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Huang(10) **Pub. No.: US 2009/0002596 A1**(43) **Pub. Date: Jan. 1, 2009**(54) **LIQUID CRYSTAL PANEL HAVING
REFLECTIVE FILM CORRESPONDING TO
NON-DISPLAY REGION AND LIQUID
CRYSTAL DISPLAY WITH SAME**(30) **Foreign Application Priority Data**

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INNOLUX DISPLAY CORP.**(57) **ABSTRACT**

An exemplary liquid crystal panel includes a first substrate assembly, a second substrate assembly parallel to the first substrate assembly, and a liquid crystal layer sandwiched between the first substrate assembly and the second substrate assembly. The second substrate assembly includes a transparent substrate and a reflective layer provided on a surface of the transparent substrate facing the first substrate assembly. The liquid crystal panel includes a display region and a non-display region. The reflective layer is positioned corresponding to the non-display region.

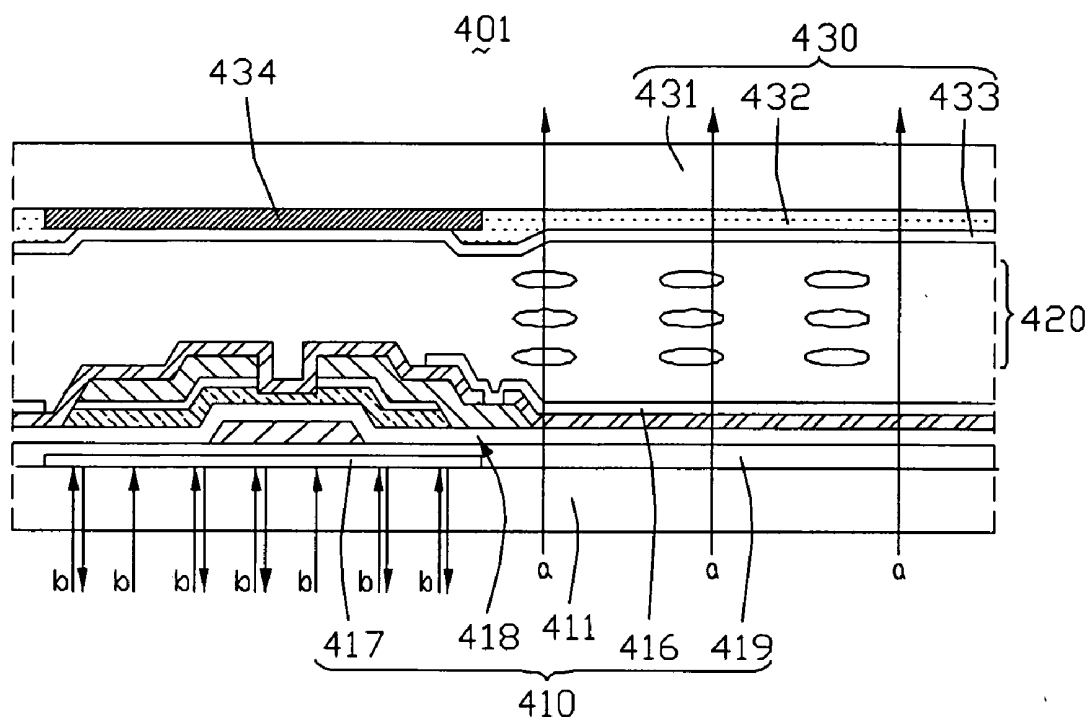
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FIG. 2

430

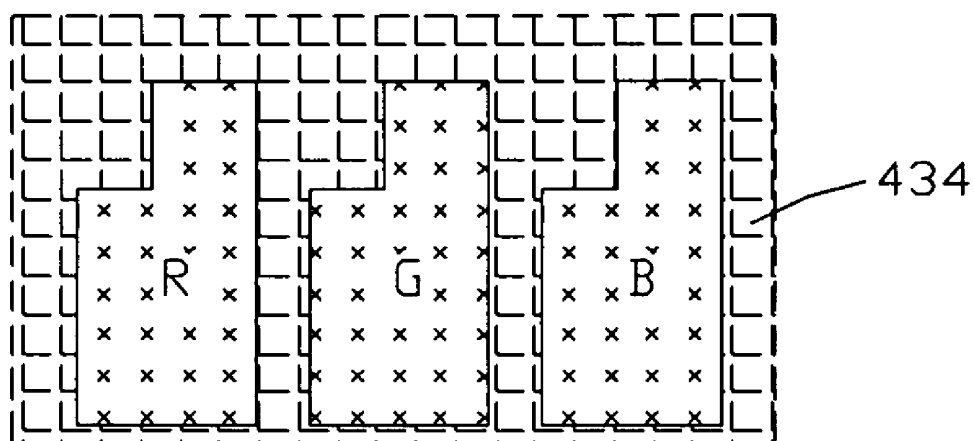


FIG. 3

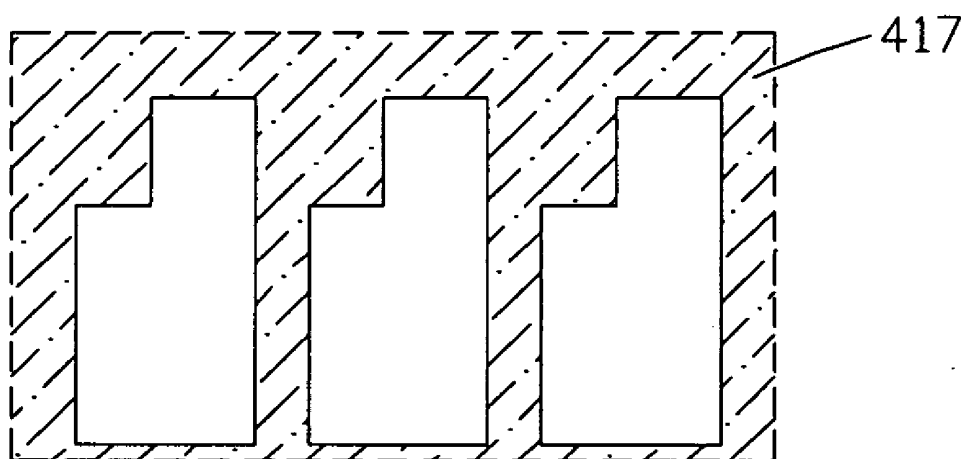


FIG. 4

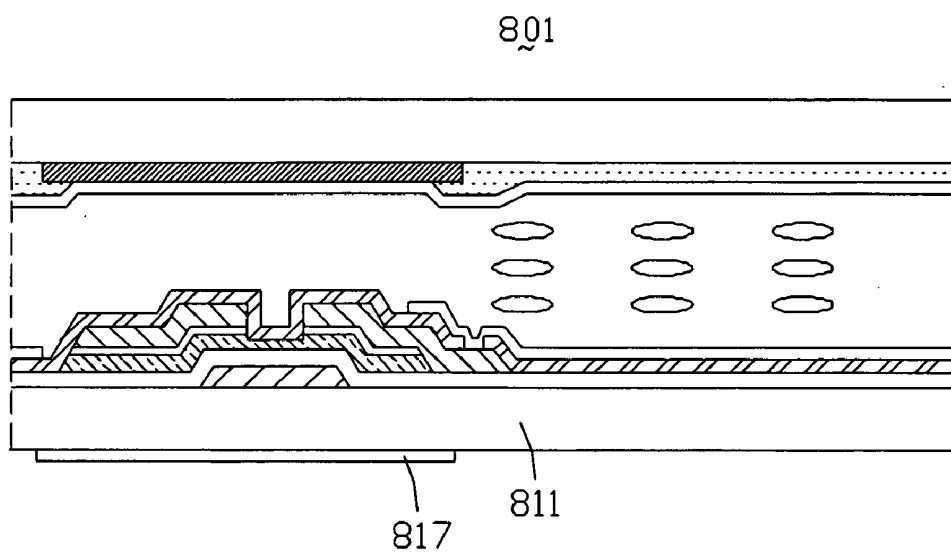


FIG. 5

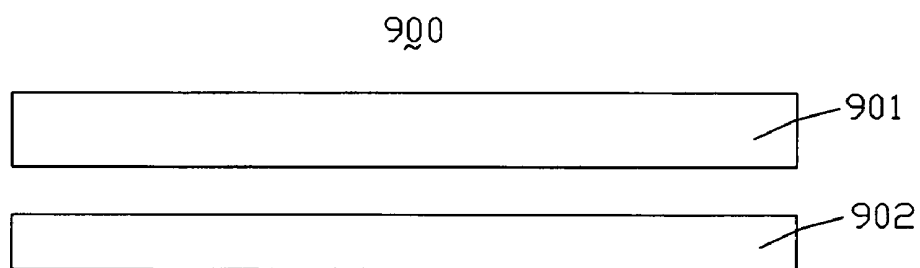


FIG. 6

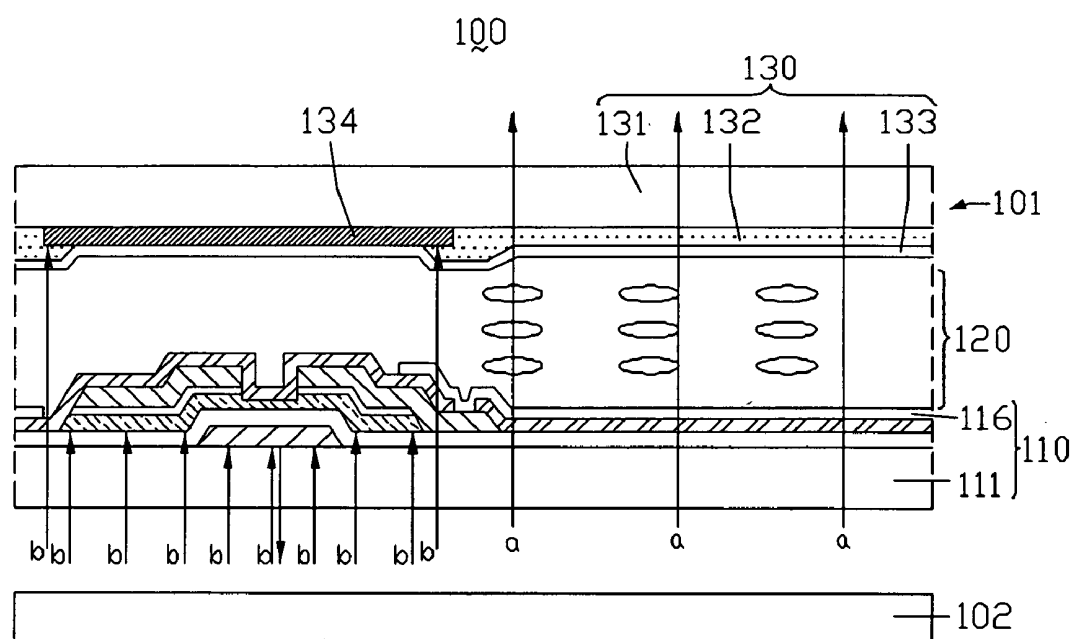


FIG. 7
(RELATED ART)

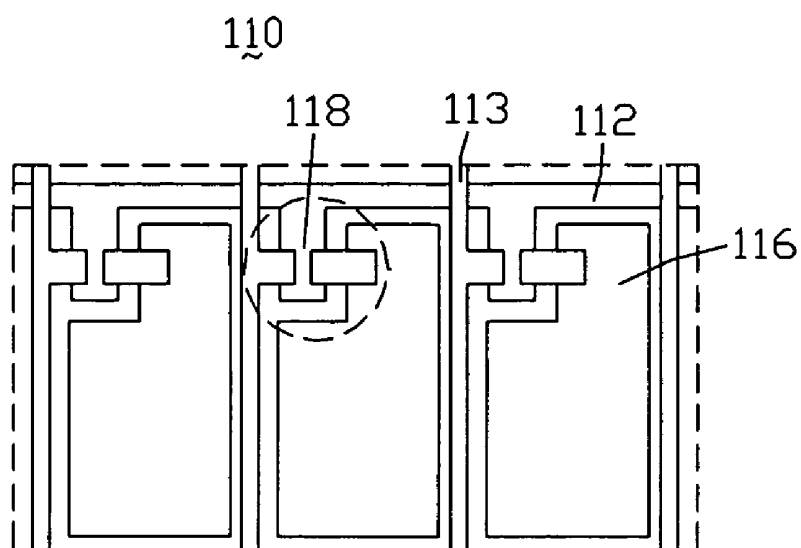


FIG. 8
(RELATED ART)

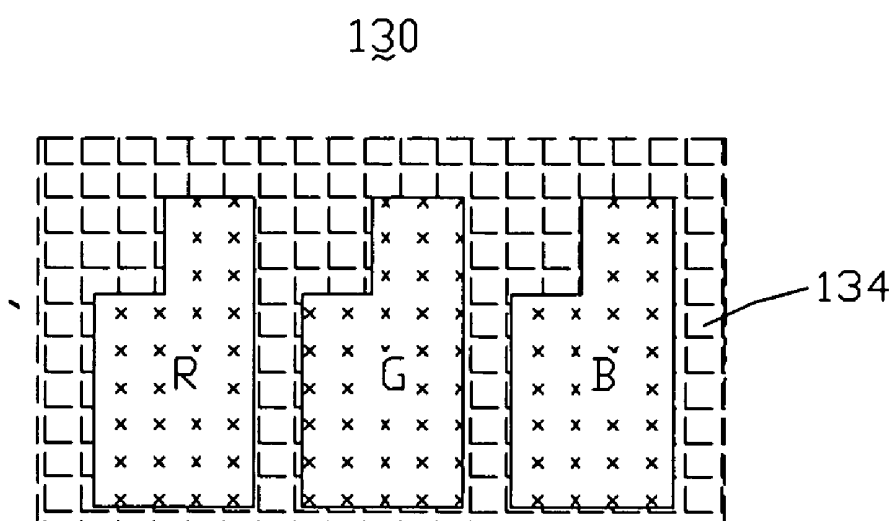


FIG. 9
(RELATED ART)

**LIQUID CRYSTAL PANEL HAVING
REFLECTIVE FILM CORRESPONDING TO
NON-DISPLAY REGION AND LIQUID
CRYSTAL DISPLAY WITH SAME**

[0001] The present invention relates to a liquid crystal panel having a reflective film corresponding to a non-display region thereof, and to a liquid crystal display using the liquid crystal panel.

BACKGROUND

[0002] Liquid crystal displays have the advantages of portability, low power consumption, and low radiation, and because of this they have been widely used in various portable information products such as notebooks, personal digital assistants (PDAs), video cameras, and the like. Furthermore, liquid crystal displays are considered by many to have the potential to completely replace CRT (cathode ray tube) monitors and televisions.

[0003] Referring to FIG. 7, part of a typical liquid crystal display is schematically shown. The liquid crystal display 100 includes a liquid crystal panel 101, and a backlight module 102 used for illuminating the liquid crystal panel 101. The liquid crystal panel 101 includes a first substrate assembly 110, a second substrate assembly 130 parallel to the first substrate assembly 110, and a liquid crystal layer 120 sandwiched between the first substrate assembly 110 and the second substrate assembly 120. The backlight module 102 is provided adjacent to the first substrate assembly 110.

[0004] Referring also to FIG. 8, the first substrate assembly 110 includes a first transparent substrate 111, a number n (where n is a natural number) of gate lines 112, a number m (where m is also a natural number) of data lines 113, a plurality of thin film transistors (TFTs) 118, and a plurality of pixel electrodes 116.

[0005] The gate lines 112 are parallel to each other, with each gate line 112 extending along a first direction. The data lines 113 are parallel to each other, with each data line 113 extending along a second direction orthogonal to the first direction. The gate lines 112 and the data lines 113 cross each other, thereby defining a plurality of pixel regions (not labeled). The pixel electrodes 116 are disposed in the pixel regions, respectively.

[0006] Referring also to FIG. 9, the second substrate assembly 130 includes a second transparent substrate 131, a color filter 132 provided on an inner surface of the second transparent substrate 131, and a common electrode 133 provided on an inner surface of the color filter 132. The color filter 132 includes a plurality of red filters (not labeled), a plurality of green filters (not labeled), and a plurality of blue filters (not labeled) arrayed in a matrix. The color filter 132 further includes a black matrix 134 that fills spaces between the red filters, the green filters and the blue filters. The black matrix 134 is disposed corresponding to the gate lines 112, the data lines 113 and the TFTs 118. The black matrix 134 absorbs light beams incident thereon. Thus, an area of the liquid crystal panel 100 corresponding to the black matrix 134 is defined as a non-display region, and other areas of the liquid crystal panel 100 are collectively defined as a display region.

[0007] The backlight module 102 emits light beams for displaying. A part of the light beams transmits through the display region of the liquid crystal panel 100 such that images

or text is displayed. Another part of the light beams reaches the non-display region of the liquid crystal panel 100. A majority of these light beams are absorbed by the black matrix 134, the gate lines 112, the data lines 113, and the TFTs 118, and a minority of these light beams are reflected back to the backlight module 102 by the gate lines 112, the data lines 113, and the TFTs 118.

[0008] However, a reflective ratio of the gate lines 112, the data lines 113, and the TFTs 118 is low. Therefore a rate of utilization of the light beams emitted by the backlight module 102 is correspondingly low.

[0009] What is needed, therefore, is a liquid crystal panel that can overcome the above-described deficiencies. What is also needed is a liquid crystal display employing the liquid crystal panel.

SUMMARY

[0010] In one preferred embodiment, a liquid crystal panel includes a first substrate assembly, a second substrate assembly parallel to the first substrate assembly, and a liquid crystal layer sandwiched between the first substrate assembly and the second substrate assembly. The second substrate assembly includes a transparent substrate, and a reflective layer provided on a surface of the transparent substrate facing the first substrate assembly. The liquid crystal panel includes a display region and a non-display region. The reflective layer is positioned corresponding to the non-display region.

[0011] Other novel features and advantages will become more apparent from the following detailed description of preferred and exemplary embodiments when taken in conjunction with the accompanying drawings. In the drawings, all the views are schematic.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIG. 1 is a side, cross-sectional view of part of a liquid crystal panel according to a first embodiment of the present invention, the liquid crystal display including a first substrate assembly and a second substrate assembly.

[0013] FIG. 2 is a top plan view of part of the first substrate assembly of the liquid crystal display of the first embodiment, the first substrate assembly including a reflective film (not shown).

[0014] FIG. 3 is a top plan view of part of the second substrate assembly of the liquid crystal display of the first embodiment, the part shown corresponding to the part of the first substrate assembly shown in FIG. 2.

[0015] FIG. 4 is similar to FIG. 2, but showing the reflective film.

[0016] FIG. 5 is a side, cross-sectional view of part of a liquid crystal panel according to a second embodiment of the present invention.

[0017] FIG. 6 is an exploded, side plan view of a liquid crystal display according to another embodiment of the present invention, the liquid crystal display including the liquid crystal panel of either the first embodiment or the second embodiment.

[0018] FIG. 7 is a side, cross-sectional view of part of a conventional liquid crystal display, the liquid crystal display including a first substrate assembly and a second substrate assembly.

[0019] FIG. 8 is a top plan view of part of the first substrate assembly of the conventional liquid crystal display of FIG. 7.

[0020] FIG. 9 is a top plan view of part of the second substrate assembly of the conventional liquid crystal display of FIG. 7, the part shown corresponding to the part of the first substrate assembly shown in FIG. 8.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0021] Reference will now be made to the drawings to describe preferred and exemplary embodiments in detail.

[0022] Referring to FIG. 1, part of a liquid crystal panel 401 according to a first embodiment of the present invention is shown. The liquid crystal panel 401 includes a first substrate assembly 410, a second substrate assembly 430 parallel to the first substrate assembly 410, and a liquid crystal layer 420 sandwiched between the first substrate assembly 410 and the second substrate assembly 430.

[0023] Referring also to FIG. 2, the first substrate assembly 410 includes a first transparent substrate 411, a reflective film 417 located on a surface of the transparent substrate 411 facing toward the liquid crystal layer 420, a passivation layer 419 located on a surface of the reflective film 417 facing toward the liquid crystal layer 420 and on the surface of the first transparent substrate 411 facing toward the liquid crystal layer 420, a number n (where n is a natural number) of gate lines 412, a number m (where m is also a natural number) of data lines 413, a plurality of pixel electrodes 416, and a plurality of thin film transistors (TFTs) 418. The passivation layer 419 is made from silicon nitride.

[0024] The gate lines 412 are provided on a surface of the passivation layer 419 facing toward the liquid crystal layer 420. The gate lines 412 are parallel to each other, with each gate line 412 extending along a first direction. The data lines 413 are provided on a surface of the passivation layer 419 facing toward the liquid crystal layer 420. The data lines 413 are parallel to each other, with each data line 413 extending along a second direction that is orthogonal to the first direction. The gate lines 412 and the data lines 413 cross each other, thereby defining a plurality of pixel regions (not labeled) arranged in a matrix. Each pixel region corresponds to one TFT 418 and one pixel electrode 416.

[0025] Referring also to FIG. 3, the second substrate assembly 430 includes a second transparent substrate 431, a color filter 432 located on a surface of second transparent substrate 431 facing toward the liquid crystal layer 420, and a common electrode 433 located on a surface of the color filter 432 facing toward the liquid crystal layer 420. The color filter 432 includes a plurality of red filters (not labeled), a plurality of green filters (not labeled), a plurality of blue filters (not labeled), and a black matrix 434. The red filters, the green filters, and the blue filters are arranged in a matrix. The black matrix 434 is located among the red filters, the green filters, and the blue filters. The black matrix 434 is used for filling spaces between the red filters, the green filters, and the blue filters. The black matrix 434 absorbs light beams incident thereon. An area where the black matrix 434 is located corresponds to the gate lines 412, the data lines 413, and the TFTs 418. An area of the liquid crystal panel 401 corresponding to the black matrix 434 is defined as a non-display region, and other areas of the liquid crystal display 401 are collectively defined as a display region.

[0026] Referring also to FIG. 4, the reflective film 417 is provided on the second transparent substrate 431 corresponding to the non-display region of the liquid crystal panel 401. That is, the reflective film 417 corresponds to the black matrix

434. The reflective film 417 corresponds to the gate lines 412, the data lines 413, and the TFTs 418. The reflective film 417 is made from metal material with a high reflective ratio, such as aluminum (Al) or silver (Ag).

[0027] Light beams from a backlight module (not shown) located under the liquid crystal panel 401 can be divided into a plurality of 'a' light beams and a plurality of 'b' light beams. The 'a' light beams transmit through the display region of the liquid crystal panel 401 to provide display. The 'b' light beams reach the non-display region of the liquid crystal panel 401. The 'b' light beams are reflected by the reflective film 417 back to the backlight module. Typically, a majority of the 'b' light beams are reflected again by the backlight module back to the display region of the liquid crystal panel 401. The 'b' light beams accordingly pass through the display region of the liquid crystal panel 401. Therefore, a utilization ratio of the light beams is increased correspondingly.

[0028] Compared with a conventional liquid crystal panel, the liquid crystal panel 401 includes the reflective film 417. The reflective film 417 reflects the light beams reaching the non-display region of the liquid crystal panel 401 back to the backlight module to be re-utilized. Therefore, a utilization ratio of light beams of the liquid crystal panel 401 is improved.

[0029] Referring to FIG. 5, part of a liquid crystal panel 801 according to a second embodiment of the present invention is shown. The liquid crystal panel 801 is similar to the liquid crystal panel 401. However, the liquid crystal panel 801 includes a reflective film 817 located on a lower surface of a second transparent substrate 811. The reflective film 817 corresponds to a non-display region of the liquid crystal panel 801. No passivation layer is needed.

[0030] Referring to FIG. 6, a liquid crystal display 900 according to another embodiment of the present invention is shown. The liquid crystal display 900 includes a liquid crystal panel 901, and a backlight module 902 disposed at a bottom side of the liquid crystal panel 901. The backlight module 902 is used for providing uniform light beams for the liquid crystal panel 901. The liquid crystal panel 901 can be one of the liquid crystal panels 401, 801 described above. Unlike with a conventional liquid crystal display, the liquid crystal display 900 includes the liquid crystal panel 901 having a reflective film (not shown) corresponding to a non-display region thereof. Light beams reaching the non-display region are reflected back to the backlight module 902, and are reflected again by the backlight module 902 back to the liquid crystal panel 901. Many of most of these reflected light beams reach a display region of the liquid crystal panel 901 and are thus utilized. Therefore, a utilization ratio of the liquid crystal display 900 is improved.

[0031] It is believed that the present embodiments and their advantages will be understood from the foregoing description, and it will be apparent that various changes may be made thereto without departing from the spirit and scope of the invention or sacrificing all of its material advantages, the examples hereinbefore described merely being preferred or exemplary embodiments of the invention.

What is claimed is:

1. A liquid crystal panel comprising:
 - a first substrate assembly;
 - a second substrate assembly parallel to the first substrate assembly, the second substrate assembly comprising:

- a transparent substrate; and
 - a reflective layer provided on a surface of the transparent substrate facing the first substrate assembly; and
 - a liquid crystal layer sandwiched between the first substrate assembly and the second substrate assembly, the liquid crystal panel defining a display region and a non-display region, the reflective layer positioned corresponding to the non-display region.
2. The liquid crystal panel of claim 1, wherein the color filter assembly comprises a plurality of red filters, a plurality of green filters, a plurality of blue filters, and a black matrix, the red filters, the green filters, the blue filters being arranged in a matrix, the black matrix filling spaces between the red filters, the green filters, and the blue filters, the black matrix positioned corresponding to the non-display region.
3. The liquid crystal panel of claim 2, wherein the second substrate assembly further comprises a passivation layer covering the transparent substrate and the reflective layer.
4. The liquid crystal panel of claim 3, wherein the second substrate assembly further comprises a plurality of parallel gate lines extending along a first direction, a plurality of parallel data lines extending along a second direction perpendicular to the first direction, and a plurality of thin film transistors provided in the vicinity of intersections of the gate lines and the data lines, the gate lines, the data lines, and the thin film transistors corresponding to the non-display region.
5. The liquid crystal panel of claim 1, wherein the reflective layer is made from metal materials having high reflective ratio.
6. The liquid crystal panel of claim 1, wherein the reflective layer is made from at least one of aluminum and silver.
7. The liquid crystal panel of claim 4, wherein the passivation layer is made from silicon nitride.
8. A liquid crystal panel comprising:
- a first substrate assembly;
 - a second substrate assembly parallel to the first substrate assembly, the second substrate assembly comprising:
 - a transparent substrate; and
 - a reflective layer provided on a surface of the transparent substrate that faces away from the first substrate assembly; and
 - a liquid crystal layer sandwiched between the first substrate assembly and the second substrate assembly, the liquid crystal panel defining a display region and a non-display region, the reflective layer positioned corresponding to the non-display region.
9. The liquid crystal panel of claim 8, wherein the color filter assembly comprises a plurality of red filters, a plurality of green filters, a plurality of blue filters, and a black matrix, the red filters, the green filters, the blue filters being arranged in a matrix, the black matrix filling spaces between the red filters, the green filters, and the blue filters, the black matrix positioned corresponding to the non-display region.
10. The liquid crystal panel of claim 9, wherein the second substrate assembly further comprises a plurality of parallel

gate lines extending along a first direction, a plurality of parallel data lines extending along a second direction perpendicular to the first direction, and a plurality of thin film transistors provided in the vicinity of intersections of the gate lines and the data lines, the gate lines, the data lines, and the thin film transistor positioned corresponding to the non-display region.

11. The liquid crystal panel of claim 8, wherein the reflective layer is made from metal materials having high reflective ratio.

12. The liquid crystal panel of claim 8, wherein the reflective layer is made from at least one of aluminum and silver.

13. A liquid crystal display comprising:

- a liquid crystal panel; and
- a backlight module adjacent the liquid crystal panel, the backlight module configured for providing light beams for the liquid crystal panel, the liquid crystal panel comprising:
 - a first substrate assembly;
 - a second substrate assembly parallel to the first substrate assembly, the second substrate assembly comprising:
 - a transparent substrate; and
 - a reflective layer provided on a surface of the transparent substrate; and
 - a liquid crystal layer sandwiched between the first substrate assembly and the second substrate assembly, the liquid crystal panel defining a display region and a non-display region, the reflective layer positioned corresponding to the non-display region.

14. The liquid crystal display of claim 13, wherein the reflective layer is provided on a surface of the transparent substrate facing the first substrate assembly.

15. The liquid crystal display of claim 13, wherein the reflective film is positioned on a surface of the transparent substrate that faces away from the first substrate assembly.

16. The liquid crystal display of claim 13, wherein the color filter assembly comprises a plurality of red filters, a plurality of green filters, a plurality of blue filters, and a black matrix, the red filters, the green filters, the blue filters being arranged in a matrix, the black matrix filling spaces the red filters, the green filters, and the blue filters, the black matrix positioned corresponding to the non-display region.

17. The liquid crystal display of claim 16, wherein the second substrate assembly further comprises a passivation layer covering the transparent substrate and the reflective layer.

18. The liquid crystal display of claim 13, wherein the reflective layer is made from metal materials having high reflective ratio.

19. The liquid crystal display of claim 13, wherein the reflective layer is made from at least one of aluminum and silver.

20. The liquid crystal display of claim 17, wherein the passivation layer is made from silicon nitride.

* * * * *

专利名称(译)	具有对应于非显示区域的反射膜的液晶面板和具有该液晶面板的液晶显示器		
公开(公告)号	US20090002596A1	公开(公告)日	2009-01-01
申请号	US12/154838	申请日	2008-05-27
[标]申请(专利权)人(译)	群康科技(深圳)有限公司 群创光电股份有限公司		
申请(专利权)人(译)	INNOCOM科技 (深圳) 有限公司. 群创光电股份有限公司.		
当前申请(专利权)人(译)	群创光电		
[标]发明人	HUANG MING LI		
发明人	HUANG, MING-LI		
IPC分类号	G02F1/1335		
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优先权	200710074610.6 2007-05-25 CN		
其他公开文献	US7973891		
外部链接	Espacenet USPTO		

摘要(译)

示例性液晶面板包括第一基板组件，平行于第一基板组件的第二基板组件，以及夹在第一基板组件和第二基板组件之间的液晶层。第二基板组件包括透明基板和设置在透明基板的面对第一基板组件的表面上的反射层。液晶面板包括显示区域和非显示区域。反射层对应于非显示区域定位。

