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(54) **LIQUID CRYSTAL DISPLAY DEVICE AND METHOD FOR FABRICATING THE SAME**

(52) **U.S. Cl.** 349/106

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(57) **ABSTRACT**

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A LCD device and a method for fabricating the same is disclosed that decreases the fabrication time of the LCD device by obtaining a white color in a fourth pixel region using first, second, and third auxiliary color filter layers, and improve the resolution for the white color by controlling the width of the auxiliary color filter layers. The device includes first and second substrates having first, second, third and fourth pixel regions arranged repetitively; a black matrix layer formed on the second substrate corresponding to portions of the substrates other than the pixel regions; first, second and third color filter layers respectively formed on the first, second, and third pixel regions of the second substrate; first, second, and third auxiliary color filter layers formed on the fourth pixel region of the second substrate to display a white color; and a liquid crystal layer formed between the first and second substrates.

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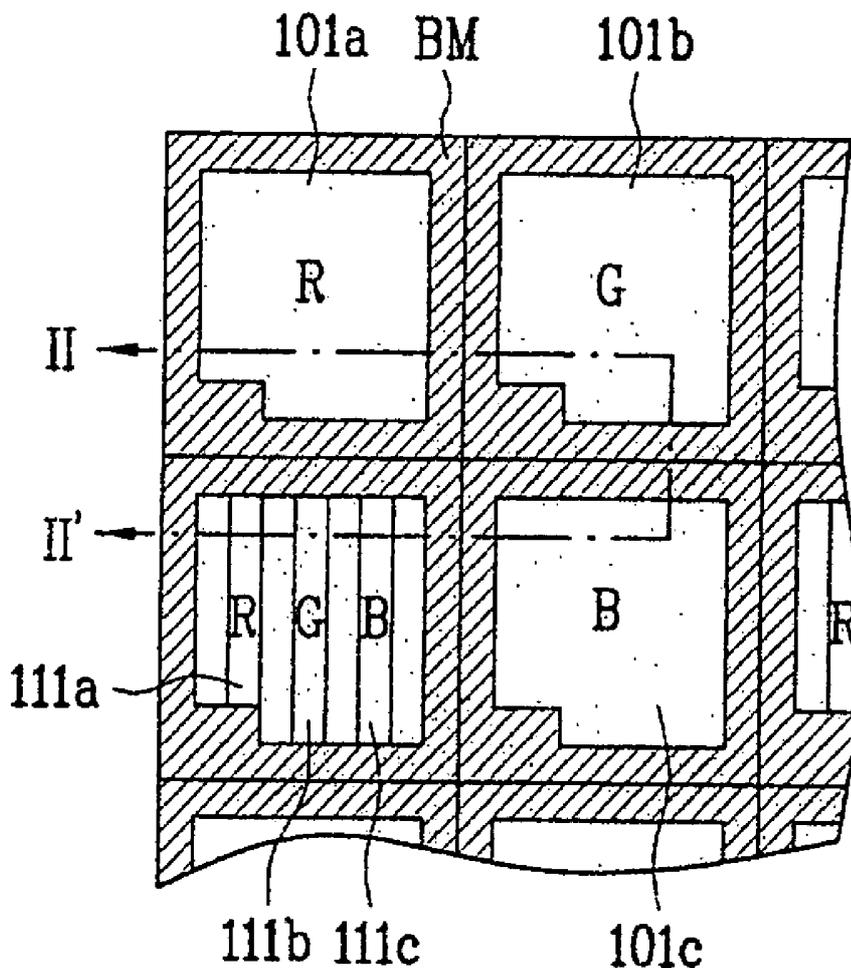


FIG. 1
Related Art

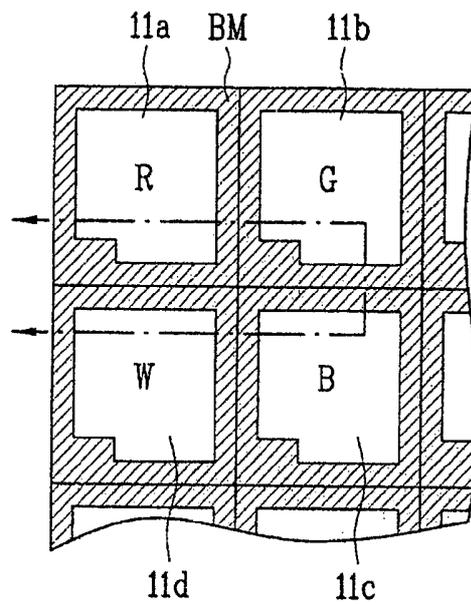


FIG. 2
Related Art

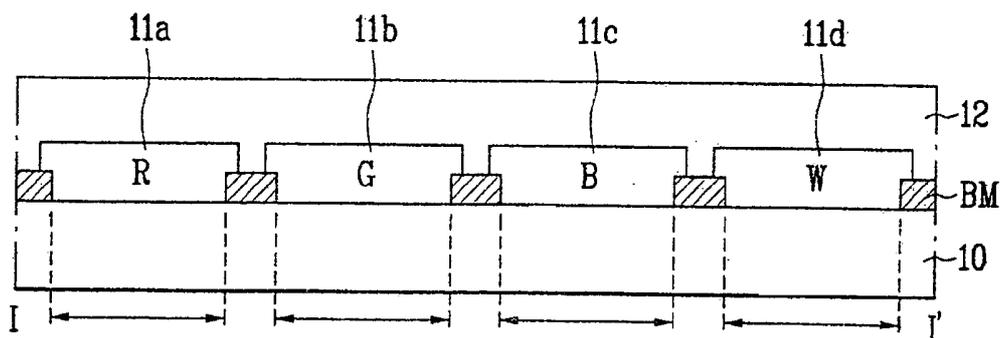


FIG. 3A
Related Art

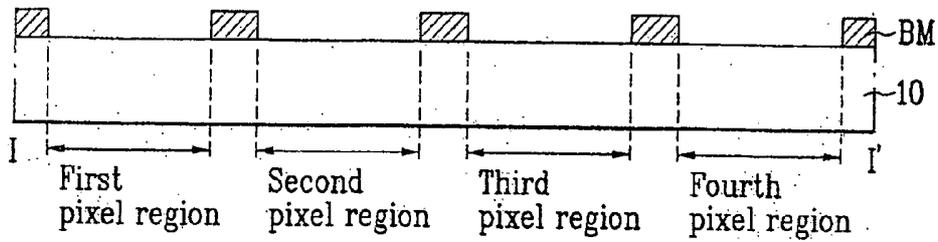


FIG. 3B
Related Art

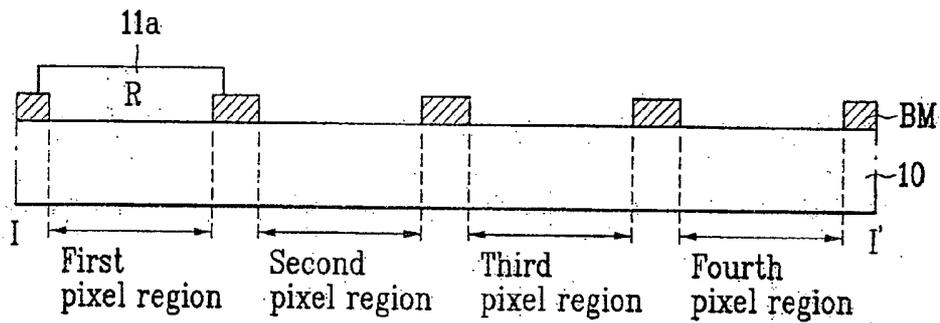


FIG. 3C
Related Art

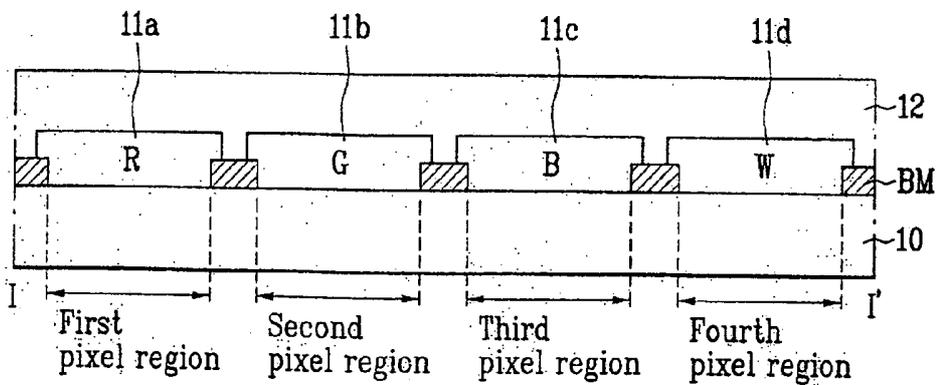


FIG. 4

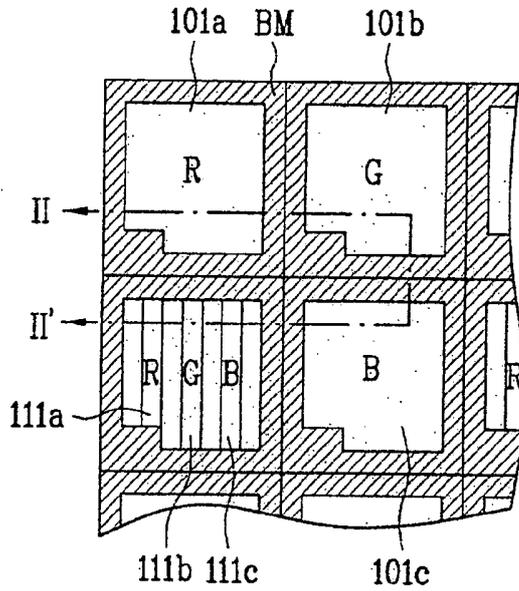


FIG. 5

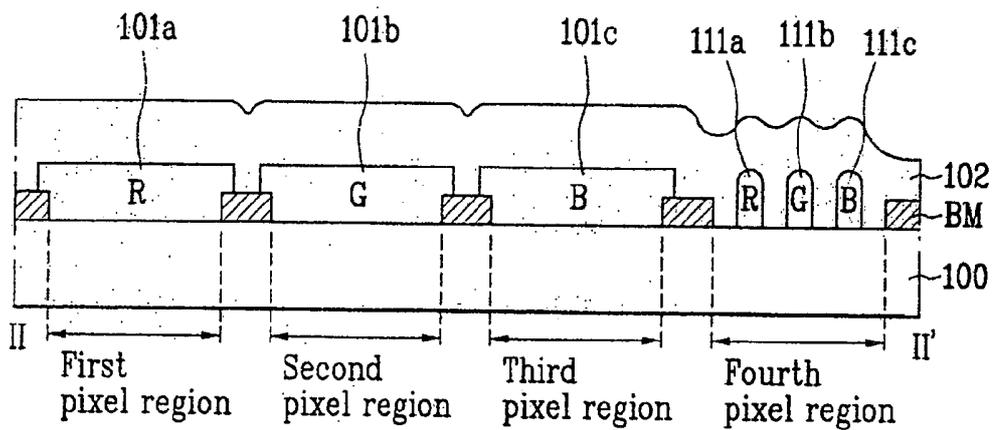


FIG. 6

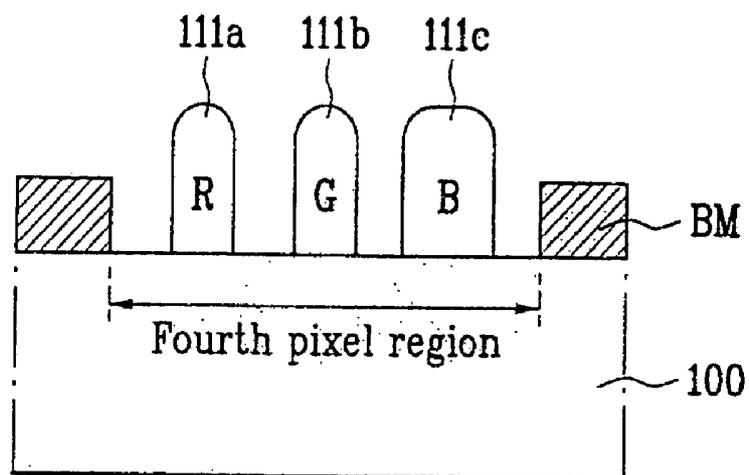


FIG. 7

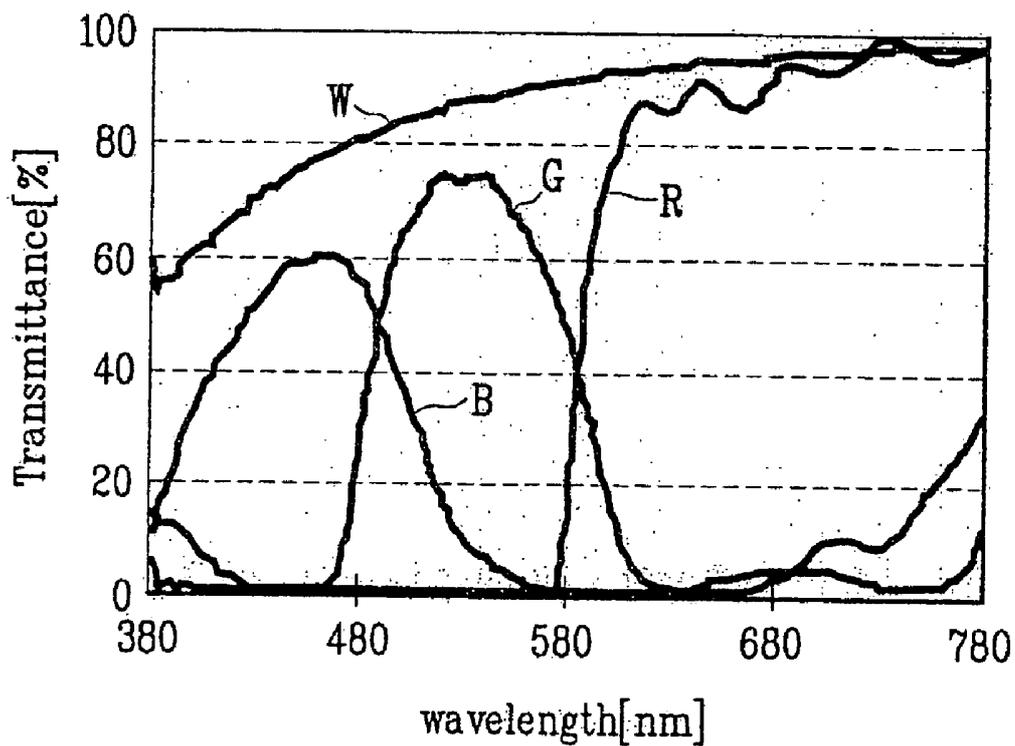


FIG. 8A

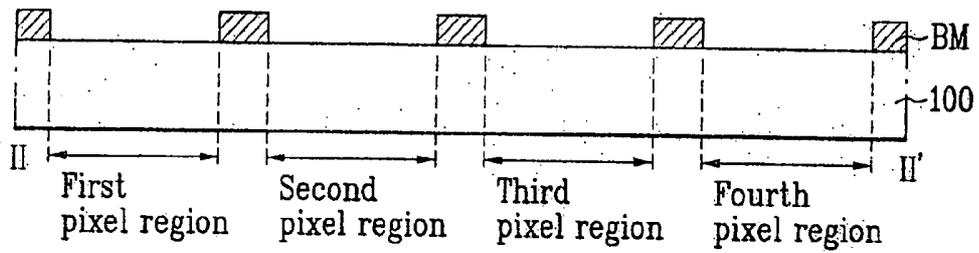


FIG. 8B

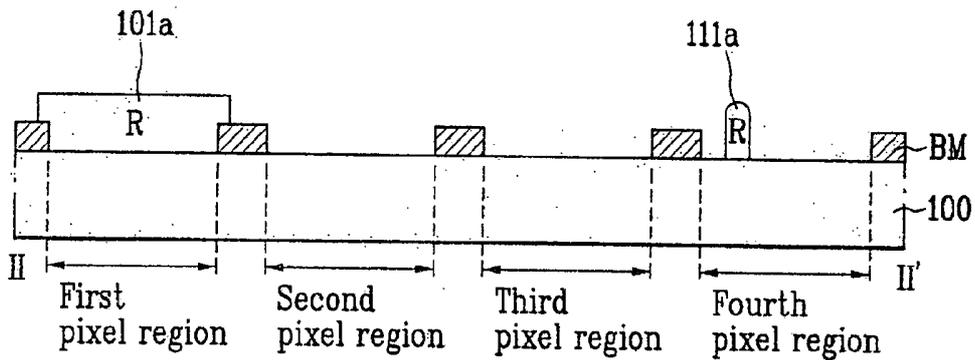


FIG. 8C

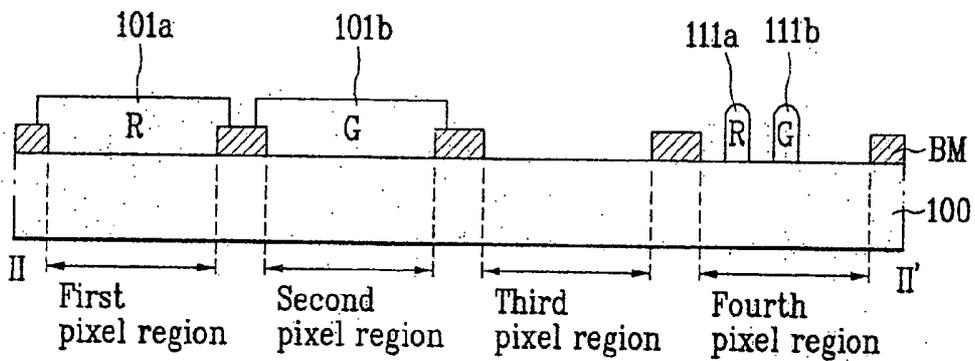


FIG. 8D

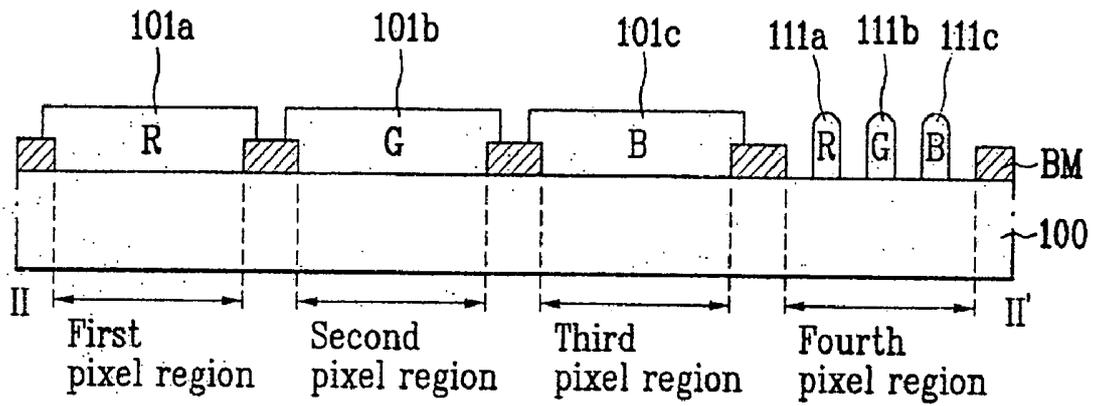


FIG. 8E

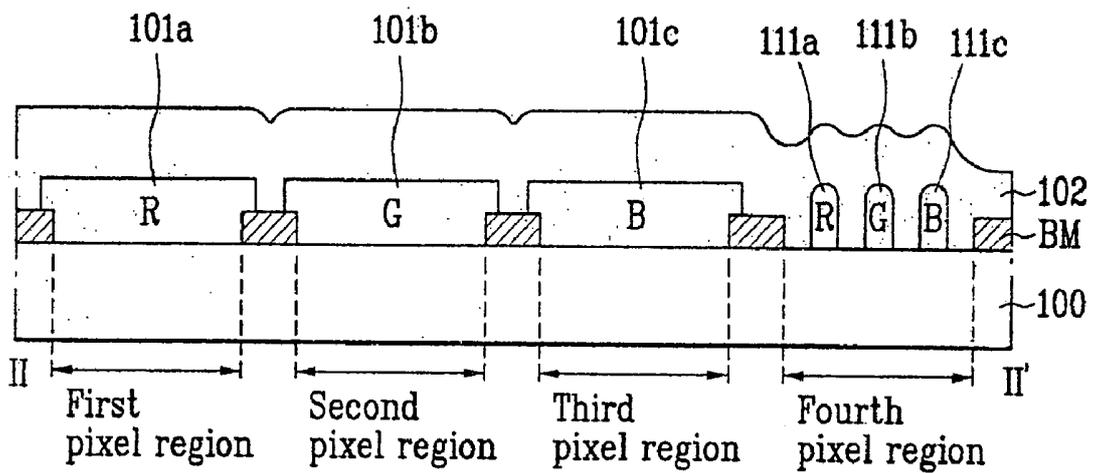


FIG. 9

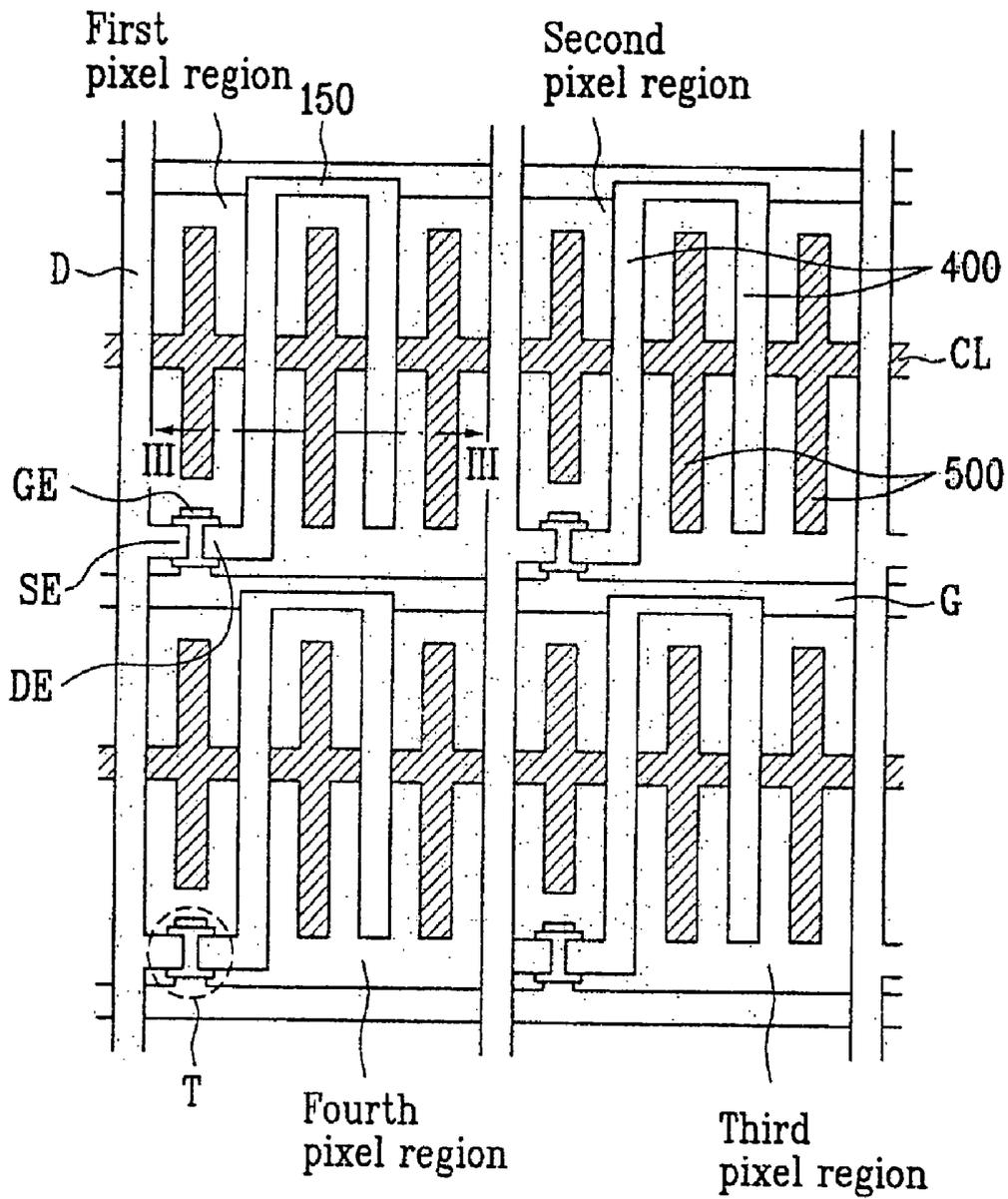


FIG. 10

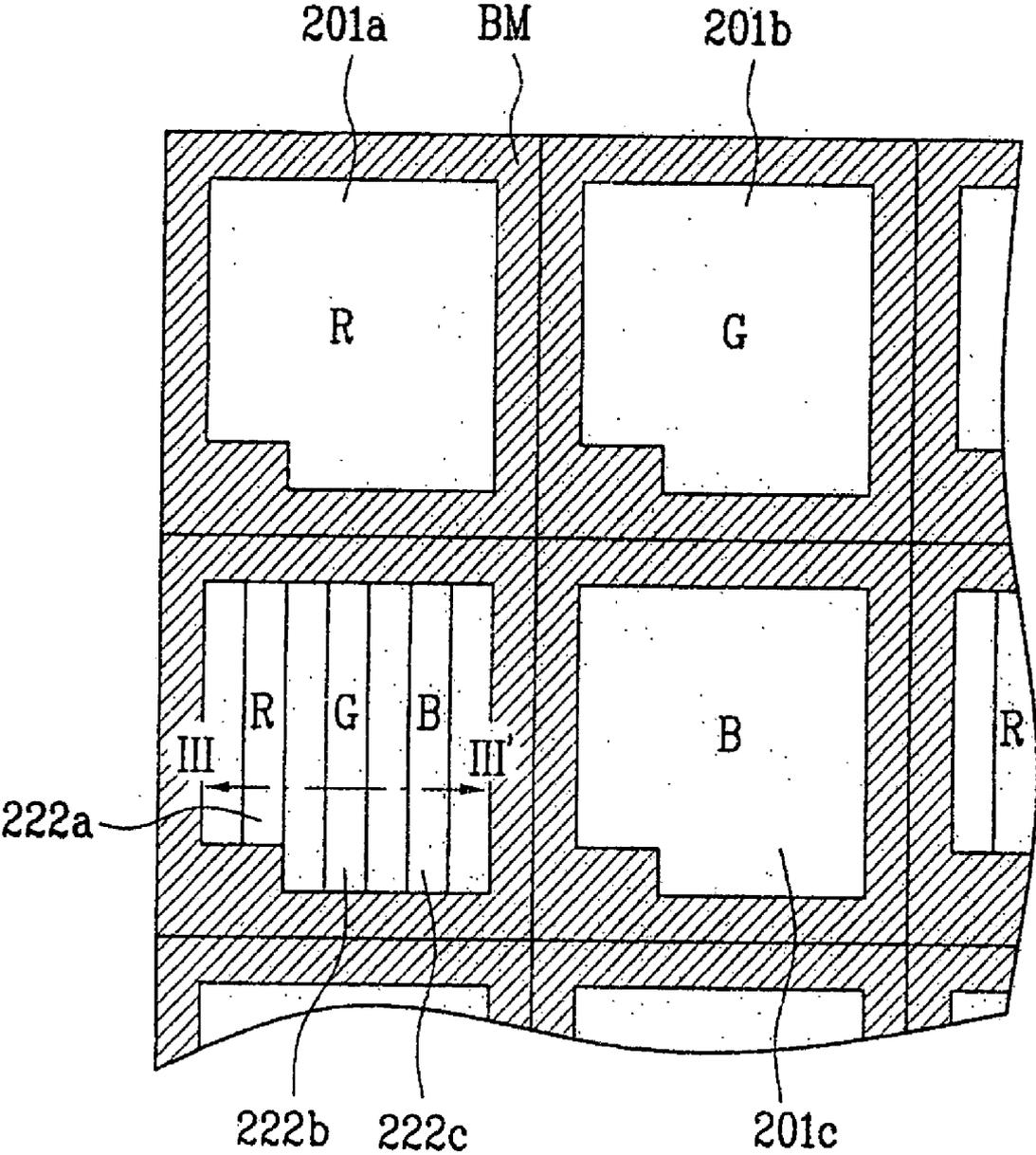


FIG. 11

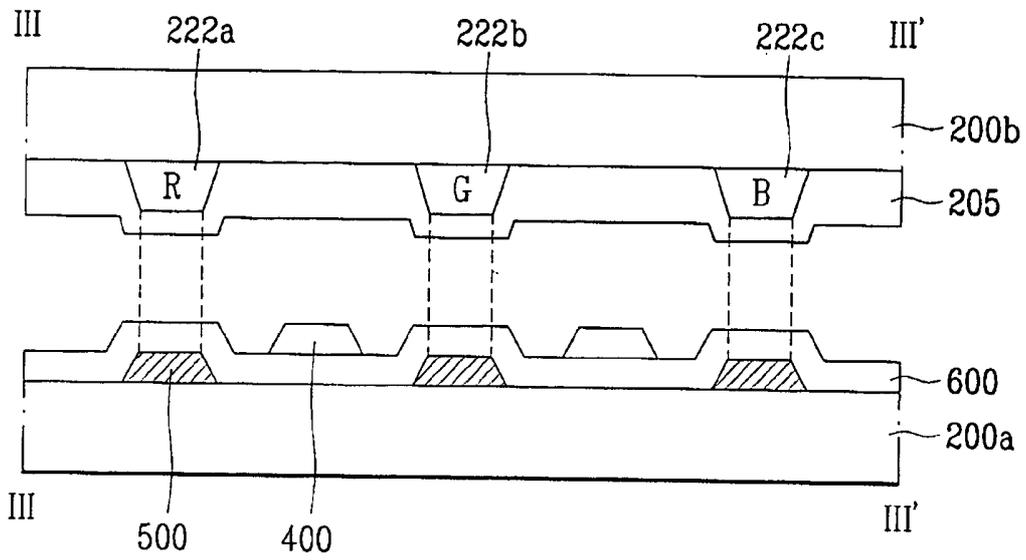


FIG. 12

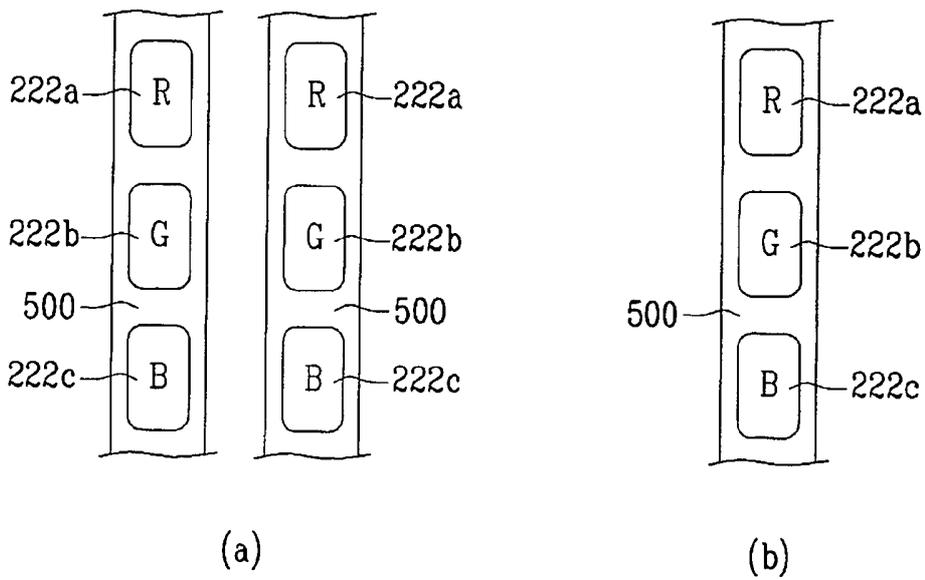


FIG. 13A

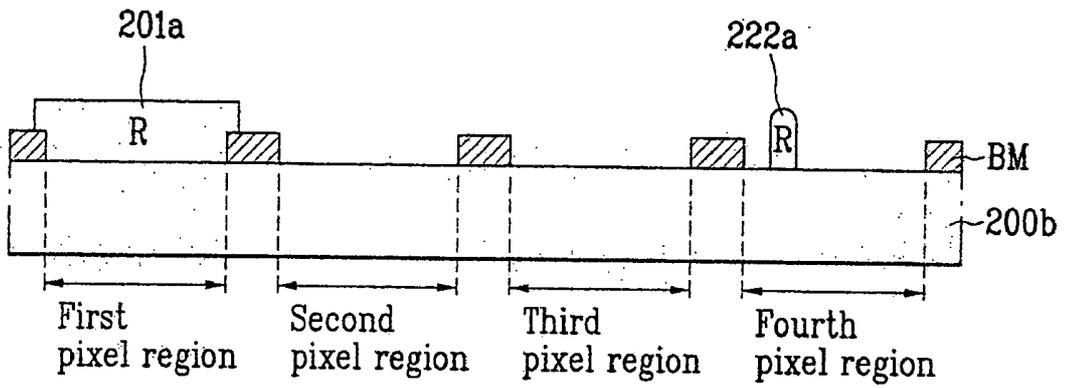


FIG. 13B

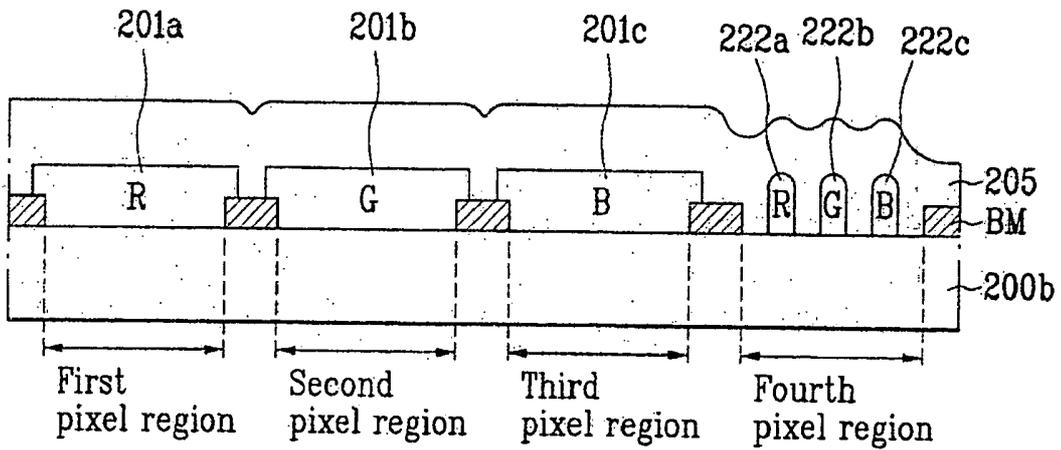
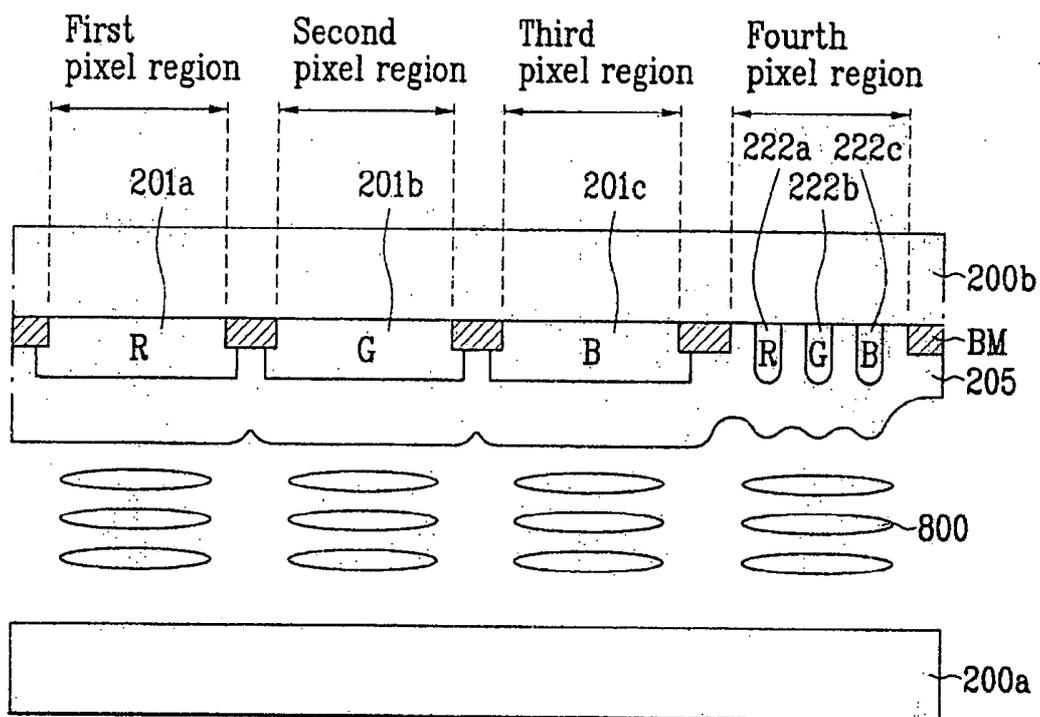


FIG. 13C



LIQUID CRYSTAL DISPLAY DEVICE AND METHOD FOR FABRICATING THE SAME

[0001] This application claims the benefit of the Korean Application No. P2003-87560, filed on Dec. 4, 2003, which is hereby incorporated by reference for all purposes as if fully set forth herein.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to a liquid crystal display (LCD) device, and more particularly, to a liquid crystal display (LCD) device to improve the resolution for a white color and a method for fabricating the same.

[0004] 2. Discussion of the Related Art

[0005] Demands for various display devices have increased with the development of an information-based society. Accordingly, many efforts have been made to research and develop various flat display devices such as liquid crystal display (LCD), plasma display panel (PDP), electroluminescent display (ELD), and vacuum fluorescent display (VFD). Some species of flat display devices have already been applied to displays for various equipment.

[0006] Among the various flat display devices, liquid crystal display (LCD) devices have been most widely used due to advantageous characteristics of thin profile, lightness in weight, and low power consumption. In addition to mobile type displays, LCD devices have been developed for computer monitors and televisions to receive and display broadcasts.

[0007] The LCD device includes first and second substrates bonded to each other at a predetermined interval, and a liquid crystal layer formed between the first and second substrates. The first substrate (TFT array substrate) includes a plurality of gate lines arranged along a first direction at fixed intervals, a plurality of data lines arranged along a second direction perpendicular to the first direction at fixed intervals, a plurality of pixel electrodes arranged in a matrix-type configuration within pixel regions defined by crossings of the gate and data lines, and a plurality of thin film transistors for transmitting signals from the data lines to the pixel electrodes. The second substrate (color filter array substrate) includes a black matrix layer that prevents light from leaking on portions of the first substrate except the pixel regions, an R/G/B color filter layer for displaying various colors, and a common electrode for producing the image. The first and second substrates are bonded together by a sealant, and liquid crystal is injected between the first and second substrates. Alignment layers are respectively formed on opposing surfaces of the first and second substrates, wherein the alignment layers are rubbed to align the liquid crystal layer.

[0008] Herein, the color filter layer of the second substrate is comprised of unit pixels including three sub-pixels, wherein the three sub-pixels are formed of R(red), G(green), and B(blue) colors. Recently, to improve luminance of the image displayed on the LCD panel, the unit pixel may include four sub-pixels. That is, in addition to the sub-pixels of R, G, and B colors, a sub-pixel of a white (W) color may be included, so that the unit pixel may be comprised of the sub-pixels of R, G, B, and W colors.

[0009] A related art color filter substrate using a color filter layer of R, G, B, and W will be described with reference to the accompanying drawings.

[0010] FIG. 1 is a schematic view of a related art color filter substrate. FIG. 2 is a cross sectional view of a related art color filter substrate along I-I' of FIG. 1.

[0011] As shown in FIG. 1 and FIG. 2, a related art color filter substrate includes a substrate 10, a black matrix layer BM, first to fourth color filter layers 11a, 11b, 11c, 11d, and an overcoat layer 12. First to fourth pixel regions are repetitively formed on the substrate 10, and the black matrix layer BM is formed on an entire surface of the substrate 10, except the pixel regions, to prevent light leakage on the portions other than the pixel regions. Also, the first, second, third, and fourth color filter layers 11a, 11b, 11c, 11d are formed on the respective pixel regions, and the overcoat layer 12 is formed on the entire surface of the substrate 10 including the respective color filter layers 11a, 11b, 11c, 11d.

[0012] Herein, the first, second, and third color filter layers 11a, 11b, 11c are formed of dyed resist or resin. That is, the first, second, and third color filter layers 11a, 11b, 11c are respectively formed of red-dyed, green-dyed, and blue-dyed resist or resin to display the respective colors. The fourth color filter layer 11d is formed of transparent resist or resin having no pigment to improve luminance by transmitting the incident light.

[0013] A method for fabricating the related art color filter substrate will be described as follows.

[0014] FIG. 3A to FIG. 3C are cross sectional views of the fabrication process of a related art color filter substrate along I-I' of FIG. 1.

[0015] First, as shown in FIG. 3A, after preparing the substrate 10 having the first to fourth pixel regions repetitively arranged, chrome or resin is deposited on the substrate 10, and then is patterned by photolithography. As a result, the black matrix layer BM is formed on the entire surface of the substrate 10 including the respective pixel regions.

[0016] Subsequently, as shown in FIG. 3B, the red resist or resin is coated on the substrate 10 having the black matrix layer BM, and then the substrate 10 coated with the red resist or resin is patterned by photolithography, thereby forming the first color filter layer 11a on the first pixel region of the substrate 10.

[0017] Next, as shown in FIG. 3C, the green resist or resin is coated on the substrate 10 having the first color filter layer 11a, and then the substrate 10 is patterned by photolithography, thereby forming the second color filter layer 11b on the second pixel region of the substrate 10.

[0018] After that, the blue resist or resin is coated on the substrate 10 having the first and second color filter layers 11a, 11b, and then the substrate 10 is patterned by photolithography, thereby forming the third color filter layer 11c on the third pixel region of the substrate 10.

[0019] Subsequently, the transparent resist is coated on the substrate 10 having the first, second, and third color filter layers 11a, 11b, 11c, and then the substrate 10 coated with the transparent resist is patterned by photolithography, thereby forming the fourth color filter layer 11d on the fourth pixel region of the substrate 10.

[0020] Then, the overcoat layer **12** is formed on the entire surface of the substrate **10** including the first, second, third, and fourth color filter layers **11a**, **11b**, **11c**, **11d**, thereby completing the fabrication process of the color filter substrate.

[0021] However, the related art color filter substrate using the R, G, B, and W color filter layers has the following disadvantages.

[0022] In the related art fabrication process of the color filter substrate, in order to form the white color filter layer, it requires additional process steps of coating the transparent resist on the substrate, and etching the substrate coated with the transparent resist by photolithography, thereby increasing the fabrication time, and decreasing the yield.

[0023] Also, there is a difference of resolution between the white color obtained by the white color filter layer of the color filter substrate, and the white color obtained by the R, G, and B color filter layers of the other pixel regions, thereby deteriorating the entire color resolution for the white color.

SUMMARY OF THE INVENTION

[0024] Accordingly, the present invention is directed to a liquid crystal display (LCD) device and a method for fabricating the same that substantially obviates one or more problems due to limitations and disadvantages of the related art.

[0025] An advantage of the present invention is to provide a liquid crystal display (LCD) device and a method for fabricating the same to improve the resolution for a white color of a LCD device, and to simplify the fabrication process.

[0026] Additional advantages and features of the invention will be set forth in part in the description which follows and in part will become apparent to those having ordinary skill in the art upon examination of the following or may be learned from practice of the invention. The advantages of the invention may be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

[0027] To achieve these and other advantages and in accordance with the purpose of the invention, as embodied and broadly described herein, a liquid crystal display (LCD) device includes first and second substrates having first, second, third and fourth pixel regions arranged repetitively; a black matrix layer formed on the second substrate corresponding to the portions of the substrates other than the pixel regions; first, second and third color filter layers respectively formed on the first, second, and third pixel regions of the second substrate; first, second, and third auxiliary color filter layers formed on the fourth pixel region of the second substrate to display a white color; and a liquid crystal layer formed between the first and second substrates.

[0028] In another aspect of the present invention, a method for fabricating an LCD device includes preparing first and second substrates having first, second, third and fourth pixel regions arranged repetitively; forming a black matrix layer on the second substrate corresponding to portions of the substrates other than the pixel regions; forming a first color filter layer on the first pixel region of the second substrate, and a first auxiliary color filter layer on the fourth

pixel region, simultaneously; forming a second color filter layer on the second pixel region of the second substrate, and a second auxiliary color filter layer on the fourth pixel region, simultaneously; forming a third color filter layer on the third pixel region of the second substrate, and a third auxiliary color filter layer on the fourth pixel region, simultaneously; and forming a liquid crystal layer between the first and second substrates.

[0029] It is to be understood that both the foregoing general description and the following detailed description of the present invention are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this application, illustrate embodiment(s) of the invention and together with the description serve to explain the principle of the invention. In the drawings:

[0031] **FIG. 1** is a schematic view of a related art color filter substrate;

[0032] **FIG. 2** is a cross sectional view of a related art color filter substrate along I-I' of **FIG. 1**;

[0033] **FIG. 3A** to **FIG. 3C** are cross sectional views of the fabrication process of a related art color filter substrate along I-I' of **FIG. 1**;

[0034] **FIG. 4** is a plan view of a color filter substrate according to an embodiment of the present invention;

[0035] **FIG. 5** is a cross sectional view of a color filter substrate along II-II' of **FIG. 4**;

[0036] **FIG. 6** is a cross sectional view of a color filter substrate having a third auxiliary color filter layer of which thickness is controlled to improve the resolution for a white color;

[0037] **FIG. 7** is a spectrum showing the transmittance of red, green, blue, and white colors according to the light wavelength;

[0038] **FIG. 8A** to **FIG. 8E** are cross sectional views of the fabrication process of a color filter substrate along II-II' of **FIG. 4**;

[0039] **FIG. 9** is a schematic view of four pixel regions of a first substrate in an IPS mode LCD device according to an embodiment of the present invention;

[0040] **FIG. 10** is a schematic view of respective color filter layers and auxiliary color filter layers formed on a second substrate, wherein the respective color filter layers are formed to correspond with respective pixel regions of a first substrate of **FIG. 9**;

[0041] **FIG. 11** is a cross sectional view of an IPS mode LCD device along III-III' of **FIG. 10**;

[0042] **FIG. 12** is a plan view of a common electrode and an auxiliary color filter layer, showing the correlation between the common electrode and respective auxiliary color filter layers formed in a fourth pixel region; and

[0043] FIG. 13A to FIG. 13C are cross sectional views of the fabrication process of an IPS mode LCD device according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

[0044] Reference will now be made in detail to embodiments of the present invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

[0045] Hereinafter, an LCD device according to the present invention and a method for fabricating the same will be described with reference to the accompanying drawings.

[0046] FIG. 4 is a plan view of a color filter substrate according to an embodiment of the present invention. FIG. 5 is a cross sectional view of a color filter substrate along II-II' of FIG. 4.

[0047] As shown in FIG. 4 and FIG. 5, a color filter substrate of an LCD device according to an embodiment of the present invention includes a substrate 100, a black matrix layer BM, first to third color filter layers 101a, 101b, 101c, first to third auxiliary color filter layers 111a, 111b, 111c, and an overcoat layer 102. The first, second, third, and fourth pixel regions are repetitively formed on the substrate 100, and the black matrix layer BM is formed on an entire surface of the substrate 100 except the pixel regions to prevent light leakage on the portions other than the pixel regions. Also, the first, second, and third color filter layers 101a, 101b, 101c, are respectively formed in the first, second, and third pixel regions. The first, second, and third auxiliary color filter layers 111a, 111b, 111c are formed in the fourth pixel region to display a white color in the fourth pixel region. Then, the overcoat layer 102 is formed on the entire surface of the substrate 100 including the respective color filter layers 101a, 101b, 101c, and the respective auxiliary color filter layers 111a, 111b, 111c to simultaneously planarize the entire surface of the substrate 100 and to display the white color in the fourth pixel region.

[0048] The respective first, second, and third auxiliary color filter layers 111a, 111b, 111c formed in the fourth pixel region are narrower than the first, second, and third color filter layers 101a, 101b, 101c that correspond to the first, second, and third pixel regions. Also, the first, second, and third auxiliary color filter layers 111a, 111b, 111c, formed in the fourth pixel region, are spaced apart from one another, and the overcoat layer 102 is formed between each of the auxiliary color filter layers 111a, 111b, 111c.

[0049] Generally, the first to third color filter layers 101a, 101b, 101c, and the first to third auxiliary color filter layers 111a, 111b, 111c are respectively formed of red-dyed, green-dyed, and blue-dyed resist or resin. Accordingly, the red, green, and blue colors are obtained in the respective first, second, and third pixel regions through the first, second, and third color filter layers 101a, 101b, 101c, and the white color is obtained in the fourth pixel region by mixing the red, green, and blue colors, together.

[0050] Also, the overcoat layer 102 is formed between each of the auxiliary color filter layers 111a, 111b, 111c of the fourth pixel region, so that the light passing through the overcoat layer 102 is displayed as a white color. In the fourth

pixel region, the white color obtained by the first to third auxiliary color filter layers 111a, 111b, 111c is mixed with the white color obtained by the overcoat layer 102. In this manner, the fourth pixel region of the color filter substrate according to the present invention functions as the white color filter layer for displaying the white color.

[0051] As shown in FIG. 6, the third auxiliary color filter layer 111c corresponding to the blue color in the fourth pixel region is wider than each of the first and second auxiliary color filter layers 111a, 111b, so that it is possible to improve the resolution for the white color obtained by mixing the colors of the first, second, and third auxiliary color filter layers 111a, 111b, 111c together.

[0052] As shown in FIG. 7, the light passing through the overcoat layer 102 has the highest resolution for the white color. However, the light passing through the third auxiliary color filter layer 111c for the blue color has the lowest resolution among the light passing through the first, second, and third auxiliary color filter layers 111a, 111b, 111c. As a result, the white color obtained by mixing the lights passing through the first, second, and third auxiliary color filter layers 111a, 111b, 111c has a lower resolution than the white color obtained by the overcoat layer.

[0053] Thus, as the third auxiliary color filter layer 111c for the blue color is wider than each of the first and second auxiliary color filter layers 111a, 111b, more light passes through the third auxiliary color filter layer 111c. That is, the transmittance of the blue (B) color increases, whereby the peak of transmittance for the blue color, passing through the third auxiliary color filter layer 111c, becomes closer to the transmittance of the white color passing through the overcoat layer 102. As a result, the white color obtained by mixing the light passing through the first, second, and third auxiliary color filter layers 111a, 111b, 111c is similar in the resolution to the white color obtained by the overcoat layer 102.

[0054] In the related art color filter substrate, the pixel regions are formed in the constant size, and the respective color filter layers 101a, 101b, 101c corresponding to the pixel regions are formed in the constant size, so that it is difficult to improve the resolution for the white color. In the color filter substrate according to the present invention, it is possible to control the size of the auxiliary color filter layers 111a, 111b, 111c formed in the fourth pixel region, especially, the third auxiliary color filter layer 111c, thereby improving the resolution for the white color.

[0055] A method for fabricating the color filter substrate of the LCD device according to the present invention will be described as follows. FIG. 8A to FIG. 8E are cross sectional views of the fabrication process of a color filter substrate along II-II' of FIG. 4.

[0056] First, as shown in FIG. 8A, after preparing the substrate 100 having the first to fourth pixel regions repetitively arranged, the chrome or resin is deposited on the substrate 100, and then patterned by photolithography. As a result, the black matrix layer BM is formed on the entire surface of the substrate 100 except the respective pixel regions.

[0057] Subsequently, as shown in FIG. 8B, a red resist or resin is coated on the substrate 100 having the black matrix layer BM, and then the substrate 100 coated with the red

resist or resin is patterned by photolithography to form the first color filter layer **101a** on the first pixel region of the substrate **100**, and the first auxiliary color filter layer **111a** on a predetermined portion of the fourth pixel region, simultaneously. At this time, the first auxiliary color filter layer **111a** of the fourth pixel region is narrower than the first color filter layer **101a** of the first pixel region.

[0058] Next, as shown in **FIG. 8C**, a green resist or resin is coated on the substrate **100** having the first color filter layer **101a**, and then patterned by photolithography, thereby forming the second color filter layer **101b** on the second pixel region of the substrate **100**, and the second auxiliary color filter layer **111b** on a predetermined portion of the fourth pixel region, simultaneously. At this time, the second auxiliary color filter layer **111b** of the fourth pixel region is narrower than the second color filter layer **101b** of the second pixel region. Also, the second auxiliary color filter layer **111b** is spaced apart from the first auxiliary color filter layer **111a**.

[0059] After that, as shown in **FIG. 8D**, a blue resist or resin is coated on the substrate **100** having the first and second color filter layers **101a**, **101b** and the first and second auxiliary color filter layers **111a**, **111b**, and then patterned by photolithography, thereby forming the third color filter layer **101c** on the third pixel region of the substrate **100**, and the third auxiliary color filter layer **111c** on a predetermined portion of the fourth pixel region, simultaneously. At this time, the third auxiliary color filter layer **111c** of the fourth pixel region is narrower than the third color filter layer **101c** of the third pixel region. Also, the third auxiliary color filter layer **111c** is spaced apart from the first and second auxiliary color filter layers **111a** and **111b**.

[0060] The resolution for the white color, as described above, the third auxiliary color filter layer **111c** of the fourth pixel region is wider than each of the first and second auxiliary color filter layers **111a**, **111b** of the fourth pixel region.

[0061] Subsequently, as shown in **FIG. 8E**, the overcoat layer **102** is formed on the entire surface of the substrate **100** including the first to third color filter layers **101a**, **101b**, **101c**, and the first to third auxiliary color filter layers **111a**, **111b**, **111c**, to planarize the step coverage between the color filter layers **101a**, **101b**, **101c** and the auxiliary color filter layers **111a**, **111b**, **111c**.

[0062] The first, second, and third auxiliary color filter layers **111a**, **111b**, **111c** of the fourth pixel region are spaced apart from one another, and the overcoat layer **102** is formed between each of the auxiliary color filter layers **111a**, **111b**, **111c**. Thus, in order to obtain the white color in the fourth pixel region, it is required to form the first, second, and third auxiliary color filter layers **111a**, **111b**, **111c**, and the overcoat layer **102**.

[0063] Based upon the fabrication process of the color filter substrate of the present invention, it is possible to form a color filter layer having improved resolution for the white color in the fourth pixel region without the need for additional fabrication process steps.

[0064] An IPS mode LCD device using the color filter substrate according to the present invention will be described as follows.

[0065] **FIG. 9** is a schematic view of four pixel regions of a first substrate in an IPS mode LCD device according to an embodiment of the present invention. **FIG. 10** is a schematic view of respective color filter layers and auxiliary color filter layers formed on a second substrate, wherein the respective color filter layers correspond to respective pixel regions of a first substrate of **FIG. 9**. **FIG. 11** is a cross sectional view of an IPS mode LCD device along III-III' of **FIG. 10**.

[0066] As shown in **FIG. 9** and **FIG. 10**, an IPS mode LCD device according to an embodiment of the present invention includes first and second substrates **200a** and **200b** facing each other, pixel and common electrodes **400** and **500**, a black matrix layer BM, first to third color filter layers **201a**, **201b**, **201c**, first to third auxiliary color filter layers **222a**, **222b**, **222c**, and an overcoat layer **205**. At this time, first, second, third and fourth pixel regions are repetitively formed on the first and second substrates **200a** and **200b**. Also, the pixel and common electrodes **400** and **500** are formed substantially in parallel within the respective pixel regions of the first substrate **200a**. The black matrix layer BM is formed on an entire surface of the second substrate **200b** except the pixel regions, to prevent light leakage on the portions other than the pixel regions. Then, the respective first, second, and third color filter layers **201a**, **201b**, **201c**, are formed on the first, second, and third pixel regions of the second substrate **200b**. The first, second, and third auxiliary color filter layers **222a**, **222b**, **222c** are formed on the fourth pixel region to display the white color in the fourth pixel region. Also, the overcoat layer **205** is formed on the entire surface of the second substrate **200b** including the respective color filter layers **201a**, **201b**, **201c**, and the respective auxiliary color filter layers **222a**, **222b**, **222c**.

[0067] More specifically, as shown in **FIG. 9**, the first substrate **200a** includes a plurality of gate lines G, a plurality of data lines D, a thin film transistor T, a common line CL, the plurality of common electrodes **500**, the plurality of pixel electrodes **400**, and a storage electrode **150**. That is, the plurality of gate lines G are formed substantially in perpendicular to the plurality of data lines D to define the pixel regions. Also, the thin film transistor T is formed at a crossing portion of the gate G and data D lines, and the common line CL is formed substantially in parallel to the gate line G within the pixel region. Then, the plurality of common electrodes **500**, extending from the common line CL, are formed substantially in parallel to the data line D. The plurality of pixel electrodes **400** extend from a drain electrode DE of the thin film transistor T, and each of the pixel electrodes **400** is formed between the common electrodes **500**, substantially in parallel. Then, the storage electrode **150** extends from the pixel electrode **400**, wherein the storage electrode **150** is formed on the gate line G.

[0068] Herein, a non-explained reference 'SE' is a source electrode, and a non-explained reference 'GE' is a gate electrode.

[0069] The second substrate **200b**, opposite to the first substrate **200a**, will be described in detail.

[0070] That is, as shown in **FIG. 10**, in the fourth pixel region of the second substrate **200b**, the first, second, and third auxiliary color filter layers **222a**, **222b**, **222c** are formed in one region. Also, the respective first, second, and third auxiliary color filter layers **222a**, **222b**, **222c** are narrower than the first, second, and third color filter layers

201a, 201b, 201c formed to correspond with the first, second, and third pixel regions, respectively.

[0071] Also the first, second, and third auxiliary color filter layers **222a, 222b, 222c** of the fourth pixel region are spaced apart from one another, and the overcoat layer **205** is formed between each of the auxiliary color filter layers **222a, 222b, 222c**.

[0072] Generally, the first to third color filter layers **201a, 201b, 201c**, and the first to third auxiliary color filter layers **222a, 222b, 222c** are respectively formed of red-dyed, green-dyed, and blue-dyed resist or resin. Thus, the red, green, and blue colors are obtained in the respective first, second, and third pixel regions through the first, second, and third color filter layers **201a, 201b, 201c**, and the white color is obtained in the fourth pixel region by mixing the red, green, and blue colors, together.

[0073] Also, the overcoat layer **205** is formed between each of the auxiliary color filter layers **222a, 222b, 222c** of the fourth pixel region, so that the light passing through the overcoat layer **205** is displayed as the white color. In the fourth pixel region, the white color obtained by the first to third auxiliary color filter layers **222a, 222b, 222c** is mixed with the white color obtained by the overcoat layer **205**. In this manner, the fourth pixel region of the IPS mode LCD device according to the present invention functions as the white color filter layer for displaying the white color.

[0074] Meanwhile, as described above, the third auxiliary color filter layer **222c** corresponding to the blue color in the fourth pixel region is wider than each of the first and second auxiliary color filter layers **222a** and **222b**, so that it is possible to improve the resolution for the white color obtained by mixing the colors of the first, second, and third auxiliary color filter layers **222a, 222b, 222c** together.

[0075] As shown in FIG. 11, the first, second, and third auxiliary color filter layers **222a, 222b, 222c**, formed on the fourth pixel region of the second substrate **200b**, are formed to correspond with the common electrodes **500** of the first substrate **200a**. That is, supposing that the common electrodes **500**, arranged from the left side to the right side of FIG. 11, are referred to as the first, second, and third common electrodes in order, the first auxiliary color filter layer **222a** of the fourth pixel region corresponds to the first common electrode, the second auxiliary color filter layer **222b** corresponds to the second common electrode, and the third auxiliary color filter layer **222c** corresponds to the third common electrode.

[0076] If one or two common electrodes **500** are formed on the fourth pixel region of the first substrate **200a**, the respective auxiliary color filter layers **222a, 222b, 222c** of the fourth pixel region may be divided and formed to correspond to the common electrodes **500**.

[0077] FIG. 12 is a plan view showing the correlation between the common electrode and the auxiliary color filter layer.

[0078] That is, as shown in (a) of FIG. 12, when two electrodes **500**, referred to as the first and second common electrodes, respectively, the first, second, and third auxiliary color filter layers **222a, 222b, 222c** may be correspondent to three parts formed by dividing the first common electrode into three, and the other first, second, and third auxiliary

color filter layers **222a, 222b, 222c** may be correspondent to three parts formed by dividing the second common electrode into three.

[0079] As shown in (b) of FIG. 12, if one common electrode **500** is formed, the common electrode may be divided into three parts, and the first, second, and third auxiliary color filter layers **222a, 222b, 222c** may be formed to correspond with the respective three parts.

[0080] In this case, the first, second, and third auxiliary color filter layers **222a, 222b, 222c**, formed in the fourth pixel region, correspond to the common electrodes **500** to prevent the aperture ratio for the white color, obtained by the overcoat layer **205** of the fourth pixel region, from being decreased due to the auxiliary color filter layers **222a, 222b, 222c**.

[0081] A method for fabricating the IPS mode LCD device according to another embodiment of the present invention will be described as follows. FIG. 13A to FIG. 13C are cross sectional views of the fabrication process of the IPS mode LCD device according to the embodiment of the present invention.

[0082] First, the second substrate **200b**, having the first, second, third, and fourth pixel regions repetitively arranged, is prepared. At this time, the second substrate **200b** is explained with reference to FIG. 9 and FIG. 11. For convenience of the explanation, the common electrodes **500**, arranged from the left side to the right side of FIG. 11, are referred to as the first, second, and third common electrodes, in order.

[0083] That is, as described above, the first substrate **200a** includes the plurality of gate lines G, the plurality of data lines D, the thin film transistor T, the common line CL, the plurality of common electrodes **500**, the pixel electrode **400**, and the storage electrode **150**. At this time, the plurality of gate lines G are formed substantially in perpendicular to the plurality of data lines D to define the pixel regions. Also, the thin film transistor T is formed at the crossing portion of the gate G and data D lines, and the common line CL is formed substantially in parallel to the gate lines G, within the pixel region. Then, the plurality of common electrodes **500**, extending from the common line CL, are formed substantially in parallel to the data lines D. The pixel electrodes **400** extend from the drain electrode DE of the thin film transistor T, and each of the pixel electrodes **400** is formed between the common electrodes **500**, substantially in parallel. Also, the storage electrode **150** extends from the pixel electrode **400**, wherein the storage electrode **150** is formed on the gate line G.

[0084] Subsequently, as shown in FIG. 13A, after preparing the second substrate **200b** having the first, second, third, and fourth pixel regions repetitively arranged to correspond with the first substrate **200a**, chrome or resin is deposited on the second substrate **200b**, and then patterned by photolithography, thereby forming the black matrix layer BM on the entire surface of the second substrate **200b** except the pixel regions.

[0085] After that, a red resist or resin is coated on the second substrate **200b** having the black matrix layer BM, and then the second substrate **200b** coated with the red resist or resin is patterned by photolithography, thereby forming the first color filter layer **201a** on the first pixel region of the

second substrate **200b**, and the first auxiliary color filter layer **222a** on a predetermined portion of the fourth pixel region, simultaneously. At this time, the first auxiliary color filter layer **222a** of the fourth pixel region is narrower than the first color filter layer **201a** of the first pixel region. Also, the first auxiliary color filter layer **222a** is formed to correspond with the first common electrode **500** of the fourth pixel region of the first substrate **200a**.

[0086] Next, as shown in **FIG. 13B**, a green resist or resin is coated on the second substrate **200b** having the first color filter layer **201a**, and then the second substrate **200b** is patterned by photolithography, thereby forming the second color filter layer **201b** on the second pixel region of the second substrate **200b**, and the second auxiliary color filter layer **222b** on a predetermined portion of the fourth pixel region, simultaneously. At this time, the second auxiliary color filter layer **222b** of the fourth pixel region is narrower than the second color filter layer **201b** of the second pixel region. Also, the second auxiliary color filter layer **222b** is formed to correspond to the second common electrode **500** of the fourth pixel region of the first substrate **200a**.

[0087] Then, a blue resist or resin is coated on the second substrate **200b** having the first and second color filter layers **201a** and **201b**, and then the second substrate **200b** is patterned by photolithography, thereby forming the third color filter layer **201c** on the third pixel region of the second substrate **200b**, and the third auxiliary color filter layer **222c** on a predetermined portion of the fourth pixel region, simultaneously. At this time, the third auxiliary color filter layer **222c** of the fourth pixel region is narrower than the third color filter layer **201c** of the third pixel region. Also, the third auxiliary color filter layer **222c** is formed to correspond with the third common electrode **500** of the fourth pixel region of the first substrate **200a**.

[0088] Herein, the third auxiliary color filter layer **222c** of the fourth pixel region may be wider than each of the first and second auxiliary color filter layers **222a** and **222b** of the fourth pixel region. The third auxiliary color filter layer **222c** may be wider than the third common electrode **500**, as described above, to improve the resolution for the white color.

[0089] Subsequently, the overcoat layer **205** is formed on the entire surface of the second substrate **200b** including the first, second, and third color filter layers **201a**, **201b**, **201c**, and the first, second, and third auxiliary color filter layers **222a**, **222b**, **222c**, so that it is possible to planarize the step coverage between each of the color filter layers **201a**, **201b**, **201c** and each of the auxiliary color filter layers **222a**, **222b**, **222c**.

[0090] At this time, the first, second, and third auxiliary color filter layers **222a**, **222b**, **222c**, formed in the fourth pixel region, are spaced apart from one another, and the overcoat layer **205** is formed between each of the auxiliary color filter layers **222a**, **222b**, **222c**.

[0091] Accordingly, the first, second, and third auxiliary color filter layers **222a**, **222b**, **222c** and the overcoat layer **205** are formed to obtain the white color in the fourth pixel region.

[0092] After that, as shown in **FIG. 13C**, a liquid crystal layer **800** is formed between the first substrate **200a** and the

second substrate **200b**, thereby completing the fabrication process of the IPS mode LCD device.

[0093] At this time, the liquid crystal layer **800** may be formed in a method of injecting liquid crystal between the first and second substrates **200a** and **200b** after bonding the first and second substrates **200a** and **200b** to each other, or in a method of bonding the first and second substrates **200a** and **200b** to each other after dispensing liquid crystal on any one of the first and second substrates **200a** and **200b**.

[0094] In the fabrication process of the IPS mode LCD device according to the present invention, it is possible to form the color filter layer having improved resolution for the white color in the fourth pixel region by the first, second, and third auxiliary color filter layers **222a**, without the need for an additional fabrication process step. Also, the respective auxiliary color filter layers **222a**, **222b**, **222c** are formed to correspond with the common electrodes **500**, thereby improving the aperture ratio.

[0095] As described above, the IPS mode LCD device and the method for fabricating the same have the following advantages.

[0096] First, it is possible to form the auxiliary color filter layer for displaying the white color without an additional fabrication process step, thereby decreasing fabrication time.

[0097] Also, it is easy to control the width of the respective color filter layers formed in the same pixel region, thereby improving the resolution for the white color obtained by mixing the light passing through the respective auxiliary color filter layers and the respective color filter layers.

[0098] It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention. Thus, it is intended that the present invention covers the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

What is claimed is:

1. A liquid crystal display (LCD) device, comprising:

first and second substrates having first, second, third and fourth pixel regions arranged repetitively;

a black matrix layer formed on the second substrate corresponding to portions of the substrates other than the pixel regions;

first, second and third color filter layers respectively formed on the first, second, and third pixel regions of the second substrate;

first, second, and third auxiliary color filter layers formed on the fourth pixel region of the second substrate to display a white color; and

a liquid crystal layer formed between the first and second substrates.

2. The LCD device of claim 1, wherein the first, second, and third color filter layers are respectively formed of red-dyed, green-dyed, and blue-dyed resist or resin, and the first, second, and third auxiliary color filter layers are respectively formed of red-dyed, green-dyed, and blue-dyed resist or resin.

3. The LCD device of claim 1, further comprising an overcoat layer on an entire surface of the second substrate including the color filter layers and the auxiliary color filter layers.

4. The LCD device of claim 1, wherein each of the first, second, and third auxiliary color filter layers is narrower than each of the first, second, and third color filter layers.

5. The LCD device of claim 1, wherein the first, second, and third auxiliary color filter layers are spaced apart from one another.

6. The LCD device of claim 1, wherein the third auxiliary color filter layer is wider than each of the first and second auxiliary color filter layers.

7. The LCD device of claim 1, wherein the first substrate includes a gate line, a data line substantially perpendicular to the gate line, and a thin film transistor formed at a crossing portion of the gate and data lines.

8. The LCD device of claim 1, wherein common and pixel electrodes are formed substantially parallel to each other on the first substrate.

9. The LCD device of claim 8, wherein the respective first, second, and third auxiliary color filter layers are formed to correspond with the common electrodes of the first substrate.

10. The LCD device of claim 9, wherein the respective first, second, and third auxiliary color filter layers correspond to three parts formed by dividing the common electrode of the first substrate.

11. A method for fabricating an LCD device comprising:

preparing first and second substrates having first, second, third and fourth pixel regions arranged repetitively;

forming a black matrix layer on the second substrate corresponding to portions of the substrates other than the pixel regions;

forming a first color filter layer on the first pixel region of the second substrate, and a first auxiliary color filter layer on the fourth pixel region, simultaneously;

forming a second color filter layer on the second pixel region of the second substrate, and a second auxiliary color filter layer on the fourth pixel region, simultaneously;

forming a third color filter layer on the third pixel region of the second substrate, and a third auxiliary color filter layer on the fourth pixel region, simultaneously; and

forming a liquid crystal layer between the first and second substrates.

12. The method of claim 11, wherein the first, second, and third color filter layers are respectively formed of red-dyed, green-dyed, and blue-dyed resist or resin, and the first, second, and third auxiliary color filter layers are respectively formed of red-dyed, green-dyed, and blue-dyed resist or resin.

13. The method of claim 11, further comprising forming an overcoat layer on an entire surface of the second substrate including the color filter layers and the auxiliary color filter layers.

14. The method of claim 11, wherein each of the first, second, and third auxiliary color filter layers is narrower than each of the first, second, and third color filter layers.

15. The method of claim 11, wherein the first, second, and third auxiliary color filter layers are spaced apart from one another.

16. The method of claim 11, wherein the third auxiliary color filter layer is wider than each of the first and second auxiliary color filter layers.

17. The method of claim 11, wherein preparing the first substrate includes forming a gate line, a data line substantially perpendicular to the gate line, and a thin film transistor at a crossing portion of the gate and data lines.

18. The method of claim 11, wherein preparing the first substrate includes forming common and pixel electrodes on the first substrate substantially in parallel.

19. The method of claim 18, wherein the respective first, second, and third auxiliary color filter layers are formed to correspond to the common electrodes of the first substrate.

20. The method of claim 19, wherein the respective first, second, and third auxiliary color filter layers correspond to three parts formed by dividing the common electrode of the first substrate.

21. The method of claim 11, wherein forming the liquid crystal layer includes injecting liquid crystal between the first and second substrates after bonding the first and second substrates to each other.

22. The method of claim 11, wherein forming the liquid crystal layer includes bonding the first and second substrates to each other after dispensing liquid crystal on one of the first and second substrates.

* * * * *

专利名称(译)	液晶显示装置及其制造方法		
公开(公告)号	US20050122445A1	公开(公告)日	2005-06-09
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摘要(译)

公开了一种LCD装置及其制造方法，其通过使用第一，第二和第三辅助滤色器层在第四像素区域中获得白色来减少LCD装置的制造时间，并提高白色的分辨率通过控制辅助滤色器层的宽度来实现颜色。该器件包括具有重复排列的第一，第二，第三和第四像素区域的第一和第二基板；形成在第二基板上的黑矩阵层，对应于除像素区域之外的基板的部分；第一，第二和第三滤色器层分别形成在第二基板的第一，第二和第三像素区域上；第一，第二和第三辅助滤色器层形成在第二基板的第四像素区域上以显示白色；以及在第一和第二基板之间形成的液晶层。

