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CRYSTAL DISPLAY DEVICE**(52) **U.S. CL.**CPC **G02F 1/133621** (2013.01); **G02F**
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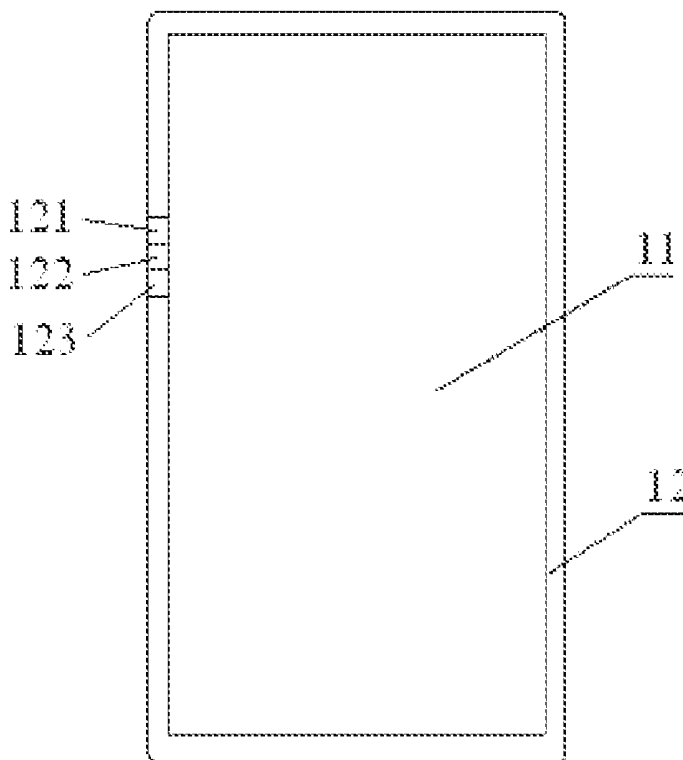
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(57)

ABSTRACT

A quantum dot diaphragm is disclosed. The quantum dot diaphragm comprises a color gamut conversion region and a color gamut non-effective region surrounding the color gamut conversion region, wherein the color gamut non-effective region is provided with a quantum phosphor layer. According to the present disclosure, the color gamut non-effective region is provided with the quantum phosphor layer, so that the technical defect that an area of the diaphragm along the cutting line would become useless when the diaphragm is cut can be eliminated, and a color gamut conversion function of the quantum dot diaphragm can be further improved. The manufacturing procedure of the quantum dot diaphragm according to the present disclosure is simple. After the quantum dot diaphragm is cut, the color gamut non-effective region of the quantum dot diaphragm could be coated with the quantum phosphor, and then the quantum dot diaphragm needs to be assembled to the module product, so that the electronic products with high color gamut can be obtained.

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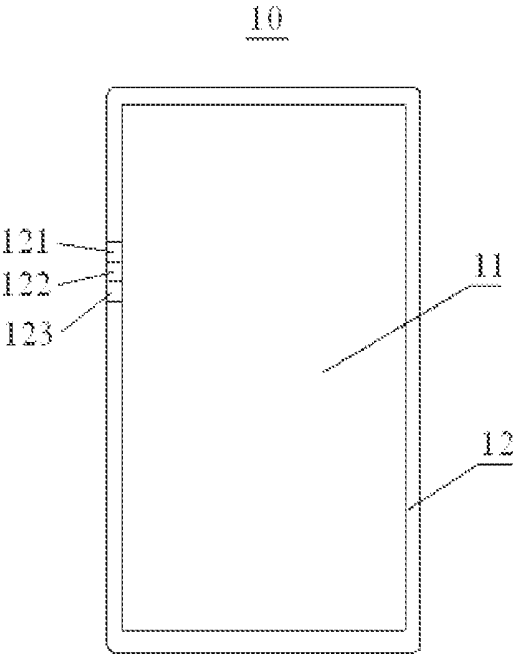


Fig. 1

QUANTUM DOT DIAPHRAGM AND LIQUID CRYSTAL DISPLAY DEVICE

CROSS REFERENCE TO RELATED APPLICATION

[0001] The present application claims benefit of Chinese patent application CN 201510223177.2, entitled “Quantum Dot Diaphragm and Liquid Crystal Display Device” and filed on May 5, 2015, the entirety of which is incorporated herein by reference.

FIELD OF THE INVENTION

[0002] The present disclosure relates to the technical field of liquid crystal display, and particularly to a quantum dot diaphragm and a liquid crystal display device.

BACKGROUND OF THE INVENTION

[0003] With the development of electronic products, there is an increasingly high requirement for color gamut of the electronic products, and thus high color gamut design has become an important direction of electronic product design. At present, in the designing of high color gamut products, the color gamut conversion is generally realized by a quantum dot diaphragm which has a color gamut conversion function with a relatively high efficiency. However, when the diaphragm is cut, an area of the diaphragm along a cutting line thereof with a width about 1 mm would become useless. Consequently, with respect to mobile electronic products having a relatively narrow frame, the quantum dot diaphragm cannot be applied to these products satisfactorily.

[0004] In order to solve the aforesaid technical problem, a method through which the technical defect that an area of the diaphragm along the cutting line would become useless when the diaphragm is cut can be eliminated is needed, so that a better color gamut conversion function of the quantum dot diaphragm can be realized.

SUMMARY OF THE INVENTION

[0005] The present disclosure provides a quantum dot diaphragm in order to further improve a color gamut conversion function thereof.

[0006] The quantum dot diaphragm according to the present disclosure comprises a color gamut conversion region and a color gamut non-effective region surrounding the color gamut conversion region, wherein the color gamut non-effective region is provided with a quantum phosphor layer.

[0007] According to the present disclosure, the color gamut non-effective region is provided with the quantum phosphor layer, so that the technical defect that an area of the diaphragm along the cutting line would become useless when the diaphragm is cut can be eliminated, and a color gamut conversion function of the quantum dot diaphragm can be further improved. The manufacturing procedure of the quantum dot diaphragm according to the present disclosure is simple. After the quantum dot diaphragm is cut, the color gamut non-effective region of the quantum dot diaphragm could be coated with the quantum phosphor, and then the quantum dot diaphragm needs to be assembled to the module product, so that the electronic products with high color gamut can be obtained. It can be understood that, according to the present disclosure, the whole quantum dot diaphragm can be coated with the quantum phosphor layer. However, the whole quantum dot diaphragm being coated

with the quantum phosphor layer is not cost-efficient since the quantum phosphor is relatively expensive.

[0008] According to some embodiments, an outside surface of the color gamut conversion region is flush with an outside surface of the color gamut non-effective region which is provided with the quantum phosphor layer. The flatness of an outside surface of the whole quantum dot diaphragm can be fully guaranteed with this arrangement, so that the quantum dot diaphragm can have a same thickness in each region thereof, and the color gamut conversion function of the quantum dot diaphragm can be further improved.

[0009] According to some embodiments, the quantum phosphor layer comprises a variety of quantum dots that can convert light received into light with different colors, which forms white light after mixture thereof. The color gamut conversion function can be realized by the quantum phosphor layer. The light that is emitted by a light source can be converted into the light with different colors by the quantum phosphor layer, and the light with different colors can form white light with a higher color gamut after mixture thereof.

[0010] According to some embodiments, the quantum phosphor layer comprises a plurality of transparent regions through which blue light can transmit, and a plurality of first quantum dot regions and second quantum dot regions which can at least be excited by the blue light and emit red light and green light respectively. According to one implementation, the blue light can be emitted by the light source. When the blue light irradiates the quantum phosphor layer, it can transmit directly through the transparent regions. At the same time, the first quantum dot regions and the second quantum dot regions can be excited by the blue light and then emit red light and green light respectively. The red light and the green light can mix with the blue light which transmits through the transparent regions so as to form the white light with a higher color gamut.

[0011] According to some embodiments, the transparent regions, the first quantum dot regions, and the second quantum dot regions are arranged in the color gamut non-effective region in an alternate manner. The aforesaid regions each can be arranged in the color gamut non-effective region conveniently with this disposition, and the light which exits from the color gamut non-effective region can become more uniform. Preferably, the transparent regions, the first quantum dot regions, and the second quantum dot regions each have a strip shape, and strip widths thereof can be selected with a certain ratio thereamong according to actual needs.

[0012] According to some embodiments, the transparent regions, the first quantum dot regions, and the second quantum dot regions each have a same light transmission area. With this arrangement, the light which exits from the transparent regions, the light which exits from the first quantum dot regions, and the light which exits from the second quantum dot regions share a same proportion, and thus the light exiting therefrom can become more uniform.

[0013] According to some embodiments, the quantum dot diaphragm is provided with a protection layer on an outside surface thereof. On the one hand, the flatness of the surface of the quantum dot diaphragm can be improved by the protection layer. On the other hand, the quantum dot diaphragm can be well protected by the protection layer, so that the color gamut conversion function thereof can be realized.

[0014] The present disclosure further provides a liquid crystal display device which comprises the aforesaid quantum dot diaphragm. In the liquid crystal display device with the aforesaid quantum dot diaphragm, a higher color gamut can be realized since the quantum dot diaphragm has a good color gamut conversion function.

[0015] According to some embodiments, the liquid crystal display device further comprises a backlight module and a liquid crystal panel, wherein the quantum dot diaphragm is arranged between the backlight module and the liquid crystal panel.

[0016] Compared with the prior art, the following advantages can be brought about according to the present disclosure.

[0017] 1) The quantum dot diaphragm according to the present disclosure has a full color gamut conversion function. That is, the technical defect that an area of the diaphragm along the cutting line would become useless when the diaphragm is cut can be eliminated through arranging the quantum phosphor layer in the color gamut non-effective region and designing the quantum phosphor layer appropriately.

[0018] 2) The manufacturing procedure of the quantum dot diaphragm according to the present disclosure is simple. After the quantum dot diaphragm is cut, the color gamut non-effective region thereof needs to be coated with the quantum phosphor simply, so that the quantum dot diaphragm is manufactured.

[0019] 3) The quantum dot diaphragm according to the present disclosure can be applied to a variety of liquid crystal display devices, so that a high color gamut design of the variety of liquid crystal display devices can be realized.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] The present disclosure will be illustrated in detail hereinafter with reference to the embodiments and the drawings. In the drawing:

[0021] FIG. 1 schematically shows a structure of a quantum dot diaphragm according to the present disclosure.

[0022] In the drawings, a same component is represented by a same reference sign. The drawings are not drawn according to actual scale.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0023] The present disclosure will be further illustrated hereinafter with reference to the drawings.

[0024] The details described herein are only specific examples used for discussing the implementations of the present disclosure. The most useful and most understandable description on the principle and concept of the present disclosure is provided. The structural details which go beyond the scope of basic understanding of the present disclosure are not provided herein. Therefore, those skilled in the art can clearly understand, based on the description and the accompanying drawings, how to implement the present disclosure in different ways.

[0025] FIG. 1 schematically shows a structure of a quantum dot diaphragm 10 according to the present disclosure. The quantum dot diaphragm 10 comprises a color gamut conversion region 11 and a color gamut non-effective region 12 surrounding the color gamut conversion region 11,

wherein the color gamut non-effective region 12 is provided with a quantum phosphor layer (the quantum phosphor layer is not shown in FIG. 1).

[0026] According to the present disclosure, the color gamut non-effective region 12 is provided with the quantum phosphor layer, so that the technical defect that an area of the diaphragm along the cutting line would become useless when the diaphragm is cut can be eliminated, and a color gamut conversion function of the quantum dot diaphragm 10 can be further improved. The manufacturing procedure of the quantum dot diaphragm 10 according to the present disclosure is simple. After the quantum dot diaphragm 10 is cut, the color gamut non-effective region 12 of the quantum dot diaphragm 10 could be coated with the quantum phosphor, and then the quantum dot diaphragm 10 needs to be assembled to the module product, so that the electronic products with high color gamut can be obtained. It can be understood that, according to the present disclosure, the whole quantum dot diaphragm 10 can be coated with the quantum phosphor layer. However, the whole quantum dot diaphragm 10 being coated with the quantum phosphor layer is not cost-efficient since the quantum phosphor is relatively expensive.

[0027] Preferably, an outside surface of the color gamut conversion region 11 is on a level with an outside surface of the color gamut non-effective region 12 which is provided with the quantum phosphor layer. The flatness of an outside surface of the whole quantum dot diaphragm 10 can be fully guaranteed with this arrangement, so that the quantum dot diaphragm 10 can have a same thickness in each region thereof, and the color gamut conversion function of the quantum dot diaphragm can be further improved.

[0028] According to the present disclosure, the quantum phosphor layer comprises a variety of quantum dots that can convert light received into light with different colors, which forms white light after mixture thereof. The color gamut conversion function can be realized by the quantum phosphor layer. The light that is emitted by a light source can be converted into the light with different colors by the quantum phosphor layer, and the light with different colors can form white light with a higher color gamut after mixture thereof.

[0029] According to the embodiment as shown in FIG. 1, the quantum phosphor layer comprises a plurality of transparent regions 121 through which blue light can transmit, and a plurality of first quantum dot regions 122 and second quantum dot regions 123 which can at least be excited by the blue light and emit red light and green light respectively. According to the present embodiment, the blue light can be emitted by the light source. When the blue light irradiates the quantum phosphor layer, it can transmit directly through the transparent regions 121. At the same time, the first quantum dot regions 122 and the second quantum dot regions 123 can be excited by the blue light and then emit red light and green light respectively. The red light and the green light can mix with the blue light which transmits through the transparent regions 121 so as to form the white light with a higher color gamut.

[0030] Preferably, as shown in FIG. 1, the transparent regions 121, the first quantum dot regions 122, and the second quantum dot regions 123 are arranged in the color gamut non-effective region 12 alternately. The aforesaid regions each can be arranged in the color gamut non-effective region 12 conveniently with this disposition, and the light which exits from the color gamut non-effective

region 12 can become more uniform. Preferably, the transparent regions 121, the first quantum dot regions 122, and the second quantum dot regions 123 each have a strip shape, and strip widths thereof can be selected with a certain ratio thereamong according to actual needs.

[0031] More preferably, the transparent regions 121, the first quantum dot regions 122, and the second quantum dot regions 123 each have a same light transmission area. With this arrangement, the light which exits from the transparent regions 121, the light which exits from the first quantum dot regions 122, and the light which exits from the second quantum dot regions 123 share a same proportion, and thus the light exiting therefrom can become more uniform.

[0032] Moreover, the quantum dot diaphragm 10 according to the present disclosure is provided with a protection layer on an outside surface thereof. On the one hand, the flatness of the surface of the quantum dot diaphragm 10 can be improved by the protection layer. On the other hand, the quantum dot diaphragm 10 can be well protected by the protection layer, so that the color gamut conversion function thereof can be realized.

[0033] The present disclosure further provides a liquid crystal display device which comprises the aforesaid quantum dot diaphragm. In the liquid crystal display device with the aforesaid quantum dot diaphragm, a higher color gamut can be realized since the quantum dot diaphragm has a good color gamut conversion function. The quantum dot diaphragm according to the present disclosure can be applied to a variety of liquid crystal display devices, so that a high color gamut design of the variety of liquid crystal display devices can be realized. The quantum dot diaphragm is preferably arranged between a backlight module and a liquid crystal panel.

[0034] The quantum dot diaphragm according to the present disclosure has a full color gamut conversion function, and the manufacturing procedure thereof is simple. Therefore, the quantum dot diaphragm can be widely used in a variety of display products.

[0035] It should be noted that, the above embodiments are described only for better understanding, rather than restricting the present disclosure. Those skilled in the art can make amendments to the present disclosure within the scope as defined in the claims and without departing from the spirit and scope of the present disclosure. The present disclosure is described according to specific methods, materials, and implementations, but the present disclosure is not restricted by the details disclosed herein. On the contrary, the present disclosure is applicable for the equivalent structures, methods, and applications with the same functions as those defined in the claims.

1. A quantum dot diaphragm, comprising a color gamut conversion region and a color gamut non-effective region surrounding the color gamut conversion region, wherein the color gamut non-effective region is provided with a quantum phosphor layer.

2. The quantum dot diaphragm according to claim 1, wherein an outside surface of the color gamut conversion region is flush with an outside surface of the color gamut non-effective region which is provided with the quantum phosphor layer.

3. The quantum dot diaphragm according to claim 1, wherein the quantum phosphor layer comprises a variety of

quantum dots that can convert light received therein into light with different colors, which forms white light after mixture.

4. The quantum dot diaphragm according to claim 2, wherein the quantum phosphor layer comprises a variety of quantum dots that can convert light received therein into light with different colors, which forms white light after mixture.

5. The quantum dot diaphragm according to claim 1, wherein the quantum phosphor layer comprises a plurality of transparent regions through which blue light can transmit, and a plurality of first quantum dot regions and second quantum dot regions which can at least be excited by the blue light and emit red light and green light respectively.

6. The quantum dot diaphragm according to claim 5, wherein the transparent regions, the first quantum dot regions, and the second quantum dot regions are arranged in the color gamut non-effective region in an alternate manner.

7. The quantum dot diaphragm according to claim 6, wherein the transparent regions, the first quantum dot regions, and the second quantum dot regions each have a strip shape.

8. The quantum dot diaphragm according to claim 2, wherein the quantum phosphor layer comprises a plurality of transparent regions through which blue light can transmit, and a plurality of first quantum dot regions and second quantum dot regions which can at least be excited by the blue light and emit red light and green light respectively.

9. The quantum dot diaphragm according to claim 8, wherein the transparent regions, the first quantum dot regions, and the second quantum dot regions are arranged in the color gamut non-effective region in an alternate manner.

10. The quantum dot diaphragm according to claim 9, wherein the transparent regions, the first quantum dot regions, and the second quantum dot regions each have a strip shape.

11. The quantum dot diaphragm according to claim 5, wherein the transparent regions, the first quantum dot regions, and the second quantum dot regions each have a same light transmission area.

12. The quantum dot diaphragm according to claim 8, wherein the transparent regions, the first quantum dot regions, and the second quantum dot regions each have a same light transmission area.

13. The quantum dot diaphragm according to claim 1, wherein the quantum dot diaphragm is provided with a protection layer on an outside surface thereof.

14. The quantum dot diaphragm according to claim 2, wherein the quantum dot diaphragm is provided with a protection layer on an outside surface thereof.

15. A liquid crystal display device, comprising a quantum dot diaphragm, which comprises a color gamut conversion region and a color gamut non-effective region surrounding the color gamut conversion region, wherein the color gamut non-effective region is provided with a quantum phosphor layer.

16. The liquid crystal display device according to claim 15, wherein an outside surface of the color gamut conversion region is flush with an outside surface of the color gamut non-effective region which is provided with the quantum phosphor layer.

17. The liquid crystal display device according to claim 15, further comprising a backlight module and a liquid

crystal panel, wherein the quantum dot diaphragm is arranged between the backlight module and the liquid crystal panel.

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专利名称(译)	量子点光阑和液晶显示装置		
公开(公告)号	US20170219886A1	公开(公告)日	2017-08-03
申请号	US14/778210	申请日	2015-05-14
[标]申请(专利权)人(译)	武汉华星光电技术有限公司		
申请(专利权)人(译)	中国武汉恒星光电科技有限公司.		
当前申请(专利权)人(译)	中国武汉恒星光电科技有限公司.		
[标]发明人	ZHANG YANXUE		
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IPC分类号	G02F1/1335		
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优先权	201510223177.2 2015-05-05 CN		
其他公开文献	US10690965		
外部链接	Espacenet USPTO		

摘要(译)

公开了一种量子点振膜。量子点光阑包括色域转换区域和围绕色域转换区域的色域非有效区域，其中色域非有效区域设置有量子荧光层。根据本发明，色域非有效区域设置有量子荧光层，从而可以消除在切割光阑时沿着切割线的光阑区域变得无用的技术缺陷，并且量子点光阑的色域转换功能可以进一步提高。根据本公开的量子点光阑的制造过程简单。量子点光阑切割后，量子点光阑的色域无效区域可以涂上量子荧光粉，然后需要将量子点光阑组装到模块产品上，使电子产品高可以获得色域。

