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HWANG et al.(10) **Pub. No.: US 2009/0122226 A1**(43) **Pub. Date: May 14, 2009**(54) **LIQUID CRYSTAL DISPLAY DEVICE AND
MOBILE STATION HAVING THE SAME****Publication Classification**(51) **Int. Cl.****G02F 1/13357** (2006.01)**G02F 1/1335** (2006.01)(52) **U.S. Cl. 349/63; 349/96; 349/98; 349/114**

(57)

ABSTRACT

A liquid crystal display device includes: a transreflective liquid crystal panel; a front light unit supplying light to the transreflective liquid crystal panel; and a polarizer disposed on the transreflective liquid crystal panel and having an upper surface where fine protrusions are formed. In another aspect of the present invention, a liquid crystal display device includes: a transreflective liquid crystal panel; a first retardation compensation film formed under the transreflective liquid crystal panel; a first polarizer formed under the first retardation compensation film; a second retardation compensation film formed on the transreflective liquid crystal panel; and a second polarizer formed on the second retardation compensation film and having an upper surface where fine protrusions are formed. In a further another aspect of the present invention, a mobile station includes: a liquid crystal display device including a transreflective liquid crystal panel, a front light unit supplying light to the transreflective liquid crystal panel, and a polarizer disposed on the transreflective liquid crystal panel and having an upper surface where fine protrusions are formed; a communication unit performing communication with external devices; and a controller controlling the communication unit and an image display operation of the liquid crystal display device.

(76) Inventors: **Hyun Ha HWANG**, Kangnam-gu
(KR); **Seung Gon KANG**,
Hwasung-shi (KR)

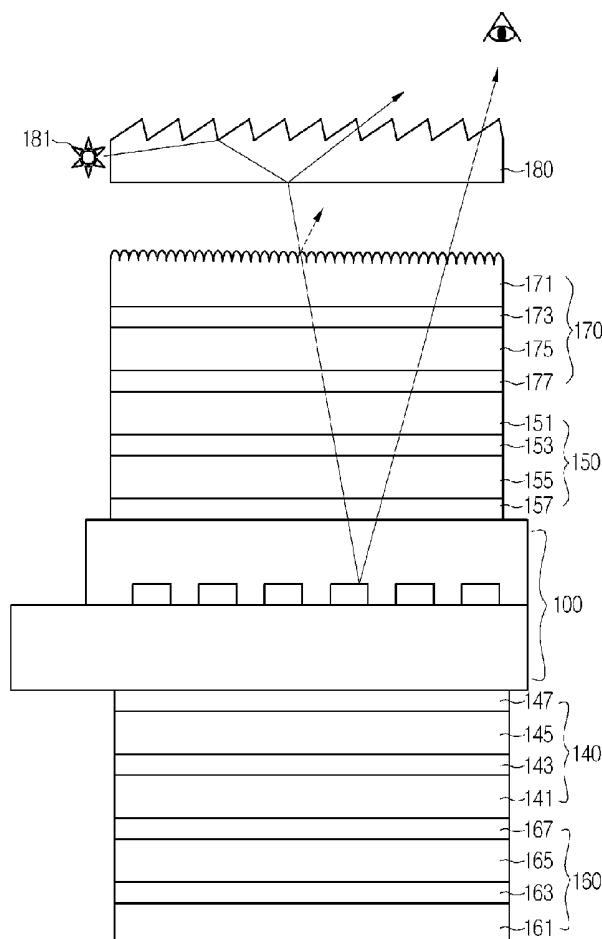
Correspondence Address:

SALIWANCHIK LLOYD & SALIWANCHIK
A PROFESSIONAL ASSOCIATION
PO Box 142950
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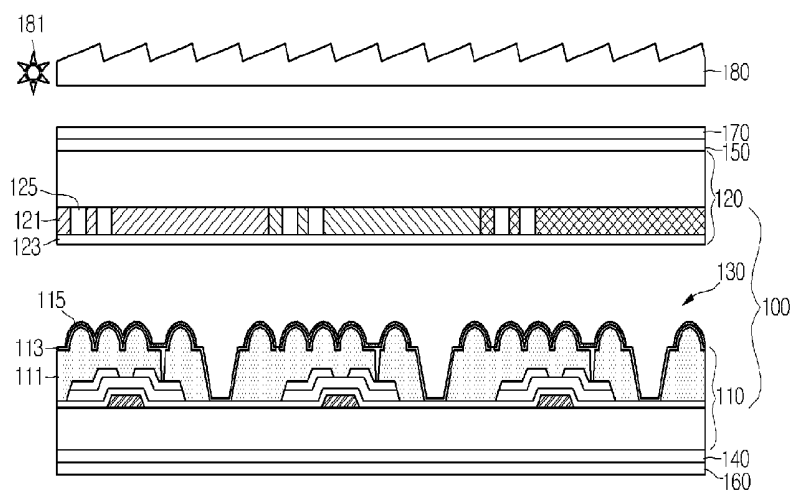
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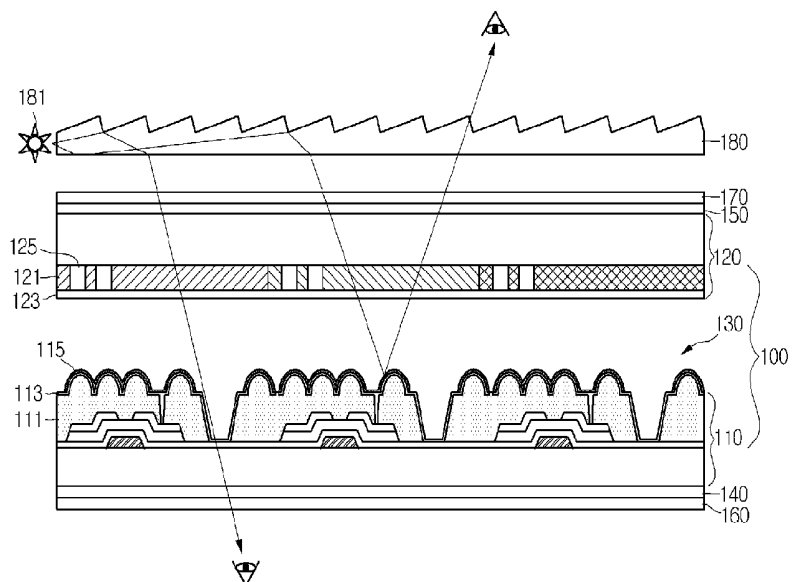
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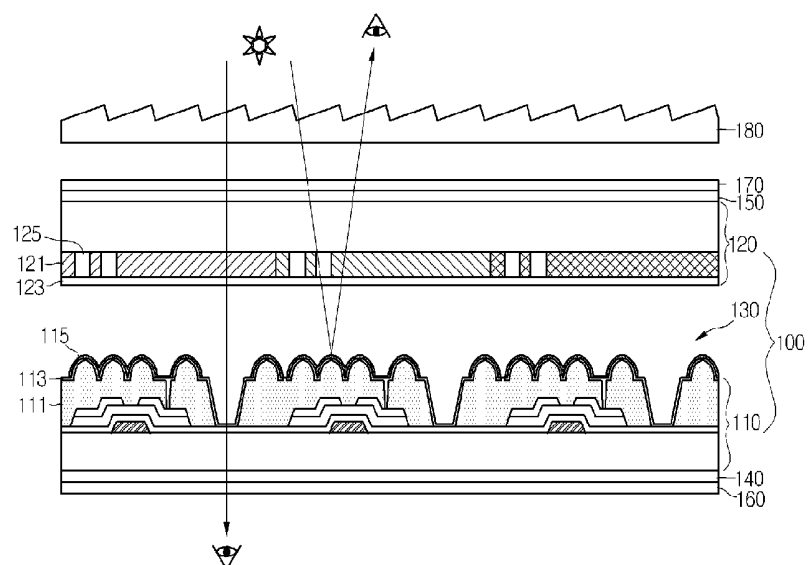
[Fig. 1]



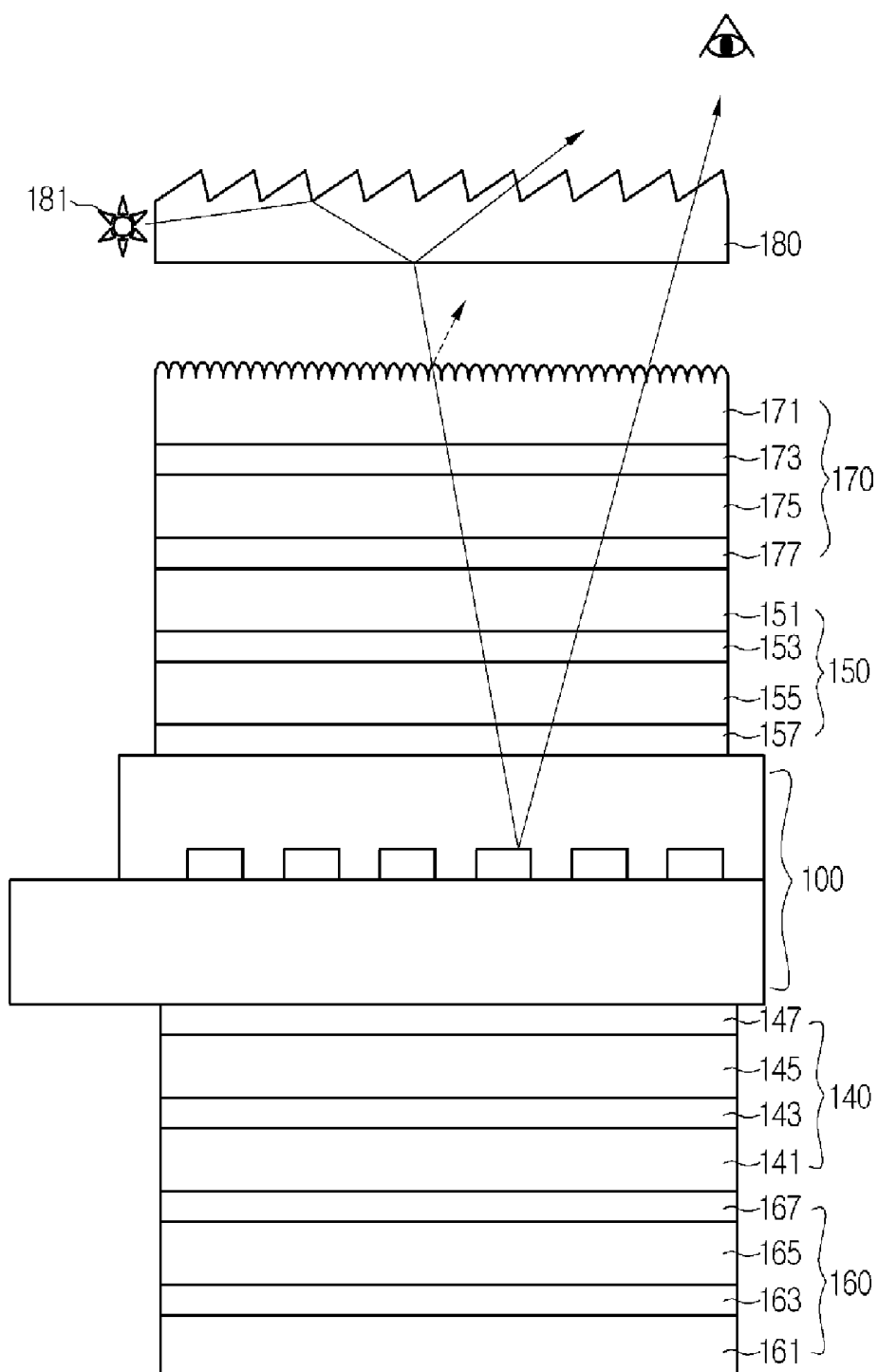
[Fig. 2]



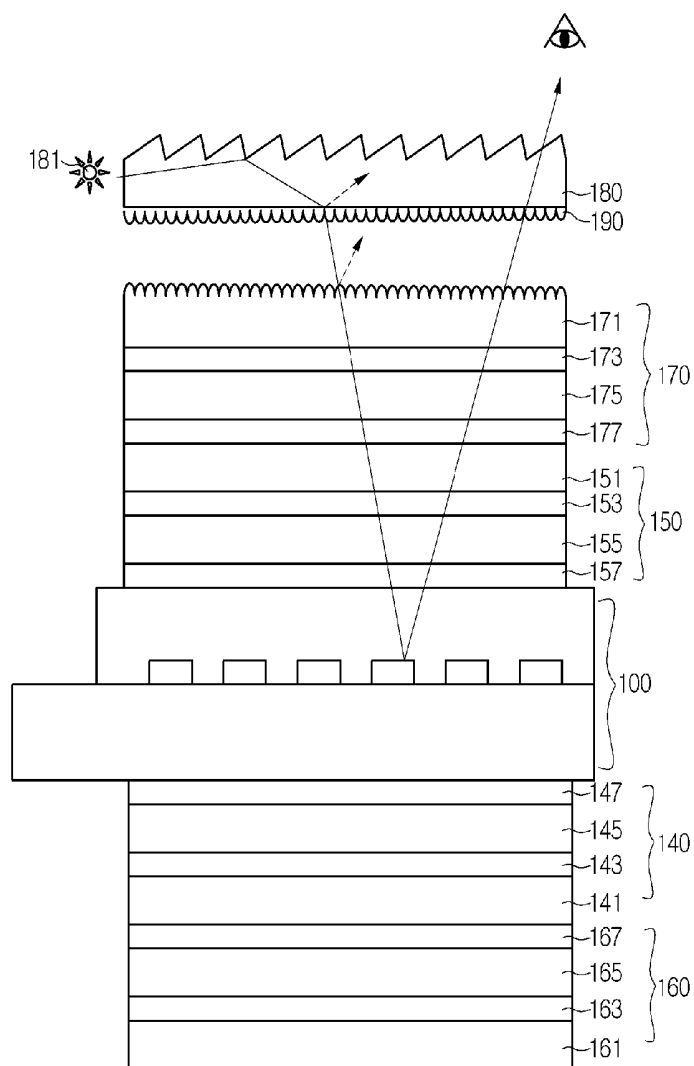
[Fig. 3]



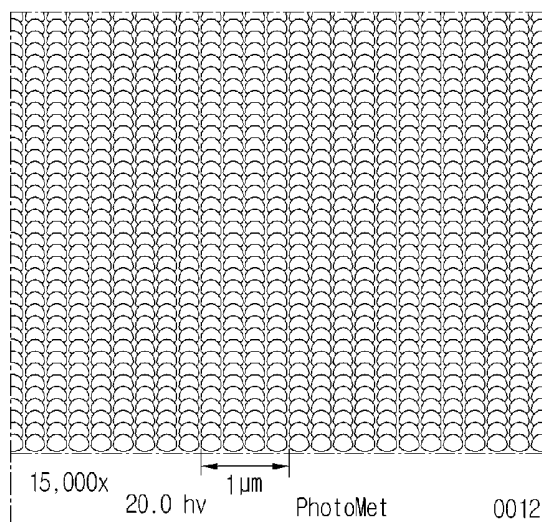
[Fig. 4]



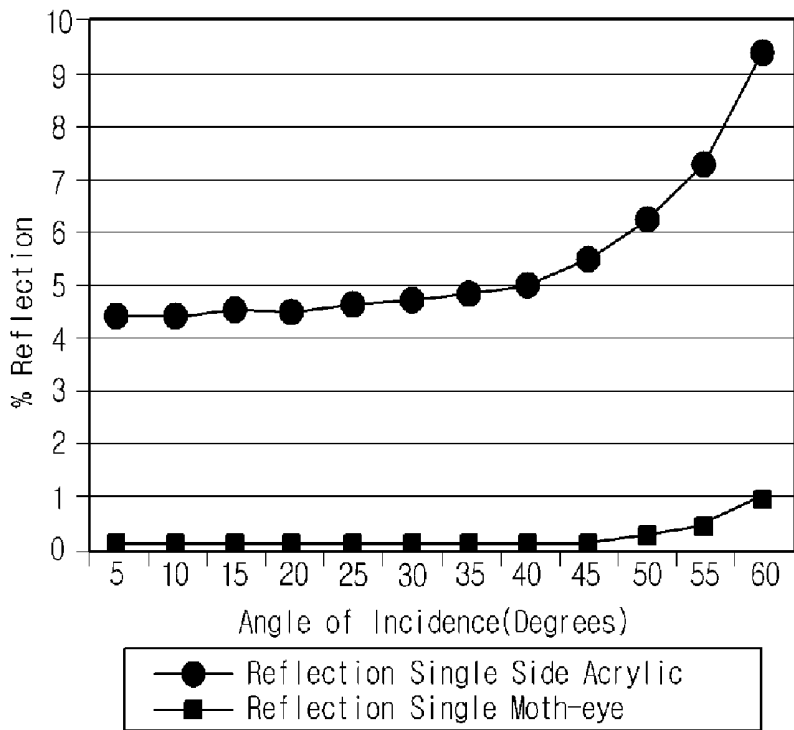
[Fig. 5]



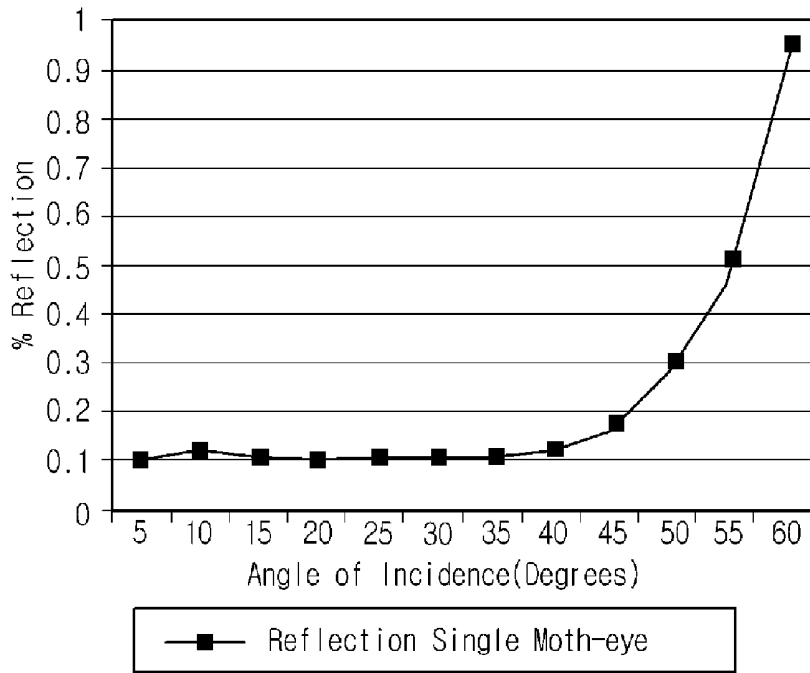
[Fig. 6]



[Fig. 7]



[Fig. 8]



LIQUID CRYSTAL DISPLAY DEVICE AND MOBILE STATION HAVING THE SAME

TECHNICAL FIELD

[0001] The present invention relates to a liquid crystal display device (LCD), and more particularly, to an LCD capable of bidirectionally displaying an image in front and rear directions using a transreflective liquid crystal panel and a mobile station having the same.

BACKGROUND ART

[0002] Among image display devices, a cathode ray tube (CRT) display device has been most widely used up to now. However, the CRT display device is very disadvantageous because it has large volume and weight compared to its display area.

[0003] Therefore, the CRT display device is gradually replaced by a thin film type flat panel display device (FPD) that can be used in any place because it has a small thickness while having a large display area.

[0004] An example of the FPD is a liquid crystal display device (LCD). The LCD operates using the optical anisotropy and polarization of liquid crystal. The LCD has a thin and long structure and its molecules have the characteristics of directionality and polarizability. Thus, the molecular arrangement direction of liquid crystal can be adjusted by applying an artificial electric field to the liquid crystal molecules. In the LCD, by adjustment of the liquid crystal alignment direction, a liquid crystal panel transmits or reflects light by the optical anisotropy of the liquid crystal according to the arrangement direction of liquid crystal molecules, thereby displaying images and colors.

[0005] Recently, various researches are conducted on a dual display that can bidirectionally display an image in front and rear directions.

DISCLOSURE OF INVENTION

Technical Problem

[0006] The present invention provides an LCD that can bidirectionally display an image in front and rear directions using a transreflective liquid crystal panel.

[0007] The present invention also provides a slim mobile station that can bidirectionally display an image using an LCD having a transreflective liquid crystal panel.

Technical Solution

[0008] The present invention provides a liquid crystal display device including: a transreflective liquid crystal panel; a front light unit supplying light to the transreflective liquid crystal panel; and a polarizer disposed on the transreflective liquid crystal panel and having an upper surface where fine protrusions are formed.

[0009] And the present invention provides a liquid crystal display device including: a transreflective liquid crystal panel; a first retardation compensation film formed under the transreflective liquid crystal panel; a first polarizer formed under the first retardation compensation film; a second retardation compensation film formed on the transreflective liquid crystal panel; and a second polarizer formed on the second retardation compensation film and having an upper surface where fine protrusions are formed.

[0010] And the present invention provides a mobile station including: a liquid crystal display device including a transreflective liquid crystal panel, a front light unit supplying light to the transreflective liquid crystal panel, and a polarizer disposed on the transreflective liquid crystal panel and having an upper surface where fine protrusions are formed; a communication unit performing communication with external devices; and a controller controlling the communication unit and an image display operation of the liquid crystal display device.

ADVANTAGEOUS EFFECTS

[0011] According to the present invention, it is possible to provide an LCD that bidirectionally displays an image in front and rear directions using a transreflective liquid crystal panel.

[0012] Also, it is possible to provide a slim mobile station that bidirectionally display an image using an LCD having a transreflective liquid crystal panel.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] FIG. 1 schematically illustrates the structure of an LCD according to the present invention.

[0014] FIG. 2 illustrates that an image is displayed using light provided from a front light unit in the LCD according to the present invention.

[0015] FIG. 3 illustrates that an image is displayed using an external light source in the LCD according to the present invention.

[0016] FIG. 4 illustrates an LCD according to an embodiment of the present invention.

[0017] FIG. 5 illustrates an LCD according to another embodiment of the present invention.

[0018] FIG. 6 illustrates the shape of a moth-eye type embossing polarizer used in the LCD according to the present invention.

[0019] FIG. 7 is a graph comparing the characteristics of the moth-eye type embossing polarizer used in the LCD according to the present invention with the characteristics of a general polarizer.

[0020] FIG. 8 is a graph illustrating the characteristics of the moth-eye type embossing polarizer used in the LCD according to the present invention.

MODE FOR THE INVENTION

[0021] Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

[0022] FIG. 1 schematically illustrates the structure of an LCD according to the present invention.

[0023] Referring to FIG. 1, an LCD according to the present invention includes: a transreflective liquid crystal panel 100; a front light unit 180 supplying light for image display to the transreflective liquid crystal panel 100; and a second polarizer 170 disposed on the transreflective liquid crystal panel 100. Fine protrusions are formed on an upper surface of the second polarizer 170.

[0024] The fine protrusions of the second polarizer 170 are formed in a moth-eye structure, which will be described in detail later.

[0025] In the LCD according to the present invention, the front light unit 180 is disposed at a front side of the transreflective liquid crystal panel 100 and thus an image can be

bidirectionally displayed in front and rear directions of the transreflective liquid crystal panel 100. A reference numeral 181 denotes a light source provided at the front light unit 180.

[0026] That is, the LCD provides a first display mode in which light reflected by a reflective electrode 115 of the transreflective liquid crystal panel 100 is used to display an image at the front side of the transreflective liquid crystal panel 100. Also, the LCD provides a second display mode in which light transmitted through a transmissive electrode 113 of the transreflective liquid crystal panel 100 is used to display an image at a rear side of the transreflective liquid crystal panel 100.

[0027] A second retardation compensation film 150 is disposed on the transreflective liquid crystal panel 100, and a first retardation compensation film 140 and a first polarizer 160 are disposed under the transreflective liquid crystal panel 100.

[0028] The transreflective liquid crystal panel 100 includes a first substrate 110, a second substrate 120, and a liquid crystal layer 130, which are well known to those skilled in the art.

[0029] The first substrate 110 includes: an array device having a thin film transistor; the transmissive electrode 113 formed on the array device and transmitting incident light to display an image; and the reflective electrode 115 formed at a portion of an upper surface of the transmissive electrode 113 and reflecting incident light to display an image. A convex-concave layer 111 for forming protrusions is formed in a lower region of the reflective electrode 115. The convex-concave layer 111 may be formed of organic material or inorganic material.

[0030] A case where the reflective electrode 115 is formed on the transmissible electrode 113 is illustrated as an example. However, the transmissive electrode 113 and the reflective electrode 115 are alternately formed on the array device. The transmissive electrode 113 and the reflective electrode 115 may be arranged and formed in various methods. These methods are not an important matter of interest in the present invention and thus their descriptions will be omitted for conciseness.

[0031] The array device includes: a plurality of gate lines formed in a first direction, a plurality of data lines formed perpendicular to the gate lines; pixel regions defined by the gate and data lines; and thin film transistors formed at intersections of the gate and data lines.

[0032] The second substrate 120 is disposed facing the first substrate 110. The second substrate 120 includes: a color filter 121 formed at a position corresponding to the transmissive electrode 113; and a common electrode 123 formed on a lower surface of the color filter 121. Light holes 125 may be formed at the color filter 121. When the light holes 125 are formed at the color filter 121, light transmittance can be increased to enhance the entire brightness.

[0033] The liquid crystal layer 130 is filled between the first and second substrates 110 and 120. The transreflective liquid crystal panel 100 may be configured in an electrically-controlled birefringence (ECB) mode. For example, the transreflective liquid crystal panel 100 may be configured in a dual cell gap ECB mode such that it has a twist angle of 0° and a birefringence value ($\Delta n \cdot d$) of 0.20~0.40 μm for a transmissive mode. The dual cell gap means a case where a reflective region is formed to have $\frac{1}{2}$ times the cell gap of a transmissive region.

[0034] Alternatively, the transreflective liquid crystal panel 100 may be configured in a vertical alignment (VA) mode. For example, the transreflective liquid crystal panel 100 may be configured in a VA mode such that it has a twist angle of 0° and a birefringence value ($\Delta n \cdot d$) of 0.20~0.40 μm for a transmission mode. The VA mode may be a dual cell gap VA mode where a reflective region is formed to have $\frac{1}{2}$ times the cell gap of a transmissive region.

[0035] The first retardation compensation film 140 and the first polarizer 160 are formed on a lower surface of the first substrate 110, and the second retardation compensation film 150 and the second polarizer 170 are formed on an upper surface of the second substrate 120.

[0036] The first and second retardation compensation films 140 and 150 may be formed using a wideband phase retardation plate. At this time, the wideband phase plate may be configured to perform a function of changing linearly-polarized light having passed through the polarizer into circularly-polarized light. This can be implemented in such a way that the wideband phase retardation plate is configured to generate a phase retardation of $\lambda/4$ with respect to an incident wave.

[0037] As an example, the wideband phase retardation plate may be configured to include a $\lambda/2$ plate (HWP) and a $\lambda/4$ plate (QWP). In this structure of two-sheet phase difference film, the film is generally formed of Arton from JSR or S-Cina from Sekisui. Alternatively, a one-sheet phase difference film may be used to form the wideband phase retardation plate generating a phase retardation of $\lambda/4$. The wideband phase retardation plate may be formed of one wide retardation film (WRF) using a reciprocal dispersion film from Sanritz.

[0038] An operation in which an image is displayed in the above LCD will now be described in detail with reference to FIGS. 2 and 3. FIG. 2 illustrates that an image is displayed using light provided from a front light unit in the LCD. FIG. 3 illustrates that an image is displayed using an external light source in the LCD.

[0039] At first, referring to FIG. 2, what an image is displayed using light provided from a front light unit will be explained.

[0040] Referring to FIG. 2, light provided from the light source 181 of the front light unit 180 is used to bidirectionally display an image at the front and rear sides of the transreflective liquid crystal panel 100.

[0041] The front light unit 180 has the light source 181 at the side thereof. The light source 181 may be configured with an LED. The LED may be configured with a white LED, or red/green/blue LEDs. Alternatively, the light source 181 may be configured with a cold cathode fluorescent lamp (CCFL).

[0042] That is, the LCD provides a first display mode in which light reflected by a reflective electrode 115 of the transreflective liquid crystal panel 100 is used to display an image at the front side of the transreflective liquid crystal panel 100. Also, the LCD provides a second display mode in which light transmitted through a transmissive electrode 113 of the transreflective liquid crystal panel 100 is used to display an image at a rear side of the transreflective liquid crystal panel 100.

[0043] Referring to FIG. 3, light provided from an external light source (e.g., the sun and a peripheral illuminator) is used to bidirectionally display an image at the front and rear sides of the transreflective liquid crystal panel 100. That is, when the front light unit 180 is in an off state, light received from the

external light source is used to bidirectionally display an image at the front and rear sides of the transreflective liquid crystal panel 100.

[0044] FIG. 4 illustrates an LCD according to an embodiment of the present invention.

[0045] Referring to FIG. 4, the LCD according to the embodiment of the present invention includes: a transreflective liquid crystal panel 100; a first retardation compensation film 140; a second retardation compensation film 150; a first polarizer 160; a second polarizer 170; and a front light unit 180 having a light source 181.

[0046] The first retardation compensation film 140 includes a first retardation film 141, a second retardation film 145, and adhesives 143 and 147. The second retardation compensation film 150 includes a third retardation film 151, a fourth retardation film 155, and adhesive 153 and 157. The first and third retardation films 141 and 151 may be configured to generate a phase retardation of $\lambda/2$. The second and fourth retardation films 145 and 155 may be configured to generate a phase retardation of $\lambda/4$.

[0047] The first polarizer 160 includes transparent support 161 and 165, a polarization film 163, and an adhesive 167. The second polarizer 170 includes an embossing transparent support 171, a transparent support 175, a polarization film 173, and an adhesive 177. The transparent supports 161, 165 and 175 and the embossing transparent support 171 may be formed of tri-acetate cellulose (TAC). The polarization films 163 and 173 may be formed of poly-vinyl alcohol (PVA).

[0048] Fine protrusions are formed on an upper surface of the embossing transparent support 171. The fine protrusions may be formed in a moth-eye structure.

[0049] In the above LCD, light (indicated by a dotted line) reflected upward by the embossing transparent support 171 can be blocked to enhance the quality of a displayed image.

[0050] Also, the second polarizer 170 is configured to have haze characteristics. Accordingly, it is possible to prevent the occurrence of moire and bright lines that may be caused by light interference between a prism pattern of a light guide plate of the front light unit 180 and a periodic pixel pattern of the transreflective liquid crystal panel 100. At this time, the second polarizer 170 is configured to have a haze value of less than 30%. This can be implemented using a diffusion adhesive or an embedded diffuser of the transparent support.

[0051] FIG. 5 illustrates an LCD according to another embodiment of the present invention.

[0052] Referring to FIG. 5, unlike the embodiment of FIG. 4, the LCD according to another embodiment of the present invention further includes a fine protrusion portion 190 formed on a lower surface of the front light unit 180. The fine protrusion portion 190 may be formed in a moth-eye structure.

[0053] In this LCD, light (indicated by a dotted line) reflected upward by the embossing transparent support 171 can be blocked. Also, light (indicated by a dotted line) reflected upward at an interface between the front light unit 180 and the fine protrusion portion 190 can be blocked to further enhance the quality of a displayed image.

[0054] The characteristics of the moth-eye type embossing polarizer of the present invention will now be described in detail with reference to FIGS. 6 through 8. FIG. 6 illustrates the shape of a moth-eye type embossing polarizer used in the LCD according to the present invention. FIG. 7 is a graph comparing the characteristics of the moth-eye type embossing polarizer used in the LCD according to the present inven-

tion with the characteristics of a general polarizer. FIG. 8 is a graph illustrating the characteristics of the moth-eye type embossing polarizer used in the LCD according to the present invention.

[0055] In the present invention, a uniform protrusion array with a moth-eye structure illustrated in FIG. 6 is formed to reduce the reflection of light received from the outside. This reflection prevention surface with the moth-eye structure is formed to have a height of about 200 nm and a protrusion pitch of about 250 nm (with smaller than wavelength of light).

[0056] This moth-eye structure may be formed by holographic lithography using a photoresist. In detail, after a moth-eye master is manufactured, the moth-eye structure can be inexpensively manufactured by performing replication using a stamping method.

[0057] The embossing polarizer with the moth-eye surface structure operates according to the following principle. That is, the interface of the polarizer is formed to have a refractivity changing gradually, not abruptly, thereby minimizing the reflection of incident light.

[0058] The graph of FIG. 7 illustrates the difference between a light reflectance depending on an incident angle between a general acryl surface and a moth-eye type surface. FIG. 8 is an enlarged view of the light reflectance at the moth-eye type surface.

[0059] As can be seen from FIGS. 7 and 8, the embossing polarizer has little surface reflectance of 0.1% depending on an incident angle, whereas a polarizer with an acryl surface has high surface reflectance of 4.5~9.5% depending on an incident angle.

[0060] Accordingly, when the moth-eye type embossing polarizer is used, the surface reflection at the polarizer surface can be almost removed to enhance the light transmittance and contrast.

[0061] Meanwhile, the above mentioned LCD can be used as a dual display device. Accordingly, when the LCD according to the present invention is used in a mobile station (e.g., mobile communication terminals, and PDAs), since an image can be bidirectionally displayed in the front and rear directions of the liquid crystal panel, it is possible to implement a mobile station that can perform various image display functions. This mobile station includes: a communication unit performing communication with external devices; and a controller controlling the communication unit and the image display of the LCD.

[0062] For example, when the LCD according to the present invention is applied to a mobile station with a digital camera function, a picture image of the same size and resolution can be simultaneously viewed by several users in the front and rear directions of the mobile station.

INDUSTRIAL APPLICABILITY

[0063] By the LCD according to the present invention, it is possible to bidirectionally display an image in front and rear directions using a transreflective liquid crystal panel.

[0064] Also, since the embossing polarizer and the embossing front light unit is used in the LCD, the surface reflection at the respective interfaces can be minimized to the light transmittance. Accordingly, the brightness and the contrast in the reflection mode can be enhanced.

[0065] Also, since the polarizer with the haze characteristics is used in the LCD, it is possible to reduce the phenom-

enon of moire and bright lines that is generated by light interference between the liquid crystal panel and the front light unit.

[0066] Also, it is possible to provide the slim mobile station that bidirectionally display an image using LCD having a liquid crystal panel. For example, the present invention makes it possible to manufacture a liquid crystal display module for two-direction image display, which has a thickness of less than 3.5 mm.

1. A liquid crystal display device comprising:
 - a transreflective liquid crystal panel;
 - a front light unit for supplying light to the transreflective liquid crystal panel; and
 - a polarizer disposed on the transreflective liquid crystal panel and having an upper surface comprising fine protrusions.
2. The liquid crystal display device according to claim 1, wherein the first front light unit performs a first display mode by using light reflected at a reflective region of the transreflective liquid crystal panel to display an image at a front side of the transreflective liquid crystal panel; and
 - the first front light unit performs a second display mode by using light transmitted through a transmissive region of the transreflective liquid crystal panel to display an image at a rear side of the transreflective liquid crystal panel.
3. The liquid crystal display device according to claim 1, wherein the front light unit has a light source at a side thereof.
4. The liquid crystal display device according to claim 3, wherein the light source comprises an LED or a CCFL.
5. The liquid crystal display device according to claim 1, wherein the transreflective liquid crystal panel comprises:
 - a first substrate including an array device, a transmissive electrode for transmitting incident light to display an image, and a reflective electrode for reflecting incident light to display an image;
 - a second substrate disposed facing the first substrate and having a color filter formed at a position corresponding to the transmissive electrode of the first substrate; and
 - a liquid crystal layer filled between the first substrate and the second substrate.
6. The liquid crystal display device according to claim 5, wherein the second substrate includes a common electrode formed on a lower surface of the color filter.
7. The liquid crystal display device according to claim 1, wherein the transreflective liquid crystal panel comprises:
 - a first substrate including an array device performing a switching function, a convex-concave layer formed of an organic or inorganic material, a transmissive electrode formed on the convex-concave layer, and a reflective electrode formed on the convex-concave layer;
 - a second substrate disposed facing the first substrate and having a color filter formed at a position corresponding to the transmissive electrode of the first substrate; and
 - a liquid crystal layer filled between the first substrate and the second substrate.
8. The liquid crystal display device according to claim 7, wherein the second substrate includes a common electrode formed on a lower surface of the color filter.
9. The liquid crystal display device according to claim 1, further comprising at least one phase retardation plate formed under and/or on the transreflective liquid crystal panel.

10. The liquid crystal display device according to claim 9, wherein the at least one phase retardation plate changes linearly-polarized light having passed through the polarizer into circularly-polarized light.

11. The liquid crystal display device according to claim 9, wherein a phase retardation plate of the at least one phase retardation plate generates a phase retardation of $\lambda/4$ with respect to an incident wave.

12. The liquid crystal display device according to claim 9, wherein the at least one phase retardation plate comprises a $\lambda/2$ plate and a $\lambda/4$ plate.

13. The liquid crystal display device according to claim 9, wherein the at least one phase retardation plate comprises one wide retardation film having a reciprocal dispersion function.

14. The liquid crystal display device according to claim 1, wherein the fine protrusions of the polarizer are formed in a moth-eye structure.

15. The liquid crystal display device according to claim 1, further comprising a second fine protrusion portion formed on a lower surface of the front light unit.

16. The liquid crystal display device according to claim 15, wherein the second fine protrusion portion of the front light unit is formed in a moth-eye structure.

17. The liquid crystal display device according to claim 1, wherein the polarizer comprises a polarization film and a transparent support.

18. The liquid crystal display device according to claim 1, wherein the polarizer has haze characteristics.

19. The liquid crystal display device according to claim 18, wherein the polarizer has a haze value of less than 30%.

20. The liquid crystal display device according to claim 1, wherein the transreflective liquid crystal panel operates in an electrically-controlled birefringence (ECB) mode.

21. The liquid crystal display device according to claim 1, wherein the transreflective liquid crystal panel is configured in a dual cell gap ECB mode such that it has a twist angle of 0° and a birefringence value of $0.20\text{--}0.40\ \mu\text{m}$.

22. The liquid crystal display device according to claim 5, further comprising light holes formed at the color filter of the second substrate.

23. The liquid crystal display device according to claim 1, wherein the transreflective liquid crystal panel operates in a vertical alignment (VA) mode.

24. The liquid crystal display device according to claim 1, wherein the transreflective liquid crystal panel is configured in a VA mode such that it has a twist angle of 0° and a birefringence value of $0.20\text{--}0.40\ \mu\text{m}$.

25. A liquid crystal display device comprising:

- a transreflective liquid crystal panel;
- a first retardation compensation film formed under the transreflective liquid crystal panel;
- a first polarizer formed under the first retardation compensation film;
- a second retardation compensation film formed on the transreflective liquid crystal panel; and
- a second polarizer formed on the second retardation compensation film and having an upper surface comprising fine protrusions.

26. The liquid crystal display device according to claim 25, wherein the transreflective liquid crystal panel comprises:

- a first substrate including an array device performing a switching function, a convex-concave layer formed of an organic or inorganic material, a transmissive elec-

trode formed on the convex-concave layer, and a reflective electrode formed on the convex-concave layer;

a second substrate disposed at a position corresponding to the first substrate and having a color filter formed at a position corresponding to the transmissive electrode of the first substrate; and

a liquid crystal layer filled between the first substrate and the second substrate.

27. The liquid crystal display device according to claim **25**, wherein the first and second retardation compensation films each comprise include a retardation film and an adhesive.

28. The liquid crystal display device according to claim **25**, wherein the first and second polarizer each comprise a transparent support, a polarization film, and an adhesive.

29. A mobile station comprising:

a liquid crystal display device including a transreflective liquid crystal panel; a front light unit for supplying light to the transreflective liquid crystal panel; and a polarizer disposed on the transreflective liquid crystal panel and having an upper surface comprising fine protrusions;

a communication unit to perform communication with external devices; and

a controller to control the communication unit and an image display operation of the liquid crystal display device.

30. The mobile station according to claim **29**, wherein the liquid crystal display device further includes at least one phase retardation plate formed under and/or on the transreflective liquid crystal panel.

31. The mobile station according to claim **29**, wherein the fine protrusions of the polarizer are formed in a moth-eye structure.

32. The mobile station according to claim **29**, wherein the liquid crystal display device further includes a moth-eye type fine protrusion portion formed on a lower surface of the front light unit.

33. The liquid crystal display device according to claim **1**, wherein the front light unit comprises an off state for allowing light to be provided from an external light source.

34. The liquid crystal display device according to claim **1**, wherein the polarizer has an interface that is formed with a refractivity that changes gradually.

35. The liquid crystal display device according to claim **7**, wherein the reflective electrode is formed on the transmissive electrode.

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专利名称(译)	液晶显示装置和具有相同功能的移动台		
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[标]申请(专利权)人(译)	HWANG HYUN HA KANG SEUNG GON		
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[标]发明人	HWANG HYUN HA KANG SEUNG GON		
发明人	HWANG, HYUN HA KANG, SEUNG GON		
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外部链接	Espacenet USPTO		

摘要(译)

一种液晶显示装置，包括：透射反射液晶面板；前透光单元，向透射反射型液晶面板提供光；偏振器设置在透射反射型液晶面板上，并具有形成微小突起的上表面。在本发明的另一方面，液晶显示装置包括：透射反射液晶面板；在透射反射型液晶面板下形成的第一延迟补偿膜；在第一延迟补偿膜下形成的第一偏振器；在透射反射型液晶面板上形成第二延迟补偿膜；第二偏振器形成在第二延迟补偿膜上并具有形成微小突起的上表面。在本发明的另一个方面，一种移动台包括：液晶显示装置，包括透射反射液晶面板，向透射反射型液晶面板提供光的前光单元，以及设置在透射反射液晶面板上的偏振器并且具有形成微小突起的上表面；通信单元，与外部设备进行通信；控制通信单元的控制器和液晶显示装置的图像显示操作。

