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(54) **COLOR FILTER SUBSTRATE AND LIQUID CRYSTAL DISPLAY DEVICE**

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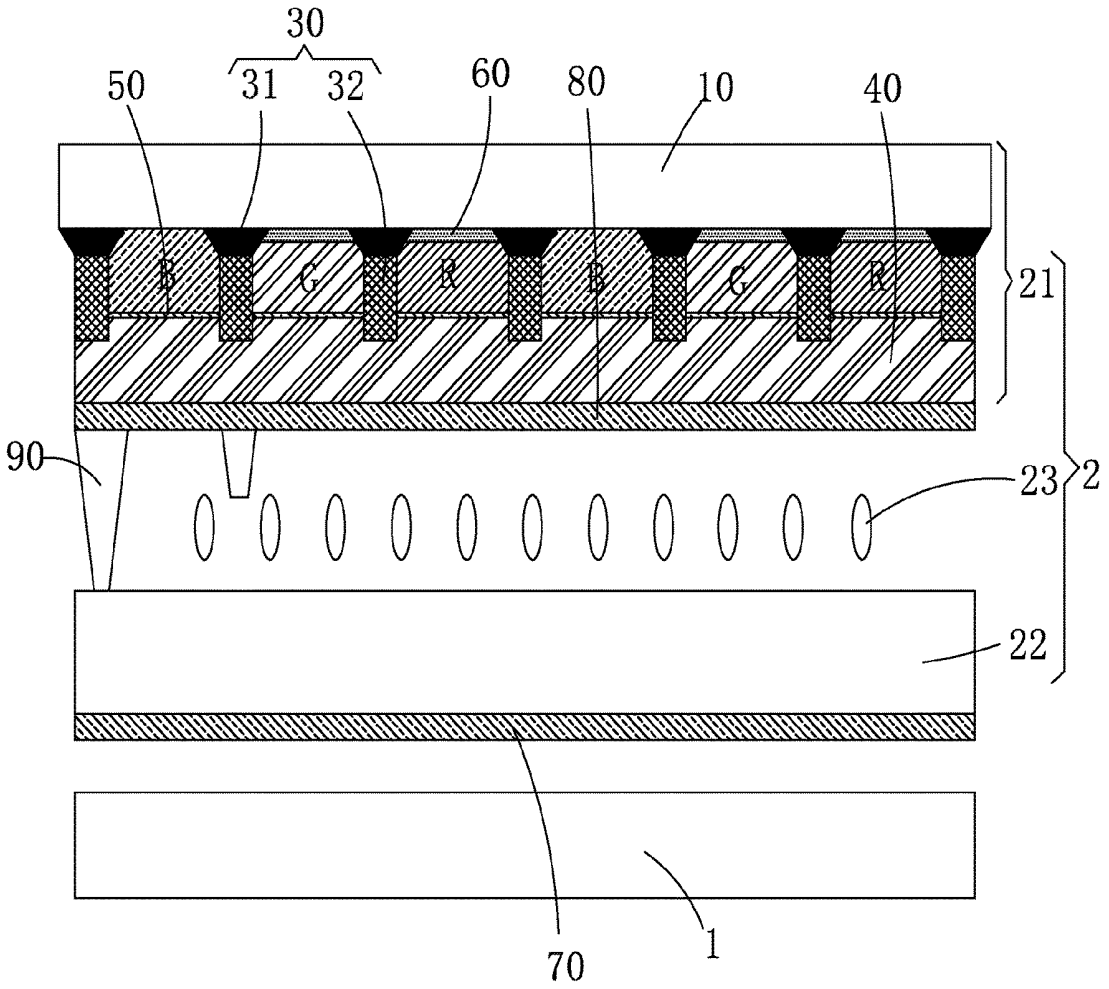
(57) **ABSTRACT**

Provided are a color filter substrate and a liquid crystal display device. The color filter substrate includes a base substrate, a plurality of quantum dot filter units arranged in an array on the base substrate and retaining walls disposed among the quantum dot filter units on the base substrate; the retaining wall includes a black matrix layer disposed on the base substrate and a reflective layer disposed on the black matrix layer, and the retaining wall has a thickness greater than a thickness of the quantum dot filter unit. The reflective layer can re-reflect light irradiated on a surface thereof to the quantum dot filter units for secondary utilization, thereby improving utilization of the light while avoiding color mixture through the other quantum dot filter units.



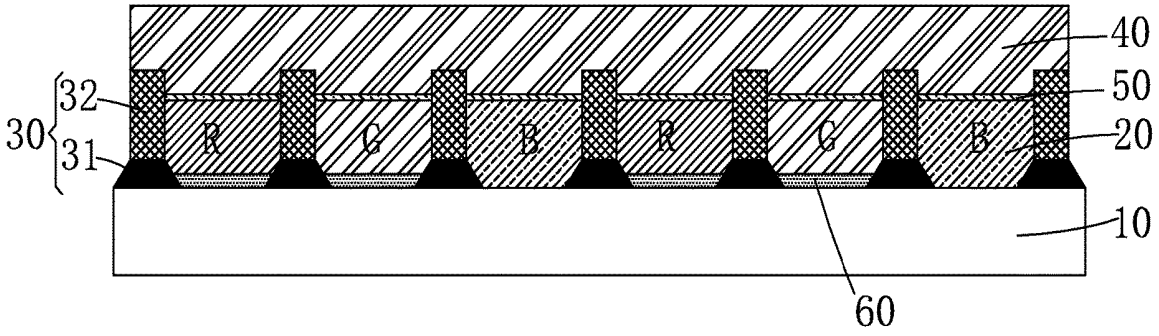


FIG. 1

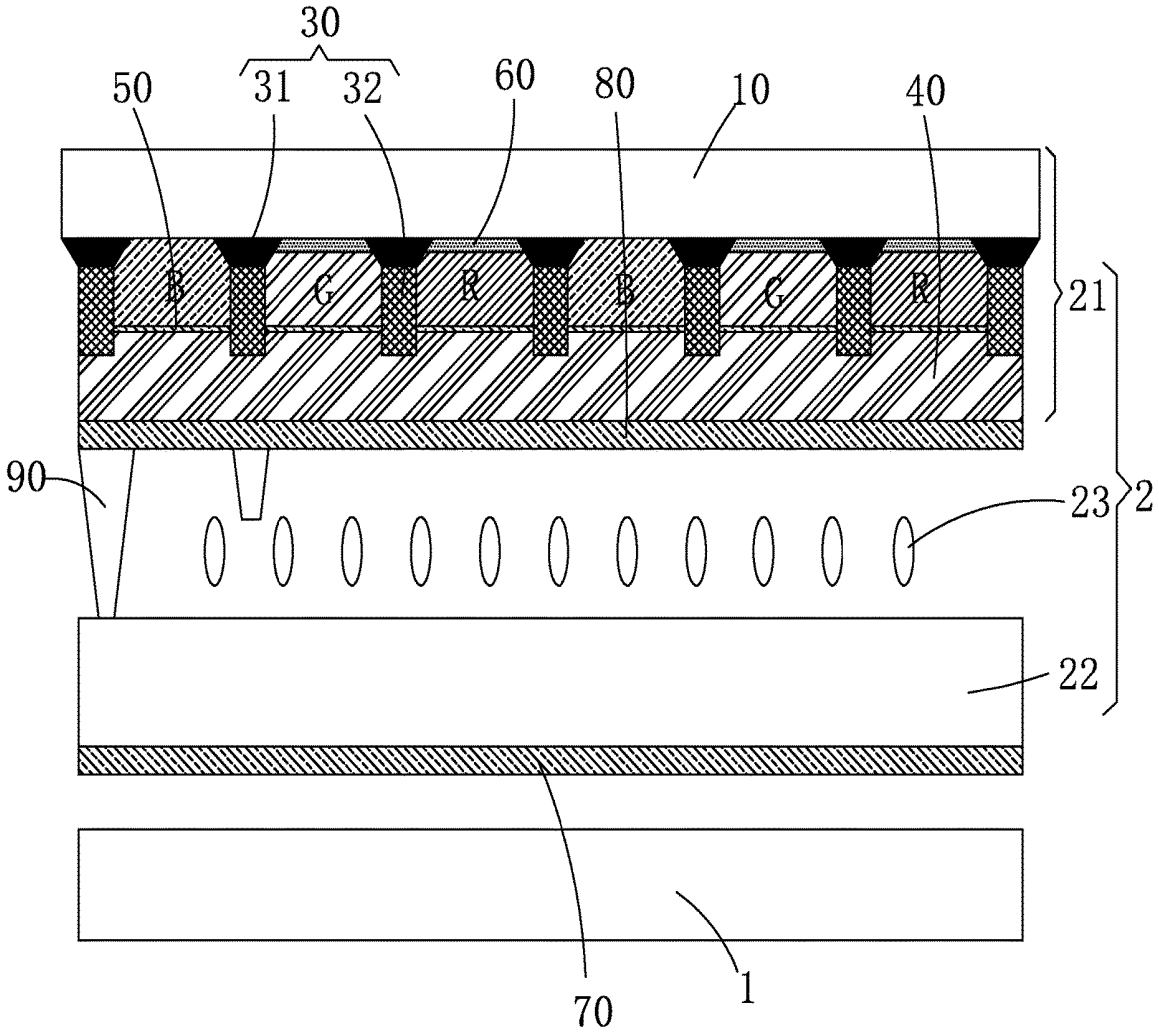


FIG. 2

COLOR FILTER SUBSTRATE AND LIQUID CRYSTAL DISPLAY DEVICE

FIELD OF THE INVENTION

[0001] The present invention relates to a display field, and more particularly to a color filter substrate and a liquid crystal display device.

BACKGROUND OF THE INVENTION

[0002] The Liquid Crystal Display (LCD) possesses advantages of thin body, power saving and no radiation to be widely used in many application scope. Such as LCD TV, mobile phone, personal digital assistant (PDA), digital camera, notebook, laptop, and dominates the flat panel display field.

[0003] The working principle of the liquid crystal display is that liquid crystal molecules are injected between the Thin Film Transistor Array Substrate (TFT array substrate) and the Color Filter (CF) substrate. The light of backlight module is refracted to generate images by applying driving voltages to the two substrates for controlling the rotations of the liquid crystal molecules.

[0004] The colors of the liquid crystal display are realized by color filters (CF). The conventional color filters include red, green and blue photoresists arranged in a certain order. When the light emitted from the backlight passes through the red, green and blue photoresists, only the light corresponding to the red, green and blue bands can be transmitted to convert the light emitted by the backlight into red light, green light and blue light of three colors. However, the conventional color filters have poor utilization of light, low transmittance. The transmission peak of the conventional color resist material is wide and the color density is limited. Thus, it is difficult to realize the disadvantage of wide color gamut, which cannot satisfy the requirements of the users for image displaying quality.

[0005] Quantum Dots (QDs) are spherical semiconductor nanoparticles composed of II-VI or III-V elements with a particle size generally ranging from a few nanometers to tens of nanometers. Due to the existence of the quantum confinement effect of the quantum dot material, the original continuous energy level structure becomes a discrete energy level structure and can emit visible light as being excited by the outside. Quantum dot material possesses a small half-height width and a luminescent color can be easily adjusted by the size, structure or composition of the quantum dot material. Therefore, it is applied to a display device to replace the existing red photoresist and green photoresist and blue photoresist. Other structures will continue to follow the technical process of the conventional liquid crystal display device, and respective quantum dot filter units are separated by a black matrix to ensure that color mixture does not occur between different colors. However, the film thickness of the current quantum filter unit is generally 3 μm to 6 μm, and the current technical black matrix cannot achieve a scale of 2 μm or more, so it is difficult to separate different quantum filter units by relying on one single layer of black matrix. It is prone to color mixture, resulting in poor display.

SUMMARY OF THE INVENTION

[0006] An objective of the present invention is to provide a color filter substrate, which can effectively separate respective quantum dot filter units to improve light utilization while avoiding color mixture.

[0007] Another objective of the present invention is to provide a liquid crystal display device, which can effectively separate respective quantum dot filter units to improve light utilization while avoiding color mixture.

[0008] For realizing the aforesaid objectives, the present invention provides a color filter substrate, including a base substrate, a plurality of quantum dot filter units arranged in an array on the base substrate and retaining walls disposed among the quantum dot filter units on the base substrate;

[0009] wherein the retaining wall includes a black matrix layer disposed on the base substrate and a reflective layer disposed on the black matrix layer, and the retaining wall has a thickness greater than a thickness of the quantum dot filter unit.

[0010] A reflectivity of the reflective layer is greater than 70%;

[0011] the reflective layer has a thickness of 3 μm to 6 μm, and an optical density value of the reflective layer per one micrometer thickness is greater than 1.

[0012] The color filter substrate further includes a protective layer on the quantum dot filter units and on the retaining walls, and a water-oxygen barrier layer between the quantum dot filter units and the protective layer.

[0013] The plurality of quantum dot filter units include red quantum dot filter units, green quantum dot filter units and blue quantum dot filter units that are alternately arranged in sequence.

[0014] wherein a blue filter layer is further disposed between the red quantum dot filter unit and the base substrate and between the green quantum dot filter unit and the base substrate.

[0015] The present invention further provides a liquid crystal display device, including a backlight module and a liquid crystal display panel disposed above the backlight module;

[0016] wherein the liquid crystal display panel includes: a color filter substrate, a counter substrate disposed opposite to the color filter substrate and a liquid crystal layer between the color filter substrate and the counter substrate; the backlight module is located on a side of the counter substrate away from the color filter substrate;

[0017] wherein the color filter substrate includes a first base substrate, a plurality of quantum dot filter units arranged in an array on the first base substrate and retaining walls disposed among the quantum dot filter units on the first base substrate;

[0018] wherein the retaining wall includes a black matrix layer disposed on the first base substrate and a reflective layer disposed on the black matrix layer, and the retaining wall has a thickness greater than a thickness of the quantum dot filter unit.

[0019] A reflectivity of the reflective layer is greater than 70%;

[0020] the reflective layer has a thickness of 3 μm to 6 μm, and an optical density value of the reflective layer of per 1 μm thickness is greater than 1.

[0021] The color filter substrate further includes a protective layer on the quantum dot filter units and on the retaining walls, and a water-oxygen barrier layer between the quantum dot filter units and the protective layer.

[0022] The plurality of quantum dot filter units include red quantum dot filter units, green quantum dot filter units and blue quantum dot filter units that are alternately arranged in sequence;

[0023] wherein a blue filter layer is further disposed between the red quantum dot filter unit and the base substrate and between the green quantum dot filter unit and the base substrate.

[0024] The liquid crystal display device further includes a first polarizing layer and a second polarizing layer;

[0025] wherein the first polarizing layer is located between the counter substrate and the backlight module, and the second polarizing layer is located between the color filter substrate and the liquid crystal layer.

[0026] The benefits of the present invention are: the present invention provides a color filter substrate. The color filter substrate includes a base substrate, a plurality of quantum dot filter units arranged in an array on the base substrate and retaining walls disposed among the quantum dot filter units on the base substrate; the retaining wall includes a black matrix layer disposed on the base substrate and a reflective layer disposed on the black matrix layer, and the retaining wall has a thickness greater than a thickness of the quantum dot filter unit. The reflective layer can re-reflect light irradiated on a surface thereof to the quantum dot filter units for secondary utilization, thereby improving utilization of the light while avoiding color mixture through the other quantum dot filter units. The present invention further provides a liquid crystal display device, which can effectively separate respective quantum dot filter units to improve light utilization while avoiding color mixture.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] In order to better understand the characteristics and technical aspect of the invention, please refer to the following detailed description and accompanying drawings of the present invention. However, the drawings are provided for reference only and are not intended to be limiting of the invention.

[0028] In drawings,

[0029] FIG. **1** is a structural diagram of a color filter substrate of the present invention;

[0030] FIG. **2** is a structural diagram of a liquid crystal display device of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0031] For better explaining the technical solution and the effect of the present invention, the present invention will be further described in detail with the accompanying drawings and the specific embodiments.

[0032] Please refer to FIG. **1**. The present invention provides a color filter substrate, including a base substrate **10**, a plurality of quantum dot filter units **20** arranged in an array on the base substrate **10** and retaining walls **30** disposed among the quantum dot filter units **20** on the base substrate **10**;

[0033] The retaining wall **30** includes a black matrix layer **31** disposed on the base substrate **10** and a reflective layer **32** disposed on the black matrix layer **31**, and the retaining wall **30** has a thickness greater than a thickness of the quantum dot filter unit **20**.

[0034] Specifically, by separating the respective quantum dot filter units **20** with forming the retaining walls **30** by superimposing the reflective layers **32** on the black matrix layers **31**, the thickness of the black matrix layer **31** can be compensated for, such that the thickness of the retaining wall **30** is greater than the thickness of the quantum dot filter unit **20**. Meanwhile, by the arrangement of the reflective layer **32**, the light irradiated on the surface thereof can be re-reflected into the quantum dot filter unit **20** for secondary utilization to improve the utilization of the light, wherein the light irradiated on the surface of the reflective layer **32** includes light excited by the quantum dot filter units **20** and incident backlight. Furthermore, the reflective layer **32** is also capable of blocking the light irradiated on the surface thereof from entering the other quantum dot filter units **20**, thereby avoiding color mixture and ensuring display effects.

[0035] For ensuring the reflection and light blocking effects of the reflective layer **32**, the reflectivity of the reflective layer **32** in the present invention is greater than 70%, and the reflective layer has a thickness of 3 μm to 6 μm, and an optical density value of the reflective layer **32** of per 1 μm thickness is greater than 1. Thus, it can be ensured that most of the light irradiated on the surface of the reflective layer **32** is reflected back into the quantum dot filter units **20**, and the remaining portion of the light is absorbed by the reflective layer **32**, thereby effectively preventing the light from passing through the quantum dot filter units **20**, resulting in color mixture or color shift.

[0036] Specifically, the color filter substrate further includes a protective layer **40** on the quantum dot filter units **20** and on the retaining walls **30**, and a water-oxygen barrier layer **50** between the quantum dot filter units **20** and the protective layer **40**. The water-oxygen barrier layer **50** serves to prevent the quantum dot filter units **20** from being infiltrated by water and oxygen, resulting in device failure.

[0037] Specifically, the plurality of quantum dot filter units **20** include red quantum dot filter units R, green quantum dot filter units G and blue quantum dot filter units B that are alternately arranged in sequence. A blue filter layer **60** is further disposed between the red quantum dot filter unit R and the base substrate **10** and between the green quantum dot filter unit G and the base substrate **10**. The red quantum dot filter unit R, the green quantum dot filter unit G and the blue quantum dot filter unit B are respectively used to generate red light, green light and blue light under excitation of the incident backlight. The blue filter layer **60** is used for further filtering the red light and the green light to remove blue light components therein and to improve color purity.

[0038] Please refer to FIG. **2**. The present invention further provides a liquid crystal display device, including a backlight module **1** and a liquid crystal display panel **2** disposed above the backlight module **1**;

[0039] wherein the liquid crystal display panel **2** includes: a color filter substrate **21**, a counter substrate **22** disposed opposite to the color filter substrate **21** and a liquid crystal layer **23** between the color filter substrate **21** and the counter substrate **22**; the backlight module **1** is located on a side of the counter substrate **22** away from the color filter substrate **21**;

[0040] wherein the color filter substrate **21** includes a first base substrate **10**, a plurality of quantum dot filter units **20** arranged in an array on the first base substrate **10** and

retaining walls **30** disposed among the quantum dot filter units **20** on the first base substrate **10**;

[0041] The retaining wall **30** includes a black matrix layer **31** disposed on the first base substrate **10** and a reflective layer **32** disposed on the black matrix layer **31**, and the retaining wall **30** has a thickness greater than a thickness of the quantum dot filter unit **20**.

[0042] Specifically, by separating the respective quantum dot filter units **20** with forming the retaining walls **30** by superimposing the reflective layers **32** on the black matrix layers **31**, the thickness of the black matrix layer **31** can be compensated for, such that the thickness of the retaining wall **30** is greater than the thickness of the quantum dot filter unit **20**. Meanwhile, by the arrangement of the reflective layer **32**, the light irradiated on the surface thereof can be re-reflected into the quantum dot filter unit **20** for secondary utilization to improve the utilization of the light, wherein the light irradiated on the surface of the reflective layer **32** includes light excited by the quantum dot filter units **20** and incident backlight. Furthermore, the reflective layer **32** is also capable of blocking the light irradiated on the surface thereof from entering the other quantum dot filter units **20**, thereby avoiding color mixture and ensuring display effects.

[0043] For ensuring the reflection and light blocking effects of the reflective layer **32**, the reflectivity of the reflective layer **32** in the present invention is greater than 70%, and the reflective layer has a thickness of 3 μm to 6 μm, and an optical density value of the reflective layer **32** of per 1 μm thickness is greater than 1. Thus, it can be ensured that most of the light irradiated on the surface of the reflective layer **32** is reflected back into the quantum dot filter units **20**, and the remaining portion of the light is absorbed by the reflective layer **32**, thereby effectively preventing the light from passing through the quantum dot filter units **20**, resulting in color mixture or color shift.

[0044] Specifically, the color filter substrate further includes a protective layer **40** on the quantum dot filter units **20** and on the retaining walls **30**, and a water-oxygen barrier layer **50** between the quantum dot filter units **20** and the protective layer **40**. The water-oxygen barrier layer **50** serves to prevent the quantum dot filter units **20** from being infiltrated by water and oxygen, resulting in device failure.

[0045] Specifically, the plurality of quantum dot filter units **20** include red quantum dot filter units R, green quantum dot filter units G and blue quantum dot filter units B that are alternately arranged in sequence. A blue filter layer **60** is further disposed between the red quantum dot filter unit R and the base substrate **10** and between the green quantum dot filter unit G and the base substrate **10**. The red quantum dot filter unit R, the green quantum dot filter unit G and the blue quantum dot filter unit B are respectively used to generate red light, green light and blue light under excitation of the incident backlight. The blue filter layer **60** is used for further filtering the red light and the green light to remove blue light components therein and to improve color purity.

[0046] Specifically, the counter substrate **22** is an array substrate on which a thin film transistor array is formed.

[0047] Specifically, spacers **90** for supporting a gap between the counter substrate **22** and the color filter substrate **21** are further formed between the counter substrate **22** and the color filter substrate **21**. The spacers **90** include a primary spacer and a sub spacer having a height less than the main spacer, and the spacers **90** are located above areas in which the retaining walls **30** are located.

[0048] Specifically, since the light generated by the quantum dot filter unit **20** is unpolarized light, the present invention adjusts the position of the polarizer of the liquid crystal display device. Specifically, the liquid crystal display device further includes a first polarizing layer **70** and a second polarizing layer **80**; the first polarizing layer **70** is located between the counter substrate **22** and the backlight module **1**, and the second polarizing layer **80** is located between the color filter substrate **21** and the liquid crystal layer **23**. By placing the second polarizing layer **80** between the color filter substrate **21** and the liquid crystal layer **23**, the problem that the light generated by the quantum dot filter unit **20** is unpolarized light and cannot be emitted from the polarizing layer can be avoided.

[0049] Specifically, the polarization axes of the first polarizing layer **70** and the second polarizing layer **80** are perpendicular.

[0050] Preferably, the second polarizing layer **80** is a metal grating polarizing layer.

[0051] In conclusion, the present invention provides a color filter substrate. The color filter substrate includes a base substrate, a plurality of quantum dot filter units arranged in an array on the base substrate and retaining walls disposed among the quantum dot filter units on the base substrate; the retaining wall includes a black matrix layer disposed on the base substrate and a reflective layer disposed on the black matrix layer, and the retaining wall has a thickness greater than a thickness of the quantum dot filter unit. The reflective layer can re-reflect light irradiated on a surface thereof to the quantum dot filter units for secondary utilization, thereby improving utilization of the light while avoiding color mixture through the other quantum dot filter units. The present invention further provides a liquid crystal display device, which can effectively separate respective quantum dot filter units to improve light utilization while avoiding color mixture.

[0052] Above are only specific embodiments of the present invention, the scope of the present invention is not limited to this, and to any persons who are skilled in the art, change or replacement which is easily derived should be covered by the protected scope of the invention. Thus, the protected scope of the invention should go by the subject claims.

What is claimed is:

1. A color filter substrate, including a base substrate, a plurality of quantum dot filter units arranged in an array on the base substrate and retaining walls disposed among the quantum dot filter units on the base substrate;

wherein the retaining wall includes a black matrix layer disposed on the base substrate and a reflective layer disposed on the black matrix layer, and the retaining wall has a thickness greater than a thickness of the quantum dot filter unit.

2. The color filter substrate according to claim **1**, wherein a reflectivity of the reflective layer is greater than 70%;

the reflective layer has a thickness of 3 μm to 6 μm, and an optical density value of the reflective layer per one micrometer thickness is greater than 1.

3. The color filter substrate according to claim **1**, further including a protective layer on the quantum dot filter units and on the retaining walls, and a water-oxygen barrier layer between the quantum dot filter units and the protective layer.

4. The color filter substrate according to claim **1**, wherein the plurality of quantum dot filter units include red quantum dot filter units, green quantum dot filter units and blue quantum dot filter units that are alternately arranged in sequence.

5. The color filter substrate according to claim **1**, wherein a blue filter layer is further disposed between the red quantum dot filter unit and the base substrate and between the green quantum dot filter unit and the base substrate.

6. A liquid crystal display device, including a backlight module and a liquid crystal display panel disposed above the backlight module;

wherein the liquid crystal display panel includes: a color filter substrate, a counter substrate disposed opposite to the color filter substrate and a liquid crystal layer between the color filter substrate and the counter substrate; the backlight module is located on a side of the counter substrate away from the color filter substrate;

wherein the color filter substrate includes a first base substrate, a plurality of quantum dot filter units arranged in an array on the first base substrate and retaining walls disposed among the quantum dot filter units on the first base substrate;

wherein the retaining wall includes a black matrix layer disposed on the first base substrate and a reflective layer disposed on the black matrix layer, and the retaining wall has a thickness greater than a thickness of the quantum dot filter unit.

7. The liquid crystal display device according to claim **6**, wherein a reflectivity of the reflective layer is greater than 70%;

the reflective layer has a thickness of 3 μm to 6 μm, and an optical density value of the reflective layer per one micrometer thickness is greater than 1.

8. The liquid crystal display device according to claim **6**, wherein the color filter substrate further includes a protective layer on the quantum dot filter units and on the retaining walls, and a water-oxygen barrier layer between the quantum dot filter units and the protective layer.

9. The liquid crystal display device according to claim **6**, wherein the plurality of quantum dot filter units include red quantum dot filter units, green quantum dot filter units and blue quantum dot filter units that are alternately arranged in sequence;

wherein a blue filter layer is further disposed between the red quantum dot filter unit and the base substrate and between the green quantum dot filter unit and the base substrate.

10. The liquid crystal display device according to claim **6**, further including a first polarizing layer and a second polarizing layer;

wherein the first polarizing layer is located between the counter substrate and the backlight module, and the second polarizing layer is located between the color filter substrate and the liquid crystal layer.

* * * * *

专利名称(译)	滤色器基板和液晶显示装置		
公开(公告)号	US20200133053A1	公开(公告)日	2020-04-30
申请号	US16/335253	申请日	2018-11-19
[标]申请(专利权)人(译)	武汉华星光电技术有限公司		
发明人	YANG, CHAOQUN HUANG, CHANGCHIH		
IPC分类号	G02F1/1335 G02F1/13357		
CPC分类号	G02F1/133512 G02F2001/133565 G02F2001/133614 G02F1/133528 G02F2201/50 G02F2202/36 G02F2001/133567 G02F1/133617 G02F1/133514 G02F1/133553 G02F2001/133311 G02F2201/501		
优先权	201811253620.0 2018-10-25 CN		
外部链接	Espacenet USPTO		

摘要(译)

提供一种滤色器基板和液晶显示装置。 所述滤色器基板包括：基底基板；在所述基底基板上排列成阵列的多个量子点过滤器单元；以及在所述基底基板上的所述量子点过滤器单元之间配置的挡土墙； 挡墙包括设置在基底基板上的黑矩阵层和设置在黑矩阵层上的反射层，并且挡墙的厚度大于量子点滤波器单元的厚度。 反射层可以将其表面上照射的光重新反射到量子点滤光器单元以进行二次利用，从而提高光的利用率，同时避免通过其他量子点滤光器单元的颜色混合。