

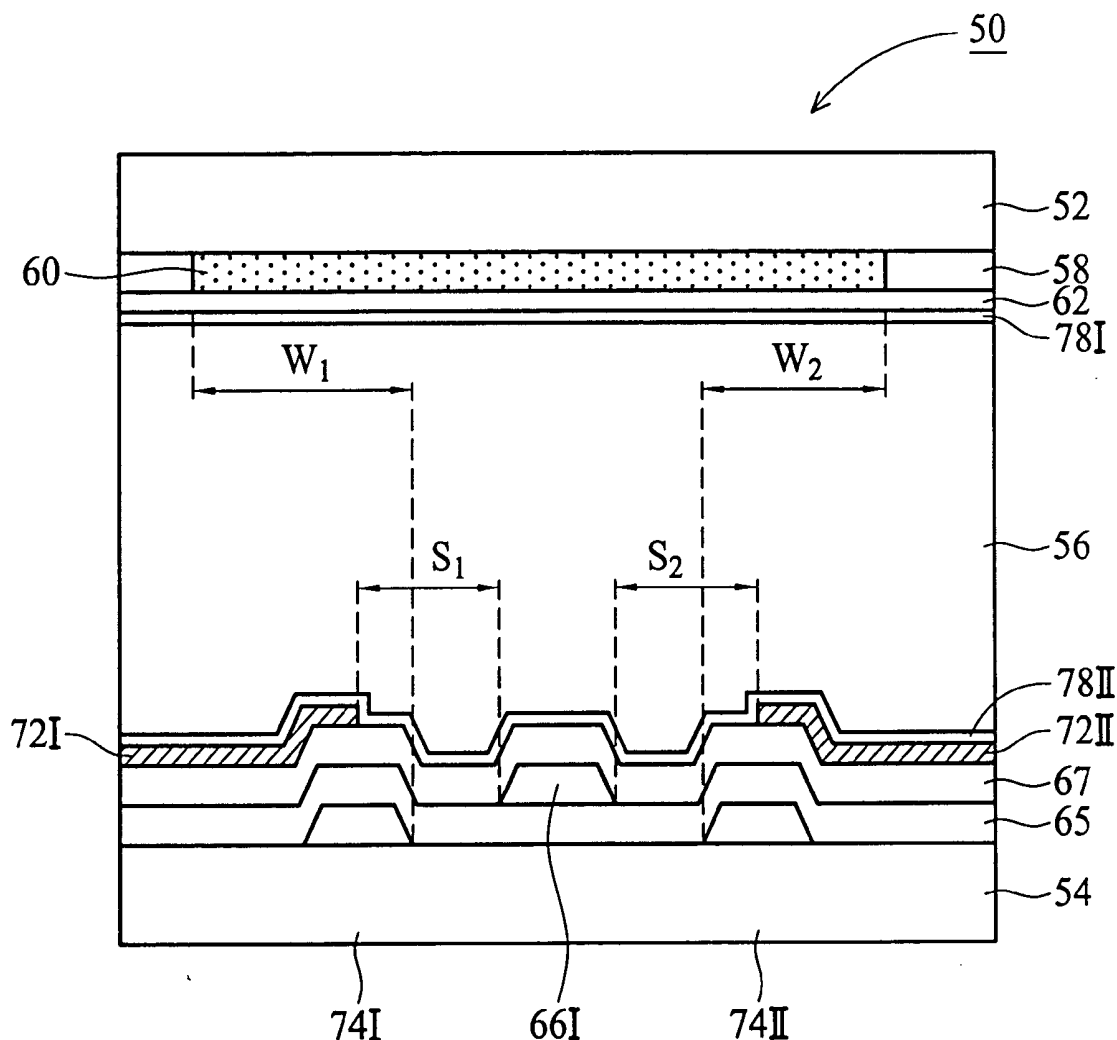


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A liquid crystal display device has a pixel electrode layer formed between a first data bus line and a second bus line. A first space between the first data bus line and the periphery of the pixel electrode layer is different from a second space between the second data bus line and the periphery of the pixel electrode layer.

(21) Appl. No.: **10/621,881**



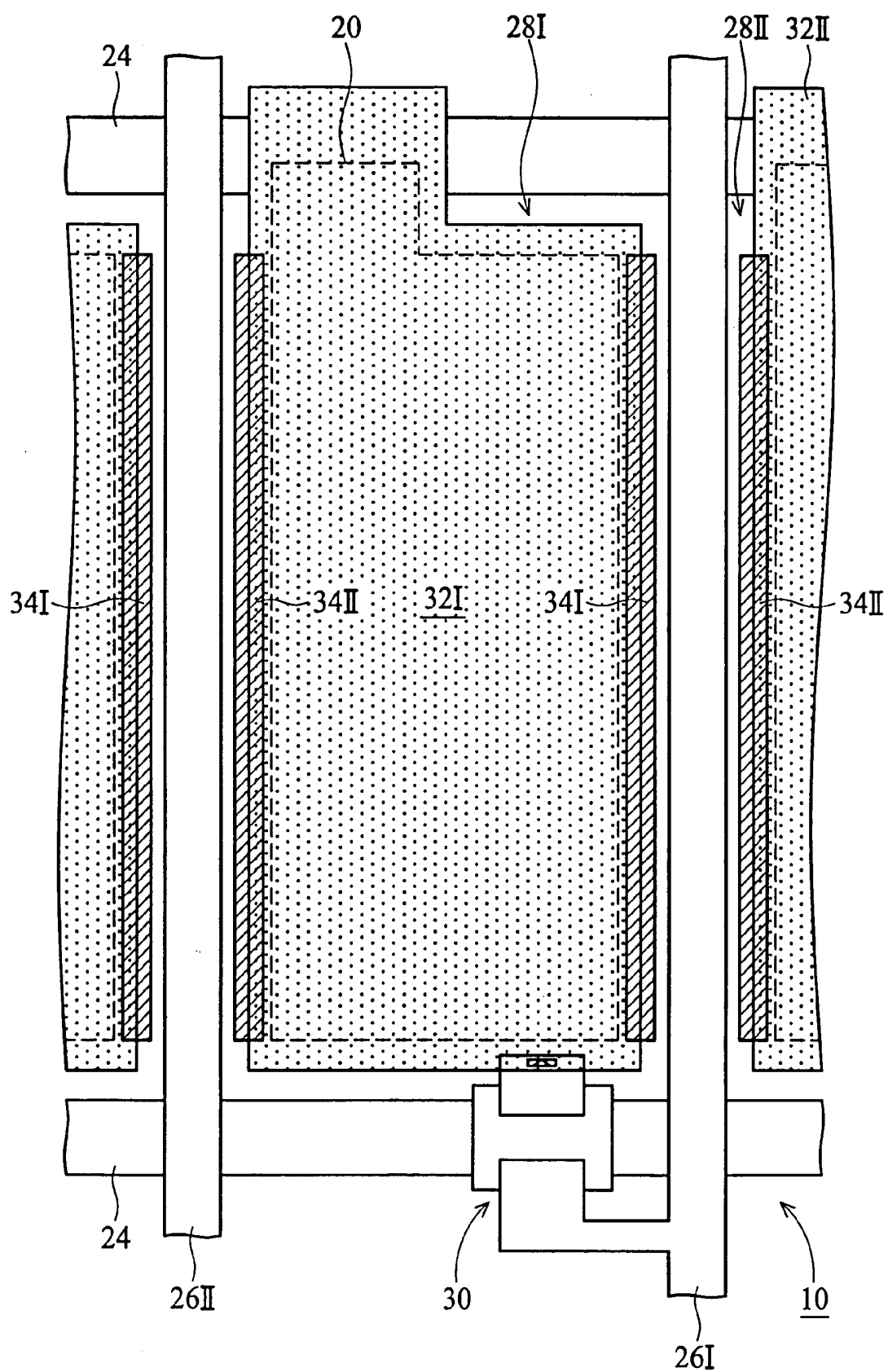


FIG. 1 (PRIOR ART)

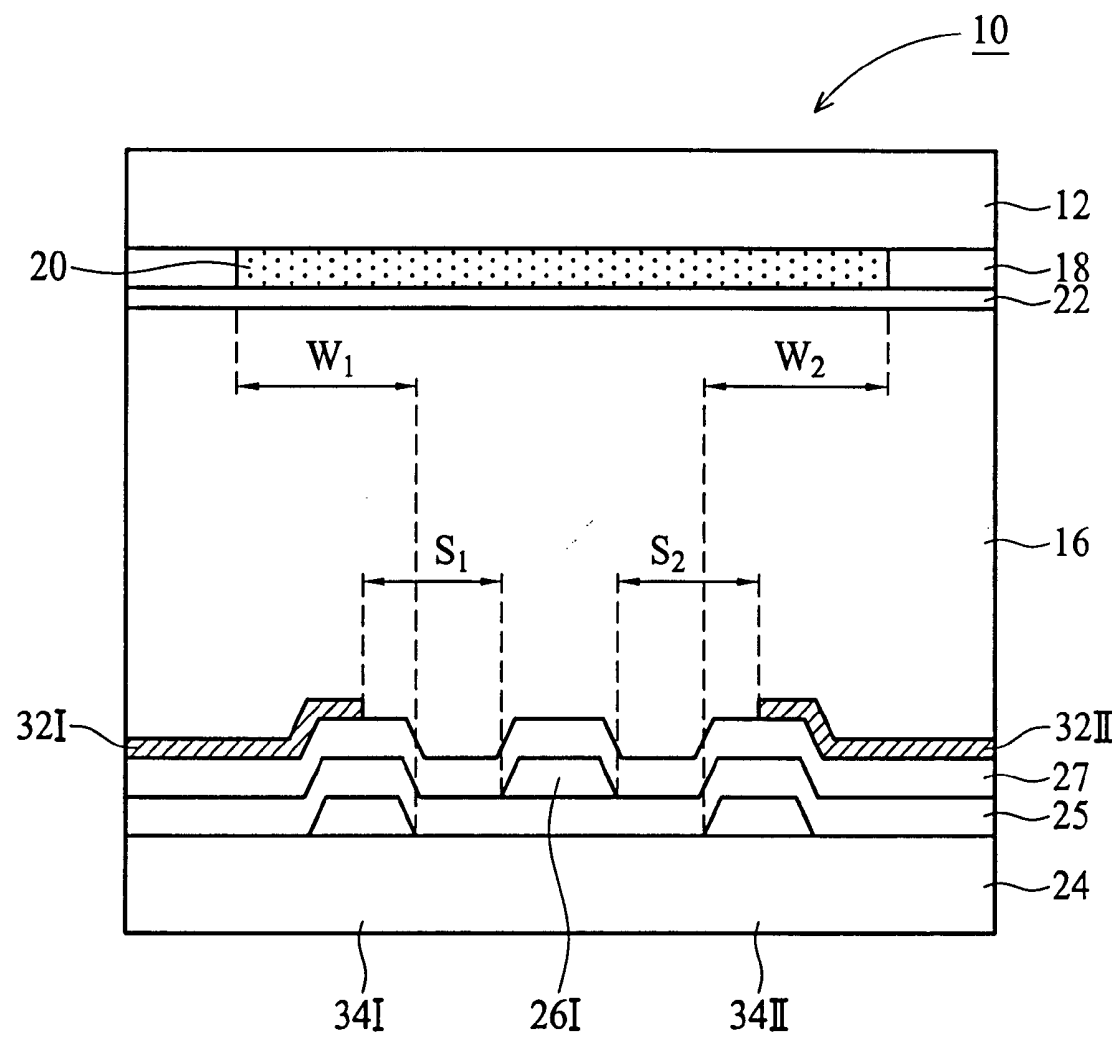


FIG. 2 (PRIOR ART)

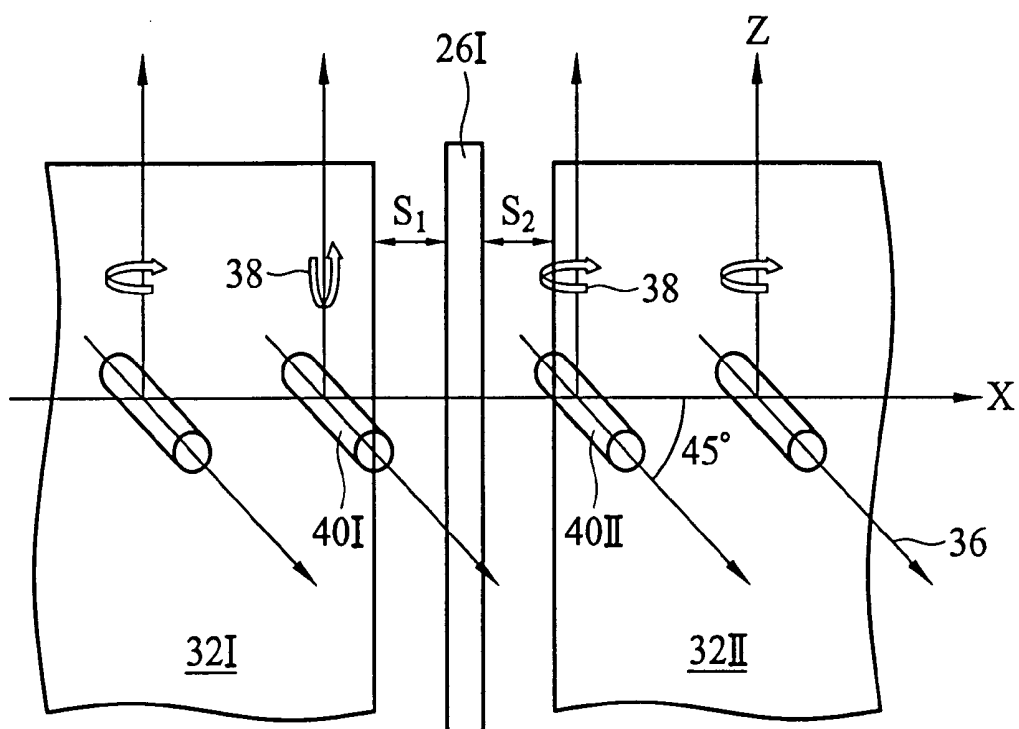
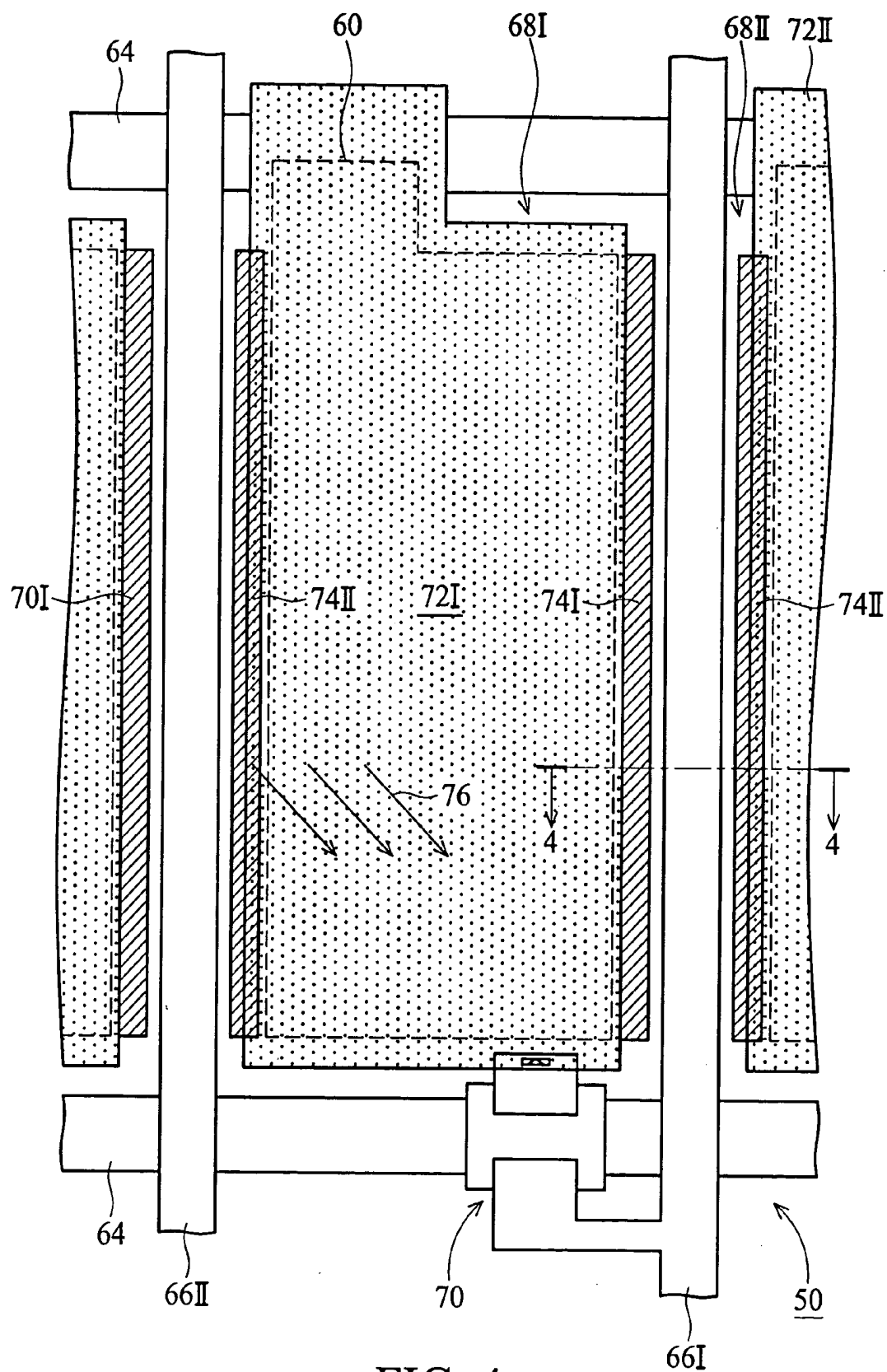


FIG. 3 (PRIOR ART)



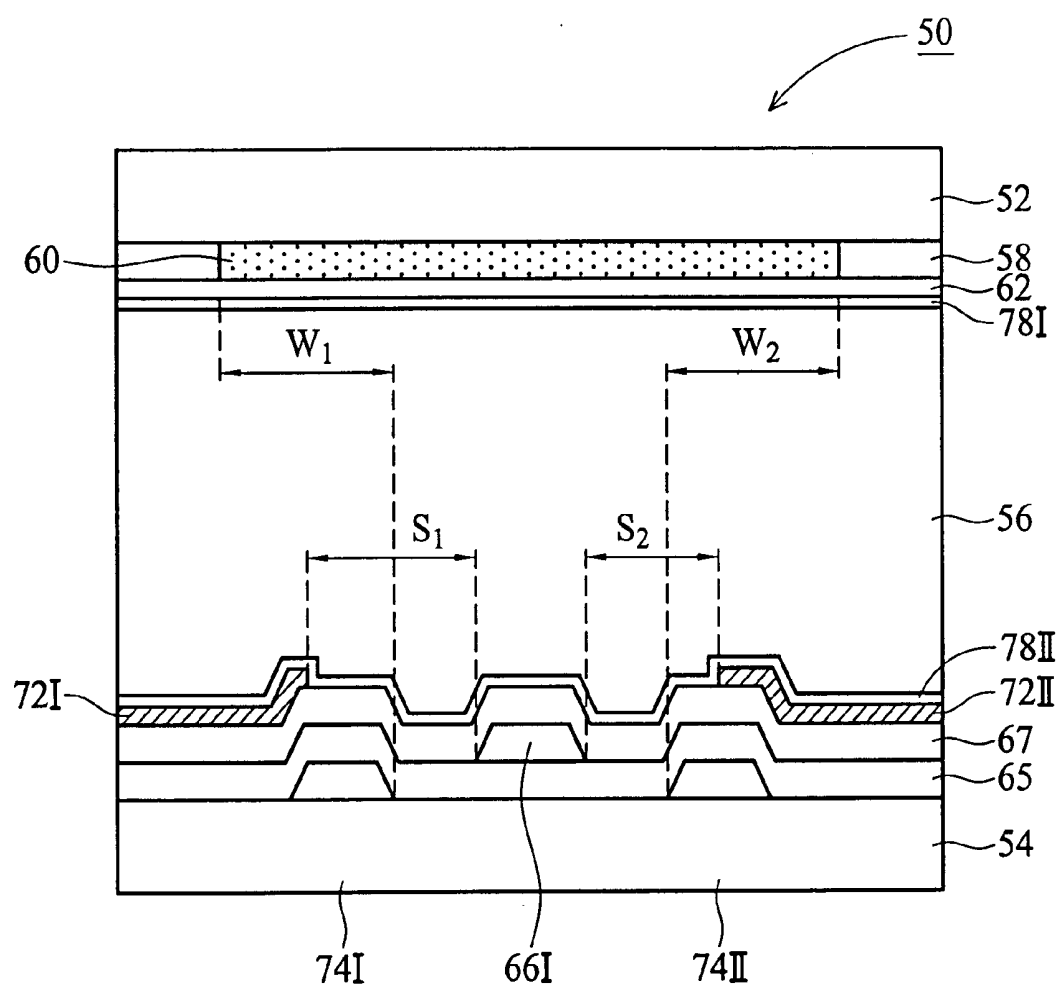


FIG. 5

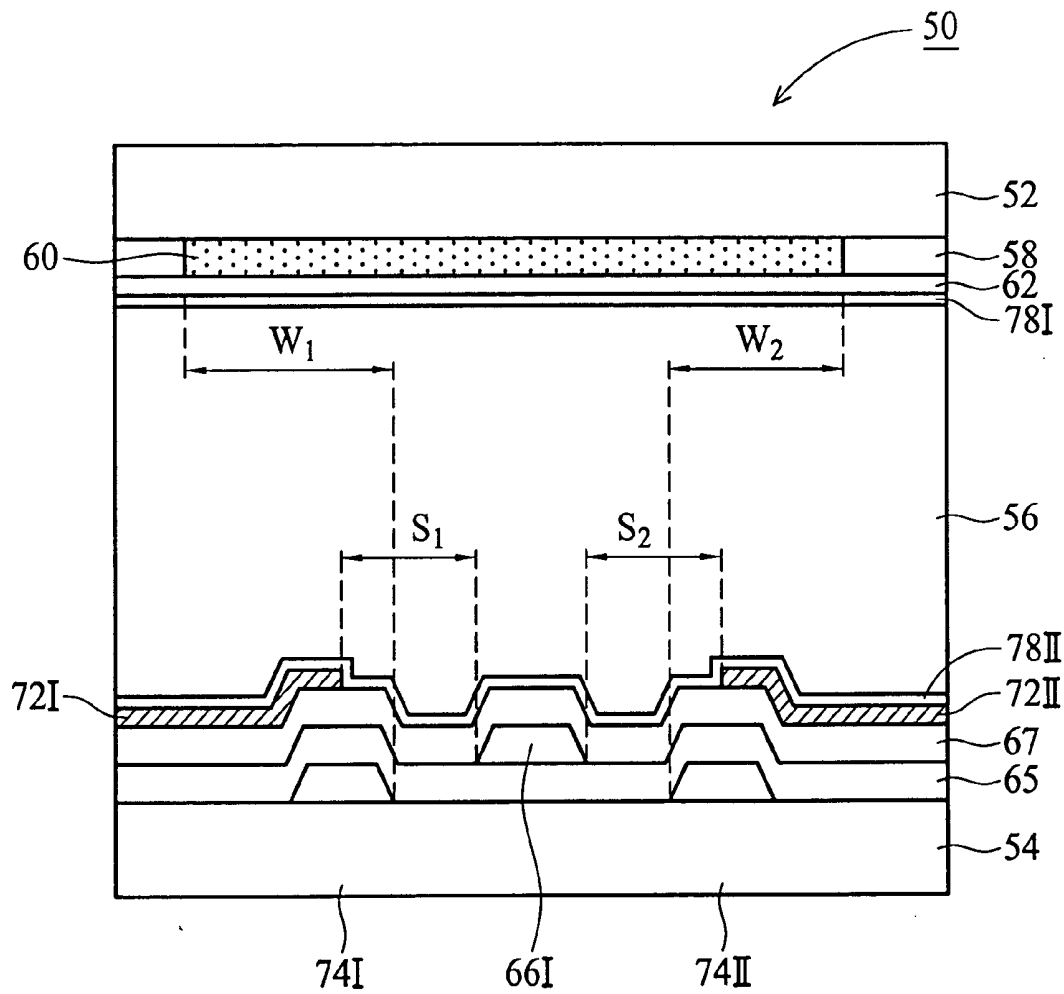


FIG. 6

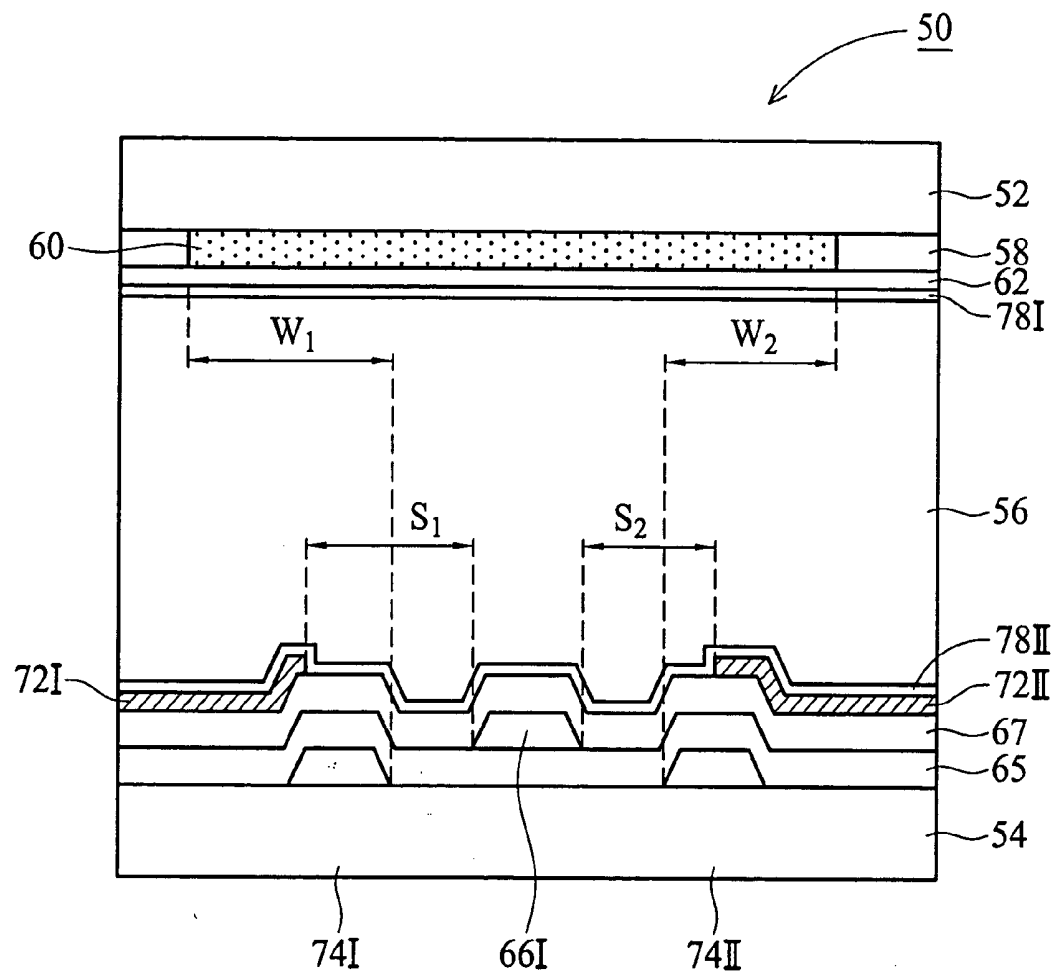


FIG. 7

LIQUID CRYSTAL DISPLAY DEVICE AND FABRICATION METHOD THEREOF

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The invention relates to a liquid crystal display (LCD) device and more particularly to an LCD device with a non-symmetric design for a space between a data bus line and a pixel electrode in order to effectively prevent a disclination effect generated in a liquid crystal reverse region.

[0003] 2. Description of the Related Art

[0004] Liquid crystal display (LCD) devices are a well-known form of flat panel display with advantages of low power consumption, light weight, thin profile and low driving voltage. Liquid crystal molecules change their orientations and photo-electronic effects when an electrical field is applied. In an LCD display region, an array of pixel regions is patterned by horizontally extended scanning bus lines and vertically extended data bus lines. For a TFT-LCD device, each pixel region has a thin film transistor (TFT) and a pixel electrode, in which the TFT serves as a switching device. The conventional electrode array design for a TFT-LCD device, however, has the disadvantage of the so-called Mura phenomenon caused by a disclination effect. The Mura phenomenon is considered a push Mura area with light strips which are visible on the LCD screen and detectable in gray scale.

[0005] The disclination effect is caused by a strong lateral direction electrical field between the pixel electrode and the data bus line, resulting in a light leakage area. In order to eliminate the disclination effect, a transparent insulating film with a thickness of 1 μm or more is interposed between the data bus line and the pixel electrode, and the space between two adjacent pixel electrodes is narrowed to reach 2~5 μm to overlap the periphery of the data bus line. This electrode array design, however, causes problems of coupling capacitance and cross talk between the pixel electrode and the data bus line.

[0006] Currently, two approaches to the disclination effect have been developed, in which one is to keep a sufficient space between the pixel electrode and the data bus line, and the other one is to employ a BM (black matrix) pattern for shielding the light leakage area. FIG. 1 is a plane view illustrating an electrode array of a conventional TFT-LCD device. FIG. 2 is a cross-section along line 1-1 of FIG. 1 illustrating the space between the data bus line and the pixel electrode. A TFT-LCD device 10 comprises an upper glass substrate 12, a lower glass substrate 14 and an LC layer 16 interposed therebetween. The upper glass substrate 12 comprises a color filter (CF) layer 18, a black matrix (BM) layer 20 and a common electrode layer 22. The lower glass substrate 14 comprises a plurality of horizontally extended scanning bus lines 24 and a plurality of vertically extended data bus lines 26 which are perpendicularly arranged in a matrix form to define a plurality of pixel areas 28. Each of the pixel areas 28 comprises a TFT device 30, a pixel electrode layer 32 and a pair of light-shielding layers 34.

[0007] First, a first metal layer is deposited and patterned as the light-shielding layers 34 and the scanning bus lines 24, and then a gate insulating layer 25 is deposited thereon.

Next, a second metal layer is deposited and patterned as the data bus lines 26, and then a passivation layer 27 is deposited on the data bus lines 26 and the gate insulating layer 27. Next, a transparent conductive layer is deposited and patterned as the pixel electrode layer 32. In addition, the BM layer 20 overlap the TFT device 30, the light-leakage gap between the scanning bus line 24 and the periphery of the pixel electrode layer 32, and the light-leakage gap between the data bus line 26 and the periphery of the pixel electrode layer 32. Also, the BM layer 20 may fully overlaps the light-shielding layers 34.

[0008] In FIG. 1, the light-shielding layer 34 extends along the data bus line 26 without connecting the scanning bus line 24 and is positioned in a space between the data bus line 26 and the periphery of the pixel electrode layer 32. Preferably, in the first pixel area 28I, the first light-shielding layer 34I is positioned in a first space between the first data bus line 26I and the periphery of the first pixel electrode layer 32I, and the second light-shielding layer 34II is positioned in a second space between the second data bus line 26II and the periphery of the first pixel electrode layer 32I. Also, the first-shielding layer 34I is partially overlapped by the periphery of the first pixel electrode layer 32I, and the second-shielding layer 34II is partially overlapped by the periphery of the first pixel electrode layer 32I.

[0009] In FIG. 2, using the first data bus line 26I as the criterion, a symbol " S_1 " indicates a first space between the first data bus line 34I and the periphery of the first pixel electrode layer 32I within the first pixel area 28I, and a symbol " S_2 " indicates a second space between the first data bus line 26I and the periphery of the second pixel electrode layer 32I within the second pixel area 28II. According to a symmetric design, the first space S_1 is equal to the second space S_2 , approximately 3.5 μm . Also, a symbol " W_1 " indicates a first overlapping width between the BM layer 20 and the first light-shielding layer 34I, and a symbol " W_2 " indicates a second overlapping width between the BM layer 20 and the second light-shielding layer 34II. According to a symmetric design, the first overlapping width W_1 is equal to the second overlapping width W_2 , approximately 6.0 μm .

[0010] In order to prevent the disclination effect, the conventional TFT-LCD device 10 employs the sufficient space S_1 or S_2 to minimize the coupling capacitance and the electrical field between the data bus line 26 and the periphery of the pixel electrode layer 32. The symmetric design rule for the spaces S_1 and S_2 , however, is ineffective because the disclination level in the first space S_1 is different from that in the second space S_2 in accordance with a rubbing direction and the LC molecule rotation. FIG. 3 is a plane view illustrating the disclination level in the first space S_1 and the second space S_2 . An arrow 36 indicates a rubbing direction on an alignment film, an arrow 38 indicates an LC rotating direction, and the character 40 indicates an LC molecule. When an outer voltage is applied to the TFT-LCD device 10, the LC molecules 40 arise in a pretilt direction in accordance with the rubbing direction 36. When a strong lateral electrical field between the pixel electrode layer 32 and the data bus line 26 is generated in reverse to the pretilt direction, the LC molecule 40 is oriented to the direction of the lateral electrical field to reach a reverse tilt state, resulting in a disclination effect at a boundary between the normal tilt region and the reverse tilt region. In particular when the rubbing direction 36 is at a 45° angle to the X axis,

the LC molecule **40I** adjacent to the first space S_1 always rotates to the reverse tilt state, thus the disclination effect adjacent to the first space S_1 is more serious than that adjacent to the second space S_2 . Based on the symmetric design for the first space S_1 and the second space S_2 , a larger space between the data bus line **26** and the periphery of the pixel electrode layer **32** is required to solve the disclination effect found in the first space S_1 , but an accompanying problem of increased light leakage occurs.

SUMMARY OF THE INVENTION

[0011] Accordingly, an object of the present invention is to provide an LCD device with a non-symmetric design for a space between a pixel electrode and a data bus line in order to effectively prevent a disclination effect generated in a liquid crystal reverse region.

[0012] According to the object of the invention, a liquid crystal display device comprises a first substrate, a second substrate and a liquid crystal layer formed therebetween. A plurality of scanning bus lines and a plurality of data bus lines are perpendicularly arranged in a matrix form to define a plurality of pixel areas. A plurality of TFT devices is formed in the plurality of pixels, respectively. A plurality of pixel electrode layers is formed in the plurality of pixels, respectively. In each pixel area, the pixel electrode layer is formed between a first data bus line and a second data bus line, and a first space between the first data bus line and the periphery of the pixel electrode layer is different from a second space between the second data bus line and the periphery of the pixel electrode layer.

DESCRIPTION OF THE DRAWINGS

[0013] The present invention will become more fully understood from the detailed description given hereinbelow and the accompanying drawings, given by way of illustration only and thus not intended to be limitative of the present invention.

[0014] FIG. 1 is a plane view illustrating an electrode array of a conventional TFT-LCD device.

[0015] FIG. 2 is a cross-section along line 1-1 of FIG. 1 illustrating the space between the data bus line and the pixel electrode.

[0016] FIG. 3 is a plane view illustrating the disclination level in the first space and the second space.

[0017] FIG. 4 is a plane view illustrating an electrode array of a TFT-LCD device according to the first embodiment of the present invention.

[0018] FIG. 5 is a cross-section along line 4-4 of FIG. 4 illustrating the non-symmetric design for the data bus line and the pixel electrode.

[0019] FIG. 6 is a cross-section illustrating a non-symmetric design according to the second embodiment of the present invention.

[0020] FIG. 7 is a cross-section illustrating a non-symmetric design according to the third embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0021] First Embodiment

[0022] FIG. 4 is a plane view illustrating an electrode array of a TFT-LCD device according to the first embodiment of the present invention. FIG. 5 is a cross-section along line 4-4 of FIG. 4 illustrating the non-symmetric design for the data bus line and the pixel electrode.

[0023] A TFT-LCD device **50** comprises an upper substrate **52**, a lower substrate **54** and an LC layer **56** interposed therebetween. Preferably, the upper substrate **52** and the lower substrate **54** are glass substrates and opposed to each other in parallel. The upper substrate **52** comprises a color filter (CF) layer **58**, an opaque layer **60**, a common electrode layer **62** and an upper alignment film **78I** with a rubbing direction **76**. Preferably, the opaque layer **60** is a black matrix (BM) layer.

[0024] The lower substrate **54** comprises a plurality of horizontally extended scanning bus lines **64** and a plurality of vertically extended data bus lines **66** which are perpendicularly arranged in a matrix form to define a plurality of pixel areas **68**. Each of the pixel areas **68** comprises a TFT device **70**, a pixel electrode layer **72** and a pair of light-shielding layers **74**. In addition, the opaque layer **60** overlaps the TFT device **70**, the light-leakage gap between the scanning bus line **64** and the periphery of the pixel electrode layer **72**, and the light-leakage gap between the data bus line **66** and the periphery of the pixel electrode layer **72**. Also, the opaque layer **60** may partially or fully overlap the light-shielding layer **74** in accordance with the non-symmetric design rule of the first embodiment.

[0025] The fabrication method for an electrode array on the lower substrate **54** is now described. First, a first metal layer is deposited and patterned as the light-shielding layers **74** and the scanning bus lines **64**, and then a gate insulating layer **65** is deposited thereon. Next, a second metal layer is deposited and patterned as the data bus lines **66**, and then a passivation layer **67** is deposited on the data bus lines **66** and the gate insulating layer **65**. Next, a transparent conductive layer (such as an ITO layer) is deposited and patterned as the pixel electrode layer **72**. Finally, a lower alignment film **78II** with a rubbing direction **76** is formed on the pixel electrodes layer **72** and the passivation layer **67**.

[0026] In FIG. 4, the light-shielding layer **74** extends along the data bus line **66** without connecting the scanning bus line **64** and is positioned in a space between the data bus line **66** and the periphery of the pixel electrode layer **72**. Preferably, in the first pixel area **68I**, the first light-shielding layer **74I** is positioned in a first space between the first data bus line **66I** and the periphery of the first pixel electrode layer **72I**, and the second light-shielding layer **74II** is positioned in a second space between the second data bus line **66II** and the periphery of the first pixel electrode layer **72I**. Moreover, in accordance with the non-symmetric design rule of the first embodiment, the first-shielding layer **74I** or the second-shielding layer **74II** may be partially overlapped by the periphery of the first pixel electrode layer **72I**. Alternatively, the first-shielding layer **74I** or the second-shielding layer **74II** may not be overlapped by the periphery of the first pixel electrode layer **72I**.

[0027] In FIG. 5, using the first data bus line **66I** as the criterion, a symbol " S_1 " indicates a first space between the

first data bus line **64I** and the periphery of the first pixel electrode layer **72I** within the first pixel area **68I**, and a symbol " S_2 " indicates a second space between the first data bus line **66I** and the periphery of the second pixel electrode layer **72II** within the second pixel area **68II**. According to a non-symmetric design for the TFT-LCD device **50**, the first space S_1 of 3~5 μm and the second space S_2 of 3~5 μm satisfy the formula: $S_1 \neq S_2$. Especially when an included angle between the rubbing direction **76** and the data bus line **66** is 40~50 degrees, the first space S_1 between the first data bus line **66I** and the periphery of the first pixel electrode layer **72I** is a liquid crystal reverse region, and the second space S_2 between the first data bus line **66I** and the periphery of the second pixel electrode layer **72II** is a liquid crystal non-reverse region. Thus, the first space S_1 and the second space S_2 satisfy the formula: $S_1 > S_2$, in which the first space S_1 is preferably 4~5 μm , and the second space S_2 is preferably 2~3 μm .

[0028] Also, a symbol " W_1 " indicates a first overlapping width between the opaque layer **60** and the first light-shielding layer **74I**, and a symbol " W_2 " indicates a second overlapping width between the opaque layer **60** and the second light-shielding layer **74II**. The first embodiment provides a symmetric design for the first overlapping width W_1 and the second overlapping width W_2 , thus the first overlapping width W_1 of 5~7 μm and the second overlapping width W_2 of 5~7 μm satisfy the formula: $W_1 = W_2$. Preferably, the first overlapping width W_1 is preferably 6 μm , and the second overlapping width W_2 is 6 μm .

[0029] Compared with the conventional symmetric design rule for the spaces S_1 and S_2 , the present invention provides a non-symmetric design for the spaces S_1 and S_2 to effectively prevent the disclination effect from the different disclination levels in the first space S_1 and the second space S_2 . Particularly, the first space S_1 larger than the second space S_2 can solve the serious disclination effect in the liquid crystal reverse region without increasing light leakage by enlarging the first space S_1 and the second space S_2 at the same time.

[0030] Second Embodiment

[0031] FIG. 6 is a cross-section illustrating a non-symmetric design according to the second embodiment of the present invention.

[0032] The elements in the second embodiment are substantially similar to that of the first embodiment, with the similar portions omitted herein. One dissimilar portion is a non-symmetric design for the first overlapping width W_1 and the second overlapping width W_2 , and the other one dissimilar portion is a symmetric design for the first space S_1 and the second space S_2 . According to a non-symmetric design for the first overlapping width W_1 and the second overlapping width W_2 , the first overlapping width W_1 of 4~8 μm and the second overlapping width W_2 of 4~8 μm satisfy the formula: $W_1 \neq W_2$. Especially when an included angle between the rubbing direction **76** and the data bus line **66** is 40~50 degrees, the first space S_1 is a liquid crystal reverse region, and the second space S_2 is a liquid crystal non-reverse region, thus the first overlapping width W_1 and the second overlapping width W_2 satisfy the formula: $W_1 > W_2$, in which the first overlapping width W_1 is preferably 6.5~7.5 μm and the second overlapping width W_2 is preferably 4.5~5.5 μm . With regard to the symmetric design for the first

space S_1 and the second space S_2 , the first space S_1 of 3~5 μm and the second space S_2 of 3~5 μm satisfy the formula: $S_1 = S_2$. Preferably, the first space S_1 is 3.5 μm , and the second space S_2 is 3.5 μm .

[0033] Compared with the conventional symmetric design rule for the overlapping widths W_1 and W_2 , the present invention provides a non-symmetric design for the overlapping widths W_1 and W_2 to effectively prevent the disclination effect from the different disclination levels in the first overlapping width W_1 and the second overlapping width W_2 . Particularly, the first overlapping width W_1 larger than the second overlapping width W_2 can solve the serious disclination effect in the liquid crystal reverse region without reducing an aperture ratio by enlarging the overlapping widths W_1 and W_2 at the same time.

[0034] Third Embodiment

[0035] FIG. 7 is a cross-section illustrating a non-symmetric design according to the third embodiment of the present invention.

[0036] The elements in the third embodiment are substantially similar to that of the first embodiment and the second embodiment, with the similar portions omitted herein. The third embodiment combines the non-symmetric design for the spaces S_1 and S_2 and the non-symmetric design for the overlapping widths W_1 and W_2 to achieve the advantageous described in the first embodiment and the second embodiment.

[0037] According to the non-symmetric design for the spacings S_1 and S_2 , the first space S_1 of 3~5 μm and the second space S_2 of 3~5 μm satisfy the formula: S_1, S_2 . Especially when an included angle between the rubbing direction **76** and the data bus line **66** is 40~50 degrees, the first space S_1 and the second space S_2 satisfy the formula: $S_1 > S_2$, in which the first space S_1 is preferably 4~5 μm and the second space S_2 is preferably 2~3 μm . According to the non-symmetric design for the overlapping widths W_1 and W_2 , the first overlapping width W_1 of 4~8 μm and the second overlapping width W_2 of 4~8 μm satisfy the formula: $W_1 \neq W_2$. Especially when an included angle between the rubbing direction **76** and the data bus line **66** is 40~50 degrees, the first overlapping width W_1 and the second overlapping width W_2 satisfy the formula: $W_1 > W_2$, in which the first overlapping width W_1 is preferably 6.5~7.5 μm and the second overlapping width W_2 is preferably 4.5~5.5 μm .

[0038] Compared with the conventional symmetric design rule for the spacings S_1 and S_2 as well as the conventional symmetric design rule for the overlapping widths W_1 and W_2 , the present invention provides a non-symmetric design for the spacings S_1 and S_2 as well as a non-symmetric design for the overlapping widths W_1 and W_2 to effectively prevent the disclination effect from the different disclination levels at opposite sides of the data bus line **66**. This solves the serious disclination problem in the liquid crystal reverse region without deteriorating light leakage and sacrificing aperture ratio.

[0039] While the invention has been described by way of example and in terms of the preferred embodiments, it is to be understood that the invention is not limited to the disclosed embodiments. To the contrary, it is intended to cover various modifications and similar arrangements (as would be apparent to those skilled in the art). Therefore, the

scope of the appended claims should be accorded the broadest interpretation so as to encompass all such modifications and similar arrangements.

What is claimed is:

1. A liquid crystal display device, comprising:

a first substrate and a second substrate opposing each other;

a liquid crystal layer formed between the first substrate and the second substrate;

a plurality of scanning bus lines and a plurality of data bus lines arranged in a matrix form to define a plurality of pixel areas;

a plurality of TFT devices formed in the plurality of pixels, respectively; and

a plurality of pixel electrode layers formed in the plurality of pixels, respectively;

wherein, in each pixel area, the pixel electrode layer is formed between a first data bus line and a second data bus line; and

wherein, in each pixel area, a first space between the first data bus line and the periphery of the pixel electrode layer is different from a second space between the second data bus line and the periphery of the pixel electrode layer.

2. The liquid crystal display device as claimed in claim 1, further comprising:

an alignment film of a rubbing direction in the plurality of pixels, respectively;

wherein, when an included angle between the rubbing direction and the data bus line is 40~50 degrees, the first space between the first data bus line and the periphery of the pixel electrode layer is a liquid crystal reverse region, and the second space between the second data bus line and the periphery of the pixel electrode is a liquid crystal non-reverse region; and

wherein, the first space adjacent to the liquid crystal reverse region is larger than the second space adjacent to the liquid crystal non-reverse region.

3. The liquid crystal display as claimed in claim 2, wherein the first space is 4~5 μm and the second space is 2~3 μm .

4. The liquid crystal display device as claimed in claim 1, further comprising:

an opaque layer overlapping the first data bus line, the second data bus line, the first space and the second space; and

a plurality of light-shielding layers formed in the plurality of pixel areas, respectively;

wherein, in each pixel area, a first light-shielding layer is formed between the first data bus line and the periphery of the pixel electrode layer; and

wherein, in each pixel area, a second light-shielding layer is formed between the second data bus line and the periphery of the pixel electrode layer; and

wherein, a first overlapping width is defined between the opaque layer and the first light-shielding layer, and a

second overlapping width is defined between the opaque layer and the second light-shielding layer.

5. The liquid crystal display as claimed in claim 4, wherein the first overlapping width is equal to the second overlapping width.

6. The liquid crystal display as claimed in claim 4, wherein the first overlapping width is different from the second overlapping width.

7. The liquid crystal display device as claimed in claim 6, further comprising:

an alignment film of a rubbing direction formed in the plurality of pixels, respectively;

wherein, when an included angle between the rubbing direction and the data bus line is 40-50 degrees, the first space between the first data bus line and the periphery of the pixel electrode layer is a liquid crystal reverse region, and the second space between the second data bus line and the periphery of the pixel electrode is a liquid crystal non-reverse region; and

wherein, the first overlapping width adjacent to the liquid crystal reverse region is larger than the second overlapping width adjacent to the liquid crystal non-reverse region.

8. The liquid crystal display as claimed in claim 7, wherein the first overlapping width is 6.5~7.5 μm and the second overlapping width is 4.5~5.5 μm .

9. The liquid crystal display device as claimed in claim 4, wherein the second substrate further comprises:

a gate insulating layer formed overlying the second substrate and covering the scanning bus lines and the light-shielding layers, in which the data bus lines are formed overlying the gate insulating layer; and

a passivation layer formed overlying the gate insulating layer and covering the data bus lines, in which the pixel electrode layers are formed overlying the passivation layer.

10. The liquid crystal display as claimed in claim 1, wherein the first substrate further comprises a color filter layer and a common electrode layer.

11. A liquid crystal display device, comprising:

a first substrate and a second substrate opposing to each other;

a liquid crystal layer formed between the first substrate and the second substrate;

a plurality of scanning bus lines and a plurality of data bus lines arranged in a matrix form to define a plurality of pixel areas;

a plurality of TFT devices formed in the plurality of pixels, respectively;

a plurality of pixel electrode layers formed in the plurality of pixels, respectively;

a plurality of light-shielding layers formed in the plurality of pixel areas overlying the second substrate, respectively; and

an opaque layer formed overlying the first substrate;

wherein, in each pixel area, the pixel electrode layer is formed between a first data bus line and a second data bus line, in which a first distance is kept between the

first data bus line and the periphery of the pixel electrode layer, and a second space is kept between the second data bus line and the periphery of the pixel electrode layer;

wherein, in each pixel area, a first light-shielding layer is formed between the first data bus line and the periphery of the pixel electrode layer, and a second light-shielding layer is formed between the second data bus line and the periphery of the pixel electrode layer;

wherein, the opaque layer overlaps the first data bus line, the second data bus line, the first space and the second space;

wherein, in each pixel area, a first overlapping width between the opaque layer and the first light-shielding layer is different from a second overlapping width between the opaque layer and the second light-shielding layer.

12. The liquid crystal display device as claimed in claim 11, further comprising:

an alignment film of a rubbing direction formed in the plurality of pixels, respectively;

wherein, when an included angle between the rubbing direction and the data bus line is 40~50 degrees, the first space between the first data bus line and the periphery of the pixel electrode layer is a liquid crystal reverse region, and the second space between the second data bus line and the periphery of the pixel electrode is a liquid crystal non-reverse region; and

wherein, the first overlapping width adjacent to the liquid crystal reverse region is larger than the second overlapping width adjacent to the liquid crystal non-reverse region.

13. The liquid crystal display as claimed in claim 12, wherein the first overlapping width is 6.5~7.5 μm and the second overlapping width is 4.5~5.5 μm .

14. The liquid crystal display as claimed in claim 11, wherein the first space is equal to the second space.

15. The liquid crystal display as claimed in claim 11, wherein the first space is different from the second space.

16. The liquid crystal display device as claimed in claim 15, further comprising:

an alignment film of a rubbing direction formed in the plurality of pixels, respectively;

wherein, when an included angle between the rubbing direction and the data bus line is 40~50 degrees, the first space between the first data bus line and the periphery of the pixel electrode layer is a liquid crystal reverse region, and the second space between the second data bus line and the periphery of the pixel electrode is a liquid crystal non-reverse region; and

wherein, the first space adjacent to the liquid crystal reverse region is larger than the second space adjacent to the liquid crystal non-reverse region.

17. The liquid crystal display as claimed in claim 16, wherein the first overlapping width is 4~5 μm and the second overlapping width is 2~3 μm .

18. The liquid crystal display device as claimed in claim 11, wherein the second substrate further comprises:

a gate insulating layer formed overlying the second substrate and covering the scanning bus lines and the light-shielding layers, in which the data bus lines are formed overlying the gate insulating layer; and

a passivation layer formed overlying the gate insulating layer and covering the data bus lines, in which the pixel electrode layers are formed overlying the passivation layer.

19. The liquid crystal display as claimed in claim 11, wherein the first substrate further comprises a color filter layer and a common electrode layer.

20. A fabrication method for a liquid crystal display device, comprising steps of:

providing a first substrate;

forming a plurality of scanning bus lines and a plurality of light-shielding layers overlying the first substrate;

forming a gate insulating layer overlying the first substrate to cover the scanning bus lines and the light-shielding layers;

forming a plurality of data bus lines overlying the gate insulating layer, in which the data bus lines and the scanning bus lines are arranged in a matrix form to define a plurality of pixel areas;

forming a plurality of TFT devices in the plurality of pixels, respectively; and

forming a plurality of pixel electrode layers overlying the passivation layer in the plurality of pixels, respectively;

wherein, in each pixel area, the pixel electrode layer is formed between a first data bus line and a second data bus line; and

wherein, in each pixel area, a first space between the first data bus line and the periphery of the pixel electrode layer is different from a second space between the second data bus line and the periphery of the pixel electrode layer.

21. The fabrication method for a liquid crystal display device as claimed in claim 20, further comprising a step of:

forming an alignment film of a rubbing direction overlying the pixel electrode and the passivation layer;

wherein, when an included angle between the rubbing direction and the data bus line is 40~50 degrees, the first space between the first data bus line and the periphery of the pixel electrode layer is a liquid crystal reverse region, and the second space between the second data bus line and the periphery of the pixel electrode is a liquid crystal non-reverse region; and

wherein, the first space adjacent to the liquid crystal reverse region is larger than the second space adjacent to the liquid crystal non-reverse region.

22. The fabrication method for a liquid crystal display device as claimed in claim 21, wherein the first space is 4~5 μm and the second space is 2~3 μm .

23. The fabrication method for a liquid crystal display device as claimed in claim 20, further comprising steps:

providing a second substrate opposing to the first substrate; and

forming an opaque layer overlying the second substrate, in which the opaque layer overlaps the first data bus line, the second data bus line, the first space and the second space;

wherein, in each pixel area, the first light-shielding layer is formed between the first data bus line and the periphery of the pixel electrode layer;

wherein, in each pixel area, the second light-shielding layer is formed between the second data bus line and the periphery of the pixel electrode layer; and

wherein, a first overlapping width is defined between the opaque layer and the first light-shielding layer, and a second overlapping width is defined between the opaque layer and the second light-shielding layer.

24. The fabrication method for a liquid crystal display as claimed in claim 23, wherein the first overlapping width is equal to the second overlapping width.

25. The fabrication method for a liquid crystal display as claimed in claim 23, wherein the first overlapping width is different from the second overlapping width.

26. The fabrication method for a liquid crystal display as claimed in claim 25, further comprising a step of:

forming an alignment film of a rubbing direction overlying the pixel electrode layer and the passivation layer;

wherein, when an included angle between the rubbing direction and the data bus line is 40~50 degrees, the first space between the first data bus line and the periphery of the pixel electrode layer is a liquid crystal reverse region, and the second space between the second data bus line and the periphery of the pixel electrode is a liquid crystal non-reverse region; and

wherein, the first overlapping width adjacent to the liquid crystal reverse region is larger than the second overlapping width adjacent to the liquid crystal non-reverse region.

27. The fabrication method for a liquid crystal display as claimed in claim 26, wherein the first overlapping width is 6.5~7.5 μm and the second overlapping width is 4.5~5.5 μm .

28. The fabrication method for a liquid crystal display as claimed in claim 23, further comprising steps of:

forming a color filter layer overlying the second substrate;

forming a common electrode layer overlying the color filter layer and the opaque layer; and

forming an alignment layer overlying the common electrode layer.

29. The fabrication method for a liquid crystal display as claimed in claim 23, further comprising a step of forming a liquid crystal layer between the first substrate and the second substrate.

30. A fabrication method for a liquid crystal display device, comprising steps of:

providing a first substrate;

forming a plurality of scanning bus lines and a plurality of light-shielding layers overlying the first substrate;

forming a gate insulating layer overlying the first substrate to cover the scanning bus lines and the light-shielding layers;

forming a plurality of data bus lines overlying the gate insulating layer, in which the data bus lines and the scanning bus lines are arranged in a matrix form to define a plurality of pixel areas;

forming a plurality of TFT devices in the plurality of pixels, respectively;

forming a plurality of pixel electrode layers overlying the passivation layer in the plurality of pixels, respectively;

providing a second substrate opposing to the first substrate; and

forming an opaque layer overlying the second substrate;

wherein, in each pixel area, the pixel electrode layer is formed between a first data bus line and a second data bus line; and

wherein, in each pixel area, a first space is kept between the first data bus line and the periphery of the pixel electrode layer, and a second space is kept between the second data bus line and the periphery of the pixel electrode layer; and

wherein, in each pixel area, a first light-shielding layer is formed between the first data bus line and the periphery of the pixel electrode layer, and a second light-shielding layer is formed between the second data bus line and the periphery of the pixel electrode layer; and

wherein, the opaque layer overlaps the first data bus line, the second data bus line, the first space and the second space; and

wherein, a first overlapping width between the opaque layer and the first light-shielding layer is different from a second overlapping width between the opaque layer and the second light-shielding layer.

31. The fabrication method for a liquid crystal display device as claimed in claim 30, further comprising a step of:

forming an alignment film of a rubbing direction overlying the pixel electrode and the passivation layer;

wherein, when an included angle between the rubbing direction and the data bus line is 40~50 degrees, the first space between the first data bus line and the periphery of the pixel electrode layer is a liquid crystal reverse region, and the second space between the second data bus line and the periphery of the pixel electrode is a liquid crystal non-reverse region; and

wherein, the first overlapping width adjacent to the liquid crystal reverse region is larger than the second overlapping width adjacent to the liquid crystal non-reverse region.

32. The fabrication method for a liquid crystal display device as claimed in claim 31, wherein the first space is 6.5~7.5 μm and the second space is 4.5~5.5 μm .

33. The fabrication method for a liquid crystal display as claimed in claim 30, wherein the first space is equal to the second space.

34. The fabrication method for a liquid crystal display as claimed in claim 30, wherein the first space is different from the second space.

35. The fabrication method for a liquid crystal display as claimed in claim 34, further comprising a step of:

forming an alignment film of a rubbing direction overlying the pixel electrode layer and the passivation layer;

wherein, when an included angle between the rubbing direction and the data bus line is 40~50 degrees, the first space between the first data bus line and the periphery of the pixel electrode layer is a liquid crystal reverse region, and the second space between the second data bus line and the periphery of the pixel electrode is a liquid crystal non-reverse region; and

wherein, the first space adjacent to the liquid crystal reverse region is larger than the second space adjacent to the liquid crystal non-reverse region.

36. The fabrication method for a liquid crystal display as claimed in claim 35, wherein the first overlapping width is 4~5 μm and the second overlapping width is 2~3 μm .

37. The fabrication method for a liquid crystal display as claimed in claim 30, further comprising steps of:

forming a color filter layer overlying the second substrate;

forming a common electrode layer overlying the color filter layer and the opaque layer; and

forming an alignment layer overlying the common electrode layer.

38. The fabrication method for a liquid crystal display as claimed in claim 30, further comprising a step of forming a liquid crystal layer between the first substrate and the second substrate.

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摘要(译)

液晶显示装置具有形成在第一数据总线和第二总线之间的像素电极层。
第一数据总线和像素电极层的外围之间的第一空间不同于第二数据总线
和像素电极层的外围之间的第二空间。

