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Sohn et al.(10) **Pub. No.: US 2007/0159569 A1**(43) **Pub. Date: Jul. 12, 2007**(54) **LIQUID CRYSTAL DISPLAY****Publication Classification**(76) **Inventors:** **Ji-won Sohn**, Seoul (KR);
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G02F 1/136 (2006.01)(52) **U.S. Cl.** **349/43**(57) **ABSTRACT**

The liquid crystal display includes a thin film transistor (TFT) panel including a pixel electrode in a rectangular shape having a transverse length longer than a longitudinal length, the pixel electrode including a first domain divider and having upper and lower half portions arranged symmetrically with respect to a transverse long axis passing through a center of the pixel electrode, a common electrode panel including a common electrode facing the pixel electrode, the common electrode including a second domain divider arranged parallel with the first domain divider, and a liquid crystal layer interposed between the TFT panel and the common electrode panel.

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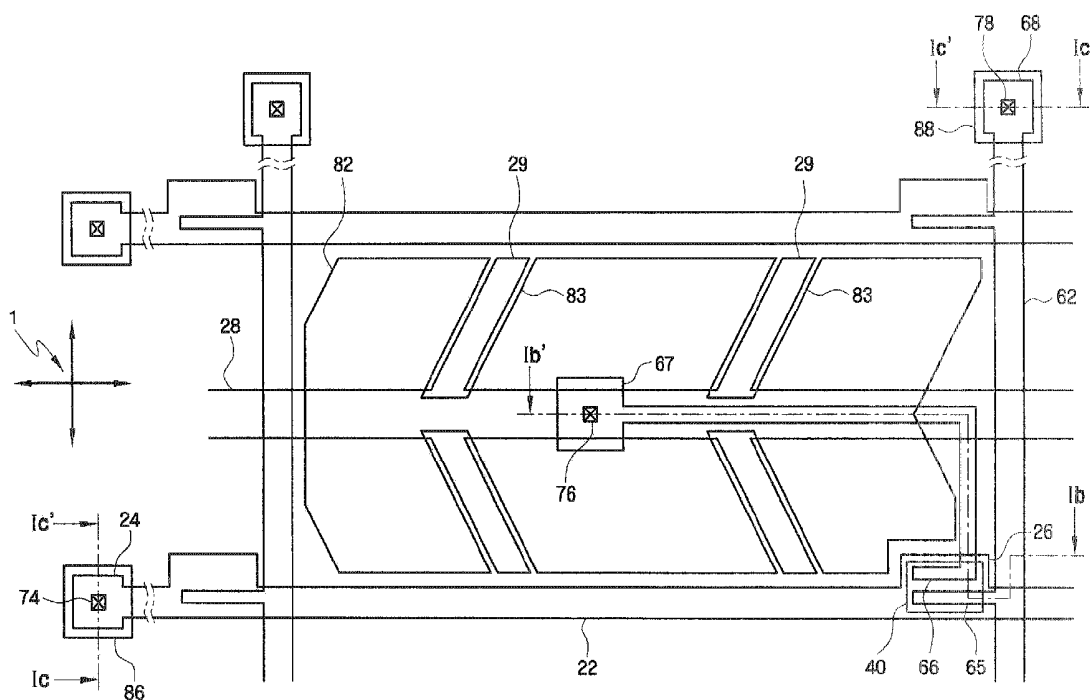


FIG. 1A

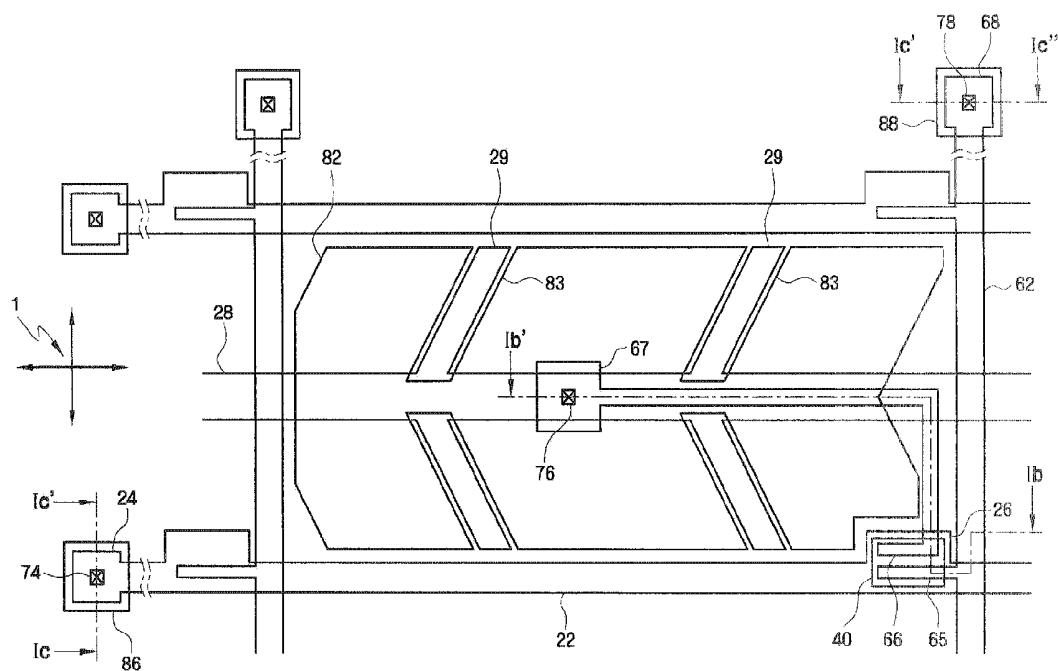


FIG. 1B

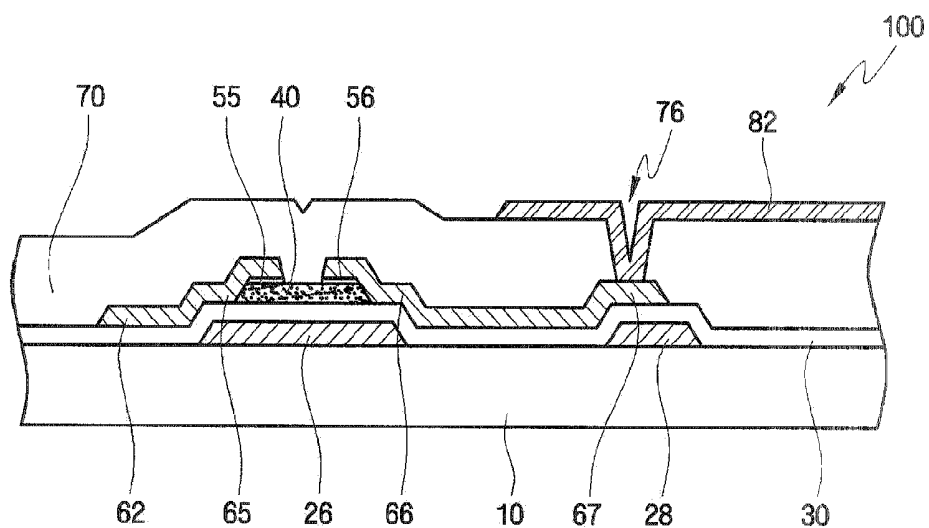


FIG. 1C

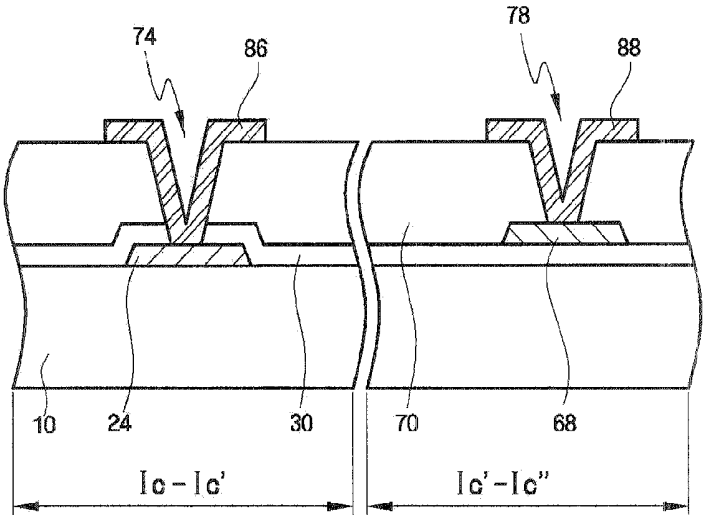


FIG. 2

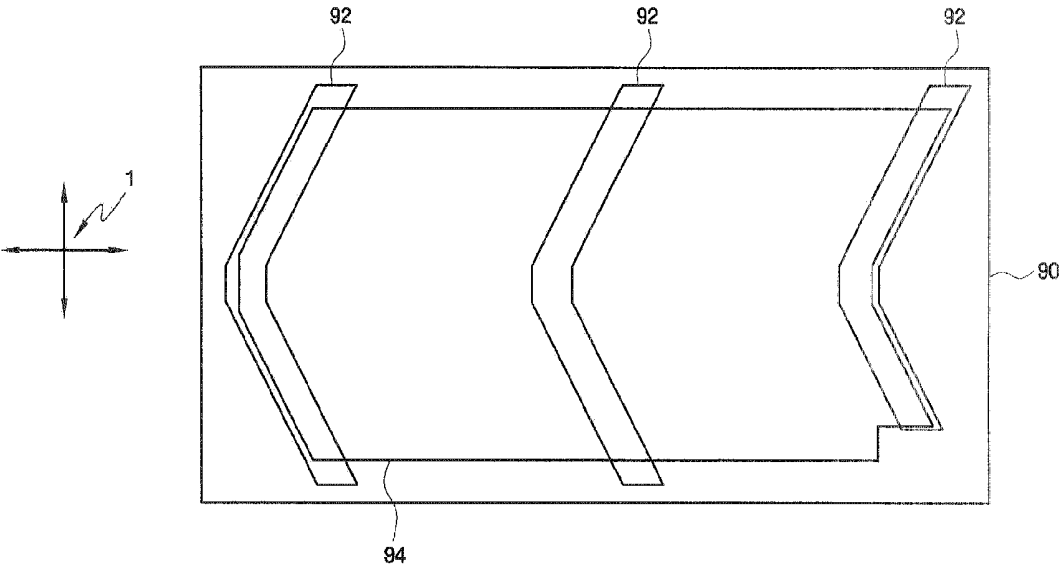


FIG. 3C

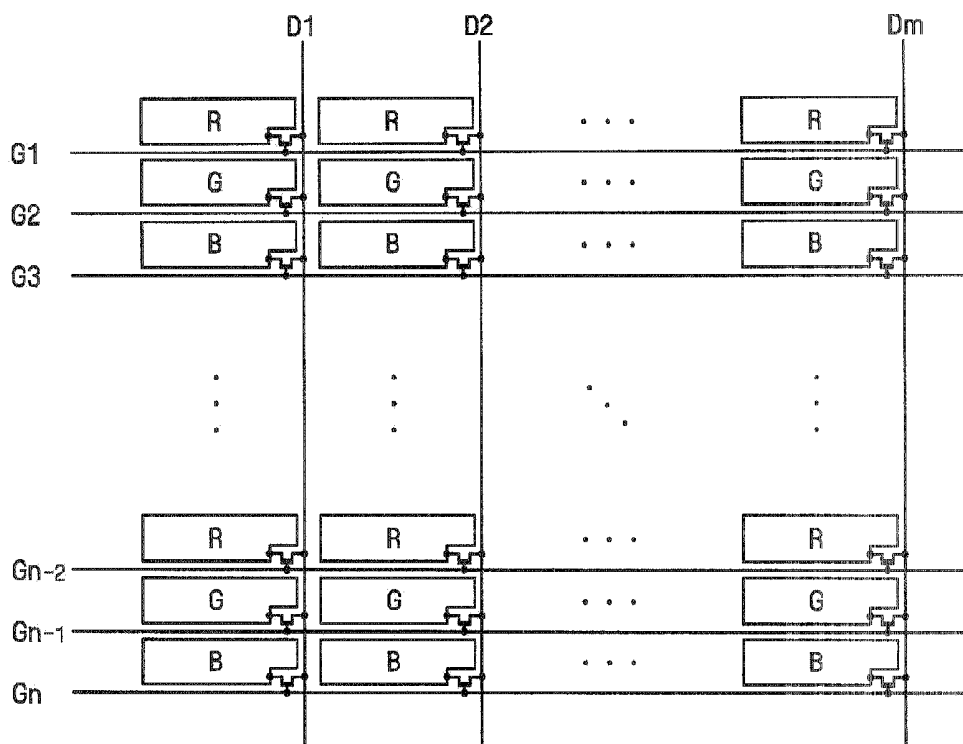


FIG. 4

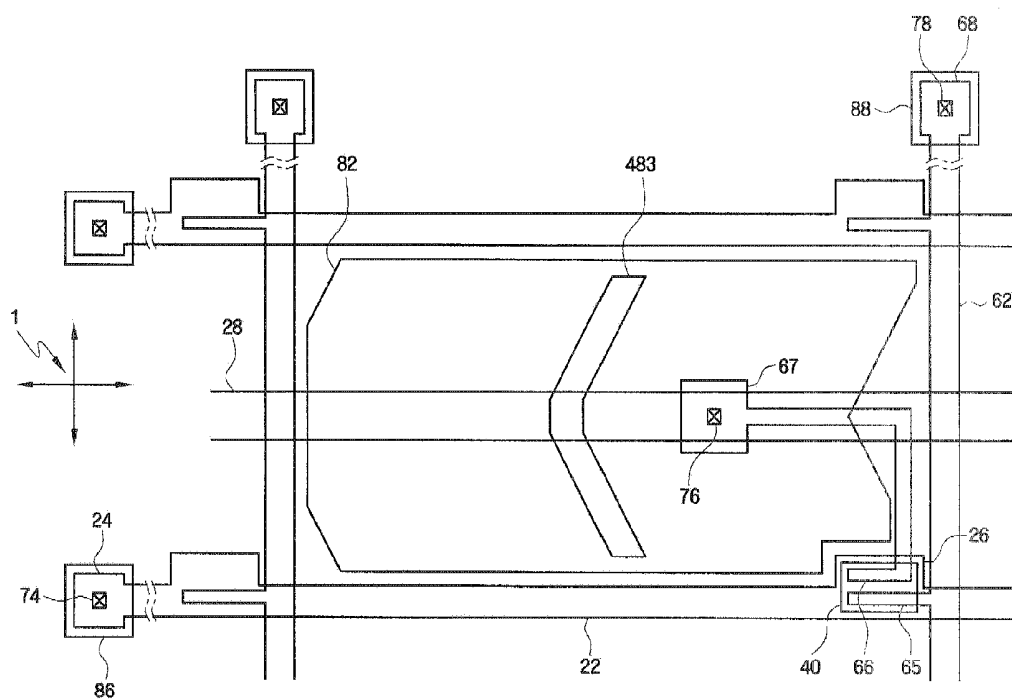


FIG. 5

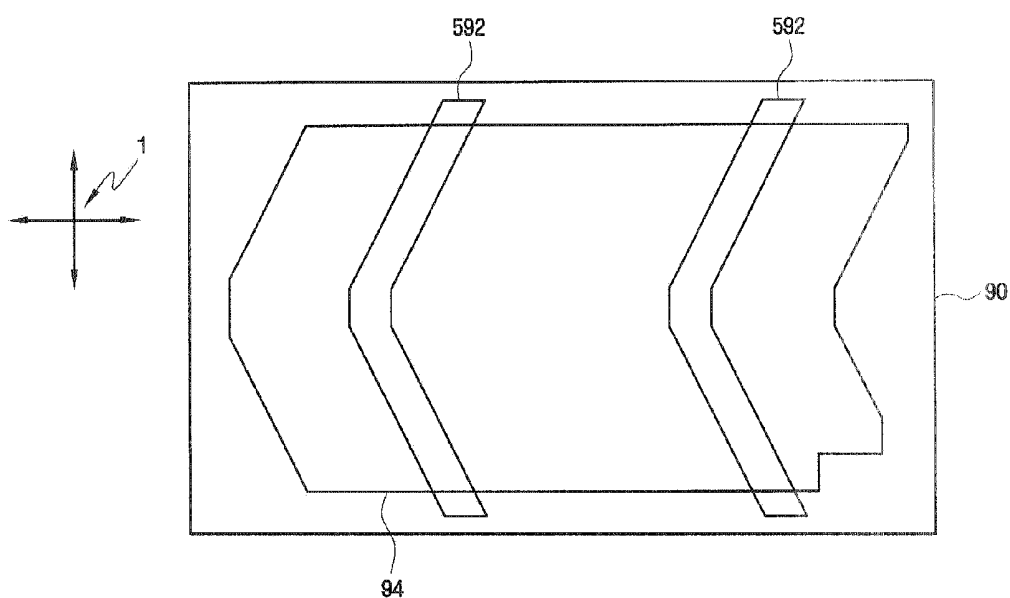


FIG. 6

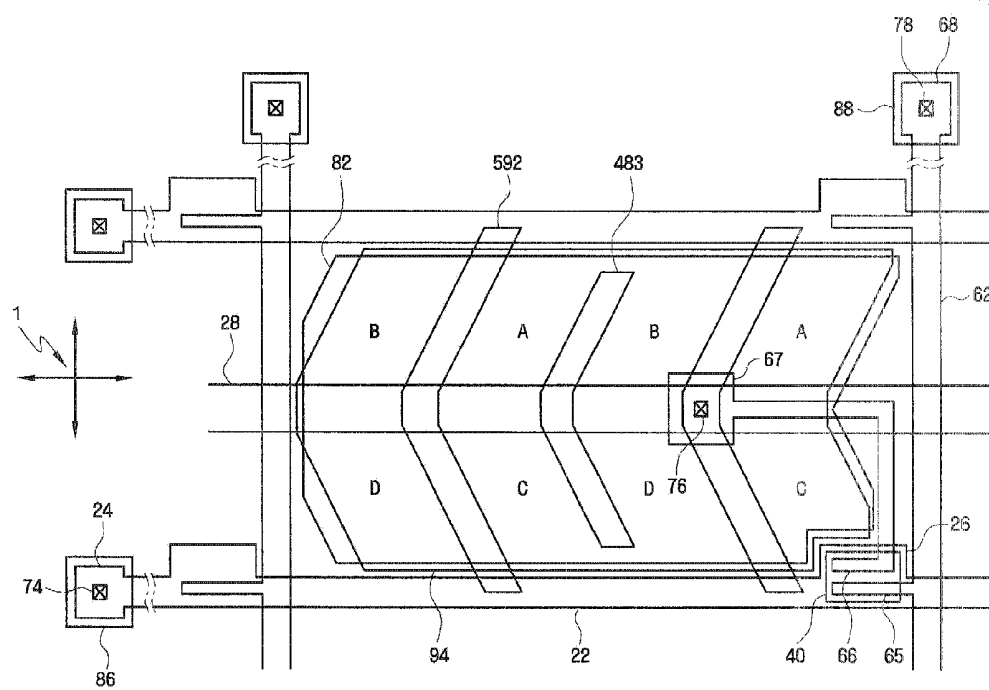


FIG. 7

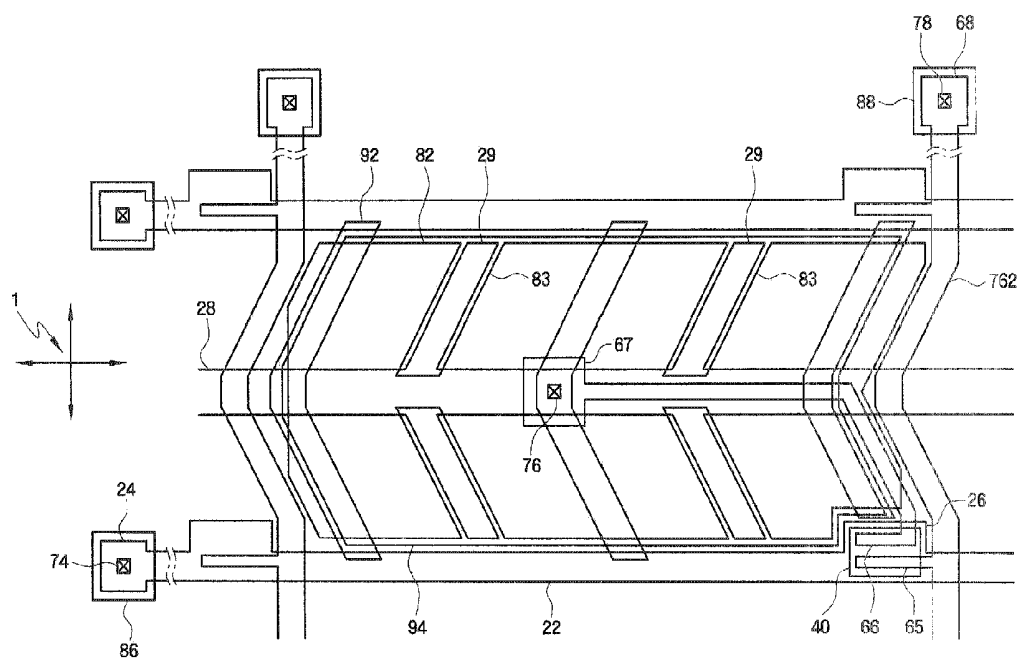
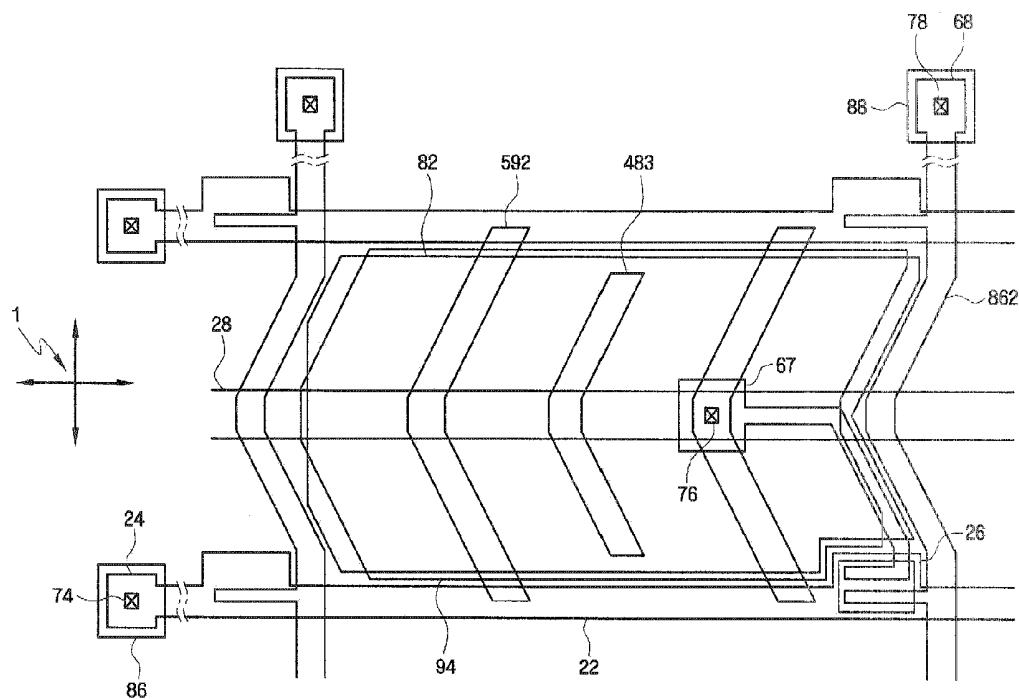


FIG. 8



LIQUID CRYSTAL DISPLAY

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority from Korean Patent Application No. 10-2005-0128986 filed on Dec. 23, 2005, the disclosure of which is incorporated herein by reference in its entirety.

BACKGROUND OF THE INVENTION

[0002] 1. Technical Field

[0003] The present disclosure relates to a liquid crystal display, and more particularly, to a vertically aligned liquid crystal display having a pixel divided into a plurality of domains.

[0004] 2. Discussion of the Related Art

[0005] A liquid crystal display (LCD) is a widely used flat panel display. An LCD can include two substrates comprising field-generating electrodes such as pixel electrodes and a common electrode and a liquid crystal (LC) layer interposed therebetween. The LCD displays images by applying voltages to the field-generating electrodes to generate an electric field in the LC layer, which determines orientations of LC molecules in the LC layer to adjust polarization of incident light.

[0006] A vertical alignment (VA) mode LCD, which aligns LC molecules such that the long axes of the LC molecules are perpendicular to the substrates in the absence of an electric field, has a high contrast ratio and a wide reference viewing angle. The reference viewing angle is defined as a viewing angle making the contrast ratio equal to 1:10 or as a limit angle for the inversion in luminance between the grays.

[0007] A wide viewing angle of the VA mode LCD can be realized by, for example, cutouts in the field-generating electrodes and protrusions on the field-generating electrodes. The cutouts and the protrusions can determine the tilt directions of the LC molecules. The tilt directions can be distributed into several directions by using the cutouts and the protrusions such that the reference viewing angle can be widened.

[0008] In a conventional LCD, a wide viewing angle can be achieved by arranging LC molecules in units of domains using domain dividing means such as, for example, cutouts and protrusions. However, data lines disposed in the vicinity of a pixel electrode and extending in a longitudinal direction may not coincide with the tilt directions of the LC molecules, which may cause textures to the data lines, resulting in light leakage.

SUMMARY OF THE INVENTION

[0009] Exemplary embodiments of the present invention provide a liquid crystal display which can prevent instantaneous residual images and textures and can achieve a high aperture ratio and an enhanced wide viewing angle.

[0010] Exemplary embodiments of the present invention provide a method of manufacturing the liquid crystal display panel.

[0011] According to an embodiment of the present invention, a liquid crystal display includes a TFT panel including a thin film transistor (TFT) panel including a pixel electrode in a rectangular shape having a transverse length longer than a longitudinal length, the pixel electrode including a first

domain divider and having upper and lower half portions arranged symmetrically with respect to a transverse long axis passing through a center of the pixel electrode, a common electrode panel including a common electrode facing the pixel electrode, the common electrode including a second domain divider arranged parallel with the first domain divider, and a liquid crystal layer interposed between the TFT panel and the common electrode panel.

[0012] According to an embodiment of the present invention, a liquid crystal display including an insulating substrate, a plurality of gate lines formed on the insulating substrate, a plurality of data lines crossing the plurality of gate lines, a plurality of pixel electrodes formed on the insulating substrate in a matrix and each pixel electrode having a first side parallel to the plurality of gate lines and a second side shorter than the first side, the second side being adjacent to the first side, a common electrode facing the plurality of pixel electrodes, and a liquid crystal layer interposed between the plurality of pixel electrodes and the common electrode panel and having liquid crystal molecules, wherein the liquid crystal layer includes a first domain group and a second domain group, the first domain group including the liquid crystal molecules aligned at an angle of approximately 135 degrees or approximately -45 degrees with respect to the gate lines and the second domain group including the liquid crystal molecules aligned at an angle of approximately -135 degrees or approximately 45 degrees with respect to the gate lines.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] Exemplary embodiments of the present invention can be understood in more detail from the following description taken in conjunction with the accompanying drawings in which:

[0014] FIG. 1A is a layout view of a thin film transistor (TFT) panel of a liquid crystal display (LCD) according to an embodiment of the present invention;

[0015] FIG. 1B is a cross-sectional view of the TFT panel taken along the line Ib-Ib' of FIG. 1A;

[0016] FIG. 1C is a cross-sectional view of the TFT panel taken along the lines Ic-Ic' and Ic'-Ic'' of FIG. 1A;

[0017] FIG. 2 is a layout view of a common electrode panel of the LCD according to an embodiment of the present invention;

[0018] FIG. 3A is a layout view of the LCD according to an embodiment of the present invention including the TFT panel shown in FIG. 1A and the common electrode panel shown in FIG. 2;

[0019] FIG. 3B is a cross-sectional view of the LCD taken along the line IIIb-IIIb' of FIG. 3A;

[0020] FIG. 3C is a schematic diagram of a pixel array of the LCD shown in FIG. 3A;

[0021] FIG. 4 is a layout view of a TFT panel of an LCD according to an embodiment of the present invention;

[0022] FIG. 5 is a layout view of a common electrode panel of the LCD according to an embodiment of the present invention;

[0023] FIG. 6 is a layout view of the LCD according to an embodiment of the present invention including the TFT panel shown in FIG. 4 and the common electrode panel shown in FIG. 5;

[0024] FIG. 7 is a layout view of an LCD according to an embodiment of the present invention; and

[0025] FIG. 8 is a layout view of an LCD according to an embodiment of the present invention.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0026] Exemplary embodiments of the present invention are more fully described below with reference to the accompanying drawings. The present invention may, however, be embodied in many different forms and should not be construed as being limited to the embodiments set forth herein.

[0027] In an embodiment of the present invention, a liquid crystal display includes a thin film transistor (TFT) panel having a TFT defined by a gate line and a data line, a common electrode panel, which is separated from and faces the TFT panel, including a common electrode, and a liquid crystal layer interposed between the TFT panel and the common electrode panel. Long axes of the LC molecules in the liquid crystal layer are disposed substantially perpendicular to the panels.

[0028] A thin film transistor (TFT) panel 100 is described with reference to FIGS. 1A through 1C. FIG. 1A is a layout view of a thin film transistor (TFT) panel of a liquid crystal display (LCD) according to an embodiment of the present invention. FIG. 1B is a cross-sectional view of the TFT panel taken along the line Ib-Ib' of FIG. 1A. FIG. 1C is a cross-sectional view of the TFT panel taken along the lines Ic-Ic' and Ic-Ic'' of FIG. 1A.

[0029] A gate line 22 is formed on an insulating substrate 10 in a transverse direction, and a gate electrode 26 is connected to the gate line 22 in the form of a protrusion. A gate line terminal 24 for applying a gate signal from another layer or an external circuit and for transmitting the received gate signal to the gate line 22 is formed at an end of the gate line 22. The width of the gate line terminal 24 is large enough for connecting an external circuit. The gate line 22, the gate line terminal 24, and the gate electrode 26 constitute a gate wire (22, 24, 26).

[0030] A storage electrode line 28 extending substantially in a transverse direction across a pixel area is formed on the insulating substrate 10. A storage electrode 29 branched from the storage electrode line 28 is formed along a domain divider 83 for dividing a pixel electrode 82 into a plurality of domains. The storage electrode line 28 and the storage electrode 29 constitute a storage electrode wire (28, 29). In an embodiment of the present invention, to increase an aperture ratio of the LCD, the storage electrode line 28 extends in a transverse direction across a center of the pixel electrode 82 to be substantially in parallel to the gate line 22, and the storage electrode 29 is formed to overlap the domain divider 83. In embodiments of the present invention, the shape and arrangement of the storage electrode 29 and the storage electrode line 28 may vary as long as a predetermined storage capacitance can be established with respect to the pixel electrode 82.

[0031] The gate wire (22, 24, 26) and the storage electrode wire (28, 29) may comprise, for example, Al containing metal such as Al and Al alloy, Ag containing metal such as Ag and Ag alloy, Cu containing metal such as Cu and Cu alloy, Mo containing metal such as Mo and Mo alloy, Cr, Ti or Ta. The gate wire (22, 24, 26) and the storage electrode wire (28, 29) may have a multi-layered structure including two conductive films (not shown) having different physical characteristics. One of the two films can be a low resistivity metal including, for example, Al containing metal, Ag

containing metal, and Cu containing metal for reducing signal delay or voltage drop in the gate wire (22, 24, 26) and the storage electrode wire (28, 29). The other film can comprise a material such as, for example, a Mo containing metal, Cr, Ta or Ti, which have good physical, chemical, and electrical contact characteristics with other materials such as, for example, indium tin oxide (ITO) or indium zinc oxide (IZO). Examples of combinations of the two films are a lower Cr film and an upper Al (or Al alloy) film and a lower Al (or Al alloy) film and an upper Mo (or Mo alloy) film. The gate wire (22, 24, 26) may comprise various metals or conductors.

[0032] A gate insulating layer 30 is formed on the gate wire (22, 24, 26) and the storage electrode wire (28, 29).

[0033] A semiconductor layer 40 comprising, for example, hydrogenated amorphous silicon or polycrystalline silicon, is formed on the gate insulating layer 30. The semiconductor layer 40 may be formed in various shapes such as, for example, an island shape or a stripe shape. In an embodiment of the present invention, the semiconductor layer 40 may be formed in an island shape extending over the gate electrode 26 under the data line 62. When the semiconductor layer 40 is formed in a stripe shape, the semiconductor layer 40 may be disposed under the data line 62 and extend up to the gate electrode 26.

[0034] Ohmic contact layers 55 and 56 comprising, for example, silicide or n+ amorphous silicon hydride in which an n-type impurity is highly doped, are formed on the semiconductor layer 40. The ohmic contact layers 55 and 56 may have a variety of shapes, including, for example, an island shape and a stripe shape. For example, when the ohmic contact layers 55 and 56 are formed in an island shape, the ohmic contact layers 55 and 56 are positioned below a source electrode 65 and a drain electrode 66. When the ohmic contact layers 55 and 56 are formed in a stripe shape, the ohmic contact layers 55 and 56 may extend below a data line 62.

[0035] The data line 62 and the drain electrode 66 are formed on the ohmic contact layers 55 and 56 and the gate insulating layer 30. The data line 62 extends lengthwise and intersects the gate line 22 to define a pixel. A transverse length of each pixel defined by the data line 62 and the gate line 22 is longer than a longitudinal length. In other words, the pixel has a substantially rectangular shape, and a distance between two neighboring gate lines 22 is smaller than a distance between two neighboring data lines 62. The source electrode 65 protrudes from the data line 62 in the form of a branch and extends over the semiconductor layer 40. A data line terminal 68 for applying a data signal from another layer or an external circuit and for transmitting the received gate signal to the data line 62 is formed at an end of the data line 62. The width of the data line terminal 68 is large enough for connecting to an external circuit. The drain electrode 66 is separated from the source electrode 65 and is positioned on the semiconductor layer 40. The drain electrode 66 is formed opposite to the source electrode 65 with respect to the gate electrode 26.

[0036] The drain electrode 66 comprises a stripe pattern on the semiconductor layer 40 and a drain electrode pad 67 extending from the stripe pattern having a large enough area. A contact hole 76 is positioned in the drain electrode pad 67. In an embodiment of the present invention, the drain electrode pad 67 can be positioned at the center of a pixel area. The drain electrode pad 67 electrically connected with the

pixel electrode **82** through the contact hole **76** may partially overlap the storage electrode wire (**28**, **29**). A shape and arrangement of the drain electrode pad **67** may vary as long as predetermined storage capacitance can be established with respect to the pixel electrode **82**. The data line **62**, the data line terminal **68**, the source electrode **65**, the drain electrode **66**, and the drain electrode pad **67** constitute a data wire (**62**, **65**, **66**, **67**, **68**).

[0037] The data wire (**62**, **65**, **66**, **67**, **68**) may comprise, for example, chromium (Cr), a molybdenum (Mo) containing metal, a refractory metal such as, for example, tantalum (Ta) or titanium (Ti). The data wire (**62**, **65**, **66**, **67**, **68**) may be formed as a single layer or multiple layers including a lower film (not shown) comprising a refractory metal film and a low-resistivity upper film (not shown). Examples of the multiple layers include a double-layered structure having a lower Cr film and an upper Al (or Al alloy) film, a double-layered structure having a lower Al (or Al alloy) film and an upper Mo (or Mo alloy) film, and a triple-layered structure having a lower Mo film, an intermediate Al film, and an upper Mo film.

[0038] At least a portion of the source electrode **65** overlaps the semiconductor layer **40**, and at least a portion of the drain electrode **66** facing the source electrode **65** overlaps the semiconductor layer **40**. The ohmic contact layers **55** and **56** are interposed between the underlying semiconductor layer **40** and each of the overlying source electrode **65** and drain electrode **66** to reduce the contact resistance therebetween.

[0039] A passivation layer **70** comprising an insulating layer is formed on the data line **63**, the drain electrode **66** and the exposed semiconductor layer **40**. The passivation layer **70** may comprise, for example, an inorganic insulator such as silicon nitride or silicon oxide, a photosensitive organic material having a good flatness characteristic, or a low dielectric insulating material such as a-Si:C:O and a-Si:O:F formed by plasma enhanced chemical vapor deposition (PECVD). Alternatively, to protect the exposed semiconductor layer **40** and maintain an organic property thereof, the passivation layer **70** may be formed as a double-layered structure having a lower inorganic layer and an upper organic layer.

[0040] Contact holes **76** and **78** are formed in the passivation layer **70** to expose the drain electrode pad **67** and the data line terminal **68**, respectively. The contact hole **74** exposing the gate line terminal **24** is formed in the passivation layer **70** and the gate insulating layer **30**.

[0041] The pixel electrode **82** is formed on the passivation layer **70** according to a pixel shape. The pixel electrode **82** can have a substantially rectangular shape having a transverse length longer than a longitudinal length. The pixel electrode **82** can be partitioned by the domain divider **83** forming an angle of approximately 45 degrees or approximately -45 degrees with respect to a transmissive axis **1** of a polarizer. The domain divider **83** includes upper half portions and lower half portions with respect to the transverse long axis passing through a center of the pixel electrode **82**. The upper half portions are parallel with each other, and the lower half portions are parallel with each other. The upper half portions and the lower half portions form an angle with respect to the gate lines **22**. For example, the upper half portions form an angle of approximately -45 degrees with respect to the gate lines **22** and lower half portions form an angle of approximately 45 degrees with

respect to the gate lines **22**. Each of the upper and lower half portions are arranged separately from each other with respect to the transverse long axis. In an embodiment of the present invention, the domain divider **83** can be, for example, a plurality of cutouts provided in a diagonal direction. In an alternative embodiment of the present invention, protrusions may be formed on the pixel electrode **82**.

[0042] An auxiliary gate line terminal **86** and an auxiliary data line terminal **88** connected to the gate line terminal **24** and the data line terminal **68** via the contact holes **74** and **78**, respectively, are also formed on the passivation layer **70**. The pixel electrode **82**, the auxiliary gate line terminal **86** and the auxiliary data line terminal **88** comprise, for example, a transparent conductor such as ITO or IZO or a reflective conductor such as Al. The auxiliary gate line terminal **86** and the auxiliary data line terminal **88** are complement adhesions to external circuit devices.

[0043] The pixel electrode **82** is physically and electrically connected to the drain electrode **66** via the contact hole **76** and receives a data voltage from the drain electrode **66**.

[0044] An alignment film (not shown) for alignment of LC molecules may be formed on the pixel electrode **82**, the auxiliary gate line terminal **86** and the auxiliary data line terminal **88** and the passivation layer **70**.

[0045] A common electrode panel **200** of an LCD according to an embodiment of the present invention and an LCD including the common electrode panel **200** is described with reference to FIGS. **2** through **3C**. FIG. **2** is a layout view of a common electrode panel of an LCD according to an embodiment of the present invention. FIG. **3A** is a layout view of an LCD according to an embodiment of the present invention including the TFT panel shown in FIG. **1A** and the common electrode panel shown in FIG. **2**. FIG. **3B** is a cross-sectional view of the LCD taken along the line IIIb-IIIb' of FIG. **3A**. FIG. **3C** is a schematic diagram of a pixel array of the LCD shown in FIG. **3A**.

[0046] Referring to FIGS. **2** through **3B**, a black matrix **94** for preventing light leakage is formed on an insulating substrate **96** comprising a transparent insulating material, such as, for example, glass. The black matrix **94** may be formed by depositing an opaque material on a base panel substrate and etching the same. The black matrix **94** improves an image quality by preventing light leakage. Red, green, and blue color filters **98** are sequentially arranged to form a unit pixel. The red, green, and blue color filters **98** are primarily arranged on an area of a pixel area where the black matrix **94** is not formed, and selectively transmit light in a predetermined range of wavelengths. As shown in FIG. **3C**, since the LCD according to an embodiment of the present invention has a pixel longer in a transverse direction than in a longitudinal direction, the red, green, and blue color filters **98** can be repeatedly arranged in sequence along data lines **D1**, **D2**, . . . , **Dm**. To reduce flickering, the LCD may be driven by, for example, a "1 dot inversion" method, a "2 dot inversion" method, or a "(1+2) dot inversion" method.

[0047] A common electrode **90** comprising a transparent conductive material such as, for example, ITO or IZO and having a domain divider **92**, is formed on the color filters **98**.

[0048] The common electrode **90**, which faces the pixel electrode **82**, has the domain divider **92** forming an angle of approximately 45 degrees or approximately -45 degrees with respect to the transmissive axis **1** of a polarizer. The domain divider **92** has upper and lower portions with respect to the transverse long axis passing through the center of the

pixel electrode **82**. The upper portions are parallel with each other, and the lower portions are parallel with each other. The pixel electrode **82** is longer in a transverse direction than in a longitudinal direction. In an embodiment of the present invention, the domain divider **92** can be a plurality of cutouts provided in a diagonal direction. In an alternative embodiment of the present invention, protrusions formed on the common electrode **90** may be provided as the domain divider **92**.

[0049] As shown in FIG. 3A, the domain divider **83** and the domain divider **92** divide a pixel region into a plurality of domains. The domain dividers **83** and **92** can be cutouts or protrusions. Domains of the pixel electrode **82** are divided in a longitudinal direction with respect to the transverse long axis passing through the center of the pixel electrode **82**. The transverse length of the pixel electrode **82** is longer than the longitudinal length of the pixel electrode **82**. The storage electrode line **28** may be formed along the transverse long axis. The domain dividers **83** and **92** are formed in a diagonal direction between the transverse long axis and gate line **22**. The domains of the pixel electrode **82** are divided into transverse direction. In an embodiment of the present invention, the domain divider **83** of the pixel electrode **82** and the domain divider **92** of the common electrode **90** may be alternately arranged in a transverse direction along the gate lines **22**. In an embodiment, a domain divider **92** of the common electrode **90** is formed in a center of the pixel electrode **82**, the domain divider **83** of the pixel electrode **82** is formed at both sides of the domain divider **92** of the common electrode **90**, and another domain divider **92** of the common electrode **90** is formed at either side of the domain divider **83** of the pixel electrode **82**.

[0050] In an embodiment of the present invention, the pixel electrode **82** includes 8 domains divided by the storage electrode line **28** and the domain dividers **83** and **92**. In an alternative embodiment of the present invention, the domains can be more or less than eight (8).

[0051] An overcoat layer (not shown), which is an insulating layer comprising an organic material, may be interposed between the common electrode **90** and the color filters **98**. The overcoat planarizes the common electrode panel **200**. In an alternative embodiment, the overcoat layer can be omitted. An alignment film (not shown) for aligning liquid crystal molecules may be coated on the common electrode **90**.

[0052] Referring to FIG. 3A, the drain electrode pad **67** is disposed in the center of the pixel electrode **82** to overlap the domain divider **92** of the common electrode **90** to increase an aperture ratio. The drain electrode pad **67** may have various shapes and arrangements.

[0053] Referring to FIG. 3B, the TFT panel **100** and the common electrode panel **200** facing the TFT panel **100** are aligned and connected to each other, and the liquid crystal layer **300** including liquid crystal molecules is interposed therebetween.

[0054] The liquid crystal molecules in the liquid crystal layer **300** are aligned such that long axes of the molecules are substantially perpendicular to the TFT panel **100** and the common electrode panel **200** when there is no electric field applied between the TFT panel **100** and the common electrode panel **200**. In an embodiment, the liquid crystal layer **300** has negative dielectric anisotropy. The TFT panel **100** and the common electrode panel **200** are aligned such that the pixel electrode **82** completely overlaps the correspond-

ing color filter **98**. A pixel area can be divided into multiple domains by the domain divider **83** of the pixel electrode **82** and the domain divider **92** of the common electrode **90**. The pixel area can be divided into multiple domains according to tilt directions upon application of a primary electric field generated by the liquid crystal molecules included in the liquid crystal layer **300**.

[0055] An LCD according to an embodiment of the present invention may further include a polarizing panel, a backlight, and a compensation panel.

[0056] A polarizing panel including a pair of polarizers, may be attached to external surfaces of the LCD such that the transmissive axis **1** of each polarizer is crossed. The pair of polarizers may be positioned so that the transmissive axis **1** of the polarizer can be substantially parallel with the gate lines **22**.

[0057] Referring to FIG. 3A, the application of an electric field to the liquid crystal layer **300** provides tilted liquid crystal molecules in the respective domains in a direction substantially perpendicular to the domain dividers **83** and **92**. Thus, the liquid crystal molecules in the respective domains form an angle of approximately 45 degrees or approximately -45 degrees with respect to the transmissive axis **1** of the polarizer. A lateral electric field produced between the domain dividers **83** and **92** facilitates alignment of the liquid crystal molecules included in the respective domains.

[0058] The multiple domains divided by the domain dividers **83** and **92** according to the tilt directions of the liquid crystal molecules are described with reference to FIG. 3A. The pixel electrode **82** is divided into first and second domain groups in a longitudinal direction with respect to the transverse long axis passing through the center of the pixel electrode **82**. The first domain group includes a plurality of domains A aligned at an angle of approximately 135 degrees and a plurality of domains B aligned at an angle of approximately -45 degrees with respect to the gate lines **22**. The second domain group includes a plurality of domains C aligned at an angle of approximately -135 degrees and a plurality of domains D aligned at an angle of approximately 45 degrees with respect to the gate lines **22**. As shown in FIG. 3A, the first domain group can be arranged such that each of the plurality of domains A and each of the plurality of domains B are alternately arranged. The domains select alternately from the domains A and B, for example, in an A-B-A-B order, may be arranged. The second domain group can be arranged such that each of the plurality of domains C and each of the plurality of domains D are alternately arranged. The domains selected alternately from the domains C and D, for example, in a C-D-C-D order, may be arranged.

[0059] An LCD according to an embodiment of the present invention prevents textures and light leakage.

[0060] The pixel electrode **82** can be a substantially rectangular shape having a transverse length longer than a longitudinal length. The storage electrode line **28** crosses the center of the pixel electrode **82** so that the storage electrode line **28** extends substantially parallel with the gate lines **22**. The domain divider **83** provided in the pixel electrode **82** forms an angle of approximately 45 degrees or -45 degrees with respect to the transmissive axis **1** of the polarizer. In the common electrode **90** facing the pixel electrode **82**, the domain divider **92** forms an angle of approximately 45 degrees or approximately -45 degrees with respect to the

transmissive axis **1** of the polarizer. In such a method, a pixel can be partitioned into multiple domains using the pixel electrode **82** and the domain dividers **83** and **92**.

[0061] When an electric field is applied to liquid crystal molecules due to a voltage difference between the pixel electrode **82** and the common electrode **90**, the liquid crystal molecules in the respective domains are tilted in a direction perpendicular to the domain dividers **83** and **92**. Accordingly, the liquid crystal molecules in the respective domains are tilted at an angle of approximately 45 degrees or approximately -45 degrees with respect to the transmissive axis **1** of the polarizer.

[0062] An LCD according to an embodiment can achieve a wide viewing angle by driving a pixel divided into multiple domains and can increase a high aperture ratio by reducing an occupied area using the domain dividers **83** and **92**. An instantaneous residual image can be suppressed by adjusting a distance between the domain divider **83** formed on the pixel electrode **82** and the domain divider **92** formed on the common electrode **90**.

[0063] In an LCD, textures may cause light leakage. Textures may occur in the vicinity of the data lines **62** extending in the longitudinal direction because a relatively high data voltage is transmitted through the data lines **62**. The high data voltage produces a lateral electric field in the vicinity of the data lines **62**. Thus, when an electric field is applied to liquid crystal molecules in the vicinity of the data lines **62**, the liquid crystal molecules are affected by both the lateral electric field produced from the data lines **62** and a lateral electric field produced from the domain dividers **83** and **92** extending in diagonal directions. Tilt directions of the liquid crystal molecules in a single domain are different from one another, resulting in textures and light leakage. In an LCD according to an embodiment of the present invention, since the transverse length of the pixel electrode **82** is longer than the longitudinal length thereof, occurrence of textures due to the lateral electric field produced from the data lines **62** can be suppressed by reducing an area of the pixel electrode **82** adjacent to the data lines **62**.

[0064] In an LCD according to an embodiment of the present invention, when using the passivation layer **70** comprising an inorganic material, a storage electrode **29** in the form of a branch of a storage electrode line **28** may overlap the domain divider **83**, thereby reducing a width of the domain divider **83** formed on the pixel electrode **82** to approximately 6 μm or less. In other words, since the passivation layer **70** comprising an inorganic material has a relatively small thickness, a lateral electric field effect produced from the storage electrode **29** can be strengthened. Therefore, even if the width of the domain divider **83** is reduced to approximately 6 μm or less, a sufficient lateral electric field can be achieved by forming the storage electrode **29** below the domain divider **83**.

[0065] A liquid crystal display according to an embodiment of the present invention is described with reference to FIGS. **4** through **6**. FIG. **4** is a layout view of a TFT panel of an LCD according to an embodiment of the present invention. FIG. **5** is a layout view of a common electrode panel of the LCD according to an embodiment of the present invention. FIG. **6** is a layout view of the LCD according to an embodiment of the present invention including the TFT panel shown in FIG. **4** and the common electrode panel shown in FIG. **5**. The liquid crystal display panel in accordance with an embodiment has a substantially similar con-

figuration as the liquid crystal display panel according to the embodiment described in connection with FIG. **1** through FIG. **3C** except for the following.

[0066] Referring to FIGS. **4** through **6**, the pixel electrode **82** is divided into multiple domains by a domain divider **483** forming an angle of approximately 45 degrees or approximately -45 degrees with respect to a transmissive axis **1** of a polarizer. The domain divider **483** of the pixel electrode **82** is formed in a center of the pixel electrode **82**. The common electrode **90** is divided into multiple domains by a domain divider **592** forming an angle of approximately 45 degrees or approximately -45 degrees with respect to the transmissive axis **1** of the polarizer. The domain divider **592** of the common electrode **90** is formed at both sides of the domain divider **483** of the pixel electrode **82**. In an embodiment, cutouts are provided on the pixel electrode **82** or the common electrode **90** in a diagonal direction. In an embodiment, protrusions may be provided on the pixel electrode **82** or the common electrode **90** as a domain divider. The pixel electrode **82** may be divided into multiple domains by the domain divider **483** of the pixel electrode **82** and the domain divider **592** of the common electrode **90**.

[0067] Multiple domains divided by the domain dividers **483** and **592** according to the tilt directions of the liquid crystal molecules is described with reference to FIG. **6**. The pixel electrode **82** is divided into first and second domain groups in a longitudinal direction with respect to the transverse long axis passing through the center of the pixel electrode **82**. In an embodiment, the first domain group includes a plurality of domains A aligned at an angle of approximately 135 degrees and a plurality of domains B aligned at an angle of approximately -45 degrees with respect to gate lines **22**. The second domain group includes a plurality of domains C aligned at an angle of approximately -135 degrees and a plurality of domains D aligned at an angle of approximately 45 degrees with respect to the gate lines **22**. As shown in FIG. **6**, the first domain group can be arranged such that each of the plurality of domains A and each of the plurality of domains B are alternately arranged. The domains selected alternately from the domains A and B, for example, in a B-A-B-A order, may be arranged. The second domain group can be arranged such that each of the plurality of domains C and each of the plurality of domains D are alternately arranged. The domains selected alternately from the domains C and D, for example, in a D-C-D-C order, may be arranged.

[0068] An LCD according to an embodiment can achieve a wide viewing angle by driving a pixel divided into multiple domains and increasing a high aperture ratio by reducing an occupied area using the domain dividers **483** and **592**. In addition, an instantaneous residual image can be suppressed by adjusting a distance between the domain divider **483** formed on the pixel electrode **82** and the domain divider **592** formed on the common electrode **90**.

[0069] Since the transverse length of the pixel electrode **82** is longer than the longitudinal length thereof, occurrence of textures due to the lateral electric field produced from data lines **62** can be suppressed by reducing an area of the pixel electrode **82** adjacent to the data lines **62**.

[0070] When a passivation layer **70** having a double-layered structure comprising an inorganic material and an organic material is used and the passivation layer **70** has a relatively large thickness, a lateral electric field effect produced from a storage electrode **29** may not be significant.

Therefore, to achieve a sufficient lateral electric field, a width of the domain divider **83** can be reduced to approximately 10 μm or less.

[0071] A liquid crystal display according to an embodiment of the present invention is described with reference to FIG. 7. FIG. 7 is a layout view of an LCD according to an embodiment of the present invention. The liquid crystal display panel in this embodiment has a substantially similar configuration as the liquid crystal display panel according to an embodiment described in connection with FIGS. 1A through 3C except for the following.

[0072] Referring to FIG. 7, each of data lines **762** includes bent portions and longitudinal portions. The bent portions of the data line **762** form an angle of approximately 45 degrees or -45 degrees with respect to a transmissive axis **1** of a polarizer. Therefore, occurrence of texture due to abnormal alignment of liquid crystal molecules in the vicinity of data line **762** can be prevented by producing lateral electric fields of the same directions to domain dividers **83** and **92** and the data lines **762**.

[0073] A liquid crystal display according to an embodiment of the present invention is described with reference to FIG. 8. FIG. 8 is a layout view of an LCD according to an embodiment of the present invention. A liquid crystal display panel in this embodiment has a substantially similar configuration as the liquid crystal display panel in an embodiment described in connection with FIG. 4 through FIG. 6 except for the following.

[0074] Referring to FIG. 8, each of data lines **862** includes bent portions and longitudinal portions. The bent portions of the data line **862** form an angle of approximately 45 degrees or approximately -45 degrees with respect to a transmissive axis **1** of a polarizer. Therefore, occurrence of textures due to abnormal alignment of liquid crystal molecules in the vicinity of data line **862** can be prevented by producing lateral electric fields of the same directions to domain dividers **483** and **592** and the data lines **862**.

[0075] According to an embodiment of the present invention, instantaneous residual images and textures can be prevented and a high aperture ratio and a wide viewing angle can be achieved.

[0076] Although the exemplary embodiments of the present invention have been described with reference to the accompanying drawings, it is to be understood that the present invention should not be limited to these precise embodiments but various changes and modifications can be made by one ordinary skill in the art without departing from the spirit and scope of the present invention. All such changes and modifications are intended to be included with the scope of the invention as defined by the appended claims.

What is claimed is:

1. A liquid crystal display comprising:

a thin film transistor (TFT) panel including a pixel electrode in a rectangular shape having a transverse length longer than a longitudinal length, the pixel electrode including a first domain divider and having upper and lower half portions arranged symmetrically with respect to a transverse long axis passing through a center of the pixel electrode;

a common electrode panel including a common electrode facing the pixel electrode, the common electrode including a second domain divider arranged parallel with the first domain divider; and

a liquid crystal layer interposed between the TFT panel and the common electrode panel.

2. The liquid crystal display of claim 1, further comprising first and second polarizers attached to external surfaces of the TFT panel and the common electrode panel, respectively.

3. The liquid crystal display of claim 2, wherein the first and second domain dividers form an angle of approximately 45 degrees or approximately -45 degrees with respect to a transmissive axis of each polarizer.

4. The liquid crystal display of claim 3, wherein in the first and second domain dividers, portions forming an angle of approximately 45 degrees and portions forming an angle of approximately -45 degrees with respect to the transmissive axis of the polarizer are separately arranged from one another with respect to the transverse long axis.

5. The liquid crystal display of claim 1, wherein the first and second domain dividers are alternately arranged.

6. The liquid crystal display of claim 1, wherein the second domain divider is positioned in the center of the pixel electrode and the first domain divider is positioned at both sides of the second domain divider.

7. The liquid crystal display of claim 6, further comprising a storage electrode wire provided on the TFT panel to form a storage capacity together with the pixel electrode, wherein the storage electrode wire comprises a storage electrode line extending in the transverse long axis passing through the center of the pixel electrode, and a storage electrode branched from the storage electrode line to overlap the first domain divider.

8. The liquid crystal display of claim 1, wherein the first domain divider is positioned in the center of the pixel electrode and the second domain divider is positioned at both sides of the first domain divider.

9. The liquid crystal display of claim 8, further comprising a storage electrode wire provided on the TFT panel to form a storage capacitor together with the pixel electrode, wherein the storage electrode line extends in the transverse long axis passing through the center of the pixel electrode.

10. The liquid crystal display of claim 1, further comprising a passivation layer provided below the pixel electrode, wherein the passivation layer comprises an inorganic insulator and protects a structure on the TFT panel, and the first domain divider has a width of approximately 6 μm or less.

11. The liquid crystal display of claim 1, further comprising a passivation layer provided below the pixel electrode, wherein the passivation layer protects a structure on the TFT panel and includes a double-layered structure comprising an inorganic layer and an organic layer, and the first domain divider has a width of approximately 10 μm or less.

12. The liquid crystal display of claim 1, wherein the common electrode panel comprises color filters arranged on an area corresponding to the pixel electrode, the color filters including red, green, and blue color filters repeatedly arranged in a longitudinal direction.

13. The liquid crystal display of claim 1, wherein the TFT panel comprises:

an insulating substrate;

a gate line extending on the insulating substrate in a transverse direction;

a data line crossing the gate line and extending in a longitudinal direction; and

a TFT connected to the gate line, the data line, and the pixel electrode.

14. The liquid crystal display of claim **1**, wherein the TFT panel comprises:

- an insulating substrate;
- a gate line extending on the insulating substrate in a transverse direction;
- a data line crossing the gate line and having bent portions and longitudinal portions; and
- a TFT connected to the gate line, the data line and the pixel electrode.

15. The liquid crystal display of claim **14**, further comprising first and second polarizers attached to external surfaces of the TFT panel and the common electrode panel, respectively.

16. The liquid crystal display of claim **15**, wherein the bent portions of the data line form an angle of approximately 45 degrees or approximately -45 degrees with respect to a transmissive axis of each polarizer.

17. A liquid crystal display comprising:

- an insulating substrate;
- a plurality of gate lines formed on the insulating substrate;
- a plurality of data lines crossing the plurality of gate lines;
- a plurality of pixel electrodes formed on the insulating substrate in a matrix and each pixel electrode having a first side parallel to the plurality of gate lines and a second side shorter than the first side, the second side being adjacent to the first side;
- a common electrode facing the plurality of pixel electrodes; and
- a liquid crystal layer interposed between the plurality of pixel electrodes and the common electrode panel and having liquid crystal molecules, wherein the liquid crystal layer includes a first domain group and a second domain group, the first domain group including the liquid crystal molecules aligned at an angle of approxi-

mately 135 degrees or approximately -45 degrees with respect to the gate lines and the second domain group including the liquid crystal molecules aligned at an angle of approximately -135 degrees or approximately 45 degrees with respect to the gate lines.

18. The liquid crystal display of claim **17**, wherein the first domain group includes a plurality of domains aligned at an angle of approximately 135 degrees and a plurality of domains aligned at an angle of approximately -45 degrees with respect to the gate lines, and the second domain group includes a plurality of domains aligned at an angle or approximately -135 degrees and a plurality of domains aligned at an angle of approximately 45 degrees with respect to the gate lines.

19. The liquid crystal display of claim **17**, wherein the pixel electrode includes a first domain divider, wherein each of the plurality of domains includes upper and lower half portions arranged symmetrically with respect to a transverse long axis passing through the center of the pixel electrode, and the common electrode includes a second domain divider parallel to the first domain divider.

20. The liquid crystal display of claim **19**, wherein the first domain divider includes a first portion forming an angle of approximately 45 degrees and a second portion forming an angle of approximately -45 degrees with respect to the gate lines.

21. The liquid crystal display of claim **20**, wherein the first and second portions are separately arranged from each other with respect to the transverse long axis.

22. The liquid crystal display of claim **19**, wherein the first and second domain dividers are alternately arranged.

* * * * *

专利名称(译)	液晶显示器		
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摘要(译)

该液晶显示器包括薄膜晶体管 (TFT) 面板, 该薄膜晶体管 (TFT) 面板包括矩形形状的像素电极, 该像素电极具有比纵向长度更长的横向长度, 该像素电极包括第一畴分隔器并具有相对于对称布置的上半部和下半部穿过像素电极的中心的横向长轴, 包括面向像素电极的公共电极的公共电极板, 公共电极包括与第一畴分隔器平行布置的第二畴分隔器, 以及插入其间的液晶层TFT面板和公共电极面板。

