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(54) **SUBSTRATE WITH PARALLAX BARRIER LAYER, METHOD FOR PRODUCING SUBSTRATE WITH PARALLAX BARRIER LAYER, AND THREE-DIMENSIONAL DISPLAY**

(75) Inventors: **Akira Imai**, Nara (JP); **Akira Nakagawa**, Matsubara (JP); **Toshihiro Matsumoto**, Nara (JP)

(73) Assignee: **Sharp Kabushiki Kaisha**, Osaka (JP)

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G02F 1/1333 (2006.01)

(52) **U.S. Cl.** **349/122**; 349/110

(58) **Field of Classification Search** 349/122, 349/110

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,969,850 A * 10/1999 Harrold et al. 359/320

(Continued)

FOREIGN PATENT DOCUMENTS

JP 1-307703 12/1989

(Continued)

OTHER PUBLICATIONS

English translation of the International Preliminary Examination Report mailed Oct. 6, 2003 in corresponding PCT Application No. PCT/JP2003/009054.

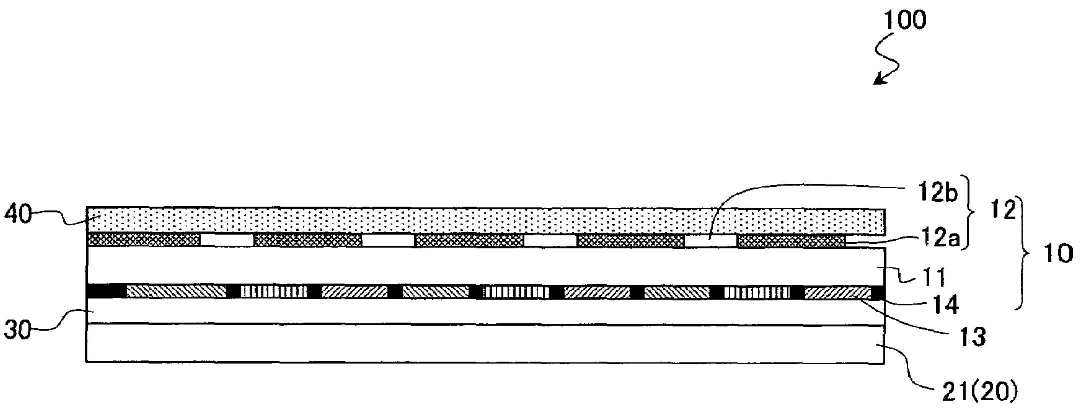
(Continued)

Primary Examiner—David C. Nelms
Assistant Examiner—David Y Chung
(74) *Attorney, Agent, or Firm*—Nixon & Vanderhye P.C.

(57) **ABSTRACT**

The present invention provides a three-dimensional display device, which can display a 3D image of higher quality than a conventional one by arranging a parallax barrier layer with higher positioning accuracy, and a method for fabricating such a display device. The three-dimensional display device **100** includes a first substrate **11**, which is provided closer to the viewer and which is made of a transparent material, a second substrate **21** arranged so as to face the first substrate **11**, a liquid crystal layer **30** provided between the first substrate **11** and the second substrate **21**, and a parallax barrier layer **12** provided on the surface of the first substrate so as to face the viewer. A polarizer **40** is further provided on the surface of the viewer-side substrate **10** that includes the parallax barrier layer **12** thereon.

10 Claims, 4 Drawing Sheets



U.S. PATENT DOCUMENTS

6,055,013	A	4/2000	Woodgate et al.	
6,143,450	A *	11/2000	Sobue et al.	430/7
6,437,915	B2 *	8/2002	Moseley et al.	359/465
6,768,534	B2 *	7/2004	Iwase et al.	349/153
7,058,252	B2 *	6/2006	Woodgate et al.	385/16

FOREIGN PATENT DOCUMENTS

JP	3-230699	10/1991
JP	08-163605	6/1996
JP	9-50019	2/1997
JP	11-95167	4/1999
JP	2000-39509	2/2000
JP	2000-98126	4/2000
JP	2001-075108	3/2001

OTHER PUBLICATIONS

International Search Report.

* cited by examiner

FIG.1

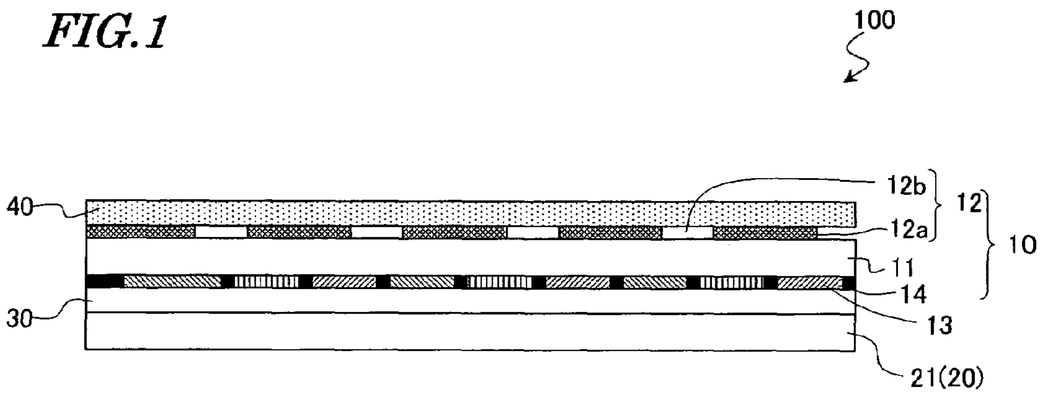


FIG.2

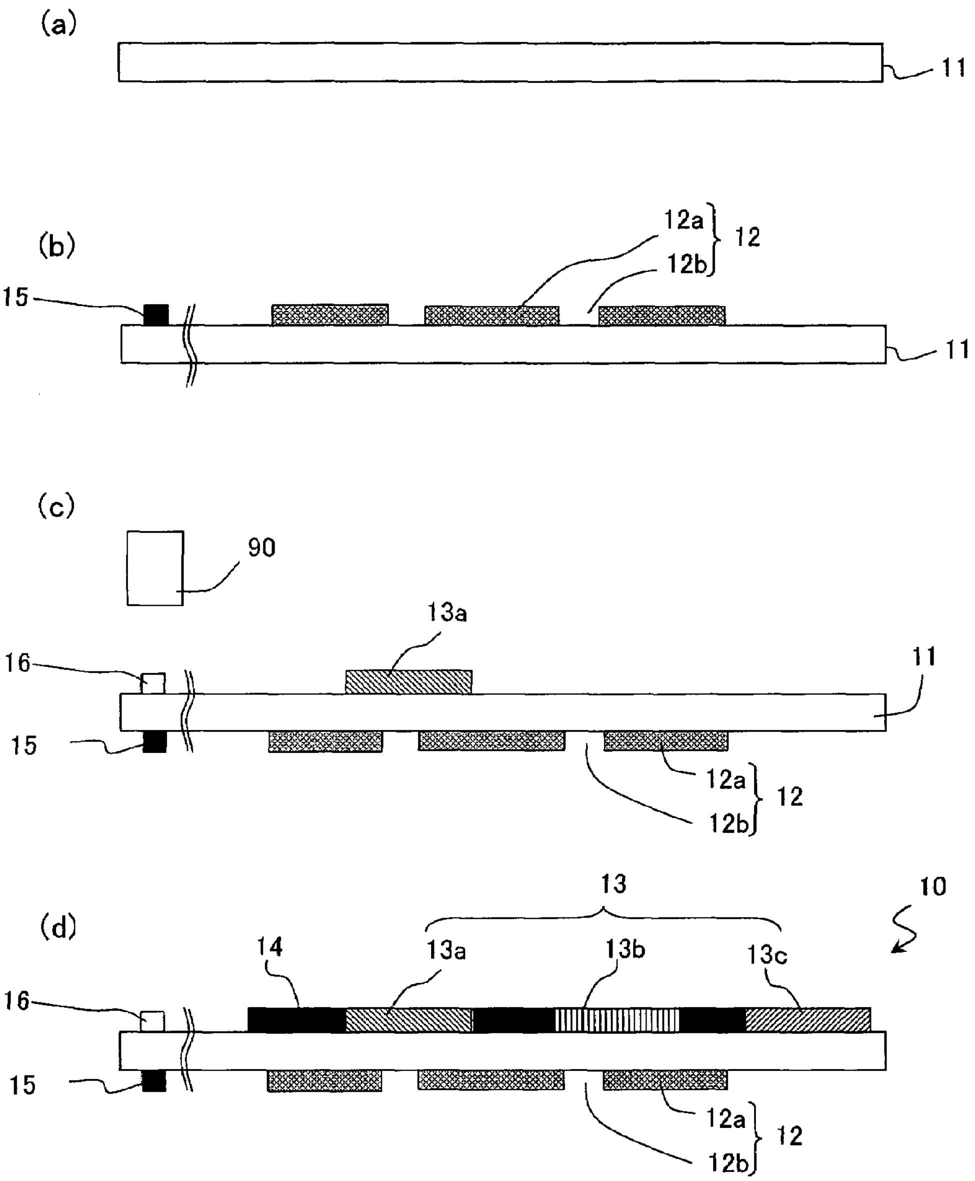

(a)
11
(b)
12a
12
12b
15
11
(c)
90
13a
16
11
15
12a
12
12b
(d)
13
10
14
13a
13b
13c
16
15
12a
12
12b

FIG.3

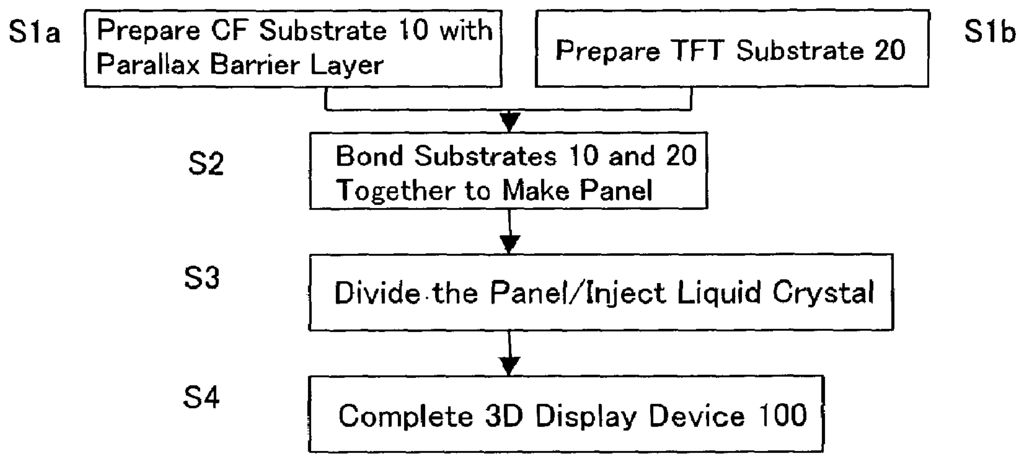
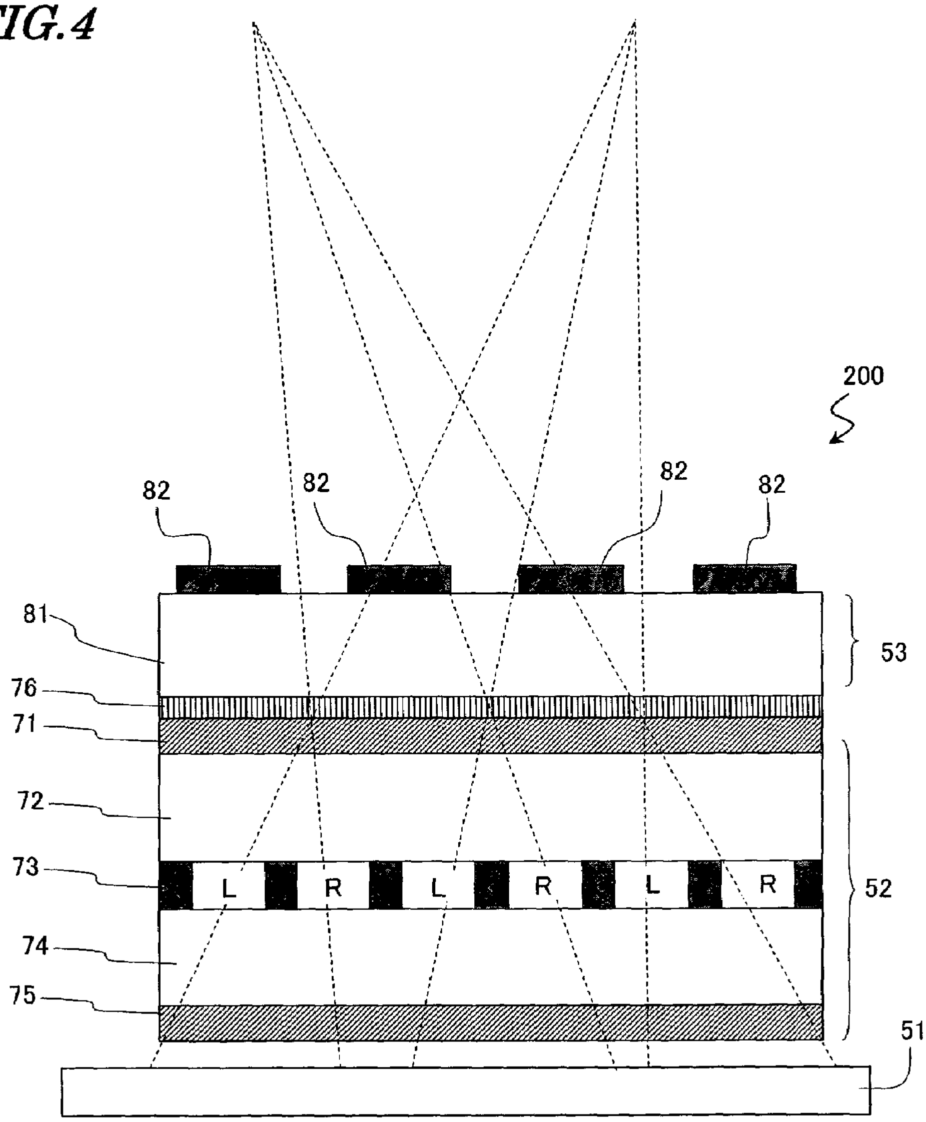

S1a
Prepare CF Substrate 10 with Parallax Barrier Layer
Prepare TFT Substrate 20
S1b
S2
Bond Substrates 10 and 20 Together to Make Panel
S3
Divide the Panel/Inject Liquid Crystal
S4
Complete 3D Display Device 100

FIG.4



SUBSTRATE WITH PARALLAX BARRIER LAYER, METHOD FOR PRODUCING SUBSTRATE WITH PARALLAX BARRIER LAYER, AND THREE-DIMENSIONAL DISPLAY

This application is the US national phase of international application PCT/JP2003/009054 filed 16 Jul. 2003 which designated the U.S. and claims benefit of JP 2002-220348, dated 29 Jul. 2002, the entire content of which is hereby incorporated by reference.

TECHNICAL FIELD

The present invention relates to a substrate with a parallax barrier layer for use in a three-dimensional display device (i.e., 3D video display device), for example, a method for fabricating such a substrate, and a display device including such a parallax barrier layer.

BACKGROUND ART

A three-dimensional display device, in which a parallax barrier layer is provided for an LCD panel so as to face the viewer, is known in the art. For example, Japanese Patent Application Laid-Open Publication No. 11-95167 discloses a three-dimensional display device **200** as schematically shown in FIG. **4**.

The three-dimensional display device **200** shown in FIG. **4** includes an LCD panel **52** as a display panel and a substrate **53** with a parallax barrier layer (which will be referred to herein as a "parallax barrier substrate **53**"), which is provided in contact with the surface of the LCD panel **52** so as to function as optical splitting means for splitting incoming light into right and left pictures. The parallax barrier substrate **53** is obtained by providing a parallax barrier layer **82**, consisting of a lot of striped opaque portions, on a substrate **81** made of glass or a transparent resin, for example. The parallax barrier substrate **53** is arranged such that the surface of the substrate **81** thereof contacts with the surface of the LCD panel **52**.

In the LCD panel **52**, a liquid crystal layer **73** is sandwiched between two glass substrates **72** and **74**, a light-outgoing-side polarizer **71** is provided on the glass substrate **72** that is located closer to the viewer (such a location will be referred to herein as "on the light outgoing side"), and a light-incoming-side polarizer **75** is provided on the glass substrate **74** that is located closer to a backlight **51** (such a location will be referred to herein as "on the light incoming side"). In the liquid crystal layer **73** of the LCD panel **52**, right-eye and left-eye pictures are alternately arranged every other column. The right-eye picture, obtained by transmitting the light coming from the backlight **51**, is split by the parallax barrier substrate **53**. As a result, the viewer sees only the left-eye picture with his or her left eye and only the right-eye picture with his or her right eye, thereby sensing a three-dimensional picture.

In this three-dimensional display device **200**, the surface of the polarizer **71** of the LCD panel **52** is covered with an antireflection coating **76** to minimize the reflection at the interface where the parallax barrier substrate **53** and the LCD panel **52** contact with each other. As a result, the amount of light reflected back from the interface through the LCD panel **52** can be reduced and therefore, interference fringes, which would otherwise be produced a lot due to an interference with the light reflected by the polarizer **71**, can be cut down.

In every conventional three-dimensional display device including this three-dimensional display device **200** (see

FIGS. **4** through **7** of the publication identified above), the parallax barrier substrate **53** is bonded as an external member to the LCD panel **52** including the polarizer **71**. That is to say, between the parallax barrier layer **82** and pixels (i.e., the liquid crystal layer **73**), the viewer-side substrate **72** of the display panel, the polarizer **71**, the antireflection coating **76** and the substrate **81** are stacked in this order as viewed upward from the liquid crystal layer **73**. In addition, an adhesive layer (not shown) for bonding the parallax barrier substrate **81** is further provided.

For that reason, it is difficult to accurately control the distance between the parallax barrier layer **82** and the pixels or to make this distance uniform all over the display plane. Furthermore, it is also hard to position the parallax barrier layer **82** with respect to the pixels on the display plane with sufficiently high accuracy.

If the distance from the parallax barrier layer **82** to one pixel (of the liquid crystal layer **73**) were different from the distance from that layer **82** to another pixel within the same plane, then interference fringes or moire fringes would be created or the display luminance might vary, thus possibly deteriorating the display quality.

Also, if the positioning accuracy were low within the display plane, then the pixel aperture ratio might decrease so much as to create moire fringes, too.

Furthermore, as there are a lot of interfaces between the liquid crystal layer **73** and the viewer, the display quality might be decreased seriously by a significant loss of the light due to reflection at those interfaces.

The higher the definition of display panels, the more critical these various problems are likely to get. Furthermore, particularly in a method of fabricating a display device in which a large scale panel is fabricated by performing a single flow of processing steps on the same big substrate and then divided into a number of smaller scale panels, if the parallax barrier substrate were bonded to the large scale panel, then those problems would arise easily to decrease the yield and productivity significantly. What is worse, once the parallax barrier substrate has been bonded, it is very difficult to cut the assembly into smaller pieces just as intended.

DISCLOSURE OF INVENTION

In order to overcome the problems described above, a primary object of the present invention is to provide a display-device, which can display an image of higher quality than a conventional one by arranging a parallax barrier layer with higher positioning accuracy, and a method for fabricating such a display device. The display device is used as a device for presenting mutually different pictures to viewpoints in two directions (e.g., a three-dimensional display device that can present a 3D image (3D image display device)). Another object of the present invention is to provide a substrate with a parallax barrier layer, which can be used effectively in such a display device, and a method for fabricating such a substrate.

A method for fabricating a substrate with a parallax barrier layer according to the present invention includes steps of: (a) preparing a first substrate, which has a first principal surface and a second principal surface that are opposed to each other and which is made of a transparent material; (b) providing a parallax barrier layer with a predetermined pattern on the first principal surface of the first substrate; and (c) forming a first layer, which satisfies a prescribed positional relationship with the parallax barrier layer, on the-second principal surface of the first substrate, whereby the above objects are achieved.

In one preferred embodiment, the step (b) includes a step of making a first alignment mark.

In another preferred embodiment, the step (c) includes a step of locating the first alignment mark through the first substrate and achieving alignment with respect to the first alignment mark.

The first alignment mark is preferably made of the material of the parallax barrier layer.

The parallax barrier layer is preferably made of a metallic material.

The step (c) may include either a step of forming a color filter layer as the first layer or a step of forming a black matrix layer as the first layer. It is naturally possible that the step (c) includes a step of forming both a color filter layer and a black matrix layer. Alternatively, the step (c) may include step of forming any other component as the first layer.

The step (c) may further include a step of making a second alignment mark of the material of the first layer.

A method for fabricating a three-dimensional display device according to the present invention includes steps of: (A) preparing a substrate with a parallax barrier layer by one of the methods described above; (B) securing a second substrate to the substrate with the parallax barrier layer with a predetermined gap provided between the two substrates; and (C) forming a display medium layer between the substrate with the parallax barrier layer and the second substrate, whereby the above objects are achieved.

In one preferred embodiment, the method further includes a step of (D) dividing a panel, in which the substrate with the parallax barrier layer and the second substrate are combined with each other, into a number of smaller panels after one of the steps (B) and (C).

In another preferred embodiment, the display medium layer is a liquid crystal layer. In that case, the method may further include a step of arranging a polarizer on a viewer-side surface of the parallax barrier layer after the step (D).

A display device according to the present invention is characterized by being fabricated by one of the methods described above.

Another display device according to the present invention includes: a first substrate, which is arranged closer to a viewer and which is made of a transparent material; a second substrate opposed to the first substrate; a display medium layer interposed between the first and second substrates; and a parallax barrier layer provided on the surface of the first substrate so as to face the viewer.

Still another display device according to the present invention includes: a first substrate, which is arranged closer to a viewer and which is made of a transparent material; a second substrate opposed to the first substrate; a liquid crystal layer interposed between the first and second substrates; a polarizer located closer to the viewer than the first substrate is; and a parallax barrier layer provided between the first substrate and the polarizer.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a cross-sectional view schematically illustrating a three-dimensional display device **100** according to a preferred embodiment of the present invention.

FIGS. **2**(*a*) through **2**(*d*) are cross-sectional views schematically illustrating a method for fabricating a counter substrate **10** with a parallax barrier layer according to a preferred embodiment of the present invention.

FIG. **3** is a flowchart showing the process of making a plurality of display devices out of a single large scale panel by using the counter substrate **10** with a parallax barrier layer according to the present invention.

FIG. **4** is a cross-sectional view schematically illustrating a conventional three-dimensional display device **200**.

BEST MODE FOR CARRYING OUT THE INVENTION

Hereinafter, structures of a display device and, a substrate with a parallax barrier layer and methods for fabricating them according to preferred embodiments of the present invention will be described with reference to the accompanying drawings.

A display device according to the present invention can present mutually different pictures to at least two viewpoints. As used herein, the "viewpoints" may belong to either a single person or a number of persons. In the former case, the "viewpoints" are the positions of the right and left eyes of that viewer. In the latter case, the "viewpoints" are the respective locations of those people.

When applied to a single viewer, a display device according to the present invention is implemented as a three-dimensional display device that can present a 3D image to him or her and may be used in a cell phone or a TV, for example. On the other hand, when applied to a number of viewers, another display device according to the present invention is implemented as a display device that can present mutually different pictures to them and may be used as a TV monitor or a display for presenting a picture of a car navigation system to the driver at the driver's seat of a car and a TV picture to the person at the passenger's seat. In this case, the "mutually different pictures" do not have to be associated with each other.

In the following preferred embodiments, a device for presenting a 3D picture using an LCD will be described as an example. However, the present invention is in no way limited to such a preferred embodiment using an LCD.

FIG. **1** schematically illustrates a cross-sectional structure of a three-dimensional display device **100** according to a preferred embodiment of the present invention.

The three-dimensional display device **100** includes a first substrate **11**, which is arranged closer to the viewer and which is made of a transparent material, a second substrate **21** opposed to the first substrate **11**, a liquid crystal layer **30** interposed between the first and second substrates **11** and **21**, and a parallax barrier layer **12** provided on the surface of the first substrate so as to face the viewer.

A color filter layer **13** with a black matrix **14** is provided on the first substrate **11** so as to face the liquid crystal layer **30**. If necessary, an electrode (e.g., a counter electrode, not shown) and/or an alignment film (not shown, either) may be additionally provided. The parallax barrier layer **12** includes opaque portions **12***a* and translucent portions **12***b*. The opaque and translucent portions **12***a* and **12***b* are arranged in a predetermined pattern and so as to correspond with the pixel arrangement such that a light ray that has been transmitted through a particular one of those pixels will eventually reach the viewer's right or left eye just as intended. The thickness of the first substrate **11** and the arrangement of the translucent portions **12***b* may be appropriately determined according to the size of the LCD panel and the (designed) viewing distance.

On the second substrate **21**, pixel electrodes, TFTs, data lines and/or alignment film (none of which is shown in FIG. **1**) may be provided if necessary so as to face the liquid crystal layer **30**.

In this preferred embodiment, the first and second substrates **11** and **21** are typically made of a transparent material such as glass or plastic and may be covered with an inorganic protective coating as needed. However, neither the first substrate **11** nor the second substrate **21** includes electrodes, TFTs, data lines or any other circuit element or the color filter layer **13**, black matrix **14**, polarizer **40** or any other optical element contributing directly to the display operation. In a reflective display device, the second substrate **21** does not have to be transparent and may be a semiconductor substrate, for example.

In the following description, the assembly obtained by arranging the color filter layer **13**, black matrix **14**, electrodes and alignment film on the first substrate **11** will be referred to herein as a "counter substrate **10**", and the assembly obtained by arranging the electrodes, TFTs, data lines and other circuit elements and the alignment film on the second substrate **21** will be referred to herein as a "TFT substrate **20**". This preferred embodiment is an active-matrix-addressed display device including TFTs. However, the present invention is in no way limited to this specific preferred embodiment. Alternatively, the present invention is also applicable for use in an active-matrix-addressed display device including MIMs or a passive display device, too. In the assembling process step for a display device (to be described later), the counter substrate **10** and the TFT substrate **20** are bonded together as a pair of substrates.

Unlike the conventional three-dimensional display device in which the substrate **53** with a parallax barrier layer is attached afterward to the display panel **52** as already described with reference to FIG. **4**, the parallax barrier layer **12** is provided directly on the principal surface of the first substrate **11** on the viewer side of the display panel in the three-dimensional display device **100** of this preferred embodiment. That is to say, in this three-dimensional display device **100**, the parallax barrier layer **12** is located between the substrate **11** and the polarizer **40**.

As described above, in the three-dimensional display device **100** of this preferred embodiment, neither the substrate **53** (see FIG. **4**) nor the adhesive layer for bonding the substrate **53** as an external member is present between the parallax barrier layer **12** and the liquid crystal layer **30**. Thus, there should be no variation in the distance between the parallax barrier layer **12** and the liquid crystal layer **30**. In addition, since the number of interfaces present between the parallax barrier layer **12** and the liquid crystal layer **30** is smaller than in the conventional three-dimensional display device, the loss of the light due to reflection, for example, can be reduced.

Among other things, if the counter substrate **10** with the parallax barrier layer is fabricated by the method to be described below, then the parallax barrier layer **12** can be positioned with respect to the color filter layer **13** with the black matrix **14** much more accurately. In addition, by providing the parallax barrier layer **12** in advance for the first substrate **11** to make up an LCD panel, a manufacturing process in which a large scale panel is once fabricated and then divided into smaller fractions can be adopted. As a result, the manufacturing process can be simplified and can be carried out at a lower cost.

Hereinafter, a method for fabricating a counter substrate **10** with a parallax barrier layer according to a preferred embodiment of the present invention will be described with reference to FIGS. **2**(*a*) through **2**(*d*).

First, as shown in FIG. **2**(*a*), a first substrate **11** of glass, for example, is prepared.

Next, as shown in FIG. **2**(*b*), a parallax barrier layer **12** is formed on the principal surface of the first substrate **11**. In the parallax barrier layer **12**, opaque portions **12***a* and translucent portions **12***b* are arranged in a predetermined pattern. The parallax barrier layer **12** may be made of any arbitrary material as long as the material has some opacity. For example, a resin material or metallic material with some degree of opacity may be used. The method of forming the parallax barrier layer **12** is not particularly limited, either. Instead, any known method may be appropriately selected according to the material used. As an example, a metallic material (e.g., chromium) is preferably used because such a material is not subject to damage easily through a series of process steps for fabricating the counter substrate **10** and because a sufficient degree of opacity is guaranteed even with a relatively thin film.

In this process step, a first alignment mark **15** is preferably made for the purpose of alignment when a color filter layer **13** is provided after that. The first alignment mark **15** is preferably made of the material of the parallax barrier layer **12** and is preferably left during the process of forming the parallax barrier layer **12**. The location of the first alignment mark **12** may be appropriately selected. However, the first alignment mark **15** is preferably located around an edge of the first substrate **11** so as not to overlap with the color filter layer **13** and so on to be provided later. It should be noted that if the alignment is carried out with the pattern of the parallax barrier layer **12**, then the first alignment mark **15** may be omitted.

Next, as shown in FIG. **2**(*c*), a color filter layer **13** is formed on the other principal surface (i.e., the back surface) of the first substrate **11**, which is opposite to the principal surface on which the parallax barrier layer **12** has been provided. In the illustrated example, color filters in the three colors of R, G and B or C, M and Y, for example, are sequentially provided.

Specifically, first, on the back surface of the first substrate **11** on which the parallax barrier layer **12** has been provided, a first color layer **13***a* to make up the color filter layer **13** is defined in a predetermined pattern. In this process step, the first color layer **13***a* is positioned by getting the first alignment mark **15** detected by a CCD camera, for example, through the first substrate **11**. This alignment may be done by using either transmitted light or reflected light. Also, the CCD method does not have to be adopted but any other method may be used, too.

If the first color layer **13**a is defined by a photolithographic process, for example, then a first photosensitive resin layer to be the first color layer **13***a* is deposited almost over the entire back surface of the first substrate **11** so as not to overlap with the first alignment mark **15**. Next, a photomask is aligned with respect to the first alignment mark **15**, thereby exposing the first photosensitive resin layer to a radiation. Thereafter, development and other process steps are carried out to define the first color layer **13***a*.

In this process step of defining the first color layer **13***a*, a second alignment mark **16** is preferably made on the back surface of the first substrate **11**. The second alignment mark **16** is preferably made of the material of the first color layer **13***a* and is preferably left during the process of forming the first color layer **13***a*. If the alignment is done by reference to the second alignment mark in each of the process steps of defining second and third color layers **13***b* and **13***c* after the first color layer **13***a* has been defined, then these three color layers **13***a*, **13***b* and **13***c* can be aligned with each other more accurately.

If the alignment were done by reference to the first alignment mark, for example, then the positioning accuracy would be within about 10 μm. Also, the patterning accuracy (i.e., the variation in the width) of the first color layer **13***a* would be within about 3 μm. Accordingly, an alignment margin of at most about 25 μm should be provided for the first and second color layers **13***a* and **13***b*. On the other hand, if the second alignment mark **16** is used, then an alignment accuracy of about 3 μm or less, which is equal to that of a conventional process of forming a color filter layer, is achieved. The location of the second alignment mark **16** is not particularly limited, either. However, the second alignment mark **16** is preferably provided so as not to overlap with any of second and third photosensitive resin layers to be the second and third color layers **13***b* and **13***c*, respectively, while these layers **13***b* and **13***c* are being defined.

Thereafter, the black matrix **14** is formed as shown in FIG. **2**(*d*) and then a counter electrode and an alignment film (none of which is shown in FIG. **2**(*d*)) are further provided if necessary, thereby obtaining a counter substrate **10**. The counter substrate **10** of this preferred embodiment may be used as a color filter substrate (CF substrate) for a TFT LCD.

In the preferred embodiment described above, the color filter layer **13** (i.e., the first color layer **13***a*) is formed first on the back surface of the first substrate **11** as a layer that satisfies a prescribed positional relationship with the parallax barrier layer **12**. Alternatively, the black matrix **14** or any other layer may be provided there first. It is naturally possible to omit either the color filter layer **13** or the black matrix **14**. In any case, the second alignment mark is preferably made during the process step of forming the first layer that needs alignment.

According to the present invention, the counter substrate **10** has the parallax barrier layer **12**. Accordingly, a lot of display devices can be made efficiently from a single large scale panel by adopting the process shown in FIG. **3**. The process of mass-producing display devices from a single large scale panel is adopted extensively today and may be carried out by a known method. Thus, the detailed description thereof will be omitted herein.

First, in Step S**1***a*, a large scale CF substrate **10** with a parallax barrier layer **12** is prepared. The CF substrate **10** has preferably been fabricated by performing the process steps that have been described with reference to FIG. **2** on a large scale glass substrate as the first substrate **11**. Meanwhile, in Step S**1***b*, a large scale TFT substrate **20** is also prepared. The large scale TFT substrate **20** is also fabricated by a known method and the description thereof will be omitted herein.

Next, in Step S**2**, the large scale CF substrate **10** and the large scale TFT substrate **20** are bonded together and secured to each other with a predetermined gap provided between them, thereby obtaining a large scale panel. This bonding process step may be carried out by a known method using a seal agent.

Subsequently, in Step S**3**, the large scale panel may be divided into a number of smaller panels, a liquid crystal material may be injected into each of those panels and the assembly may be sealed, for example. In this case, the process steps of injecting the liquid crystal material and sealing the assembly may be performed first, and then the large scale panel may be divided.

Thereafter, in Step S**4**, a polarizer **40**, a backside polarizer, a phase plate and so on may be bonded as needed to each of the resultant smaller panels, and then a driver circuit, a power supply circuit, a backlight and so on are further provided for each panel, thereby obtaining a three-dimensional display device **100**.

In this case, if the parallax barrier layer **12** is made of a metallic material, then the parallax barrier layer **12** can be relatively thin (will have a thickness of 0.1 μm to 0.2 μm, for example). In that case, the translucent portions **12***b* will be filled with the adhesive layer for bonding the polarizer **40** to the parallax barrier layer **12**. As a result, no air layer will be created between the parallax barrier layer **12** and the polarizer **40** and the loss of light due to reflection can be minimized. Naturally, the refractive index of the adhesive layer is preferably matched to that of the first substrate **11**. It should be noted that depending on the display mode of the LCD, a phase plate (not shown) is further provide between the CF substrate **10** and the polarizer **40**. In that case, the polarizer **40** described above may be replaced with the phase plate.

In the preferred embodiment described above, a process, in which a large scale panel is fabricated first and then the process steps of injecting a liquid crystal material and sealing the assembly, has been described as an example. Alternatively, a process in which the liquid crystal material is dripped onto either the substrate **10** or the substrate **20** and then the two substrates **10** and **20** are bonded together may be carried out instead.

As described above, according to the present invention, a process of fabricating a display panel by using a large scale CF substrate **10** that already includes a parallax barrier layer **12** can be adopted. Accordingly, in making forty display panels out of a single large scale panel, for example, the process step of aligning the parallax barrier substrate **53** with each of the separated display panels needs to be carried out forty times in total according to the conventional method. In contrast, according to the present invention, the alignment needs to be done just once. Naturally, there is no need to carry out the process step of bonding the parallax barrier substrate **53** itself.

Thus, according to the present invention, a three-dimensional display device, in which a parallax barrier layer is arranged with a higher positioning accuracy and which can display a 3D image of higher quality than a conventional one, an be manufactured with high productivity.

Furthermore, if there are multiple viewers, a display device that can present a number of different pictures to them can be fabricated by the manufacturing process described above. Such a display device can be fabricated by changing the arrangement pattern of the opaque portions **12***a* and translucent portions **12***b* shown in FIG. **2**(*b*). That is to say, the opaque portions **12***a* and translucent portions **12***b* need to be arranged such that the light that has been transmitted through a particular pixel reaches at least two viewers who are separate from each other by a predetermined distance.

Various preferred embodiments of the present invention have been described as being applied to a liquid crystal display device. However, the present invention is also applicable for use in a display device including a display medium layer other than a liquid crystal layer (e.g., to an electrophoretic display device).

INDUSTRIAL APPLICABILITY

The present invention provides a display device, which can display a 3D image of higher quality than a conventional one, or present respectively different pictures to the viewpoints of multiple viewers, by arranging a parallax barrier layer with higher positioning accuracy, and a method for fabricating such a display device. The present invention also provides a substrate with a parallax barrier layer, which can be used effectively in such a display device, and a method for fabricating the substrate. The present invention can be used effectively in a high-definition display device of high display quality and a method for fabricating such a display device.

The invention claimed is:

1. A method for fabricating a substrate with a parallax barrier layer, the method comprising:

(a) preparing a first substrate, which has a first principal surface and a second principal surface that are opposed to each other and which is made of a transparent material;

(b) providing a parallax barrier layer with a predetermined pattern on the first principal surface of the first substrate;

(c) forming a first layer, which satisfies a prescribed positional relationship with the parallax barrier layer, on the second principal surface of the first substrate; and

wherein the step (b) includes a step of making a first alignment mark, wherein the alignment mark is formed in the parallax barrier, and step (c) comprises using the alignment mark in the parallax barrier in forming the first layer.

2. The method of claim **1**, wherein the step (c) includes a step of locating the first alignment mark through the first substrate and achieving alignment with respect to the first alignment mark.

3. The method of claim **1**, wherein the first alignment mark is made of a material of the parallax barrier layer.

4. The method of claim **1**, wherein the parallax barrier layer is made of a metallic material.

5. The method of claim **1**, wherein the step (c) includes a step of forming a color filter layer as the first layer.

6. The method of claim **1**, wherein the step (c) includes a step of forming a black matrix layer as the first layer.

7. A method for fabricating a display device, the method comprising steps of:

(A) preparing a substrate with a parallax barrier layer by the method of claim **1**,

(B) securing a second substrate to the substrate with the parallax barrier layer with a predetermined gap provided between the two substrates; and

(C) forming a display medium layer between the substrate with the parallax barrier layer and the second substrate.

8. The method of claim **7**, further comprising a step of (D) dividing a panel, in which the substrate with the parallax barrier layer and the second substrate are combined with each other, into a number of smaller panels after one of the steps (B) and (C).

9. The method of claim **7**, wherein the display medium layer is a liquid crystal layer.

10. The method of claim **9**, further comprising a step of arranging a polarizer on a viewer-side surface of the parallax barrier layer after the step (D).

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专利名称(译)	具有视差屏障层的基板，用于制造具有视差屏障层的基板的方法和三维显示器		
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[标]申请(专利权)人(译)	今井AKIRA 中川AKIRA 松本俊		
申请(专利权)人(译)	今井AKIRA 中川AKIRA 松本俊		
当前申请(专利权)人(译)	夏普株式会社		
[标]发明人	IMAI AKIRA NAKAGAWA AKIRA MATSUMOTO TOSHIHIRO		
发明人	IMAI, AKIRA NAKAGAWA, AKIRA MATSUMOTO, TOSHIHIRO		
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摘要(译)

本发明提供了一种三维显示装置，其可以通过布置具有更高定位精度的视差屏障层来显示比传统的3D图像质量更高的3D图像，以及制造这种显示装置的方法。三维显示装置100包括：第一基板11，其设置为更靠近观察者并且由透明材料制成;第二基板21，被布置为面对第一基板11;液晶层30，设置在第一基板11和第二基板11之间。第一基板11和第二基板21，以及设置在第一基板的表面上以便面向观察者的视差屏障层12。偏振器40还设置在观察器侧基板10的表面上，该表面上包括视差屏障层12。