



US007889288B2

(12) **United States Patent**
Choi

(10) **Patent No.:** **US 7,889,288 B2**
(45) **Date of Patent:** **Feb. 15, 2011**

(54) **DUAL REFLECTIVE LIQUID CRYSTAL
DISPLAY DEVICE**

(75) Inventor: **Su-Seok Choi**, Gyeonggi-Do (KR)

(73) Assignee: **LG Display Co., Ltd.**, Seoul (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 663 days.

(21) Appl. No.: **11/012,124**

(22) Filed: **Dec. 16, 2004**

(65) **Prior Publication Data**

US 2005/0134767 A1 Jun. 23, 2005

(30) **Foreign Application Priority Data**

Dec. 20, 2003 (KR) 10-2003-0094290

(51) **Int. Cl.**
G02F 1/1335 (2006.01)

(52) **U.S. Cl.** **349/61; 349/65; 349/113**

(58) **Field of Classification Search** None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,158,484 A * 6/1979 Nishiyama 349/113
6,064,456 A * 5/2000 Taniguchi et al. 349/113

6,295,109 B1 * 9/2001 Kubo et al. 349/119
6,347,874 B1 * 2/2002 Boyd et al. 362/628
6,897,914 B2 * 5/2005 Yoshida 349/65
2003/0063243 A1 * 4/2003 Roosendaal et al. 349/113
2003/0174270 A1 9/2003 Kim
2003/0210366 A1 * 11/2003 Huang et al. 349/113
2005/0046768 A1 * 3/2005 Wu 349/65

FOREIGN PATENT DOCUMENTS

CN 1195118 10/1998
CN 1195119 A 10/1998
CN 1438529 A 8/2003
JP 2002-357825 12/2002
JP 2003-161945 6/2003

* cited by examiner

Primary Examiner—David Nelms

Assistant Examiner—Lucy P Chien

(74) *Attorney, Agent, or Firm*—McKenna Long & Aldridge LLP

(57) **ABSTRACT**

A liquid crystal display device includes a first substrate having a first polarizer and a first retardation layer; a second substrate having a second polarizer and a second retardation layer; and a pixel between the first and second substrates, the pixel having a thin film transistor, a first reflective layer on the first substrate, a second reflective layer on the second substrate, a liquid crystal layer between the first and second substrates.

8 Claims, 5 Drawing Sheets

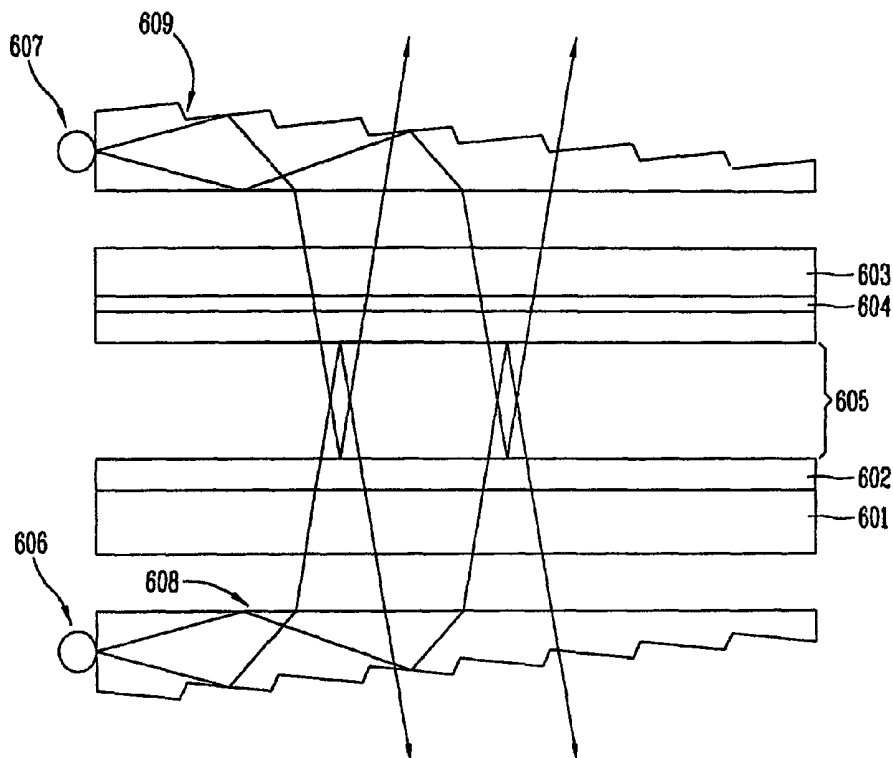


FIG. 1
RELATED ART

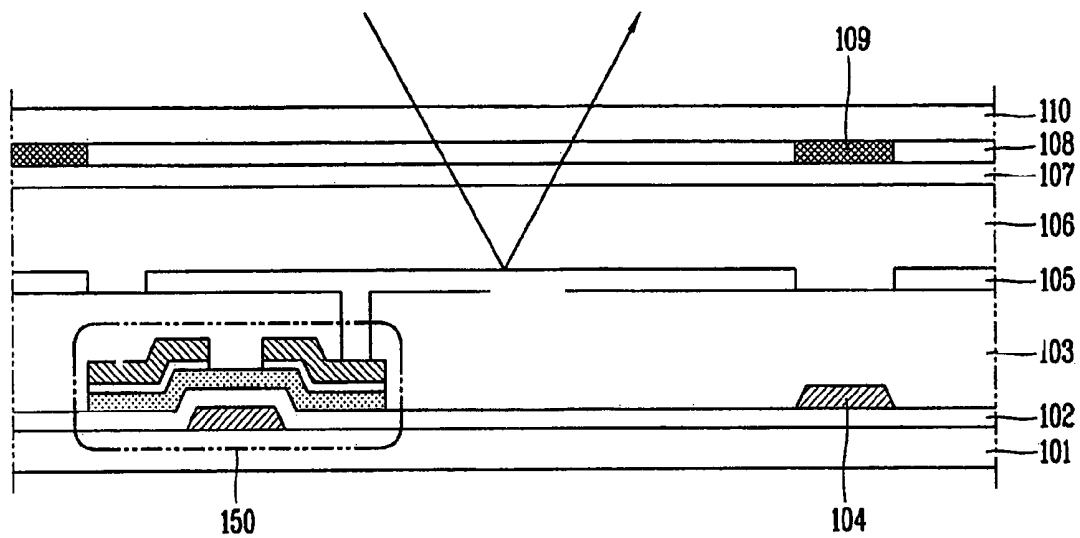


FIG. 2

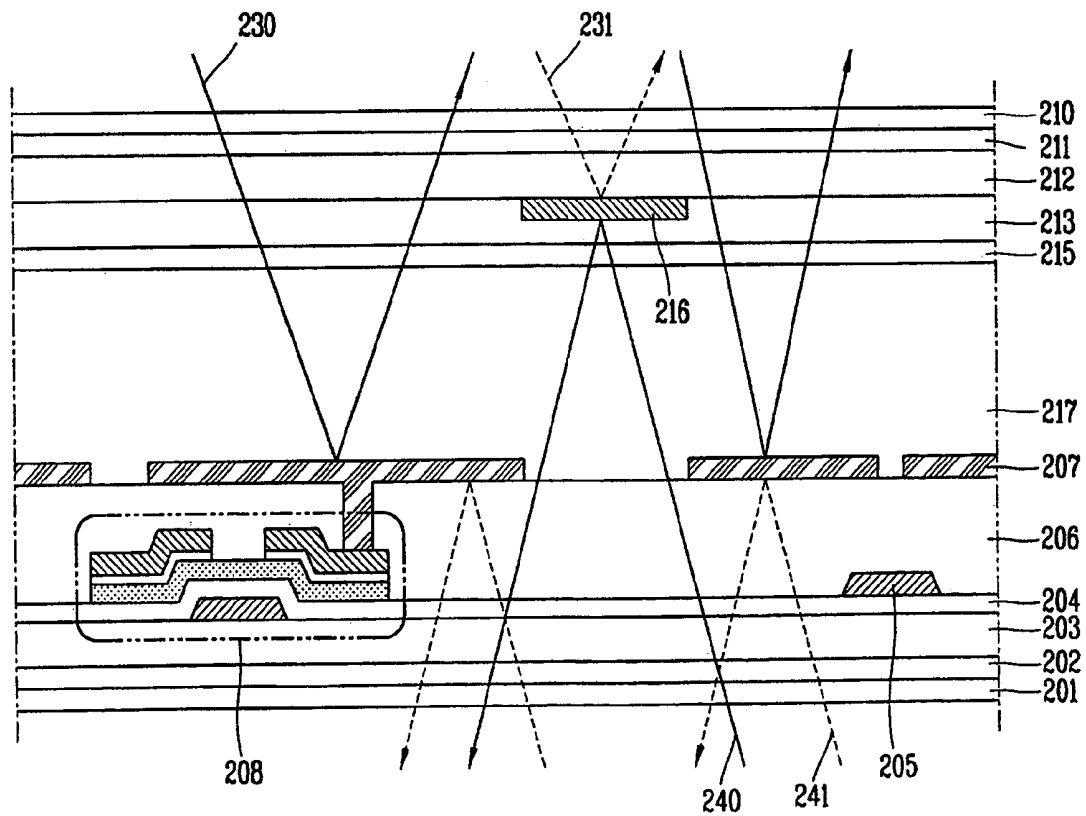


FIG. 3

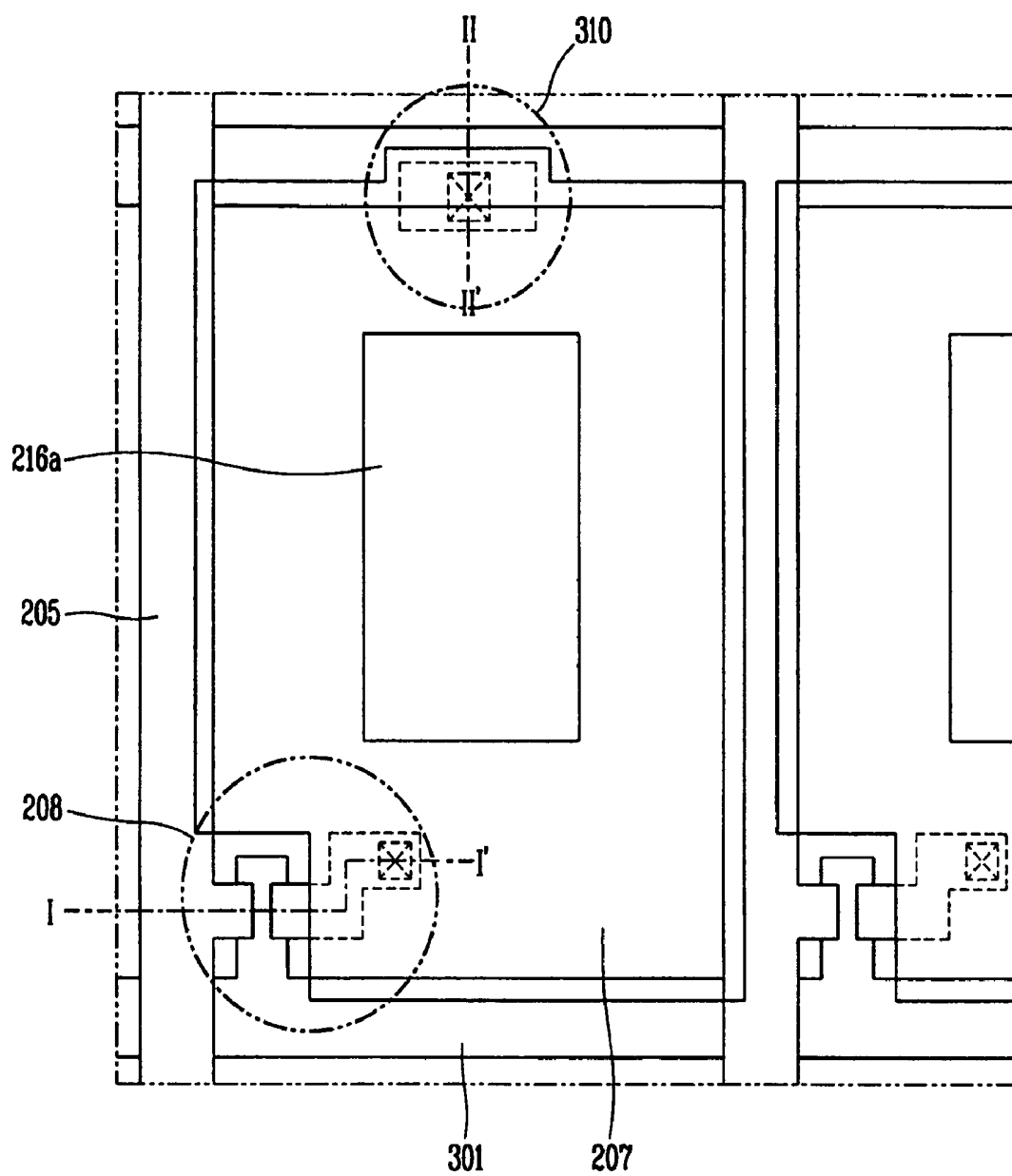


FIG. 4

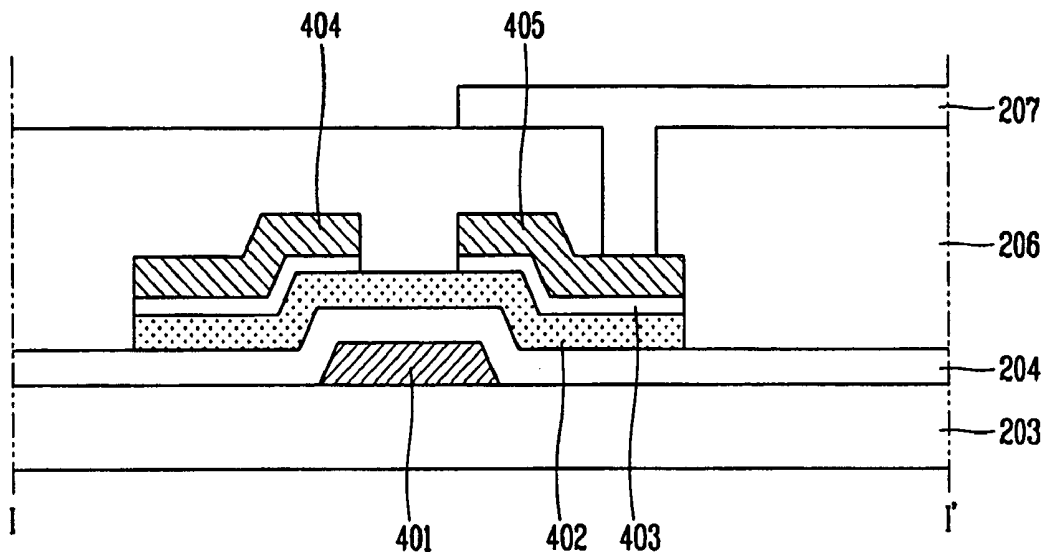


FIG. 5

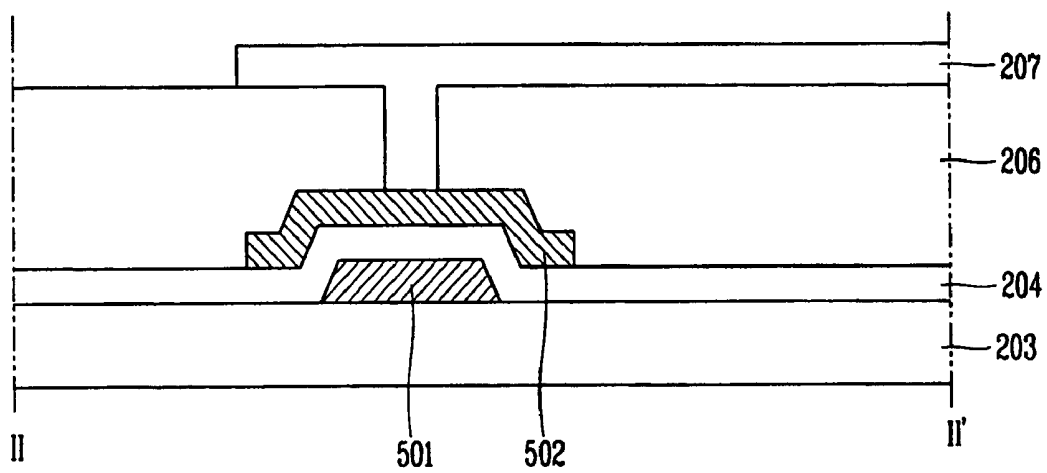


FIG. 6A

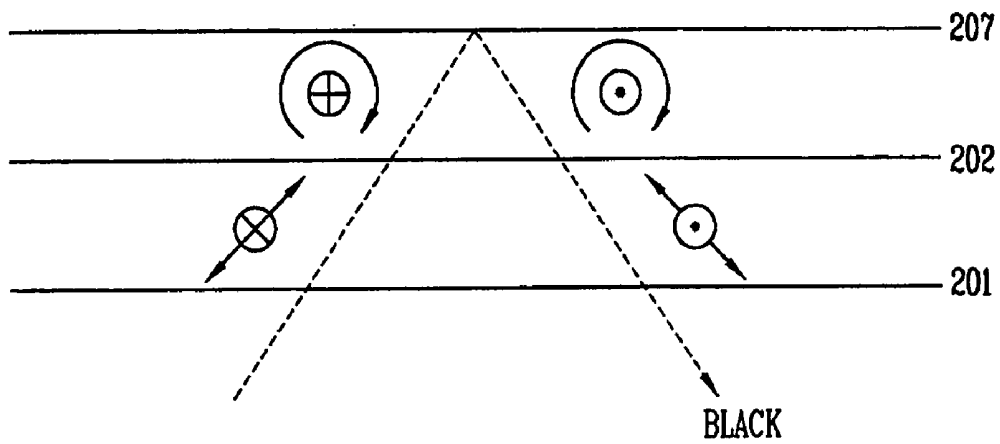


FIG. 6B

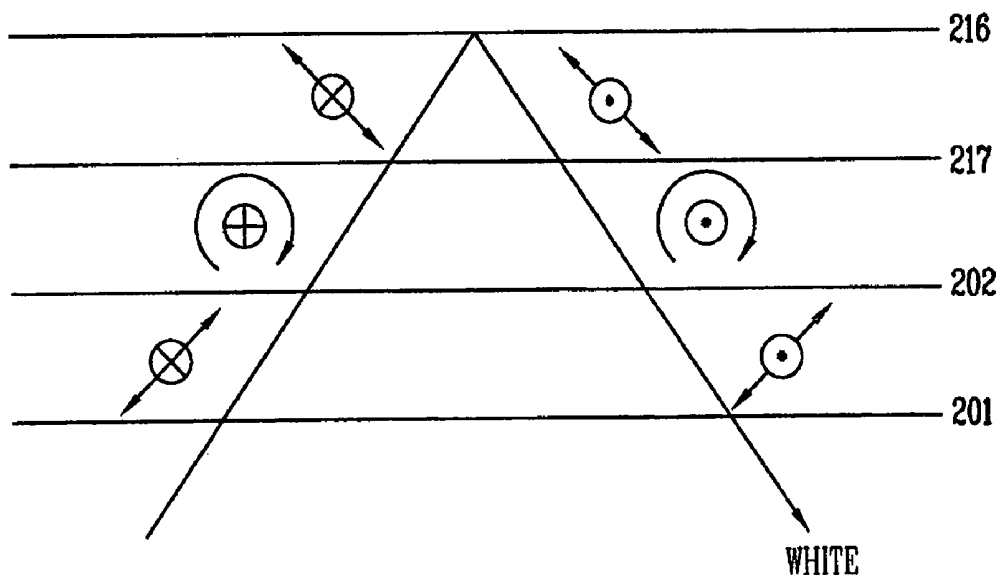
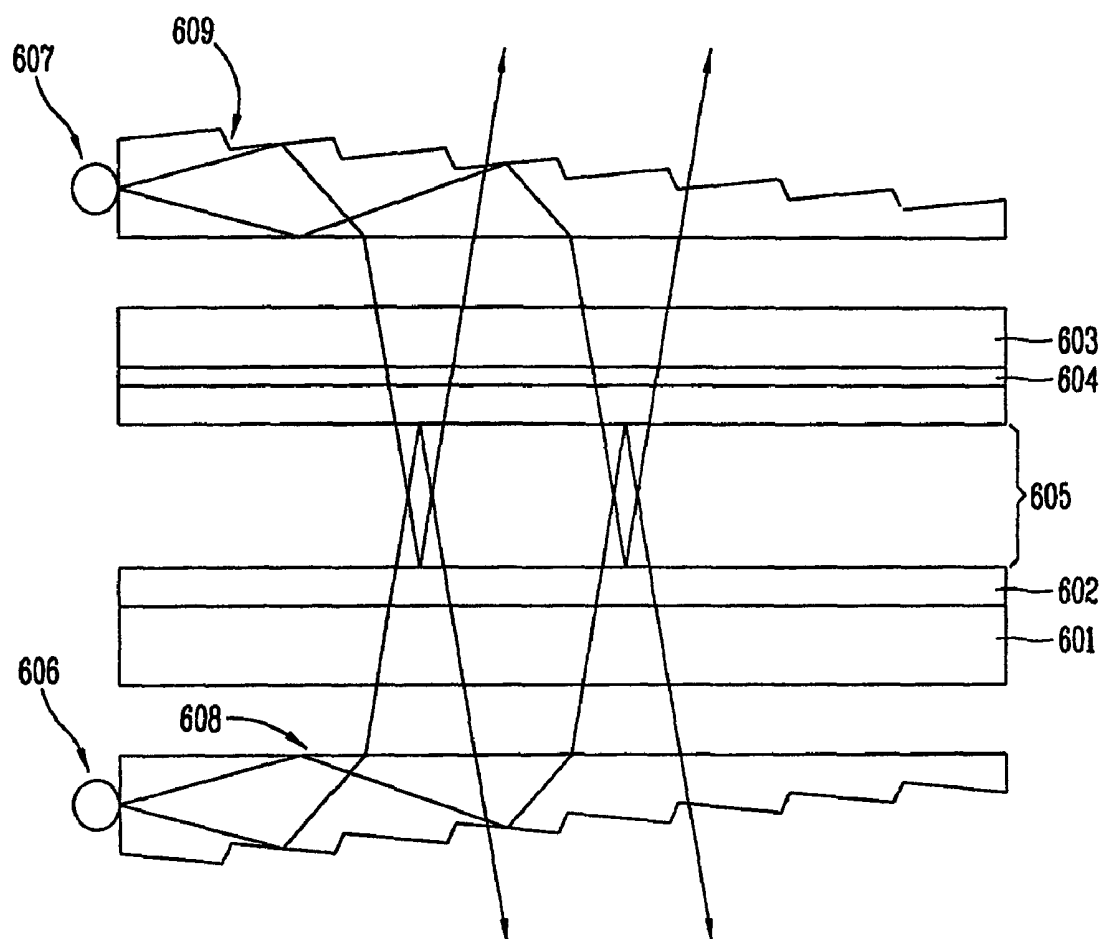


FIG. 7



DUAL REFLECTIVE LIQUID CRYSTAL DISPLAY DEVICE

This application claims the benefit of Korean Patent Appli-
cation No. 2003-94290, filed on Dec. 20, 2003, which is
hereby incorporated by reference for all purposes as if fully
set forth herein.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a reflective liquid crystal
display (LCD) device, and more particularly, to a dual-reflec-
tive LCD device and a method for fabricating the same that
can display the same information at both surfaces thereof.

2. Discussion of the Related Art

A liquid crystal display (LCD) device is one of the most
spotlighted display devices, and is being widely used as an
image display device applied to various products such as TV
monitors, computer monitors, mobile phones, etc. Especially,
a reflective LCD device, which may use external light, is used
for mobile electronic devices, because it carries a screen with
a thin film and consumes less power.

Hereinafter, a structure of a reflective LCD device accord-
ing to a related art will be explained with reference to FIG. 1.

The reflective LCD device includes a TFT (Thin Film
Transistor) array substrate where a thin film transistor (TFT)
is formed, and a color filter substrate where a color filter layer
is formed. A liquid crystal layer is filled between the TFT
array substrate and the color filter substrate. The TFT array
substrate includes a transparent substrate **101**, a plurality of
gate lines (not shown) formed on the substrate, and a plurality
of data lines **104** crossing the gate lines, a TFT **150** formed
near the crossing region between the gate lines and the data
lines **104**, a passivation layer **103** formed of an organic layer
or an inorganic layer, which protect the TFT, and a reflective
layer **105** formed on the passivation layer. The color filter
substrate includes a substrate **110**, a black matrix **109** formed
on the substrate, a color filter layer **108** formed on the sub-
strate, and a common electrode **107** formed on the color filter
layer.

The reflective LCD may further include a spacer (not
shown) for maintaining a cell gap between the TFT array
substrate and the color filter substrate, and an alignment layer
(not shown) for an alignment of liquid crystal. A liquid crystal
layer **106** having a dielectric constant and a refractive anisot-
ropy is formed between the TFT array substrate and the color
filter substrate. The TFT array substrate and the color filter
substrate are assembled to each other by a sealant (not shown)
formed at a peripheral portion of the display region, thereby
forming a reflective LCD panel.

When external light is irradiated on the reflective LCD
device, the external light passes through the upper color filter
substrate and the liquid crystal layer **106**, and then is reflected
by the reflection layer **105** formed on the TFT array substrate.

However, in the reflective LCD device, since images are
displayed only on one surface of the LCD device, users can
not view the images from the opposite direction. To solve this
disadvantage of the reflective LCD device, a method is pro-
posed in which a reflective LCD device has two LCD panels
bonded together. However, because such a reflective LCD

device has two LCD panels, the structure becomes compli-
cated and the production cost increases.

SUMMARY OF THE INVENTION

Accordingly, the present invention is directed to a dual-
reflective liquid crystal display device that substantially obvi-
ate one or more of the problems due to limitations and disad-
vantages of the related art.

An advantage of the present invention is to provide a dual-
reflective LCD device that can display the same information
at both surfaces of a transparent substrate.

Another advantage of the present invention is to provide a
dual-reflective LCD device capable of reducing fabrication
costs by using one liquid crystal layer.

Still another advantage of the present invention is to pro-
vide a dual-reflective LCD device capable of being operated
without an external light source.

Additional features and advantages of the invention will be
set forth in the description which follows, and in part will be
apparent from the description, or may be learned by practice
of the invention. The objectives and other advantages of the
invention will be realized and attained by the structure par-
ticularly pointed out in the written description and claims
hereof as well as the appended drawings.

To achieve these and other advantages and in accordance
with the purpose of the present invention, as embodied and
broadly described, a liquid crystal display device includes a
first substrate having a first polarizer and a first retardation
layer; a second substrate having a second polarizer and a
second retardation layer; and a pixel between the first and
second substrates, the pixel having a thin film transistor, a first
reflective layer on the first substrate, a second reflective layer
on the second substrate, a liquid crystal layer between the first
and second substrates.

The LCD device further includes an auxiliary light source.

In another aspect of the present invention, a liquid crystal
display device includes a first substrate having a first reflec-
tive layer; a second substrate having a second reflective layer;
and a liquid crystal layer between the first and second sub-
strates, wherein the light reflected by the first reflective layer
of light incident on the first substrate is shielded, and the light
reflected by the second reflective layer of light incident on the
first substrate is used for displaying first information, wherein
the light reflected by the second reflective layer of light inci-
dent on the second substrate is shielded, and the light reflected
by the first reflective layer of light incident on the second
substrate is used for displaying second information, and
wherein the second information is substantially the same as
the first information.

In still another aspect of the present invention, a display
device having a display panel includes a first side of the
display panel having a first reflective layer; and a second side
of the display panel having a second reflective layer, wherein
the first side of the display panel displays first information
using the light reflected from the second reflective layer, and
the second side of the display panel displays second informa-
tion using the light reflected from the first reflective layer,
wherein the first information is substantially the same as the
second information.

It is to be understood that both the foregoing general
description and the following detailed description are exem-

plary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and together with the description serve to explain the principles of the invention.

In the drawings:

FIG. 1 is a sectional view illustrating a structure of a reflective LCD device according to a related art;

FIG. 2 is a sectional view illustrating a dual-reflective LCD device according to the first embodiment of the present invention;

FIG. 3 is a plan view illustrating the dual reflective LCD device of FIG. 2;

FIG. 4 is a sectional view taken along the line I-I' of FIG. 3, illustrating a structure of a TFT according to the present invention;

FIG. 5 is a sectional view taken along the line II-II' of FIG. 3, illustrating a structure of a storage capacitor according to the present invention;

FIGS. 6A and 6B are schematic views illustrating an operating principle of a dual-reflective LCD device according to the present invention; and

FIG. 7 is a schematic sectional view illustrating a dual-reflective LCD device according to the second embodiment of the present invention.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

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

Hereinafter, a structure of a dual-reflective liquid crystal display (LCD) device according to a first embodiment of the present invention will be explained with reference to FIGS. 2 and 3. FIG. 2 is a sectional view illustrating a dual-reflective LCD device according to the first embodiment of the present invention, and FIG. 3 is a plan view illustrating the dual reflective LCD device of FIG. 2.

Referring to FIGS. 2 and 3, a dual-reflective LCD device according to the first embodiment of the present invention includes a TFT (Thin Film Transistor) array substrate and a color filter substrate facing each other. A liquid crystal layer 217 is formed between the TFT array substrate and the color filter substrate.

The TFT array substrate includes a first transparent substrate 203 having a plurality of TFTs 208. A first polarizer 201 for polarizing incident light and a first retardation film 202 for phase-delaying light polarized by the first polarizer 201 are formed at an outer side of the first substrate 203. The first retardation film 202 is formed between the first transparent substrate 203 and the first polarizer 201. The TFTs 208 are arranged in a matrix configuration on the first substrate 203 as a switching device for switching unit pixels. A plurality of gate lines 301 and a plurality of data lines 205 crossing the gate lines are further formed on the first substrate 203. The TFTs 208 are formed near the crossing between the gate lines and the data lines, and a unit pixel region is defined by the gate lines 301 and the data lines 205.

The array substrate further includes a passivation layer 206 of an organic material or an inorganic material for protecting the TFTs, and a first reflection layer 207 for reflecting incident

light formed on the passivation layer 206. Each unit pixel has the first reflection layer 207, which is connected to the TFT 208 through a contact hole in the passivation layer 206.

The first reflection layer 207 in a unit pixel has an opening portion 216a, as illustrated in FIG. 3. Through the opening portion 216a, light incident from a lower portion reaches the upper color filter layer. The opening portion 216a may be formed at a center region of the first reflection layer 207 with a predetermined size. Light reflected through the opening portion 216a enables a user to view images in one direction of the dual-reflective LCD device of the present invention. When determining the size of the opening portion 216a, the aperture ratio, brightness, and other characteristics of the dual-reflective LCD should be taken into consideration. The first reflection layer 207 may have a convex-concave shape to increase the reflectivity. The first reflection layer having a convex-concave shape can collect light in the user direction, and reflect light uniformly to all directions to achieve uniform picture quality.

Still referring to FIGS. 2 and 3, the color filter substrate includes a second transparent substrate 212, a second reflection layer 216, a second retardation film 211, a color filter layer 213, a common electrode 215 and a second polarizer 210. The second polarizer 210 polarizes light incident on an outer surface the second substrate 212, and the second retardation film 211 delays the phase of the polarized light. The second reflection layer 216 reflects light incident from a direction of the TFT array substrate, the color filter layer 213 is used for displaying color images, and the common electrode 215 of a transparent conductive material applies an electric field to the liquid crystal layer 217. The color filter layer 213 has sub-color filter layers of R, G, and B, and the three R, G and B sub-color filters constitute one unit pixel.

The second reflection layer 216 in a unit pixel is formed on the color filter substrate, corresponding to the opening portion 216a of the first reflection layer 207. That is, light passing through the opening portion 216a of the first reflection layer 207 is reflected by the second reflection layer 216, and is then emitted in a direction of the TFT array substrate. Therefore, the size of the second reflection layer 216 may be equal to or larger than the opening portion 216a.

Referring to FIG. 3, the TFT 208 is formed near the crossing between the gate line 301 and the data line 205. The first reflection layer 207 connected to the drain electrode of the TFT 208 is formed in the unit pixel region. The opening portion 216a is formed at a center region of the first reflection layer 207. Through the opening portion 216a, light incident from an outside of the TFT array substrate reaches the second reflection layer 216. The second reflection layer 216 is formed to correspond to the opening portion 216a of the first reflection layer 207, and the size of the second reflection layer 216 may be equal to or larger than the opening portion 216a.

A structure of a TFT according to the present invention will be explained with reference to FIG. 4. FIG. 4 is a sectional view taken along the line I-I' of FIG. 3, illustrating a structure of a TFT according to the present invention.

The TFT of the LCD device according to the present invention includes a gate electrode 401 formed on the substrate 203, a gate insulating layer 204 formed on the substrate where the gate electrode 401 is formed, a semiconductor layer 402 formed on the gate insulating layer 204, a second semiconductor layer 403 formed on the semiconductor layer at a region except a channel layer and into which a high concentration impurity ion is injected, source and drain electrodes 404 and 405 ohmic-contacting the second semiconductor layer 403, the passivation layer 206 for protecting the device, and the first reflection layer 207 connected to the drain elec-

trode **405**. The source electrode is connected to the data line **205**, and the TFT drives a pixel by gate and data signals.

A structure of a storage capacitor will be explained with reference to FIG. 5. FIG. 5 is a sectional view taken along the line II-II' of FIG. 3, illustrating a structure of a storage capacitor according to the present invention. FIG. 5 illustrates a storage on gate (SOG) type capacitor in which a capacitor structure is formed on a gate line.

A gate line **501** is formed on the substrate **203**, and the gate insulating layer **204** is formed on the gate line. Also, a storage electrode **502** is formed on the gate insulating layer **204**, over the gate line **501**. The storage electrode **502** is connected to the first reflection layer **207** formed on the passivation layer **206**, thereby forming a storage capacitor.

Hereinafter, an operational principle of the dual reflective LCD device of the present invention will be explained. FIGS. 6A and 6B are schematic views illustrating an operating principle of a dual-reflective LCD device according to the present invention.

First, an operational principle with respect to light incident on the array substrate will be explained with reference to FIGS. 6A and 6B. Some of the light incident on the array substrate is reflected by the first reflection layer **207** and thus is shielded by the first polarizer **201**. Some of the light incident on the array substrate is reflected by the second reflection layer **216** and thus passes through the TFT array substrate.

Referring to FIG. 6A, among light incident on the array substrate, only a linearly-polarized light parallel to a polarization axis of the first polarization layer **201** passes through the first polarization layer **201**. The linearly-polarized light is phase-delayed by the first retardation film **202** to become right circularly polarized light. Therefore, the first retardation film **202** may be a quarter wave plate for phase-delaying light by 90°. The right circularly polarized light is reflected by the first reflection layer **207**, and thus is converted into left circularly polarized light. The left circularly polarized light passes through the first retardation film **202**, and thus is converted into a linearly-polarized light perpendicular to the polarization axis of the first polarizer **201**. Therefore, this linearly-polarized light is shielded by the first polarizer **201**.

Referring to FIG. 6B, the light passing through the opening portion of the first reflection layer among the light incident on the TFT array substrate is right circularly polarized light, as explained above. The right circularly polarized light then passes through the liquid crystal layer **217** and thus becomes a linearly-polarized light perpendicular to the linearly-polarized light by the first polarizer **201**. The linearly-polarized light is then reflected by the second reflection layer **216** and again passes through the liquid crystal layer **217**, and thus becomes right circularly polarized light. The right circularly polarized light passes through the first retardation film **202** and thus becomes a linearly-polarized light parallel to the polarization axis of the first polarizer **201**. Therefore, this linearly-polarized light passes through the first polarizer **201**. That is, the right circularly polarized light becomes white.

In the above explanation, it is assumed that the polarized light passes through the liquid crystal layer in a direction perpendicular to the long axis of the liquid crystal molecules of the liquid crystal layer. Thus, gray levels can be obtained by applying different voltages between the two substrates to control the direction of the long axis of the liquid crystal molecules.

Next, light incident on the color filter substrate will be explained. Light incident on the color filter substrate is also reflected or shielded in accordance with the operational principle discussed with reference to FIGS. 6A and 6B.

That is, among light incident on the color filter substrate from outside, the light reflected by the second reflection layer **216** sequentially passes through the second polarizer **210**, the second retardation film **211**, the second reflection layer **216**, the second retardation film **211**, and the second polarizer **210** and thus is shielded (the dotted line **231** of FIG. 2). The second retardation film **211** may be a quarter wave plate.

Among light incident on the color filter substrate from outside, the light reflected by the first reflection layer **207** sequentially passes through the second polarizer **210**, the second retardation film **211**, the liquid crystal layer **217**, the first reflection layer **207**, the liquid crystal layer **217**, the second retardation film **211**, and the second polarizer **210** (the solid line **230** of FIG. 2). Thus, the light reflected by the first reflection layer **207** can pass through or is shielded by the color filter substrate, depending on the direction of the light when passing through the liquid crystal layer. That is, as explained with respect to the light incident on the TFT array substrate, when the polarized light passes through the liquid crystal layer in a direction perpendicular to the long axis of the liquid crystal molecules, the polarized light becomes white (the solid line **230**).

Accordingly, the user can view the same information from both sides of the dual-reflective LCD device. However, according to the dual-reflective LCD device of the first embodiment, the user can view information from both directions only with external light. To solve such a problem, a dual-reflective LCD device according to a second embodiment of the present invention includes an auxiliary light source so that it can be used when there is no external light source.

A dual-reflective LCD device according to the second embodiment of the present invention is provided with a first auxiliary light source and a second auxiliary light source outside first and second polarizers. The TFT array substrate of the second embodiment has the same structure as that of the first embodiment. A structure of a dual-reflective LCD device according to the second embodiment of the present invention will be explained with reference to FIG. 7.

Referring to FIG. 7, an LCD device according to the second embodiment of the present invention includes a TFT array substrate **601** having a first reflection layer **602**, a color filter substrate **603** having a second reflection layer **604**, a first auxiliary light source **606** formed at a lateral surface of the TFT array substrate, a first light guide layer **608** for reflecting the light generated from the first auxiliary light source **606** to a liquid crystal layer **605**, a second auxiliary light source **607** formed at a lateral surface of the color filter substrate **603**, and a second light guide layer **609** for reflecting the light generated from the second auxiliary light source **607** to the liquid crystal layer **605**. The TFT array substrate and the color filter substrate have the same constructions as those of the first embodiment of the present invention. The first auxiliary light source **606** and the second auxiliary light source **607** may generate white light close to natural light.

The first and second auxiliary light sources can be installed at lateral surfaces of the TFT array substrate and the color filter substrate. Each auxiliary light source is connected to an inverter (not shown) for supplying power to the light source, and is further provided with a switch (not shown) for selectively turning on/off the light source. The first light guide layer **608** is installed at an inner surface of the TFT array substrate in order to introduce the light generated from the first auxiliary light source **606** into the liquid crystal layer **605**, and the second light guide layer **609** is installed at an

inner surface of the color filter substrate to introduce the light generated from the second auxiliary light source 607 into the liquid crystal layer 605.

The first light guide layer 608 and the second light guide layer 609 can be provided with a step on one surface thereof to increase reflectivity of the light introduced from the light source. Another surface of the first light guide layer 608 and the second light guide layer 609 may have a flat surface.

According to the present invention, the LCD device may turn off the auxiliary light sources when there is external light, and turn on the auxiliary light sources when there is no or insufficient external light. Accordingly, the LCD device can be effectively used regardless of external light conditions.

As aforementioned, with the dual-reflective LCD device according to the present invention, the user can view the same image or information from both sides of the liquid crystal panel. Also, because an auxiliary light source is provided, the LCD device can be effectively used regardless of external light conditions. Additionally, because the dual-reflective LCD device has only one liquid crystal panel, the fabrication cost can be reduced.

It will be apparent to those skilled in the art that various modifications and variations can be made in the above-discussed display device and the driving method thereof without departing from the spirit or scope of the invention. Thus, it is intended that the present invention cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

What is claimed is:

1. A dual reflective liquid crystal display device comprising:

a first substrate having a first polarizer and a first retardation layer, wherein the first polarizer and the first retardation layer are formed at an outer surface of the first substrate;

a first light guide layer at an outer side of the first substrate, wherein the first light guide layer is provided with a step at one surface thereof;

a first auxiliary light source formed at a lateral surface of the first substrate;

a second substrate having a second polarizer and a second retardation layer, wherein the second polarizer and the second retardation layer are formed at an outer surface of the second substrate;

a second light guide layer at an outer side of the second substrate, wherein the second light guide layer is provided with a step at one surface thereof;

a second auxiliary light source formed at a lateral surface of the second substrate; and

a pixel between the first and second substrates, the pixel having a thin film transistor, a first reflective layer on the first substrate, a second reflective layer on the second substrate, and the second retardation layer are formed at an outer surface of the second substrate, a liquid crystal layer between the first and second substrates,

wherein the first reflection layer has an opening portion and a convex-concave shape to increase a reflection efficiency, and the second reflection layer corresponds to the opening portion of the first reflection layer, and the size of the second reflection layer is equal to or larger than the opening portion, wherein the second reflection layer is formed at an inner surface of the second substrate;

wherein first light incident through the opening portion of the first reflective layer on the first substrate is reflected by the second reflective layer, to pass through the first substrate; and second light incident through the second

substrate is reflected by the first reflective layer, to pass through the second substrate, and wherein the first and second auxiliary light sources are turned off when there is external light, and the first and second auxiliary light sources are turned on when there is no external light so that an user views image or information from both sides of the liquid crystal display device,

and wherein the light provided from the first auxiliary light source incident through the first light guide layer is reflected by the second reflective layer so that a first image is viewed through the first light guide layer at an outer side of the first substrate, and the light provided from the second auxiliary light source incident through the second light guide layer is reflected by the first reflective layer so that a second image is viewed through the second light guide layer at an outer side of the second substrate, and the first image is the same image as the second image.

2. The device of claim 1, wherein the first and second retardation layers delay the phase of light by about 90°.

3. The device of claim 1, wherein the second substrate further includes a common electrode.

4. The device of claim 1, wherein incident light on the first substrate reflected by the first reflective layer is shielded by the first polarizer.

5. A dual reflective liquid crystal display device comprising:

a first substrate having a first reflective layer, wherein the first reflection layer has an opening portion and a convex-concave shape to increase a reflection efficiency;

a first light guide layer at an outer side of the first substrate, wherein the first light guide layer is provided with a step at one surface thereof;

a first auxiliary light source formed at a lateral surface of the first substrate;

a second substrate having a second reflective layer and a color filter layer thereon, the color filter disposed over the second reflective layer, wherein the second reflection layer corresponds to the opening portion of the first reflection layer, and the size of the second reflection layer is equal to or larger than the opening portion, wherein the first and second substrates include first and second retardation films, respectively, and wherein the retardation films include a quarter wave plate;

a second light guide layer at an outer side of the second substrate, wherein the second light guide layer is provided with a step at one surface thereof;

a second auxiliary light source formed at a lateral surface of the second substrate; and

a liquid crystal layer between the first and second substrates,

wherein light reflected by the first reflective layer of first light incident on the first substrate is shielded, and light reflected by the second reflective layer of the first light incident on the first substrate is used for displaying first information,

wherein light reflected by the second reflective layer of second light incident on the second substrate is shielded, and light reflected by the first reflective layer of the second light incident on the second substrate is used for displaying second information, and wherein the second information is substantially the same as the first information, and wherein the first and second auxiliary light sources are turned off when there is external light, and the first and second auxiliary light sources are turned on

9

when there is no external light so that an user views image or information from both sides of the liquid crystal display device,

and wherein the light provided from the first auxiliary light source incident through the first light guide layer is reflected by the second reflective layer so that a first image is viewed through the first light guide layer at an outer side of the first substrate, and the light provided from the second auxiliary light source incident through the second light guide layer is reflected by the first reflective layer so that a second image is viewed through the second light guide layer at an outer side of the second substrate, and the first image is the same image as the second image.

6. A dual reflective liquid crystal display device having a display panel comprising:

a first side of a transistor array substrate of a display panel having a first reflective layer, wherein the first reflection layer has an opening portion and a convex-concave shape to increase a reflection efficiency; and

a first light guide layer at an outer side of the transistor array substrate, wherein the first light guide layer is provided with a step at one surface thereof;

a first auxiliary light source formed at a lateral surface of the transistor array substrate;

a second side of a color filter array substrate of the display panel having a second reflective layer and a color filter layer thereon, the color filter layer disposed over the second reflective layer,

a second light guide layer at an outer side of the color filter array substrate, wherein the second light guide layer is provided with a step at one surface thereof;

a second auxiliary light source formed at a lateral surface of the color filter array substrate;

wherein the second reflection layer corresponds to the opening portion of the first reflection layer, and the size of the second reflection layer is equal to or larger than the opening portion,

wherein the first side of the transistor array substrate of the display panel displays first information using first light reflected from the second reflective layer, and the second side of the color filter array substrate of the display panel displays second information using second light reflected from the first reflective layer, wherein the first light is incident through the transistor array substrate, and the second light is incident through the color filter array substrate; and wherein the first information is substantially the same as the second information, and wherein the first and second auxiliary light sources are turned off when there is external light, and the first and second auxiliary light sources are turned on when there is no external light so that an user views image or information from both sides of the display panel,

and wherein the light provided from the first auxiliary light source incident through the first light guide layer is reflected by the second reflective layer so that a first

10

image is viewed through the first light guide layer at an outer side of the first substrate, and the light provided from the second auxiliary light source incident through the second light guide layer is reflected by the first reflective layer so that a second image is viewed through the second light guide layer at an outer side of the second substrate, and the first image is the same image as the second image.

7. The device of claim 6, wherein the first and second sides of the display panel further include first and second retardation layers, respectively.

8. A dual reflective liquid crystal display device having a display panel comprising:

a transistor array substrate having a first reflective plate;

a color filter substrate having a second reflection plate and a color filter layer thereon, the color filter layer disposed over the second reflective plate;

a first auxiliary light source formed at a lateral surface of the transistor array substrate;

a first light guide plate for reflecting light generated from the first auxiliary

light source to a liquid crystal layer, wherein the first light guide plate is provided with a step at one surface thereof to completely reflect light introduced from the first auxiliary light source to the liquid crystal layer;

a second auxiliary light source formed at a lateral surface of the color filter substrate; and

a second light guide plate for reflecting light generated from the second

auxiliary light source to the liquid crystal layer, wherein the second light guide plate is provided with a step at one surface thereof to completely reflect light introduced from the second auxiliary light source to the liquid crystal layer,

wherein light introduced from the first auxiliary light source is reflected by the second reflection plate, and light introduced from the second auxiliary light source is reflected by the first reflection plate, and wherein the first and second auxiliary light sources are turned off when there is external light, and the first and second auxiliary light sources are turned on when there is no external light so that an user views image or information from both sides of the liquid crystal display device,

and wherein the light provided from the first auxiliary light source incident through the first light guide layer is reflected by the second reflective layer so that a first image is viewed through the first light guide layer at an outer side of the first substrate, and the light provided from the second auxiliary light source incident through the second light guide layer is reflected by the first reflective layer so that a second image is viewed through the second light guide layer at an outer side of the second substrate, and the first image is the same image as the second image.

* * * * *

专利名称(译)	双反射液晶显示装置		
公开(公告)号	US7889288	公开(公告)日	2011-02-15
申请号	US11/012124	申请日	2004-12-16
[标]申请(专利权)人(译)	蔡苏SEOK		
申请(专利权)人(译)	蔡苏硕		
当前申请(专利权)人(译)	LG DISPLAY CO. , LTD.		
[标]发明人	CHOI SU SEOK		
发明人	CHOI, SU-SEOK		
IPC分类号	G02F1/1335 G02F1/1347 G02F1/133 G02F1/13357 G02F1/1343		
CPC分类号	G02F1/1343 G02F2001/133342 G02F2001/133616 G02F2203/02		
审查员(译)	内尔姆斯, DAVID		
优先权	1020030094290 2003-12-20 KR		
其他公开文献	US20050134767A1		
外部链接	Espacenet USPTO		

摘要(译)

一种液晶显示装置，包括具有第一偏振器和第一延迟层的第一基板；第二基板，具有第二偏振器和第二延迟层；第一和第二基板之间的像素，像素具有薄膜晶体管，第一基板上的第一反射层，第二基板上的第二反射层，第一基板和第二基板之间的液晶层。

