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(54) **MICRO LED DISPLAY DEVICE**

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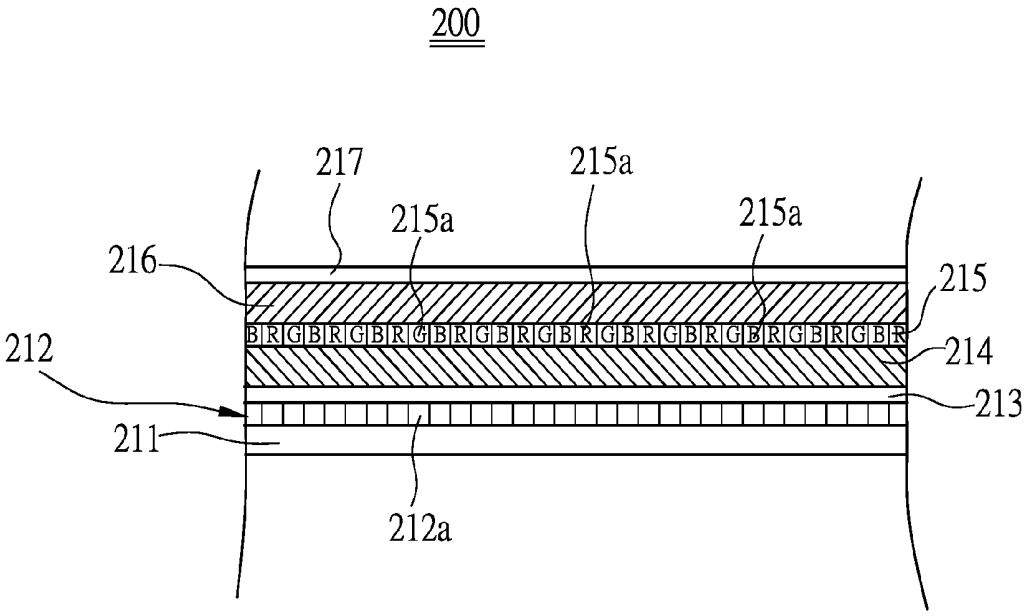
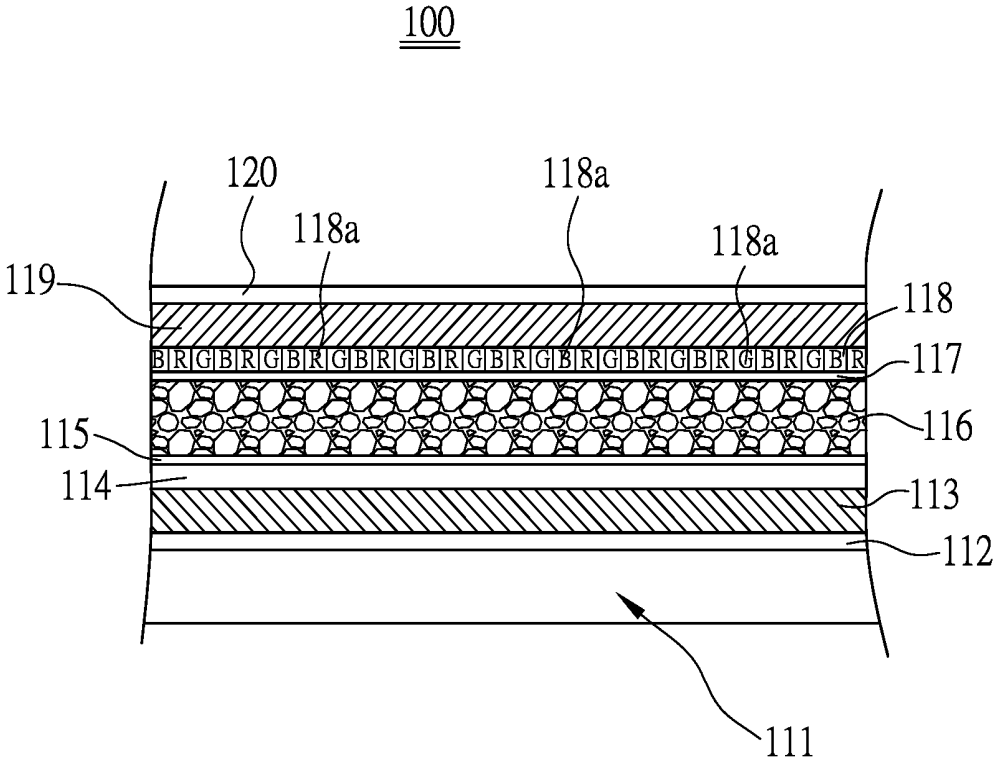
CPC ***H01L 27/156*** (2013.01); *G02B 5/201* (2013.01); ***H01L 33/507*** (2013.01)

(57) **ABSTRACT**

A micro LED display device includes a micro LED array, a light transmission layer, a color filter and a polarizer. The micro LED array includes a plurality of micro LEDs. The light transmission layer is located above the micro LED array. The color filter is located above the light transmission layer. The polarizer is located above the color filter.





Prior Art

Fig. 1

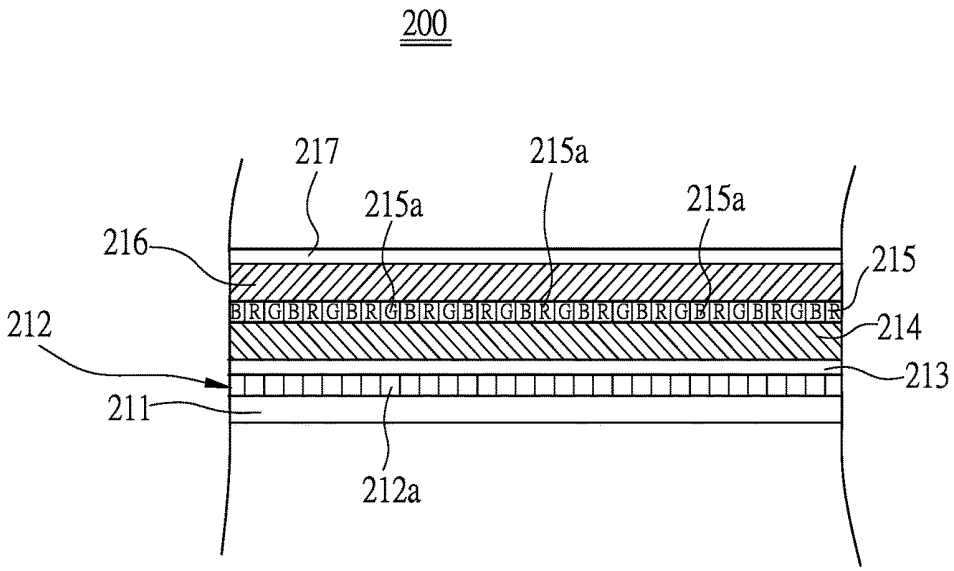


Fig. 2

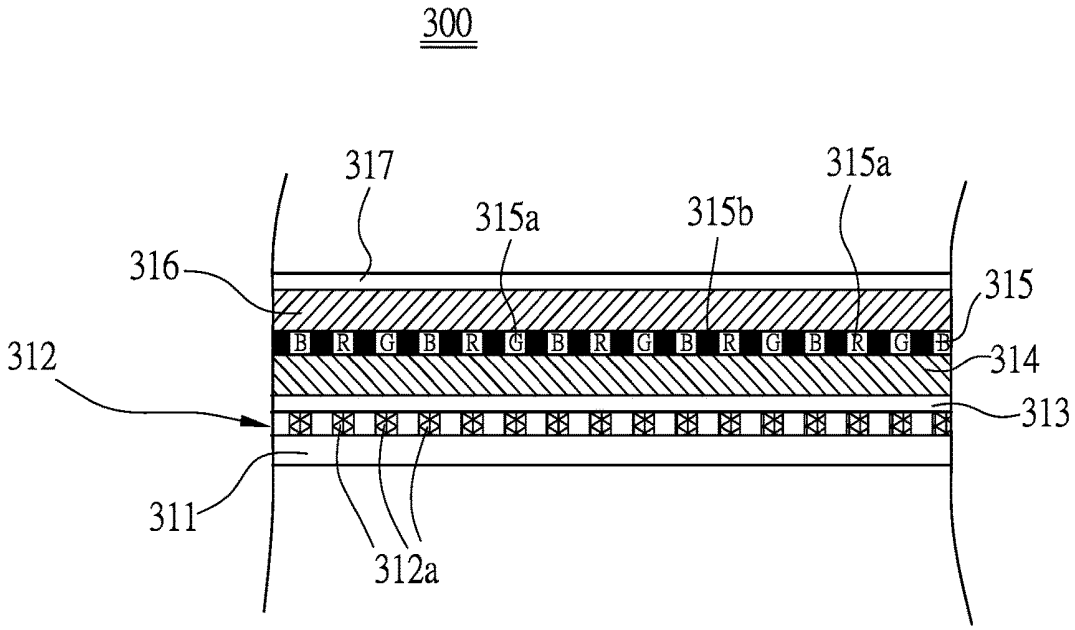

300
317
315a
315b
315a
316
315
B R G B R G B R G B R G B R G B
312
314
313
311
312a

Fig. 3

MICRO LED DISPLAY DEVICE

RELATED APPLICATIONS

[0001] This application claims priority to TW Application Serial Number 107103892, filed Feb. 2, 2018, which is herein incorporated by reference.

BACKGROUND

Technical Field

[0002] The present disclosure relates to a display device. More particularly, the present disclosure relates to a micro LED display device.

Description of Related Art

[0003] Recently, a display device has been rapidly developed as an important human-machine interface. A portable electronic device, a computer or a television can represent complicated messages through the display device.

[0004] Owing to the demands on the large visible area, compact volume and low energy consumption, a liquid crystal display (LCD) device is getting more popular and has become a mainstream. A conventional LCD device **100** is shown in FIG. **1**. The LCD device **100** includes, from bottom to top, a backlight module **111**, a first polarizer **112**, a first substrate **113**, a transistor layer **114**, a first electrode **115**, a liquid crystal layer **116**, a second electrode **117**, a color filter **118**, a second substrate **119** and a second polarizer **120**. The operation mechanism of the LCD device **100** is then briefly described. The liquid crystal molecules in the liquid crystal layer **116** are twisted when a voltage is applied. One or more transistors in the transistor layer **114** is/are used to control the twisted direction of the liquid crystal molecules and are functioned as a light switch. Furthermore, lights emitted from the backlight module **111** are passed through the first polarizer **112** and the second polarizer **120** for generating different polarized direction lights to incorporate with the twisted directions of the liquid crystal molecules to control the brightness variation to form a gray scale. For generating color lights, a plurality of sub-pixel units **118***a* are disposed on the color filter **118**, and a single pixel is constructed by combining a sub-pixel unit **118***a* corresponded to a red light color, a sub-pixel unit **118***a* corresponded to a green light color and a sub-pixel unit **118***a* corresponded to a blue light color. Therefore, an image with a full color can be formed by combining a plurality of pixels. Furthermore, an alignment film can be disposed on the first substrate **113** and the second substrate **119** for aligning the liquid crystal molecules. A voltage can be applied to the transistor layer **114** through the first electrode layer **115** and the second electrode **117**.

[0005] However, the power efficiency and the brightness (contrast) of such kind of LCD device **100** is low because only few lights emitted from the backlight module **111** can pass through the liquid crystal layer **116**. Furthermore, the manufacturing processes of the transistor layer **114** are complicated thereby increasing the manufacturing cost. A kind of OLED device has been reached to the market as an alternative of the LCD device **100**. Although the OLED device has larger viewing angle then the conventional LCD device **100**, however, issues such as light color flashing and light color decay still exist and will cause a short lifetime.

[0006] Therefore, there is a need to develop a display device having high power efficiency, large viewing angle and long lifetime.

SUMMARY

[0007] According to one aspect of the present disclosure, a micro LED display device is provided. The micro LED display device includes a micro LED array, a light transmission layer, a color filter and a polarizer. The micro LED array includes a plurality of micro LEDs. The light transmission layer is located above the micro LED array. The color filter is located above the light transmission layer. The polarizer is located above the color filter.

[0008] In one example, the micro LED display device further includes an electrode layer, wherein the electrode layer drives the micro LED array to emit lights.

[0009] In one example, the micro LED display device further includes a first substrate and a second substrate, wherein the first substrate is located between the light transmission layer and the color filter, and the second substrate is located between the color filter and the polarizer.

[0010] In one example, the light transmission layer includes a quantum dot film, a polarizer film, a light enhancing film or a diffusion film.

[0011] In one example, the color filter includes a plurality of sub-pixel units; a color of each of the sub-pixel units is corresponded to a red color, a green color or a blue color.

[0012] In one example, a light color emitted from each of the micro LEDs includes a red light color, a green light color or a blue light color, and a color of each of the sub-pixel units is corresponded to the light color of each of the micro LEDs.

[0013] In one example, each of the micro LEDs emits a single light color.

[0014] In one example, each of the sub-pixel units of the color filter is departed by a mask.

[0015] In one example, each of the micro LEDs is aligned correspondingly to each of the sub-pixel units.

[0016] In one example, the sub-pixel units of the color filter are aligned in a linear shape, a square shape, a triangle shape or a mosaic shape.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] The present disclosure can be more fully understood by reading the following detailed description of the embodiment, with reference made to the accompanying drawings as follows:

[0018] FIG. **1** is a schematic view showing a conventional LCD device;

[0019] FIG. **2** is a schematic view showing a micro LED display device according to one embodiment of the present disclosure; and

[0020] FIG. **3** is a schematic view showing a micro LED display device according to another embodiment of the present disclosure.

DETAILED DESCRIPTION

[0021] FIG. **2** is a schematic view showing a micro LED display device **200** according to one embodiment of the present disclosure. The micro LED display device **200** includes a micro LED array **212**, a light transmission layer **213**, a color filter **215** and a polarizer **217**. In one example, the light transmission layer **213** is located above the micro

LED array **212**; the color filter **215** is located above the light transmission layer **213**; and the polarizer **217** is located above the color filter **215**. The micro LED display device **200** also includes a first substrate **214** and a second substrate **216**. The first substrate **214** is located between the light transmission layer **213** and the color filter **215**. The second substrate **216** is located between the color filter **215** and the polarizer **217**. The micro LED display device **200** can further include an electrode layer **211**. The electrode layer **211** can be located under the micro LED array **212** for electrically driving the micro LED array **212** to emit lights.

[0022] The operation mechanism of the micro LED display device **200** is then described. The micro LED array **212** includes a plurality of micro LEDs **212***a* which are aligned in order. Each of the micro LEDs **212***a* is electrically driven by the electrode layer **211**, and can emit a light spontaneously. The electrode layer **211** can be made from conductive materials (metal or other materials), and can provide the required electric power. The lights emitted from the micro LED array **212** pass through the light transmission layer **213** located above. The micro LED **212***a* is commonly an inorganic LED, and the light emitted therefrom is commonly a point light source. Although the micro LEDs **212***a* can be aligned together to form an array to provide a large-area surface light source, however, controlling the alignment of the micro LEDs is still a challenge. In the present disclosure, the light transmission layer **213** can include a quantum dot film, a polarizer film, a light enhancing film, a diffusion film or a combination thereof. Therefore, a light shape of the light passed through the light transmission layer **213** can be enlarged for providing a uniformity surface light source.

[0023] For generating a color variation, the color filter **215** is disposed above the light transmission layer **213**. It is known that an image is constructed by a plurality of pixels. The color filter **215** includes a plurality of sub-pixel units **215***a*. A single pixel can be formed by combining some of the sub-pixels **215***a*. For example, in a three primary color system, a sub-pixel unit **215***a* corresponded to a red color, a sub-pixel unit **215***a* corresponded to a green color and a sub-pixel unit **215***a* corresponded to a blue color are combined to form a single pixel. In a four primary color system, a sub-pixel unit **215***a* corresponded to a red color, a sub-pixel unit **215***a* corresponded to a green color, a sub-pixel unit **215***a* corresponded to a blue color and a sub-pixel unit **215***a* corresponded to a yellow color are combined to form a single pixel. In a six primary color system, a sub-pixel unit **215***a* corresponded to a red color, a sub-pixel unit **215***a* corresponded to a green color, a sub-pixel unit **215***a* corresponded to a blue color, a sub-pixel unit **215***a* corresponded to a cyan color, a sub-pixel unit **215***a* corresponded to a purple color and a sub-pixel unit **215***a* corresponded to a yellow color are combined to form a single pixel. A better color saturation and color reproduction can be achieved while using more sub-pixel units **215***a* with different colors. Furthermore, an alignment form of the sub-pixel units **215***a* also has influence on the color saturation. In other word, the sub-pixel units **215***a* of the color filter **215** can be aligned in a linear shape, a square shape, a triangle shape or a mosaic shape fir obtaining different color saturation.

[0024] A color variation is formed when a light passes through the color filter **215**, and the micro LED array **212** is used to provide a required light source. The micro LED array **212** includes a plurality of micro LEDs **212***a*, and each of the micro LEDs **212***a* is aligned correspondingly to each of the sub-pixel units **215***a* of the color filter **215**. Each of the micro LEDs **212***a* can emit the same or different light color. In one example, if the sub-pixel units **215***a* of the color filter **215** uses a three primary color system, a light color emitted from each of the micro LEDs includes a red light color, a green light color or a blue light color.

[0025] The polarizer **217** is used for generating a brightness variation (gray scale). A polarization angle and a polarization direction of a light can be adjusted when the light passes through the polarizer **217**. Thus, the brightness variation (gray scale) can be adjusted for producing a colorful illumination as a natural light.

[0026] FIG. **3** is a schematic view showing a micro LED display device **300** according to another embodiment of the present disclosure. In FIG. **3**, similar as the micro LED display device **200** in FIG. **2**, the micro LED display device **300** includes an electrode layer **311**, a micro LED array **312**, a light transmission layer **313**, a first substrate **314**, a color filter **315**, a second substrate **316** and a polarizer **317**. The details of the functions and the alignment order of each layer are similar as that in FIG. **2**, and are not addressed herein. The difference between the micro LED display device **200** and the micro LED display device **300** is that each of the sub-pixel units **315***a* in the micro LED display device **300** is departed by a mask **315***b*. The mask **315***b* can be used to block a scattered light for preventing the interference from the scattered light. The mask **315***b* can be made of black materials to form a so-call black matrix. Furthermore, each of the sub-pixel units **315***b* is aligned from each other, and each of the micro LEDs **312***a* is aligned correspondingly to each of the sub-pixel units **315***b*.

[0027] In the micro LED display device **200**, **300**, the emitted light is provided by the micro LED array **212**, **312**, and the micro LED array **212**, **312** includes a plurality of micro LEDs **212***a*, **312***a* which are made of inorganic materials. The mechanism of color Illumination of such micro LED display device **200**, **300** is significantly different from the conventional LCD device. Therefore, in the micro LED display device **200**, **300** of the present disclosure, the backlight controlling structure can be simplified thereby reducing the manufacturing cost. Furthermore, the micro LED display device **200**, **300** of the present disclosure has higher power efficiency, wider viewing angle and longer lifetime.

[0028] Although the present disclosure has been described in considerable detail with reference to certain embodiments thereof, other embodiments are possible. Therefore, the spirit and scope of the appended claims should not be limited to the description of the embodiments contained herein.

[0029] It will be apparent to those skilled in the art that various modifications and variations can be made to the structure of the present disclosure without departing from the scope or spirit of the disclosure. In view of the foregoing, it is intended that the present disclosure cover modifications and variations of this disclosure provided they fall within the scope of the following claims.

What is claimed is:

1. A micro LED display device, comprising:

a micro LED array comprising a plurality of micro LEDs;

a light transmission layer located above the micro led array;

a color filter located above the light transmission layer; and

a polarizer located above the color filter.

2. The micro LED display device of claim 1, further comprising:

an electrode layer, wherein the electrode layer drives the micro LED array to emit lights.

3. The micro LED display device of claim 1, further comprising:

a first substrate and a second substrate, wherein the first substrate is located between the light transmission layer and the color filter, and the second substrate is located between the color filter and the polarizer.

4. The micro LED display device of claim 1, wherein the light transmission layer comprises a quantum dot film, a polarizer film, a light enhancing film or a diffusion film.

5. The micro LED display device of claim 1, wherein the color filter comprises a plurality of sub-pixel units, a color of each of the sub-pixel units is corresponded to a red color, a green color or a blue color.

6. The micro LED display device of claim 1, wherein a light color emitted from each of the micro LEDs comprises a red light color, a green light color or a blue light color.

7. The micro LED display device of claim 6, wherein a color of each of the sub-pixel units is corresponded to the light color of each of the micro LEDs.

8. The micro LED display device of claim 5, wherein each of the micro LEDs emits a single light color.

9. The micro LED display device of claim 1, wherein each of the sub-pixel units of the color filter is departed by a mask.

10. The micro LED display device of claim 1, wherein each of the micro LEDs is aligned correspondingly to each of the sub-pixel units.

11. The micro LED display device of claim 1, wherein the sub-pixel units of the color filter are aligned in a linear shape, a square shape, a triangle shape or a mosaic shape.

* * * * *

专利名称(译)	微型LED显示装置		
公开(公告)号	US20190245006A1	公开(公告)日	2019-08-08
申请号	US16/136233	申请日	2018-09-19
[标]发明人	TSAI PING YU CHEN CHUNG CHING		
发明人	TSAI, PING-YU CHEN, CHUNG-CHING		
IPC分类号	H01L27/15 H01L33/50		
CPC分类号	H01L27/156 H01L33/507 G02B5/201 G02B5/3025 H01L25/0753 H01L33/58		
优先权	107103892 2018-02-02 TW		
外部链接	Espacenet USPTO		

摘要(译)

微LED显示装置包括微LED阵列，光透射层，滤色器和偏振器。微LED阵列包括多个微LED。光传输层位于微LED阵列上方。滤色器位于光透射层上方。偏振器位于滤色器上方。