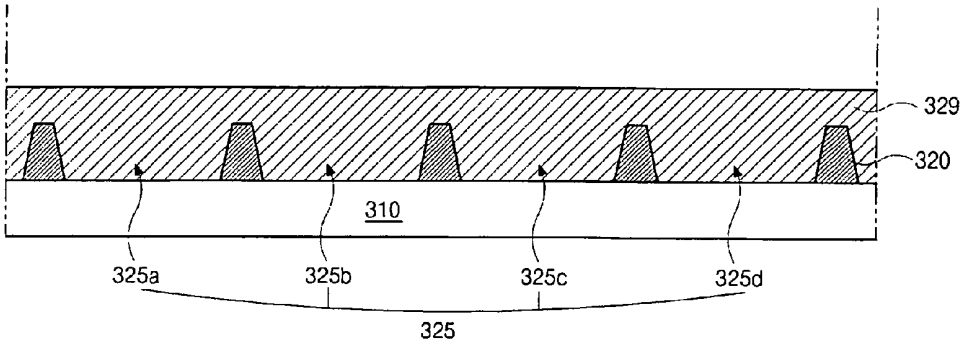

329
320
310
325a
325b
325c
325d
325

FIG. 6C

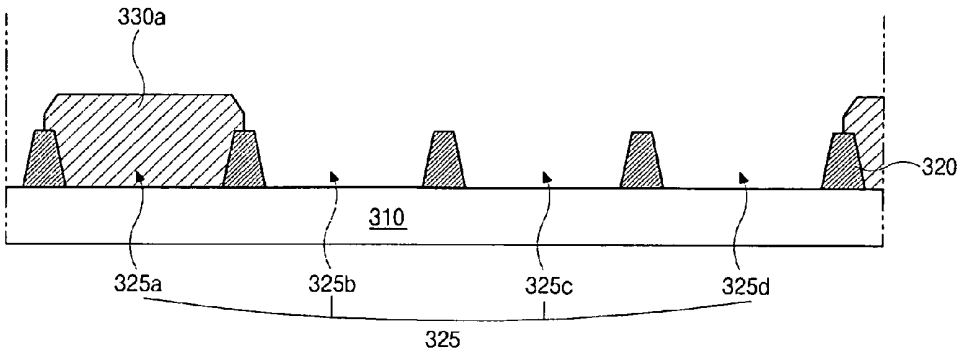

330a
320
310
325a
325b
325c
325d
325

FIG. 6D

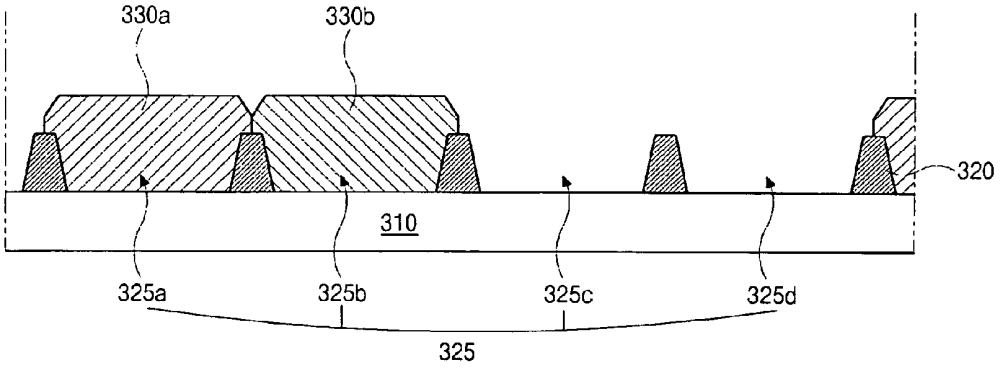

330a
330b
320
310
325a
325b
325c
325d
325

FIG. 6E

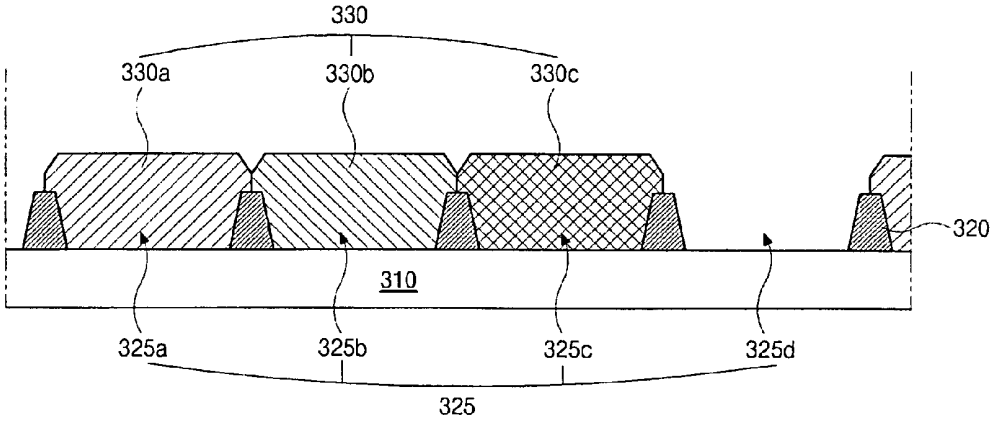

330
330a
330b
330c
320
310
325a
325b
325c
325d
325

FIG. 6F

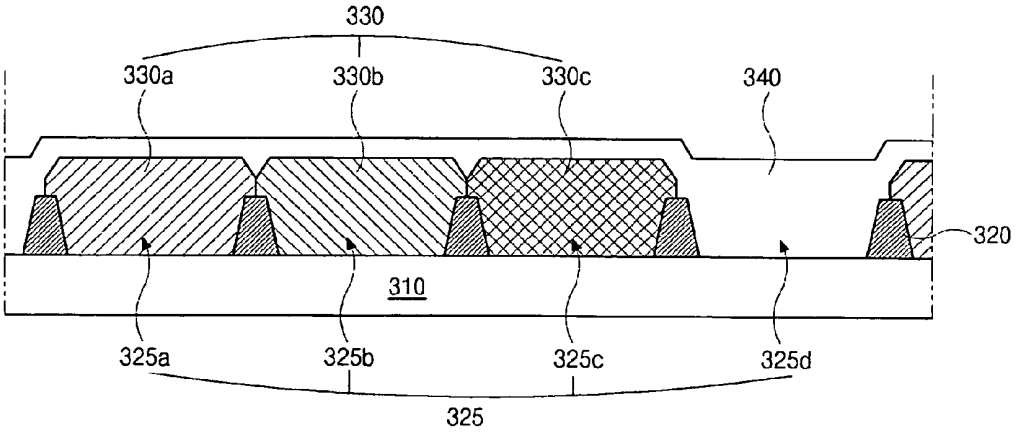

330
330a
330b
330c
340
320
310
325a
325b
325c
325d
325

FIG. 6G

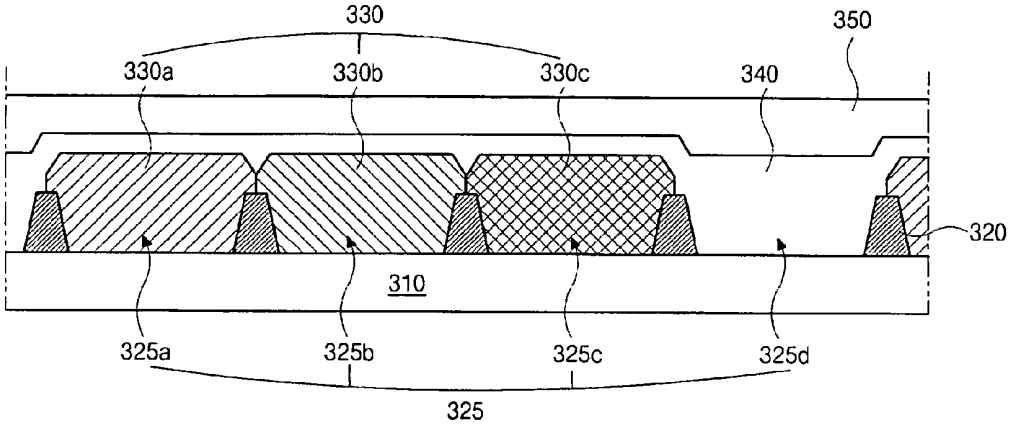

330
350
330a
330b
330c
340
320
310
325a
325b
325c
325d
325

FIG. 7

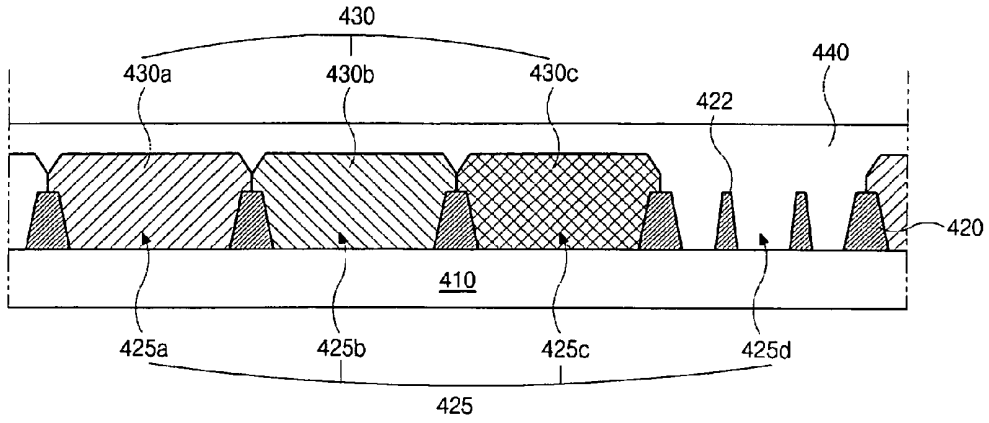

430
430a
430b
430c
440
422
420
410
425a
425b
425c
425d
425

FIG. 8A

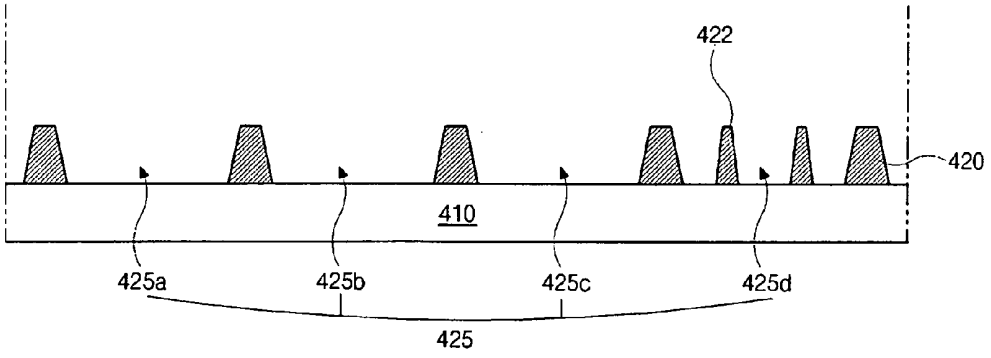

422
420
410
425a
425b
425c
425d
425

FIG. 8B

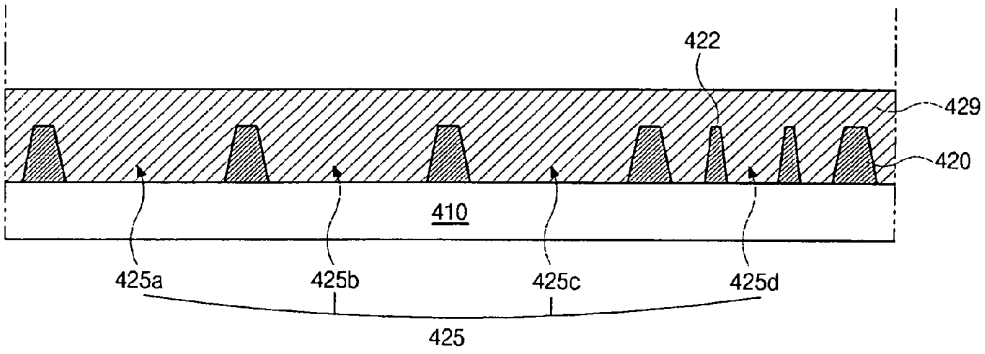

422
429
420
410
425a
425b
425c
425d
425

FIG. 8C

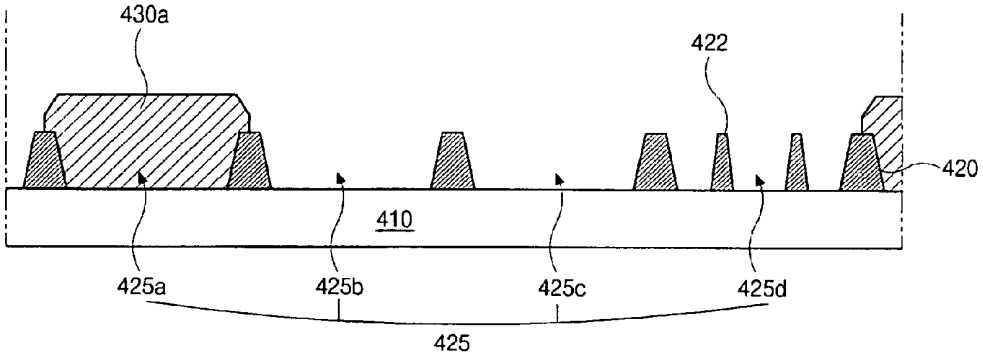

430a
422
420
410
425a
425b
425c
425d
425

FIG. 8D

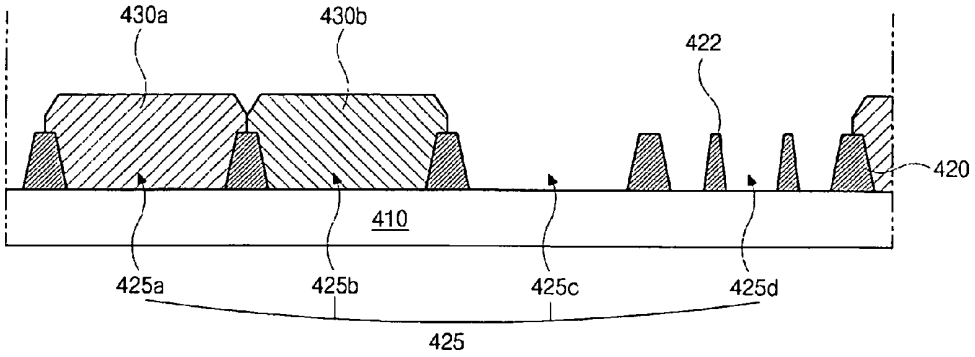

430a
430b
422
420
410
425a
425b
425c
425d
425

FIG. 8E

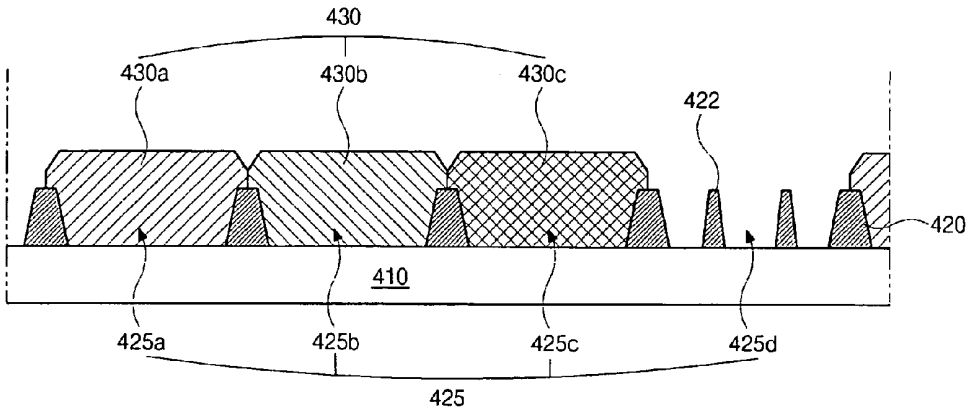
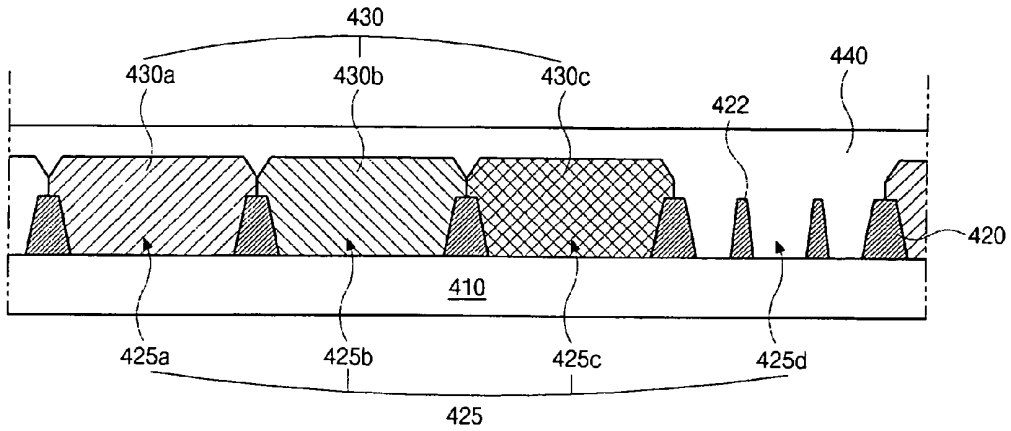

430
430a
430b
430c
422
420
410
425a
425b
425c
425d
425

FIG. 8F



SUBSTRATE FOR A LIQUID CRYSTAL DISPLAY AND A FABRICATING METHOD THEREOF

The application claims the benefit of Korean Patent Application No. 2003-95717, filed on Dec. 23, 2003, which is hereby incorporated by reference for all purposes as if fully set forth herein.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a liquid crystal display (LCD), and more particularly, to a color filter substrate for an LCD and a fabricating method thereof.

2. Discussion of the Related Art

Until recently, display devices generally employed cathode-ray tubes (CRTs). Presently, many efforts are being made to study and develop various types of flat panel displays, such as liquid crystal displays (LCDs), plasma display panels (PDPs), field emission displays (FEDs), and electro-luminescence displays (ELDs), as substitutions for CRTs.

Of these flat panel displays, the LCD has high resolution images, lightness, thin profile, compact size, and low voltage power supply requirements.

FIG. **1** is a schematic view of an LCD according to the related art.

In FIG. **1**, an LCD **11** includes a color filter substrate **5**, an array substrate **22**, and a liquid crystal layer **14** interposed between the two substrates **5** and **22**.

The array substrate **22** as a lower substrate includes a data line **15** and a gate line **13** to define a sub-pixel region P, a pixel electrode **17** and a thin film transistor T as a switching element in the sub-pixel region P.

The color filter substrate **5** as an upper substrate includes red, green and blue color filter patterns **8** (R, G and B) corresponding to the respective sub-pixel regions P to display red, green and blue colors, respectively, a black matrix **6** between the adjacent color filter patterns **8**, and a common electrode **18** on the color filter pattern **8** and the black matrix **6**.

In the LCD of FIG. **1**, red, green and blue sub-pixels, which have red, green and blue color filter patterns R, G and B, respectively, constitute one pixel to display color images.

FIG. **2** is a cross-sectional view of an RGB color filter substrate for an LCD according to the related art.

In FIG. **2**, an RGB color filter substrate includes red, green and blue color filter patterns **130***a*, **130***b* and **130***c*, and further includes a black matrix **120** having first, second and third opening **125***a*, **125***b* and **125***c* corresponding to the red, green and blue color filter patterns **130***a*, **130***b* and **130***c*. A planarization layer **140** is disposed on the color filter pattern **130** to planarize the RGB color filter substrate.

Recently, to increase brightness of displayed images, the color filter substrate includes a white color filter pattern as well as red, green and blue color filter patterns.

FIG. **3** is a cross-sectional view of an RGBW color filter substrate for an LCD according to the related art.

In FIG. **3**, the RGBW color filter substrate includes red, green and blue color filter patterns **230***a*, **230***b* and **230***c* like the RGB color filter substrate of FIG. **2**, and further includes a white color filter pattern **230***d*.

FIGS. **4**A to **4**G are cross-sectional views of a fabricating method of an RGBW color filter substrate for an LCD according to the related art.

In FIG. **4**A, a light-shielding material is deposited on a substrate **210** and patterned to form a black matrix **220**. The black matrix **220** includes first, second, third and fourth openings **225***a*, **225***b*, **225***c* and **225***d* corresponding to respective sub-pixel regions.

In FIG. **4**B, a red color resin **229** is deposited on the substrate **210** having the black matrix **220**.

In FIG. **4**C, the red color resin **229** (in FIG. **4**B) is patterned to form a red color filter pattern **230***a* in the first opening **225***a*.

In FIG. **4**D, a green color resin is deposited on the substrate **210** having the red color filter pattern **230***a* and patterned to form a green color filter pattern **230***b* in the second opening **225***b*. In other words, the green color filter pattern **230***b* is formed in a similar method of forming the red color filter pattern **230***a*.

In FIGS. **4**E and **4**F, blue and white color filter patterns **230***c* and **230***d* are formed in the third and fourth openings **225***c* and **225***d* in a similar method of forming the red and green color filter patterns **230***a* and **230***b*.

In FIG. **4**G, a planarization layer **240** is formed on the color filter pattern **230**.

In the fabricating method of the related art RGBW color filter substrate, since the RGBW color filter substrate includes the white color filter pattern, in addition to patterning processes to form red, green and blue color filter patterns, a patterning process is needed to form the white color filter pattern. Therefore, processes and costs to fabricate the color filter substrate increase.

SUMMARY OF THE INVENTION

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

An advantage of the present invention is to provide a substrate for a liquid crystal display and a fabricating method thereof that can reduce fabrication processes and costs.

Additional features and advantages of the present 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 substrate for a liquid crystal display includes a black matrix on a substrate having first, second, third and fourth sub-pixel regions, wherein the black matrix includes first, second, third and fourth openings corresponding to the first, second, third and fourth sub-pixel regions, respectively, first, second and third color filter patterns corresponding to the first, second and third openings, respectively, a first planarization layer on the first, second and third color filter patterns and filling the fourth opening, and a second planarization layer on the first planarization layer.

In another aspect of the present invention, a substrate for a liquid crystal display (LCD) includes a black matrix on a substrate having first, second, third and fourth sub-pixel regions, wherein the black matrix includes first, second, third and fourth openings corresponding to the first, second, third and fourth sub-pixel regions, respectively, at least one dummy pattern in the fourth opening, first, second and third color filter patterns corresponding to the first, second and third openings, respectively, and a planarization layer on the first, second and third color filter patterns and filling the fourth opening.

In yet another aspect of the present invention, a fabricating method of a substrate for a liquid crystal display (LCD) includes forming a black matrix on a substrate having first, second, third and fourth sub-pixel regions, wherein the black matrix includes first, second, third and fourth openings corresponding to the first, second, third and fourth sub-pixel regions, respectively, forming first, second and third color filter patterns corresponding to the first, second and third openings, respectively, forming a first planarization layer on the first, second and third color filter patterns, the first planarization layer filling the fourth opening, and forming a second planarization layer on the first planarization layer.

In still another aspect of the present invention, a fabricating method of a substrate for a liquid crystal display (LCD) includes forming a black matrix on a substrate having first, second, third and fourth sub-pixel regions, wherein the black matrix includes first, second, third and fourth openings corresponding to the first, second, third and fourth sub-pixel regions, respectively, forming at least one dummy pattern in the fourth opening, forming first, second and third color filter patterns corresponding to the first, second and third openings, respectively, and forming a planarization layer on the first, second and third color filter patterns, the planarization layer filling the fourth opening.

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 view of an LCD according to the related art;

FIG. **2** is a cross-sectional view of an RGB color filter substrate for an LCD according to the related art;

FIG. **3** is a cross-sectional view of an RGBW color filter substrate for an LCD according to the related art;

FIGS. **4**A to **4**G are cross-sectional views of a fabricating method of an RGBW color filter substrate for an LCD according to the related art;

FIG. **5** is a cross-sectional view of an RGBW color filter substrate for a liquid crystal display (LCD) according to a first embodiment of the present invention;

FIGS. **6**A to **6**G are cross-sectional views of a fabricating method of an RGBW color filter substrate for an LCD according to the first embodiment of the present invention;

FIG. **7** is a cross-sectional view of an RGBW color filter substrate for an LCD according to a second embodiment of the present invention; and

FIGS. **8**A to **8**F are cross-sectional views of a fabricating method of an RGBW color filter substrate for an LCD according to the second embodiment of the present invention.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

Reference will now be made in detail to embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

First Embodiment

FIG. **5** is a cross-sectional view of an RGBW color filter substrate for a liquid crystal display (LCD) according to a first embodiment of the present invention.

In FIG. **5**, an RGBW color filter substrate includes a black matrix **320** having a opening **325**, a color filter pattern **330**, and first and second planarization layers **340** and **350**.

The black matrix **320** is made of light-shielding material, and corresponds to array patterns such as a thin film transistor, a data line and a gate line in an array substrate to prevent emission of an abnormal light. The opening **325** corresponds to each sub-pixel region defined by a gate line and a data line crossing each other. The opening **325** includes first, second, third and fourth openings **325***a*, **325***b*, **325***c* and **325***d* corresponding to the respective sub-pixel regions, i.e. red, green, blue and white sub-pixel regions, respectively.

The color filter pattern **330** includes red, green and blue color filter patterns **330***a*, **330***b* and **330***c* in the first, second and third openings **325***a*, **325***b* and **325***c*, respectively.

The first planarization layer **340** is disposed on the color filter pattern **330** and fills the fourth opening **325***d*, and the second planarization layer **350** is disposed on the first planarization layer **340**. The first and second planarization layers **340** and **350** planarize the RGBW substrate. Additionally, the first and second planarization layers **340** and **350** corresponding to the fourth opening **325***d* acts as a white color filter pattern to display white color.

Since a separate color filter pattern is not disposed in the fourth opening **325***d*, a surface of the first planarization layer **340** corresponding to the fourth opening **325***d* may be lower than that corresponding to the color filter pattern **330**, and a thickness of the first planarization layer **340** corresponding to the fourth opening **325***d* may be thicker than that corresponding to the color filter pattern **330**. A surface of the second planarization layer **350** corresponding to the fourth opening **325***d* may be substantially equal to that corresponding to the color filter pattern **330**, and a thickness of the second planarization layer **350** corresponding to the fourth opening **325***d* may be thicker than that corresponding to the color filter pattern **330**. Accordingly, the first and second planarization layers **340** and **350** act as a white color filter pattern as well as a layer to planarize the RGBW color filter substrate. Since the first and second planarization layers **340** and **350** act as a white color filter pattern, the first and second planarization layers **340** and **350** may be made of transparent material such as organic material including acrylic.

FIGS. **6**A to **6**G are cross-sectional views of a fabricating method of an RGBW color filter substrate for an LCD according to the first embodiment of the present invention.

In FIG. **6**A, a light-shielding material is deposited on a substrate **310** and patterned to form a black matrix **320**. The black matrix **320** includes first, second, third and fourth openings **325***a*, **325***b*, **325***c* and **325***d* corresponding to red, green, blue and white sub-pixel regions, respectively.

In FIG. **6**B, a red color resin **329** is deposited on the substrate **310** having the black matrix **320**. The red color resin **329** is optical-sensitive material.

In FIG. **6**C, the red color resin **329** (in FIG. **6**B) is patterned to form a red color filter pattern **330***a* in the first opening **325***a*. Since the red color resin is optical-sensitive material, a photoresist needs not in photolithography to pattern the red color resin. In the patterning process for the red color pattern **330***a*, a red color resin is exposed on a light with a photo-mask having a light-transmission portion and a light-blocking portion. When the red color resin is a positive-type resin, a light-exposed portion of which is removed, the light-blocking

portion of the photo-mask corresponds to the first opening **325***a*. On the contrary, when the red color resin is a negative-type resin, a light-exposed portion of which remains, the light-transmission portion of the photo-mask corresponds to the first opening **325***a*.

In FIG. **6**D, a green color resin is deposited on the substrate **310** having the red color filter pattern **330***a* and patterned to form a green color filter pattern **330***b* in the second opening **325***b*. In other words, the green color filter pattern **330***b* is formed in a similar method of forming the red color filter pattern **330***a*.

In FIG. **6**E, blue color filter pattern **330***c* is formed in the third opening **325***c* in a similar method of forming the red and green color filter patterns **330***a* and **330***b*.

In FIG. **6**F, a first planarization layer **340** is formed on the color filter pattern **330**, and fills the fourth opening **325***d*. The first planarization layer **340** may be cured after deposited.

In FIG. **6**G, a second planarization layer **350** is formed on the first planarization layer **340**. The second planarization layer **350** may be cured after deposited.

In the first embodiment of the present invention, instead of a white color filter pattern, first and second planarization layers are used. Accordingly, the patterning process to form a white color filter pattern can be removed. Therefore, processes and costs to fabricate the color filter substrate can be reduced.

Second Embodiment

FIG. **7** is a cross-sectional view of an RGBW color filter substrate for an LCD according to a second embodiment of the present invention.

An RGBW color filter substrate in FIG. **7** is similar to that in FIG. **5**, except for structures in the fourth opening corresponding to the white sub-pixel region. In the second embodiment, explanations of the similar parts to the first embodiment will be omitted.

In FIG. **7**, the RGBW color filter substrate includes a color filter pattern **430** like that in FIG. **5**. However, the RGBW color filter substrate of a second embodiment includes at least one dummy pattern **422** in a fourth opening **425***d*, and one planarization layer **440** instead of the two planarization layers in the first embodiment.

Since the dummy pattern **422** is disposed in the fourth opening **425***d*, the fourth opening **425***d* has a smaller volume than each of other openings **425***a*, **425***b* and **425***c*. Accordingly, instead of the two planarization layers in the first embodiment, the one planarization layer **440** may planarize the RGBW color filter substrate. To fill portions of the fourth opening **425***d*, the dummy pattern **422** may have a thin and thick shape such as a column. The dummy pattern **422** may be made of the same material as a black matrix **420**. The dummy pattern **422** may have a width thinner than the black matrix **420**. Accordingly, a surface of the planarization layer **440** corresponding to the fourth opening **425***d* may be substantially equal to that corresponding to the color filter pattern **430**, and a thickness of the second planarization layer **440** corresponding to the fourth opening **425***d* may be thicker than that corresponding to the color filter pattern **430**

FIGS. **8**A to **8**F are cross-sectional views of a fabricating method of an RGBW color filter substrate for an LCD according to the second embodiment of the present invention. A fabricating method of the second embodiment is similar to that of the first embodiment, except for structures in the fourth opening corresponding to the white sub-pixel region.

In FIG. **8**A, a light-shielding material is deposited on a substrate **410** and patterned to form a black matrix **420** and at least one dummy pattern **422**. The black matrix **420** includes first, second, third and fourth openings **425***a*, **425***b*, **425***c* and **425***d* corresponding to red, green, blue and white sub-pixel regions, respectively, and the dummy pattern **422** is disposed in the fourth opening **425***d*.

In FIGS. **8**B to **8**E, in a method similar to the first embodiment, red, green and blue color filter patterns **430***a*, **430***b* and **430***c* are formed in the first, second and third openings **425***a*, **425***b* and **425***c*, respectively.

In FIG. **8**F, a planarization layer **440** is formed on the color filter pattern **430** to planarize the color filter pattern **430**, and fills the fourth opening **425***d* having the dummy pattern **422**.

In the second embodiment of the present invention, instead of a white color filter pattern, a dummy pattern is employed in the same process of forming the black matrix, and thus one planarization layer is enough to planarize the RGBW color filter substrate. Accordingly, patterning process to form a white color filter pattern can be removed. Therefore, processes and costs to fabricate the color filter substrate can be reduced.

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

What is claimed is:

1. A substrate for a liquid crystal display (LCD), comprising:

a black matrix on a substrate having first, second, third and fourth sub-pixel regions, wherein the black matrix includes first, second, third and fourth openings corresponding to the first, second, third and fourth sub-pixel regions, respectively;

at least one dummy pattern in the fourth opening, wherein the at least one dummy pattern is made of the same material as the black matrix;

first, second and third color filter patterns corresponding to the first, second and third openings, respectively; and

a planarization layer on the first, second and third color filter patterns and filling the fourth opening,

wherein a total area of the dummy pattern is smaller than an area of the fourth opening excluding the dummy pattern.

2. The substrate according to claim **1**, wherein a surface of the planarization layer corresponding to the fourth opening is substantially equal to a surface of the planarization layer corresponding to the first, second and third openings.

3. The substrate according to claim **1**, wherein the planarization layer is made of transparent organic material.

4. The substrate according to claim **3**, wherein the transparent organic material includes acrylic.

5. The substrate according to claim **1**, wherein the first, second and third color filter patterns are made of red, green and blue color resins, respectively.

6. The substrate according to claim **1**, wherein a width of the at least one dummy pattern is thinner than that of the black matrix.

7. A fabricating method of a substrate for a liquid crystal display (LCD), comprising:

forming a black matrix on a substrate having first, second, third and fourth sub-pixel regions, wherein the black matrix includes first, second, third and fourth openings corresponding to the first, second, third and fourth sub-pixel regions, respectively;

forming at least one dummy pattern in the fourth opening, wherein the at least one dummy pattern is made of the same material as the black matrix;

forming first, second and third color filter patterns corresponding to the first, second and third openings, respectively; and

forming a planarization layer on the first, second and third color filter patterns, the planarization layer filling the fourth opening,

wherein a total area of the dummy pattern is smaller than an area of the fourth opening excluding the dummy pattern.

8. The method according to claim **7**, wherein a surface of the planarization layer corresponding to the fourth opening is substantially equal to a surface of the planarization layer corresponding to the first, second and third openings.

9. The method according to claim **7**, wherein the planarization layer is made of transparent organic material.

10. The method according to claim **9**, wherein the transparent organic material includes acrylic.

11. The method according to claim **7**, wherein the first, second and third color filter patterns are made of red, green and blue color resins, respectively.

12. The method according to claim **7**, wherein a width of the at least one dummy pattern is thinner than that of the black matrix.

* * * * *

专利名称(译)	用于液晶显示器的基板及其制造方法		
公开(公告)号	US7515225	公开(公告)日	2009-04-07
申请号	US11/011066	申请日	2004-12-15
[标]申请(专利权)人(译)	朴钟金		
申请(专利权)人(译)	朴钟金		
当前申请(专利权)人(译)	LG DISPLAY CO.，LTD.		
[标]发明人	PARK JONG JIN		
发明人	PARK, JONG-JIN		
IPC分类号	G02F1/1335 G02F1/1343 G02B5/20 G02F1/133 G02F1/1333		
CPC分类号	G02F1/1333 G02F1/133512 G02F1/133516 G02F2001/133357		
审查员(译)	NGUYEN，龚便T.		
优先权	1020030095717 2003-12-23 KR		
其他公开文献	US20050134788A1		
外部链接	Espacenet USPTO		

摘要(译)

用于液晶显示器的基板包括在具有第一，第二，第三和第四子像素区域的基板上的黑矩阵，其中黑矩阵包括对应于第一，第二，第三和第四子像素的第一，第二，第三和第四开口子像素区域，分别对应于第一，第二和第三开口的第一，第二和第三滤色器图案，第一，第二和第三滤色器图案上的第一平坦化层和填充第四开口，以及第二，第二，第二和第三滤色器图案第一平坦化层上的平坦化层。