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(54) Light leakage reduction in vertically-aligned liquid crystal displays using polymeric particles formed on an alignment layer

Verkleinerung der Menge des Verlustlichts in einer Flüssigkristallanzeige des senkrecht orientierten Typs mittels polymerischer Teilchen, die auf einer Orientierungsschicht gebildet sind

Reduction des pertes lumineuses de la lumière dans un système d'affichage à cristaux liquides de type alignement vertical utilisant des particules formées sur une couche d'alignement

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(56) References cited:
US-A1- 2008 252 807 **US-A1- 2010 188 623**
US-A1- 2011 304 526

- **HANAOKA K ET AL: "40.1: A New MVA-LCD by Polymer Sustained Alignment Technology", 2004 SID INTERNATIONAL SYMPOSIUM. SEATTLE, WA, MAY 25 - 27, 2004; [SID INTERNATIONAL SYMPOSIUM], SAN JOSE, CA : SID, US, vol. XXXV, 25 May 2004 (2004-05-25), pages 1200-1203, XP007011936,**

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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The disclosure related in general to a vertically aligned liquid crystal display device, and particularly to such a display device having superior display quality.

Description of the Related Art

[0002] Liquid crystal displays have been applied in a variety of electronic products, such as laptops, tablet PCs, and etc. Moreover, along with the rapid advance of large-sized flat panel displays in the market, liquid crystal displays with light weight and miniaturized sizes have played very important roles and gradually replaced CRT displays to become the main stream in the market.

[0003] Currently, vertical alignment liquid crystal display panels are one of the main stream products. However, vertical alignment liquid crystal display panels have issues of light leakage, which affect the display quality thereof. Therefore, researchers have been working on providing vertical alignment liquid crystal display panels having superior display quality.

[0004] US 2008 / 0 252 807 discloses an active-matrix, vertically aligned liquid crystal display that exhibits all the features of the preamble of claim 1. In this display, alignment layers are processed using a photo-polymerization technique, commonly known as polymer sustained alignment (PSA). If an insufficient electric field is supplied in the peripheral wiring region of the display during the polymerization process, the orientation of polymer precipitates there is random, whereas in the display region, the precipitates are oriented according to the field applied there during the photo-polymerization process. Such displays, however, can suffer from undesirable light leakage at their edges. A display is also disclosed in this document in which both regions are subject to electric fields during photo-polymerisation. In the non-display region the field is achieved by dummy electrodes.

[0005] US 2001 / 0 304 526 discloses an active matrix, transflective, vertically aligned liquid crystal display having reflective and transmissive zones. In this display, the alignment layers are treated by irradiation with UV light in a PSA-process. The liquid crystal layer is provided with monomers which form particles of polymerisation product during the irradiation; these particles are then deposited on the alignment layers to form "alignment sustaining layers". By performing the irradiation in the presence of an electric field, the pre-tilt angles of the liquid crystal molecules at the alignment layers can be fixed.

[0006] US 2010 / 0188 623 discusses a light-leakage problem in an active-matrix, vertically aligned liquid crystal display. In this document the effect of having the same alignment treatment by means of UV-irradiation in both the display and the non-display regions on the amount light leakage is discussed. The document goes on to discuss the case in which no alignment treatment is provided in the non-display region (although there is still an alignment layer).

[0007] Hanaoka et al. ("40.1: A New MVA-LCD by Polymer Sustained Alignment Technology" in the Digest of the 2004 SID International Symposium in Seattle, US, pages 1200-1203) discloses a multi-domain MVA-LCD also using PSA technology. The device exhibits a higher and more uniform brightness as well as a faster switching time than VA-LCDs employing protrusions and cut-outs for liquid crystal alignment.

SUMMARY OF THE INVENTION

[0008] The disclosure is directed to a vertically aligned liquid crystal display device. In the embodiments, the agglomerate polymer particles (called "agglomerates" in the rest of this description) located corresponding to at least a portion of the trace area have a higher number of particles per unit area (called "distribution density" in the rest of this description) than those located corresponding to the pixel area, such that the light transmittance of the wiring area (called "trace area" in the rest of this description) is lowered; accordingly, the light leakage of the display device is reduced, and the qualities of the display images are improved.

[0009] A vertically aligned liquid crystal display device according to the invention is defined in claim 1.

[0010] Aspects of the invention will become better understood with regard to the following detailed description of the preferred but non-limiting embodiment(s). The following description is made with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

FIG. 1A shows a top view of a display panel according to an embodiment of the present disclosure;

FIG. 1B shows a cross-sectional view along the cross-sectional line 1B-1B' of FIG. 1A;

FIG. 2 shows a cross-sectional view of a display panel according to another embodiment of the present disclosure;

FIG. 3 shows a top view of a display panel according to a further embodiment of the present disclosure;

FIG. 4 shows a top view of a display panel according to a still further embodiment of the present disclosure;

FIG. 5 shows a simplified explosion diagram of a display device according to an embodiment of the present disclosure; and

FIG. 6 shows a cross-sectional view of a display device according to another embodiment of the present disclosure.

DETAILED DESCRIPTION OF THE INVENTION

[0012] According to the embodiments of the present disclosure, in the display device, the agglomerates located corresponding to at least a portion of the trace area have a higher distribution density than those located corresponding to the pixel area, such that the light transmittance of the trace area is lowered; accordingly, the light leakage of the display device is reduced, and the qualities of the display images are improved. The embodiments are described in details with reference to the accompanying drawings. The identical elements of the embodiments are designated with the same or similar reference numerals. Also, it is to be noted that the drawings may be simplified for illustrating the embodiments. Thus, the specification and the drawings are to be regard as an illustrative sense rather than a restrictive sense. The details of the structures of the embodiments are for exemplification only.

[0013] FIG. 1A shows a top view of a display panel 100 according to an embodiment of the present disclosure, and FIG. 1B shows a cross-sectional view along the cross-sectional line 1B-1B' of FIG. 1A. Referring to FIGS. 1A-1B, the display panel 100 includes a first substrate 110 and a plurality of agglomerates 120. The first substrate 110 has a display area A and a non-display area B adjacent to the display area A. The display area A represents the area of the display panel 100 for displaying images, and the non-display area B represents the area not for displaying images. The agglomerates 120 are disposed on the first substrate 110. In an embodiment, as shown in FIG. 1A, the non-display area B surrounds the display area A.

[0014] In the embodiment, the distribution density of the agglomerates 120 located in at least a portion of the non-display area B is different from the distribution density of the agglomerates 120 located in the display area A. In other words, the agglomerates 120 located in different portions of the non-display area B may have different distribution densities; that is, the agglomerates 120 located in at least some portions of the non-display area B have distribution densities different from the distribution density of the agglomerates 120 located in the display area A. Moreover, the agglomerates 120 have irregular shapes and sizes. In the embodiment, the display area A is such as an area in the pixel area for displaying images, and the non-display area B is such as a trace area. However, the non-display area B may include any area which is not for displaying images and is not limited to the above-mentioned example.

[0015] In an embodiment, the distribution density of the agglomerates 120 located in the non-display area B having a size of 10-50 nm is different from the distribution density of the agglomerates 120 located in the non-display area B having a size of 50-100 nm. Moreover, among the agglomerates 120 located in the non-display area B, those with a size of 10-50 nm have a higher distribution density than those with a size of 50-100 nm.

[0016] In another embodiment, among the agglomerates 120 having a size of 50-100 nm, those located in at least a portion (e.g. some local regions) of the non-display area B have a different distance between the agglomerates 120 from the distance between those located in the display area A. For example, among the agglomerates 120 having a size of 50-100 nm, the distance between any two of the adjacent agglomerates 120 located in the non-display area B is different from the distance between any two of the adjacent agglomerates 120 located in the display area A. In an embodiment, among the agglomerates 120 having a size of 50-100 nm, the distance between any two of the adjacent agglomerates 120 located in the non-display area B is smaller than the distance between any two of the adjacent agglomerates 120 located in the display area A. It is to be noted that the distance described herein indicates at least one of a minimum distance or an average distance.

[0017] In the embodiment, the agglomerates 120 located in the non-display area B do not have any particular arrangement(s) and orientation(s). In other words, the agglomerates 120 are arranged irregularly on the first substrate 110. The agglomerates 120 located in the display area A have particular arrangement(s) for aligning the liquid crystals to tilt toward particular direction(s). The agglomerates 120 located in different areas may be provided with different functions according to the irradiation curing process applied thereon and whether an electric field is applied thereon. The distribution density of the agglomerates 120 located in at least a portion of the non-display area B is higher than the distribution density of the irregularly arranged agglomerates 120 located in the display area A. Since the agglomerates 120 located in the non-display area B do not have any particular orientation(s), the liquid crystals in the area do not tilt toward particular direction(s), thereby the area turns into a dark area, which lowers the light transmittance, and hence the light leakage issue of the display panel 100 can be improved.

[0018] As shown in FIGS. 1A-1B, the display panel 100 may further include a second substrate 130, a seal 140, a liquid crystal layer 150, and a plurality of spacers (160). The second substrate 130 and the first substrate 110 are disposed opposite to each other. The liquid crystal layer 150 and the seal 140 are disposed between the first substrate 110 and the second substrate 130. The seal 140 is located outside the non-display area B. The spacers 160 are disposed between the first substrate 110 and the second substrate 130 for providing a gap for disposing the liquid crystal layer 150. The spacers 160 may have different heights for proving buffering when the panel is pressed. The agglomerates 120 are in direct contact with the liquid crystal molecules in the liquid crystal layer 150. It is also important to point out that the agglomerates 120 are not necessarily drawn to scale according to the actual products, and the drawings are for illustrating the embodiments only and not for limiting the scope of protection of the disclosure.

[0019] In the embodiment, since the agglomerates 120 located in the non-display area B are not provided with any alignment functions for guiding particular directions, and accordingly are not provided with any alignment functions for the liquid crystal molecules. Therefore, in the non-display area B, the liquid crystal molecules in the liquid crystal layer 150 may tilt toward any possible directions, thereby the light transmittance of the non-display area is lowered, forming an excellent dark area, and the light leakage issue of the display panel 100 is improved, which further increases the contrast and quality of the images displayed in the display area.

[0020] According to the embodiments of the present disclosure, the agglomerates 120 are not limited to have particular sizes or shapes, and the sizes can be adjusted according to application needs. In an embodiment, the distribution density of the agglomerates 120 having a size of 10-100 nm located in the non-display area B is higher than the distribution density of the agglomerates 120 having a size of 10-100 nm located in the display area A. In another embodiment, in the non-display area B, the distribution density of the agglomerates 120 having a size of 10-50 nm is higher than the distribution density of the agglomerates 120 having a size of 50-100 nm. In a further embodiment, in the non-display area B, the distribution density of the agglomerates 120 having a size of 50-100 nm located on the first substrate 110 is lower than the distribution density of those located on the second substrate 130. It is important to point out that since the agglomerates 120 do not have particular shapes, the term of "size" refers to the dimension(s) of the agglomerates 120, which may be diameter, height, width, or any expression suitable for representing the size of one agglomerate 120.

[0021] In the embodiment, the display panel 100 may further include a thin film transistor array and a color filter layer on the first substrate 110. In an alternative embodiment, the color filter layer may be disposed on the second substrate 130.

[0022] In the embodiment, the display panel 100 includes a first alignment layer (170) arranged on the first substrate (110) and a second alignment layer (170) arranged on the second substrate (130) such that the liquid crystal layer (150) is disposed between the first and the second alignment layers (170). In an embodiment, as shown in FIGS. 1A-1B, the display panel 100 includes two alignment layers 170 formed on the first substrate 110 and the second substrate 130, respectively, and the agglomerates 120 are formed on the alignment layer 170 located close to the first substrate 110. In the embodiment, the alignment layer 170 may be a polyimide (PI) film.

[0023] In the embodiment, the agglomerates 120 may be formed by a variety of processes. In an embodiment, UV curable monomers are added while forming the liquid crystal layer 150 or the alignment layer 170, and then a UV irradiation process is performed from the first substrate 110 side or the second substrate 130 side for forming the agglomerates 120 on the first substrate 110 or on the alignment layer 170. The material of the agglomerates 120 formed by irradiating UV curable monomers is polymer. Polymerization degrees of the polymer in different areas are different from one another; thereby the distribution densities of the agglomerates 120 in different areas are different.

[0024] In an embodiment, the display panel 100 is such as a nano-protrusion vertical aligned liquid crystal display panel, and the agglomerates 120 and the nano-protrusion alignment structure, as the agglomerates (200) in the display area A are called, the surface of the alignment layer 170 are formed from the same monomers. For example, the nano-protrusion alignment structure can be formed in the display area A by polymerizing the monomers in the display area A while an external electric field is continuously applied thereon, and the agglomerates 120 can be formed by polymerizing the monomers in the non-display area B without applying any external electric field, the agglomerates 120 being irregularly arranged and lacking particular alignment directions. As such, the nano-protrusion alignment structure located in the display area A can help the liquid crystal molecules to align with predetermined direction(s), and the agglomerates 120, lacking particular alignment directions, located in the non-display area B can cause the liquid crystal molecules in the non-display area B to tilt toward various directions for forming an excellent dark area. As such, the possibility of the light leakage of the display panel 100 is decreased, and the contrast and the displaying quality of the display panel 100 are improved.

[0025] The aforementioned nano-protrusion alignment structure and the agglomerates 120 located in different designated areas may be manufactured by various processes. For example, via the design of a patterned electrode, wherein the patterned electrode is not formed on the area of the substrate corresponding to the non-display area B, the monomers located corresponding to the non-display area B are therefore not influenced by the electric field while being cured by UV irradiation. Alternatively, a patterned mask is applied to shield the non-display area B while the monomers are irradiated with UV light and applied with a continuously electric field, such that the monomers in the non-display area B do not undergo polymerization reaction, and the monomers in the non-display area B undergo polymerization under UV irradiation after the electric field is removed.

[0026] Furthermore, the above-mentioned shielding design from the UV irradiation for the non-display area B can utilize additional patterned masks or structural arrangements of originally existing elements in the display panel. For example, a metal wiring or a black matrix located in the non-display area B can be used for shielding the non-display area B from UV irradiation. The black matrix can be designed as a patterned black matrix with through holes for UV light to pass through, such that the monomers in the non-display area B may undergo polymerization reaction to form the agglomerates 120. In the embodiment, the UV irradiation is preferably performed from the substrate side without the color filter layer disposed thereon.

[0027] In other words, the formation of a number of the agglomerates 120, which are irregularly arranged and lack alignment functions, in the non-display area B can further consume the residual monomers in the liquid crystal layer 150. As such, the polar impurities absorbed by the un-reacted monomers in the liquid crystal layer 150 or that the residual monomers polymerize and form protrusion structures with alignment functions in the non-display area B can be reduced. Accordingly, deterioration of materials is reduced, light leakage of the display panel is decreased, and the contrast and displaying quality of the display panel can be further improved.

[0028] FIG. 2 shows a cross-sectional view of a display panel 200 according to another embodiment of the present disclosure. As shown in FIG. 2, a plurality of the agglomerates 120 may be further disposed on the second substrate 130. In the embodiment, in the non-display area B, the distribution density of the agglomerates 120 located on the first substrate 110 is different from the distribution density of the agglomerates 120 located on the second substrate 130. For example, while the agglomerates 120 are formed by a UV curing process performed on UV curable monomers, the agglomerates 120 formed on the UV irradiation side of the substrate, which side is closer to the UV light, have a relatively high distribution density and a relatively large size. Alternatively, the sizes and the locations of the agglomerates 120 can be controlled by adjusting the focus or the wavelength range of the UV irradiation.

[0029] In an embodiment, in the non-display area B, the distribution density of the agglomerates 120 having a size of 50-100 nm located on the first substrate 110 is lower than the distribution density of the agglomerates 120 located on the second substrate 130. In the present embodiment, the agglomerates 120 are formed by a UV irradiation process performed on UV curable monomers, and the UV irradiation process is performed from the second substrate 130 side.

[0030] FIG. 3 shows a top view of a display panel 300 according to a further embodiment of the present disclosure. As shown in FIG. 3, the seal 140 has a first width W1 and a first sidewall 140s, and the first sidewall 140s is adjacent to the non-display area B. The non-display area B can be divided into two regions B1 and B2. The region B1 includes the range starting from the first sidewall 140s and extending a second width W2 away from the first sidewall 140s, the second width W2 is the distance between the first sidewall 140s and the second sidewall B1s, and the second width W2 is less than the first width W1. The region B2 includes a range starting from the second sidewall B1s and extending a third width W3 away from the second sidewall B1s, the third width W3 is the distance between the second sidewall B1s and the third sidewall B2s, and the third width W3 is larger than one time the first width W1 to less than two times the first width W1. In the embodiment, the distribution density of the agglomerates 120 on the second substrate 130 and located in the region B1 is different from the distribution density of the agglomerates 120 located in the region B2. The amount of the agglomerates 120 having a size of 50-100 nm located in the region B1 is more than the amount of the agglomerates 120 having a size of 50-100 nm located in the region B2. In the embodiment, by controlling the range the UV irradiation covers and the wavelength of the UV irradiation, the agglomerates 120 can be formed together with the curing of the seal 140 by the UV irradiation process. Accordingly, the seal 140 and the agglomerates 120 can be formed in single UV irradiation step. As such, the irradiation energy is reduced, the monomers neighboring the seal 140 can react together and form the agglomerates 120 having relatively large sizes, and the light leakage of the display panel can be further reduced.

[0031] FIG. 4 shows a top view of a display panel 400 according to a still further embodiment of the present disclosure. In the embodiment, as shown in FIG. 4, the non-display area B' is disposed adjacent to the display area A' but not surrounding the display area A'. The distribution density of the agglomerates 120 located in at least a portion of the non-display area B' is different from the distribution density of the agglomerates 120 located in the display area A'. In an embodiment, the distribution density of the agglomerates 120 having a size of 10-100 nm located in the non-display area B' is higher than the distribution density of the agglomerates 120 having a size of 10-100 nm located in the display area A'. In another embodiment, the distribution density of the agglomerates 120 (with no size limitation) located in at least a portion of the non-display area B' is higher than the distribution density of the agglomerates 120 (with no size limitation) located in the display area A'.

[0032] FIG. 5 shows a simplified explosion diagram of a display device 500 according to an embodiment of the present disclosure, and FIG. 6 shows a cross-sectional view of a display device 600 according to another embodiment of the present disclosure. It is to be noted that some of the elements in FIGS. 5-6 are omitted or simplified for illustrating the embodiments. The details of the structures of the embodiments are not drawn to scale and for exemplification only, thus not for limiting the scope of protection of the disclosure. In the present embodiment, the seal 540 is adjacent to and aligned with the sidewalls of the substrates 110/130. In an alternative embodiment, the seal is not necessarily adjacent to the sidewalls of the substrate 110/130.

[0033] Referring to FIGS. 5-6, the display device 500 includes a display panel 500A. The display panel 500A includes the first substrate 110, the second substrate 130, at least a data line DL, at least a scan line SL, a trace area D, the liquid crystal layer 550, the alignment layer 570, the spacers 560, the seal 540, and the agglomerates 120. The first substrate 110 and the second substrate 130 are disposed opposite to each other. The first substrate 110 has at least a pixel area C having a plurality of pixels P. The data line DL and the scan line SL are intersected for defining the pixel area C. The trace area D is located outside the pixel area C. The liquid crystal layer 550 and the alignment layer 570 are disposed between the first substrate 110 and the second substrate 130. The spacers 560 are disposed between the first substrate 110 and the second substrate 130 for providing a gap for disposing the liquid crystal layer 550. The seal 540 is disposed between the first substrate 110 and the second substrate 130 and located outside the trace area D. The agglomerates 120 are formed on the alignment layer 570. The distribution density of the agglomerates 120 located corresponding to at least a portion of the trace area D is higher than the distribution density of the agglomerates 120 located corresponding to the pixel area C.

[0034] In the embodiment, the display panel 500A includes, for example, two alignment layers 570 formed on the first substrate 110 and the second substrate 130, respectively. The agglomerates 120 are formed on at least one of the alignment layers 570 on at least one of the first substrate 110 or the second substrate 130. The above-mentioned agglomerates 120 located corresponding to the trace area D or corresponding to the pixel area C may be formed on both of the alignment layer 570 on the first substrate 110 and the second substrate 130. In fact, the above-mentioned agglomerates 120 located corresponding to the trace area D or corresponding to the pixel area C simply refers to the range which the agglomerates 120 are located corresponding to.

[0035] As shown in FIGS. 5-6, the display device 500 may further include a black matrix (BM) 580, a thin film transistor array 590, and a color filter layer 591. The thin film transistor array 590 and the color filter layer 591 are disposed on the first substrate 110, and the black matrix 580 is disposed on the second substrate 130. In the embodiment, the trace area D may include one or more than one driver on panel 585, such as a gate driver on panel (GOP) or a data drive on panel or both of the above. One set of GOP is illustrated in FIG. 5; however, a plurality sets of the gate driver and/or the data drive on panel may be arranged as well depending on the design requirements.

[0036] In an embodiment, in the trace area D, the distribution density of the agglomerates 120 on the first substrate 110 is different from the distribution density of the agglomerates 120 on the second substrate 130.

[0037] In an embodiment, in the trace area D, the distribution density of the agglomerates 120 having a size of 10-50 nm is higher than the distribution density of the agglomerates 120 having a size of 50-100 nm.

[0038] In an embodiment, referring to FIGS. 3 and 5-6, the seal 540 has the first width W1 and the first sidewall 540s adjacent to the trace area D. The trace area D can be divided into two regions. The first region includes the range starting from the first sidewall 540s and extending the second width W2 away from the first sidewall 540s, and the second width W2 is less than the first width W1. The second region includes a range starting from the first region and extending the third width W3 away from the sidewall adjacent to the first region, and the third width W3 is higher than one time the first width W1 to less than two times the first width W1. In the embodiment, the distribution density of the agglomerates 120 on the second substrate 130 and located in the first region is different from the distribution density of the agglomerates 120 located in the second region.

[0039] While the invention has been described by way of example and in terms of the preferred embodiment(s), it is to be understood that the invention is not limited thereto. On the contrary, the scope of the invention is defined by the appended claims.

Claims

1. A vertically-aligned liquid crystal display device, comprising:

   a display panel (100, 200, 300, 400, 500) comprising:

      a first substrate (110) and a second substrate (130) disposed opposite to the first substrate (110), wherein the first substrate has at least a pixel area (C, A) having a plurality of pixels and the pixel area corresponds to a display area (A); a plurality of data lines (DL) and a plurality of scan lines (SL) arranged on the first substrate (110) such that the pixel area (C, A) is defined as the area where at least a data line (DL) and a scan line (SL) intersect; a wiring area (D, B) located outside the pixel area, wherein the wiring area (D, B) corresponds to a non-display area B);
      a liquid crystal layer (150) comprising liquid crystal molecules and disposed between the first substrate (110) and the second substrate (130); a first alignment layer (170, 570) arranged on the first substrate (110) and a second alignment layer arranged on the second substrate (130), such that the liquid crystal layer (150) is disposed between the first and the second alignment layers (170, 570); a plurality of spacers (160, 560) disposed between the first substrate (110) and the second substrate (130); a seal (140, 540) disposed between the first

substrate (110) and the second substrate (130) and located outside the wiring area (D, B); and a plurality of agglomerate polymer particles (120) formed on at least one of the alignment layers (170); wherein the agglomerate polymer particles (120) located in the non-display area (B) do not have any particular arrangement and orientation whereas the agglomerate polymer particles (120) located in the display area (A) have a particular arrangement for aligning the liquid crystal molecules to tilt toward a particular direction;

characterized in that:

the number of the agglomerate polymer particles (120) per unit area located corresponding to at least a portion of the wiring area (D, B) is higher than the number of the agglomerate polymer particles (120) per unit area of those located corresponding to the pixel area (C, A), such that the light transmittance of the wiring area (D, B) is lowered.

2. The vertically-aligned liquid crystal display device according to claim 1, wherein the number of the agglomerate polymer particles (120) per unit area having a size of 10-100 nm located in the wiring area (D, B) is higher than the number of the agglomerate polymer particles (120) per unit area having a size of 10-100 nm located in the pixel area.

3. The vertically-aligned liquid crystal display device according to claim 1, wherein the agglomerate polymer particles (120) are formed on the first and the second alignment layers (170, 570) and the number of the agglomerate polymer particles (120) per unit area located in the wiring area (D, B) on the first substrate (110) is different from the number of the agglomerate polymer particles (120) per unit area on the second substrate (130).

4. The vertically-aligned liquid crystal display device according to claim 1, wherein the number of the agglomerate polymer particles (120) per unit area located in the wiring area (D, B) having a size of 10-50 nm is higher than the number of the agglomerate polymer particles (120) per unit area located in the wiring area (D, B) having a size of 50-100 nm.

5. The vertically-aligned liquid crystal display device according to claim 1, wherein the seal (140) has a first width W1, (in plan view) and a first sidewall (140s), the first sidewall (140s) is adjacent to the wiring area (D, B), the agglomerate polymer particles (120) are formed on the second alignment layer (170, 570) and the number of the agglomerate polymer particles (120) per unit area located on the second substrate (130) within a distance range B1 starting from the first sidewall (140s) to less than one times the distance of the first width, W1, away from the first sidewall (140s) is different from the number of the agglomerate polymer particles (120) per unit area located within a distance range B2 starting from a distance of more than one times the first width, W1, to a distance of less than three times the first width, W1, away from the first sidewall (140s).

6. The vertically-aligned liquid crystal display device according to claim 1, wherein the distance between the agglomerate polymer particles (120) having a size of 50-100 nm located in the wiring area (D) is different from the distance between those located in the pixel area.

7. The vertically-aligned liquid crystal display device according to claim 1, wherein the agglomerate polymer particles (120) are formed on the first and the second alignment layers (170, 570) and the number of the agglomerate polymer particles (120) per unit area having a size of 50-100 nm located in the wiring area (D, B) on the first substrate (110) is lower than the number of the agglomerate polymer particles (120) per unit area of those on the second substrate (130).

8. The vertically-aligned device according to claim 1, wherein the wiring area (D, B) is adjacent to the pixel area (C, A).

9. The vertically-aligned liquid crystal display device according to claim 1, further comprising a black matrix (580) on the second substrate (130).

10. The vertically-aligned liquid crystal display device according to claim 1, further comprising a thin film transistor array (590) on the first substrate (110).

11. The vertically-aligned liquid crystal display device according to claim 1, further comprising a color filter layer (591) the first substrate (110).

12. The vertically-aligned liquid crystal display device according to claim 1, wherein the wiring area comprises a gate driver on panel (585), abbreviated to GOP, or a data driver on panel (585).

Patentansprüche

1. Vertikal ausgerichtete Flüssigkristallanzeigevorrichtung, umfassend:

ein Anzeige-Panel (100, 200, 300, 400, 500), umfassend:

ein erstes Substrat (110) und ein zweites Substrat (130), das sich gegenüber dem ersten Substrat (110) befindet, wobei das erste Substrat wenigstens einen Pixelbereich (C, A) mit einer Vielzahl von Pixeln aufweist und der Pixelbereich einem Anzeigebereich (A) entspricht;
eine Vielzahl von Datenleitungen (DL) und eine Vielzahl von Scanleitungen (SL), die auf dem ersten Substrat (110) angeordnet sind, so dass der Pixelbereich (C, A) als der Bereich definiert ist, wo sich wenigstens eine Datenleitung (DL) und eine Scanleitung (SL) schneiden;
einen Verdrahtungsbereich (D, B), der sich außerhalb des Pixelbereichs befindet, wobei der Verdrahtungsbereich (D, B) einem Nichtanzeigebereich (B) entspricht;
eine Flüssigkristallschicht (150), die Flüssigkristallmoleküle umfasst und sich zwischen dem ersten Substrat (110) und dem zweiten Substrat (130) befindet;
eine erste Ausrichtungsschicht (170, 570), die auf dem ersten Substrat (110) angeordnet ist, und eine zweite Ausrichtungsschicht, die auf dem zweiten Substrat (130) angeordnet ist, so dass sich die Flüssigkristallschicht (150) zwischen der ersten und der zweiten Ausrichtungsschicht (170, 570) befindet;
eine Vielzahl von Abstandshaltern (160, 560), die sich zwischen dem ersten Substrat (110) und dem zweiten Substrat (130) befinden;
eine Dichtung (140, 540), die sich zwischen dem ersten Substrat (110) und dem zweiten Substrat (130) befindet und außerhalb des Verdrahtungsbereichs (D, B) positioniert ist; und
eine Vielzahl von Agglomeratpolymerteilchen (120), die auf wenigstens einer der Ausrichtungsschichten (170) gebildet sind; wobei die Agglomeratpolymerteilchen (120), die sich im Nichtanzeigebereich (B) befinden, keine bestimmte Anordnung und Ausrichtung aufweisen, während die Agglomeratpolymerteilchen (120), die sich im Anzeigebereich (A) befinden, eine bestimmte Anordnung aufweisen, um die Flüssigkristallmoleküle so auszurichten, dass sie in eine bestimmte Richtung gekippt sind;
dadurch gekennzeichnet, dass
die Anzahl der Agglomeratpolymerteilchen (120) pro Flächeneinheit, die so positioniert sind, dass sie wenigstens einem Teil des Verdrahtungsbereichs (D, B) entsprechen, höher ist als die Anzahl der Agglomeratpolymerteilchen (120) pro Flächeneinheit derjenigen, die so positioniert sind, dass sie dem Pixelbereich (C, A) entsprechen, so dass die Lichtdurchlässigkeit des Verdrahtungsbereichs (D, B) gesenkt ist.

2. Vertikal ausgerichtete Flüssigkristallanzeigevorrichtung gemäß Anspruch 1, wobei die Anzahl der Agglomeratpolymerteilchen (120) pro Flächeneinheit, die eine Größe von 10-100 nm aufweisen und sich im Verdrahtungsbereich (D, B) befinden, höher ist als die Anzahl der Agglomeratpolymerteilchen (120) pro Flächeneinheit, die eine Größe von 10-100 nm aufweisen und sich im Pixelbereich befinden.

3. Vertikal ausgerichtete Flüssigkristallanzeigevorrichtung gemäß Anspruch 1, wobei die Agglomeratpolymerteilchen (120) auf der ersten und der zweiten Ausrichtungsschicht (170, 570) gebildet sind und die Anzahl der Agglomeratpolymerteilchen (120) pro Flächeneinheit, die sich im Verdrahtungsbereich (D, B) auf dem ersten Substrat (110) befinden, von der Anzahl der Agglomeratpolymerteilchen (120) pro Flächeneinheit auf dem zweiten Substrat (130) verschieden ist.

4. Vertikal ausgerichtete Flüssigkristallanzeigevorrichtung gemäß Anspruch 1, wobei die Anzahl der Agglomeratpolymerteilchen (120) pro Flächeneinheit im Verdrahtungsbereich (D, B), die eine Größe von 10-50 nm aufweisen, höher ist als die Anzahl der Agglomeratpolymerteilchen (120) pro Flächeneinheit, die sich im Verdrahtungsbereich (D, B) befinden und eine Größe von 50-100 nm aufweisen.

5. Vertikal ausgerichtete Flüssigkristallanzeigevorrichtung gemäß Anspruch 1, wobei die Dichtung (140) eine erste Breite W1 (in der Draufsicht) und eine erste Seitenwand (140s) aufweist, wobei die erste Seitenwand (140s) dem Verdrahtungsbereich (D, B) benachbart ist, die Agglomeratpolymerteilchen (120) auf der zweiten Ausrichtungsschicht (170, 570) gebildet sind und die Anzahl der Agglomeratpolymerteilchen (120) pro Flächeneinheit, die sich auf dem zweiten Substrat (130) innerhalb eines Abstandsbereichs B1 beginnend ab der ersten Seitenwand (140s) bis weniger als den einfachen Abstand der ersten Breite W1 von der ersten Seitenwand (140s) weg befinden, von der Anzahl der Agglomeratpolymerteilchen (120) pro Flächeneinheit, die sich innerhalb eines Abstandsbereichs B2 beginnend ab einem Abstand von mehr als der einfachen ersten Breite W1 bis zu einem Abstand von weniger als dem Dreifachen der ersten Breite W1 von der ersten Seitenwand (140s) weg befinden, verschieden ist.

6. Vertikal ausgerichtete Flüssigkristallanzeigevorrichtung gemäß Anspruch 1, wobei der Abstand zwischen den Agglomeratpolymerteilchen (120), die ei-

ne Größe von 50-100 nm aufweisen und sich im Verdrahtungsbereich (D) befinden, von dem Abstand zwischen solchen, die sich im Pixelbereich befinden, verschieden ist.

7. Vertikal ausgerichtete Flüssigkristallanzeigevorrichtung gemäß Anspruch 1, wobei die Agglomeratpolymerteilchen (120) auf der ersten und der zweiten Ausrichtungsschicht (170, 570) gebildet sind und die Anzahl der Agglomeratpolymerteilchen (120) pro Flächeneinheit, die eine Größe von 50-100 nm aufweisen und sich im Verdrahtungsbereich (D, B) auf dem ersten Substrat (110) befinden, geringer ist als die Anzahl der Agglomeratpolymerteilchen (120) pro Flächeneinheit derselben auf dem zweiten Substrat (130).

8. Vertikal ausgerichtete Vorrichtung gemäß Anspruch 1, wobei der Verdrahtungsbereich (D, B) dem Pixelbereich (C, A) benachbart ist.

9. Vertikal ausgerichtete Flüssigkristallanzeigevorrichtung gemäß Anspruch 1, weiterhin umfassend eine schwarze Matrix (580) auf dem zweiten Substrat (130).

10. Vertikal ausgerichtete Flüssigkristallanzeigevorrichtung gemäß Anspruch 1, weiterhin umfassend einen Dünnschichttransistorarray (590) auf dem ersten Substrat (110).

11. Vertikal ausgerichtete Flüssigkristallanzeigevorrichtung gemäß Anspruch 1, weiterhin umfassend eine Farbfilterschicht (591) das erste Substrat (110).

12. Vertikal ausgerichtete Flüssigkristallanzeigevorrichtung gemäß Anspruch 1, wobei der Verdrahtungsbereich einen Gate-Treiber auf dem Panel (585), der mit GOP abgekürzt wird, oder einen Datentreiber auf dem Panel (585) umfasst.

Revendications

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

un panneau d'affichage (100, 200, 300, 400, 500), comprenant :

un premier substrat (110) et un deuxième substrat (130) situé en face dudit premier substrat (110), dans lequel le premier substrat présente au moins une zone de pixels (C, A) ayant une pluralité de pixels, la zone de pixels correspondant à une zone d'affichage (A),
une pluralité de lignes de données (DL) et une pluralité de lignes de balayage (SL) arrangées sur le premier substrat (110) de manière que la zone de pixels (C, A) soit définie comme la zone où au moins une ligne de données (DL) et une ligne de balayage (SL) se croisent,
une zone d'interconnexion (D, B) située en dehors de la zone de pixels, ladite zone d'interconnexion (D, B) correspondant à une zone de non affichage (B),
une couche de cristaux liquides (150) comprenant des molécules de cristaux liquides et située entre le premier substrat (110) et le deuxième substrat (130),
une première couche d'alignement (170, 570) arrangée sur le premier substrat (110), et une deuxième couche d'alignement arrangée sur le deuxième substrat (130), de manière que la couche de cristaux liquides (150) se situe entre lesdites première et deuxième couches d'alignement (170, 570),
une pluralité d'entretoises (160, 560) situées entre le premier substrat (110) et le deuxième substrat (130),
un joint (140, 540) procuré entre le premier substrat (110) et le deuxième substrat (130), et situé en dehors de la zone d'interconnexion (D, B), et
une pluralité de particules de polymère agglomérées (120) formées sur au moins une des couches d'alignement (170),
dans lequel les particules de polymère agglomérées (120) situées dans la zone de non affichage (B) ne présentent pas d'arrangements ou orientations particulaires, alors que les particules de polymère agglomérées (120) situées dans la zone d'affichage (A) présentent un arrangement particulaire pour aligner les molécules de cristaux liquides de manière qu'elles soient inclinées vers une direction particulaire,
caractérisé en ce que
le nombre des particules de polymère agglomérées (120) par unité de surface situées correspondant à au moins une partie de la zone d'interconnexion (D, B) est supérieur au nombre des particules de polymère agglomérées (120) par unité de surface de celles situées correspondant à la zone de pixels (C, A), de manière que la transmission lumineuse de la zone d'interconnexion (D, B) est réduite.

2. Dispositif d'affichage à cristaux liquides alignés verticalement selon la revendication 1, dans lequel le nombre des particules de polymère agglomérées (120) par unité de surface ayant une taille de 10-100 nm situées dans la zone d'interconnexion (D, B) est supérieur au nombre des particules de polymère agglomérées (120) par unité de surface ayant une taille de 10-100 nm, situées dans la zone de pixels.

3. Dispositif d'affichage à cristaux liquides alignés verticalement selon la revendication 1, dans lequel les particules de polymère agglomérées (120) sont formées sur les première et deuxième couches d'alignement (170, 570), et le nombre des particules de polymère agglomérées (120) par unité de surface situées dans la zone d'interconnexion (D, B) sur le premier substrat (110) est différent du nombre des particules de polymère agglomérées (120) par unité de surface sur le deuxième substrat (130).

4. Dispositif d'affichage à cristaux liquides alignés verticalement selon la revendication 1, dans lequel le nombre des particules de polymère agglomérées (120) par unité de surface situées dans la zone d'interconnexion (D, B) et ayant une taille de 10-50 nm est supérieur au nombre des particules de polymère agglomérées (120) par unité de surface situées dans la zone d'interconnexion (D, B) ayant une taille de 50-100 nm.

5. Dispositif d'affichage à cristaux liquides alignés verticalement selon la revendication 1, dans lequel ledit joint (140) présente une première largeur W1 (en vue de dessus) et une première paroi latérale (140s), la première paroi latérale (140s) est adjacente à la zone d'interconnexion (D, B), les particules de polymère agglomérées (120) sont formées sur la deuxième couche d'alignement (170, 570), et le nombre des particules de polymère agglomérées (120) par unité de surface situées sur le deuxième substrat (130) dans une plage de distances B1 allant à partir de la première paroi latérale (140s) à moins d'une fois la distance de la première largeur W1 loin de la première paroi latérale (140s) est différent du nombre des particules de polymère agglomérées (120) par unité de surface situées dans une plage de distances B2 allant à partir d'une distance de plus d'une fois la première largeur W1 à une distance de moins de trois fois la première largeur W1 loin de la première paroi latérale (140s).

6. Dispositif d'affichage à cristaux liquides alignés verticalement selon la revendication 1, dans lequel la distance entre les particules de polymère agglomérées (120) ayant une taille de 50-100 nm situées dans la zone d'interconnexion (D) est différente de la distance entre celles situées dans la zone de pixels.

7. Dispositif d'affichage à cristaux liquides alignés verticalement selon la revendication 1, dans lequel les particules de polymère agglomérées (120) sont formées sur la première et deuxième couches d'alignement (170, 570), et le nombre des particules de polymère agglomérées (120) par unité de surface ayant une taille de 50-100 nm situées dans la zone d'interconnexion (D, B) sur le premier substrat (110) est inférieur au nombre des particules de polymère agglomérées (120) par unité de surface de celles sur le deuxième substrat (130).

8. Dispositif aligné verticalement selon la revendication 1, dans lequel la zone d'interconnexion (D, B) est adjacente à la zone de pixels (C, A).

9. Dispositif d'affichage à cristaux liquides alignés verticalement selon la revendication 1, comprenant en outre une matrice noire (580) sur le deuxième substrat (130).

10. Dispositif d'affichage à cristaux liquides alignés verticalement selon la revendication 1, comprenant en outre une matrice de transistors à couche mince (590) sur le premier substrat (110).

11. Dispositif d'affichage à cristaux liquides alignés verticalement selon la revendication 1, comprenant en outre une couche de filtre de couleur (591) le premier substrat (110).

12. Dispositif d'affichage à cristaux liquides alignés verticalement selon la revendication 1, dans lequel la zone d'interconnexion comprend une commande de grille sur le panneau (585), abrégé comme GOP, ou une commande de données sur le panneau (585).

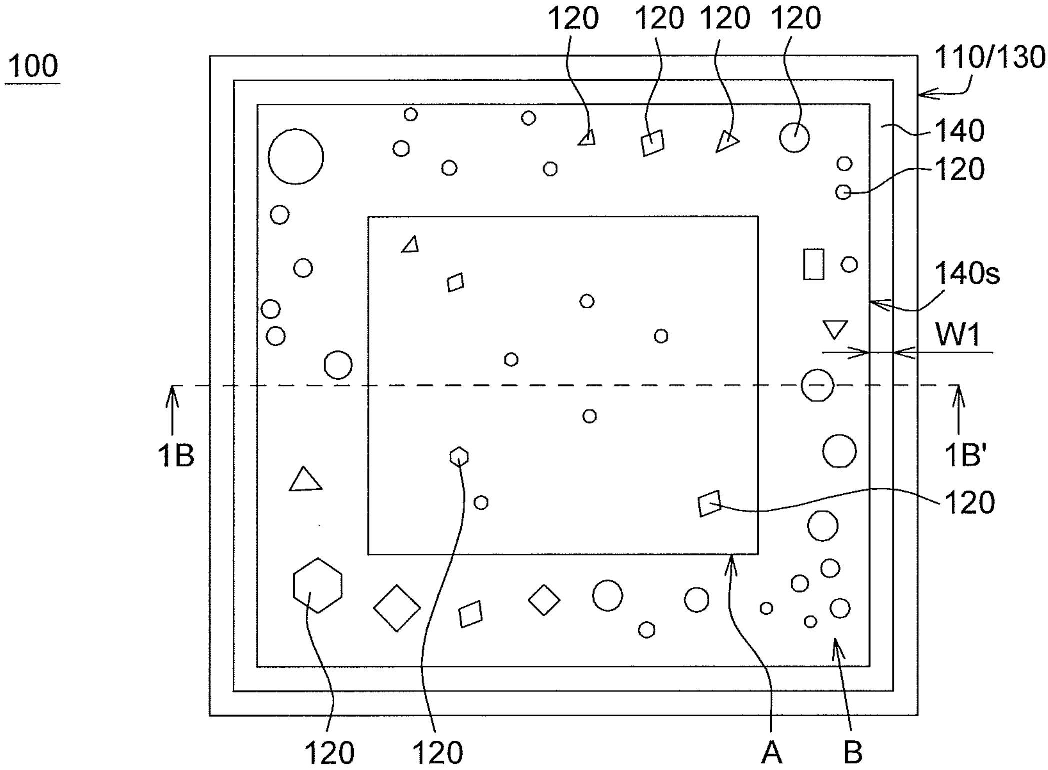
100
120
120
120
120
110/130
140
120
140s
W1
1B
1B'
120
120
120
A
B

FIG. 1A

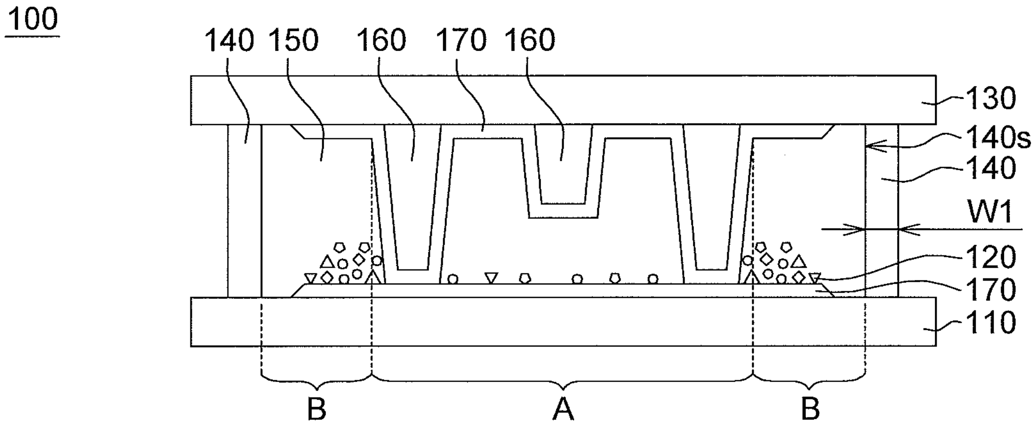
100
140
150
160
170
160
130
140s
140
W1
120
170
110
B
A
B

FIG. 1B

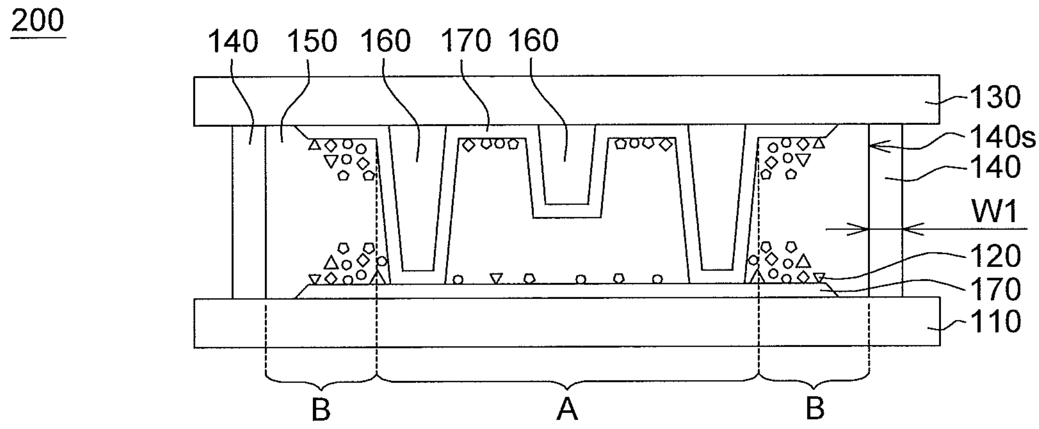
200
140
150
160
170
160
130
140s
140
W1
120
170
110
B
A
B

FIG. 2

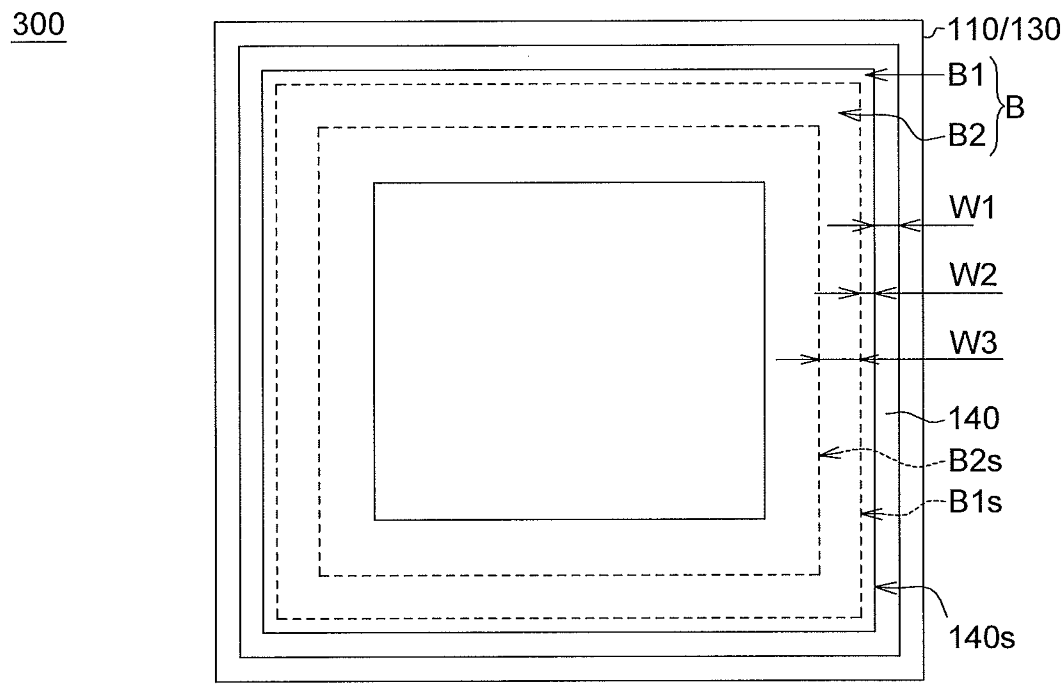
300
110/130
B1
B2
B
W1
W2
W3
140
B2s
B1s
140s

FIG. 3

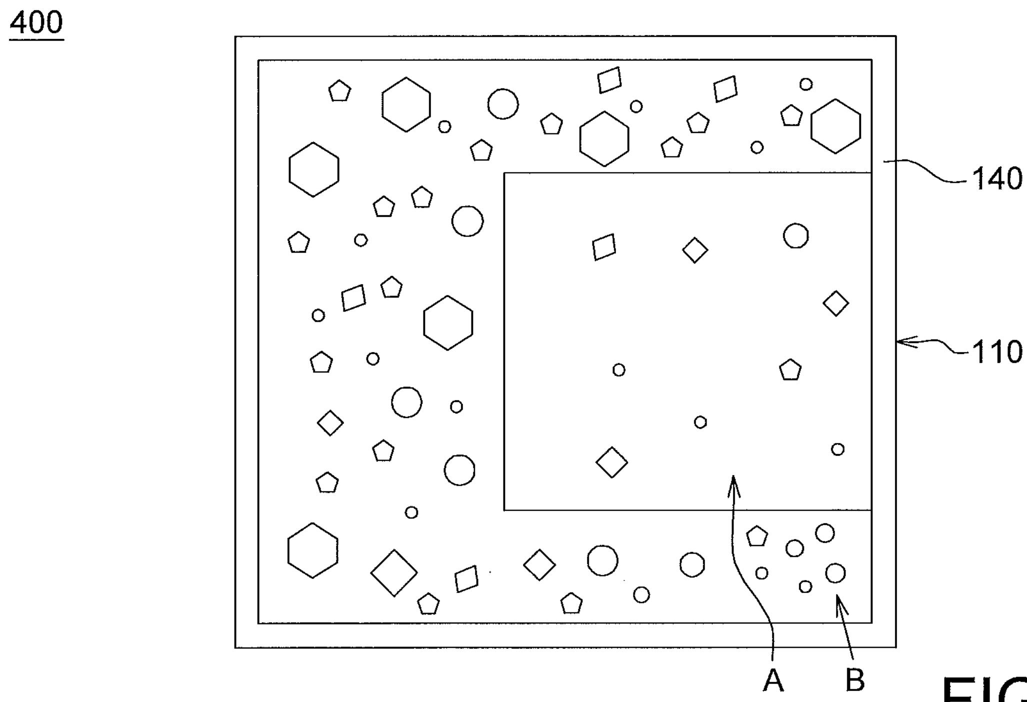

FIG. 4

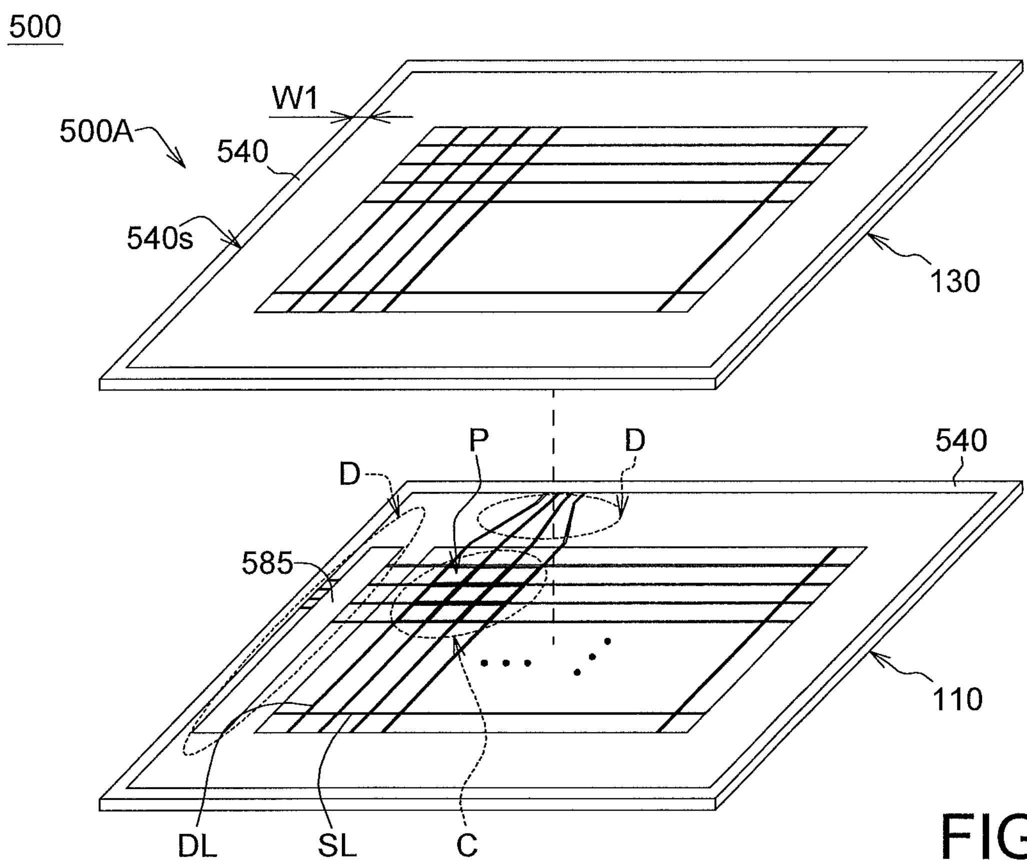

FIG. 5

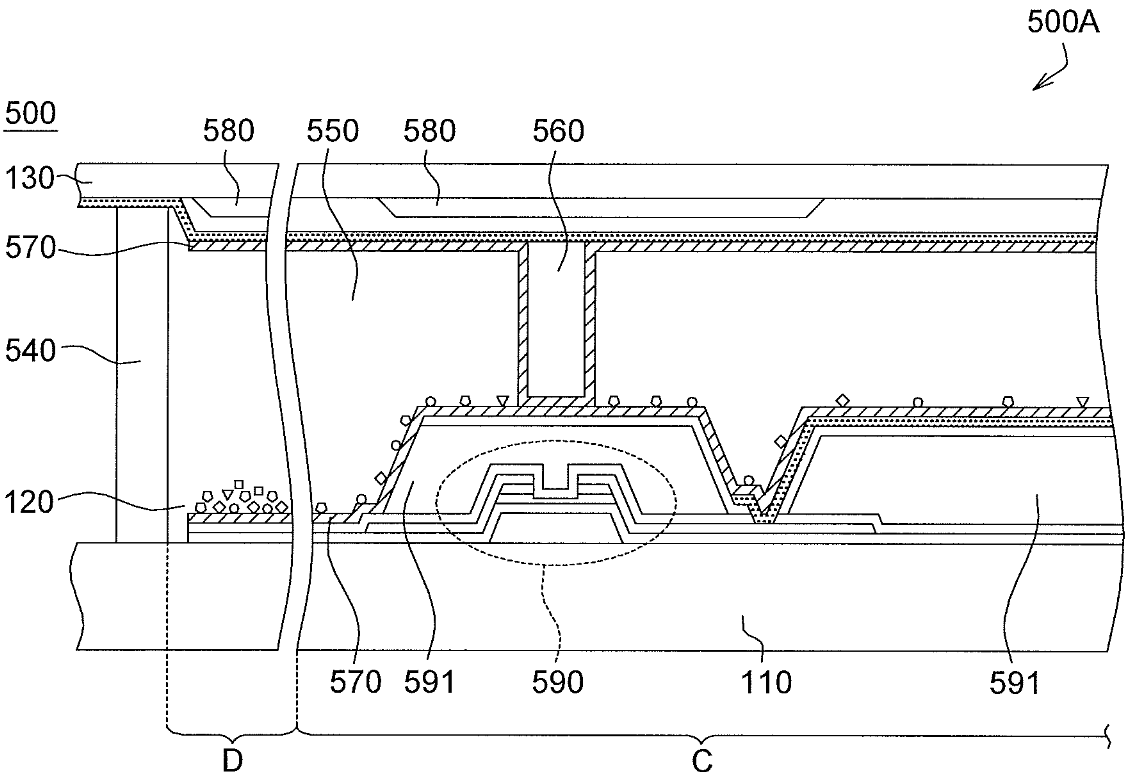

FIG. 6

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 20080252807 A **[0004]**
- US 20010304526 A **[0005]**
- US 20100188623 A **[0006]**

Non-patent literature cited in the description

- **HANAOKA et al.** 40.1: A New MVA-LCD by Polymer Sustained Alignment Technology. *Digest of the 2004 SID International Symposium in Seattle,* 1200-1203 **[0007]**

专利名称(译)	使用在取向层上形成的聚合物颗粒在垂直取向的液晶显示器中减少漏光		
公开(公告)号	EP2843466B1	公开(公告)日	2018-01-10
申请号	EP2013191535	申请日	2013-11-05
[标]申请(专利权)人(译)	群创光电股份有限公司		
申请(专利权)人(译)	群创光电		
当前申请(专利权)人(译)	群创光电		
[标]发明人	HSU HSU KUAN CHU HSIA CHING LIU KUEI LING CHEN FU CHENG CHIU KUO HAO		
发明人	HSU, HSU-KUAN CHU, HSIA-CHING LIU, KUEI-LING CHEN, FU-CHENG CHIU, KUO-HAO		
IPC分类号	G02F1/1337 G02F1/1333 G02F1/139 G02F1/137		
CPC分类号	G02F1/133753 G02F1/133788 G02F1/1393 G02F2001/133388 G02F2001/133776 G02F2001/13396 G02F2202/36 G02F1/1337 G02F1/1339 G02F1/13392 G02F1/13394 G02F1/136209 G02F2001/13775		
优先权	102130893 2013-08-28 TW		
其他公开文献	EP2843466A1		
外部链接	Espacenet		

摘要(译)

公开了一种垂直对准的LCD（100），其通过减少非显示区域中的漏光而改善了对比度和显示质量。通过选择性照射存在于取向层或LC层中的单体，在取向层（170）上形成与LC单元中的液晶（LC）层（150）直接接触的附聚颗粒（120）。这些颗粒在非显示区域（B）中比在显示区域（A）中更密集地分布。显示区域中的颗粒在施加电场的情况下形成，该电场使它们在优选方向上对准（形成纳米突起），从而在那里提供LC分子的排序;然而，在非显示区域中形成颗粒期间没有施加场：这些在形状，尺寸和取向上变化很大，防止了LC层的排序并且大大减少了那里的漏光。

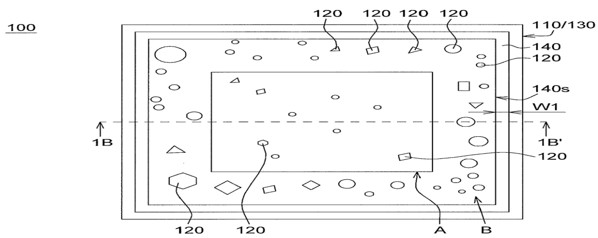

FIG. 1A

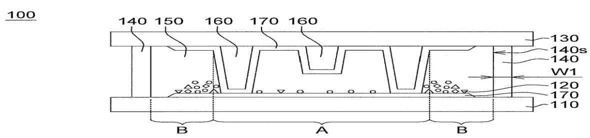

FIG. 1B