

(19)



(11)

**EP 3 026 486 B1**

(12)

**EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:

**11.09.2019 Bulletin 2019/37**

(51) Int Cl.:

**G02F 1/1335** <sup>(2006.01)</sup>      **G02F 1/1362** <sup>(2006.01)</sup>  
**B82Y 30/00** <sup>(2011.01)</sup>      **G02F 1/13363** <sup>(2006.01)</sup>  
**G02B 5/20** <sup>(2006.01)</sup>      **G02F 1/1333** <sup>(2006.01)</sup>  
**C09K 11/56** <sup>(2006.01)</sup>

(21) Application number: **13854211.3**

(22) Date of filing: **10.10.2013**

(86) International application number:  
**PCT/CN2013/084978**

(87) International publication number:  
**WO 2015/010370 (29.01.2015 Gazette 2015/04)**

(54) **LIQUID CRYSTAL DISPLAY SCREEN AND DISPLAY DEVICE**

FLÜSSIGKRISTALLANZEIGEBILDSCHIRM UND ANZEIGEVORRICHTUNG

ÉCRAN D’AFFICHAGE À CRISTAUX LIQUIDES ET DISPOSITIF D’AFFICHAGE

(84) Designated Contracting States:

**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**

- **DONG, Xue**  
**Beijing 100176 (CN)**
- **GUO, Jian**  
**Beijing 100176 (CN)**

(30) Priority: **24.07.2013 CN 201310313938**

(43) Date of publication of application:  
**01.06.2016 Bulletin 2016/22**

(74) Representative: **Brötz, Helmut et al**  
**Rieder & Partner mbB**  
**Patentanwälte - Rechtsanwalt**  
**Corneliusstrasse 45**  
**42329 Wuppertal (DE)**

(73) Proprietors:

- **BOE Technology Group Co., Ltd.**  
**Beijing 100015 (CN)**
- **Beijing BOE Optoelectronics Technology Co., Ltd.**  
**Beijing 100176 (CN)**

(56) References cited:

**WO-A1-2010/056240**      **CN-A- 101 567 406**  
**CN-A- 102 866 535**      **CN-A- 103 091 895**  
**US-A1- 2005 146 258**      **US-A1- 2007 007 881**  
**US-A1- 2008 302 977**      **US-A1- 2013 010 229**  
**US-B2- 6 744 960**

(72) Inventors:

- **GUO, Renwei**  
**Beijing 100176 (CN)**

**EP 3 026 486 B1**

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

## Description

### TECHNICAL FIELD

**[0001]** Embodiments of the present invention relate to a liquid crystal display (LCD) device.

### STATE OF THE ART

**[0002]** CN 103 091 895 discloses a display device and a manufacturing method. The display device includes a blue light backlight source and a liquid crystal display panel, and the liquid crystal display panel comprises a first substrate, a second substrate. The first substrate or the second substrate includes a color filter layer which includes a black matrix pattern and a red pixel pattern and a green pixel pattern. The red pixel pattern and the green pixel pattern are quantum dot material thin film patterns respectively emitting red light and green light under the excitement of blue light. An additional blue light filter layer for the red and green pixels is mentioned.

**[0003]** US 2013/010229 A1 discloses a liquid crystal display panel wherein monochromatic light is transmitted through a liquid crystal layer and converted into white light having a plurality of wavelength through an upper photo conversion layer.

**[0004]** US 2008/302977 A1 discloses a light emitting module, also as backlight, for producing a visible light by ultraviolet excitation, like sunlight. The module comprising an excitation light source member and means for wavelength modulation.

**[0005]** US 6,744,960 B2 discloses a fluorescent structure comprising a plurality of quantum dots.

### BACKGROUND

**[0006]** Quantum dots (QDs), also referred to as nanocrystals, are nanoparticles composed of group II-VI element or group III-V element. The particle size of the QDs is generally between 1 and 20 nm. As electrons and holes are subjected to quantum confinement, continuous energy band structures are converted into discrete energy level structures, and hence the QDs can emit fluorescent light after excitation.

**[0007]** The emission spectrum of QDs may be controlled by the variation of the size of QDs. The emission spectrum of QDs may cover the entire visible light spectrum by the variation of the size and the chemical composition of QDs. Taking CdTe QDs as an example, when the particle size of the QDs is increased from 2.5 nm to 4.0 nm, the emission wavelength of the QDs can be changed from 510 nm to 660 nm.

**[0008]** Currently, the QDs may be used as molecular probes and applied to fluorescent labels and also may be applied to display devices by means of the emission characteristic of the QDs. When monochromatic QDs are used for a light source of a backlight module of an LCD, the monochromatic QDs are excited by a blue-light light-

emitting diode (LED) and emit white ambient light formed by the mixture of monochromatic light and blue light. The resultant light has a larger color gamut, so that the image quality can be improved.

**[0009]** A current LCD has relatively low display brightness in the situation of intense outdoor light when applied to outdoor display, and hence the viewing effect can be affected. In general, the transfective display mode can be adopted to brighten the LCD. However, the aperture ratio of pixel units in the LCD can be reduced when the transfective display mode is adopted.

### SUMMARY

**[0010]** Embodiments of the present invention provide a liquid crystal display, LCD, device, which is configured to achieve high-brightness outdoor display.

**[0011]** The embodiments of the present invention provide an LCD device according to claim 1.

**[0012]** In the LCD provided by the embodiments of the present invention, in the case of outdoor display, ultraviolet light in sunlight will irradiate the QD layers which will emit light after excited by the ultraviolet light. In this way, light running through the color filters is the sum of the backlight and the light emitted by the QD layers after excitation. Therefore, the display brightness of the LCD can be enhanced and the outdoor viewability of the LCD can be improved.

**[0013]** For instance, in the LCD provided by a not claimed example, the QD layers are excited by the ultraviolet light in sunlight and emit monochromatic light of the color of the corresponding sub-pixel units, so that the light emitted by the QD layers after the excitation of the ultraviolet light can be maximally utilized. The QD layers of the embodiments of the present invention are excited by the ultraviolet light in sunlight and emit white light. Compared with the case that the QD layers are excited to emit monochromatic light, the complexity of the preparation process can be reduced.

**[0014]** For instance, in the LCD provided by an embodiment of the present invention, the QD layer comprises a high molecular polymer network and QDs uniformly distributed in the high molecular polymer network.

**[0015]** For instance, in the LCD provided by an embodiment of the present invention, the QD layers are disposed on one side of the array substrate facing towards the liquid crystal layer or disposed on one side of the array substrate away from the liquid crystal layer.

**[0016]** For instance, in the LCD provided by an embodiment of the present invention, an electrode structure comprising a common electrode and a pixel electrode which are mutually insulated is disposed on one side of the array substrate facing towards the liquid crystal layer; and the QD layer is disposed on one side of the electrode structure facing towards the liquid crystal layer.

**[0017]** For instance, in the LCD provided by an embodiment of the present invention, a first planarization layer is disposed between the electrode structures and

the QD layers.

**[0018]** For instance, in the LCD provided by an embodiment of the present invention, a quarter-wave optical retardation layer is disposed between the QD layers and the liquid crystal layer. The quarter-wave optical retardation layer may convert circularly polarized light emitted by the QD layers after excitation into linearly polarized light, so that the light emitted by the QD layers after excitation can be better utilized.

**[0019]** For instance, in the LCD provided by an embodiment of the present invention, a second planarization layer is disposed on one side of the QD layer facing towards the liquid crystal layer; and the quarter-wave optical retardation layer is disposed on one side of the second planarization layer facing towards the liquid crystal layer.

**[0020]** For instance, in the LCD provided by an embodiment of the present invention, the color filters are disposed on one side of the array substrate facing towards the liquid crystal layer or disposed on one side of the opposing substrate facing towards the liquid crystal layer.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0021]** Simple description will be given below to the accompanying drawings of the embodiments to provide a more clear understanding of the technical proposals of the embodiments of the present invention. It will be obvious to those skilled in the art that the drawings described below only involve some embodiments of the present invention.

FIGS. 1a and 1b are respectively schematic structural views of an LCD provided by an embodiment of the present invention;

FIGS. 2a and 2b are respectively schematic diagrams of the LCD provided by an embodiment of the present invention in outdoor display and indoor display respectively;

FIGS. 3a to 3m are respectively schematic structural views of the steps for manufacturing an array substrate in a first embodiment; and

FIGS. 4a to 4c are respectively schematic structural views of the steps for manufacturing an array substrate in a second embodiment.

#### DETAILED DESCRIPTION

**[0022]** For more clear understanding of the objectives, technical proposals and advantages of the embodiments of the present invention, clear and complete description will be given below to the technical proposals of the embodiments of the present invention with reference to the accompanying drawings of the embodiments of the present invention.

**[0023]** The shape and size of film layers in the accompanying drawings do not reflect the true scale of an array

substrate or an opposing substrate. The film layers are only partial structures of the array substrate and only intended to illustrate the content of the present invention.

**[0024]** An embodiment of the present invention comprises an LCD. As illustrated in FIGS. 1a and 1b, the LCD comprises an opposing substrate 1, an array substrate 2 and a liquid crystal layer 3 disposed between the opposing substrate 1 and the array substrate 2. The array substrate 2 is provided thereon with a plurality of pixel units that are arranged in an array, and each pixel unit comprises a plurality of sub-pixel units (as illustrated by a dotted line frame in the figure) for displaying different colors.

**[0025]** The array substrate may be provided with a plurality of gate lines and a plurality of data lines which are intercrossed to define the pixel units arranged in a matrix. Each pixel unit comprises a thin-film transistor (TFT) functioning as a switch element and a pixel electrode configured to control the arrangement of liquid crystals, and may further include a common electrode as desired. For instance, a gate electrode of the TFT of each pixel is electrically connected or integrally formed with a corresponding gate line; a source electrode is electrically connected or integrally formed with a corresponding data line; and a drain electrode is electrically connected or integrally formed with corresponding pixel electrode.

**[0026]** QD layers 01 capable of allowing backlight to pass through are disposed at positions on the array substrate 2 corresponding to the sub-pixel unit of at least one color in the pixel units. The QD layers 01 are excited by ultraviolet light in sunlight and emit white light.

**[0027]** The LCD is provided with color filters 02 corresponding to the sub-pixel units. The color filters 02 are disposed between the QD layers 01 and the opposing substrate 1, for instance, may be disposed on the opposing substrate 1 (as illustrated in FIG. 1a) or disposed on the array substrate 2 (as illustrated in FIG. 1b).

**[0028]** It should be noted that the QD layers may be only disposed in a display area of the LCD as long as the backlight from the backlight module can transmit through the QD layer(s) and be used for display under the modulation of the liquid crystal layer because the QD layers are light-transparent in the corresponding display area of the LCD.

**[0029]** In the LCD device provided by the embodiment of the present invention, as illustrated in FIG. 2a, in the case of outdoor display, the ultraviolet light in the sunlight will irradiate the QD layers 01 which will emit light after excited by the ultraviolet light, and the light can be emitted to the outside of the LCD again. In this way, the light running through the color filters 02 is the sum of the backlight from the backlight module 100 and the light emitted by the QD layers 01 after excitation, and hence the display brightness of the LCD can be enhanced and the outdoor viewability of the LCD can be improved. In the LCD device provided by the embodiment of the present invention, as illustrated in FIG. 2b, in the case of an indoor use of the display, as the light intensity of indoor ultravi-

olet light is relatively weak, the QD layers 01 do not emit light. Therefore, the light running through the color filters 02 is only the backlight from the backlight module 100, and the LCD can still display normally.

**[0030]** The QD layers 01 are disposed at positions of the array substrate 2, corresponding to all the sub-pixel units.

**[0031]** In a specific example, the LCD provided by the embodiment of the present invention may have the following structure that: the color filters 02 are disposed on the opposing substrate 1, namely a color filter substrate. As illustrated in FIG. 1a, the color filters 02 are disposed on one side of the opposing substrate 1 facing towards the liquid crystal layer 3. In the LCD, the light emitted by the QD layers 01 after excitation and the backlight from the backlight module will be used for display through the light filtering of the color filters 02 after being modulated by the liquid crystal layer 3.

**[0032]** Of course, the LCD provided by an embodiment of the present invention may also have the following structure that: the color filters 02 are disposed on the array substrate 2, namely the structure of Color-Filter-on-Array (COA). As illustrated in FIG. 1b, the color filters 02 are disposed on one side of the array substrate 2 facing towards the liquid crystal layer 3. In the LCD, the light emitted by the QD layers after excitation and the backlight from the backlight module will be used for display by means of the modulation of the liquid crystal layer 3 after being subjected to the light filtering of the color filters 02.

**[0033]** In the LCD provided by an embodiment of the present invention, the QD layers emit white light after excited by the ultraviolet light in the sunlight. Compared with the not claimed case that the QD layers emit monochromatic light after excitation, although one part of light will lose, the QD layers in the sub-pixel units may be prepared by a same material, and hence the complexity of the preparation process can be reduced. In the case that the QD layers emit the white light after excited by the ultraviolet light in the sunlight, QDs of various sizes may be mixed to form the QD layers. For instance, QDs for generating red, green, and blue (RGB) light after excitation correspondingly are mixed to form the QD layers. Light of various colors generated by the QD layers after the excitation of the ultraviolet light is mixed to produce white light.

**[0034]** For instance, for the convenience of implementation, in the LCD provided by an embodiment of the present invention, the QD layer may be formed of a high molecular polymer network and QDs uniformly distributed in the high molecular polymer network.

**[0035]** Moreover, for instance, the high molecular polymer network may be formed from the polymerization reaction of polymerizable monomers having double-bonds and organic modifiers, containing hydroxyl functional groups and sulfhydryl bonds, provided on surfaces of the QDs, and may also be formed from the polymerization of a mixture of phenolic resin derivatives and diazo

naphthol derivatives after the irradiation of ultraviolet light under the action of a photoinitiator. Both the high molecular polymer networks produced by the two ways allow the QDs to be uniformly distributed in the high molecular polymer networks, so that the aggregation of the QDs can be prevented and the QD yield can be increased. Moreover, the high molecular polymer network can isolate the QDs from the atmosphere and prevent the QDs from contacting oxygen, and hence the service life of the QDs can be prolonged. Of course, the high molecular polymer network may also be made of other materials. No limitation will be given here.

**[0036]** Moreover, as the emission wavelength of the QDs is relevant to the particle size of the QDs and the material(s) of the QDs. Taking zinc sulfide (ZnS) QDs as an example, QDs with the size of 9 to 10 nm mainly emit red light; QDs with the size of 8 nm emit yellow light; and QDs with the size of 7 nm emit green light. Therefore, the QDs distributed in the high molecular polymer network may comprise QDs with different sizes and may also comprise QDs made of different materials, as long as the QDs can emit white light after excited by the ultraviolet light.

**[0037]** Of course, the materials of the QDs include, but are not limited to, the above-mentioned substances. Other materials which are the same as or similar to the above substances in characteristics are also applicable. For instance, the QDs in the embodiment may be made of at least one material selected from the group consisting of ZnS, zinc oxide (ZnO), gallium nitride (GaN), zinc selenide (ZnSe), cadmium sulfide (CdS), gallium selenide (GaSe), cadmium selenide (CdSe), zinc telluride (ZnTe), cadmium telluride (CdTe), gallium arsenide (GaAs), indium phosphide (InP), and lead telluride (PbTe).

**[0038]** The LCD provided by the embodiments of the present invention may be applied in various modes, for instance, may be applied to advanced super dimension switch (ADSDS) mode LCD and may also be applied to the traditional twisted nematic (TN) mode or vertical alignment (VA) mode LCD. No limitation will be given here. For instance, as for the TN mode LCD, a common electrode may be formed on an opposing substrate as required and configured to cooperate with pixel electrodes on an array substrate to form electric fields for driving liquid crystal materials.

**[0039]** All the LCDs provided by the embodiments of the present invention are illustrated by taking the ADSDS mode LCD as an example.

**[0040]** For instance, in the LCD provided by an embodiment of the present invention, the QD layers 01 may be disposed on one side of the array substrate 2 facing towards the liquid crystal layer 3. Of course, the QD layers 01 may also be disposed on one side of the array substrate 2 away from the liquid crystal layer 3. No limitation will be given here.

**[0041]** Moreover, for instance, in the LCD provided by an embodiment of the present invention, as illustrated in FIGS. 1a and 1b, a electrode structure 03 formed by com-

mon electrodes 031 and pixel electrodes 032 which are mutually insulated are disposed on one side of the array substrate 2 facing towards the liquid crystal layer 3; and the QD layer 01 may be disposed on one side of the electrode structure 03 facing towards the liquid crystal layer 3. Of course, the QD layers 01 may also be disposed between other film layers in the array substrate 2 according to the requirement of the preparation process. No limitation will be given here. In addition, the common electrodes 031 and the pixel electrodes 032 of the electrode structure 03 may be as illustrated in FIGS. 1a and 1b: the common electrodes 031 are disposed above the pixel electrodes 032. The common electrodes 031 may also be disposed below the pixel electrodes 032. No limitation will be given here.

**[0042]** For instance, in the LCD provided by an embodiment of the present invention, for the convenience of arranging the QD layers 01, a first planarization layer 04 may further be disposed between the electrode structures 03 and the QD layers 01, as illustrated in FIGS. 1a and 1b.

**[0043]** In the LCD provided by an embodiment of the present invention, as the QD layers 01 may emit circularly polarized light in part after excited by the ultraviolet light, and the circularly polarized light cannot be modulated by liquid crystals. Therefore, in order to maximally utilize the light emitted by the QD layers after excitation, as illustrated in FIGS. 1a and 1b, in one example, a quarter-wave optical retardation layer 05 may further be disposed between the QD layers 01 and the liquid crystal layer 3 and can convert the circularly polarized light emitted by the QD layers 01 after excitation into linearly polarized light.

**[0044]** For instance, in the LCD provided by an embodiment of the present invention, for the convenience of arranging the quarter-wave optical retardation layer 05, a second planarization layer 06 may further be disposed on one side of the QD layer 01 facing towards the liquid crystal layer 3, and the quarter-wave optical retardation layer 05 is disposed on one side of the second planarization layer 06 facing towards the liquid crystal layer 3. For instance, the quarter-wave optical retardation layer 05 may be directly disposed on the second planarization layer 06, as illustrated in FIGS. 1a and 1b.

**[0045]** Detailed description will be given below to the manufacturing process of the array substrate 2, in which the QD layers 01 are disposed on one side of the array substrate 2 facing towards the liquid crystal layer 3.

#### Example 1

**[0046]** The color filters 02 in the LCD are disposed on the opposing substrate 1. The manufacturing process of the corresponding array substrate 2 comprises the following steps:

(1) forming patterns comprising gate lines (not shown) and gate electrodes 07 on the array sub-

strate 2, as illustrated in FIG. 3a;

(2) forming a gate insulating layer 08 on the patterns of the gate electrodes 07, as illustrated in FIG. 3b, in which the gate insulating layer 08 covers the gate lines and the gate electrodes 07;

(3) forming a pattern comprising active layers 09 on the gate insulating layer 08 in which the active layers 09 are disposed over the gate electrodes 07 as illustrated in FIG. 3c;

(4) forming patterns comprising data lines (not shown) and source/drain electrodes 10 on the pattern of the active layers 09, as illustrated in FIG. 3d;

(5) forming a first insulating (PVX) layer 11 on the patterns of the source/drain electrodes 10 and the gate insulating layer 08, in which through holes 110 are formed in the first insulating layers 11, as illustrated in FIG. 3e;

(6) forming pixel electrodes 032 on the first insulating (PVX) layer 11, in which the pixel electrodes 032 are connected with drain electrodes of the source/drain electrodes 10 via the through holes 110 in the first insulating layer 11 as illustrated in FIG. 3f;

(7) forming a second insulating (PVX) layer 12 on the pixel electrode 032, as illustrated in FIG. 3g;

(8) forming common electrodes 031 on the second insulating (PVX) layer 12, as illustrated in FIG. 3h;

(9) forming a first planarization layer 04 on the common electrodes 031, as illustrated in FIG. 3i, for instance, the first planarization layer 04 may be made of a resin material;

(10) preparing QD layers 01 on the first planarization layer 04, as illustrated in FIG. 3j;

(11) forming a second planarization layer 06 on the QD layers 01, as illustrated in FIG. 3k, for instance, the second planarization layer 06 comprising a resin material;

(12) forming a quarter-wave optical retardation layer 05 on the second planarization layer 06, as illustrated in FIG. 3l; and

(13) forming a resin layer 13 on the quarter-wave optical retardation layer 05, as illustrated in FIG. 3m.

#### Example 2

**[0047]** The color filters 02 in the LCD are disposed on the array substrate 2. The manufacturing process of the corresponding array substrate 2 further comprises the following steps apart from comprising the steps (1) to (13) in the example 1:

(14) forming a black matrix 14 on the resin layer 13, as illustrated in FIG. 4a;

(15) forming color filters 02 on the resin layer 13, as illustrated in FIG. 4b; and

(16) forming a protective layer 15 on the black matrix 14 and the color filters 02, as illustrated in FIG. 4c.

**[0048]** The present invention provides a liquid crystal

display device, which comprises the LCD provided by an embodiment of the present invention and a backlight module.

**[0049]** In the LCD device provided by the embodiments of the present invention, when the LCD device is applied to outdoor display, the ultraviolet light in the sunlight will irradiate the QD layers which will emit light after excited by the ultraviolet light. Therefore, the light running through the color filters is the sum of the backlight and the light emitted by the QD layers after excitation, and hence the display brightness of the LCD can be enhanced and the outdoor viewability of the LCD can be improved.

**[0050]** The foregoing is only the preferred embodiments of the present invention and not intended to limit the scope of protection of the present invention. The scope of protection of the present invention should be defined by the appended claims.

### Claims

1. A liquid crystal display (LCD) device, comprising an opposing substrate, an array substrate, a liquid crystal layer disposed between the opposing substrate and the array substrate and a backlight module (100) on the array substrate side, wherein the array substrate is provided with a plurality of pixel units; each pixel unit comprises a plurality of sub-pixel units for displaying different colors; quantum dot (QD) layers, allowing backlight from the backlight module, used for display, to be transmitted, are disposed in a plane at positions on the array substrate corresponding to the sub-pixel units of all the pixel units; the QD layers are adapted to be excited by ultraviolet light in sunlight and to emit white light in each sub-pixel unit; and the LCD is provided with color filters corresponding to the sub-pixel units; and the color filters are disposed between the QD layers and the opposing substrate.
2. The LCD device according to claim 1, wherein the QD layers comprise a high molecular polymer network and QDs uniformly distributed in the high molecular polymer network.
3. The LCD device according to any one of claims 1 or 2, wherein the QD layers are disposed on one side of the array substrate facing towards the liquid crystal layer or disposed on one side of the array substrate away from the liquid crystal layer.
4. The LCD device according to any one of claims 1 to 3, wherein an electrode structure formed by a common electrode and a pixel electrode which are mutually insulated is disposed on one side of the array substrate facing towards the liquid crystal layer; and the QD layers are disposed on one side of the electrode structure facing towards the liquid crystal layer.

5. The LCD device according to claim 4, wherein a first planarization layer is disposed between the electrode structures and the QD layers.
6. The LCD device according to any one of claims 1 to 5, wherein a quarter-wave optical retardation layer is disposed between the QD layers and the liquid crystal layer.
7. The LCD device according to claim 6, wherein a second planarization layer is disposed on one side of the QD layers facing towards the liquid crystal layer; and the quarter-wave optical retardation layer is disposed on one side of the second planarization layer facing towards the liquid crystal layer.
8. The LCD device according to any one of claims 1 to 7, wherein the color filters are disposed on one side of the array substrate facing towards the liquid crystal layer or disposed on one side of the opposing substrate facing towards the liquid crystal layer.

### Patentansprüche

1. Flüssigkristallanzeige - (LCD) Vorrichtung, umfassend ein gegenüberliegendes Substrat, ein Array-Substrat, eine zwischen dem gegenüberliegenden Substrat und dem Array-Substrat angeordnete Flüssigkristallschicht und ein Hintergrundbeleuchtungsmodul (100) auf der Array-Substratseite, wobei
  - das Array-Substrat mit einer Vielzahl von Pixeleinheiten versehen ist; wobei jede Pixeleinheit eine Mehrzahl von Sub-Pixeleinheiten zur Anzeige verschiedener Farben umfasst; wobei Quantenpunkt- (QD) Schichten, die Hintergrundlicht von dem für die Anzeige verwendeten Hintergrundbeleuchtungsmodul ermöglichen, ausgesendet zu werden, in einer Ebene an Positionen auf dem Array-Substrat, die den Sub-Pixeleinheiten von allen Pixeleinheiten entsprechen, angeordnet sind; wobei die QD-Schichten daran angepasst sind, mittels ultraviolettem Licht in Sonnenlicht angeregt zu werden und weißes Licht in jede Sub-Pixeleinheit zu emittieren; und wobei das LCD mit Farbfiltern entsprechend den Sub-Pixeleinheiten versehen ist; und wobei die Farbfilter zwischen den QD-Schichten und dem gegenüberliegenden Substrat angeordnet sind.
2. LCD-Vorrichtung gemäß Anspruch 1, wobei die QD-Schichten ein hochmolekulares vernetztes Polymer umfassen und QDs gleichmäßig in dem hochmolekularen vernetzten Polymer verteilt sind.

3. LCD- Vorrichtung gemäß einem der Ansprüche 1 oder 2, wobei die QD-Schichten angeordnet sind auf einer Seite des Array-Substrates, die der Flüssigkristallschicht zugewandt ist, oder angeordnet sind auf einer Seite des Array-Substrates, die von der Flüssigkristallschicht abgewandt ist. 5
4. LCD- Vorrichtung gemäß einem der Ansprüche 1 bis 3, wobei eine Elektrodenstruktur, die mittels einer gemeinsamen Elektrode und einer Pixelelektrode, welche gegenseitig isoliert sind, auf einer Seite des Array-Substrates, die zu der Flüssigkristallschicht zeigt, angeordnet ist; und wobei die QD- Schichten auf einer Seite der Elektrodenstruktur, die der Flüssigkristallschicht zugewandt ist, angeordnet ist. 10
5. LCD- Vorrichtung gemäß Anspruch 4, wobei einer erste Planarisierungsschicht zwischen den Elektrodenstrukturen und den QD-Schichten angeordnet ist. 20
6. LCD- Vorrichtung gemäß einem der Ansprüche 1 bis 5, wobei eine optische Viertelwellen- Retardationsschicht zwischen den QD- Schichten und der Flüssigkristallschicht angeordnet ist. 25
7. LCD- Vorrichtung gemäß Anspruch 6, wobei eine zweite Planarisierungsschicht auf einer Seite der QD- Schichten, die der Flüssigkristallschicht zugewandt ist, angeordnet ist; und wobei die optische Viertelwellen- Retardationsschicht auf einer Seite der zweiten Planarisierungsschicht, die der Flüssigkristallschicht zugewandt ist, angeordnet ist. 30
8. LCD- Vorrichtung gemäß einem der Ansprüche 1 bis 7, wobei die Farbfilter auf einer Seite des Array-Substrates, die der Flüssigkristallschicht zugewandt ist, angeordnet sind oder auf einer Seite des gegenüberliegenden Substrates, die der Flüssigkristallschicht zugewandt ist, angeordnet sind. 35

### Revendications

1. Un dispositif d'affichage à cristaux liquides (LCD), comprenant un substrat opposé, un substrat de réseau, une couche de cristaux liquides disposée entre le substrat opposé et le substrat de réseau et un module de rétroéclairage (100) du côté du substrat de réseau, dans lequel le substrat de réseau est pourvu d'une pluralité d'unités de pixel ; chaque unité de pixel comprend une pluralité d'unités de sous-pixel pour afficher différentes couleurs ; des couches de points quantiques (PQ) permettant de transmettre le rétroéclairage du module de rétroéclairage utilisé pour l'affichage, sont disposées dans un plan à des positions sur le substrat du réseau correspondant aux unités de sous-pixel de toutes les unités de pixel ; les couches de PQ sont adaptées pour être excitées par la lumière ultraviolette dans la lumière du soleil et pour émettre de la lumière blanche dans chaque unité de sous-pixel ; et le LCD est muni de filtres de couleur correspondant aux unités de sous-pixel ; et les filtres de couleur sont disposés entre les couches de PQ et le substrat opposé. 50
2. Le dispositif LCD selon la revendication 1, dans lequel les couches de PQ comprennent un réseau polymère à poids moléculaire élevé et des PQ répartis uniformément dans le réseau polymère à poids moléculaire élevé. 55
3. Le dispositif LCD selon l'une quelconque des revendications 1 ou 2, dans lequel les couches de PQ sont disposées sur un côté du substrat de réseau orienté vers la couche de cristaux liquides ou sont disposées sur un côté du substrat de réseau éloigné de la couche de cristaux liquides.
4. Le dispositif LCD selon l'une quelconque des revendications 1 à 3, dans lequel une structure d'électrode formée par une électrode commune et une électrode de pixel qui sont mutuellement isolées, est disposée sur un côté du substrat de réseau orienté vers la couche de cristaux liquides ; et les couches de PQ sont disposées sur un côté de la structure d'électrode orienté vers la couche de cristal liquide.
5. Le dispositif LCD selon la revendication 4, dans lequel une première couche de planarisation est disposée entre les structures d'électrodes et les couches de PQ.
6. Le dispositif LCD selon l'une quelconque des revendications 1 à 5, dans lequel une couche de retard optique quart d'onde est disposée entre les couches de PQ et la couche de cristaux liquides.
7. Le dispositif LCD selon la revendication 6, dans lequel une deuxième couche de planarisation est disposée sur un côté des couches de PQ orienté vers la couche de cristaux liquides ; et la couche de retard optique quart d'onde est disposée sur un côté de la deuxième couche de planarisation orienté vers la couche de cristaux liquides.
8. Le dispositif LCD selon l'une quelconque des revendications 1 à 7, dans lequel les filtres de couleur sont disposés sur un côté du substrat de réseau orienté vers la couche de cristaux liquides ou sont disposés sur un côté du substrat opposé orienté vers la couche de cristaux liquides. 55

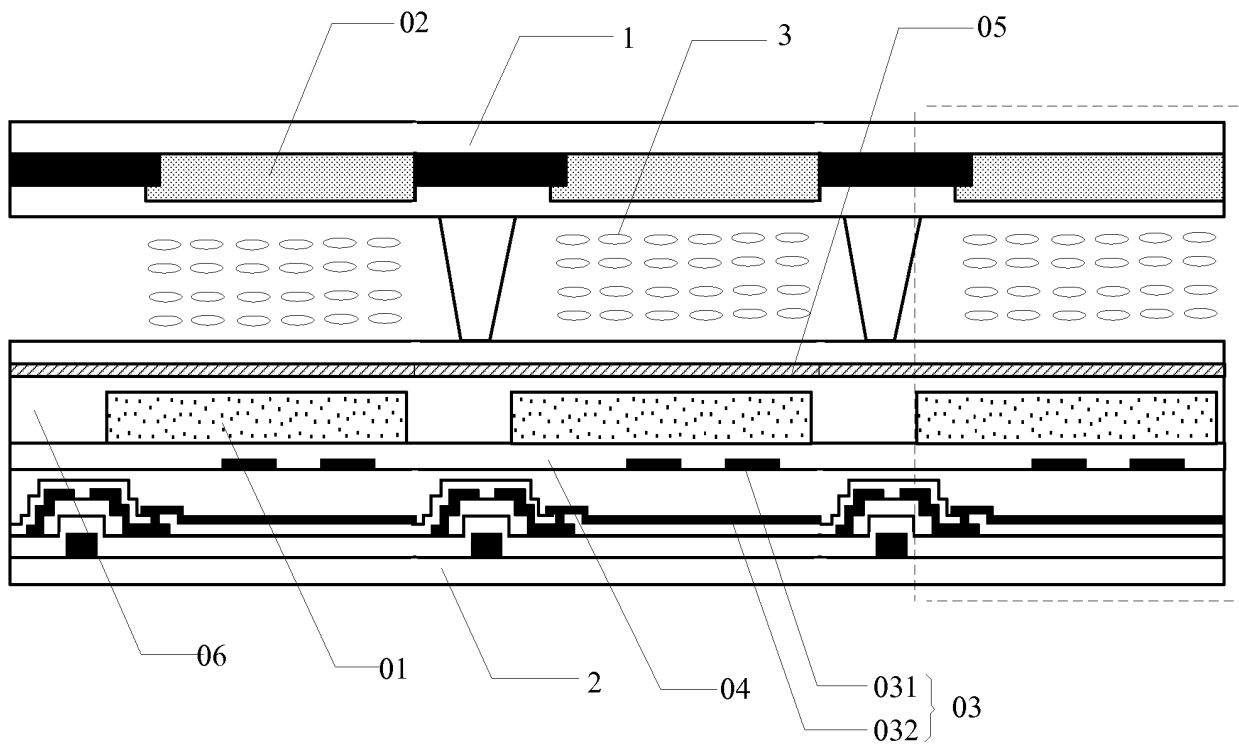


FIG. 1a

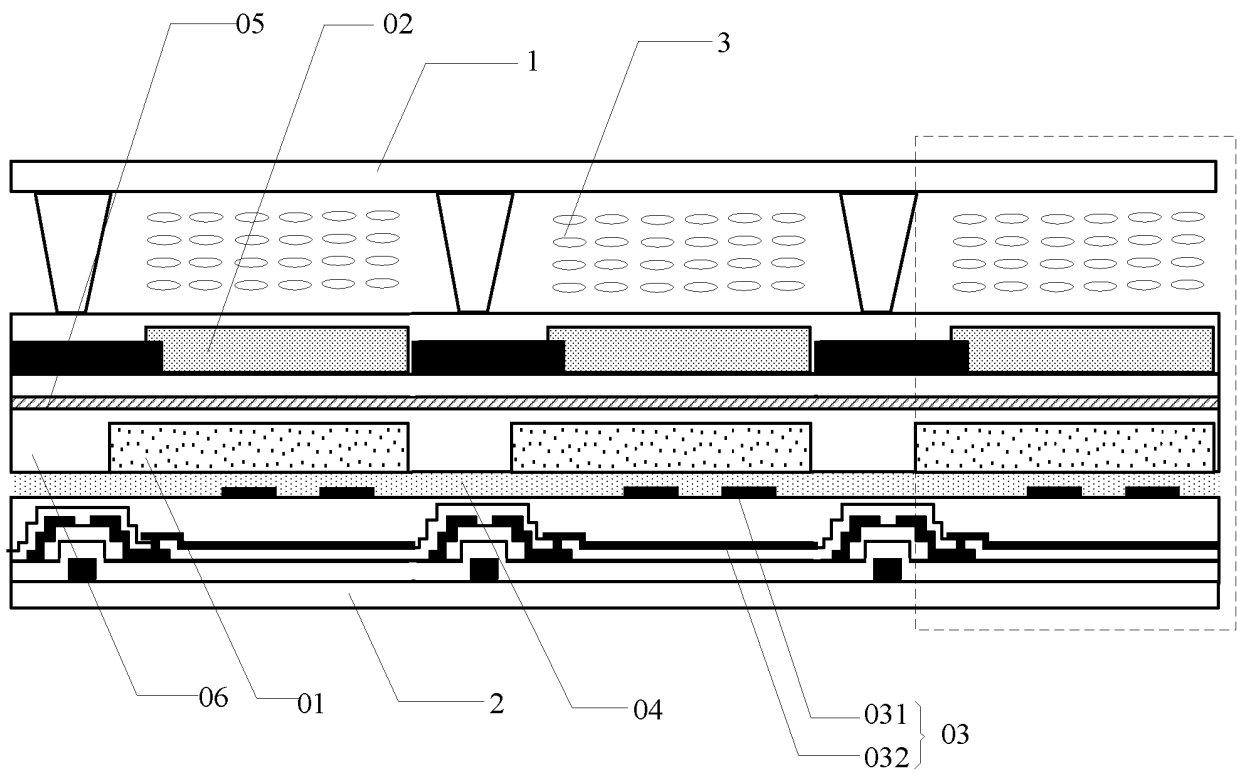


FIG. 1b

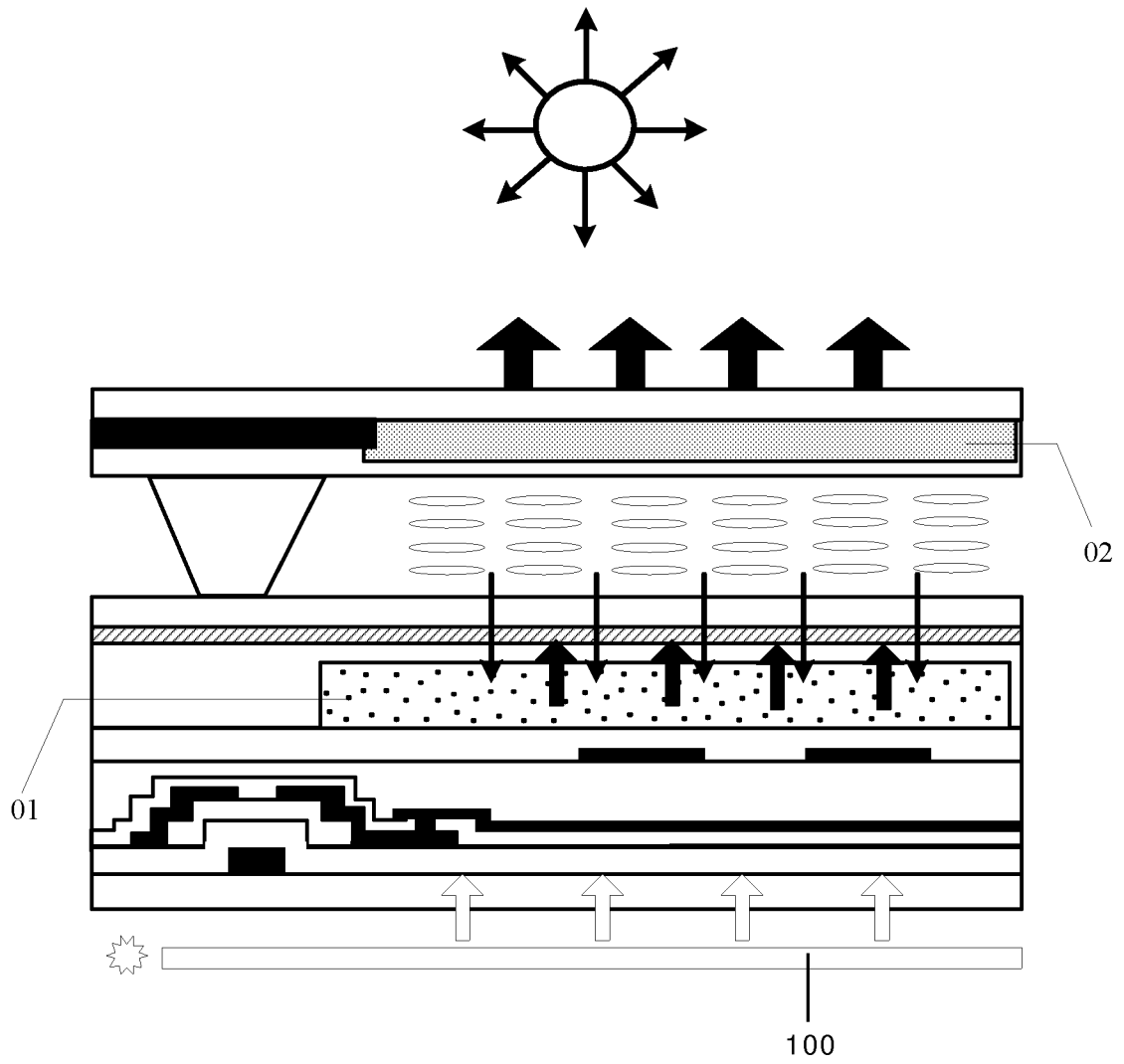


FIG. 2a

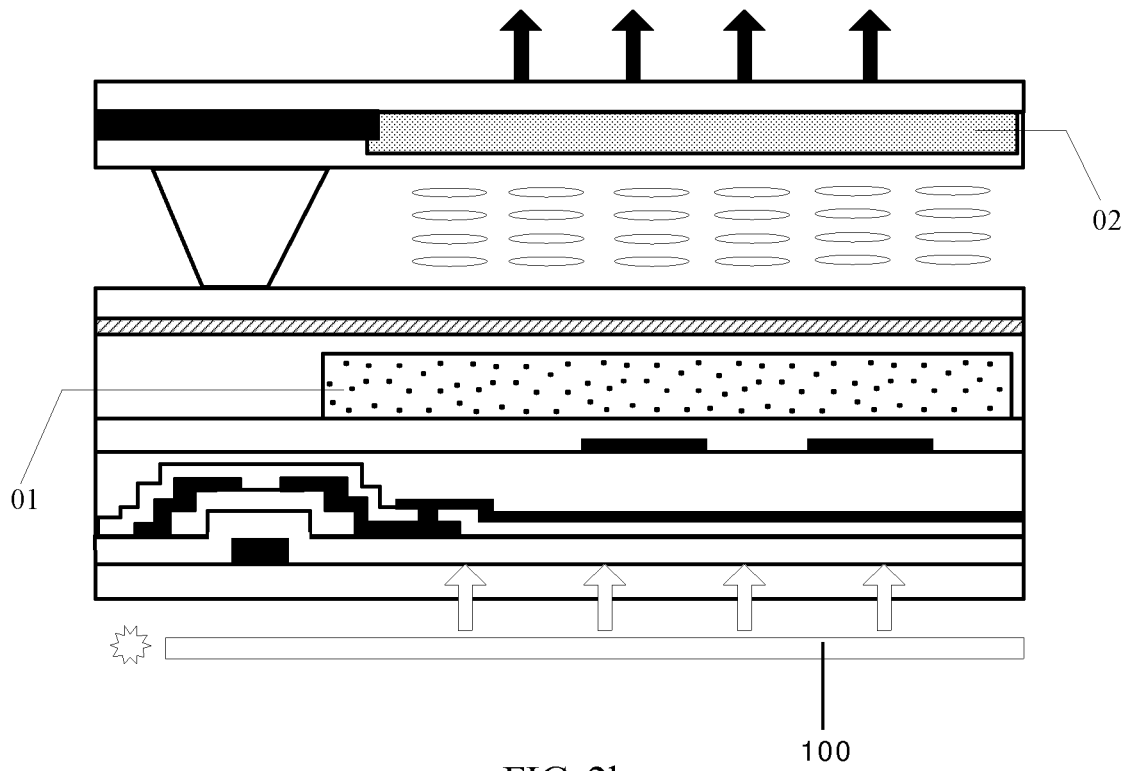


FIG. 2b

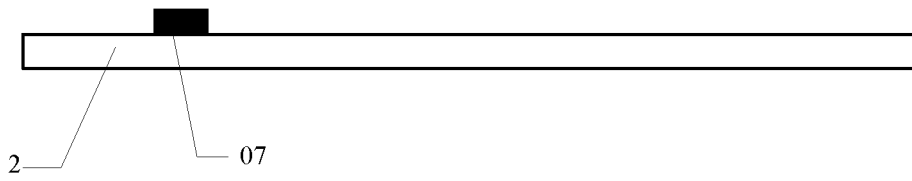


FIG. 3a

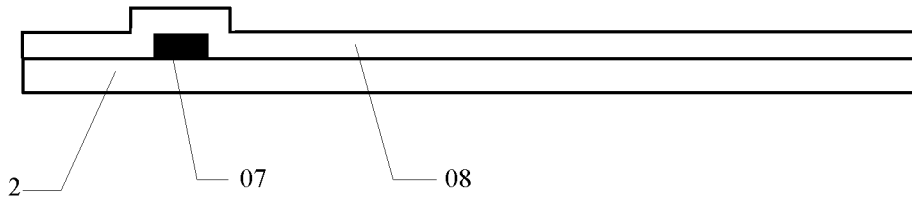


FIG. 3b

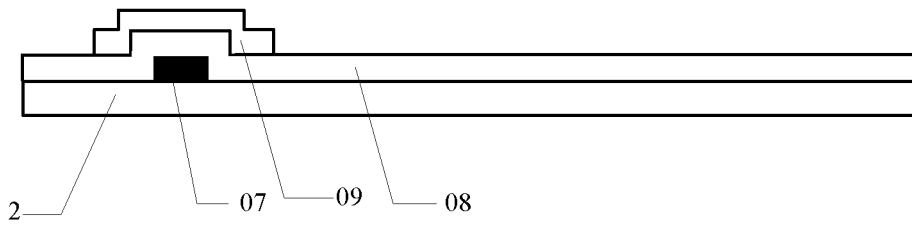


FIG. 3c

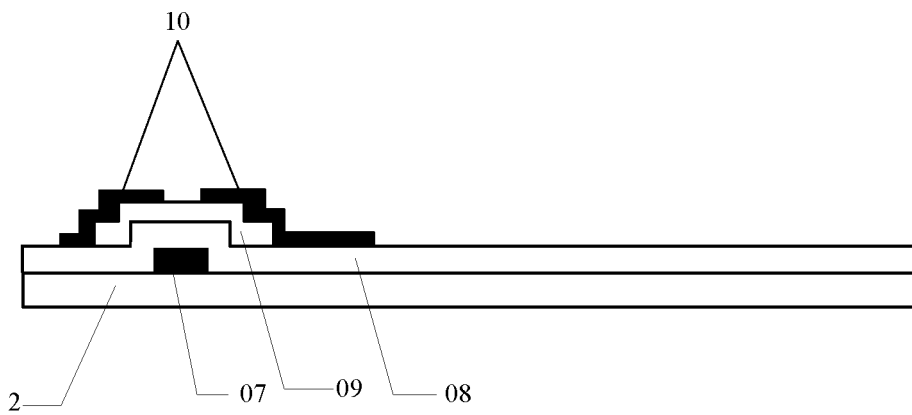


FIG. 3d

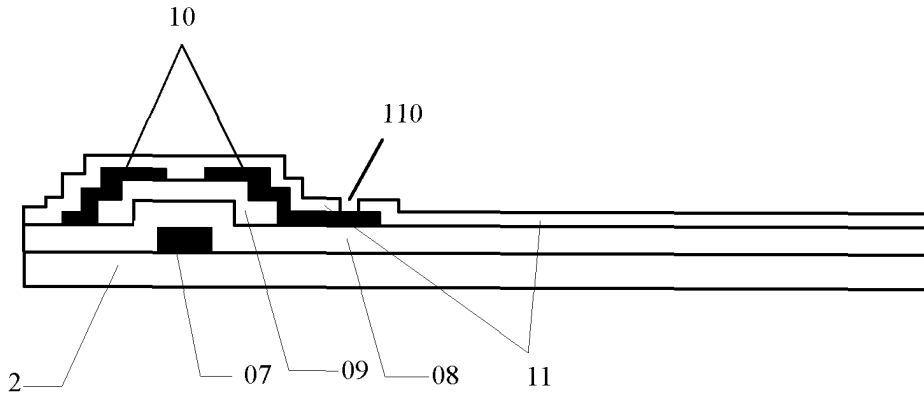


FIG. 3e

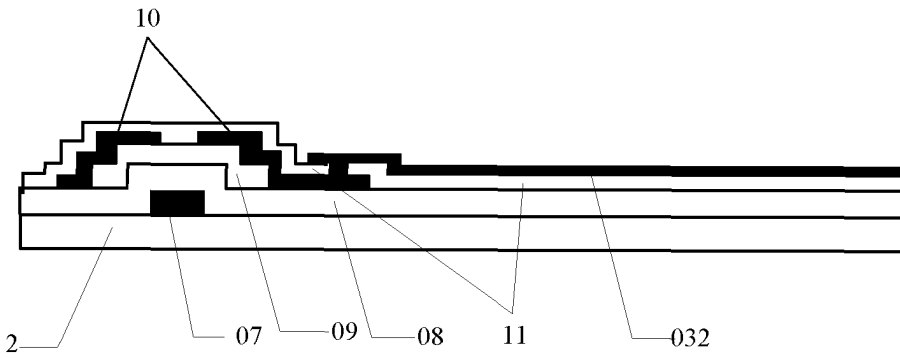


FIG. 3f

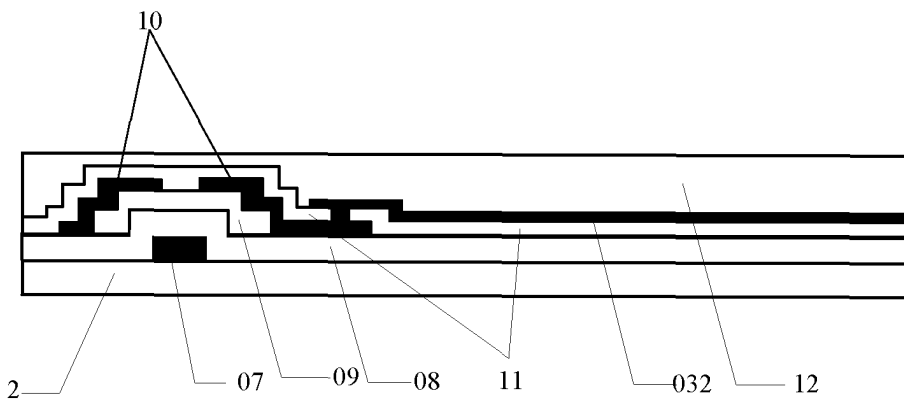


FIG. 3g

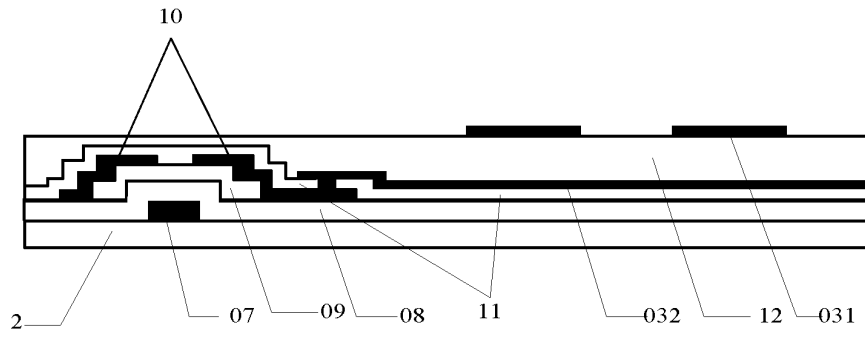


FIG. 3h

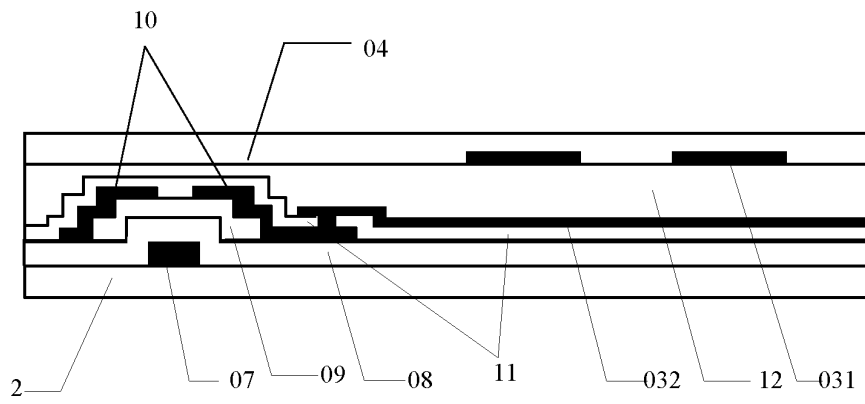


FIG. 3i

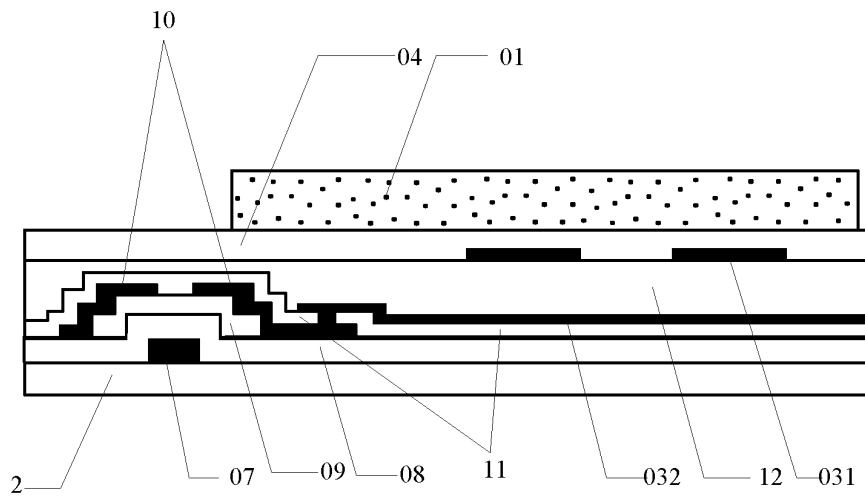


FIG. 3j

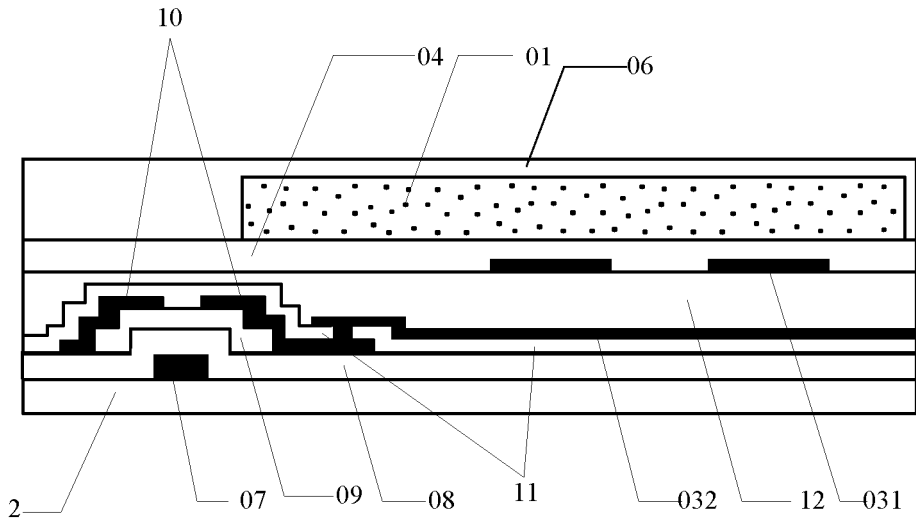


FIG. 3k

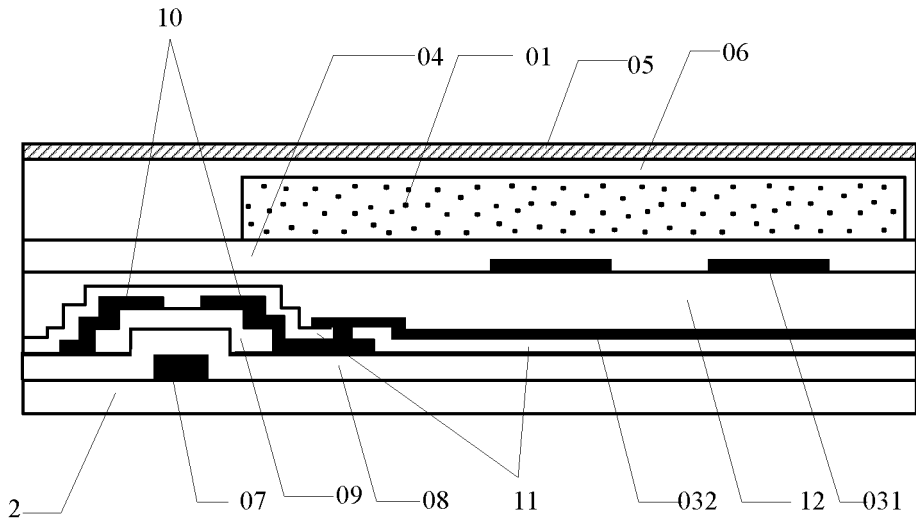


FIG. 3l

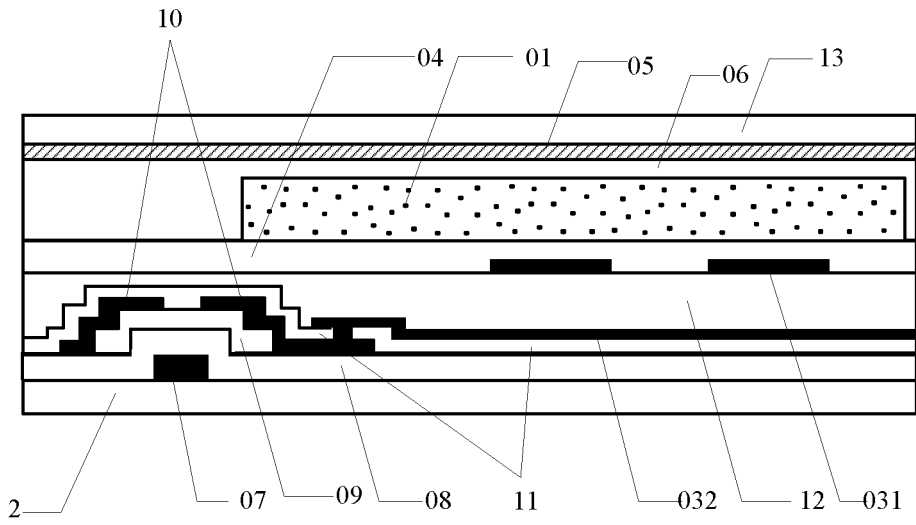


FIG. 3m

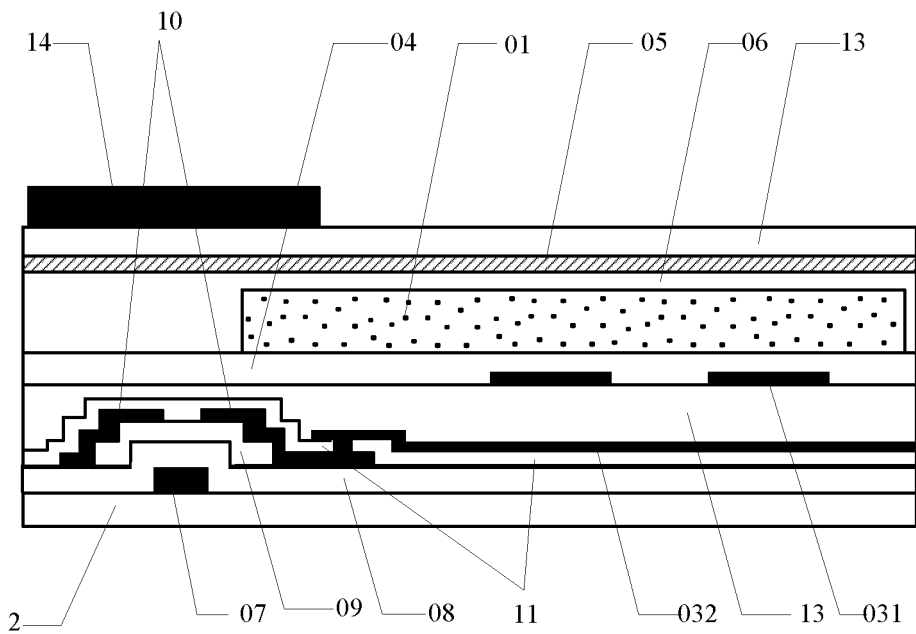


FIG. 4a

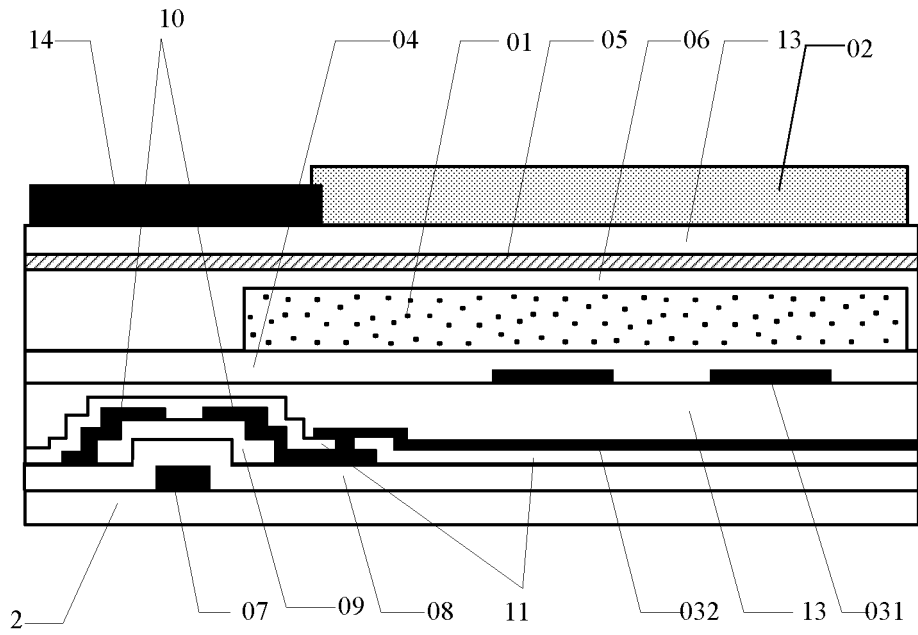


FIG. 4b

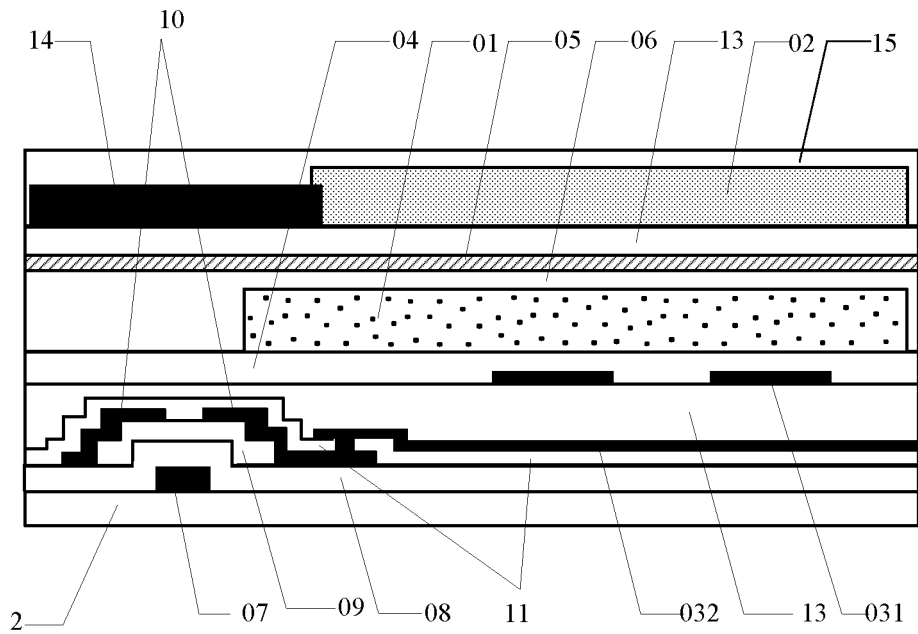


FIG. 4c

**REFERENCES CITED IN THE DESCRIPTION**

*This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.*

**Patent documents cited in the description**

- CN 103091895 [0002]
- US 2013010229 A1 [0003]
- US 2008302977 A1 [0004]
- US 6744960 B2 [0005]

专利名称(译)	液晶显示屏和显示装置		
公开(公告)号	<a href="#">EP3026486B1</a>	公开(公告)日	2019-09-11
申请号	EP2013854211	申请日	2013-10-10
[标]申请(专利权)人(译)	京东方科技集团股份有限公司 北京京东方光电科技有限公司		
申请(专利权)人(译)	京东方科技集团股份有限公司. 北京京东方光电科技有限公司.		
当前申请(专利权)人(译)	京东方科技集团股份有限公司. 北京京东方光电科技有限公司.		
[标]发明人	GUO RENWEI DONG XUE GUO JIAN		
发明人	GUO, RENWEI DONG, XUE GUO, JIAN		
IPC分类号	G02F1/1335 G02F1/1362 B82Y30/00 G02F1/13363 G02B5/20 G02F1/1333 C09K11/56		
CPC分类号	B82Y20/00 B82Y30/00 C09K11/565 G02B5/201 G02F1/133514 G02F1/133617 G02F1/1362 G02F2001/133357 G02F2001/133565 G02F2001/133614 G02F2001/133638 G02F2001/136222 G02F2201/086 G02F2202/108 G02F2202/36 G02F2203/01 G02F1/13363 G02F1/134336 G02F1/1368		
优先权	201310313938.4 2013-07-24 CN		
其他公开文献	EP3026486A1 EP3026486A4		
外部链接	<a href="#">Espacenet</a>		

摘要(译)

公开了一种液晶显示器 (LCD) 和显示装置。LCD 具有多个像素单元;每个像素单元包括多个子像素单元,用于显示不同的颜色;能够允许背光贯穿的量子点 (QD) 层 (01) 设置在阵列基板 (2) 的位置处,对应于像素单元的至少一种颜色的子像素单元;QD 层 (01) 被太阳光中的紫外光激发并发出至少具有子像素单元颜色的光;滤色器 (02) 和滤色器 (02) 设置在 QD 层 (01) 和相对基板 (1) 之间。在户外显示的情况下, LCD 具有增强的显示亮度和更高的户外可视性。

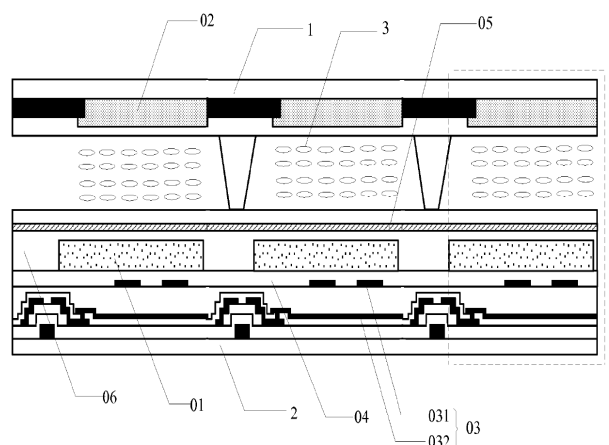


FIG. 1a