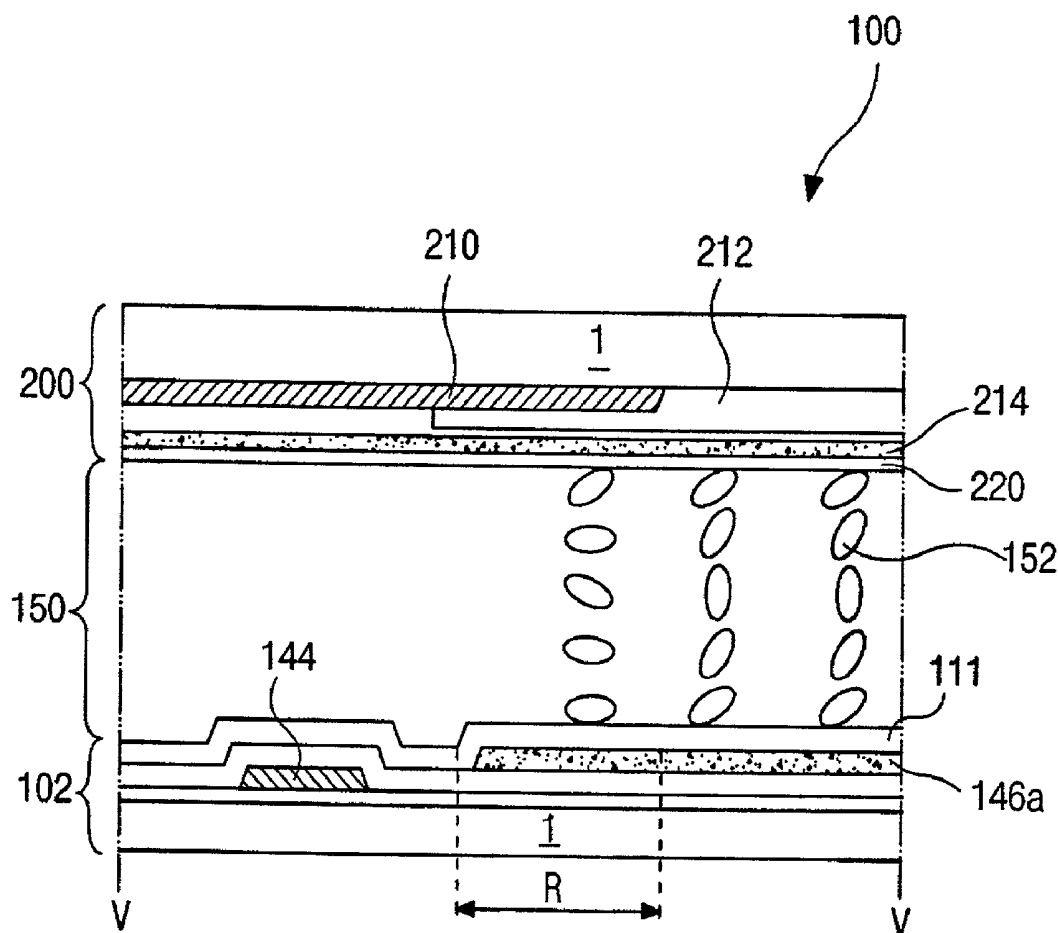




May 9, 2002



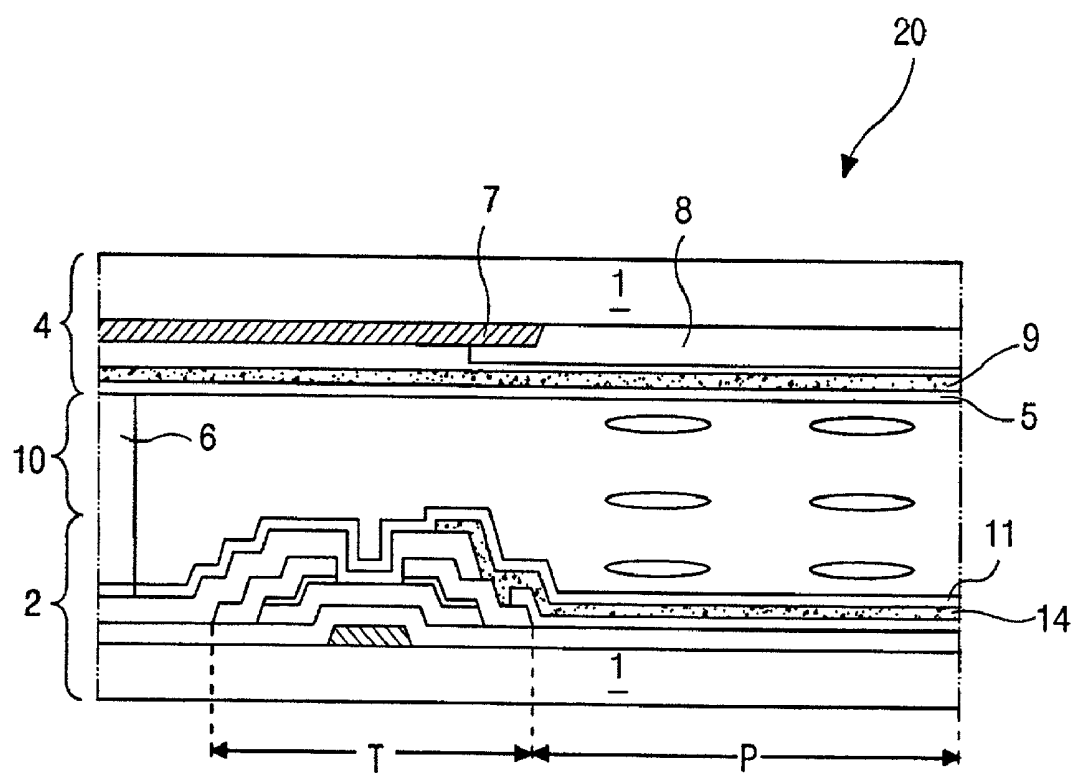


FIG.1
(RELATED ART)

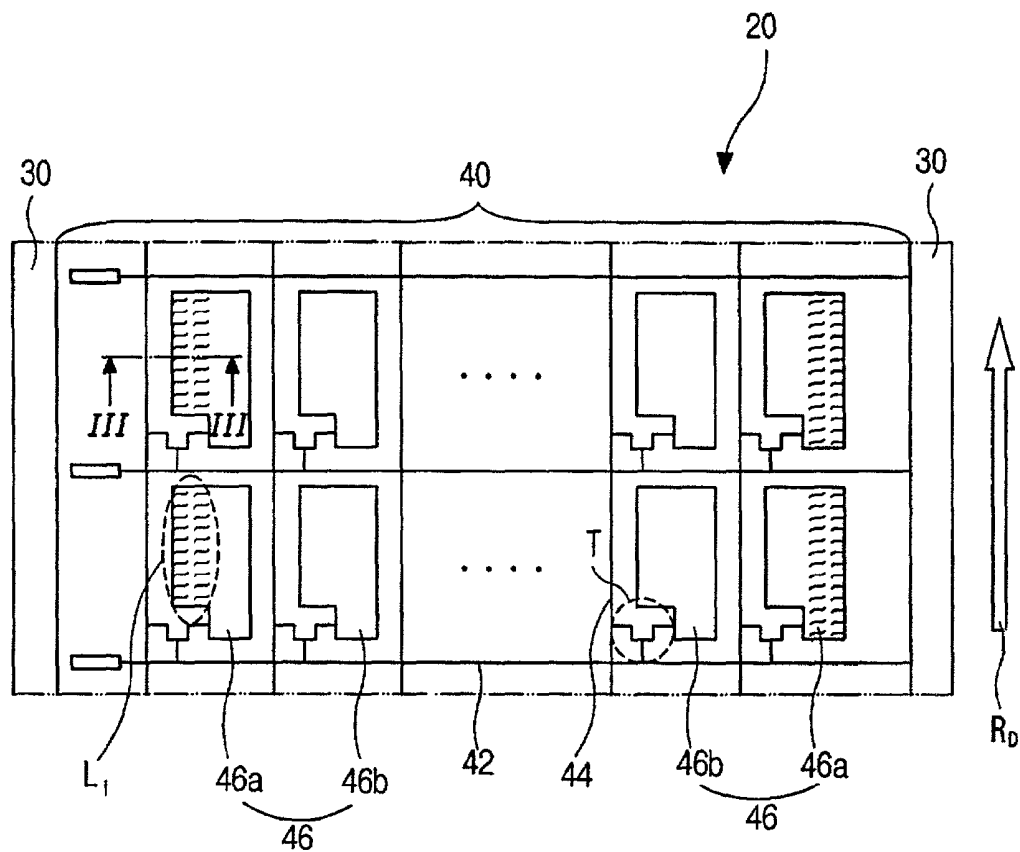


FIG. 2
(RELATED ART)

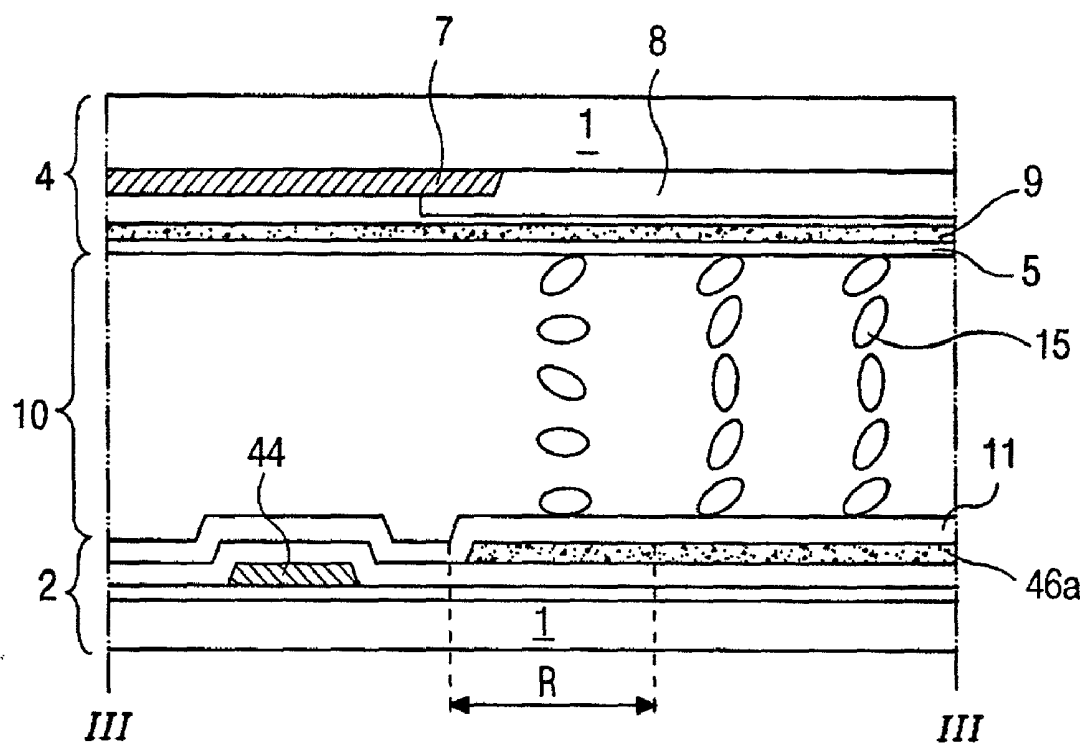


FIG.3
(RELATED ART)

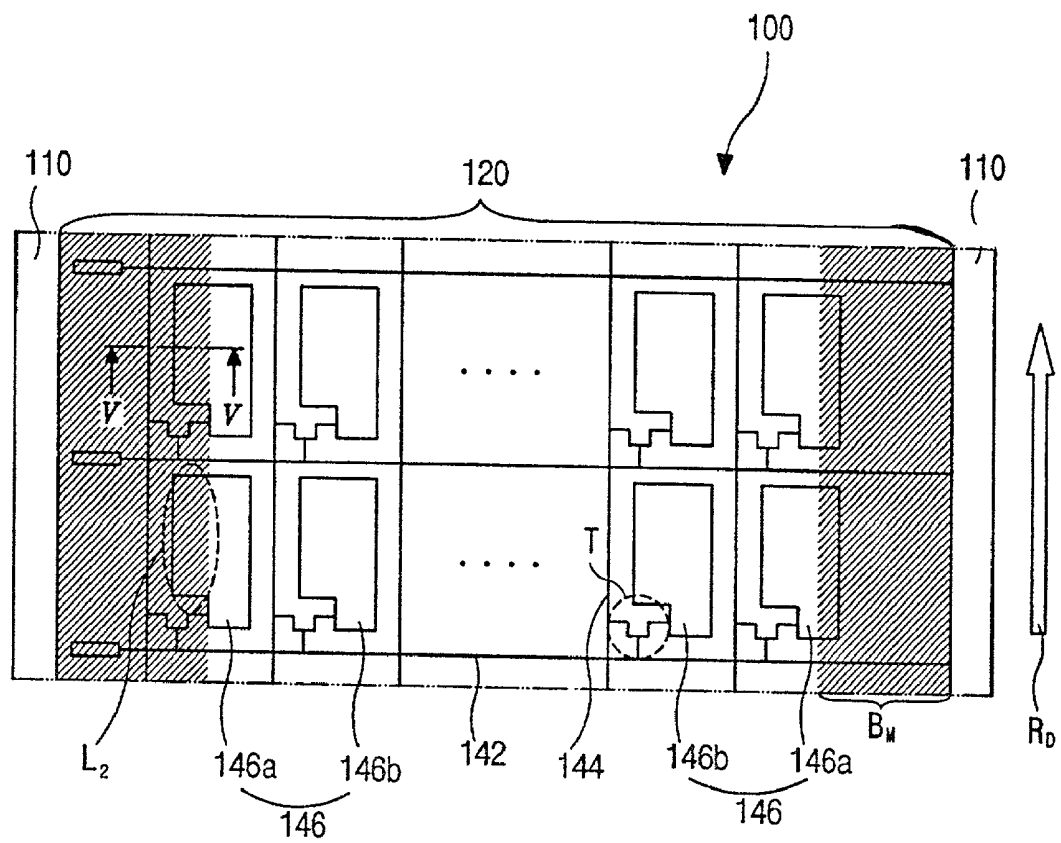


FIG. 4

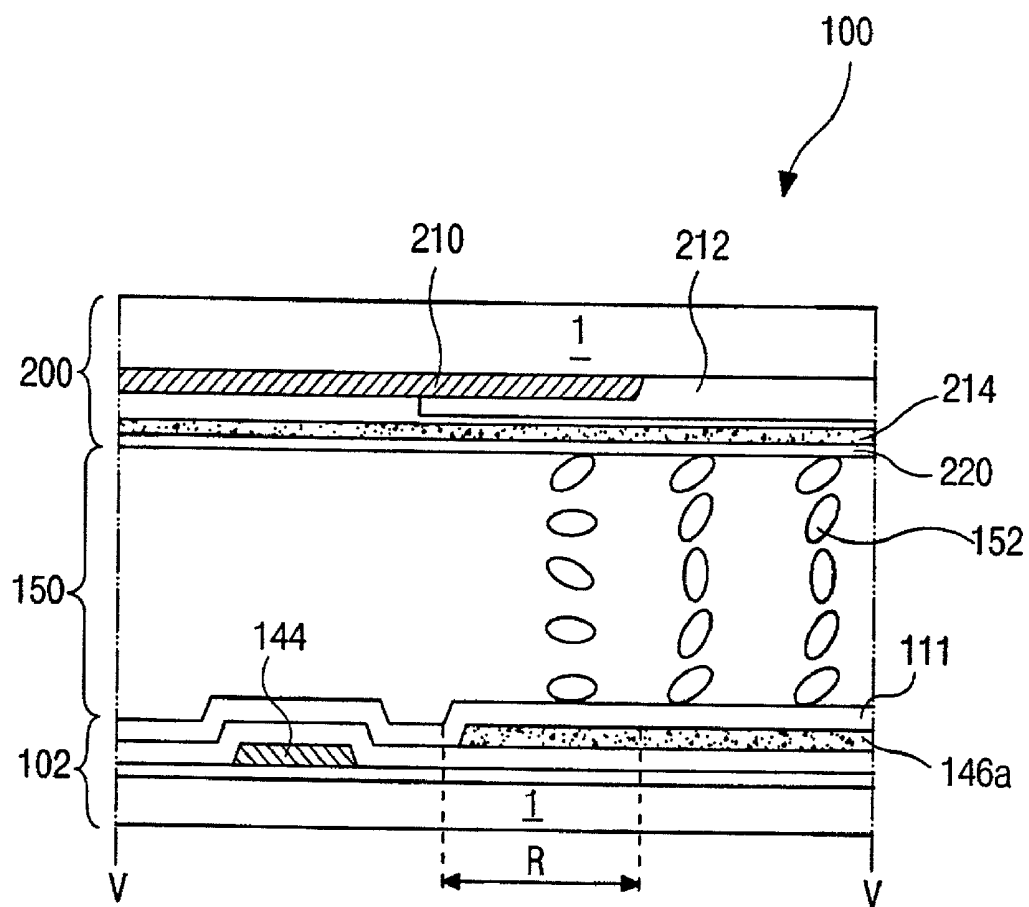


FIG.5

LIQUID CRYSTAL DISPLAY DEVICE HAVING LIGHT LEAKAGE PREVENTION

[0001] This application claims the benefit of Korean Patent Application No. 2000-62804, filed on Oct. 25, 2000, which is hereby incorporated by reference as if fully set forth herein.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to liquid crystal display devices. More particularly it relates to liquid crystal display devices preventing light leakage in peripheral portions.

[0004] 2. Discussion of the Related Art

[0005] A liquid crystal display device uses the optical anisotropy and polarization properties of liquid crystal molecules to produce an image. Liquid crystal molecules have a definite orientational alignment as a result of their long, thin shapes. That orientational alignment can be controlled by an applied electric field. In other words, as an applied electric field changes, so does the alignment of the liquid crystal molecules. Due to the optical anisotropy, the refraction of incident light depends on the orientation of the liquid crystal molecules. Thus, by properly controlling an applied electric field a desired image can be produced.

[0006] Of the different types of known LCDs, active matrix LCDs (AM-LCDs), which have thin film transistors and pixel electrodes arranged in a matrix form, are the subject of significant research and development because of their high resolution and superiority in displaying moving images.

[0007] LCD devices have wide application in office automation (OA) equipment and video units because they are light and thin, and have low power consumption characteristics. The typical liquid crystal display (LCD) panel has an upper substrate, a lower substrate and a liquid crystal layer interposed therebetween. The upper substrate, commonly referred to as a color filter substrate, usually includes a common electrode and color filters. The lower substrate, commonly referred to as an array substrate, includes switching elements, such as thin film transistors (TFTs), and pixel electrodes.

[0008] As previously described, LCD device operation is based on the principle that the alignment direction of the liquid crystal molecules is dependent upon an electric field applied between the common electrode and the pixel electrode. Thus, the alignment direction of the liquid crystal molecules is controlled by the application of an electric field to the liquid crystal layer. When the alignment direction of the liquid crystal molecules is properly adjusted, incident light is refracted along the alignment direction to display image data. The liquid crystal molecules function as an optical modulation element having variable optical characteristics that depend upon polarity of the applied voltage.

[0009] FIG. 1 is a schematic cross-sectional view illustrating a conventional LCD cell in an active matrix LCD. As shown, the LCD cell 20 has lower and upper substrates 2 and 4 and a liquid crystal (LC) layer 10 interposed therebetween. The lower substrate 2 has a thin film transistor (TFT) "T" as a switching element that switches a voltage that changes the

orientation of the LC molecules. The lower substrate 2 also includes a pixel electrode 14 that is used to apply an electric field across the LC layer 10 in response to signals applied to the TFT "T." The upper substrate 4 has a color filter 8 for producing a color, and a black matrix 7 shielding light in non-display regions and preventing the thin film transistor from light irradiation. Furthermore, the upper substrate 4 includes a common electrode 9 on the color filter 8 and black matrix 7. The common electrode 9 serves as an electrode that produces the electric field across the LC layer (with the assistance of the pixel electrode 14). The pixel electrode 14 is arranged over a pixel portion "P," i.e., a display region. A lower orientation layer 11 that serves to align the liquid crystal molecules for selectively transmitting light is disposed on the pixel electrode 14 and over the TFT "T," while an upper orientation layer 5 that serves to align the liquid crystal molecules with the lower orientation layer 11 is on the common electrode 9. Further, to prevent leakage of the LC layer 10, a pair of substrates 2 and 4 are sealed by a sealant 6.

[0010] The lower substrate needs several more processes than the upper substrate, such as a deposition process and a photolithography process. Since the deposition and photolithography processes are carried out several times when forming the array substrate, several steps are formed in an array matrix type on the lower substrate.

[0011] FIG. 2 is a schematic partial plan view showing a display region and non-display regions of the liquid crystal display of FIG. 1. In FIG. 2, the liquid crystal display cell 20 is widely divided into the display region 40 in which images are displayed, and the non-display regions 30 in which alignment keys (not shown) and shorting bars (not shown) are disposed. The alignment keys are points to align the upper substrate to the lower substrate, and the shorting bars serve in the circuit test. The non-display regions 30 are detached in later steps after the circuit test and attaching the upper substrate to the lower substrate. In the display region 40, a plurality of gate lines 42 are arranged in a transverse direction and a plurality of data lines 44 are arranged perpendicular to the plurality of gate lines 42. In each crossover point of the gate lines 42 and the data lines 44, a thin film transistor (TFT) "T" is disposed in a matrix type. A plurality of pixel electrodes 46 are placed in pixel regions defined by the gate lines 42 and the data lines 44. Further, the plurality of pixel electrodes 46 are divided into first pixel electrodes 46a disposed in peripheral portions of the display region 40, and second pixel electrodes 46b disposed in an inner portion of the display region 40.

[0012] Still referring to FIG. 2, an arrow "R_D" represents an exemplary rubbing direction when the lower orientation layer 11 of FIG. 1 is rubbed for aligning the liquid crystal molecules. At this time, the periphery such like areas "L₁" is irregularly rubbed due to the steps of the array matrix structure. Especially, when the rubbing direction is from bottom to top as shown in FIG. 2, the rubbing irregularity exceedingly occurs in both right and left areas such like the area "L₁." Further, this rubbing irregularity causes light leakage in the periphery of the liquid crystal display when a driving voltage is applied to the pixel electrodes 46.

[0013] FIG. 3 is a cross-sectional view taken along the line III-III of FIG. 2 and illustrates a peripheral portion of the display region. In FIG. 3, the lower substrate 2 includes

the first pixel electrode **46a** and the data lines **44** which are disposed over the substrate **1** and separated from each other. The lower orientation layer **11** is disposed on the first pixel electrode **46a** and over the data line **44**. The upper substrate **4** includes the black matrix **7** and color filter **8** on the substrate **1**. The common electrode **9** is disposed on the black matrix **7** and color filter **8**, and the upper orientation layer **5** is disposed on the common electrode **9**. The black matrix **7** corresponds to the non-pixel region in which the data line **44** is arranged, while the color filter **8** corresponds to the pixel region that is the display region. Liquid crystal molecules **15** are disposed between the lower substrate **2** and the upper substrate **4**, thereby forming a liquid crystal layer **10**. As a material for the upper and lower orientation layers **5** and **11**, polyimide is mainly used. Polyimide aligns the liquid crystal molecules so that they are parallel to the substrate **1**.

[0014] In general, the upper and lower orientation layers **5** and **11** are rubbed in one direction to align the liquid crystal molecules **15** and make the liquid crystal molecules **15** have pretilt angle. In the rubbing process, a rubbing fabric rolled onto a roller is widely used and the upper and lower orientation layers **5** and **11** are rubbed to have a plurality of minute grooves on their surface using this rubbing fabric. Therefore, the surfaces of the orientation layers are rubbed in a uniform direction. However, the peripheral portions of the liquid crystal display, such as a region "R" of FIG. 3, are irregularly rubbed rather than an inner portion. Especially, this rubbing irregularity easily occurs in the lower substrate **2** due to the fact that the lower substrate **2** includes several array matrix structures and has several steps caused by the array matrix elements. Especially, because of the steps between the display region **40** and the non-display regions **30** (in FIG. 2), the region "R" of FIG. 3 in the first pixel electrode **46a** is not properly rubbed. Thereby, the liquid crystal molecules **15** disposed within the region "R" of the first pixel electrode **46** are not properly arranged when the voltage is applied to the pixel electrode, thereby giving rise to light leakage. The irregularities of the surface of the region "R" (i.e., the irregularly rubbed area) depend on the rubbing direction of the orientation layer.

[0015] As described above, light leakage occurring in the periphery of the liquid crystal display deteriorates and decreases the display quality of the liquid crystal display device.

SUMMARY OF THE INVENTION

[0016] Accordingly, the present invention is directed to a liquid crystal display (LCD) device that substantially obviates one or more of the problems due to limitations and disadvantages of the related art.

[0017] An object of the present invention is to provide an LCD device, which has a structure that prevents light leakage.

[0018] Additional features and advantages of the invention will be set forth in the description which follows and in part will be apparent from the description, or may be learned by practice of the invention. The objectives and other advantages of the invention will be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

[0019] In order to achieve the above object, the present invention provides a liquid crystal display device that includes an array substrate having a display region and non-display regions, a color filter substrate disposed opposite to and spaced apart from the array substrate, a first orientation layer arranged between the array substrate and the liquid crystal layer; and a second orientation layer arranged between the color filter substrate and the liquid crystal layer. The first and second orientation layers include at least polyimide.

[0020] In the inventive liquid crystal display device, the array substrate having a display region and non-display regions includes a plurality of gate lines transversely arranged in the display region; a plurality of data lines arranged perpendicular to the plurality of gate lines in the display region; a plurality of pixel electrodes, each pixel electrode disposed in a pixel region defined by each pair of gate lines and data lines; and a plurality of thin film transistors in crossover points of the plurality of gate lines and data lines, each thin film transistor connected to each pixel electrode.

[0021] In the inventive liquid crystal display device, the color filter substrate disposed opposite to and spaced apart from the array substrate includes a plurality of color filters, each color filter corresponding to each pixel electrode; and a black matrix layer covering the periphery of the display region of the array substrate and corresponding to the non-display regions of the array substrate, wherein the black matrix layer extends over the pixel electrodes that are disposed in peripheral portions of the display regions. The color filter substrate further includes a common electrode on the black matrix layer and plurality of color filters. Especially, the black matrix layer covers portions of the pixel electrodes disposed in the periphery of the array substrate.

[0022] In another aspect of the invention, a method of making a liquid crystal display (LCD) device having first and second substrates, the first substrate having a display region and non-display regions, comprises forming a black matrix layer on a second substrate, the black matrix layer covering the non-display regions and a periphery of the display region; forming a color filter layer on the second substrate and black matrix layer; and forming a liquid crystal layer between the first substrate and the second substrate.

[0023] In a further aspect of the present invention, a method of making a liquid crystal display (LCD) device having first and second substrates, the first substrate having a display region and non-display regions, comprises forming a plurality of data lines formed on the first substrate in the non-display regions; forming a plurality of pixel electrodes formed on the first substrate in the display region; forming a lower orientation layer formed on the plurality of pixel electrodes; forming a black matrix layer on the second substrate, the black matrix layer covering the non-display regions and the periphery of the display region; forming a color filter layer on the second substrate and black matrix layer; and forming a liquid crystal layer between the first substrate and the second substrate.

[0024] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate the present invention and together with the description serve to explain the principles of that invention.

[0026] In the drawings:

[0027] FIG. 1 is a schematic cross-sectional view illustrating one pixel of a liquid crystal display device according to the related art;

[0028] FIG. 2 is a schematic partial plan view showing a display region and non-display regions of the liquid crystal display of FIG. 1;

[0029] FIG. 3 is a cross-sectional view taken along the line III-III of FIG. 2 and illustrates a peripheral portion of the display region;

[0030] FIG. 4 is a schematic partial plan view showing a display region and non-display regions of the liquid crystal display according to the present invention; and

[0031] FIG. 5 is a cross-sectional view taken along the line V-V of FIG. 4 and illustrates a peripheral portion of the display region.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENT

[0032] Reference will now be made in detail to an illustrated embodiment of the present invention, an example of which is shown in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or the parts.

[0033] In general, a liquid crystal display device includes a lower substrate (often referred to as an array substrate) in which a plurality of thin film transistors (TFTs), i.e., switching devices, are arranged; an upper substrate (often referred to as a color filter substrate) on which a plurality of color filters and a black matrix are formed; and a liquid crystal layer therebetween.

[0034] FIG. 4 is a schematic partial plan view showing a display region and non-display regions of the liquid crystal display device according to the present invention. In FIG. 2, the liquid crystal display device 100 is widely divided into the non-display regions 110 in which images are not displayed, and the display region 120 in which the images are displayed. The non-display regions 110 include alignment keys (not shown) and shorting bars (not shown). The alignment keys are the points to align the upper substrate to the lower substrate, and the shorting bars serve in the circuit test. The non-display regions 110 are detached in later steps after the circuit test and attaching the upper substrate to the lower substrate.

[0035] In the display region 120 of FIG. 4, a plurality of gate lines 142 are arranged in a transverse direction and a plurality of data lines 144 are arranged perpendicular to the plurality of gate lines 142. In each crossover point of the gate lines 142 and the data lines 144, a thin film transistor (TFT) "T" is disposed in a matrix type. A plurality of pixel electrodes 146 are placed in pixel regions defined by the gate lines 142 and the data lines 144. Further, the plurality of pixel electrodes 146 are divided into first pixel electrodes 146a disposed in peripheral portions of the display region 120, and second pixel electrodes 146b disposed in an inner portion of the display region 120.

[0036] Still referring to FIG. 2, an arrow "R_D" represents an exemplary rubbing direction when a lower orientation layer 111 of FIG. 5 is rubbed for aligning the liquid crystal molecules. At this time in FIG. 4, the periphery of the display region 120, such as an area "L₂," is irregularly rubbed due to the steps of the array matrix structure as described before. However, a black matrix 210 of FIG. 5 is disposed in periphery "B_M" (i.e., black matrix areas) of the display region 120 in FIG. 4. Especially, the black matrix 210 of FIG. 5 overlaps the irregularly rubbed areas of the first electrodes 146a, such as the area "L₂," thereby preventing light leakage caused by the rubbing irregularity.

[0037] In other words, a portion of the lower orientation layer disposed on the outer portions of the first pixel electrodes 146a is irregularly rubbed mainly due to the steps of the array matrix structures. The liquid crystal molecules disposed on this irregularly rubbed area are not properly arranged, thereby causing light leakage. Therefore, the black matrix is correspondingly formed over the black matrix areas "B_M" to cover the irregularly rubbed area, such as the area "L₂."

[0038] FIG. 5 is a cross-sectional view taken along the line V-V of FIG. 4 and illustrates a peripheral portion of the display region. In FIG. 5, the lower substrate 102 includes the first pixel electrode 146a and the data lines 144 which are disposed over the substrate 1 and separated each other. The lower orientation layer 111 is disposed on the first pixel electrode 146a and over the data line 144. The upper substrate 200 includes a black matrix 210 and a color filter 212 on the substrate 1. The common electrode 214 is disposed on the black matrix 210 and color filter 212, and the upper orientation layer 220 is disposed on the common electrode 214. Liquid crystal molecules 152 are disposed between the lower substrate 102 and the upper substrate 200, thereby forming a liquid crystal layer 150. As mentioned before, polyimide is mainly used for the lower and upper orientation layers 111 and 220. Polyimide aligns the liquid crystal molecules 152 so that they are parallel to the substrate 1.

[0039] Further referring to FIG. 5, a portion "R" of the first pixel electrode 146a is irregularly rubbed area, and thus the liquid crystal molecules 152 disposed within the portion "R" are not properly arranged. However, the black matrix 210 on the substrate 1 correspondingly covers the irregularly rubbed portion "R," thereby preventing light leakage that occurs in the portion "R." In other words, since the black matrix 210 extends over the portion "R" of the first pixel electrode 146a in which the lower orientation layer 111 is irregularly rubbed and the liquid crystal molecules 152 are not properly arranged, light leakage caused by the non-properly arranged liquid crystal molecules 152 is prevented. As aforementioned, light leakage is prevented without additional process, thereby increasing the display quality.

[0040] It will be apparent to those skilled in the art that various modifications and variations can be made in the array substrate of the present invention without departing from the spirit or scope of the invention. Thus, it is intended that the present invention cover 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:

a first substrate having a display region and non-display regions;

- a black matrix layer on a second substrate, the black matrix layer covering the non-display regions and the periphery of the display region;
 - a color filter layer on the second substrate and black matrix layer; and
 - a liquid crystal layer between the first substrate and the second substrate.
2. The device of claim 1, wherein the first substrate further comprises:
- a plurality of gate lines transversely arranged in the display region;
 - a plurality of data lines arranged perpendicular to the plurality of gate lines in the display region;
 - a plurality of pixel electrodes disposed in pixel regions defined by the gate and data lines; and
 - a plurality of thin film transistors in crossover points of the gate lines and data lines, each thin film transistor connected to each pixel electrode.
3. The device of claim 2, wherein the black matrix layer extends over the pixel electrodes disposed in peripheral portions of the display region.
4. The device of claim 2, wherein the black matrix layer covers portions of the pixel electrodes disposed in the periphery of the first substrate.
5. The device of claim 2, wherein the pixel electrodes are divided into first pixel electrodes disposed in peripheral portions of the display region, and second pixel electrodes disposed in an inner portion of the display region.
6. The device of claim 1, wherein the second substrate further comprises a common electrode on the color filter layer.
7. The device of claim 1, further comprising a first orientation layer on the first substrate.
8. The device of claim 7, wherein the first orientation layer is formed on the first pixel electrodes.
9. The device of claim 7, wherein the first orientation layer includes polyimide.
10. The device of claim 1, further comprising a second orientation layer on the second substrate.
11. The device of claim 10, wherein the second orientation layer includes polyimide.
12. A liquid crystal display (LCD) device, comprising:
- a first substrate having a display region and non-display regions;
 - a plurality of data lines formed on the first substrate in the non-display regions;
 - a plurality of pixel electrodes formed on the first substrate in the display region;
 - a lower orientation layer formed on the plurality of pixel electrodes;
 - a black matrix layer on a second substrate, the black matrix layer covering the non-display regions and the periphery of the display region;
 - a color filter layer on the second substrate and black matrix layer; and
 - a liquid crystal layer between the first substrate and the second substrate.
13. A method of making a liquid crystal display (LCD) device having first and second substrates, the first substrate having a display region and non-display regions, comprising:
- forming a black matrix layer on a second substrate, the black matrix layer covering the non-display regions and a periphery of the display region;
 - forming a color filter layer on the second substrate and black matrix layer; and
 - forming a liquid crystal layer between the first substrate and the second substrate.
14. The method of claim 1, further comprising:
- forming a plurality of gate lines transversely arranged in the display region of the first substrate;
 - forming a plurality of data lines arranged perpendicular to the plurality of gate lines in the display region of the first substrate;
 - forming a plurality of pixel electrodes disposed in pixel regions defined by the gate and data lines; and
 - forming a plurality of thin film transistors in crossover points of the gate lines and data lines, each thin film transistor connected to each pixel electrode.
15. The method of claim 14, wherein the black matrix layer extends over the pixel electrodes disposed in peripheral portions of the display region.
16. The method of claim 14, wherein the black matrix layer covers portions of the pixel electrodes disposed in the periphery of the first substrate.
17. The method of claim 14, wherein the pixel electrodes are divided into first pixel electrodes disposed in peripheral portions of the display region, and second pixel electrodes disposed in an inner portion of the display region.
18. The method of claim 13, further comprising forming a common electrode on the color filter layer of the second substrate.
19. The device of claim 13, further comprising forming a first orientation layer on the first substrate.
20. The device of claim 19, wherein the first orientation layer is formed on the first pixel electrodes.
21. The device of claim 19, wherein the first orientation layer includes polyimide.
22. The device of claim 13, further comprising a second orientation layer on the second substrate.
23. The device of claim 22, wherein the second orientation layer includes polyimide.
24. A method of making a liquid crystal display (LCD) device having first and second substrates, the first substrate having a display region and non-display regions, comprising:
- forming a plurality of data lines formed on the first substrate in the non-display regions;
 - forming a plurality of pixel electrodes formed on the first substrate in the display region;
 - forming a lower orientation layer formed on the plurality of pixel electrodes;
 - forming a black matrix layer on the second substrate, the black matrix layer covering the non-display regions and the periphery of the display region;
 - forming a color filter layer on the second substrate and black matrix layer; and
 - forming a liquid crystal layer between the first substrate and the second substrate.

专利名称(译)	具有防漏光的液晶显示装置		
公开(公告)号	US20020054253A1	公开(公告)日	2002-05-09
申请号	US09/983445	申请日	2001-10-24
[标]申请(专利权)人(译)	CHO SO幸 YOUN元均		
申请(专利权)人(译)	CHO SO-幸 YOUN韩元GYUN		
当前申请(专利权)人(译)	LG DISPLAY CO. , LTD.		
[标]发明人	CHO SO HAENG YOUN WON GYUN		
发明人	CHO, SO-HAENG YOUN, WON-GYUN		
IPC分类号	G02F1/136 G02F1/1333 G02F1/1335		
CPC分类号	G02F2001/133388 G02F1/133512		
优先权	1020000062804 2000-10-25 KR		
其他公开文献	US7414681		
外部链接	Espacenet USPTO		

摘要(译)

本发明提供一种液晶显示装置，包括阵列基板，滤色器基板和位于其间的液晶层。具有显示区域和非显示区域的阵列基板包括横向布置在显示区域中的多条栅极线；垂直于显示区域中的多条栅极线排列的多条数据线；多个像素电极，每个像素电极设置在由每对栅极线和数据线限定的像素区域中；多个栅极线和数据线的交叉点中的多个薄膜晶体管，每个薄膜晶体管连接到每个像素电极。与阵列基板相对且间隔开设置的滤色器基板包括多个滤色器，每个滤色器对应于每个像素电极；黑矩阵层覆盖阵列基板的显示区域的周边并对应阵列基板的非显示区域，其中黑矩阵层在设置在显示区域的周边部分的像素电极上延伸。

