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(54) **COLOR FILTER AND IN PLANE SWITCHING TYPE LIQUID CRYSTAL DISPLAY USING THE SAME**

(75) Inventors: **Sheng-Shiou Yeh**, Miao-Li (TW); **Mei Ling Wu**, Miao-Li (TW); **Jia-Pang Pang**, Miao-Li (TW)

Correspondence Address:
WEI TE CHUNG
FOXCONN INTERNATIONAL, INC.
1650 MEMOREX DRIVE
SANTA CLARA, CA 95050 (US)

(73) Assignee: **INNOLUX DISPLAY CORP.**

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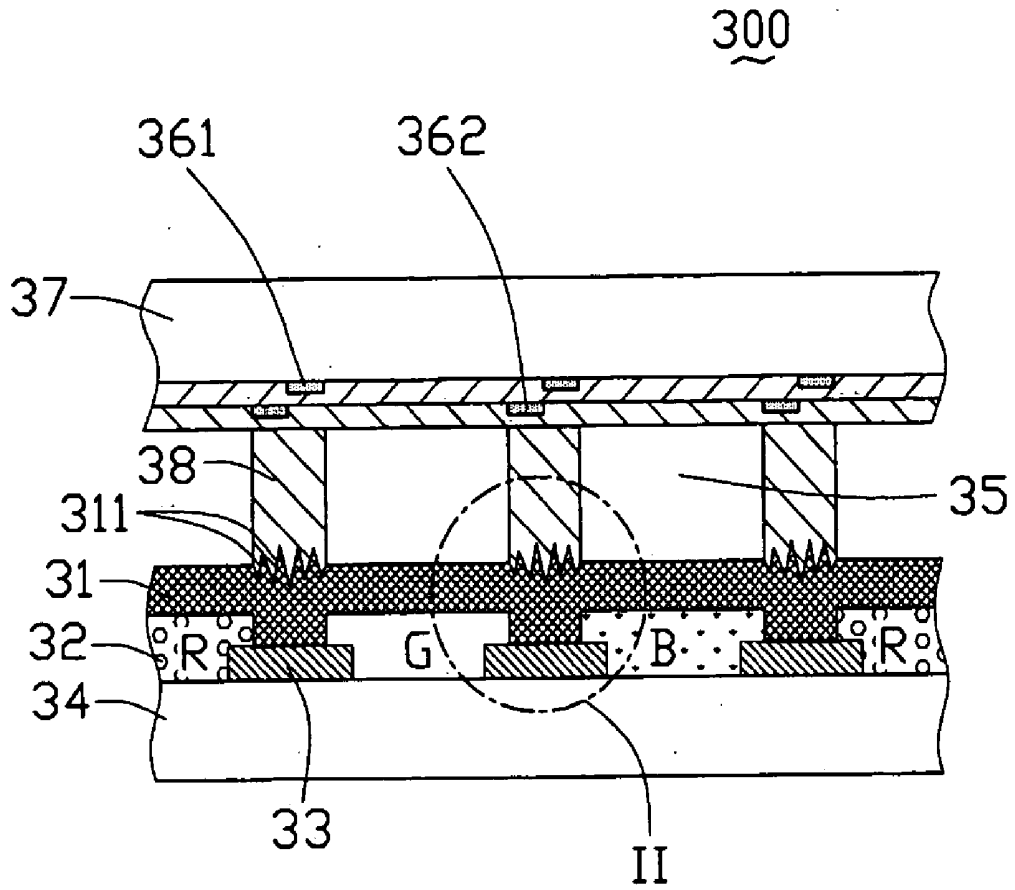
(57) **ABSTRACT**

A color filter includes a substrate, a black matrix located on the substrate, a color layer formed on the substrate, and an over coat layer formed on the substrate to cover the black matrix and the color layer. A plurality of photo spacers are located corresponding to the black matrix, and engage with the over coat layer tightly. Therefore, an IPS LCD using the above-mentioned color filter has a steady configuration, and a cell gap of the LCD is consistent.



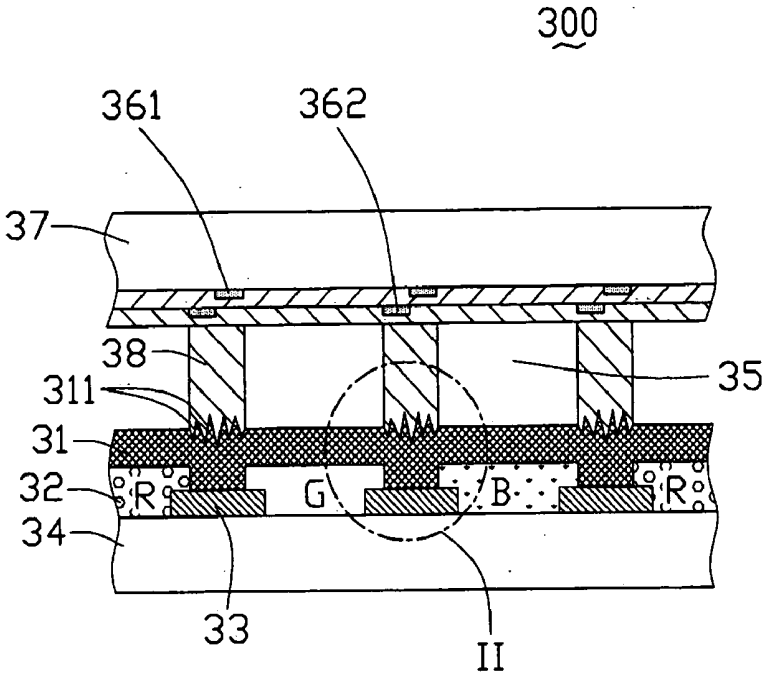


FIG. 1

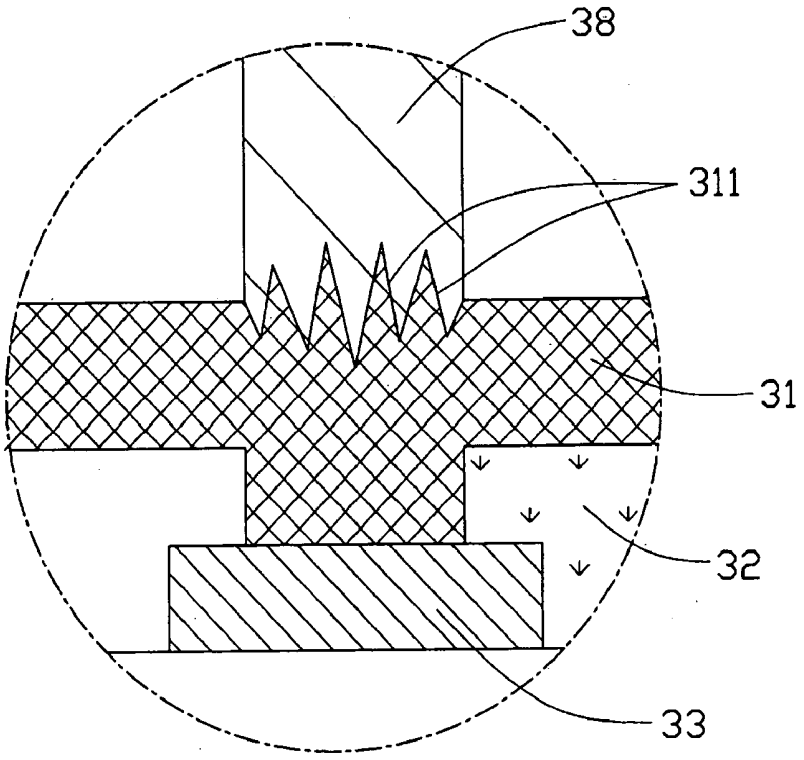


FIG. 2

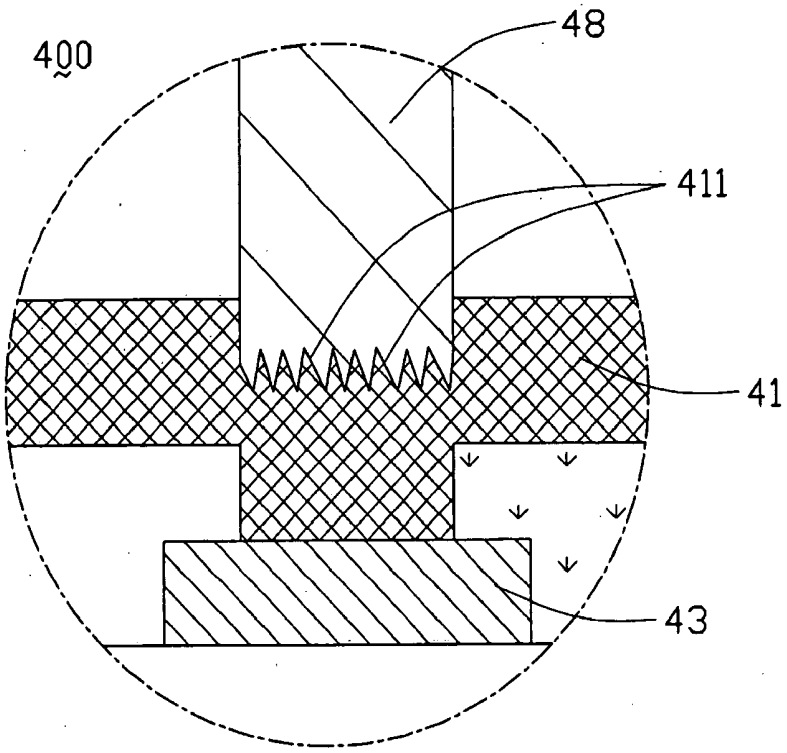


FIG. 3

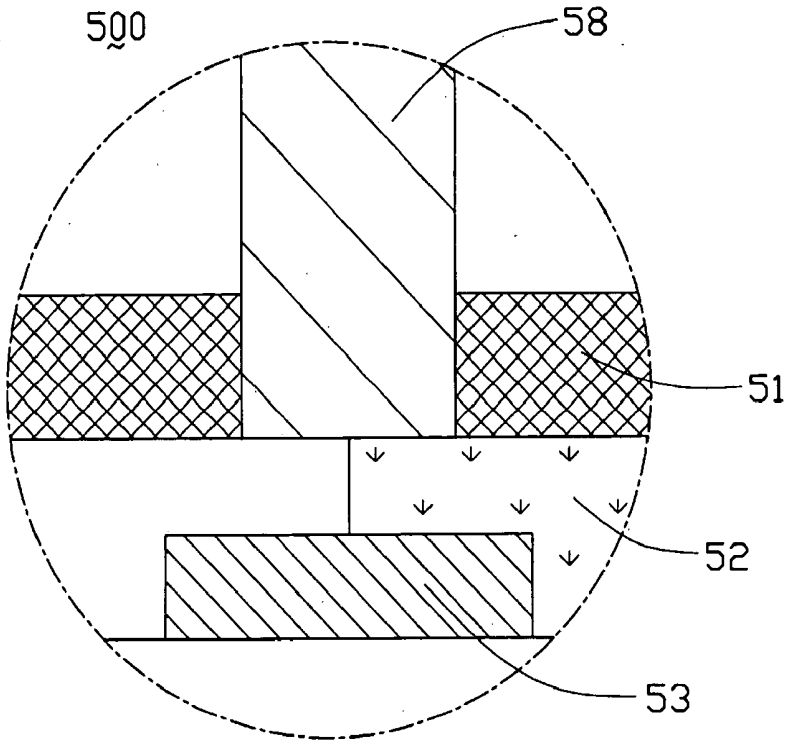


FIG. 4

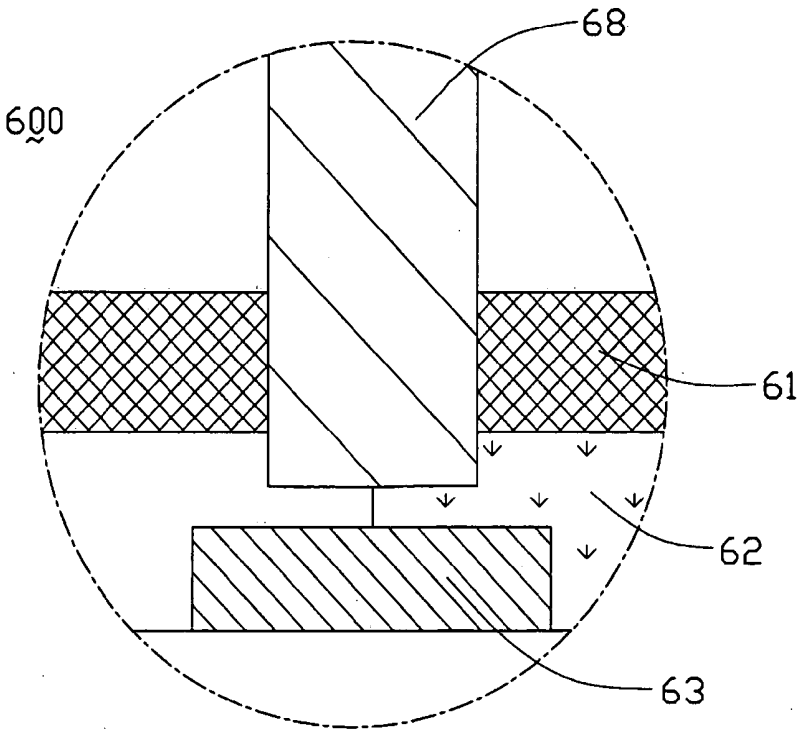


FIG. 5

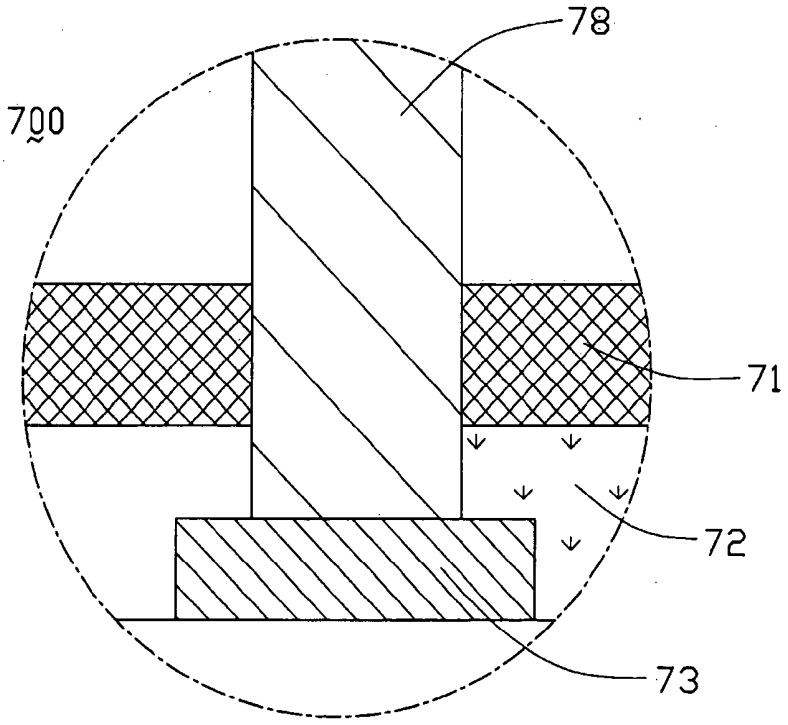


FIG. 6

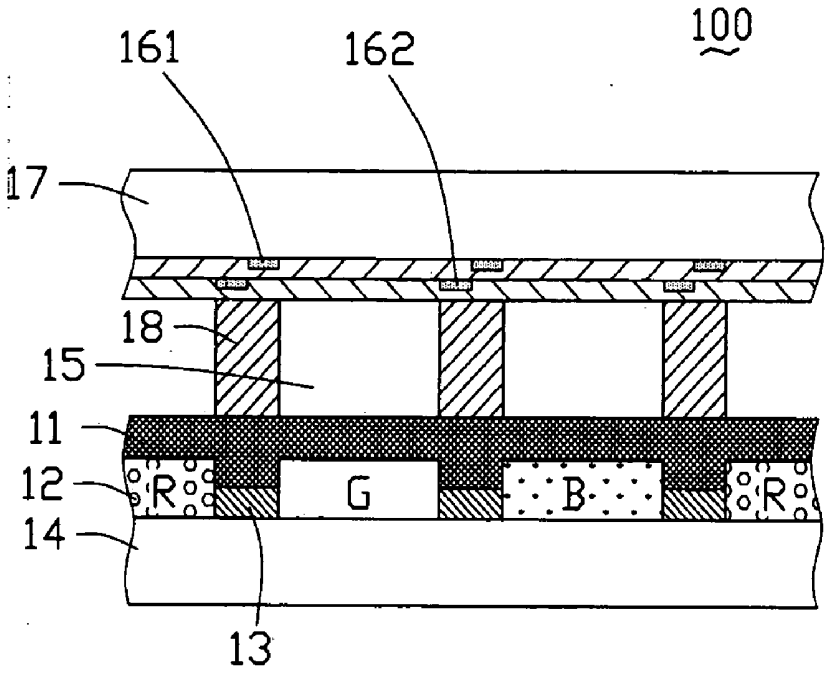


FIG. 7
(PRIOR ART)

COLOR FILTER AND IN PLANE SWITCHING TYPE LIQUID CRYSTAL DISPLAY USING THE SAME

BACKROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a liquid crystal display, and more particularly to an IPS-LCD (in-plane switching liquid crystal display) having photo spacers.

[0003] 2. Description of Prior Art

[0004] In a conventional liquid crystal display, a pair of facing transparent electrodes are respectively formed on two substrates, and are used for driving a liquid crystal layer therebetween. In such a device, a displaying means known as a TN (twisted nematic) display is adopted. That is, the liquid crystal display operates by being supplied with an electric field having a direction orthogonal to inner surfaces of the substrates.

[0005] However, the TN mode LCD has a narrow viewing angle. When the user views the display from beyond a threshold viewing angle, he/she cannot see the normal display. That is, the quality of the display greatly depends on the direction of viewing. In order to obtain a wide viewing angle, the IPS type LCD has been developed.

[0006] A detailed explanation about the configuration of a typical IPS-LCD device is provided hereinbelow, with reference to **FIG. 7**.

[0007] **FIG. 7** is a schematic, side cross-sectional view of part of a conventional IPS-LCD. The IPS-LCD **100** comprises a color filter substrate **14** and a TFT substrate **17** spaced apart from each other, a liquid crystal layer **15** including liquid crystal molecules (not labeled) sandwiched between the substrates **14**, **17**, and a plurality of photo spacers **18** disposed between the substrates **14**, **17** for supporting the IPS-LCD **100** and maintaining the space between the substrates **14**, **17**. A plurality of pixel electrodes **162** and a plurality of common electrodes **161** are formed on the lower substrate **17**, for generating an electric field to drive the liquid crystal molecules.

[0008] A structure of a color filter of the IPS-LCD **100** includes the substrate **14**, a black matrix **13** having a plurality of holes (not shown), a color layer **12**, and an over coat layer **11** covering the black matrix **13** and the color layer **12**. The photo spacers **18** are formed on the over coat layer **11** and surrounded by the liquid crystal molecules.

[0009] When a voltage is applied to the pixel and common electrodes **162** and **161**, a horizontal in-plane electric field that is parallel to a surface of the TFT substrate **17** is established between the pixel and common electrodes **162** and **161**. The liquid crystal molecules are twisted so as to align according to the electric field. That is, the long axes of the liquid crystal molecules are oriented perpendicular to the pixel and common electrodes **162** and **161**.

[0010] According to the configuration of the IPS-LCD **100**, the photo spacers **18** are directly formed on the over coat layer **11**. The over coat layer **11** is mainly made of a negative photoresist, which is similar to the material used for fabricating the photo spacers **18**. Therefore the adhesive strength between the over coat layer **11** and the photo spacers **18** is weak. The photo spacers **18** adhered to the over coat layer **11** are liable to peel off. In summary, the configuration is not steady, and cannot ensure that the cell gap of the LCD **100** is consistent and reliable. Accordingly, the display characteristics of the LCD **100** may be impaired.

[0011] It is desired to provide an improved IPS type LCD which overcomes the above-described deficiencies.

SUMMARY OF THE INVENTION

[0012] An object of the present invention to provide an IPS-LCD having a steady configuration, a consistent cell gap, and a good display.

[0013] In order to achieve the object set out above, an IPS-LCD in accordance with the present invention includes opposite first and second substrates in a spatial parallel relation, a liquid crystal layer having liquid crystal molecules interposed between the first and second substrates, and a plurality of photo spacers formed between the first and second substrates for supporting a space therebetween. The first substrate includes a black matrix, a color filter layer, and an over coat layer coated on the black matrix and the color filter layer. The plurality of photo spacers are engaged with the over coat layer tightly and located corresponding to the black matrix. The second substrate includes a first electrode matrix and a second electrode matrix, for generating an electric field to drive the liquid crystal molecules.

[0014] Unlike in a conventional LCD, the photo spacers according to the present invention are formed corresponding to the black matrix and engaged with the over coat layer tightly. Thus the LCD has a steady configuration, with the photo spacers resisting peeling off from the first substrate. In addition, the steady configuration ensures that all the photo spacers have the same height, so that the LCD has a consistent cell gap. This yields good display characteristics.

[0015] Other objects, advantages, and novel features of the present invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] **FIG. 1** is a schematic, side cross-sectional view of part of an LCD according to a first embodiment of the present invention.

[0017] **FIG. 2** is an enlarged view of a circled portion II of **FIG. 1**.

[0018] **FIG. 3** is an enlarged view of part of an LCD according to a second embodiment of the present invention, showing a photo spacer extending into an over coat layer.

[0019] **FIG. 4** is an enlarged view of part of an LCD according to a third embodiment of the present invention, showing a photo spacer abutting a color filter.

[0020] **FIG. 5** is an enlarged view of part of an LCD according to a fourth embodiment of the present invention, showing a photo spacer extending into a color filter.

[0021] **FIG. 6** is an enlarged view of part of an LCD according to a fifth embodiment of the present invention, showing a photo spacer abutting a black matrix.

[0022] **FIG. 7** is a schematic, side cross-sectional view of part of a conventional LCD.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

[0023] **FIG. 1** is a schematic, side cross-sectional view of part of an IPS-LCD **300** according to the first embodiment of the present invention. The LCD **300** includes a transparent first substrate **34**, a transparent second substrate **37** opposite to the first substrate **34**, a liquid crystal layer **35** including liquid crystal molecules (not labeled) sandwiched between the substrates **34** and **37**, and a plurality of photo spacers **38** formed between the substrates **34** and **37** for supporting the LCD **300** and maintaining the space between the substrates **34** and **37**. The substrates **34** and **37** are called a color filter substrate and a TFT (thin film transistor) substrate respectively, and are parallel to each other.

[0024] A plurality of pixel electrodes **362** and a plurality of common electrodes **361** are formed on a surface of the second substrate **37** that faces the first substrate **34**. The electrodes **362** and **361** are used for generating an electric field to drive the liquid crystal molecules.

[0025] **FIG. 1** also shows a structure of a color filter of the present invention, which includes the substrate **34**, a black matrix **33** formed on the substrate **34**, a color layer **32** also formed on the substrate **34**, and an over coat layer **31** covering the black matrix **33** and the color layer **32**. The color layer **32** comprises three primary color resists of red (R), green (G), and blue (B). The black matrix **33** includes a plurality of holes (not labeled) that are arranged in an array. The three primary color resists are coated in the holes in a repeating pattern.

[0026] Also referring to **FIG. 2**, this is an enlarged view of a circled portion II of **FIG. 1**. A plurality of rough regions **311** of the over coat layer **31** is formed according to positions of the photo spacers **38** adhered on the over coat layer **31**. The location of each photo spacer **38** corresponds to the black matrix **33**, and the photo spacer **38** is adhered on the corresponding rough region **311** of the over coat layer **31**. A plurality of protrusions is formed on the surface of each rough region **311**. During the process of forming the photo spacers **38**, a bottom surface (not labeled) of each photo spacer **38** fittingly interlocks between the protrusions, so that the photo spacers **38** tightly engage with the over coat layer **31**. The photo spacers **38** and the over coat layer **31** can each be made from a positive or a negative photoresist.

[0027] When a voltage is applied between the pixel and common electrodes **362** and **361**, a horizontal in-plane electric field that is parallel to a surface of the second substrate **37** is established between the pixel and common electrodes **362** and **361**. The liquid crystal molecules are twisted so as to align according to the electric field. That is, the long axes of the liquid crystal molecules are oriented perpendicular to the pixel and common electrodes **362** and **361**.

[0028] In summary, the rough regions **311** of the over coat layer **31** strengthen the adhesive bonding between the photo spacers **38** and the over coat layer **31**. Accordingly, the LCD **300** has a steady, reliable configuration, and a cell gap of the LCD **300** remains consistent.

[0029] **FIG. 3** is an enlarged view of part of an IPS-LCD **400** according to the second embodiment of the present invention. The LCD **400** has a configuration similar to the LCD **300** of the first embodiment. However, a plurality of photo spacers **48** is formed corresponding to a black matrix **43**, with the photo spacers **48** extending into the over coat layer **41**. That is, a bottom end (not labeled) of each photo spacer **48** is embedded in the over coat layer **41**. A plurality of rough regions **411** of the over coat layer **41** is formed according to positions of the photo spacers **48** adhered on the over coat layer **41**. During the process of forming the photo spacers **48**, a bottom end (not labeled) of each photo spacer **48** fittingly interlocks in the over coat layer **41**, so that the photo spacers **48** tightly engage with the over coat layer **41**.

[0030] **FIG. 4** is an enlarged view of part of an IPS-LCD **500** according to the third embodiment of the present invention. The LCD **500** has a configuration similar to the LCD **300** of the first embodiment. However, the three color resists of red (R), green (G), and blue (B) are formed in a continuous manner such that a color layer **52** completely covers a black matrix **53**. Photo spacers **58** are formed corresponding to the black matrix **53**. Each photo spacer **58** extends through an over coat layer **51** and abuts the color layer **52**. A bottom end (not labeled) of each photo spacer **58** fittingly interlocks between the over coat layer **51** and the color layer **52**, so that the photo spacers **58** tightly engage with the over coat layer **51** and the color layer **52**.

[0031] **FIG. 5** is an enlarged view of part of an IPS-LCD **600** according to the fourth embodiment of the present invention. The LCD **600** has a configuration similar to the LCD **500** of the third embodiment. However, photo spacers **68** are formed corresponding to a black matrix **63**, with each photo spacer **68** extending into a color layer **62**. A bottom end (not labeled) of each photo spacer **68** fittingly interlocks between the over coat layer **61** and the color layer **62**, so that the each photo spacers **68** tightly engage with the over coat layer **61** and the color layer **62**.

[0032] **FIG. 6** is an enlarged view of part of an IPS-LCD **700** according to the fifth embodiment of the present invention. The LCD **700** has a configuration similar to the LCD **500** of the third embodiment. However, photo spacers **78** are formed corresponding to a black matrix **73**, with each photo spacer **78** extending through an over coat layer **71** and a color layer **72** and abutting the black matrix **73**. A bottom end (not labeled) of each photo spacer **78** fittingly interlocks between the over coat layer **71**, color layer **72** and the black matrix **73**, so that the photo spacers **78** tightly engage with the over coat layer **61**, the color layer **72** and the black matrix **73**.

[0033] Compared with the conventional IPS-LCD **100** of the prior art, the photo spacers of the present invention are formed corresponding to the black matrix, and are tightly engaged with the over coat layer. Therefore the LCD has a steady configuration, and the photo spacers resist peeling away from the color filter substrate. In addition, the steady configuration ensures that all the photo spacers have the same height, which gives the LCD a consistent cell gap. This yields good display characteristics.

[0034] It is to be understood, however, that even though numerous characteristics and advantages of the present invention have been set out in the foregoing description, together with details of the structure and function of the invention, the disclosure is illustrative only, and changes may be made in detail, especially in matters of shape, size,

and arrangement of parts within the principles of the invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.

What is claimed is:

1. A color filter, comprising:

a substrate;

a black matrix provided on the substrate, the black matrix defining a plurality of holes therein;

a color layer formed on the substrate;

an over coat layer formed over the substrate to cover the black matrix and the color layer; and

a plurality of photo spacers located corresponding to the black matrix and engaged with the over coat layer.

2. The color filter as claimed in claim 1, wherein the over coat layer defines a plurality of regions corresponding to the photo spacers.

3. The color filter as claimed in claim 2, wherein the over coat layer comprises a plurality of protrusions at the regions.

4. The color filter as claimed in claim 3, wherein the photo spacers interlock with the protrusions.

5. The color filter as claimed in claim 1, wherein each of the photo spacers extends into the over coat layer, and an end of the photo spacer is embedded in the over coat layer.

6. The color filter as claimed in claim 5, wherein the over coat layer defines a plurality of regions corresponding to the photo spacers.

7. The color filter as claimed in claim 6, wherein the over coat layer comprises a plurality of protrusions at the regions.

8. The color filter as claimed in claim 7, wherein the ends of the photo spacers interlock with the protrusions.

9. The color filter as claimed in claim 1, wherein the color layer covers the black matrix, each of the photo spacers extends through the over coat layer and abuts the color layer, and an end of the photo spacer is interlocked between the over coat layer and the color layer.

10. The color filter as claimed in claim 1, wherein the color layer covers the black matrix, each of the photo spacers extends through the over coat layer into the color layer, and an end of the photo spacer is interlocked between the over coat layer and the color layer.

11. The color filter as claimed in claim 1, wherein each of the photo spacers extends through the over coat layer and the color layer and abuts the black matrix, and an end of the photo spacer is interlocked between the over coat layer, the color layer and the black matrix.

12. An in-plane switching type liquid crystal display, comprising:

a first substrate having a black matrix and a color layer, and an over coat layer coated on the black matrix and the color layer;

a second substrate parallel to and spaced from the first substrate, the second substrate having a first electrode matrix and a second electrode matrix for generating a driving electric field;

a liquid crystal layer comprising liquid crystal molecules interposed between the first and second substrates; and

a plurality of photo spacers provided between the first and second substrates for supporting a space therebetween, wherein the photo spacers located corresponding to the black matrix and are engaged with the over coat layer.

13. The in-plane switching type liquid crystal display as claimed in claim 12, wherein the over coat layer defines a plurality of regions corresponding to the photo spacers, the regions have a plurality of protrusions, and the photo spacers interlock with the protrusions.

14. The in-plane switching type liquid crystal display as claimed in claim 12, wherein each of the photo spacers extends into the over coat layer, the over coat layer defines a plurality of regions corresponding to the photo spacers, the regions have a plurality of protrusions, and the photo spacers interlock with the protrusions.

15. The in-plane switching type liquid crystal display as claimed in claim 12, wherein the color layer covers the black matrix, each of the photo spacers extends through the over coat layer and abuts the color layer, and an end of the photo spacer is interlocked between the over coat layer and the color layer.

16. The in-plane switching type liquid crystal display as claimed in claim 12, wherein the color layer cover the black matrix, each of the photo spacers extends through the over coat layer into the color layer, and an end of the photo spacer is interlocked between the over coat layer and the color layer.

17. The in-plane switching type liquid crystal display as claimed in claim 12, wherein each of the photo spacers extends through the over coat layer and the color layer and abuts the black matrix, and an end of the photo spacer is interlocked between the over coat layer, the color layer and the black matrix.

18. A color filter, comprising:

a substrate;

a black matrix provided on the substrate;

a color layer formed on the substrate;

an over coat layer formed over the substrate to cover the black matrix and the color layer; and

a plurality of photo spacers located on the over coat layer opposite to and essentially aligned with said black matrixes, wherein

said spacers define portions extending toward the corresponding black matrixes to be engaged with the over coat layer at least in a horizontal direction.

* * * * *

专利名称(译)	滤色器和使用该滤色器的平面转换型液晶显示器		
公开(公告)号	US20050146669A1	公开(公告)日	2005-07-07
申请号	US11/026630	申请日	2004-12-30
[标]申请(专利权)人(译)	群创光电股份有限公司		
申请(专利权)人(译)	群创光电股份有限公司.		
当前申请(专利权)人(译)	群创光电		
[标]发明人	YEH SHENG SHIOU WU MEI LING PANG JIA PANG		
发明人	YEH, SHENG-SHIOU WU, MEI LING PANG, JIA-PANG		
IPC分类号	G02F1/1335 G02F1/1339 G02F1/1343		
CPC分类号	G02F1/13394		
优先权	093100048 2004-01-02 TW		
其他公开文献	US7375776		
外部链接	Espacenet USPTO		

摘要(译)

滤色器包括基板，位于基板上的黑色矩阵，形成在基板上的彩色层，以及形成在基板上以覆盖黑色矩阵和彩色层的外涂层。多个光间隔物对应于黑色矩阵定位，并与外涂层紧密接合。因此，使用上述滤色器的IPS LCD具有稳定的配置，并且LCD的单元间隙是一致的。