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(54) Color filters of liquid crystal display and method for fabricating the same

Farbfilter einer Flüssigkristallanzeige und Herstellungsverfahren dafür

Filtres de couleur d'affichage à cristaux liquides et leur procédé de fabrication

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- **YOUNG-CHOL YANG ET AL: "31.1: Development of Six Primary-Color LCD" 2005 SID INTERNATIONAL SYMPOSIUM. BOSTON, MA, MAY 24 - 27, 2005; [SID INTERNATIONAL SYMPOSIUM], SAN JOSE, CA : SID, US, vol. XXXVI, 24 May 2005 (2005-05-24), pages 1210-1213, XP007012269**

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a color filter of a liquid crystal display (LCD) and, more particularly, to a color filter of an LCD that can implement 6 primary colors by adding cyan (C), magenta (M) and yellow (Y) complementary colors to a color reproduction range using the existing red (R), green (G) and blue (B).

2. Description of the Related Art

[0002] In general, the LCD includes two display panels and a liquid crystal layer, which has dielectric anisotropy, interposed between the two display panels.

[0003] In the LCD, an electric field is applied to the liquid crystal layer, and the strength of the electric field is controlled to adjust transmittance of light that passes through the liquid crystal layer to obtain a desired image.

[0004] The LCD is a typical device among portable flat panel displays (FPDs), and a thin film transistor (TFT) LCD including TFTs as switching elements is commonly used.

[0005] The LCD includes a plurality of sub-pixels including pixel electrodes (not shown) and red, green and blue color filters.

[0006] Each sub-pixel is driven by a signal applied via a display signal line to perform a display operation.

[0007] Signal lines include gate lines (or scan signal lines0 that transfer scan signals and data lines that transfer data signals. Each sub-pixel includes a TFT which is connected with a single gate line and a single data line, through which an image signal transferred to a pixel electrode formed in the sub-pixel is controlled.

[0008] In the related art LCD, the red (R), green (G) and blue (B) color filters are arranged in various forms.

[0009] That is, in a stripe type color filter arrangement, the same color filters are arranged in units of sub-pixel rows. In a mosaic type color filter arrangement, the red (R), green (G) and blue (B) color filters are sequentially arranged in rows and columns. In a delta type color filter arrangement, sub-pixels are disposed in zigzags in a column direction, and red (R), green (G) and blue (B) color filters are sequentially arranged.

[0010] The related art LCD using the delta-type color filter arrangement method will now be described with reference to FIG. 1 and 2.

[0011] FIG. 1 is a plan view showing sub-pixels constituting a single pixel of the related art LCD, and FIG. 2 is a sectional view of the sub-pixels constituting a single pixel of the LCD, taken along line II-II in FIG. 1.

[0012] Although not shown< the related art LCD includes a liquid crystal panel (not shown) that displays a desired image, and a backlight unit (not shown) that supplies light to the liquid crystal panel.

[0013] Here the liquid crystal panel (not shown) includes an TFT array substrate (not shown) on which TFTs are formed, a color filter substrate (not shown) which is attached to the TFT array substrate and includes red (R), green (G) and blue (B) color filters, and a liquid crystal layer (not shown) filled between the TFT array substrate and the color filter substrate.

[0014] A backlight unit of the LCD includes a plurality of lamps to provide light to the liquid crystal panel.

[0015] With reference to FIG. 1, three sub-pixels including red (R), green (G) and blue (B) color filters 13a, 17a and 21a constituting a single unit pixel 10 are formed on the color filter substrate. Here, the color filters 13a, 17a and 21a will be considered to refer to the sub-pixels.

[0016] The red (R), green (G) and blue (B) color filters 13a, 17a and 21a are arranged in a column direction.

[0017] A black matrix layer (not shown) is formed to block light at boundaries of the red (R), green (G) and blue (B) color filters 13a, 17a and 21a.

[0018] The method for fabricating the color filters of the LCD according to the related art having such array structure will now be described with reference to FIGs. 3a to 3e.

[0019] FIGs. 3a to 3e are sectional views sequentially showing the process of fabricating sub-pixels constituting a single pixel of the related art LCD.

[0020] With reference to FIG. 3, first, a black matrix layer (not shown) is formed on the color filter substrate 11, a glass substrate, with an opaque material in order to prevent light transmission to other portions than the unit pixel area.

[0021] Next, one of a color, which is among red, green and blue, resin layer is coated on the color filter substrate 11 including the black matrix layer (not shown). Here, for example, the red color resin layer 13, among the red, green and blue color resin layers, may be first coated.

[0022] And then, the red color resin layer 13 is selectively removed through exposing and developing processes using photolithography to form a red color resin layer pattern 13a. In this case, the red color resin layer pattern 13a is used as a red color filter and corresponds to the red sub-pixel.

[0023] Subsequently, as shown in FIG. 3b, a green (G) color resin layer 17 is coated on the color filter substrate 11 including the red color resin layer pattern 13a.

[0024] And then, as shown in FIG. 3c, the green color resin layer 17 is selectively removed through exposing and developing processes using photolithography to form the green color resin layer pattern 17a. In this case, the green color resin layer pattern 17a is used as a green color filter and corresponds to the green sub-pixel.

[0025] Thereafter, as shown in FIG .3d, a blue (B) color resin layer 21 is coated on the color filter substrate 11 including the red and green color resin layer patterns 13a and 17a.

[0026] And then, as shown in FIG. 3e, the blue color resin layer 21 is selectively removed through exposing and developing processes using photolithography to

form the blue color resin layer pattern 21a. In this case, the blue color resin layer pattern 21a is used as a blue color filter and corresponds to a blue sub-pixel.

[0027] The color filters of the related art LCD fabricated as described above and the fabrication method have the following problems.

[0028] That is, in the color filters of the related art LCD and its fabrication method, only the three R, G and B colors are used to form the color filters, and as shown in FIG. 4, formation of the color filters with three colors has a limitation in implementing color reproduction characteristics close to the natural colors.

[0029] Thus, a method of adding three cyan, magenta and yellow color filters to the three R, G and B color filters has been proposed, which, however, has failed to be employed for mass production because it incurs high fabrication costs for development of additional color inks (cyan, magenta and yellow) and an additional photo process.

[0030] US 2007/0008462 A1 discloses a color filter substrate and a method of manufacturing the same. The color filter includes a plurality of pixels formed in a matrix form on the color filter substrate, wherein each pixel includes first red, green, and blue sub-pixels disposed on the substrate in a first, second, and third column, respectively. Further, a pair of a second red sub-pixels and a third blue sub-pixel is arranged in the same column as the first red sub-pixel. Similarly, a pair of a second green sub-pixels and a third red sub-pixel is disposed in the second column, i.e. in the same column as the first green sub-pixel. Furthermore, a pair of a second blue sub-pixels and a third green sub-pixel is arranged in the same column as the first blue sub-pixel. Thus, cyan, magenta, and yellow can be implemented in addition to red, green, and blue.

[0031] Young-Chol Yang et al.: "31.1: Development and Six Primary-Color LCD" 2005 SID International Symposium, Boston, MA, May 24 - 27, 2005; [SID International Symposium], San Jose, CA: SID, US, Vol. XXXVI, 24 May 2005 (2005-05-24), pages 1210-1213, XP007012269 is concerned with a six primary-color LCD, wherein each pixel is divided into six sub-pixels, i.e. a red sub-pixel, a green sub-pixel, a blue sub-pixel, a cyan sub-pixel, a magenta sub-pixel, and a yellow sub-pixel. To divide a pixel into such six sub-pixels, there are two methods described, one of which is doubling the gate line and the other is doubling the data line, compared with the normal RGB pixels. Here doubling the gate line is better to minimize the shrinkage of aperture ratio, because three more lines are required for doubling the data line, while only one more line is necessary for doubling the gate line. Thus, the six sub-pixels according to this document are preferably arranged in a 2x3 matrix.

SUMMARY OF THE INVENTION

[0032] The object underlying the present invention is to provide another color filter of a liquid crystal display capable of implementing six colors including red, green, and blue without additional inks or processes, and having improved reproduction characteristics.

[0033] This object is achieved by the liquid crystal display device according to claim 1. A method for manufacturing the same is defined in claim 4.

BRIEF DESCRIPTION OF THE DRAWINGS

[0034]

FIG. 1 is a plan view showing sub-pixels constituting a single pixel of a liquid crystal display (LCD) according to the related art;

FIG. 2 is a sectional view of the sub-pixels constituting a single pixel of the LCD, taken along line II-II in FIG. 1;

FIGs. 3a to 3e are sectional views sequentially showing the process of fabricating sub-pixels of a single pixel of the LCD according to the related art;

FIG. 4 is a graph showing a color coordinate of a color filter of the LCD according to the related art;

FIG. 5 is an equivalent circuit diagram of a single sub-pixel of an LCD according to an exemplary embodiment of the present invention;

FIG. 6 is a plan view of sub-pixels constituting a single pixel of the LCD according to an exemplary embodiment of the present invention;

FIGs. 7a and 7b are sectional views constituting a single pixel of the LCD according to an exemplary embodiment of the present invention, wherein

FIG. 7a is a sectional view taken along line VIIa-VIIa in FIG. 6; and

FIG. 7b is a sectional view taken along line VIIb-VIIb in FIG. 6.

FIG. 8a to 8c are plan views for explaining the process of forming sub-pixels of a single pixel of the LCD according to an exemplary embodiment of the present invention; and

FIG. 9 is a graph showing a color coordinate of a color filter of the LCD according to an exemplary embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0035] Color filters of a liquid crystal display (LCD) and its fabrication method according to an exemplary embodiment of the present invention will now be described in detail with reference to the accompanying drawings.

[0036] FIG. 5 is an equivalent circuit diagram of a single sub-pixel of an LCD according to an exemplary embodiment of the present invention.

[0037] FIG. 6 is a plan view of sub-pixels constituting a single pixel of the LCD according to an exemplary embodiment of the present invention.

[0038] FIGs. 7a and 7b are sectional views constituting a single pixel of the LCD according to an exemplary embodiment of the present invention, wherein FIG. 7a is a

sectional view taken along line VIIa-VIIa in FIG. 6, and FIG. 7b is a sectional view taken along line VIIb-VIIb in FIG. 6.

[0039] FIG. 8a to 8c are plan views for explaining the process of forming sub-pixels of a single pixel of the LCD according to an exemplary embodiment of the present invention.

[0040] With reference to FIG. 5, the LCD according to an exemplary embodiment of the present invention includes a liquid crystal panel including a thin film transistor (TFT) array substrate 101, a color filter substrate 201 with red (R), green (G) and blue (B) color filters formed thereon, and a liquid crystal layer (not shown) filled between the substrates, and a backlight unit (not shown) that provides light to the liquid crystal panel.

[0041] A plurality of gate lines Gm-1 and Gm and a plurality of data lines Dn are arranged to cross each other to form a sub-pixel area on the TFT array substrate 101, and a TFT (T), a switching element, is formed at each crossing of the gate lines and the data lines.

[0042] A pixel electrode 109 is connected with the TFT (T) formed at each sub-pixel area.

[0043] Each sub-pixel includes the TFT (T), the switching element, connected with the gate lines Gm-1 and Gm and the data line Dn, a liquid crystal capacitor Clc connected to the TFT (T), and a storage capacitor Cst. In this case, the storage capacitor may be omitted as necessary.

[0044] The liquid crystal capacitor Clc uses the pixel electrode 109 of the lower array substrate 101 and a common electrode (not shown) of the upper color filter substrate 201 as two terminals, and the liquid crystal layer (not shown) between the two electrodes serves as a dielectric substance.

[0045] The pixel electrode 109 is connected with the TFT (T), and the common electrode (not shown) is formed on the upper color filter substrate 201 and receives a common voltage Vcom.

[0046] The common electrode (not shown) may be provided on the lower array substrate 101, and in this case, the pixel electrode 109 and the common electrode (not shown) may be formed in a linear or bar shape.

[0047] The backlight unit (not shown) of the LCD includes a plurality of lamps to provide light to the liquid crystal panel. In this case, as the lamps, CCFLs (Cold Cathode Fluorescent Lamp), EEFLs (External Electrode Fluorescent Lamps), LEDs (Light Emitting Diodes), and the like, can be used.

[0048] On the color filter substrates, a plurality of pairs of sub-pixels that implement cyan (C), magenta (M) and yellow (Y) colors together with red (R), green (G), and blue (B) colors form a single pixel as a basic unit of an image.

[0049] Although not shown, black matrixes are formed at boundaries of sub-pixels to prevent light transmission. Here, it is assumed that the black matrixes are formed at boundaries of the respective sub-pixels in the following description.

[0050] The disposition structure and disposition method of sub-pixels of the color filter substrates of the LCD according to an exemplary embodiment of the present invention will now be described in detail.

[0051] FIG. 6 is a plan view of sub-pixels constituting a single pixel of the LCD according to an exemplary embodiment of the present invention.

[0052] FIGs. 7a and 7b are sectional views constituting a single pixel of the LCD according to an exemplary embodiment of the present invention, wherein FIG. 7a is a sectional view taken along line VIIa-VIIa in FIG. 6, and FIG. 7b is a sectional view taken along line VIIb-VIIb in FIG. 6.

[0053] With reference to FIGs. 6 and 7a and 7b, the sub-pixels of a single pixel 200 of the color filters of the LCD according to an exemplary embodiment of the present invention has a basic structure of 1x6 matrix. Of the sub-pixels; the first, red (R), the first green (G) and the first blue (B) sub-pixels 203a, 205a and 207a are disposed at three columns and pairs of sub-pixels are formed at the remaining columns in a 2x3 matrix form.

[0054] In detail, in the 2x3 matrix form, a second red sub-pixel 203b and a third green sup-pixel 205c make a pair in a first column, a second green sub-pixel 20b and a third blue sub-pixel 207c make a pair in a second column, and a second blue sub-pixel 207b and a third red sub-pixel 203c make a pair in a third column.

[0055] Here, the pair of second red sub-pixel 203b and the third green sub-pixel 205c implement yellow color, the pair of second green sub-pixel 205b and third blue sub-pixel 207c implement cyan color, and the pair of second blue sub-pixel 207b and third red sub-pixel 203c implement magenta color.

[0056] In this manner the red, green, blue, cyan, magenta and yellow colors are implemented by the nine sub-pixels (namely, color filters) constituting the single pixel 200.

[0057] The method for forming a plurality of sub-pixels constituting a single pixel of the color filter will now be described with reference to FIGs. 8a to 8c.

[0058] FIG. 8a to 8c are plan views for explaining the process of forming sub-pixels of a single pixel of the LCD according to an exemplary embodiment of the present invention.

[0059] Although not shown, one of red, green and blue color filter resin layers not shown) is coated on the color filter substrate 201. Here, a case where a red color resin layer 13, among the red, green and blue color resin layers, is first coated will be taken as an example.

[0060] In this case, major components of the color resin layer include photopolymerization type photosensitive composition such as a photopolymerization initiator, monomer, a binder, and organic pigments assuming R, G and B and their similar colors.

[0061] Although not shown, a black matrix layer (not shown) is formed with an opaque material to prevent light from transmitting through other portions than unit pixel areas on the color filter substrate 201 at a previous stage

before the red color resin layer is coated. Here, it is assumed that the black matrix is formed at boundaries of the respective sub-pixels in the following description.

[0062] Subsequently, with reference to FIG. 8a, the red color resin layer (not shown) is selectively removed through exposing and developing processes using photolithography to form red color resin layer patterns 203a, 203b and 203c. In this case, the red color resin layer patterns 203a, 203b and 230c are used as the first to third red sub-pixels 203a, 203b and 230c.

[0063] Among the sub-pixels 203a, 203b and 203c, the second and third red sub-pixels 203b and 203c are disposed in columns different from that of the first red sub-pixel 203a, and respectively have an area corresponding to a half of or smaller than that of the first red sub-pixel 203a.

[0064] Thereafter, although not shown, a green color resin layer (not shown) is formed on the color filter substrate 201 including the red color resin layer patterns 203a, 230b and 203c.

[0065] And then, as shown in FIG. 8b, the green color resin layer (not shown) is selectively removed through exposing and developing processes using photolithography to form green color resin layer patterns 205a, 205b and 205c. In this case, the green color resin layer patterns 205a, 205b and 205c can be used as first to third green sub-pixels 205a, 205b and 205c.

[0066] Among the green sub-pixels 205a, 205b and 205c, the second and third green sub-pixels 205b and 205c are disposed in columns different from that of the first green sub-pixel 205a and respectively have an area corresponding to a half of or smaller than that of the first green sub-pixel 205a.

[0067] The green sub-pixels 205a, 205b and 205c do not overlap with the red sub-pixels 203a, 203b and 203c.

[0068] The second green sub-pixel 205b is disposed in the a different column from that of the second red sub-pixel 203b, and the third green sub-pixel 205c is disposed in the same column as the second red sub-pixel 203b. The third green sub-pixel 205c and the second red sub-pixel 203b disposed in the same column implement the yellow color.

[0069] Subsequently, although not shown, a blue color resin layer (not shown) is formed on the color filter substrate 201 including the red color resin layer patterns 203a, 203b and 203c and the green color resin layer patterns 205a, 205b and 205c.

[0070] And then, as shown in FIG. 8c, the blue color resin layer (not shown) is selectively removed through exposing and developing processes using photolithography to form the blue color resin layer patterns 207a, 207b and 207c, thus completing formation of the plurality of sub-pixels constituting a single pixel.

[0071] In this case, the red color resin layer patterns 207a, 207b and 207c are used as first to third blue sub-pixels 207a, 207b and 207c.

[0072] The blue sub-pixels 207a, 207b and 207c do not overlap with the red sub-pixels 203a, 203b and 203c and the green sub-pixels 205a, 205b and 205c.

[0073] The second blue sub-pixel 207b is disposed in the same column in which the third red sub-pixel 203c is disposed, and the third blue sub-pixel 207c is disposed in the same column in which the second green sub-pixel 205b is disposed.

[0074] The second blue sub-pixel 207b and the red sub-pixel 203c disposed in the same column implement a magenta color, and the third blue sub-pixel 207c and the second green sub-pixel 205b disposed in the same column implement a cyan color.

[0075] By disposing the nine sub-pixels constituting a single pixel in such manners, a change in six color coordinates of the LCD as shown in FIG. 9 can be recognized.

[0076] Namely, in FIG. 9, the triangle in the color coordinates indicates a general color coordinates, and because cyan (C), magenta (M) and yellow (Y) color coordinates are added, every color within the hexagon can be implemented.

[0077] A method for fabricating the TFTs on the array substrate which is to be attached to the color filter substrate on which a plurality of sub-pixels are formed will now be described.

[0078] Although not shown, a gate metallic material is deposited on an insulation substrate made of transparent glass to form a gate metallic film, and the gate metallic film is selectively patterned through a masking process to form gate lines and gate electrodes protruded from the gate lines.

[0079] In this case, as the gate metallic material, a aluminum-based metal such as Al, an Al alloy, etc., a silver -based metal such as Ag, an Ag alloy, etc., a molybdenum-based metal such as Mo, an Mo alloy, etc., Cr, Ti, Ta, etc.

[0080] In addition, the gate metallic film may include two layers each having different physical properties, namely, a lower layer and an upper layer. The upper layer may be made of a metal with low resistivity, such as an aluminum-based metal or silver-based metal, in order to reduce a signal delay or a voltage drop of the gate line.

[0081] The lower layer may be made of a different material, in particular, a material having good physical, chemical and electrical contact characteristics with ITO (Indium Tin Oxide) or IZO (Indium Zinc Oxide). For example, the lower layer may be made of Ti, Ta, Cr, Mo-based metal, etc. The combination of the lower layer and the upper layer can be, for example, a Cr/Al-Nd alloy.

[0082] Next, a gate insulating layer made of silicon nitride (SiNx), etc., is formed on the insulation substrate including the gate lines and the gate electrodes.

[0083] Subsequently, a semiconductor layer made of hydrogenated amorphous silicon, etc., is formed on the gate insulating layer.

[0084] And then, an ohmic contact layer made of a material such as n+ hydrogenated amorphous silicon, etc., in which silicide or 'n' type impurities are doped with a high density, is formed on the semiconductor layer.

[0085] Thereafter, the ohmic contact layer and the

semiconductor layer are selectively patterned through a masking process.

[0086] And then, a metallic material for data lines is deposited on the insulation substrate including the selectively patterned ohmic contact layer and semiconductor layer to form a metallic film for data lines, and the metallic film for data lies is then selectively patterned through a masking process to form a data line, a source electrode protruded from the data line, and a drain electrode spaced apart from the source electrode.

[0087] The data line and the gate line are formed to cross each other, and the source electrode and the drain electrode form the TFT, the switching element, together with the lower gate electrode. A channel of the TFT is formed at the semiconductor layer between the source electrode and the drain electrode.

[0088] The metallic film for data lines can be made of an aluminum-based metal, a silver-based metal, a molybdenum-based metal, Cr, Ti, Ta, etc., and may be formed as a multi-layer.

[0089] A protection layer made of an organic material having good planarization characteristics and photosensitivity, an insulation material having low dielectric constant characteristics, or silicon nitride, an in organic material, etc., is formed on the insulation substrate including the data line and the drain electrode.

[0090] And then, the protection layer is selectively patterned through a masking process to form a contact hole exposing a portion of the drain electrode in the protection layer.

[0091] Thereafter, a metallic material layer made of a transparent conductive material such as ITO or IZO or a reflective metal is deposited on the protection layer including the contact hole, and then selectively removed through a masking process to form a plurality of pixel electrodes. In this case, when data voltage is applied to the pixel electrodes, the pixel electrodes generate an electric field together with the common electrode of the upper color filter substrate which has been received a common voltage, to thus arrange liquid crystal molecules of the liquid crystal layer between the pixel electrodes and the common electrode.

[0092] In the above description, the common electrode is formed on the upper color filter substrate, and as mentioned above, it may be also formed on the lower insulation substrate as necessary.

[0093] The color filters of the LCD and its fabrication method according to the present invention have the following advantages.

[0094] First, because a plurality of sub-pixels constituting a single pixel are disposed in each different columns and in the same columns to add cyan (C), magenta (M) and yellow (Y) colors to the red (R), green (G) and blue (B) colors, the hexagon of six colors can be implemented, so color reproduction close to the natural colors can be implemented.

[0095] In particular, because the cyan (C), magenta (M) and yellow (Y) colors are implemented by using the complementary characteristics of red (R), green (G) and blue (B) colors, the six colors can be implemented without performing additional color filter forming process and masking process.

[0096] Therefore, because the six colors can be implemented without any additional process, the fabrication cost can be reduced and the color reproduction characteristics can be improved.

[0097] As the present invention may be embodied in several forms without departing from the characteristics thereof, it should also be understood that the above-described embodiments are not limited by any of the details of the foregoing description, unless otherwise specified, but rather should be construed broadly within its scope as defined in the appended claims, and therefore all changes and modifications that fall within the metes and bounds of the claims, or equivalents of such metes and bounds are therefore intended to be embraced by the appended claims.

Claims

1. A liquid crystal display device, comprising:

- a color filter substrate (201); and
- a plurality of pixels (200) formed in a matrix form on the color filter substrate (201), each pixel including nine sub-pixels comprised of a first red sub-pixel (203a), a first green sub-pixel (205a), a first blue sub-pixel (207a), a pair of second red sub-pixel (203b) and third green sub-pixel (205c), a pair of second green sub-pixel (205b) and third blue sub-pixel (207c), and a pair of second blue sub-pixel (207b) and third red sub-pixel (203c),

characterized in that the first red sub-pixel (203a), the first green sub-pixel (205a) and the first blue sub-pixel (207a) are disposed in different columns, and each of the pairs of second red sub-pixel (203b) and third green sub-pixel (205c), of second green sub-pixel (205b) and third blue sub-pixel (207c), and of second blue sub-pixel (207b) and third red sub-pixel (203c) is disposed in a column which is different from the columns in which the first red, the first green and the first blue sub-pixels (203a, 205a, 207a) and the other two pairs of second and third sub-pixels are arranged.

2. The device of claim 1, wherein the color filter substrate is attached to a thin film transistor (TFT) array substrate (101); and
a liquid crystal layer is formed between the TFT array substrate (101) and the color filter substrate (201).

3. The device of claim 1 or 2, wherein the pair of second red sub-pixel (203b) and third green sub-pixel (205c)

implement yellow (Y) color, the pair of second green sub-pixel (205b) and third blue sub-pixel (207c) implement cyan (C) color, and the pair of second blue sub-pixel (207b) and third red sub-pixel (203c) implement magenta (M) color.

4. A method for fabricating color filters of a liquid crystal display, comprising:

- providing a color filter substrate (201); and
- forming a plurality of pixels (200) on the color filter substrate (201),

wherein the forming of each pixel (200) comprised of nine sub-pixels comprises:

- forming first, second and third red sub-pixels (203a, 203b, 203c) on the color filter substrate (201);
- forming first, second and third green sub-pixels (205a, 205b, 205c) on other portions of the color filter substrate (201) than the area where the first, second and third red sub-pixels have been formed; and
- forming first, second and third blue sub-pixels (207a, 207b, 207c) on other portions of the color filter substrate (201) than the area where the first, second and third green sub-pixels and the first, second and third red sub-pixels have been formed,

wherein the first red sub-pixel (203a), the first green sub-pixel (205a) and the first blue sub-pixel (207a) are disposed in columns different from each other, and
each of the pairs of second red sub-pixel (203b) and third green sub-pixel (205c), of second green sub-pixel (205b) and third blue sub-pixel (207c), and of second blue sub-pixel (207b) and third red sub-pixel (203c) is disposed in a column which is different from the columns in which the first red, the first green and the first blue sub-pixels (203a, 205a, 207a) and the other two pairs of second and third sub-pixels are arranged.

5. The method of claim 4, wherein the pair of second red sub-pixel (203b) and third green sub-pixel (205c) implement yellow (Y) color, the pair of second green sub-pixel (205b) and third blue sub-pixel (207c) implement cyan (C) color, and the pair of second blue sub-pixel (207b) and third red sub-pixel (203c) implement magenta (M) color.

Patentansprüche

1. Flüssigkristallanzeigevorrichtung, die Folgendes umfasst:

- ein Farbfiltersubstrat (201); und
- mehrere Bildpunkte (200), die in einer Matrixform auf dem Farbfiltersubstrat (201) gebildet sind, wobei jeder Bildpunkt neun Unterbildpunkte enthält, die aus einem ersten roten Unterbildpunkt (203a), einem ersten grünen Unterbildpunkt (205a), einem ersten blauen Unterbildpunkt (207a), einem Paar aus einem zweiten roten Unterbildpunkt (203b) und einem dritten grünen Unterbildpunkt (205c), einem Paar aus einem zweiten grünen Unterbildpunkt (205b) und einem dritten blauen Unterbildpunkt (207c), und einem Paar aus einem zweiten blauen Unterbildpunkt (207b) und einem dritten roten Unterbildpunkt (203c) bestehen,

dadurch gekennzeichnet, dass der erste rote Unterbildpunkt (203a), der erste grüne Unterbildpunkt (205a) und der erste blaue Unterbildpunkt (207a) in unterschiedlichen Spalten angeordnet sind, und
jedes der Paare aus einem zweiten roten Unterbildpunkt (203b) und einem dritten grünen Unterbildpunkt (205c), aus einem zweiten grünen Unterbildpunkt (205b) und einem dritten blauen Unterbildpunkt (207c), und aus einem zweiten blauen Unterbildpunkt (207b) und einem dritten roten Unterbildpunkt (203c) in einer Spalte angeordnet ist, die sich von der Spalte unterscheidet, in der der erste rote, der erste grüne und der erste blaue Bildpunkt (203a, 205a, 206a) und die anderen zwei Paare aus zweiten und dritten Unterbildpunkten angeordnet sind.

2. Vorrichtung nach Anspruch 1, wobei das Farbfiltersubstrat an einem Dünnschichttransistoranordnungssubstrat (TFT-Anordnungssubstrat) (101) befestigt ist; und
eine Flüssigkristallschicht zwischen dem TFT-Anordnungssubstrat (101) und dem Farbfiltersubstrat (201) gebildet ist.

3. Vorrichtung nach Anspruch 1 oder 2, wobei das Paar aus dem zweiten roten Unterbildpunkt (203b) und dem dritten grünen Unterbildpunkt (205c) die Farbe Gelb (Y) implementiert, das Paar aus dem zweiten grünen Unterbildpunkt (205b) und dem dritten blauen Unterbildpunkt (207c) die Farbe Cyan (C) implementiert, und das Paar aus dem zweiten blauen Unterbildpunkt (207b) und dem dritten roten Unterbildpunkt (203c) die Farbe Magenta (M) implementiert.

4. Verfahren zum Herstellen von Farbfiltern einer Flüssigkristallanzeige, das Folgendes umfasst:

- Bereitstellen eines Farbfiltersubstrats (201); und
- Bilden mehrerer Bildpunkte (200) auf dem Farbfiltersubstrat (201), wobei das Bilden jedes Bildpunktes (200), der aus neun Unterbildpunk-

ten besteht, Folgendes umfasst:
- Bilden eines ersten, eines zweiten und eines dritten roten Unterbildpunktes (203a, 203b, 203c) auf dem Farbfiltersubstrat (201);
- Bilden eines ersten, eines zweiten und eines dritten grünen Unterbildpunktes (205a, 205b, 205c) auf anderen Abschnitten des Farbfiltersubstrats (201) als auf dem Bereich, in dem der erste, zweite und dritte rote Unterbildpunkt gebildet worden sind; und
- Bilden eines ersten, eines zweiten und eines dritten blauen Unterbildpunktes (207a, 207b, 207c) auf anderen Abschnitten des Farbfiltersubstrats (201) als auf dem Bereich, in dem der erste, zweite und dritte grüne Unterbildpunkt und der erste, zweite und dritte rote Unterbildpunkt gebildet worden sind,
- wobei der erste rote Unterbildpunkt (203a), der erste grüne Unterbildpunkt (205a) und der erste blaue Unterbildpunkt (207a) in unterschiedlichen Spalten angeordnet werden, und
- jedes der Paare aus dem zweiten roten Unterbildpunkt (203b) und dem dritten grünen Unterbildpunkt (205c), aus dem zweiten grünen Unterbildpunkt (205b) und dem dritten blauen Unterbildpunkt (207c) und aus dem zweiten blauen Unterbildpunkt (207b) und dem dritten roten Unterbildpunkt (203c) in einer Spalte angeordnet wird, die sich von den Spalten unterscheidet, in denen der erste rote, der erste grüne und der erste blaue Unterbildpunkt (203a, 205a, 207a) und die zwei anderen Paare aus zweiten und dritten Unterbildpunkten angeordnet sind.

5. Verfahren nach Anspruch 4, wobei das Paar aus dem zweiten roten Unterbildpunkt (203b) und dem dritten grünen Unterbildpunkt (205c) die Farbe Gelb (Y) implementiert, das Paar aus dem zweiten grünen Unterbildpunkt (205b) und dem dritten blauen Unterbildpunkt (207c) die Farbe Cyan (C) implementiert, und das Paar aus dem zweiten blauen Unterbildpunkt (207b) und dem dritten roten Unterbildpunkt (203c) die Farbe Magenta (M) implementiert.

Revendications

1. Dispositif d'affichage à cristaux liquides, comprenant :

- un substrat de filtre de couleur (201) ; et
- une pluralité de pixels (200) formés sous forme de matrice sur le substrat de filtre de couleur (201), chaque pixel comprenant neuf sous-pixels constitués d'un premier sous-pixel rouge (203a), d'un premier sous-pixel vert (205a), d'un premier sous-pixel bleu (207a), d'une paire de deuxième sous-pixel rouge (203b) et troisième sous-pixel vert (205c), d'une paire de deuxième sous-pixel vert (205b) et troisième sous-pixel bleu (207c), et d'une paire de deuxième sous-pixel bleu (207b) et troisième sous-pixel rouge (203c),

caractérisé en ce que le premier sous-pixel rouge (203a), le premier sous-pixel vert (205a) et le premier sous-pixel bleu (207a), sont disposés dans des colonnes différentes, et
chacune de la paire de deuxième sous-pixel rouge (203b) et troisième sous-pixel vert (205c), de deuxième sous-pixel vert (205b) et troisième sous-pixel bleu (207c), et de deuxième sous-pixel bleu (207b) et troisième sous-pixel rouge (203c) est disposée dans une colonne qui est différente des colonnes dans lesquelles les premiers sous-pixels, rouge, vert et bleu (203a, 205a, 207a) et les deux autres paires des deuxièmes et troisièmes sous-pixels sont agencés.

2. Dispositif selon la revendication 1, dans lequel le substrat de filtre de couleur est fixé à un substrat (101) de rangée de transistors à couche mince (TFT) ; et
une couche de cristaux liquides est formée entre le substrat (101) de rangée de TFT et le substrat de filtre de couleur (201).

3. Dispositif selon la revendication 1 ou 2, dans lequel la paire de deuxième sous-pixel rouge (203b) et troisième sous-pixel vert (205c) met en oeuvre la couleur jaune (Y), la paire de deuxième sous-pixel vert (205b) et troisième sous-pixel bleu (207c) met en oeuvre la couleur cyan (C) et la paire de deuxième sous-pixel bleu (207b) et troisième sous-pixel rouge (203c) met en oeuvre la couleur magenta (M).

4. Procédé de fabrication de filtres de couleur d'un écran à cristaux liquides, comprenant :

- la fourniture d'un substrat de filtre de couleur (201) ; et
- la formation d'une pluralité de pixels (200) sur le substrat de filtre de couleur (201),

dans lequel la formation de chaque pixel (200) constitué de neuf sous-pixels comprend :

- la formation de premier, deuxième et troisième sous-pixels rouges (203a, 203b, 203c) sur le substrat de filtre de couleur (201) ;
- la formation de premier, deuxième et troisième sous-pixels verts (205a, 205b, 205c) sur d'autres parties du substrat de filtre de couleur (201) que la zone où les premier, deuxième et troisième sous-pixels rouges ont été formés ; et
- la formation de premier, deuxième et troisième

sous-pixels bleus (207a, 207b, 207c) sur d'autres parties du substrat de filtre de couleur (201) que la zone où les premier, deuxième et troisième sous-pixels verts et les premier, deuxième et troisième sous-pixels rouges ont été formés ;

dans lequel le premier sous-pixel rouge (203a), le premier sous-pixel vert (205a) et le premier sous-pixel bleu (207a) sont disposés dans des colonnes différentes l'une de l'autre, et
chacune de la paire de deuxième sous-pixel rouge (203b) et troisième sous-pixel vert (205c), de deuxième sous-pixel vert (205b) et troisième sous-pixel bleu (207c), et de deuxième sous-pixel bleu (207b) et troisième sous-pixel rouge (203c) est disposée dans une colonne qui est différente des colonnes dans lesquelles les premiers sous-pixels, rouge, vert et bleu (203a, 205a, 207a) et les deux autres paires des deuxièmes et troisièmes sous-pixels sont agencés.

5. Procédé selon la revendication 4, dans lequel la paire de deuxième sous-pixel rouge (203b) et troisième sous-pixel vert (205c) met en oeuvre la couleur jaune (Y), la paire de deuxième sous-pixel vert (205b) et troisième sous-pixel bleu (207c) met en oeuvre la couleur cyan (C) et la paire de deuxième sous-pixel bleu (207b) et troisième sous-pixel rouge (203c) met en oeuvre la couleur magenta (M).

FIG. 1

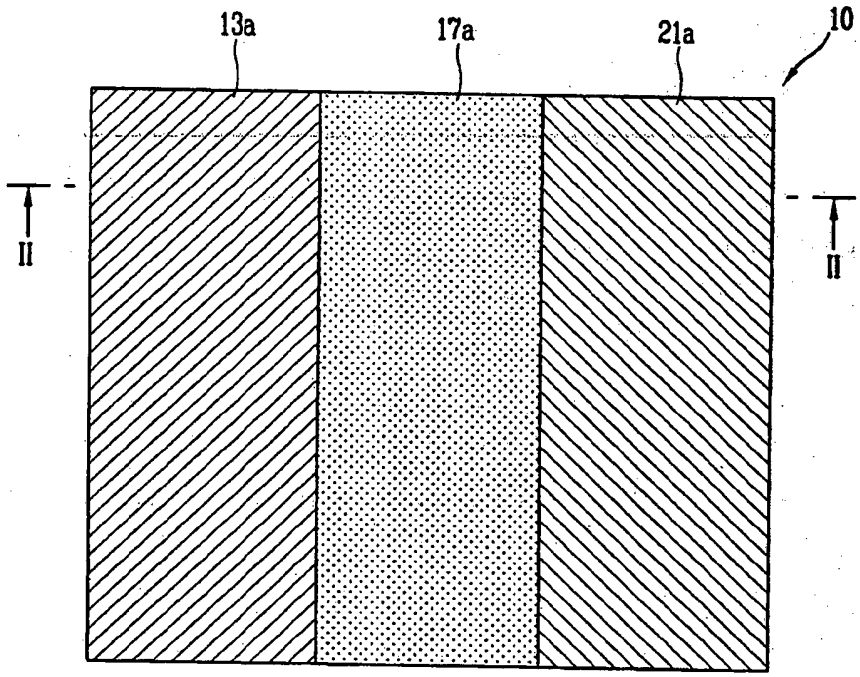


FIG. 2

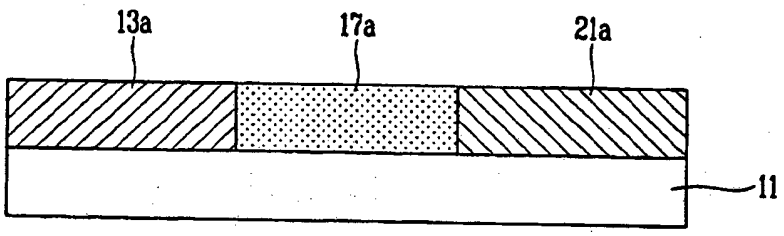


FIG. 3A

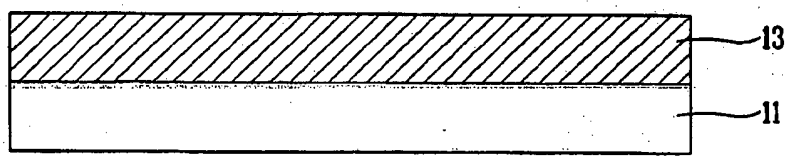


FIG. 3B

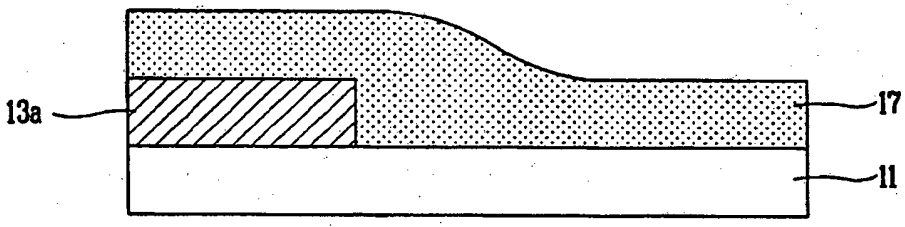


FIG. 3C

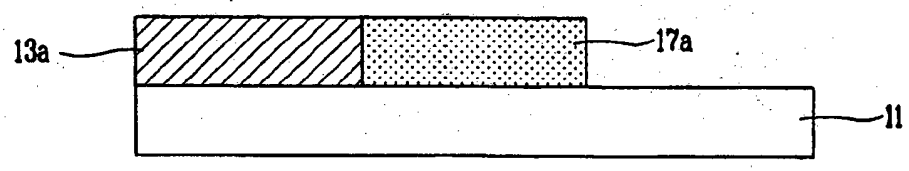


FIG. 3D

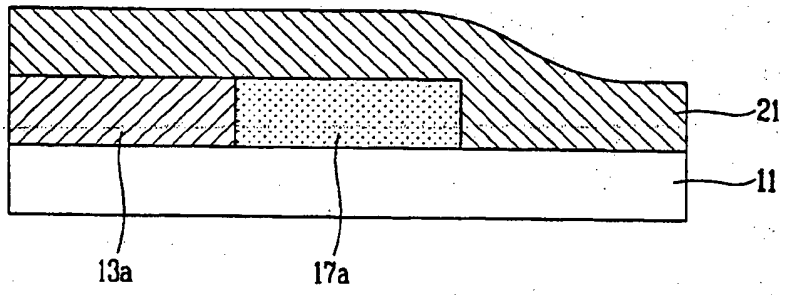


FIG. 3E

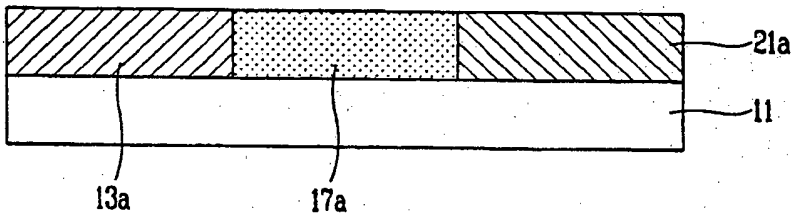
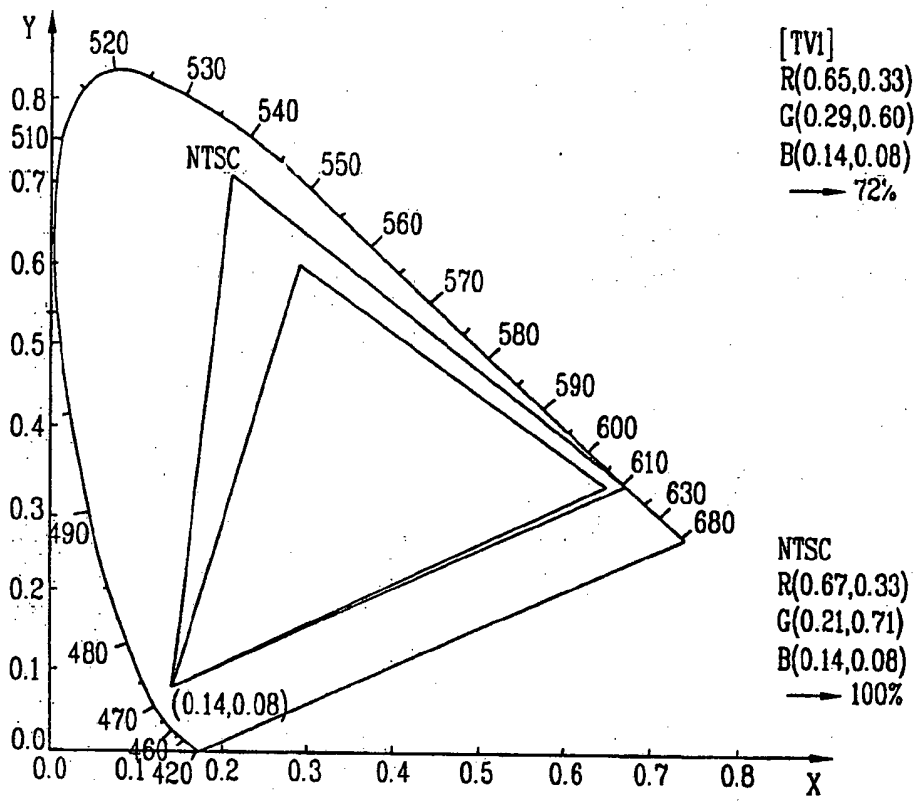


FIG. 4


Y
X
520
530
540
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560
570
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590
600
610
630
680
510
490
480
470
460
420
NTSC
(0.14,0.08)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
[TV1]
R(0.65,0.33)
G(0.29,0.60)
B(0.14,0.08)
72%
NTSC
R(0.67,0.33)
G(0.21,0.71)
B(0.14,0.08)
100%

FIG. 5

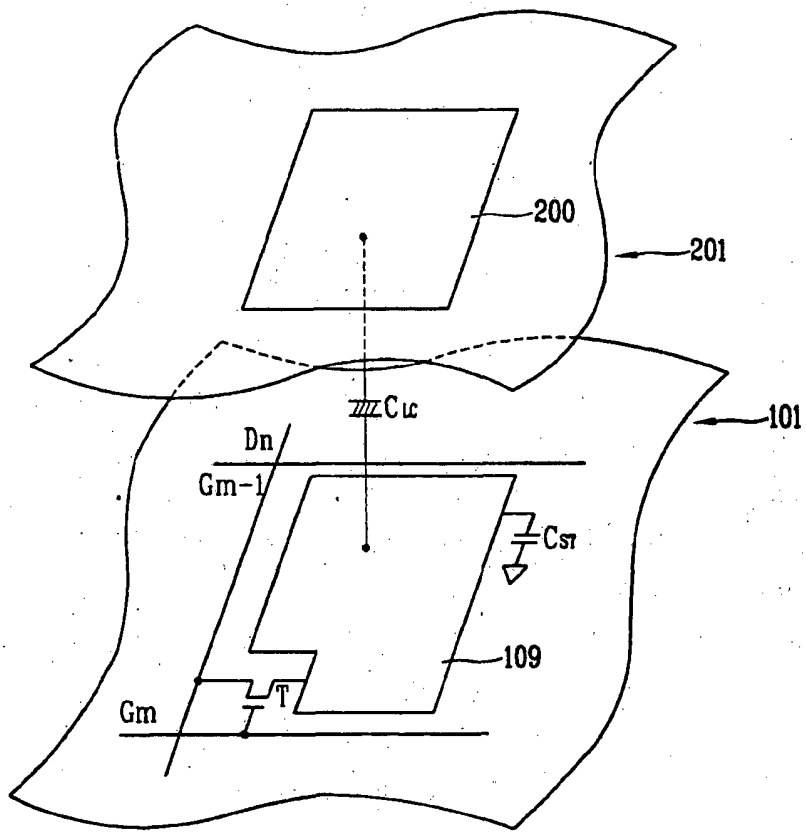


FIG. 6

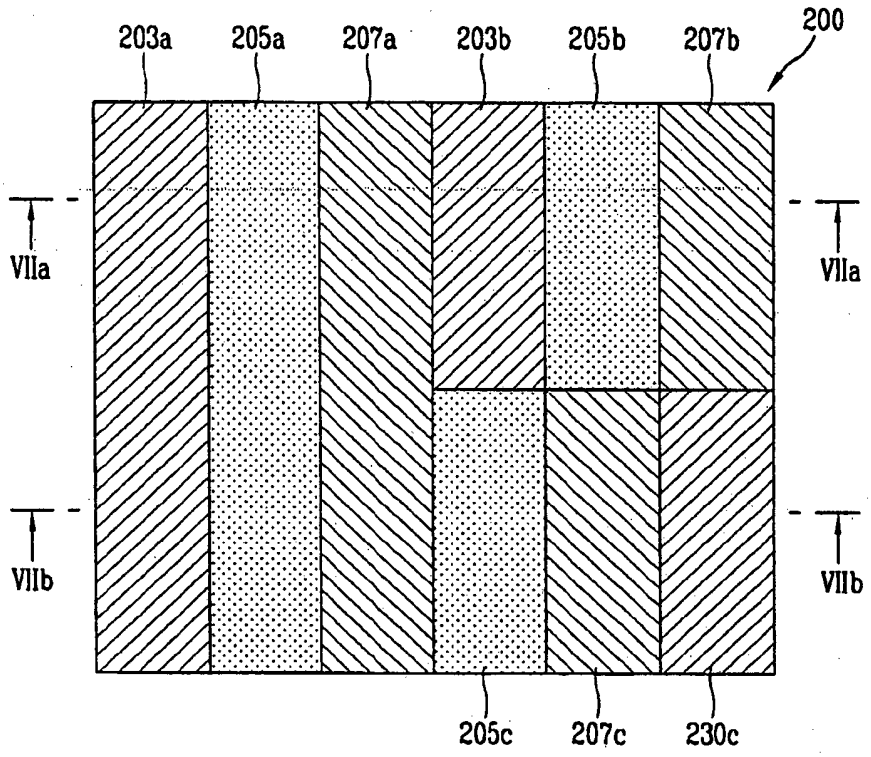


FIG. 7A

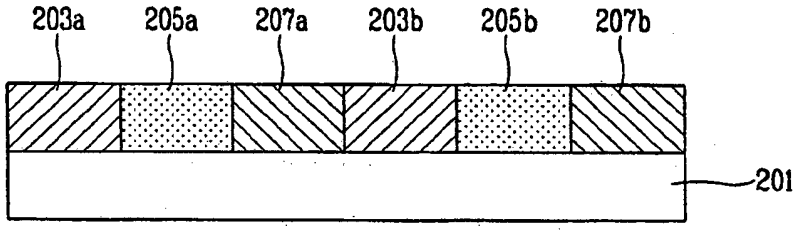


FIG. 7B

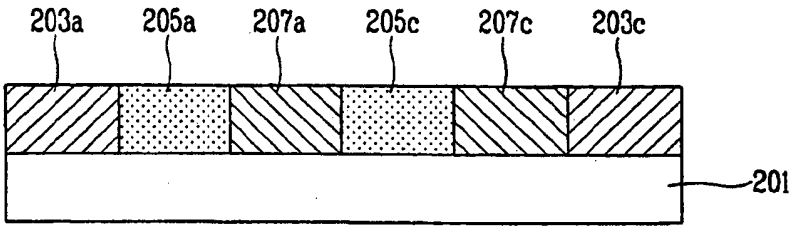


FIG. 8A

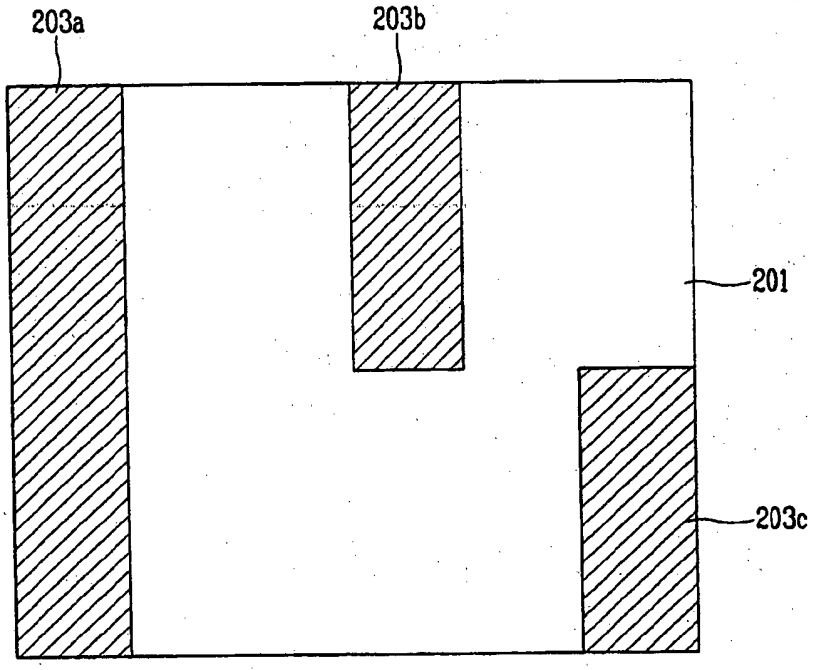


FIG. 8B

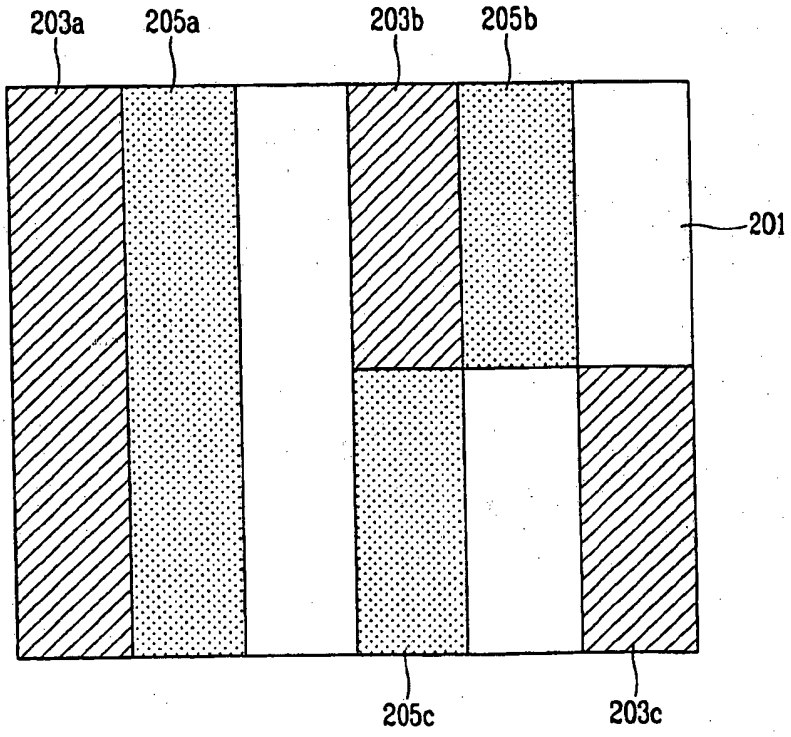


FIG. 8C

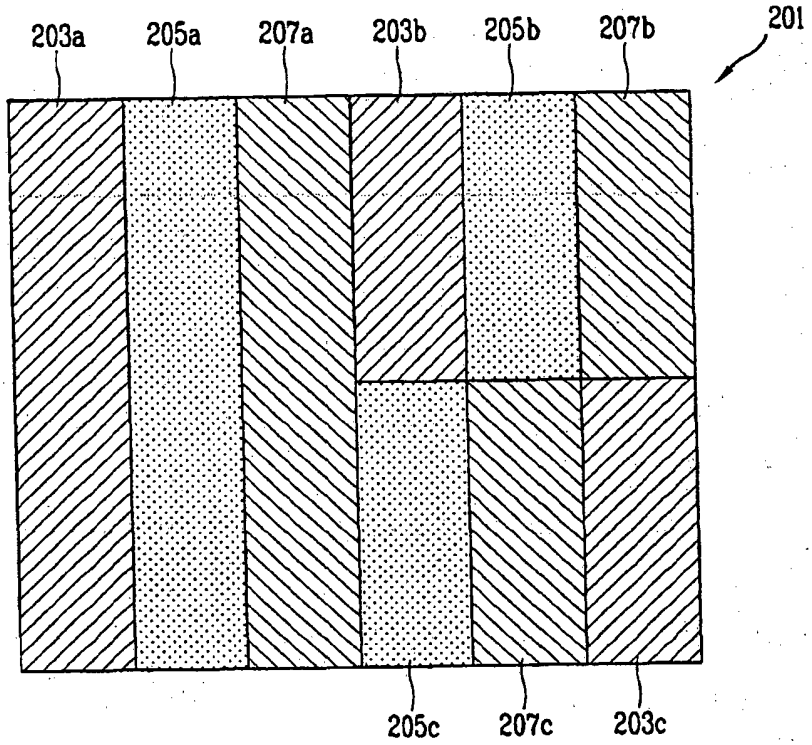
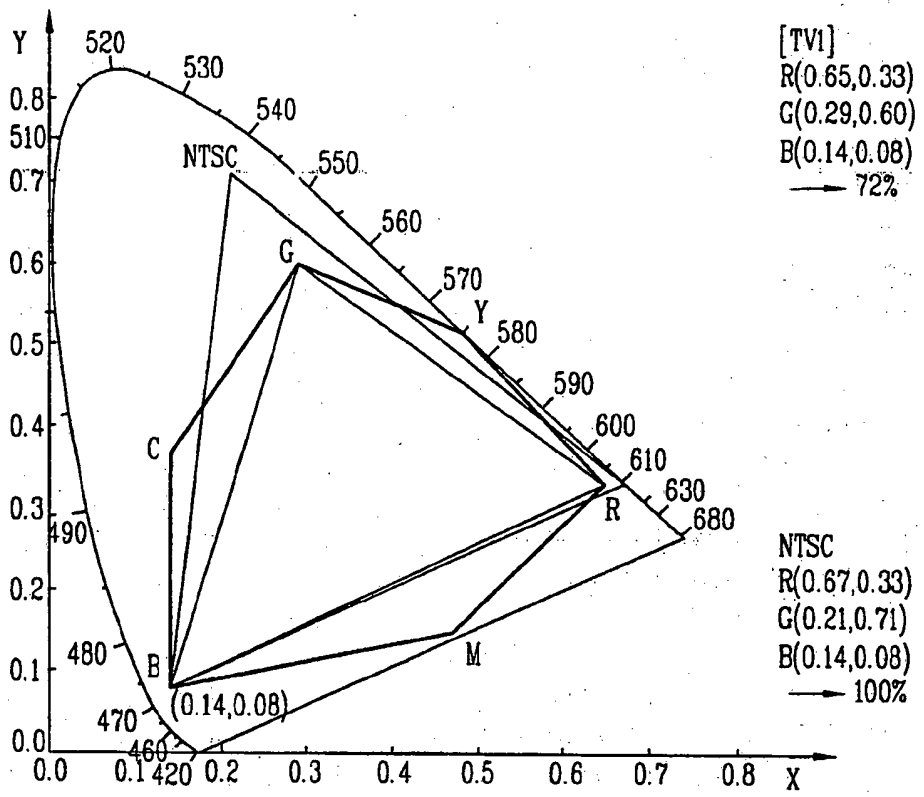


FIG. 9


Y
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460
420
NTSC
G
Y
C
R
B
M
(0.14,0.08)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
[TV1]
R(0.65,0.33)
G(0.29,0.60)
B(0.14,0.08)
72%
NTSC
R(0.67,0.33)
G(0.21,0.71)
B(0.14,0.08)
100%

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 20070008462 A1 **[0030]**

Non-patent literature cited in the description

- **YOUNG-CHOL YANG et al.** 31.1: Development and Six Primary-Color LCD. *2005 SID International Symposium, Boston, MA, May 24 - 27, 2005; [SID International Symposium,* 24 May 2005, vol. XXXVI, 1210-1213 **[0031]**

专利名称(译)	液晶显示器的滤色器及其制造方法		
公开(公告)号	EP1970750B1	公开(公告)日	2016-08-17
申请号	EP2008004721	申请日	2008-03-13
[标]申请(专利权)人(译)	乐金显示有限公司		
申请(专利权)人(译)	LG DISPLAY CO. , LTD.		
当前申请(专利权)人(译)	LG DISPLAY CO. , LTD.		
[标]发明人	PARK CHOON HO LEE JUNG JAE		
发明人	PARK, CHOON-HO LEE, JUNG-JAE		
IPC分类号	G02F1/1335 G02B5/20		
CPC分类号	G02F1/133512 G02B5/201 G02F1/133516 G02F2201/52		
优先权	1020070025111 2007-03-14 KR		
其他公开文献	EP1970750A2 EP1970750A3		
外部链接	Espacenet		

摘要(译)

液晶显示器包括：滤色器基板;多个像素以矩阵形式形成在滤色器基板上，每个像素包括第一红色子像素，第一绿色子像素，第一蓝色子像素，一对第二红色子像素和第三红色子像素绿色子像素，一对第二绿色子像素和第三蓝色子像素，以及一对第二蓝色子像素和第三红色子像素。

FIG. 1

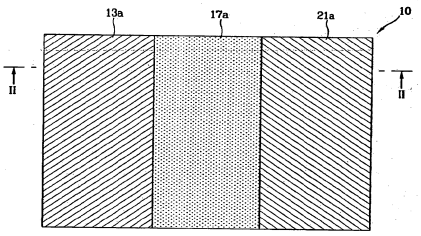

FIG. 2