US 20040141118A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2004/0141118 A1**

Chang et al. (43) **Pub. Date: Jul. 22, 2004**

(54) **LIQUID CRYSTAL DISPLAY DEVICE**

(75) Inventors: **Shih-Chang Chang**, Hsinchu (TW); **Yaw-Ming Tsai**, Taichung (TW)

Correspondence Address:
LOWE HAUPTMAN GILMAN AND BERNER, LLP
1700 DIAGONAL ROAD
SUITE 300 /310
ALEXANDRIA, VA 22314 (US)

(73) Assignee: **TOPPOLY OPTOELECTRONICS CORP.**

(21) Appl. No.: **10/347,410**

(22) Filed: **Jan. 21, 2003**

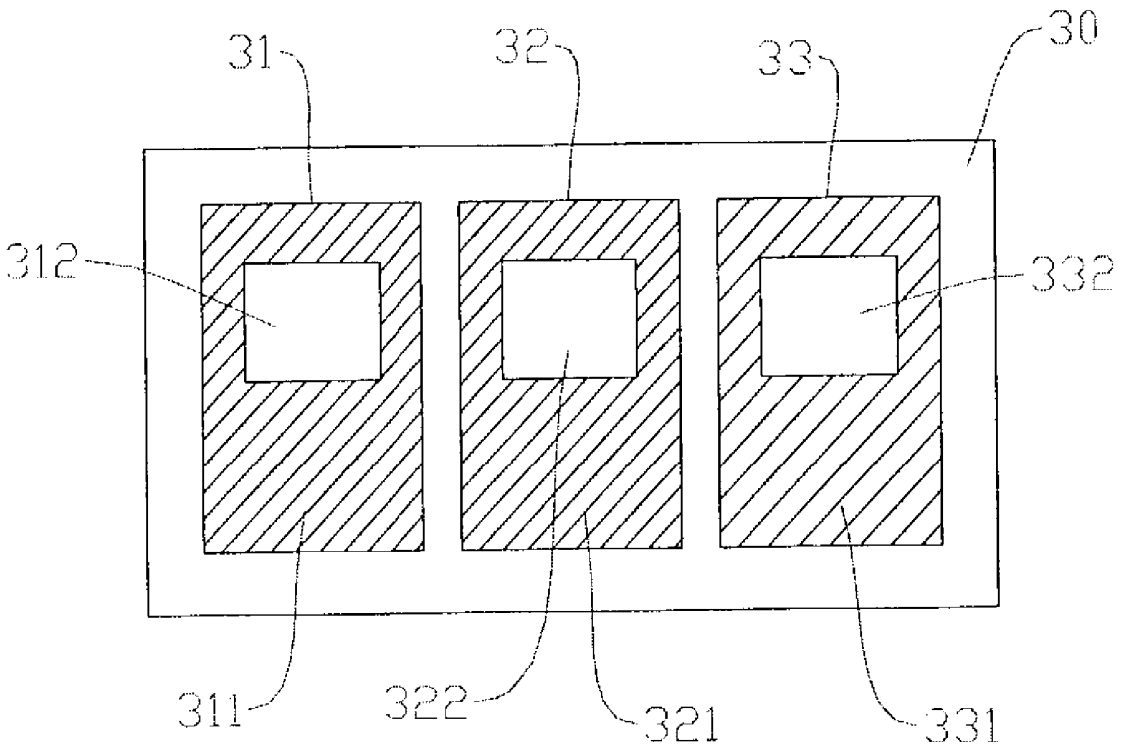
Publication Classification

(51) **Int. Cl.**[7] **G02F 1/1335**

(52) **U.S. Cl.** **349/114**

(57) **ABSTRACT**

This invention relates to a liquid crystal display (LCD) device having the best performance of contrast ratio and color saturation in the transmissive and reflective areas of color LCD by adjusting the thicknesses of two color filters on the lower and upper transparent substrates. The present invention includes a first substrate having a reflective area and a transmissive area, and a plurality of thin film transistors (TFTs) thereon; a dielectric layer on said first substrate; a first color filter on said dielectric layer; an elevated dielectric layer on said first color filter in said reflective area; a first electrode on said elevated dielectric layer in said reflective area and on said first color filter in said transmissive area, wherein the top surface of said first electrode in said reflective area is higher than the top surface of said first electrode in said transmissive area; a liquid crystal layer on said first electrode; a second electrode on said liquid crystal layer; a second color filter on said second electrode; and a second substrate on said second color filter.



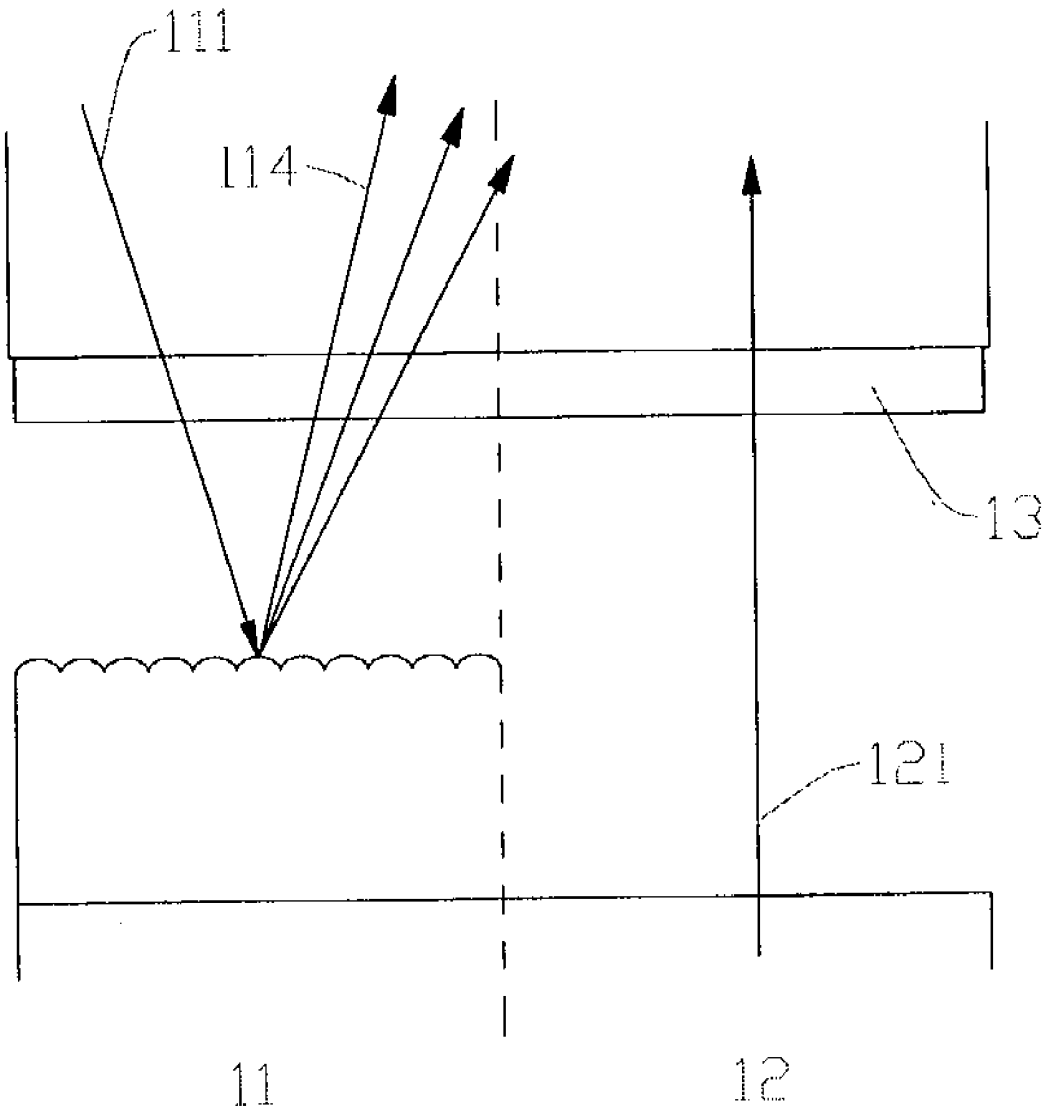


FIG.1 (PRIOR ART)

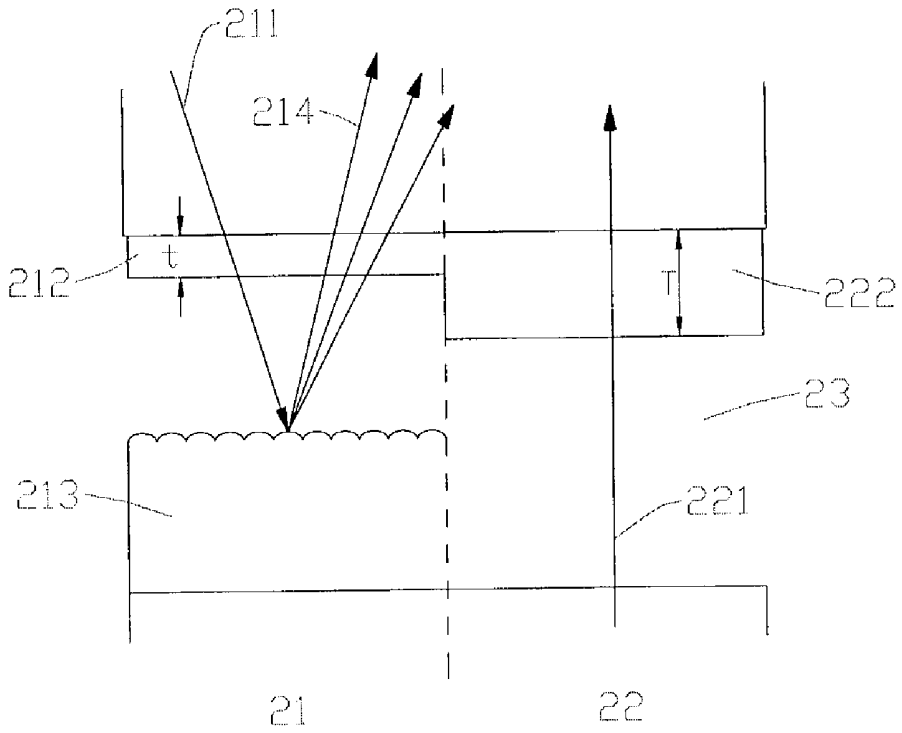


FIG.2A (PRIOR ART)

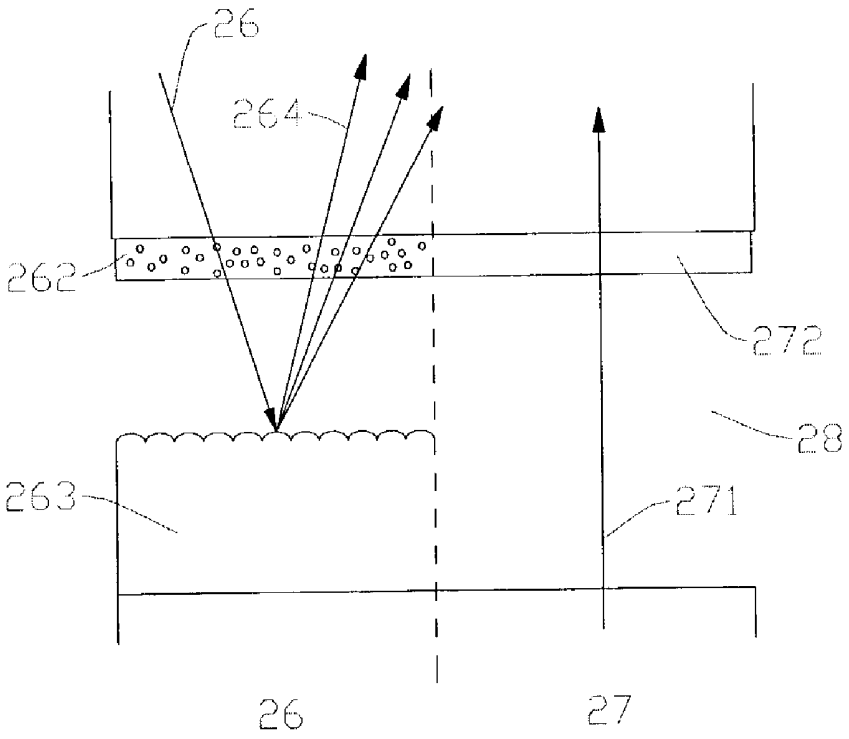


FIG.2B (PRIOR ART)

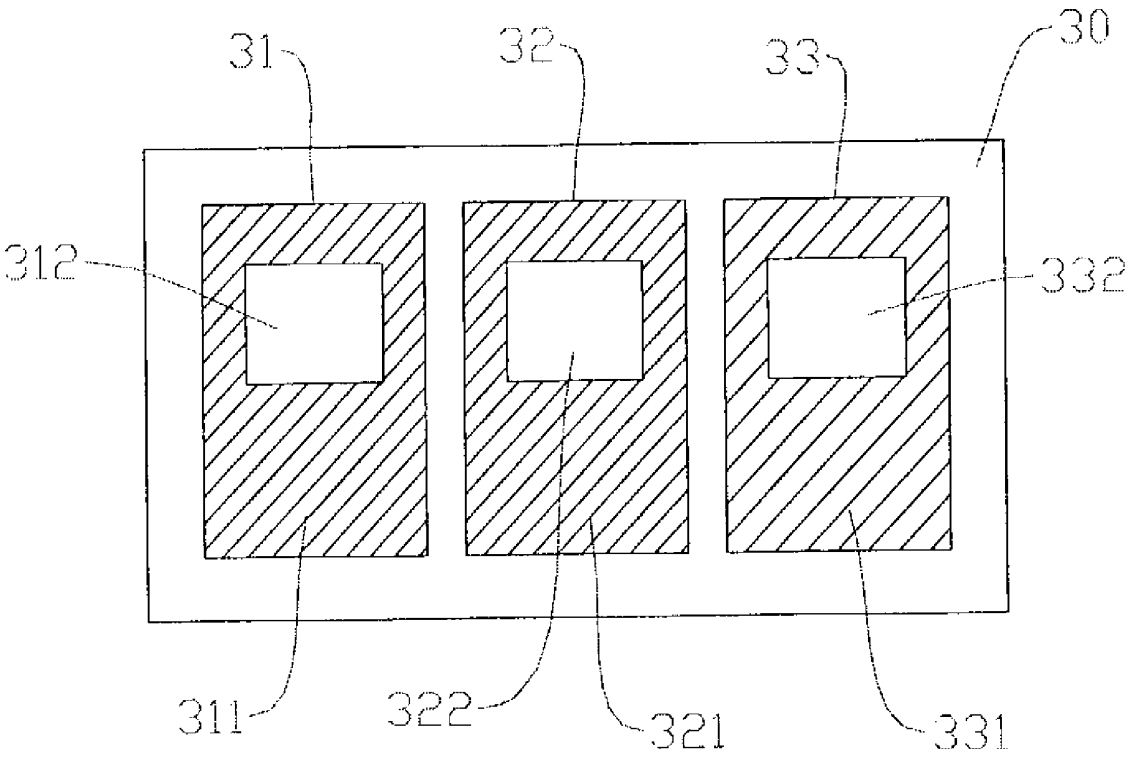


FIG.3

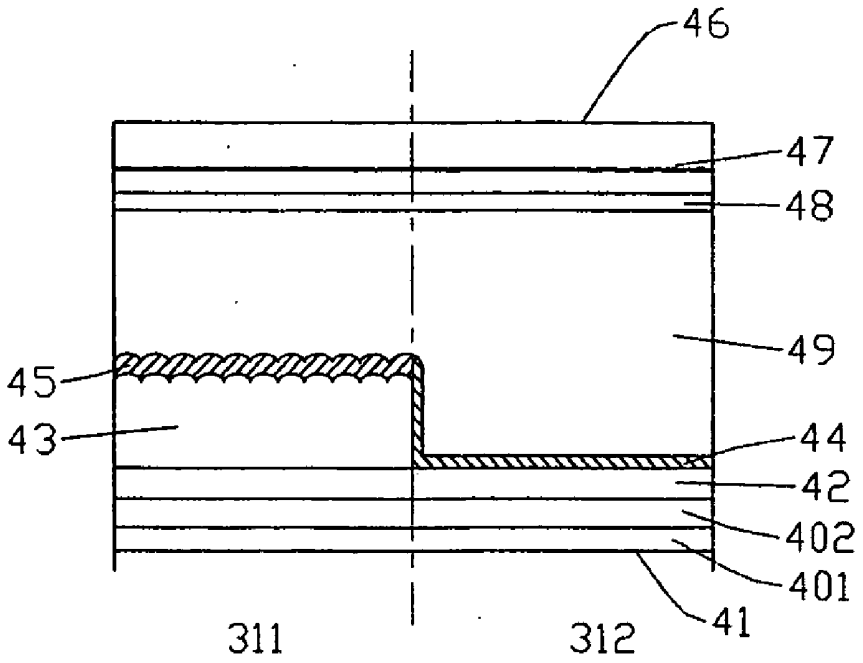

46
47
48
49
45
43
44
42
402
401
41
311
312

FIG.4

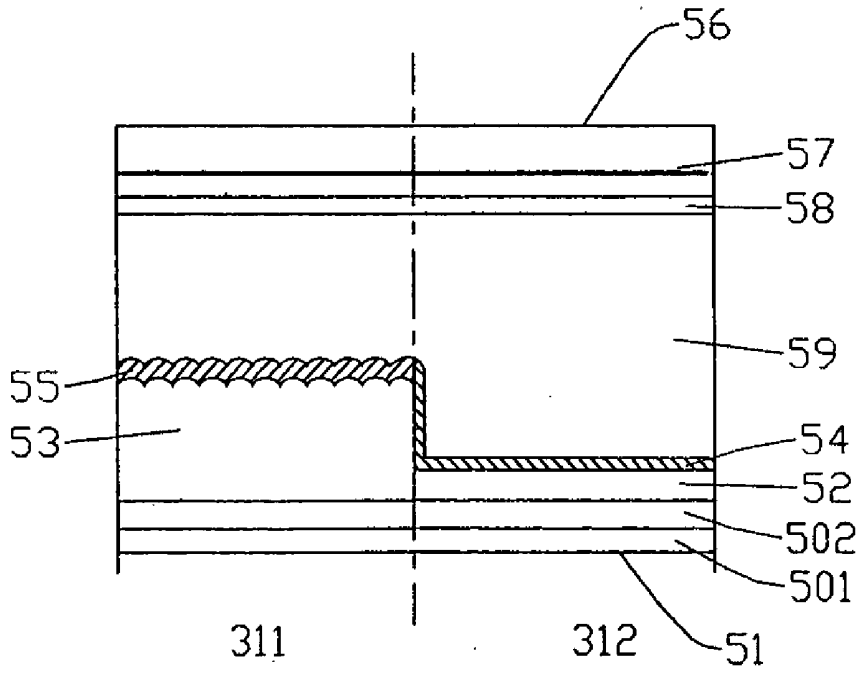

56
57
58
59
55
53
54
52
502
501
51
311
312

FIG.5

LIQUID CRYSTAL DISPLAY DEVICE

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The invention is relates to a liquid crystal display (LCD) device, more particularly to a liquid crystal display device having the best performance of contrast ratio and color saturation in the transmissive and reflective areas of color LCD by adjusting the thicknesses of two color filters on the lower and upper transparent substrates.

[0003] 2. Description of the Prior Art

[0004] A color LCD [liquid crystal display] panel comprises two transparent substrates and a liquid crystal layer between the substrates. In general, a color filter is only placed on the transparent substrate opposite to TFTs (thin film transistors). It means that the color filter and TFTs are placed on different transparent substrates respectively opposite to each other.

[0005] For the transmissive-type or reflective-type color LCD, the presented color saturation is identical because the distance for light rays passing through a color filter in the whole liquid crystal panel is the same. But for the transflective-type color LCD, please refer to **FIG. 1**, when external light rays are sufficient to display figures or pictures on the screen, the color LCD will use external light rays **111** as the light source according to the reflection theory. So light rays pass through the color filter **13** twice in the reflective area **11**, which will present the higher color saturation. When external light rays are insufficient to display figures or pictures on the screen, the color LCD will use its back light (BL) source according to the transmissive theory. Then the light rays **121** pass through the color filter **13** once in the transmissive area **12**, which will present the lower color saturation in comparison to the reflective area **11**.

[0006] Because of the above reasons, when the transflective-type color LCD uses both of the transmissive and reflective display modes at the same time, the problem of different color saturation is produced. The methods that have been practically used in the industry are illustrated in **FIG. 2A** and **FIG. 2B**. A method that the color filter in the reflective area **21** is thinner than the color filter in the transmissive area **22** is adopted. The reflective area **21** is in the left side of **FIG. 2A** and the transmissive area **22** is in the right side of **FIG. 2A**. If external light rays **211**, as the light source, are sufficient to display figures and pictures on the screen, the light rays **211** of the reflective area **21** will pass through the color filter **212** and be reflected by the reflective electrode on the elevated reflective layer **213**. Because of elevated reflective layer **213** with the bumps, many reflective light rays **214** will be produced according to the scattering theory to pass through the liquid crystal layer **23** and the color filter **212** to display figures and pictures on the screen. But when external light rays are insufficient to display figures and pictures on the screen, the LCD will use its BL **221** to pass through the liquid crystal layer **23** and the color filter **222**. Owing to the thickness t of color filter **212** be less than the thickness T of color filter **222**, it will generate the similar substantially color saturation in both of the reflective and transmissive areas under the thickness compensation theory.

[0007] Another method for making many hollow holes in the color filter at the reflective area is adopted in **FIG. 2B**. The reflective area **26** is in the left side of **FIG. 2B** and the transmissive area **27** is in the right side of **FIG. 2B**. When external light rays **261** are sufficient to display figures and pictures on the screen, the LCD will use external light rays **261** as the light source. Therefore, the light rays **261** of the reflective area **26** will pass through the color filter **262** and be reflected by the reflective electrode on the elevated reflective layer **263**. Because of elevated reflective layer **263** with the bumps, many reflective light rays **264** will be produced according to the scattering theory to pass through the liquid crystal layer **28** and the color filter **262** to display figures and pictures on the screen. But when external light rays are insufficient, the LCD will use its BL **271**, passing through the liquid crystal layer **28** and the color filter **272**, to display figures and pictures on the screen. There are many small holes in the color filter **262** and there is not any small hole in the color filter **272**. It will generate the similar substantially color saturation in both of the reflective and transmissive areas by using the small holes in the color filter of reflective area.

[0008] It still exists the problem for aligning two glass substrates either using the method that the color filter in the reflective area is thinner than the color filter in the transmissive area or the method for making many hollow holes in the color filter at the reflective area. Especially due to the present LCD have quite small pixel; it is very difficult to align the reflective and transmissive areas of two glass substrates. The problem of different color saturation in the reflective and transmissive areas will be produced while there is a little deviation on the alignment.

SUMMARY OF THE INVENTION

[0009] In the light of the state of the art described above, it is an object of the present invention to provide a liquid crystal display (LCD) device with two color filters on the lower and upper transparent substrates which is immune to the problems of the conventional LCD device described above.

[0010] It is another object of this invention to provide a liquid crystal display device with two color filters on the lower and upper transparent substrates to present the same color saturation in the reflective and transmissive areas.

[0011] It is a further object of this invention to provide a liquid crystal display device with two color filters on the lower and upper transparent substrates to overcome the problem for disaligning the reflective and transmissive areas on the lower and upper transparent substrates.

[0012] In view of the above and other objects which will become apparent as the description proceeds, there is provided according to a general aspect of the present invention a liquid crystal display device which includes a first substrate having a plurality of thin film transistors (TFTs); a dielectric layer on said first substrate; a first color filter on said dielectric layer; an elevated dielectric layer on said first color filter in the reflective areas; a first electrode on said elevated dielectric layer and said first color filter in the transmissive areas; a liquid crystal layer on said first electrode; a second color filter on said liquid crystal layer; a second electrode on said second color filter; and a second substrate on said second electrode.

[0013] Base on the idea described above, wherein said first and second substrates are transparent.

[0014] Base on the aforementioned idea, wherein the material of said dielectric layer is selected from the group consisting of SiO_2, Si_3N_4 and both.

[0015] Base on the idea described above, the material of said elevated dielectric layer is photopolymer.

[0016] Base on the aforementioned idea, wherein the thickness of said elevated dielectric layer is about 1~3 μm.

[0017] Base on the idea described above, wherein said first and second color filters comprise three non-overlapping color areas.

[0018] Base on the aforementioned idea, wherein said three color areas are red, green and blue.

[0019] Base on the idea described above, wherein the colors of identical areas on said first and second color filters are same.

[0020] Base on the aforementioned idea, wherein said first electrode is coated by using the sputter method.

[0021] Base on the idea described above, wherein the height of said first electrode on said elevated dielectric layer is higher than the height of said first electrode on said first color filter in the transmissive areas.

[0022] Base on the aforementioned idea, wherein said first electrode is electrically connected with said plurality of TFTs.

[0023] Base on the idea described above, wherein the material of said first electrode on said elevated dielectric layer is selected from the group consisting of Al, Ag and AlNd alloy.

[0024] Base on the aforementioned idea, wherein the material of said first electrode on said first color filter in the transmissive areas is selected from the group consisting of ITO (indium tin oxide) and IZO (indium zinc oxide).

[0025] Base on the idea described above, wherein the best performance in the transmissive and reflective areas can be made by adjusting the thicknesses of two color filters on the lower and upper transparent substrates.

[0026] Base on the aforementioned idea, wherein the best performance in the transmissive and reflective areas is the best performance of color saturation in the transmissive and reflective areas.

[0027] In view of the above and other objects which will become apparent as the description proceeds, there is provided according to a general aspect of the present invention a liquid crystal display device which includes a first substrate having a plurality of thin film transistors (TFTs); a dielectric layer on said first substrate; a first color filter on said dielectric layer in the transmissive areas; an elevated dielectric layer on said first color filter in the reflective areas; a reflective electrode on said elevated dielectric layer; a transmissive electrode on said first color filter; a liquid crystal layer on said reflective and transmissive electrodes; a second color filter on said liquid crystal layer; a common electrode on said second color filter; and a second substrate on said common electrode.

[0028] Base on the idea described above, wherein said first and second substrates are transparent.

[0029] Base on the aforementioned idea, wherein the material of said dielectric layer is selected from the group consisting of SiO_2, Si_3N_4 and both.

[0030] Base on the idea described above, the material of said elevated dielectric layer is photopolymer.

[0031] Base on the aforementioned idea, wherein the thickness of said elevated dielectric layer is about 1~3 μm.

[0032] Base on the idea described above, wherein said first and second color filters comprise three non-overlapping color areas.

[0033] Base on the aforementioned idea, wherein said three color areas are red, green and blue.

[0034] Base on the idea described above, wherein the colors of identical areas on said first and second color filters are same.

[0035] Base on the aforementioned idea, wherein said reflective electrode is coated by using the sputter method.

[0036] Base on the idea described above, wherein the material of said reflective electrode on said elevated dielectric layer is selected from the group consisting of Al, Ag and AlNd alloy.

[0037] Base on the aforementioned idea, wherein said transmissive electrode is coated by using the sputter method.

[0038] Base on the idea described above, wherein the material of said transmissive electrode on said first color filter in the transmissive areas is selected from the group consisting of ITO (indium tin oxide) and IZO (indium zinc oxide).

[0039] Base on the aforementioned idea, wherein said transmissive electrode is electrically connected with said reflective electrode.

[0040] Base on the idea described above, wherein said transmissive electrode is electrically connected with said plurality of TFTs.

[0041] Base on the aforementioned idea, wherein said reflective electrode is electrically connected with said plurality of TFTs.

[0042] Base on the idea described above, wherein the best performance in the transmissive and reflective areas can be made by adjusting the thicknesses of two color filters on the lower and upper transparent substrates.

[0043] Base on the aforementioned idea, wherein the best performance in the transmissive and reflective areas is the best performance of color saturation in the transmissive and reflective areas.

[0044] In view of the above and other objects which will become apparent as the description proceeds, there is provided according to a general aspect of the present invention a liquid crystal display device which includes a first substrate; a first color filter on said first substrate; an elevated dielectric layer on said first substrate in the reflective areas; a liquid crystal layer on said elevated dielectric layer and said first color filter in the transmissive areas; a second color filter on said liquid crystal layer; and a second substrate on said second color filter.

[0045] Base on the idea described above, wherein said first and second substrates are transparent.

[0046] Base on the aforementioned idea, the material of said elevated dielectric layer is photopolymer.

[0047] Base on the idea described above, wherein the thickness of said elevated dielectric layer is about 1~3 μm.

[0048] Base on the aforementioned idea, wherein said first and second color filters comprise three non-overlapping color areas.

[0049] Base on the idea described above, wherein said three color areas are red, green and blue.

[0050] Base on the aforementioned idea, wherein the colors of identical areas on said first and second color filters are same.

[0051] Base on the idea described above, wherein the best performance in the transmissive and reflective areas can be made by adjusting the thicknesses of two color filters on the lower and upper transparent substrates.

[0052] Base on the aforementioned idea, wherein the best performance in the transmissive and reflective areas is the best performance of color saturation in the transmissive and reflective areas.

BRIEF DESCRIPTION OF THE DRAWINGS

[0053] The foregoing aspects and many of the attendant advantages of this invention will become more readily appreciated as the same becomes better understood by reference to the following detailed description, when taken in conjunction with the accompanying drawings, wherein:

[0054] **FIG. 1** illustrates a cross-section view of a conventional transflective-type color LCD;

[0055] **FIG. 2A** illustrates a cross-section view of a conventional transflective-type color LCD by adopting the structure that the color filter in the reflective area is thinner than the color filter in the transmissive area to solve the problem of different color saturation;

[0056] **FIG. 2B** illustrates a cross-section view of a conventional transflective-type color LCD by adopting the structure that makes many hollow holes in the color filter at the reflective area to solve the problem of different color saturation;

[0057] **FIG. 3** illustrates a top view of single pixel according to the embodiments of this invention;

[0058] **FIG. 4** illustrates a cross-section view of sub-pixel according to the first embodiment of this invention; and

[0059] **FIG. 5** illustrates a cross-section view of sub-pixel according to the second embodiment of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0060] Some sample embodiments of the present invention will now be described in greater detail. Nevertheless, it should be recognized that the present invention can be practiced in a wide range of other embodiments besides those explicitly described, and the scope of the present invention is expressly not limited except as specified in the accompanying claims.

[0061] The first embodiment of this invention is illustrated in the top view of single pixel of **FIG. 3** and in the cross-section view of the sub-pixel of **FIG. 4**. A single pixel **30** of the color LCD comprises three sub-pixels **31**, **32**, **33**. The color of each sub-pixel is respectively red, green and blue color. It means if the sub-pixel **31** is the red sub-pixel, the sub-pixel **32** will be the green sub-pixel and the sub-pixel **33** will be the blue sub-pixel. As for the transflective-type LCD, each sub-pixel **31**, **32**, **33** can be divided into the transmissive area **312**, **322**, **332** and the reflective area **311**, **321**, **331**.

[0062] **FIG. 4** illustrates the cross-section view of the sub-pixel **31** comprises the transmissive area **312** and the reflective area **311**. First, TFTs **401** are formed on the transparent substrate **41** and a transparent dielectric layer **402** is formed thereon subsequently. The transparent dielectric layer **402** can be a SiO_2 layer, a Si_3N_4 layer or a compound layer comprised of the above two materials. Then a color filter **42** having the thickness t1 is formed on each sub-pixel. The method for forming the color filter **42** is the same with the method of prior art. The color of color filter depends on the color of corresponding sub-pixel. For example, the sub-pixel **31** is red and the part of color filter **42** corresponding to the sub-pixel **31** is red. Equally, the sub-pixel **32** is green and the part of color filter **42** corresponding to the sub-pixel **32** is green. The sub-pixel **33** is blue and the part of color filter **42** corresponding to the sub-pixel **33** is blue. After the formation of the color filter **42**, the transmissive area and the reflective area will be defined. The elevated reflective layer **43** with the bumps is formed at the reflective area. The material of elevated reflective layer **43** can be photopolymer or other opaque dielectric materials of which the thickness is about 1~3 μm. If photopolymer is used as the material of elevated reflective layer, it can be coated on the whole color filter **42** first and elevated reflective layer can be made by using the lithography and etching processes. After the formation of the patterns of the transmissive area and the reflective area, the transmissive electrode **44** and the reflective electrode **45** should be formed. The transmissive electrode **44** at the transmissive area **312** that comprises ITO (indium tin oxide) or IZO (indium zinc oxide) is coated by using the sputter method and the reflective electrode **45** at the reflective area **311** that comprises Al, Ag or AlNd alloy is coated by using the sputter method. The transmissive electrode **44**, the reflective electrode **45** and TFTs **401** are electrically connected each other.

[0063] Then the color filter **47** having the thickness t2 is formed on another transparent substrate **46** having many sub-pixels and each sub-pixel comprises the transmissive area and the reflective area. The method for forming the color filter **47** is the same with the method of prior art. The color of color filter depends on the color of corresponding sub-pixel. A common electrode **48** is formed on the color filter **47**. Finally, the two transparent substrates are sealed with the color filters **42**, **47** face to face and vacuumed, and liquid crystal is injected into the space between the two transparent substrates to form the liquid crystal layer **49**.

[0064] The light rays in the reflective area **311** pass through the color filter **47** twice and the light rays in the transmissive area **312** pass through the color filter **42** and the color filter **47**. Therefore, we can adjust the thickness t1 of color filter **42** and the thickness t2 of color filter **47** to

generate the similar or same color saturation in the reflective area and the transmissive area while the transflective-type color LCD uses both of the transmissive and reflective display modes at the same time.

[0065] The second embodiment of this invention is illustrated in the top view of single pixel of **FIG. 3** and in the cross-section view of the sub-pixel of **FIG. 5**, which illustrates the cross-section view of the sub-pixel **31** comprises the transmissive area **312** and the reflective area **311**. First, TFTs **501** are formed on the transparent substrate **51** and a transparent dielectric layer **502** is formed thereon subsequently. The transparent dielectric layer **502** can be a SiO_2 layer, a Si_3N_4 layer or a compound layer comprised of the above two materials. Then a color filter **52** having the thickness t3 is formed on each sub-pixel. The method for forming the color filter **52** is the same with the method of prior art. The color of color filter depends on the color of corresponding sub-pixel. For example, the sub-pixel **31** is red and the part of color filter **52** corresponding to the sub-pixel **31** is red. Equally, the sub-pixel **52** is green and the part of color filter **52** corresponding to the sub-pixel **32** is green. The sub-pixel **33** is blue and the part of color filter **52** corresponding to the sub-pixel **33** is blue. It is the only difference between this and the first embodiment of **FIG. 4** that there is not any the color filter **52** in the reflective area. After the formation of the color filter **52**, the transmissive area and the reflective area will be defined. The elevated reflective layer **53** with the bumps is formed at the reflective area. The material of elevated reflective layer **53** can be photopolymer or other opaque dielectric materials of which the thickness is about 1~3 μm. If photopolymer is used as the material of elevated reflective layer, it can be coated on the whole color filter **52** first and elevated reflective layer can be made by using the lithography and etching processes. After the formation of the patterns of the transmissive area and the reflective area, the transmissive electrode **54** and the reflective electrode **55** should be formed. The transmissive electrode **54** at the transmissive area **312** that comprises ITO (indium tin oxide) or IZO (indium zinc oxide) is coated by using the sputter method and the reflective electrode **55** at the reflective area **311** that comprises Al, Ag or AlNd alloy is coated by using the sputter method. The transmissive electrode **54**, the reflective electrode **55** and TFTs **501** are electrically connected each other.

[0066] Then the color filter **57** having the thickness t4 is formed on another transparent substrate **56** having many sub-pixels and each sub-pixel comprises the transmissive area and the reflective area. The method for forming the color filter **57** is the same with the method of prior art. The color of color filter depends on the color of corresponding sub-pixel. A common electrode **58** is formed on the color filter **57**. Finally, the two transparent substrates are sealed with the color filters **52**, **57** face to face and vacuumed, and liquid crystal is injected into the space between the two transparent substrates to form the liquid crystal layer **59**.

[0067] The light rays in the reflective area **311** pass through the color filter **57** twice and the light rays in the transmissive area **312** pass through the color filter **52** and the color filter **57**. Therefore, we can adjust the thickness t3 of color filter **52** and the thickness t4 of color filter **57** to generate the similar or same color saturation in the reflective area and the transmissive area while the transflective-type color LCD uses both of the transmissive and reflective display modes at the same time.

[0068] Although the specific embodiment has been illustrated and described, it will be obvious to those skilled in the art that various modifications may be made without departing from what is intended to be limited solely by the appended claims.

What is claimed is:

1. A liquid crystal display device, comprising:

a first substrate having a plurality of thin film transistors (TFTs);

a dielectric layer on said first substrate;

a first color filter on said dielectric layer;

an elevated dielectric layer on said first color filter in the reflective areas;

a first electrode on said elevated dielectric layer and said first color filter in the transmissive areas;

a liquid crystal layer on said first electrode;

a second color filter on said liquid crystal layer;

a second electrode on said second color filter; and

a second substrate on said second electrode.

2. The liquid crystal display device according to claim 1, wherein said first and second substrates are transparent.

3. The liquid crystal display device according to claim 1, wherein the material of said dielectric layer is selected from the group consisting of SiO_2, Si_3N_4 and both.

4. The liquid crystal display device according to claim 1, the material of said elevated dielectric layer is photopolymer.

5. The liquid crystal display device according to claim 4, wherein the thickness of said elevated dielectric layer is about 1~3 μm.

6. The liquid crystal display device according to claim 1, wherein said first and second color filters comprise three non-overlapping color areas.

7. The liquid crystal display device according to claim 6, wherein said three color areas are red, green and blue.

8. The liquid crystal display device according to claim 7, wherein the colors of identical areas on said first and second color filters are same.

9. The liquid crystal display device according to claim 1, wherein said first electrode is coated by using the sputter method.

10. The liquid crystal display device according to claim 1, wherein the height of said first electrode on said elevated dielectric layer is higher than the height of said first electrode on said first color filter in the transmissive areas.

11. The liquid crystal display device according to claim 9, wherein said first electrode is electrically connected with said plurality of TFTs.

12. The liquid crystal display device according to claim 9, wherein the material of said first electrode on said elevated dielectric layer is selected from the group consisting of Al, Ag and AlNd alloy.

13. The liquid crystal display device according to claim 9, wherein the material of said first electrode on said first color filter in the transmissive areas is selected from the group consisting of ITO (indium tin oxide) and IZO (indium zinc oxide).

14. The liquid crystal display device according to claim 1, wherein the best performance in the transmissive and reflective areas can be made by adjusting the thicknesses of two color filters on the lower and upper transparent substrates.

15. The liquid crystal display device according to claim 14, wherein the best performance in the transmissive and reflective areas is the best performance of color saturation in the transmissive and reflective areas.

16. A liquid crystal display device, comprising:

a first substrate having a plurality of thin film transistors (TFTs);

a dielectric layer on said first substrate;

a first color filter on said dielectric layer in the transmissive areas;

an elevated dielectric layer on said first color filter in the reflective areas;

a reflective electrode on said elevated dielectric layer;

a transmissive electrode on said first color filter;

a liquid crystal layer on said reflective and transmissive electrodes;

a second color filter on said liquid crystal layer;

a common electrode on said second color filter; and

a second substrate on said common electrode.

17. The liquid crystal display device according to claim 16, wherein said first and second substrates are transparent.

18. The liquid crystal display device according to claim 16, wherein the material of said dielectric layer is selected from the group consisting of SiO_2, Si_3N_4 and both.

19. The liquid crystal display device according to claim 16, the material of said elevated dielectric layer is photopolymer.

20. The liquid crystal display device according to claim 19, wherein the thickness of said elevated dielectric layer is about 1~3 μm.

21. The liquid crystal display device according to claim 16, wherein said first and second color filters comprise three non-overlapping color areas.

22. The liquid crystal display device according to claim 21, wherein said three color areas are red, green and blue.

23. The liquid crystal display device according to claim 22, wherein the colors of identical areas on said first and second color filters are same.

24. The liquid crystal display device according to claim 16, wherein said reflective electrode is coated by using the sputter method.

25. The liquid crystal display device according to claim 24, wherein the material of said reflective electrode on said elevated dielectric layer is selected from the group consisting of Al, Ag and AlNd alloy.

26. The liquid crystal display device according to claim 16, wherein said transmissive electrode is coated by using the sputter method.

27. The liquid crystal display device according to claim 26, wherein the material of said transmissive electrode on said first color filter in the transmissive areas is selected from the group consisting of ITO (indium tin oxide) and IZO (indium zinc oxide).

28. The liquid crystal display device according to claim 16, wherein said transmissive electrode is electrically connected with said reflective electrode.

29. The liquid crystal display device according to claim 16, wherein said transmissive electrode is electrically connected with said plurality of TFTs.

30. The liquid crystal display device according to claim 16, wherein said reflective electrode is electrically connected with said plurality of TFTs.

31. The liquid crystal display device according to claim 16, wherein the best performance in the transmissive and reflective areas can be made by adjusting the thicknesses of two color filters on the lower and upper transparent substrates.

32. The liquid crystal display device according to claim 31, wherein the best performance in the transmissive and reflective areas is the best performance of color saturation in the transmissive and reflective areas.

33. A liquid crystal display device, comprising:

a first substrate;

a first color filter on said first substrate;

an elevated dielectric layer on said first substrate in the reflective areas;

a liquid crystal layer on said elevated dielectric layer and said first color filter in the transmissive areas;

a second color filter on said liquid crystal layer; and

a second substrate on said second color filter.

34. The liquid crystal display device according to claim 33, wherein said first and second substrates are transparent.

35. The liquid crystal display device according to claim 33, the material of said elevated dielectric layer is photopolymer.

36. The liquid crystal display device according to claim 35, wherein the thickness of said elevated dielectric layer is about 1~3 μm.

37. The liquid crystal display device according to claim 33, wherein said first and second color filters comprise three non-overlapping color areas.

38. The liquid crystal display device according to claim 37, wherein said three color areas are red, green and blue.

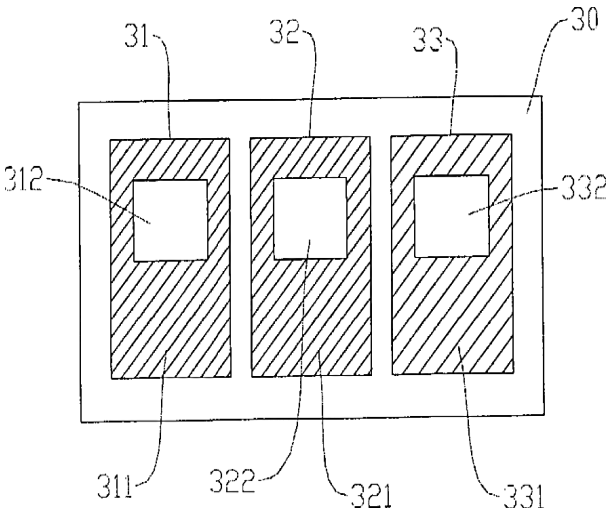
39. The liquid crystal display device according to claim 38, wherein the colors of identical areas on said first and second color filters are same.

40. The liquid crystal display device according to claim 33, wherein the best performance in the transmissive and reflective areas can be made by adjusting the thicknesses of two color filters on the lower and upper transparent substrates.

41. The liquid crystal display device according to claim 40, wherein the best performance in the transmissive and reflective areas is the best performance of color saturation in the transmissive and reflective areas.

* * * * *

专利名称(译)	液晶显示装置		
公开(公告)号	US20040141118A1	公开(公告)日	2004-07-22
申请号	US10/347410	申请日	2003-01-21
[标]申请(专利权)人(译)	统宝光电股份有限公司		
申请(专利权)人(译)	统宝光电股份有限公司.		
当前申请(专利权)人(译)	群创光电		
[标]发明人	CHANG SHIH CHANG TSAI YAW MING		
发明人	CHANG, SHIH-CHANG TSAI, YAW-MING		
IPC分类号	G02F1/1333 G02F1/1335		
CPC分类号	G02F1/133371 G02F1/133555 G02F1/133514		
其他公开文献	US6788367		
外部链接	Espacenet USPTO		

摘要(译)

液晶显示（LCD）装置本发明涉及一种液晶显示（LCD）装置，它通过调节下透明基板和上透明基板上的两个滤色器的厚度，在彩色LCD的透射和反射区域中具有最佳的对比度和色彩饱和度性能。本发明包括具有反射区域和透射区域的第一基板，以及其上的多个薄膜晶体管（TFT）；所述第一基板上的介电层;所述介电层上的第一滤色器;在所述反射区域中的所述第一滤色器上的升高的介电层;在所述反射区域中的所述升高的介电层上和所述透射区域中的所述第一滤色器上的第一电极，其中所述反射区域中的所述第一电极的顶表面高于所述透射区域中的所述第一电极的顶表面;所述第一电极上的液晶层;所述液晶层上的第二电极;所述第二电极上的第二滤色器;和在所述第二滤色器上的第二基板。