



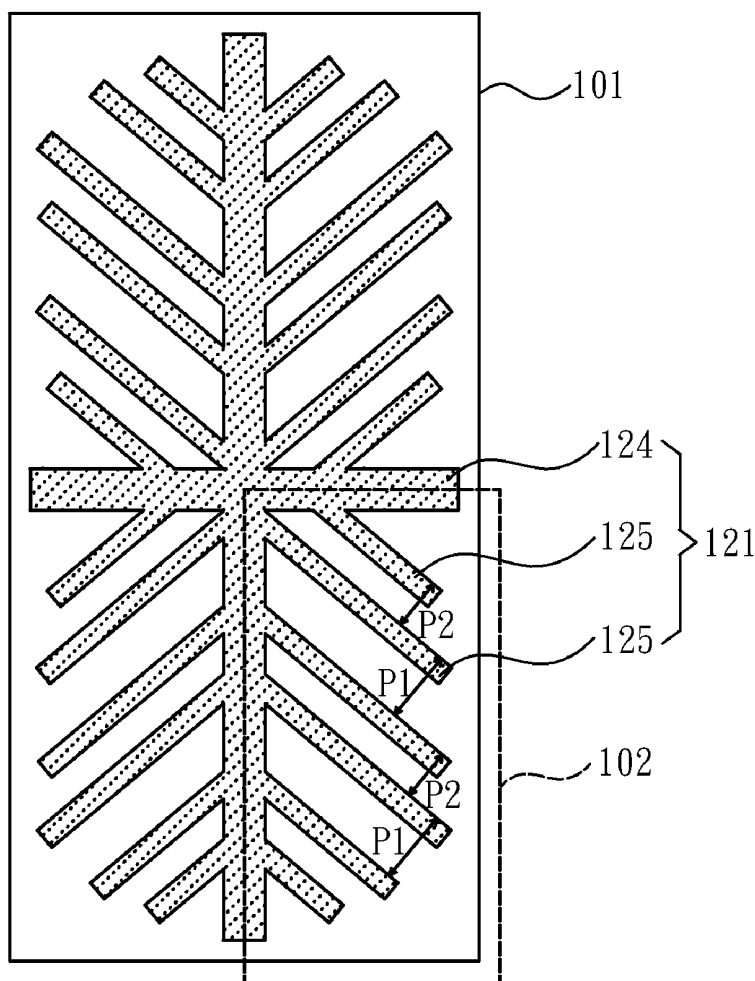
US 20130050629A1

(19) **United States**(12) **Patent Application Publication**
Kang(10) **Pub. No.: US 2013/0050629 A1**(43) **Pub. Date: Feb. 28, 2013**(54) **LIQUID CRYSTAL DISPLAY PANEL AND
DISPLAY APPARATUS USING THE SAME****Publication Classification**(75) Inventor: **Chihtsung Kang**, Shenzhen (CN)(51) **Int. Cl.**
G02F 1/1343 (2006.01)(73) Assignee: **SHENZHEN CHINA STAR
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TECHNOLOGY CO., LTD.**, Shenzhen,
Guangdong (CN)(52) **U.S. Cl.** **349/144; 349/139**(21) Appl. No.: **13/264,864**(22) PCT Filed: **Aug. 31, 2011**(86) PCT No.: **PCT/CN11/79218**§ 371 (c)(1),
(2), (4) Date: **Oct. 17, 2011**(30) **Foreign Application Priority Data**

Aug. 29, 2011 (CN) 201110251076.8

(57) **ABSTRACT**

The present invention provides a liquid crystal display panel and a display apparatus using the same. The liquid crystal display panel comprises a first substrate, a second substrate and a liquid crystal layer. The liquid crystal layer is formed between the first substrate and the second substrate. The second substrate comprises a second electrode. The second electrode includes a plurality of elongated electrode elements, and the elongated electrode elements have at least two different arrangement pitches. The liquid crystal display panel is applicable to the display apparatus. The invention can improve the color shift problem of the liquid crystal display panel.



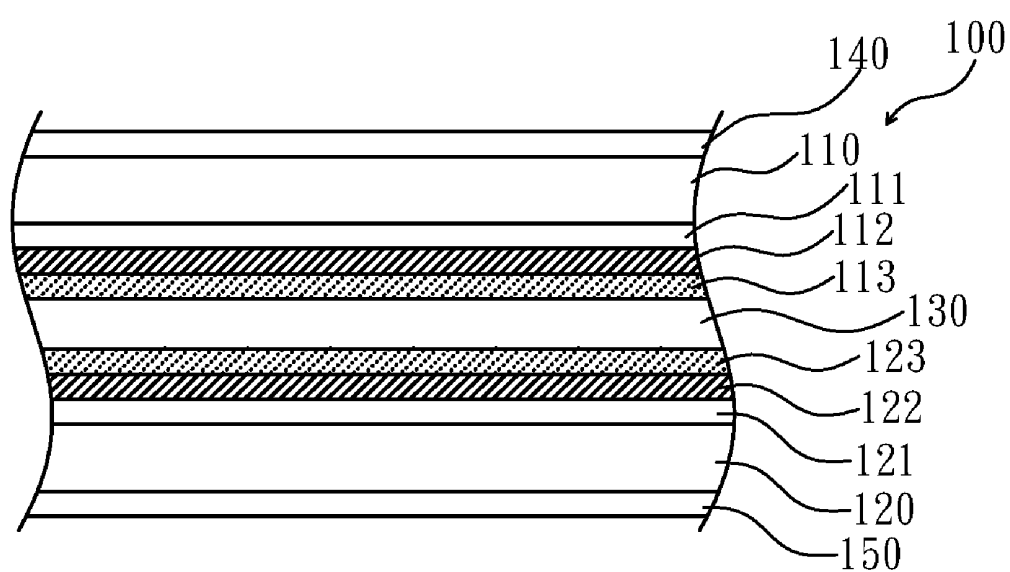


Fig.1

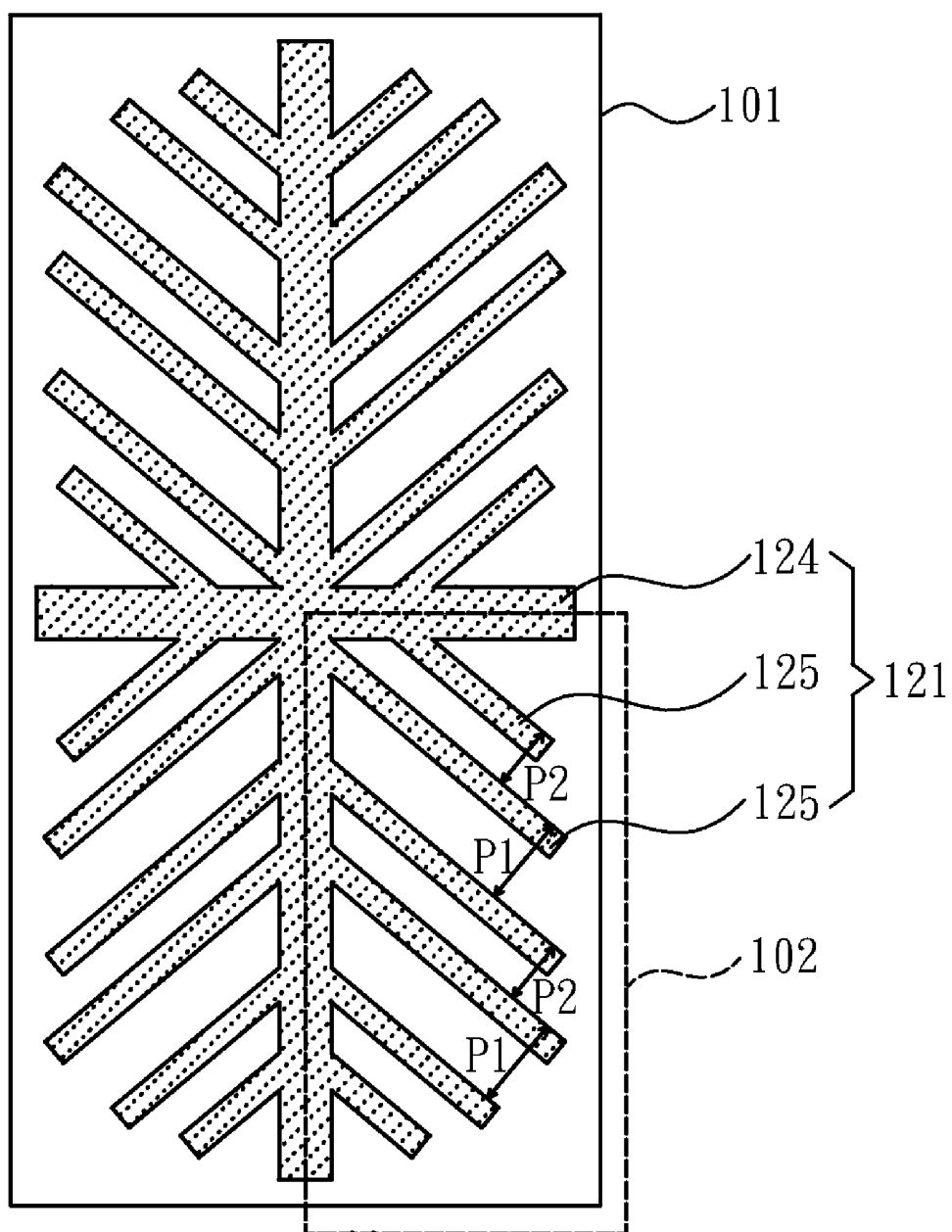


Fig.2

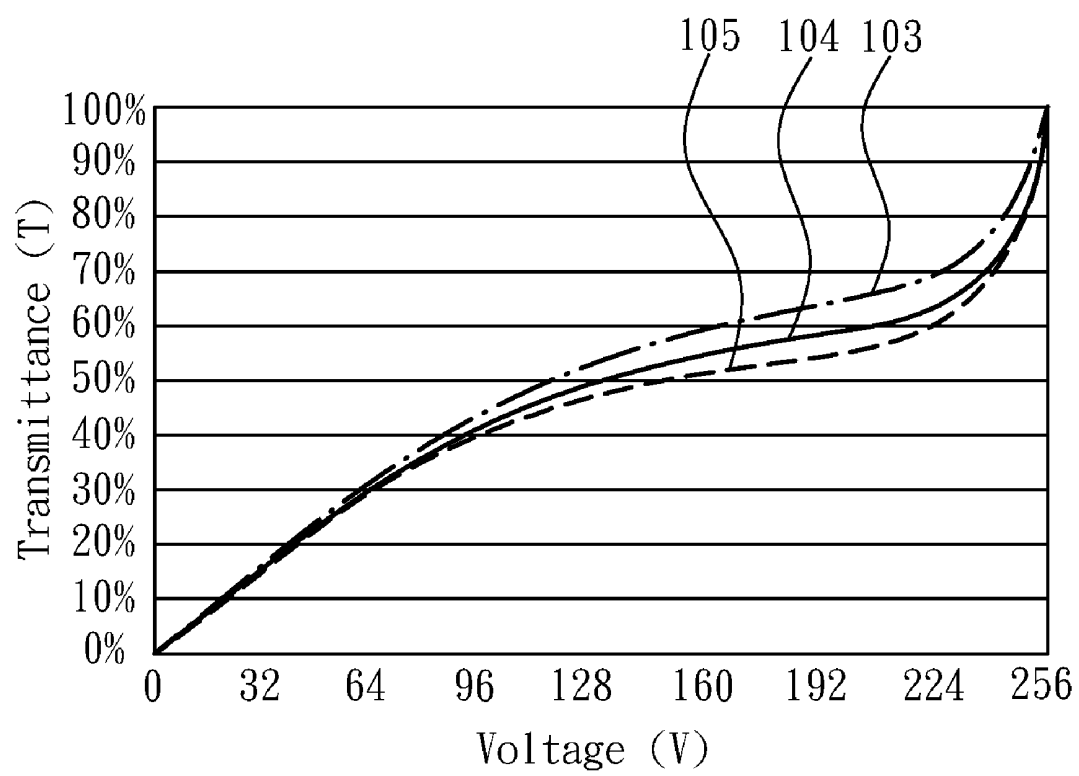


Fig.3

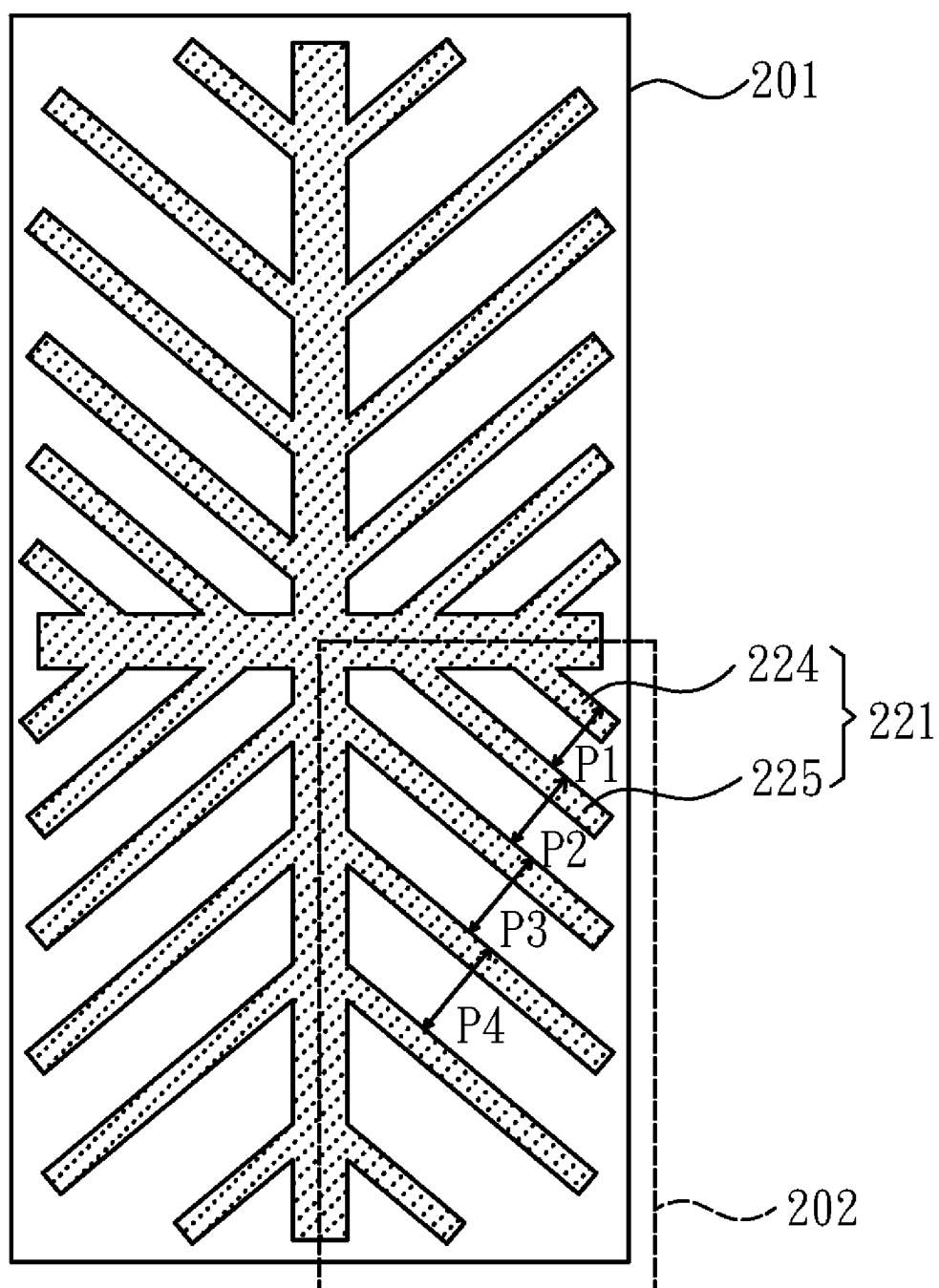


Fig.4

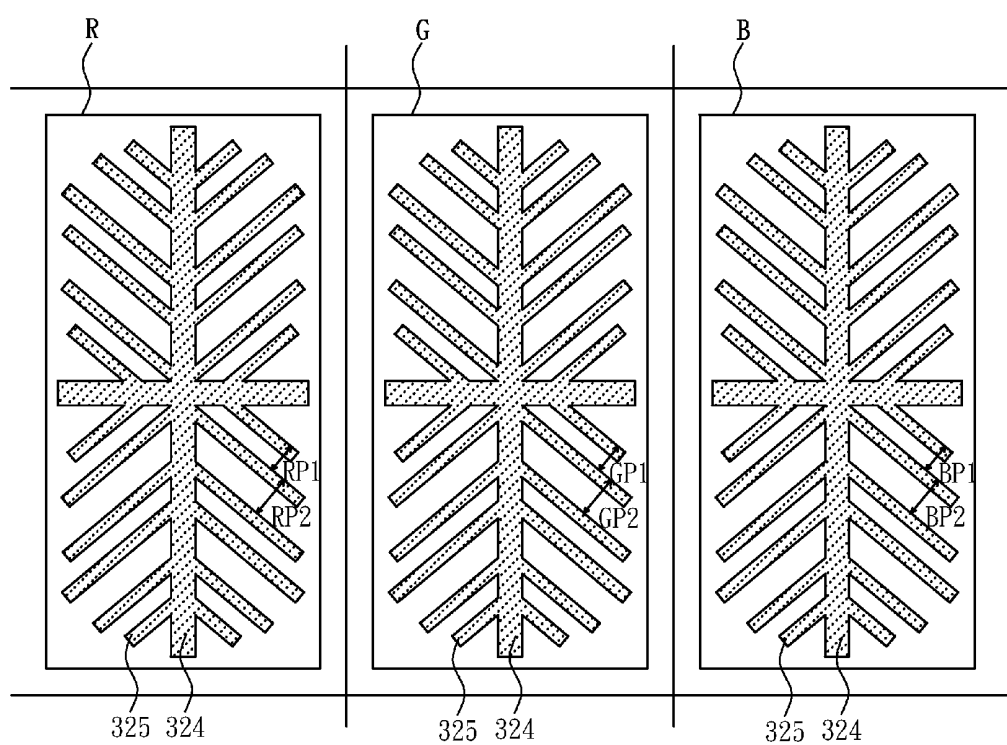


Fig.5

LIQUID CRYSTAL DISPLAY PANEL AND DISPLAY APPARATUS USING THE SAME

FIELD OF THE INVENTION

[0001] The present invention relates to a field of a liquid crystal display technology, and more particularly to a liquid crystal display (LCD) panel and a display apparatus using the same.

BACKGROUND OF THE INVENTION

[0002] Liquid crystal displays (LCDs) have been widely applied in electrical products. Currently, most of LCDs are backlight type LCDs which comprise a liquid crystal panel and a backlight module. The liquid crystal panel is composed of two transparent substrates and a liquid crystal sealed therebetween. In particular, a liquid crystal panel of a polymer stabilized vertical alignment (PSVA) type which is made using a polymer-stabilized alignment (PSA) process, can have some advantages, such as wide viewing angle, high aperture ratio, high contrast and simple process.

[0003] In the PSVA type LCD, reactive monomers can be doped in the liquid crystal between the two transparent substrates and mixed with liquid crystal molecules, wherein the a polyimide (PI) is coated on the surface of each of the transparent substrates to be an alignment layer. Subsequently, when applying a voltage and irradiating an ultraviolet (UV) light to the two transparent substrates, a phase separation arises in the reactive monomers and the liquid crystal molecules, and a polymer is formed on the alignment layer of the transparent substrate. The liquid crystal molecules are oriented along a direction of the polymer due to the interaction between the polymer and the liquid crystal molecules. Therefore, the liquid crystal molecules between the transparent substrates can have a pre-tilt angle.

[0004] However, currently, a color shift problem is likely to occur in the VA type LCD, hence deteriorating the display quality of the LCD.

[0005] As a result, it is necessary to provide an LCD panel and a display apparatus using the same to solve the problems existing in the conventional technologies, as described above.

SUMMARY OF THE INVENTION

[0006] The present invention provides an LCD panel and a display apparatus using the same to solve the color shift problem of the VA type LCD.

[0007] A primary object of the present invention is to provide a liquid crystal display panel, and the liquid crystal display panel comprises: a first substrate comprising a first electrode and a first alignment layer, wherein the first alignment layer is formed on the first electrode; a second substrate comprising a second electrode and a second alignment layer, wherein the second alignment layer is formed on the second electrode; and a liquid crystal layer formed between the first substrate and the second substrate; wherein the second electrode comprises a plurality of elongated electrode elements, and the elongated electrode elements have at least two different arrangement pitches.

[0008] Another object of the present invention is to provide a display apparatus, and the display apparatus comprises a backlight module and the above-mentioned liquid crystal display panel.

[0009] A further object of the present invention is to provide a liquid crystal display panel, and the liquid crystal

display panel comprises: a first substrate comprising a first electrode and a first alignment layer, wherein the first alignment layer is formed on the first electrode; a second substrate comprising a second electrode and a second alignment layer, wherein the second alignment layer is formed on the second electrode; and a liquid crystal layer formed between the first substrate and the second substrate; wherein the second electrode comprises a plurality of elongated electrode elements, and the elongated electrode elements have at least two different arrangement pitches, and the different arrangement pitches include a first arrangement pitch and a second arrangement pitch, and the first arrangement pitch and the second arrangement pitch are formed between the elongated electrode elements in an alternating manner, and the first arrangement pitch is 7 μm , and the second arrangement pitch is 6 μm .

[0010] In one embodiment of the present invention, the liquid crystal display panel has a plurality of pixel regions, and the second electrode in each of the pixel regions includes a main pixel electrode pattern and a plurality of elongated electrode elements, and the elongated electrode elements obliquely extend from the main pixel electrode pattern and are arranged parallel to each other.

[0011] In one embodiment of the present invention, each of the pixel regions is composed of a plurality of sub-pixel regions.

[0012] In one embodiment of the present invention, the elongated electrode elements in the sub-pixel regions have at least two different arrangement pitches.

[0013] In one embodiment of the present invention, the angle between the elongated electrode elements and the main pixel electrode pattern is in a range of 30 degrees to 60 degrees.

[0014] In one embodiment of the present invention, a first arrangement pitch is one of the different arrangement pitches, and the first arrangement pitch is 7 μm .

[0015] In one embodiment of the present invention, a width of the elongated electrode elements and a space between the elongated electrode elements are 3.5 μm and 3.5 μm ; 4 μm and 3 μm ; or 5 μm and 2 μm , respectively.

[0016] In one embodiment of the present invention, a second arrangement pitch is one of the different arrangement pitches, and the second arrangement pitch is 6 μm .

[0017] In one embodiment of the present invention, a width of the elongated electrode elements and a space between the elongated electrode elements are 3 μm and 3 μm ; or 4 μm and 2 μm , respectively.

[0018] In one embodiment of the present invention, the different arrangement pitches include a first arrangement pitch and a second arrangement pitch, and the first arrangement pitch and the second arrangement pitch are formed between the elongated electrode elements in an alternating manner.

[0019] In one embodiment of the present invention, the elongated electrode elements have three or more than three different arrangement pitches which are sequentially formed between the elongated electrode elements.

[0020] In one embodiment of the present invention, the elongated electrode elements in the two adjacent pixel regions have the different arrangement pitches.

[0021] The LCD panel and the display apparatus using the same of the present invention can improve the color shift problem of the LCD panel by adjusting the extending angles

of the elongated electrode elements, thereby enhancing the display quality of the display apparatus.

[0022] The structure and the technical means adopted by the present invention to achieve the above and other objects can be best understood by referring to the following detailed description of the preferred embodiments and the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

[0023] FIG. 1 is a cross-sectional view showing a liquid crystal display panel according to a first embodiment of the present invention;

[0024] FIG. 2 is a schematic diagram showing a pixel region of the liquid crystal display panel according to the first embodiment of the present invention;

[0025] FIG. 3 is a voltage (V)-transmittance (T) graph of a pixel according to the first embodiment of the present invention;

[0026] FIG. 4 is a schematic diagram showing a pixel region of the liquid crystal display panel according to a second embodiment of the present invention; and

[0027] FIG. 5 is a schematic diagram showing a pixel region of the liquid crystal display panel according to a third embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0028] The following embodiments are referring to the accompanying drawings for exemplifying specific implementable embodiments of the present invention. Furthermore, directional terms described by the present invention, such as upper, lower, front, back, left, right, inner, outer, side and etc., are only directions by referring to the accompanying drawings, and thus the used directional terms are used to describe and understand the present invention, but the present invention is not limited thereto.

[0029] In the drawings, structure-like elements are labeled with like reference numerals.

[0030] Referring to FIG. 1, a cross-sectional view showing a liquid crystal display (LCD) panel according to a first embodiment of the present invention is illustrated. The display apparatus of the present embodiment can comprise the liquid crystal display panel 100 and a backlight module (not shown). The liquid crystal display panel 100 is disposed opposite to the backlight module, and the backlight module may be realized as a side lighting backlight module or a bottom lighting backlight module to provide the liquid crystal display panel 100 with the back-light.

[0031] Referring to FIG. 1 again, the liquid crystal display panel 100 of the present embodiment may comprise a first substrate 110, a second substrate 120, a liquid crystal layer 130, a first polarizer 140 and a second polarizer 150. The first substrate 110 and the second substrate 120 may be realized as glass substrates or flexible plastic substrates. In this embodiment, the first substrate 110 may be a glass substrate or other material substrate with color filters (CF), and the second substrate 120 may be a glass substrate or other material substrate with a thin film transistor (TFT) array. It notes that the CF and the TFT array may also be disposed on the same substrate in other embodiments.

[0032] Referring to FIG. 1 again, the liquid crystal layer 130 is formed between the first substrate 110 and the second substrate 120 and includes reactive monomers and liquid

crystal molecules. The reactive monomers are preferably photo-sensitive monomers mixed with the liquid crystal molecules. The first polarizer 140 is disposed on one side of the first substrate 110 and opposite to the liquid crystal layer 130 (i.e. a light-emitting side of the first substrate 110). The second polarizer 150 is disposed on one side of the second substrate 120 and opposite to the liquid crystal layer 130 (i.e. a light-incident side of the second substrate 120).

[0033] Referring to FIG. 1 again, in this embodiment, the first substrate 110 can comprise a first electrode 111, a first alignment layer 112 and a first polymer alignment layer 113. The first alignment layer 112 and the first polymer alignment layer 113 are formed on the first electrode 111 in sequence. The second substrate 120 can comprise a second electrode 121, a second alignment layer 122 and a second polymer alignment layer 123. The second alignment layer 122 and the second polymer alignment layer 123 are formed on the second electrode 121 in sequence. The first electrode 111 and the second electrode 121 are preferably made of a transparent and electrically conductive material, such as ITO, IZO, AZO, GZO, TCO or ZnO. A voltage can be applied to the liquid crystal molecules of the liquid crystal layer 130 by the first electrode 111 and the second electrode 121. In this embodiment, the first electrode 111 may be a common electrode, and the second electrode 121 may be a pixel electrode. In addition, the second electrode 121 can have a plurality of regions, and the voltage applied to each of the regions may be the same or different. The alignment layers 112, 122 and the polymer alignment layers 113, 123 can have an alignment direction for determining the orientation of the liquid crystal molecules of the liquid crystal layer 130. The alignment layers 112, 122 and the polymer alignment layers 113, 123 can have a pre-tilt angle, wherein the pre-tilt angle is less than 90 degrees, preferably less than 60 degrees. Preferably, the alignment layers 112, 122 are made of a dielectric material on the substrates 110, 120 using a sputtering technique. The material of the alignment layers 112, 122 is preferably a dielectric and inorganic material, such as silicon dioxide (SiO₂). The polymer alignment layers 113, 123 are polymerized of the reactive monomers bonded with the alignment layers 112, 122.

[0034] Referring to FIG. 2, a schematic diagram showing a pixel region of the liquid crystal display panel according to the first embodiment of the present invention is illustrated. The second substrate 120 comprises a plurality of signal lines (not shown), such as gate lines and data lines, which are crisscrossed, and thereby form a plurality of pixel regions 101 arranged in an array. In each of the pixel regions 101, the second electrode 121 has a pixel pattern for forming a multi-domain alignment. In this embodiment, the second electrode 121 in each of the pixel regions 101 includes a main pixel electrode pattern 124 and a plurality of elongated electrode elements 125. The main pixel electrode pattern 124 may be a crisscross pattern, and each of the pixel regions 101 is divided into four sub-pixel regions 102 by the main pixel electrode pattern 124. In each of the sub-pixel regions 102, the elongated electrode elements 125 obliquely extend from the main pixel electrode pattern 124 and are arranged parallel to each other. The angle between the elongated electrode elements 125 and the main pixel electrode pattern 124 may be 30-60 degrees, and preferably 45 degrees. In this case, the elongated electrode elements 125 can have at least two different arrangement pitches P1, P2 therebetween.

[0035] Referring to FIG. 2 again, the arrangement pitches P1, P2 between the elongated electrode elements 125 can be

adjusted according to a color shift performance of the liquid crystal display panel **100**. In this embodiment, the different arrangement pitches include a first arrangement pitch **P1** and a second arrangement pitch **P2**. The first arrangement pitch **P1** may be 7 μm . At this time, a width of the elongated electrode elements **125** and a space between the elongated electrode elements **125** may be 3.5 μm and 3.5 μm ; 4 μm and 3 μm ; or 5 μm and 2 μm , respectively. Furthermore, the second arrangement pitch **P2** may be 6 μm . At this time, a width of the elongated electrode elements **125** and a space between the elongated electrode elements **125** may be 3 μm and 3 μm ; or 4 μm and 2 μm , respectively. In another embodiment, the first arrangement pitch **P1** or the second arrangement pitch **P2** may be 8 μm .

[0036] Moreover, in this embodiment, referring to FIG. 2, The first arrangement pitch **P1** and the second arrangement pitch **P2** can be formed between the elongated electrode elements **125** in an alternating manner for improving the color shift problem of the LCD panel **100** and achieving an effect of wide viewing angle and low color shift.

[0037] In another embodiment, the elongated electrode elements **125** in the two adjacent pixel regions **101** can also have different arrangement pitches. In a further embodiment, the elongated electrode elements **125** in the sub-pixel regions **102** can have different arrangement pitches.

[0038] Referring to FIG. 3, a voltage (V)-transmittance (T) graph of a pixel according to the first embodiment of the present invention is illustrated. In FIG. 3, a line **103** indicates a V-T relation of the pixel when the width of the elongated electrode elements **125** and the space therebetween are 4 μm and 4 μm , respectively, and a line **104** indicates a V-T relation of the pixel when the width of the elongated electrode elements **125** and the space therebetween are 5 μm and 3 μm , respectively, and a line **105** indicates a V-T relation of the pixel when the width of the elongated electrode elements **125** and the space therebetween are 4 μm and 2 μm , respectively. Referring to FIG. 3 again, when the elongated electrode elements **125** have the at least two different arrangement pitches, a V-T performance of the pixel is also different. Therefore, by adjusting the arrangement pitches between the elongated electrode elements **125**, the V-T performance of the pixel can be adjusted, so as to adjust a color shift performance of the LCD panel **100**, hence improving the color shift problem of the LCD panel **100**.

[0039] Therefore, the color shift problem in the LCD panel **100** of this embodiment can be improved by adjusting the different arrangement pitches **P1**, **P2** between the elongated electrode elements **125**. Thus, an additional control device (such a timing controller) for compensating color dispersion can be omitted, thereby reducing a design cost of the LCD panel **100**.

[0040] Referring to FIG. 4, a schematic diagram showing a pixel region of the liquid crystal display panel according to a second embodiment of the present invention is illustrated. Only the difference between the embodiment and the first embodiment are described hereinafter, and the similar construction therebetween is not stated in detail herein. In comparison with the first embodiment, the second electrode **221** of the second embodiment in each of the pixel regions **201** includes a main pixel electrode pattern **224** and a plurality of elongated electrode elements **225**. In this case, the elongated electrode elements **225** can have three or more than three different arrangement pitches **P1**, **P2**, **P3**, **P4** which are sequentially formed between the elongated electrode ele-

ments **225** in each of the sub-pixel regions **202** for adjusting the color shift performance of the LCD panel, hence improving the color shift problem of the LCD panel.

[0041] Referring to FIG. 5, a schematic diagram showing a pixel region of the liquid crystal display panel according to a third embodiment of the present invention is illustrated. Only the difference between the embodiment and the first embodiment are described hereinafter, and the similar construction therebetween is not stated in detail herein. In comparison with the first embodiment, the LCD panel of the third embodiment comprises a plurality of pixels which are composed of different color pixels R, G and B. In this case, the elongated electrode elements **325** of the second electrode of the red pixels R have at least two different arrangement pitches **RP1**, **RP2** therebetween, and the elongated electrode elements **325** of the second electrode of the green pixels G have at least two different arrangement pitches **GP1**, **GP2** therebetween, and the elongated electrode elements **325** of the second electrode of the blue pixels B have at least two different arrangement pitches **BP1**, **BP2** therebetween. Moreover, the arrangement pitches **RP1**, **RP2**, **GP1**, **GP2**, **BP1** and **BP2** can be different for improving the color shift problem of the LCD panel.

[0042] As described above, the LCD panel and the display apparatus of the present invention using the same can improve the color shift problem of the LCD panel by adjusting the arrangement pitches between the elongated electrode elements in a pixel electrode pattern, thereby enhancing the display quality of the display apparatus. Furthermore, an additional control device for compensating color dispersion is not necessary to the LCD panel, thereby reducing a design cost of the display.

[0043] The present invention has been described with a preferred embodiment thereof and it is understood that many changes and modifications to the described embodiment can be carried out without departing from the scope and the spirit of the invention that is intended to be limited only by the appended claims.

1. A liquid crystal display panel comprising:

- a first substrate comprising a first electrode and a first alignment layer, wherein the first alignment layer is formed on the first electrode;
- a second substrate comprising a second electrode and a second alignment layer, wherein the second alignment layer is formed on the second electrode; and
- a liquid crystal layer formed between the first substrate and the second substrate;

wherein the second electrode comprises a plurality of elongated electrode elements, and the elongated electrode elements have at least two different arrangement pitches, and the different arrangement pitches include a first arrangement pitch and a second arrangement pitch, and the first arrangement pitch and the second arrangement pitch are formed between the elongated electrode elements in an alternating manner, and the first arrangement pitch is 7 μm , and the second arrangement pitch is 6 μm .

2. A liquid crystal display panel comprising:

- a first substrate comprising a first electrode and a first alignment layer, wherein the first alignment layer is formed on the first electrode;
- a second substrate comprising a second electrode and a second alignment layer, wherein the second alignment layer is formed on the second electrode; and

a liquid crystal layer formed between the first substrate and the second substrate;

wherein the second electrode comprises a plurality of elongated electrode elements, and the elongated electrode elements have at least two different arrangement pitches.

3. The liquid crystal display panel according to claim 2, wherein the liquid crystal display panel has a plurality of pixel regions, and the second electrode in each of the pixel regions includes a main pixel electrode pattern and a plurality of elongated electrode elements, and the elongated electrode elements obliquely extend from the main pixel electrode pattern and are arranged parallel to each other.

4. The liquid crystal display panel according to claim 3, wherein each of the pixel regions is composed of a plurality of sub-pixel regions.

5. The liquid crystal display panel according to claim 4, wherein the elongated electrode elements in the sub-pixel regions have at least two different arrangement pitches.

6. The liquid crystal display panel according to claim 3, wherein the angle between the elongated electrode elements and the main pixel electrode pattern is in a range of 30 degrees to 60 degrees.

7. The liquid crystal display panel according to claim 2, wherein a first arrangement pitch is one of the different arrangement pitches, and the first arrangement pitch is 7 μm .

8. The liquid crystal display panel according to claim 7, wherein a width of the elongated electrode elements and a space between the elongated electrode elements are 3.5 μm and 3.5 μm ; 4 μm and 3 μm ; or 5 μm and 2 μm , respectively.

9. The liquid crystal display panel according to claim 2, wherein a second arrangement pitch is one of the different arrangement pitches, and the second arrangement pitch is 6 μm .

10. The liquid crystal display panel according to claim 9, wherein a width of the elongated electrode elements and a space between the elongated electrode elements are 3 μm and 3 μm ; or 4 μm and 2 μm , respectively.

11. The liquid crystal display panel according to claim 2, wherein the different arrangement pitches include a first arrangement pitch and a second arrangement pitch, and the first arrangement pitch and the second arrangement pitch are formed between the elongated electrode elements in an alternating manner.

12. The liquid crystal display panel according to claim 2, wherein the elongated electrode elements have three or more than three different arrangement pitches which are sequentially formed between the elongated electrode elements.

13. The liquid crystal display panel according to claim 3, wherein the elongated electrode elements in the two adjacent pixel regions have the different arrangement pitches.

14. A display apparatus comprising:

a backlight module; and

a liquid crystal display panel comprising:

a first substrate comprising a first electrode and a first alignment layer, wherein the first alignment layer is formed on the first electrode;

a second substrate comprising a second electrode and a second alignment layer, wherein the second alignment layer is formed on the second electrode; and

a liquid crystal layer formed between the first substrate and the second substrate;

wherein the second electrode comprises a plurality of elongated electrode elements, and the elongated electrode elements have at least two different arrangement pitches.

15. The display apparatus according to claim 14, wherein the liquid crystal display panel has a plurality of pixel regions, and the second electrode in each of the pixel regions includes a main pixel electrode pattern and a plurality of elongated electrode elements, and the elongated electrode elements obliquely extend from the main pixel electrode pattern and are arranged parallel to each other.

16. The display apparatus according to claim 15, wherein each of the pixel regions is composed of a plurality of sub-pixel regions.

17. The display apparatus according to claim 15, wherein the angle between the elongated electrode elements and the main pixel electrode pattern is in a range of 30 degrees to 60 degrees.

18. The display apparatus according to claim 14, wherein the different arrangement pitches include a first arrangement pitch and a second arrangement pitch, and the first arrangement pitch is 7 μm , and the second arrangement pitch is 6 μm .

19. The display apparatus according to claim 14, wherein the different arrangement pitches include a first arrangement pitch and a second arrangement pitch, and the first arrangement pitch and the second arrangement pitch are formed between the elongated electrode elements in an alternating manner.

20. The display apparatus according to claim 14, wherein the elongated electrode elements have three or more than three different arrangement pitches which are sequentially formed between the elongated electrode elements.

* * * * *

专利名称(译)	液晶显示面板和使用其的显示装置		
公开(公告)号	US20130050629A1	公开(公告)日	2013-02-28
申请号	US13/264864	申请日	2011-08-31
[标]申请(专利权)人(译)	康Chihtsung		
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当前申请(专利权)人(译)	深圳市中国星光电科技有限公司.		
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发明人	KANG, CHIHTSUNG		
IPC分类号	G02F1/1343		
CPC分类号	G02F1/133707 G02F1/134309 G02F2001/13775 G02F2001/134345 G02F2001/134372 G02F1/1393		
优先权	201110251076.8 2011-08-29 CN		
外部链接	Espacenet USPTO		

摘要(译)

本发明提供一种液晶显示面板和使用该液晶显示面板的显示装置。液晶显示面板包括第一基板，第二基板和液晶层。液晶层形成在第一基板和第二基板之间。第二基板包括第二电极。第二电极包括多个细长电极元件，并且细长电极元件具有至少两个不同的排列间距。液晶显示面板适用于显示装置。本发明可以改善液晶显示面板的色偏问题。

