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(54) Array substrate, display panel and preparing method thereof

Array-Substrat, Anzeigetafel und Herstellungsverfahren dafür

Substrat matriciel, panneau d'affichage et son procédé de préparation

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Description

TECHNICAL FIELD

[0001] Embodiments of the present invention relate to an array substrate, a display panel and a preparing method thereof.

BACKGROUND

[0002] Liquid crystal display technologies have been rapidly developed in the recent decades. The current liquid crystal display normally comprises a thin film transistor (hereinafter "TFT") array substrate, a liquid crystal layer and a color filter (hereinafter "CF") substrate disposed sequentially from bottom up. The liquid crystal layer is contained within a liquid crystal cell formed by the TFT array substrate and the CF substrate that are disposed opposite to each other. JP2006-154577A discloses a liquid crystal display which comprises an array substrate and a back light. On the array substrate, each sub-pixel is provided with a convex lens within the display region of the sub-pixel so that the oblique light ray from the back light is lead towards the perpendicular direction for display.

SUMMARY

[0003] One aspect of the present invention provides a preparing method of an array substrate, comprising a substrate, a gate line and a data line disposed on the substrate, a protective layer covering the gate line and/or the data line; a light converging structure is disposed on the protective layer over the gate line and/or the data line and along the gate line and/or the data line, so that light emitted from rear of the substrate from both sides of the gate line and/or the data line on the substrate is converged.

[0004] Another aspect of the present invention provides a display panel, comprising the aforesaid array substrate.

[0005] A further aspect of the present invention provides a preparing method of the array substrate, comprising: forming a gate line and a data line on a substrate; forming a protective layer on the gate line and the data line; a light converging structure is formed on the protective layer over the gate line and/or the data line and extends along the gate line and/or the data line.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] In order to clearly illustrate the technical solution of the embodiments of the invention or in the prior art, the illustrative drawings used for describing the embodiments will be briefly described in the following.

Fig. 1 is a cross-sectional schematic view of the array substrate according to Embodiment 1 of the present invention;

Fig. 2 is a top view of the TFT array substrate according to Embodiment 1 of the present invention;

Fig. 3 is a schematic view of the dimensions of structures in the display panel according to Embodiment 1 of the present invention;

Fig. 4 is a structural schematic view of the display panel according to Embodiment 2 of the present invention;

Fig. 5 is a structural schematic view after coating the substrate with photosensitive resin in the Embodiment 3 of the present invention;

Fig. 6 is a structural schematic view when exposing and developing the photosensitive resin layer in the Embodiment 3 of the present invention;

Fig. 7 is a structural schematic view when forming the light converging structure in the Embodiment 3 of the present invention; and

Fig. 8 is a structural schematic view when forming the pixel electrode layer in the Embodiment 3 of the present invention.

DETAILED DESCRIPTION

[0007] The array substrate, the display panel and the preparing method thereof in the embodiments of the invention will be herein described in details with reference to the drawings. It shall be clarified that the described embodiments are just a part but not all of the embodiments of the invention. Based on the described embodiments herein, those skilled in the art can obtain other embodiment(s), without any inventive work, which should be within the scope of the invention.

[0008] Unless otherwise defined, the technical or scientific terms used herein shall have the general meanings understandable for those ordinarily skilled in the field of the present invention. The words such as "a", "an", "the" or similar shall not represent limitation of numbers, but mean existence of at least one. The phrases such as "include", "comprise" or similar intend to mean the elements or objects before such words cover or are equivalent to the elements or objects listed after such words, but other elements or objects are not exclusive. The phrases "joint", "connect" or similar are not limited to physical or chemical connection, but also include electrical connection, no matter directly or indirectly. The phrases "upper", "lower", "left", "right" and etc. shall be used only to represent relative positions, wherein, when the absolute position of the described object is changed, the relative positions may be changed accordingly.

[0009] It is found by the inventors that the existing liquid crystal panels have at least the following problems: when forming a liquid crystal cell by disposing the array substrate and the color filter substrate opposite to each other, an alignment deviation may occurs between the array substrate and the color filter substrate, whereby the pixel electrode may be partially shielded by a black matrix, which causes light leakage, due to the excessive distance between two adjacent pixel electrodes or misalignment. In order to avoid image sticking caused by light leakage, the length of the black matrix needs to be increased so as to lower the aperture ratio of the color filter substrate.

[0010] Thus, the embodiments of the present invention involve an array substrate, a display panel and a preparing method thereof.

Embodiment 1

[0011] The present embodiment provides an array substrate 11, and this array substrate may be disposed opposite to an opposed substrate to form a liquid crystal cell for accommodating liquid crystal materials therein.

[0012] Fig. 1 and Fig. 2 show schematic views of the array substrate. Fig. 1 corresponds to a cross-sectional schematic view along line A-A in Fig. 2.

[0013] As shown in Fig. 1 and Fig. 2, the array substrate 11 comprises: a substrate 1, gate lines 14 and data lines 4 disposed on the substrate 1, and a protective layer 8 covering the gate lines 14 and/or data lines 4. A light converging structure 80 is disposed on the protective layer 8 over the position corresponding to a gate line 14 and/or a data line 4. That is, the light converging structure 80 may be located over any one of the gate lines 14 and the data lines 4. The gate lines 14 and the data lines 4 intersect each other to define a plurality of pixel units.

[0014] Each of the pixel units comprises a thin film transistor as a switch element, and a pixel electrode for controlling orientation of liquid crystal. For example, in each pixel, a gate electrode of the thin film transistor is electrically connected to or integrally formed with a corresponding gate line, a source electrode thereof is electrically connected to or integrally formed with a corresponding data line, and a drain electrode thereof is electrically connected to or integrally formed with a corresponding pixel electrode.

[0015] With the light converging structure 80 disposed on a gate line 14 and/or a data line 4, the lights emitted from both sides of the gate line and/or the data line on the array substrate are converged to a central portion of the corresponding black matrix, such that the light which might have been leaked out from both sides of the black matrix arrive, after convergence, at the region where the black matrix is located so as to prevent light leakage. Thus, the dimension of the black matrix may be reduced in length and width, whereby the aperture ratio of the opposed substrate is increased while the image sticking caused by the light emission can be avoided. As shown in Fig. 2, the light converging structures 80 are disposed over both the gate line 14 and the data line 4. But, the present embodiment is not limited to this, and the light converging structure 80 may be disposed over either the gate line 14 or the data line 4.

[0016] Between the protective layer 8 and the substrate 1, the array substrate further comprises an insulating layer 3; this insulating layer 3 covers the gate lines 14, and the data lines are disposed on a surface of the insulating layer 3. The material for the insulating layer 3 may be nitrogen silicon or photosensitive resin.

[0017] Furthermore, the substrate 1 may be provided with light blocking bars 2 covered by the insulating layer 3. The light blocking bars 2 may be disposed in parallel with the gate lines 14 and/or the data lines 4. Fig. 2 only shows that the light blocking bars 2 are disposed in parallel with the gate lines 4 and one both sides of each of the gate lines, but the present embodiment is not limited to this.

[0018] Pixel electrodes 90 are disposed on both sides of each light converging structure 80. The pixel electrodes 90 are located within the pixel units defined by the corresponding gate lines and data lines.

[0019] With the light blocking bars 2, the light from a backlight module (not shown) and incident to the substrate 1 is shielded so as to limit the exit of the light, and thus further to realize miniaturization of the black matrix and to increase the aperture ratio of the opposed substrate.

[0020] In one example, the light converging structures 80 and the protective layer 8 are integrally formed with a photosensitive resin.

[0021] An example of the process of forming the protective layer 8 and the light converging structures 80 comprises: depositing a photosensitive resin solution on the insulating layer and the data lines 4; performing pre-baking to form a photosensitive resin layer; forming protrusions by a patterning process; performing post-baking so as to transform the photosensitive resin layer into the protective layer 8 and the light converging structures 80.

[0022] By integrally forming the photosensitive resin into the protective layer 8 and the light converging structures 80, the process required for separately forming the light converging structures 80 can be omitted and the production efficiency of the array substrate 11 can be improved.

[0023] Since a convex lens structure has a better light converging effect, for example, the light converging structure 80 can be implemented in a convex lens structure.

[0024] During the process of post-baking the photosensitive resin layer formed with the protrusions, the photosensitive resin layer contracts inwardly such that the protrusions forms convex lens structures.

[0025] In a display panel, the liquid crystal layer 12 normally has a thickness (i.e., the cell thickness of the liquid crystal cell formed by the array substrate and the opposed substrate) of 2-3 μm, and a data line 4 normally has a thickness of 2-3 μm. As for the display panel as shown in Fig. 3, "d" is the thickness of the liquid crystal layer 12, "b" is an angle between the transmission light and the refraction light of the protective layer 8, "a" is an angle between the incident light of the protective layer 8 and the normal line of the edge of the light converging structure 80, "c" is the half of the width of a cross-section of the light converging structure 80, "r" is a curvature radius of the light converging structure 80, and "n1" is the refractivity of the light converging structure 80, and "n2" is the refractivity of the liquid crystal layer 12.

[0026] According to the law of refraction and the trigonometric function, it is known that $r = \frac{c^2 + h^2}{2h}$, wherein "c" can be adjusted according to the dimensions of the half-tone region 60 on the half-tone mask plate 6 or the grey-tone region 70 on the grey-tone mask 7 during a patterning process (refer to Fig. 6), "h" can be controlled by the rotation speed of a glue application unit, "c" can be controlled by the time period of exposure and development, such that the size of the curvature radius "r" can be controlled and the angle "a" can be determined. Since the materials of the protective layer 8 and the liquid crystal layer 12 have been determined, the angle "b" can be determined by sina/sin(90-b) =n2/n1. With a given cell thickness of the liquid crystal layer 12, the change range in the width of the black matrix 130 on the CF substrate 13 can be determined in accordance with tanb=e/d. Then, the width of the black matrix 130 can be adjusted according to the change range.

[0027] In order to better control the dimensions of the black matrix 130 of the opposed substrate 13 corresponding to the array substrate 11, to avoid image sticking caused by light leakage of the array substrate 11, and further to better adjust the aperture ratio of the opposed substrate to improve brightness of the liquid crystal display, for example, a cross-section height "h" of the light converging structure 80 may be 0.5-1.5 μm, and a cross-section width "c" of the light converting structure 80 may be 1.5-4.5 μm.

[0028] Of course, in the embodiments of the present invention, the light converging structure 80 may be disposed either over a data line 4 or over a gate line 14 only, as stated before.

Embodiment 2

[0029] Corresponding to the array substrate of the aforesaid Embodiment 1, the present embodiment further provides a display panel, as shown in Fig. 4, comprising an array substrate 11 and an opposed substrate 13.

[0030] The opposed substrate 13, for example, is a color filter substrate (CF substrate). When a color filter layer (e.g., including RGB filters) is formed on the array substrate 11, the opposed substrate may not include a color filter layer any more. In addition, the opposed substrate 13, as needed, may comprise a common electrode layer for cooperating with the pixel electrodes on the array substrate to form electric fields for driving liquid crystal.

[0031] Usually, spacers (e.g., post spacers or ball spacers) are provided between the array substrate 11 and the opposed substrate 13, and for example is fixed by sealant so as to form a liquid crystal cell with a given cell thickness. The liquid crystal cell is filled with liquid crystal and is located between the array substrate 11 and the opposed substrate 13.

[0032] The array substrate 11 comprises: a substrate 1, gate lines 14 and data lines 4 disposed on the substrate 1, a protective layer 8 covering the gate lines 14 and/or the data lines 4; light converging structures 80 are disposed on the protective layer 8 and over the gate lines 14 and/or the data lines 4.

[0033] The opposed substrate 13 is provided with a black matrix 130 corresponding to the gate lines and data lines on the array substrate 11, such that the black matrix 130 also corresponds to the light converging structures 80.

[0034] An insulating layer 3 is disposed between the protective layer 8 and the substrate 1. The insulating layer 3 covers the gate lines 14 and the data lines 4 are disposed on a surface of the insulating layer 3. Furthermore, for example, light blocking bars 2 covered by the insulating layer 3 are disposed on the substrate 1; the light blocking bars 2 may be disposed in parallel with the gate lines 14 and/or the data lines 4. In addition, pixel electrodes 90 are disposed on the protective layer 8 one both sides of the light converging structures 80.

[0035] With the light blocking bars 2, the light incident to the substrate 1 is shielded so as to limit the exit of the light, and thus further to realize miniaturization of the black matrix and to increase the aperture ratio of the color filter substrate 130.

[0036] For example, the light converging structures 80 and the protective layer 8 are integrally formed with a photosensitive resin.

[0037] An example of the process of forming the protective layer 8 and the light converging structure 80 comprises: depositing a photosensitive resin solution on the insulating layer and the data lines 4; performing pre-baking to form a photosensitive resin layer; forming protrusions by a patterning process; performing post-baking so as to transform the photosensitive resin layer into the protective layer 8 and the light converging structures 80.

[0038] By integrally forming the photosensitive resin into the protective layer 8 and the light converging structures 80, the process required by separately forming the light converging structure 80 can be omitted and the production efficiency of the array substrate 11 can be improved.

[0039] Since convex lens structure has a better light converging effect, for example, each light converging structure 80 is implemented in a convex lens structure.

[0040] During the process of post-baking the photosensitive resin layer formed with the protrusions, the photosensitive resin layer contracts inwardly such that the protrusions form convex lens structures.

[0041] In order to better control the dimensions of the black matrix of the opposed substrate 13 corresponding to the array substrate 11, to avoid image sticking caused by light leakage of the array substrate 11, and further to better adjust the aperture ratio of the opposed substrate to improve brightness of the liquid crystal display, relevant parameters may be determined according to the requirements, for example, as shown in Fig. 3, a cross-section height "h" of the light converging structure 80 may be 0.5-1.5 μm, a cross-section width "c" of the light converting structure 80 may be 1.5-4.5 μm, and a cell thickness "d" of the liquid crystal layer 12 for example may be 2-3 μm.

Embodiment 3

[0042] Corresponding to the array substrate of the aforesaid Embodiment 1, the present embodiment further provides a preparing method of the array substrate, the method comprising the following steps:

[0043] S1, forming a shielding layer on a substrate, and forming gate lines by a patterning process.

[0044] A shielding layer is deposited on the substrate 1. As shown in Fig. 5, the substrate 1 for example is a glass substrate, a plastic substrate or the like. The shielding layer may be made of a material same as that for the gate electrodes (not shown) and the gate lines. It usually may also be called as a gate metal layer and is of such a metal conductive material as chromium, aluminum, molybdenum, neodymium or the like, or a non-metal conductive material. The shielding layer is coated with photoresist and the photoresist is exposed and developed by a patterning process. After the exposure and development, the shielding layer is etched for forming the gate electrodes and the gate lines 14. In one example, light blocking bars may be formed at the same time. The light blocking bars for example may be located on both sides of the gate lines, or on both sides of the data lines to be formed afterwards.

S2, forming an insulating layer.

[0045] After the light blocking bar 2 is formed, an insulating layer 3 is formed by deposition on the substrate 1 after the step S1. For example, the material of the insulating layer 3 may be nitrogen silicon, insulating resin or the like.

S3, forming data lines on the insulating layer.

[0046] For example, an active layer of the thin film transistor may be firstly formed. For example, an amorphous silicon layer (not shown) and an amorphous silicon layer doped with phosphorus elements (not shown) are formed over the gate electrodes on the insulating layer 3. The amorphous silicon layer and the amorphous silicon layer with doped elements are patterned. The material of the active layer is not limited to the aforesaid amorphous silicon layer and may also be polysilicon, oxide semiconductor or the like. Next, a metal layer is deposed over the active layer; source electrodes (not shown) and drain electrodes (not shown) of the thin film transistors and the data lines 4 may be formed by a patterning process. The data lines 4 are, for example, connected to the source electrodes respectively.

[0047] The patterning process is, for example, a photolithography process. One example of the photolithography process comprises: coating a structure layer to be pattered with a photoresist layer, exposing the photoresist layer using a mask plate, developing the exposed photoresist layer to obtain a photoresist pattern, etching the structure layer using the photoresist pattern, and then optionally removing the photoresist pattern if desired.

[0048] S4, forming light converging structures on the protective layer over the gate lines and/or the data lines by a patterning process.

[0049] One example of step S4, as shown in Fig. 7, comprises the following steps of S40~S43.

[0050] S40, coating a photosensitive resin solution on the substrate formed with gate lines and data lines.

[0051] After the source electrodes, the drain electrodes and data lines 4 are formed on the substrate 1, the substrate is coated with the photosensitive resin solution. For example, the material of the photosensitive resin is a mixture of phenolic resin and a photo sensitizer.

[0052] S41, pre-baking the photosensitive resin solution to form a photosensitive resin layer.

[0053] Such conditions as the temperature of pre-baking may be set according to requirements. For example, pre-baking is conducted in an environment of about 110 □ so as to volatilize the solvent (e.g., organic solvent) in the photosensitive resin solution, thus forming a photosensitive resin layer 5.

[0054] S42, exposing and developing the photosensitive resin layer using a half-tone mask plate or a grey-tone mask plate, forming protrusions in a completely shielding region.

[0055] If the half-tone mask plate is adopted, the half-tone mask plate 6 comprises a half-tone region 60 and a completely shielding region 61 thereon; if the grey-tone mask plate is adopted, the grey-tone mask plate 7 comprises a grey-tone region 70 and a completely shielding region 71 thereon. The following description is provided by taking the half-tone mask plate 6 for example.

[0056] The photosensitive resin layer 5 is shielded by the half-tone mask plate 6, as shown in Fig. 6, and exposure is performed such that the upper part photosensitive resin material of the partially exposure region 51 of the photosensitive resin layer 5 corresponding to the half-tone region 60 becomes an acid material, while the unexposed region 52 maintains the original characteristics of the photosensitive resin. The exposed substrate 1 is put into a developing liquid for development. Since the developing liquid is alkali, it reacts with the upper part photosensitive resin layer 5 of the partially exposure region 51 that is become acid. The upper part photosensitive resin layer 5 of the partially exposure region 51 is removed and lower part photosensitive resin layer 5 of the partially exposure region 51 remains as a protective layer. At the same time, a protrusion 50 is formed on the photosensitive resin layer 5 of the unexposed region 52 corresponding to the completely shielding region 61, wherein the protrusion 50 is of a shape similar to a trapezoid. If desired, for example, a via hole may be further formed in the protective layer, and the half-tone mask plate 6 may further include a void region (blank region) for completely exposing the corresponding photosensitive resin part. The completely exposed photosensitive resin part is completely removed during the development process.

[0057] In this example, the photosensitive resin material is a positive photosensitive material, i.e., the exposed region is removed during the development process. In another example, the photosensitive resin material may also be a negative photosensitive material, i.e., the exposed region is retained during the development process.

[0058] The process of exposure and development using the grey-tone mask plate 7 is identical to that using the half-tone mask plate. The grey-tone region 70 corresponds to the partially exposure region. No more details are given herein for simplicity.

[0059] S43, curing the photosensitive resin layer by post-baking heating, and transforming the protrusions to form convex lens structures as the light converging structures.

[0060] The substrate 1 is heated by post-baking, and the temperature of the post-baking heating may be set according to practical situations. By post-baking heating, the photosensitive resin layer 5 and the formed protrusions 50 are gathered and contracted inwardly, and the edge of the protrusions 50 becomes smoother. During the continuous heating process, the protrusions 50 and the photosensitive resin layer 5 are cured. As shown in Fig. 7, a second insulating layer 8 and a light converging structure 80 are formed after the post-baking process.

[0061] In the process of curing the photosensitive resin layer 5, in order to avoid such problems as stripping off of the protective layer 8 caused by low adhesiveness due to excessive low temperature of the post-baking, for example, the temperature of the post-baking heating may be set at 110-150°C. After the post-baking at the temperature, the protective layer 8 formed by curing will have better adhesiveness.

[0062] S5, forming pixel electrodes on the protective layer, wherein the pixel electrodes are located on both sides of the light converging structure.

[0063] If desired, pixel electrodes may be further formed after forming the protective layer 8. The material for forming pixel electrodes, e.g., indium-tin oxide, indium-zinc oxide or the like, are deposited on the protective layer 8 so as to form a pixel electrode film 9. As shown in Fig. 8, the deposited pixel electrode film 9 will cover the light converging structures 80. The pixel electrode film 9 may be patterned using a patterning process. The pixel electrode film 9 is coated with photoresist 9, and the photoresist over the light converging structures 80 is removed by photolithography process. The pixel electrode film 9 over the convex lens structures 80 is etched and removed, such that the pixel electrode film 9 forms pixel electrodes 90 on both sides of the light converging structures 80. Up to now, the array substrate 11 shown in Fig. 1 is obtained.

[0064] In addition, the array substrate 11, if needed, may further comprise a common electrode layer for cooperating with the pixel electrodes in order to form electric fields for driving liquid crystal. The common electrode may be formed on a same layer as or on a different layer from that of the pixel electrodes. In the present embodiment, there is no need for the corresponding opposed substrate to be provided with a common electrode layer.

[0065] In another embodiment, the pixel electrodes may be formed on and under the protective layer 8 (the light converging structure 80s). That is, the pixel electrodes may be formed prior to the formation of the protective layer, where the protective layer is made of a transparent material.

Embodiment 4

[0066] In the array substrate 11 prepared by the over steps, since the protective layer 8 is formed by photosensitive resin material, which may comprise such structures as photosensitive groups and may present a color of light yellow, the liquid crystal display prepared by the array substrate 11 may have the problem of lower transmittance, or discoloration when the light transmits the TFT array substrate 11, such that the displayed color becomes dull or has deviation.

[0067] Furthermore, the following treatments may be performed after heating by post-baking, curing the photosensitive resin layer and the protrusions to form convex lens structures as the light converging structures, as shown in Fig. 5.

[0068] S44, bleaching the cured protective layer and light converging structures by ultraviolet so as to make the protective layer and the light converging structures faded.

[0069] After the photosensitive resin layer 5 is heated by post-baking to be cured into the protective layer 8, it is bleached by ultraviolet, i.e. by irradiating the protective layer 8 using ultraviolet such that the photosensitive groups in the photosensitive resin forming the protective layer 8 react. The photosensitive groups fade such that the protective layer 8 becomes a water-white and transparent structure, thus preventing the liquid crystal display prepared by the array substrate 11 from such problems as lower transmittancc or deviation of the displayed color.

[0070] The embodiments of the present invention provide an array substrate, a display panel and a preparing method thereof Over the protective layer on the gate lines and data lines, light converging structures corresponding to the gate lines and/or said data lines are formed by a patterning process, so as to converge the light emitted from the protective layer in the positions of the gate lines and/or data lines. The lights which might have been leaked out from both sides of the black matrix arrive, after convergence, at the region where the black matrix is located so as to prevent light leakage. Thus, the dimensions of the black matrix for shielding the exit lights to avoid image sticking are reduced, and the aperture ratio of the opposed substrate is increased.

[0071] The aforesaid embodiments of the present invention are given by way of illustration only and thus are not limitative of the protection scope of the present invention, which is determined by the attached claims.

Claims

1. An array substrate (11) comprising: a substrate (1), a gate line (14) and a data line (4) disposed on the substrate (1), a protective layer (8) covering the gate line (14) and/or the data line (4),
characterized in that a light converging structure (80) is disposed on the protective layer (8) over the gate line (14) and/or the data line (4) and along the gate line (14) and/or the data line (4), so that light emitted from the rear of the substrate (1) from both sides of the gate line (14) and/or the data line (4) on the substrate (1) is converged.

2. The array substrate according to claim 1, wherein the light converging structure (80) and the protective layer (8) are integrally formed with a photosensitive resin layer (5).

3. The array substrate according to claim 1 or 2, wherein pixel electrodes (9) are disposed on both sides of the light converging structure (80).

4. The array substrate according to any one of claims 1-3, wherein the light converging structure (80) is implemented as a convex lens structure (80).

5. The array substrate according to claim 4, wherein a cross-section height of the convex lens structure (80) is 0.5-1.5 μm, and a cross-section width of the convex lens structure (80) is 1.5-4.5 μm.

6. A display panel, comprising an array substrate (11) according to any one of claims 1-5.

7. The display panel according to claim 6, further comprising an opposed substrate (13) disposed opposite to the array substrate (11), wherein the opposed substrate (13) comprises a black matrix (130).

8. A preparing method of an array substrate (11), comprising:

   forming a gate line (14) and a data line (4) on a substrate (1);
   forming a protective layer (8) on the gate line (14) and the data line (4);

   characterized in that

   a light converging structure (80) is formed on the protective layer (8) over the gate line (14) and/or data line (4) and extends along the gate line (14) and/or the data line (4).

9. The method according to claim 8, wherein forming the protective layer (8) and the light converging structure (80) on the protective layer (8) comprises:

   coating a photosensitive resin solution on the substrate (1) formed with the gate line (14) and data line (4);
   pre-baking the photosensitive resin solution to form a photosensitive resin layer (5);
   exposing and developing the photosensitive resin layer (5) using a half-tone mask plate (6) or a grey-tone mask plate (7), so as to form the protective layer (8) and a protrusion (50) on the protective layer (8); and
   curing the photosensitive resin layer (5) by post-baking heating, and transforming the protrusion (50) to form a convex lens structure (80) as the light converging structure (80).

10. The method according to claim 9, after curing the photosensitive resin layer (5) by post-baking heating and transforming the protrusion (50) to form a convex lens structure (80) as the light converging structure (80), further comprising:

    bleaching the cured protective layer (8) and the light converging structure (80) by ultraviolet so as to make the protective layer (8) and the light converging structure (80) fade.

11. The method according to claim 9, wherein the temperature of the post-baking heating is at 110-150°C.

12. The method according to claim 8, after forming a light converging structure (80) on the protective layer (8) over the gate line (14) and/or data line (4), further comprising:

    forming pixel electrodes (9) on the protective layer (8), wherein the pixel electrodes (9) are located on both sides of the light converging structure (80).

Patentansprüche

1. Array-Substrat (11), umfassend: ein Substrat (1), eine Gate-Leitung (14) und eine Daten-Leitung (4) angeordnet auf dem Substrat (1), eine die Gate-Leitung (14) und/oder die Daten-Leitung (4) bedeckende Schutzschicht (8),
dadurch gekennzeichnet, dass eine Licht konvergierende Struktur (80) angeordnet ist auf der Schutz-

schicht (8) über der Gate-Leitung (14) und/oder der Daten-Leitung (4) und entlang der Gate-Leitung (14) und/oder der Daten-Leitung (4), so dass von der Rückseite des Substrats (1) emittiertes Licht von beiden Seiten der Gate-Leitung (14) und/oder der Daten-Leitung (4) auf dem Substrat (1) konvergiert wird.

2. Array-Substrat gemäß Anspruch 1, wobei die Licht konvergierende Struktur (80) und die Schutzschicht (8) integral mit einer lichtempfindlichen Harzschicht (5) gebildet sind.

3. Array-Substrat gemäß Anspruch 1 oder 2, wobei Pixel-Elektroden (9) auf beiden Seiten der Licht konvergierenden Struktur (80) angeordnet sind.

4. Array-Substrat gemäß einem der Ansprüche 1 bis 3, wobei die Licht konvergierende Struktur (80) als eine konvexe Linsenstruktur (80) implementiert ist.

5. Array-Substrat gemäß Anspruch 4, wobei eine Querschnittshöhe der konvexen Linsenstruktur (80) 0,5 -1,5 μm beträgt, und wobei eine Querschnittsbreite der konvexen Linsenstruktur (80) 1,5 - 4,5 μm beträgt.

6. Anzeigetafel, umfassend ein Array-Substrat (11) gemäß einem der Ansprüche 1 bis 5.

7. Displaytafel gemäß Anspruch 6, weiterhin umfassend ein gegenüberliegendes Substrat (13), gegenüber dem Array-Substrat (11) angeordnet, wobei das gegenüberliegende Substrat (13) eine schwarze Matrix (130) umfasst.

8. Herstellungsverfahren für ein Array-Substrat (11), umfassend: Ausbilden einer Gate-Leitung (14) und einer Daten-Leitung (4) auf einem Substrat (1); Ausbilden einer Schutzschicht (8) auf der Gate-Leitung (14) und der Daten-Leitung (4); **dadurch gekennzeichnet, dass** eine Licht konvergierende Struktur (80) auf der Schutzschicht (8) über der Gate-Leitung (14) und/oder der Daten-Leitung (4), sich entlang der Gate-Leitung (14) und/oder der Daten-Leitung (4) erstreckend ausgebildet wird.

9. Verfahren gemäß Anspruch 8, wobei das Ausbilden der Schutzschicht (8) und der Licht konvergierenden Struktur (80) auf der Schutzschicht (8) umfasst: Aufbringen einer lichtempfindlichen Harzlösung auf das mit der Gate-Leitung (14) und der Daten-Leitung (4) ausgebildete Substrat (1);
Vorbacken der lichtempfindlichen Harzlösung, um eine lichtempfindliche Harzschicht (5) auszubilden;
Belichten und Entwickeln der lichtempfindlichen Harzschicht (5) unter Verwendung einer Halbton-Maskenplatte (6) oder einer Grauton-Maskenplatte (7), um die Schutzschicht (8) und einen Vorsprung (50) auf der Schutzschicht (8) auszubilden; und
Härten der lichtempfindlichen Harzschicht (5) mittels Nachbacken-Erwärmung, und Umformen des Vorsprunges (50), um eine konvexe Linsenstruktur (80) als Licht konvergierende Struktur (80) zu bilden.

10. Verfahren gemäß Anspruch 9, nach dem Härten der lichtempfindlichen Harzschicht (5) mittels Nachback-Erwärmung und Umformung des Vorsprunges (50) zur Bildung einer konvexen Linsenstruktur (80) als Licht konvergierende Struktur (80) weiterhin umfassend: Bleichen der gehärteten Schutzschicht (8) und der Licht konvergierenden Struktur (80) mittels Ultraviolett, um die Schutzschicht (8) und die Licht konvergierende Struktur (80) zu bleichen.

11. Verfahren gemäß Anspruch 9, wobei die Temperatur des Nachback-Erwärmens bei 110 - 150°C liegt.

12. Verfahren gemäß Anspruch 8, nach dem Ausbilden einer Licht konvergierenden Struktur (80) auf der Schutzschicht (8) über der Gate-Leitung (14) und/oder der Daten-Leitung (4) weiterhin umfassend: Ausbilden von Pixel-Elektroden (9) auf der Schutzschicht (8), wobei die Pixel-Elektroden (9) auf beiden Seiten der Licht konvergierenden Struktur (80) lokalisiert sind.

Revendications

1. Substrat matriciel (11) comprenant : un substrat (1), une ligne de grille (14) et une ligne de données (4) placées sur le substrat (1), une couche protectrice (8) couvrant la ligne de grille (14) et/ou la ligne de données (4),
caractérisé en ce qu'une structure de convergence de la lumière (80) est placée sur la couche protectrice (8) par-dessus la ligne de grille (14) et/ou la ligne de données (4) et le long de la ligne de grille (14) et/ou de la ligne de données (4), de sorte que la lumière émise de l'arrière du substrat (1) des deux côtés de la ligne de grille (14) et/ou de la ligne de données (4) du substrat (1) converge.

2. Substrat matriciel selon la revendication 1, dans lequel la structure de convergence de la lumière (80) et la couche protectrice (8) sont formées d'un seul tenant avec une couche de résine photosensible (5).

3. Substrat matriciel selon la revendication 1 ou 2, dans lequel des électrodes de pixels (9) sont placées des deux côtés de la structure de convergence de la lumière (80).

4. Substrat matriciel selon l'une quelconque des revendications 1 à 3, dans lequel la structure de convergence de la lumière (80) est mise en oeuvre sous forme de structure de lentille convexe (80).

5. Substrat matriciel selon la revendication 4, dans lequel la hauteur de section transversale de la structure de lentille convexe (80) mesure de 0,5 à 1,5 μm, et la largeur de section transversale de la structure de lentille convexe (80) mesure de 1,5 à 4,5 μm.

6. Panneau d'affichage comprenant un substrat matriciel (11) selon l'une quelconque des revendications 1 à 5.

7. Panneau d'affichage selon la revendication 6, comprenant en outre un substrat opposé (13) placé en face du substrat matriciel (11), dans lequel le substrat opposé (13) comprend une matrice noire (130).

8. Procédé de préparation d'un substrat matriciel (11), comprenant :

la formation d'une ligne de grille (14) et d'une ligne de données (4) sur un substrat (1) ;
la formation d'une couche protectrice (8) sur la ligne de grille (14) et la ligne de données (4) ;
caractérisé en ce que
une structure de convergence de la lumière (80) est formée sur la couche protectrice (8) par-dessus la ligne de grille (14) et/ou la ligne de données (4) et s'étend le long de la ligne de grille (14) et/ou de la ligne de données (4).

9. Procédé selon la revendication 8, dans lequel la formation de la couche protectrice (8) et de la structure de convergence de la lumière (80) sur la couche protectrice (8) comprend :

l'application d'une solution de résine photosensible sur le substrat (1) formé avec la ligne de grille (14) et la ligne de données (4) ;
la pré-cuisson de la solution de résine photosensible pour former une couche de résine photosensible (5) ;
l'exposition et le développement de la couche de résine photosensible (5) au moyen d'une plaque de masque à demi-teintes (6) ou une plaque de masque à niveaux de gris (7), de manière à former la couche protectrice (8) et une saillie (50) sur la couche protectrice (8) ; et
la polymérisation de la couche de résine photosensible (5) par chauffage de post-cuisson, et la transformation de la saillie (50) pour former une structure de lentille convexe (80) servant de structure de convergence de la lumière (80).

10. Procédé selon la revendication 9 comprenant en outre, après polymérisation de la couche de résine photosensible (5) par chauffage de post-cuisson et transformation de la saillie (50) pour former une structure de lentille convexe (80) servant de structure de convergence de la lumière (80) :

la décoloration de la couche protectrice polymérisée (8) et de la structure de convergence de la lumière (80) par rayonnement ultraviolet afin que la couche protectrice (8) et la structure de convergence de la lumière (80) se décolorent.

11. Procédé selon la revendication 9, dans lequel la température du chauffage de post-cuisson est de 110 à 150 °C.

12. Procédé selon la revendication 8 comprenant en outre, après formation d'une structure de convergence de la lumière (80) sur la couche protectrice (8) par-dessus la ligne de grille (14) et/ou la ligne de données (4) :

la formation d'électrodes de pixels (9) sur la couche protectrice (8), les électrodes de pixels (9) étant placées des deux côtés de la structure de convergence de la lumière (80).

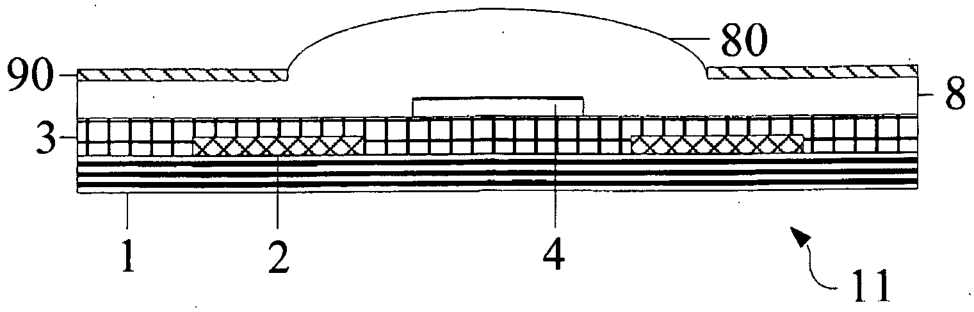

FIG.1

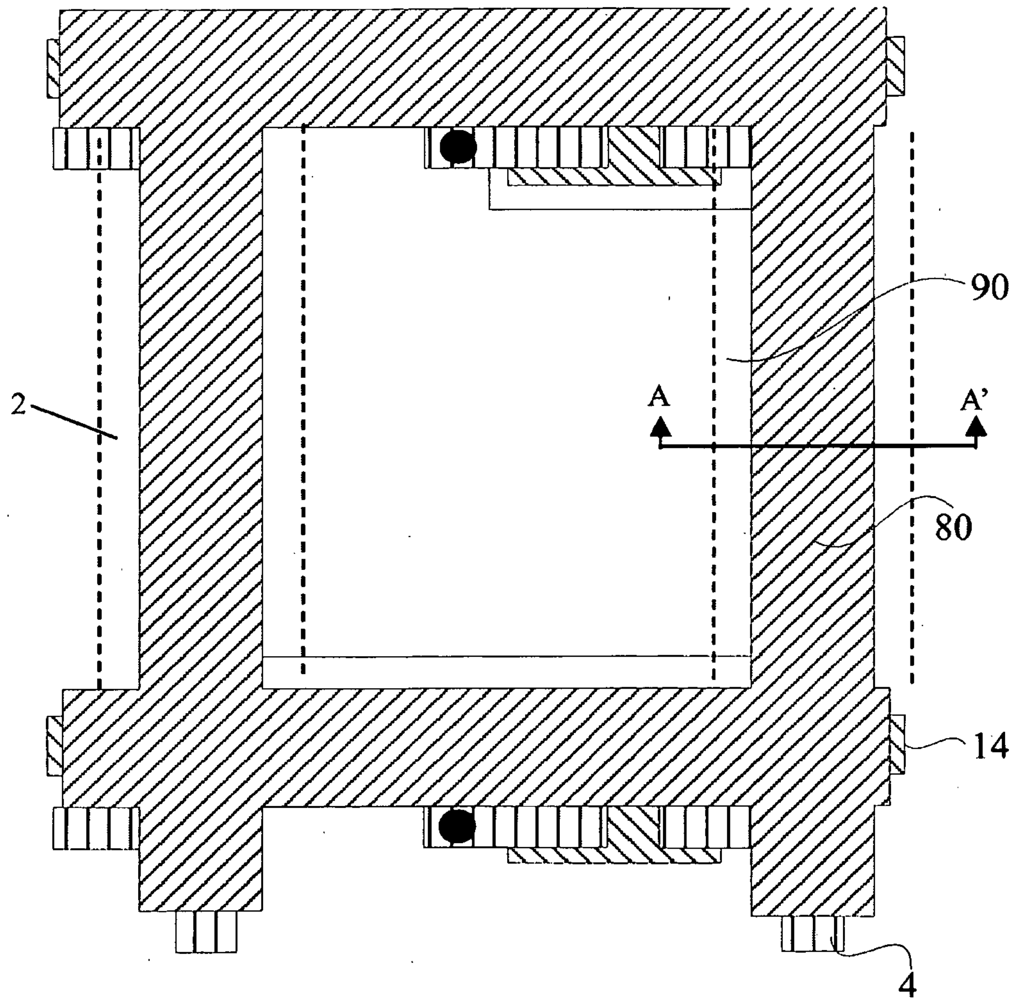

FIG.2

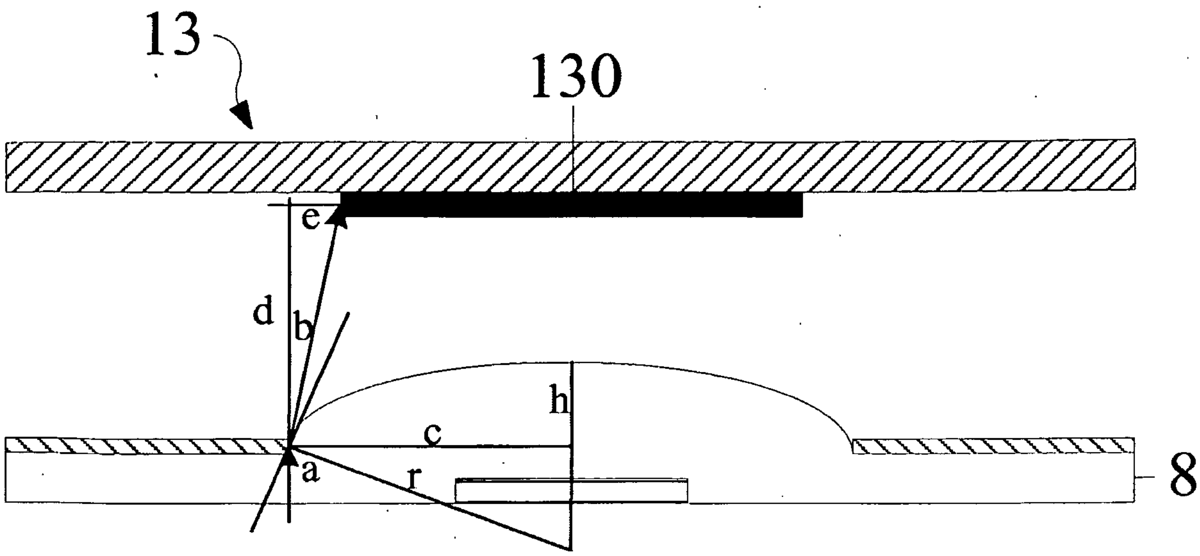

FIG.3

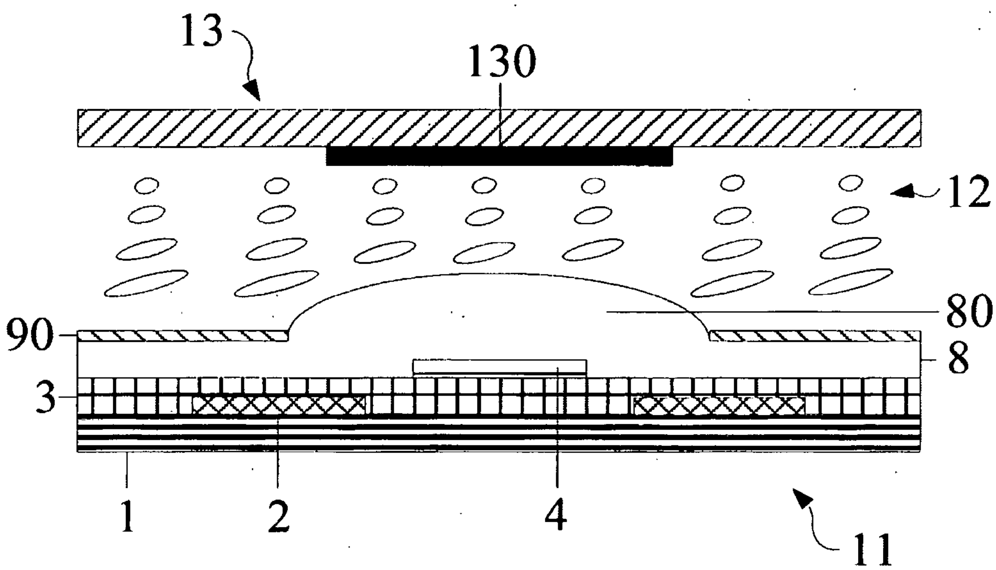

FIG.4

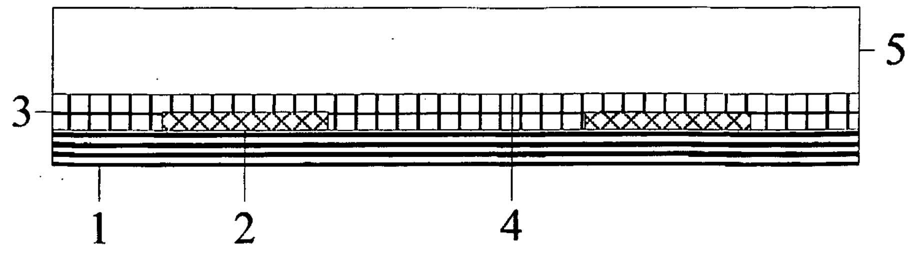

FIG.5

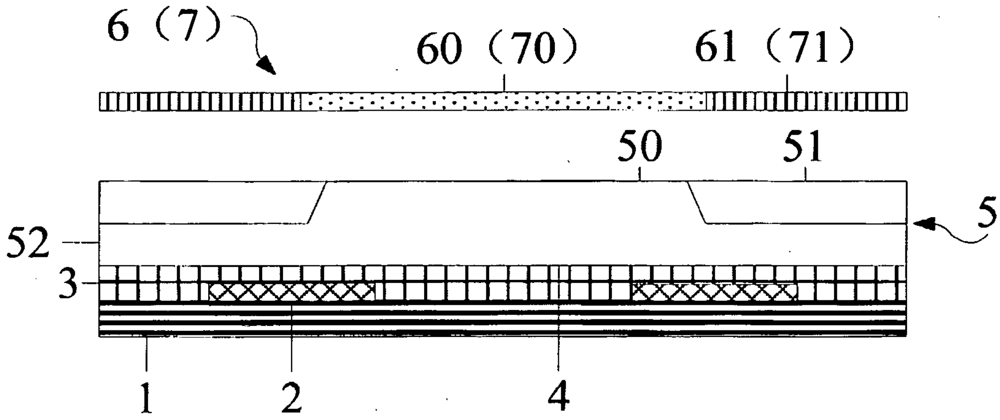

FIG.6

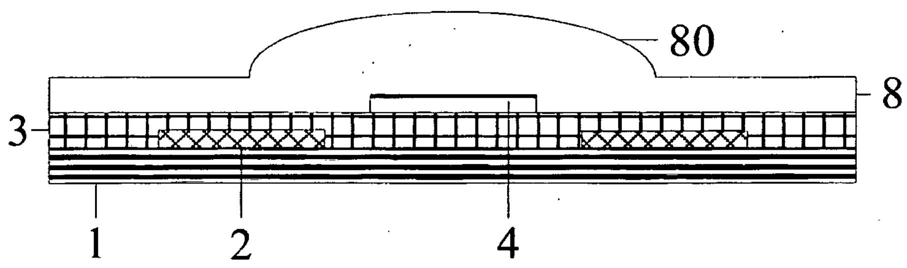

FIG.7

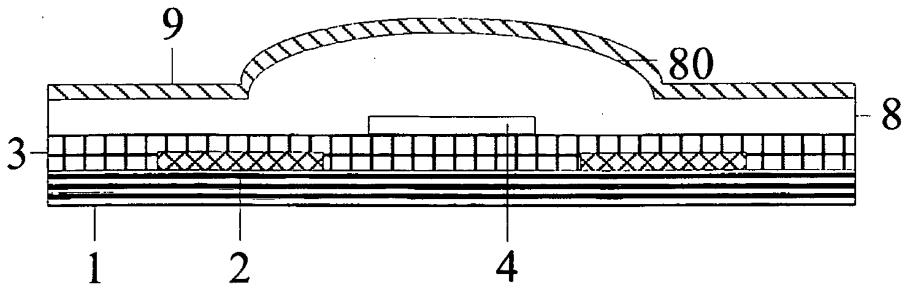

FIG.8

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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