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Kang

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(54) **LIQUID CRYSTAL DISPLAY PANEL AND
DISPLAY APPARATUS USING THE SAME**

1/133707 (2013.01); *G02F 1/134336*
(2013.01); *G02F 2001/133638* (2013.01)

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(58) **Field of Classification Search**

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See application file for complete search history.

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(56) **References Cited**

U.S. PATENT DOCUMENTS

2004/0100607 A1* 5/2004 Kawata *G02F 1/133707*
349/141
2004/0233360 A1* 11/2004 Yoshida *G02F 1/133555*
349/114
2005/0117102 A1* 6/2005 Park *G02F 1/134363*
349/141
2006/0139540 A1* 6/2006 Lu *G02F 1/133707*
349/129
2007/0008242 A1* 1/2007 Mori *G02F 1/134309*
345/60
2010/0157232 A1* 6/2010 Kim et al. 349/144

* cited by examiner

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G02F 1/1335 (2006.01)

G02F 1/1337 (2006.01)

(52) **U.S. Cl.**

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(2013.01); *G02F 1/1393* (2013.01); *G02F*

ABSTRACT

The present invention provides a liquid crystal display (LCD) panel and a display apparatus using the same. The LCD panel comprises a first substrate, a second substrate, a liquid crystal layer and quarter wave ($\lambda/4$) retarder films. The liquid crystal layer is formed between the first substrate and the second substrate. The second substrate comprises a second electrode, wherein the second electrode comprises a trunk portion and plurality of branch portions, and there are a first angle and a second angle between the trunk portion and the branch portions. The first angle is of 45 degrees, and the second angle is less than or greater than 45 degrees. The $\lambda/4$ retarder films are bonded to outer surfaces of the first substrate and the second substrate. The present invention can improve the color shift problem and the transmittance of the LCD panel.

6 Claims, 6 Drawing Sheets

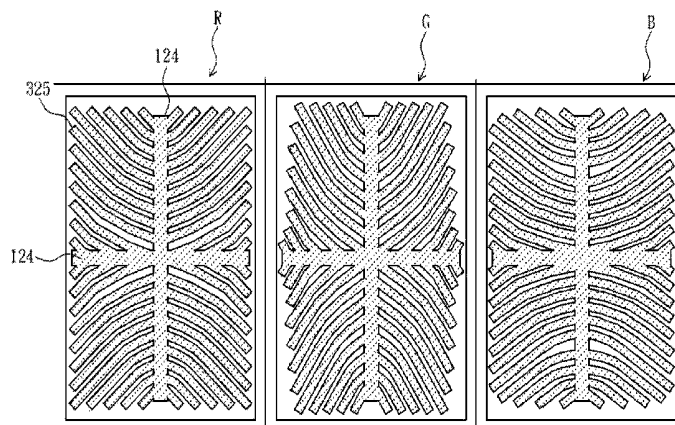


FIG.2

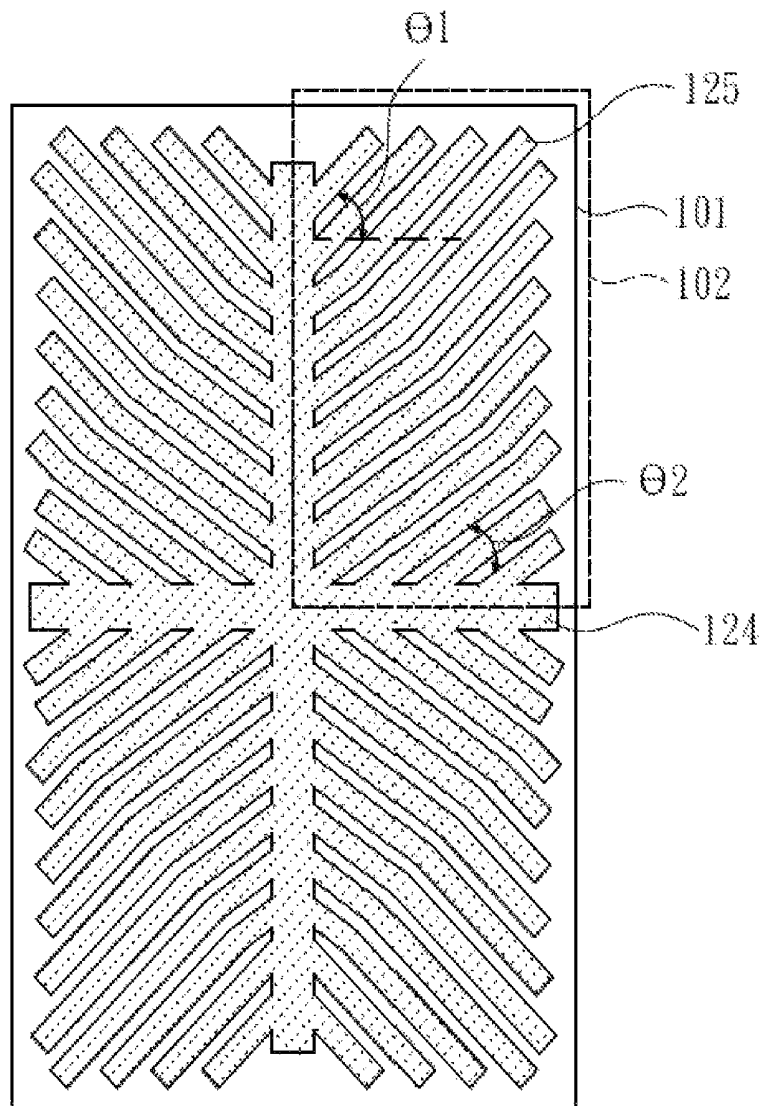


FIG.3

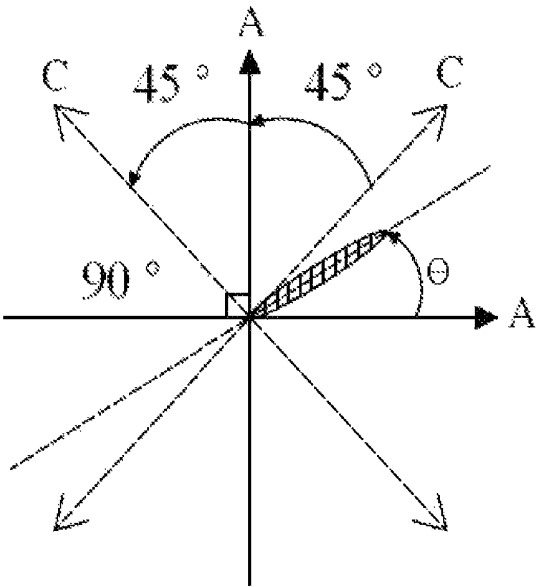


FIG.4

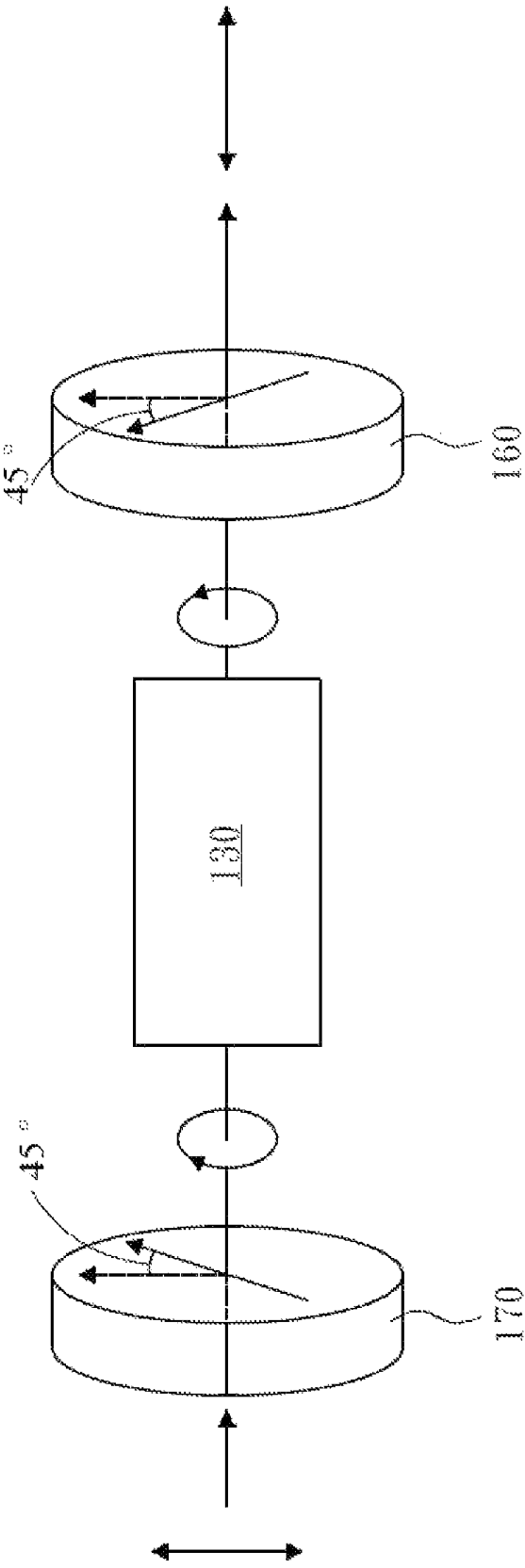


FIG.5

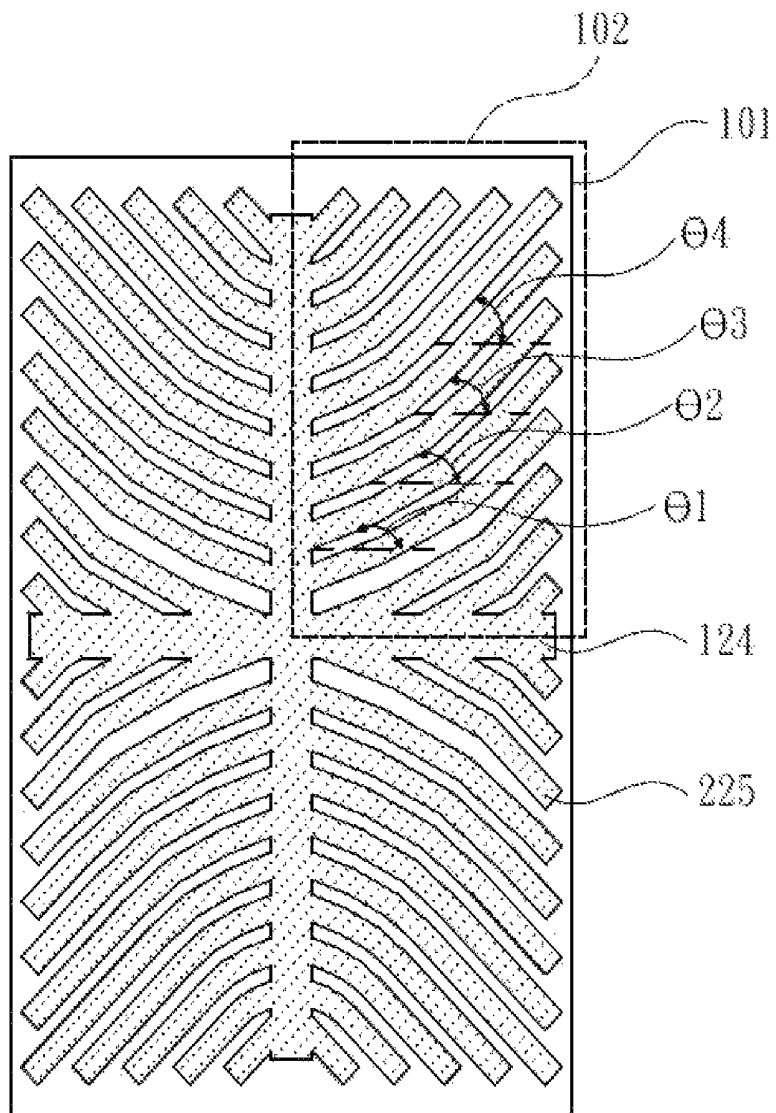


FIG. 6

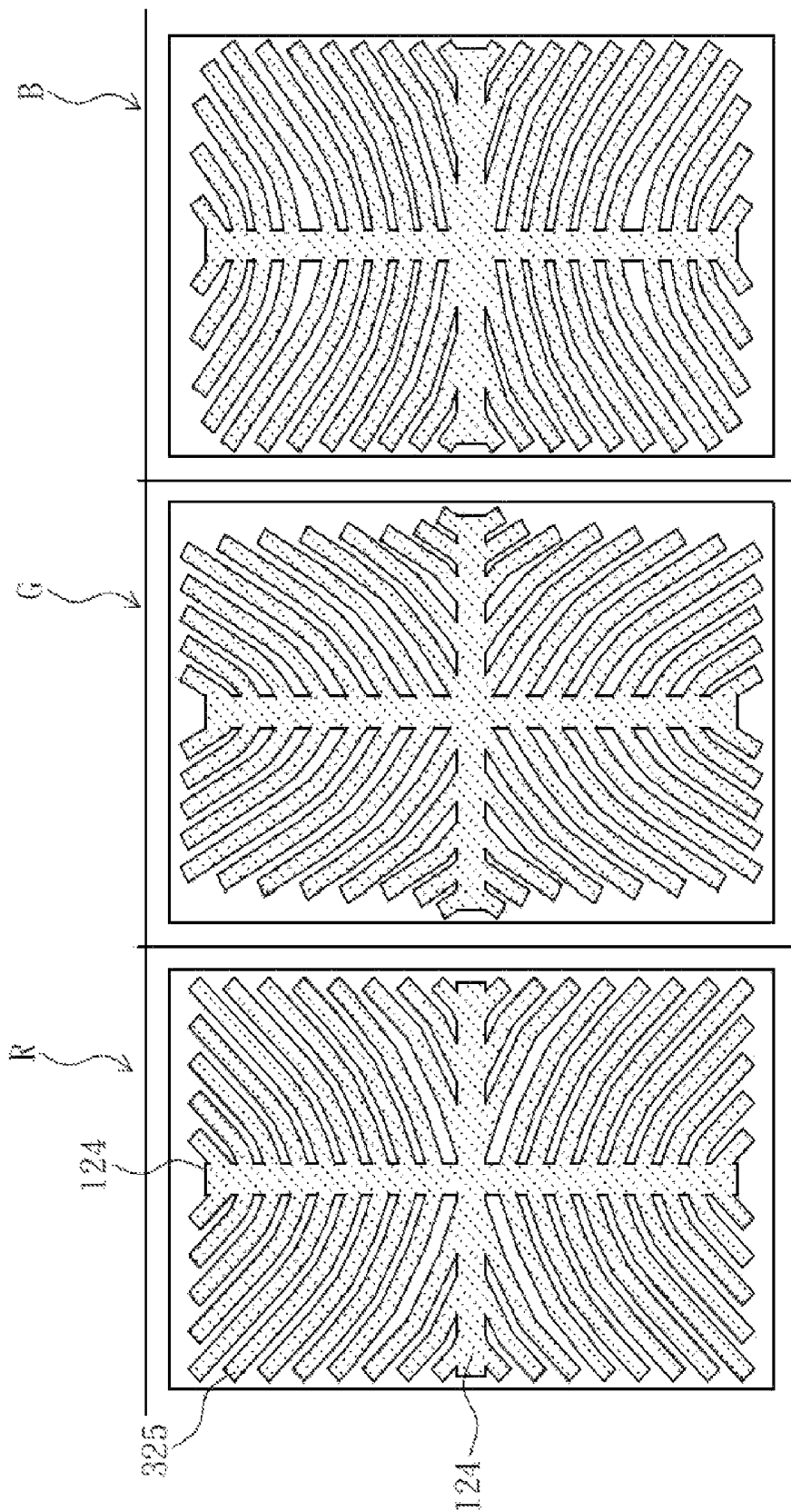


FIG. 7

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LIQUID CRYSTAL DISPLAY PANEL AND DISPLAY APPARATUS USING THE SAME

FIELD OF THE INVENTION

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

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.

At present, a vertical alignment (VA) technology has been developed for LCD panels. For example, a polymer stabilized vertical alignment (PSVA) type liquid crystal display panel 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.

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, ultra-violet (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.

However, currently, a color shift problem is likely to occur in the VA type LCD, hence deteriorating the display quality of the LCD. For improving the above-mentioned color shift problem, a pixel structure of the LCD panel may be varied, but the variation of the pixel structure may result in a reduction of a transmittance of the LCD panel.

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

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

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; a second substrate comprising a second electrode, wherein the second electrode has a pixel electrode structure, and the pixel electrode structure comprises a trunk portion and plurality of branch portions, there is a first angle and a second angle between the trunk portion and the branch portions, and the first angle is of 45 degrees, and the second angle is less than or greater than 45 degrees; a liquid crystal layer formed between the first substrate and the second substrate; a first polarizer disposed at an outer side of the first substrate; a second polarizer disposed at an outer side of

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the second substrate; a first polarizer disposed at an outer side of the first substrate; a second polarizer disposed at an outer side of the second substrate; a first quarter wave retarder film disposed between the first substrate and the first polarizer; and a second quarter wave retarder film disposed between the second substrate and the second polarizer.

Another 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; a second substrate comprising a second electrode, wherein the second electrode has a pixel electrode structure, and the pixel electrode structure comprises a trunk portion and plurality of branch portions, there is a first angle and a second angle between the trunk portion and the branch portions, and the first angle is of 45 degrees, and the second angle is in the range of 10 degrees to 80 degrees except 45 degrees; a liquid crystal layer formed between the first substrate and the second substrate; a first polarizer disposed at an outer side of the first substrate; a second polarizer disposed at an outer side of the second substrate; a first quarter wave retarder film disposed between the first substrate and the first polarizer; and a second quarter wave retarder film disposed between the second substrate and the second polarizer, wherein an angle between slow axes of the first quarter wave retarder film and the second quarter wave retarder film is 90 degrees, and an angle between the slow axis of the first quarter wave retarder film and an absorption axis of the first polarizer is 45 degrees, and an angle between the slow axis of the second quarter wave retarder film and an absorption axis of the second polarizer is 45 degrees.

A further object of the present invention is to provide a display apparatus comprising a backlight module and a liquid crystal display panel. The liquid crystal display panel comprises: a first substrate comprising a first electrode; a second substrate comprising a second electrode, wherein the second electrode has a pixel electrode structure, and the pixel electrode structure comprises a trunk portion and plurality of branch portions, there is a first angle and a second angle between the trunk portion and the branch portions, and the first angle is of 45 degrees, and the second angle is less than or greater than 45 degrees; a liquid crystal layer formed between the first substrate and the second substrate; a first polarizer disposed at an outer side of the first substrate; a second polarizer disposed at an outer side of the second substrate; a first polarizer disposed at an outer side of the first substrate; a second polarizer disposed at an outer side of the second substrate; a first quarter wave retarder film disposed between the first substrate and the first polarizer; and a second quarter wave retarder film disposed between the second substrate and the second polarizer.

In one embodiment of the present invention, the second angle is in the range of 10 degrees to 80 degrees except 45 degrees.

In one embodiment of the present invention, the second angle is in the range of 35 degrees to 55 degrees except 45 degrees.

In one embodiment of the present invention, there is further a third angle between the trunk portion and the branch portions, and the third angle is different from the first angle and the second angle.

In one embodiment of the present invention, the second angles are different from each other in a plurality of pixel regions on the second substrate.

In one embodiment of the present invention, an angle between slow axes of the first quarter wave retarder film and the second quarter wave retarder film is 90 degrees, and an angle between the slow axis of the first quarter wave retarder film and an absorption axis of the first polarizer is 45 degrees, and an angle between the slow axis of the second quarter wave retarder film and an absorption axis of the second polarizer is 45 degrees.

In the LCD panel and the display apparatus using the same of the present invention, with the use of the pixel electrode structure, the color shift problem of the VA type LCD apparatus can be improved. Moreover, the polarized direction and angles of the light rays can be adjusted by the $\lambda/4$ retarder films for enhancing the transmittance of the liquid crystal display panel.

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

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

FIG. 2 is a cross-sectional view showing a PSVA type liquid crystal display panel according to one embodiment of the present invention;

FIG. 3 is a schematic diagram showing a pixel region of the liquid crystal display panel according to one embodiment of the present invention;

FIG. 4 is a schematic diagram showing different angles according to one embodiment of the present invention;

FIG. 5 is a schematic diagram showing polarized light rays according to one embodiment of the present invention;

FIG. 6 is a schematic diagram showing a pixel region of a liquid crystal display panel according to another embodiment of the present invention; and

FIG. 7 is a schematic diagram showing pixel regions of a liquid crystal display panel according to a further embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

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.

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

Referring to FIG. 1, a cross-sectional view showing a liquid crystal display (LCD) panel according to one embodiment of the present invention is illustrated. The display apparatus of the present embodiment can comprises 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. The liquid

crystal display panel 100 may be a VA type liquid crystal display panel, such as a PSVA type liquid crystal display panel or a pattern vertical alignment (PVA) type liquid crystal display panel.

Referring to FIG. 1 again, the liquid crystal display panel 100 may comprise a first substrate 110, a second substrate 120, a liquid crystal layer 130, a first polarizer 140 and a second polarizer 150, a first quarter wave ($\lambda/4$) retarder film 160 and a second $\lambda/4$ retarder film 170. The liquid crystal layer 130 is formed between the first substrate 110 and the second substrate 120. That is, the liquid crystal layer 130 is positioned at inner sides of the first substrate 110 and the second substrate 120. The first polarizer 140 is disposed at an outer side of the first substrate 110, and the second polarizer 150 is disposed at an outer side of the second substrate 120. The first $\lambda/4$ retarder film 160 is disposed between the first substrate 110 and the first polarizer 140, and the second $\lambda/4$ retarder film 170 is disposed between the second substrate 120 and the second polarizer 150.

Referring to FIG. 1, the first substrate 110 and the second substrate 120 may be realized as glass substrates or flexible plastic substrates. 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.

Referring to FIG. 2, a cross-sectional view showing a PSVA type liquid crystal display panel according to one embodiment of the present invention is illustrated. In this embodiment, the liquid crystal display panel 100 may be, for example, a PSVA type liquid crystal display panel. At this time, the liquid crystal layer 130 can include 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).

Referring to FIG. 2 again, when the liquid crystal display panel 100 is the PSVA type liquid crystal display panel, the first substrate 110 can comprise a first electrode 111, a first alignment layer 112 and a first polymer alignment layer 113, and the second substrate 120 can comprise a second electrode 121, a second alignment layer 122 and a second polymer alignment layer 123. The first alignment layer 112 and the first polymer alignment layer 113 are formed on the first electrode 111 in sequence. 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. The alignment layers **112**, **122** are formed on the substrates **110**, **120**, respectively. The polymer alignment layers **113**, **123** are polymerized of the reactive monomers bonded with the alignment layers **112**, **122**.

Referring to FIG. 3, a schematic diagram showing a pixel region of the liquid crystal display panel according to one 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 electrode structure (or pixel pattern) for forming a multi-domain alignment. In this embodiment, the second electrode **121** in each of the pixel regions **101** comprises a trunk portion **124** and a plurality of branch portions **125**. The trunk portion **124** may be a crisscross pattern, and each of the pixel regions **101** is divided into four sub-pixel regions **102** by the trunk portion **124**. In each of the sub-pixel regions **102**, the branch portions **125** obliquely extend from the trunk portion **124** and are arranged parallel to each other. In each of the pixel regions **101**, there are a first angle $\theta 1$ and a second angle $\theta 2$ between the trunk portion **124** and the branch portions **125**, and the first angle $\theta 1$ may be of 45 degrees for enhancing a transmittance of the LCD panel **100**. The second angle $\theta 2$ may be less than or greater than 45 degrees. i.e. not equal to 45 degrees ($\theta 2 \neq 45^\circ$). For example, the second angle $\theta 2$ may be in the range of 10 degrees to 80 degrees except 45 degrees for improving the color shift problem exiting in the VA type LCD apparatus. In one embodiment, the second angle $\theta 2$ may be in the range of 35 degrees to 55 degrees except 45 degrees, such as 55 or 40 degrees.

According to an optical theory, when an angle between a tilting direction of the liquid crystal molecules and an absorption axis of the polarizer is 45 degrees, the liquid crystal display panel can have a greatest transmittance. Therefore, in embodiments of the present invention, the angle between the tilting direction of the liquid crystal molecules and an absorption axis of the polarizers **140**, **150** is adjusted, so as to enhance the transmittance of the liquid crystal display panel **100**.

Referring to FIG. 4, a schematic diagram showing different angles according to one embodiment of the present invention is illustrated. In portions of the pixel regions **101** (or the sub-pixel regions **102**), angles between the trunk portion **124** and the branch portions **125** are equal to the second angle $\theta 2$. At this time, the absorption axis of the first polarizer **140** may be vertical to the absorption axis of the second polarizer **150**. That is, an angle between the absorption axes A of the first polarizer **140** and the second polarizer **150** is 90 degrees. In this case, an angle between slow axes C of the $\lambda/4$ retarder films **160** and **170** is 90 degrees, and an angle between the axis C of the $\lambda/4$ retarder film **160** or **170** and the absorption axis A of the polarizer **140** or **150** is 45 degrees. That is, the angle between the axis C of the first $\lambda/4$ retarder film **160** and the absorption axis A of the polarizer **140** or **150** is 45 degrees, and the angle between the axis C of the second $\lambda/4$ retarder film **170** and the absorption axis A of the polarizer **140** or **150** is 45 degrees.

Referring to FIG. 5, a schematic diagram showing polarized light rays according to one embodiment of the present invention is illustrated. When the light rays are emitted from the second polarizer **150** to the first polarizer **140** of the liquid crystal display panel **100**, the light rays from the second polarizer **150** are transformed into left handed cir-

cularly polarized light rays or right handed circularly polarized light rays by the second $\lambda/4$ retarder film **170**. Subsequently, the circularly polarized light rays are transformed into another kind of circularly polarized light rays by the liquid crystal layer **130** (i.e. a liquid crystal cell). At this time, the liquid crystal layer **130** can be equivalent to a $\lambda/2$ retarder film. Subsequently, the circularly polarized light rays can be transformed into linearly polarized light rays by the first $\lambda/4$ retarder film **160**, so as to allow the light rays to pass a transmission axis of the first polarizer **140**. Therefore, when the angles between the trunk portion **124** and the branch portions **125** are equal to the second angle $\theta 2$, with the use of the $\lambda/4$ retarder films **160**, **170**, the polarized direction and angles of the light rays can be adjusted for enhancing the transmittance of the liquid crystal display panel **100**.

Referring to FIG. 6, a schematic diagram showing a pixel region of a liquid crystal display panel according to another embodiment of the present invention is illustrated. In another embodiment, there are a first angle $\theta 1$, a second angle $\theta 2$, a third angle $\theta 3$, and a fourth angle $\theta 4$ between the trunk portion **124** and the branch portions **125**, and the angles $\theta 1$, $\theta 2$, $\theta 3$ and $\theta 4$ are different from each other. In this case, the angles $\theta 1$ may be of 45 degrees, and the angles $\theta 2$, $\theta 3$ and $\theta 4$ are in the range of 10 degrees to 80 degrees except 45 degrees for improving the color shift problem exiting in the VA type LCD apparatus.

Referring to FIG. 7, a schematic diagram showing pixel regions of a liquid crystal display panel according to a further embodiment of the present invention is illustrated. In the further embodiment, the pixel regions of the second substrate **120** comprise a plurality of pixel regions R, G, B corresponding to different color lights. For example, the pixel regions R, G, B may correspond to red, green or blue filters. At this time, there are a first angle $\theta 1$, a second angle $\theta 2$, a third angle $\theta 3$, and a fourth angle $\theta 4$ between the trunk portion **124** and the branch portions **125** in the pixel regions R, G, B, and the angles $\theta 1$, $\theta 2$, $\theta 3$ and $\theta 4$ are different from each other. In this case, the angles $\theta 1$ may be of 45 degrees, and the angles $\theta 2$, $\theta 3$ and $\theta 4$ are in the range of 10 degrees to 80 degrees except 45 degrees for improving the color shift problem exiting in the VA type LCD apparatus. Moreover, the angles $\theta 2$, $\theta 3$ and $\theta 4$ between the trunk portion **124** and the branch portions **125** in the different pixel regions R, G, B are also different from each other for further improving the color shift problem. For example, in addition to the first angle $\theta 1$ of 45 degrees, the other angles between the trunk portion **124** and the branch portions **125** in the pixel regions R are different from the other angles between the trunk portion **124** and the branch portions **125** in the pixel regions G or B.

In a further embodiment, the liquid crystal display panel may be, for example, a PVA type liquid crystal display panel. At this time, the polymer alignment layers may be omitted in the liquid crystal display panel.

As described above, in the LCD panel and the display apparatus of the present invention using the same, with the use of the pixel electrode structure, the color shift problem of the VA type LCD apparatus can be improved. Moreover, the polarized direction and angles of the light rays can be adjusted by the $\lambda/4$ retarder films for enhancing the transmittance of the liquid crystal display panel. Therefore, in the LCD panel and the display apparatus of the present invention using the same, the color shift problem of the LCD panel can be improved, and the transmittance thereof can be enhanced.

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. 5

The invention claimed is:

1. A liquid crystal display panel comprising:

a first substrate comprising a first electrode;

a second substrate comprising a second electrode, 10
wherein the second electrode has a pixel electrode structure, and the pixel electrode structure comprises a trunk portion and plurality of branch portions, there is a first angle and a second angle between the trunk portion and the branch portions, and the first angle is of 45 degrees, and the second angle is in the range of 10 15
degrees to 80 degrees except 45 degrees; wherein the trunk portion is a solid cross-shaped trunk portion positioned in a center of the pixel electrode structure, and the branch portions are extended from the trunk portion in a substantially radial manner and are separated by intervals; wherein each of the branch portions has a distal end away from the trunk portion, and the distal ends of the adjacent branch portions are spaced from each other; 20 25

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

a first polarizer disposed at an outer side of the first substrate;

a second polarizer disposed at an outer side of the second substrate; 30

a first quarter wave retarder film disposed between the first substrate and the first polarizer; and

a second quarter wave retarder film disposed between the second substrate and the second polarizer, wherein an angle between slow axes of the first quarter wave retarder film and the second quarter wave retarder film is 90 degrees, and an angle between the slow axis of the first quarter wave retarder film and an absorption axis of the first polarizer is 45 degrees, and an angle between the slow axis of the second quarter wave retarder film and an absorption axis of the second polarizer is 45 degrees; 40

wherein, the second substrate comprises a plurality of first pixel regions corresponding to red filters, a plurality of second pixel regions corresponding to green filters, and a plurality of third pixel regions corresponding to blue filters, in each of the first pixel regions, second pixel regions, and third pixel regions, there are the first angle, the second angle, a third angle, and a fourth angle between the trunk portion and the branch portions, and the second angle, third angle, and fourth angle are in a range of 10 degrees to 80 degrees except 45 degrees, and the second angle, third angle, and fourth angle are different from each other; 50 55

wherein, in the first pixel regions, second pixel regions, and third pixel regions, all of the second angles, third angles, and fourth angles are different from each other.

2. The liquid crystal display panel according to claim 1, wherein the second angle is in the range of 35 degrees to 55 degrees except 45 degrees. 60

3. A liquid crystal display panel comprising:

a first substrate comprising a first electrode;

a second substrate comprising a second electrode, 65
wherein the second electrode has a pixel electrode structure, and the pixel electrode structure comprises a trunk portion and plurality of branch portions, there is

a first angle and a second angle between the trunk portion and the branch portions, and the first angle is of 45 degrees, and the second angle is less than or greater than 45 degrees; wherein the trunk portion is a solid cross-shaped trunk portion positioned in a center of the pixel electrode structure, and the branch portions are extended from the trunk portion in a substantially radial manner and are separated by intervals; wherein each of the branch portions has a distal end away from the trunk portion, and the distal ends of the adjacent branch portions are spaced from each other;

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

a first polarizer disposed at an outer side of the first substrate;

a second polarizer disposed at an outer side of the second substrate;

a first quarter wave retarder film disposed between the first substrate and the first polarizer; and

a second quarter wave retarder film disposed between the second substrate and the second polarizer;

wherein, the second substrate comprises a plurality of first pixel regions corresponding to red filters, a plurality of second pixel regions corresponding to green filters, and a plurality of third pixel regions corresponding to blue filters, in each of the first pixel regions, second pixel regions, and third pixel regions, there are the first angle, the second angle, a third angle, and a fourth angle between the trunk portion and the branch portions, and the second angle, third angle, and fourth angle are in a range of 10 degrees to 80 degrees except 45 degrees, and the second angle, third angle, and fourth angle are different from each other;

wherein, in the first pixel regions, second pixel regions, and third pixel regions, all of the second angles, third angles, and fourth angles are different from each other.

4. The liquid crystal display panel according to claim 3, wherein the second angle is in the range of 35 degrees to 55 degrees except 45 degrees.

5. A display apparatus comprising:

a backlight module; and

a liquid crystal display panel comprising:

a first substrate comprising a first electrode;

a second substrate comprising a second electrode, wherein the second electrode has a pixel electrode structure, and the pixel electrode structure comprises a trunk portion and plurality of branch portions, there is a first angle and a second angle between the trunk portion and the branch portions, and the first angle is of 45 degrees, and the second angle, is less than or greater than 45 degrees; wherein the trunk portion is a solid cross-shaped trunk portion positioned in a center of the pixel electrode structure, and the branch portions are extended from the trunk portion in a substantially radial manner and are separated by intervals; wherein each of the branch portions has a distal end away from the trunk portion, and the distal ends of the adjacent branch portions are spaced from each other;

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

a first polarizer disposed at an outer side of the first substrate;

a second polarizer disposed at an outer side of the second substrate;

a first quarter wave retarder film disposed between the first substrate and the first polarizer; and

a second quarter wave retarder film disposed between the second substrate and the second polarizer;
wherein, the second substrate comprises a plurality of first pixel regions corresponding to red filters, a plurality of second pixel regions corresponding to green filters, and a plurality of third pixel regions corresponding to blue filters, in each of the first pixel regions, second pixel regions, and third pixel regions, there are the first angle, the second angle, a third angle, and a fourth angle between the trunk portion and the branch portions, and the second angle, third angle, and fourth angle are in a range of 10 degrees to 80 degrees except 45 degrees, and the second angle, third angle, and fourth angle are different from each other;
wherein, in the first pixel regions, second pixel regions, and third pixel regions, all of the second angles, third angles, and fourth angles are different from each other.

6. The display apparatus according to claim 5, wherein the second angle is in the range of 35 degrees to 55 degrees except 45 degrees.

* * * * *

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	US9507201	公开(公告)日	2016-11-29
申请号	US13/639093	申请日	2012-05-28
[标]申请(专利权)人(译)	康Chihtsung		
申请(专利权)人(译)	康, CHIHTSUNG		
当前申请(专利权)人(译)	深圳市中国星光电科技有限公司.		
[标]发明人	KANG CHIHTSUNG		
发明人	KANG, CHIHTSUNG		
IPC分类号	G02F1/139 G02F1/13363 G02F1/1337 G02F1/1335 G02F1/1343		
CPC分类号	G02F1/133528 G02F1/1343 G02F1/1393 G02F1/133707 G02F1/134336 G02F2001/133638		
代理人(译)	FRIEDMAN, MARK M.		
助理审查员(译)	GROSS, ALEXANDER		
优先权	201210163447.1 2012-05-24 CN		
其他公开文献	US20150062496A1		
外部链接	Espacenet USPTO		

摘要(译)

本发明提供一种液晶显示 (LCD) 面板和使用该面板的显示装置。 LCD 面板包括第一基板, 第二基板, 液晶层和四分之一波长 ($\lambda/4$) 延迟膜。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, 其中第二电极包括主干部分和多个分支部分, 并且在主干部分和分支部分之间存在第一角度和第二角度。第一角度为45度, 第二角度小于或大于45度。 $\lambda/4$ 延迟膜粘合到第一基板和第二基板的外表面。本发明可以改善 LCD 面板的色移问题和透射率。

