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(19) **United States**(12) **Patent Application Publication**
Ma(10) **Pub. No.: US 2017/0146862 A1**(43) **Pub. Date: May 25, 2017**(54) **ULTRA-SLIM BEZEL DISPLAY PANEL**(57) **ABSTRACT**(71) Applicant: **Shenzhen China Star Optoelectronics Technology Co. Ltd.**, Shenzhen City (CN)(72) Inventor: **Chao Ma**, Shenzhen City (CN)(21) Appl. No.: **14/781,311**(22) PCT Filed: **Aug. 24, 2015**(86) PCT No.: **PCT/CN2015/087946**

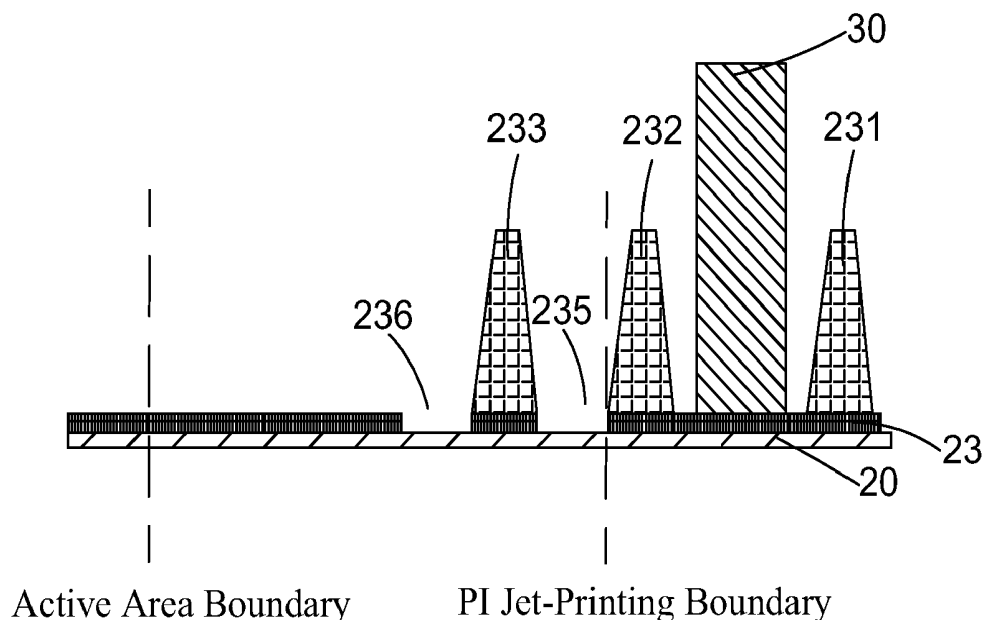
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The present invention provides an ultra-slim bezel display panel, which includes a plurality of light blocking walls formed on a peripheral area of a TFT substrate and a plurality of light blocking walls and a plurality of grooves formed on a peripheral area of the CF substrate, wherein the heights of the light blocking walls and the widths of the grooves are determined by taking an additional jet quantity resulting from precision error of a machine into consideration so that, through calculation, the laid sizes of the light blocking walls and the grooves can be correctly determined to prevent, during coating of PI liquid on the TFT substrate and the CF substrate, the PI liquid coated on an outer circumference of an active area from flowing backward into the active area and thus, improve the mura phenomenon occurring in the circumference of the active area and also, to use the light blocking walls on the inside and the outside of circumferential enclosure sealant to achieve an effect of maintaining a cell thickness of a panel around the circumferential enclosure sealant to further improve the quality of a display panel and increase yield rate. The light blocking walls that are provided on the TFT substrate and have different heights are formed through exposure by application of a half-tone mask so that the manufacturing process of the liquid crystal display panel is simplified and manufacturing cost lowered down.



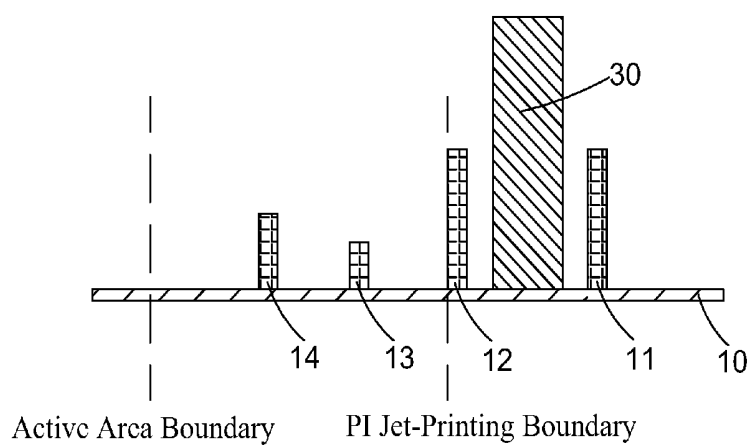


Fig. 1

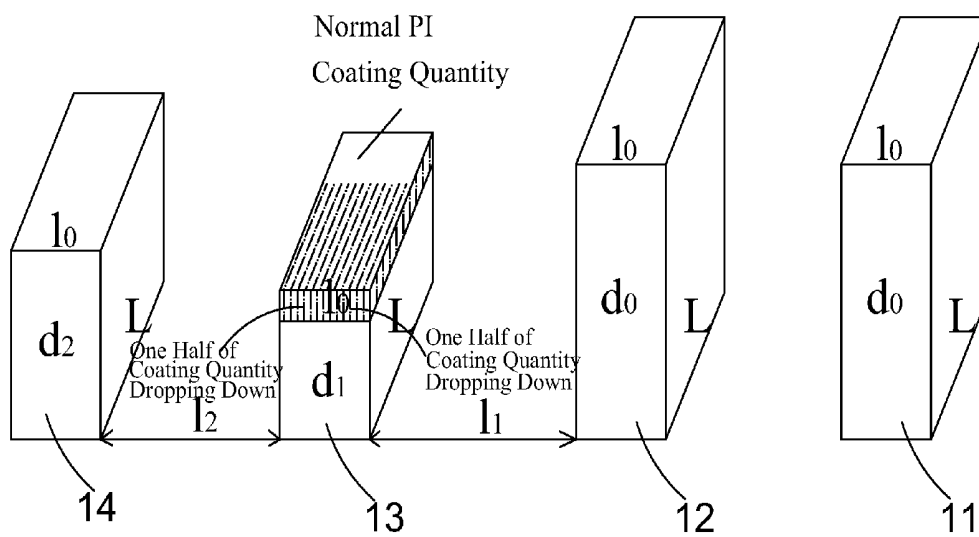


Fig. 2

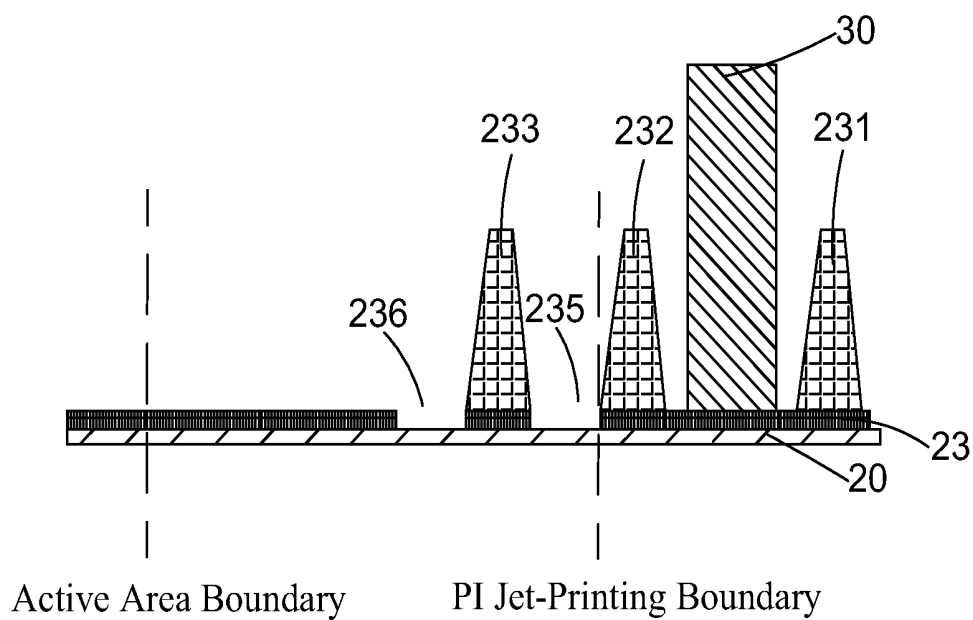


Fig. 3

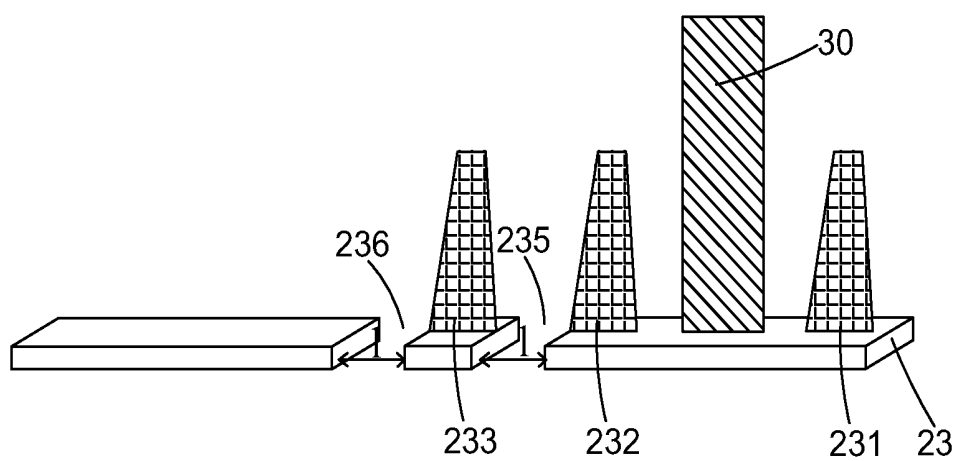


Fig. 4

ULTRA-SLIM BEZEL DISPLAY PANEL

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to the field of manufacture of display devices, and in particular to an ultra-slim bezel display panel.

[0003] 2. The Related Arts

[0004] Liquid crystal displays (LCDs) have a variety of advantages, such as thin device body, low power consumption, and being free of radiation, and are thus used widely. Most of the LCDs that are currently available in the market are backlighting LCDs, which comprise a liquid crystal display panel and a backlight module. The operation principle of the liquid crystal display panel is that liquid crystal molecules are arranged between two parallel glass substrates and electricity is applied to the glass substrates to control the liquid crystal molecules to change direction in order to refract out light from the backlight module to generate an image.

[0005] A liquid crystal display panel is generally made up of a color filter (CF) substrate, a thin-film transistor (TFT) substrate, liquid crystal (LC) interposed between the CF substrate and the TFT substrate, and sealant. The TFT substrate and the CF substrate are often each provided with an alignment film formed thereon. When put in contact with LC, the alignment film causes LC to generate a pre-tilt angle in a predetermined direction so as to provide the liquid crystal molecules with a carrying angle (wherein the value of the pre-tilt angle shows important influence on the driving voltage of TFT-LCD, contrast, response time, and view angle). The alignment film is usually made of a material selected from polyimide (PI) materials and is formed by coating a PI solution on a substrate.

[0006] With the progress of the display technology, the requirement of general consumers for consumer electronic products is no longer limited to functionality and also additionally asking for considerations regarding designs and aesthetics and good visual experience. For example, ultra-slim bezel products are currently prevailing and as the name suggests, an ultra-slim bezel is made by further narrowing down a bezel of a conventional TFT-LCD to thus expand the area of an active area (AA) thereby achieving upgraded visual experience and aesthetics of product design. In view of this, to challenge an even higher level of LCD panel design and manufacture, such as device preciseness and material performance compatibility, upgrading and improvement to a significant extent is thus necessary.

[0007] Accuracy of coating a PI solution is thus becoming important. This is because an ultra-slim bezel design is different from the prior art designs and the distance that the AA zone is spaced from an edge of a glass substrate is closer. In addition, during the coating process of the PI solution, factors, such as back flowing of PI after coating and accuracy control of film shrinkage after PI has been baked, must be considered. Once the accuracy of the PI coating at a peripheral area of a panel is not well controlled, PI on a circumferential area of an LCD panel may flow backward to the AA zone so as to cause a mura phenomenon (a phenomenon where brightness is not uniform) on a periphery of the AA zone. This would greatly affect the quality and yield rate of the panel.

[0008] In view of the above, manufacturers of the industry often intend to overcome the above problems through

change of the design. Such as a color resist wall arranged outside the AA zone to control the phenomenon of PI backward flowing. This, to some extents, still suffers the same problem of non-uniform backward flowing of PI and mura may appear on the circumference of the panel.

SUMMARY OF THE INVENTION

[0009] An object of the present invention is to provide an ultra-slim bezel display panel, which helps improve the mura phenomenon occurring in a circumference of an active area resulting from backward flowing of PI commonly encountered in an ultra-slim bezel display panel and thus increases the yield rate.

[0010] To achieve the above object, the present invention provides an ultra-slim bezel display panel, which comprises a thin-film transistor (TFT) substrate and a color filter (CF) substrate that are opposite to each other and circumferential enclosure sealant that hermetically connects between the TFT substrate and the CF substrate, the TFT substrate and the CF substrate each having an active area located in a central portion thereof and a peripheral area located on an outer circumference of the active area, the active areas and the peripheral areas of the TFT substrate and the CF substrate respectively corresponding to each other, the circumferential enclosure sealant being arranged between the peripheral areas of the TFT substrate and the CF substrate;

[0011] wherein the peripheral area of the TFT substrate comprises a plurality of light blocking walls formed thereon and the peripheral area of the CF substrate comprises a plurality of light blocking walls and a plurality of grooves formed thereon whereby when a polyimide (PI) liquid is coated on the TFT substrate and the CF substrate, the PI liquid coated on the peripheral areas is prevented from flowing backward into the active areas.

[0012] The peripheral area of the TFT substrate comprises four light blocking walls formed thereon, which are respectively, in sequence from the outside of the TFT substrate to the inside thereof, a first light blocking wall, a second light blocking wall, a third light blocking wall, and a fourth light blocking wall; and the first and second light blocking walls are respectively set on the outside and the inside of the circumferential enclosure sealant and each defines a predetermined gap with respect to the circumferential enclosure sealant, the second light blocking wall having an inner side that defines a PI jet-printing boundary, the third and fourth light blocking walls being set between a boundary of the active area and the PI jet-printing boundary;

[0013] the CF substrate comprises a block matrix formed thereon and a portion of the block matrix that is located in the peripheral area of the CF substrate comprises three light blocking walls, which are respectively, in sequence from the outside of the CF substrate to the inside thereof, a fifth light blocking wall, a sixth light blocking wall, and a seventh light blocking wall; and the fifth and sixth light blocking walls are respectively set on the outside and the inside of the circumferential enclosure sealant and each defines a predetermined gap with respect to the circumferential enclosure sealant, the sixth light blocking wall having an inner side that defines a PI jet-printing boundary, the seventh light blocking wall being set between a boundary of the active area and the PI jet-printing boundary; and

[0014] the block matrix comprises a first groove corresponding to a location between the sixth and seventh light

blocking walls and a second groove corresponding to an inner side of the seventh light blocking wall.

[0015] Widths and lengths the first, second, third, and fourth light blocking walls are identical.

[0016] A height d_2 of the fourth light blocking wall is greater than a height d_1 of the third light blocking wall and the heights d_1 and d_2 satisfy the following conditions:

$$d_1 = \frac{2Y \times l_1 + Y \times l_0}{2l_1},$$

$$d_2 = \frac{L \times Y \times l_0 + L \times Y \times l_2 + X}{L \times l_2},$$

[0017] where l_0 and L respectively denote the width and length of the third and fourth light blocking walls; l_1 is a spacing distance between the second and third light blocking walls; l_2 is a spacing distance between the third and fourth light blocking walls; X denotes precision error of a liquid machine; and Y denotes a thickness of a wet film formed through coating of the PI liquid.

[0018] Heights of the first and second light blocking walls are identical and the heights of the first and second light blocking walls, d_0 , is greater than a height of the fourth light blocking wall, d_2 .

[0019] The first, second, third, and fourth light blocking walls are formed through exposure by applying a half-tone mask.

[0020] Color resist layers are arranged under the first, second, third, and fourth light blocking walls of the TFT substrate, the first, second, third, and fourth light blocking walls and the color resist layers being formed through the same mask based manufacturing process, the first, second, third, and fourth light blocking walls being formed of color resists.

[0021] Widths and heights of the fifth, sixth, and seventh light blocking walls are identical.

[0022] Widths and heights of the first groove and the second groove are identical and the width of the first and second grooves, l , satisfies the following condition:

$$l \geq \frac{K \times Y \times L + 2L}{2L \times (H + h - Y)},$$

[0023] where K , H , L respectively denote the width, the height, and the length of the fifth, sixth, and seventh light blocking walls; h is the height of the first and second grooves; X denotes precision error of the PI liquid machine; and Y denotes a thickness of a wet film formed through coating of the PI liquid.

[0024] The active area of the CF substrate is provided with a plurality of uniformly distributed photo spacers, the fifth, sixth, and seventh light blocking walls and the photo spacers being formed through the same mask based manufacturing process, the fifth, sixth, and seventh light blocking walls and the photo spacers being formed of the same material.

[0025] The present invention also provides an ultra-slim bezel display panel, which comprises a TFT substrate and a CF substrate that are opposite to each other and circumferential enclosure sealant that hermetically connects between the TFT substrate and the CF substrate, the TFT substrate and the CF substrate each having an active area located in a

central portion thereof and a peripheral area located on an outer circumference of the active area, the active areas and the peripheral areas of the TFT substrate and the CF substrate respectively corresponding to each other, the circumferential enclosure sealant being arranged between the peripheral areas of the TFT substrate and the CF substrate; **[0026]** wherein the peripheral area of the TFT substrate comprises a plurality of light blocking walls formed thereon and the peripheral area of the CF substrate comprises a plurality of light blocking walls and a plurality of grooves formed thereon whereby when a PI liquid is coated on the TFT substrate and the CF substrate, the PI liquid coated on the peripheral areas is prevented from flowing backward into the active areas;

[0027] wherein the peripheral area of the TFT substrate comprises four light blocking walls formed thereon, which are respectively, in sequence from the outside of the TFT substrate to the inside thereof, a first light blocking wall, a second light blocking wall, a third light blocking wall, and a fourth light blocking wall; and the first and second light blocking walls are respectively set on the outside and the inside of the circumferential enclosure sealant and each defines a predetermined gap with respect to the circumferential enclosure sealant, the second light blocking wall having an inner side that defines a PI jet-printing boundary, the third and fourth light blocking walls being set between a boundary of the active area and the PI jet-printing boundary;

[0028] the CF substrate comprises a block matrix formed thereon and a portion of the block matrix that is located in the peripheral area of the CF substrate comprises three light blocking walls, which are respectively, in sequence from the outside of the CF substrate to the inside thereof, a fifth light blocking wall, a sixth light blocking wall, and a seventh light blocking wall; and the fifth and sixth light blocking walls are respectively set on the outside and the inside of the circumferential enclosure sealant and each defines a predetermined gap with respect to the circumferential enclosure sealant, the sixth light blocking wall having an inner side that defines a PI jet-printing boundary, the seventh light blocking wall being set between a boundary of the active area and the PI jet-printing boundary; and

[0029] the block matrix comprises a first groove corresponding to a location between the sixth and seventh light blocking walls and a second groove corresponding to an inner side of the seventh light blocking wall;

[0030] wherein widths and lengths the first, second, third, and fourth light blocking walls are identical;

[0031] wherein the first, second, third, and fourth light blocking walls are formed through exposure by applying a half-tone mask;

[0032] wherein color resist layers are arranged under the first, second, third, and fourth light blocking walls of the TFT substrate, the first, second, third, and fourth light blocking walls and the color resist layers being formed through the same mask based manufacturing process, the first, second, third, and fourth light blocking walls being formed of color resists;

[0033] wherein widths and heights of the fifth, sixth, and seventh light blocking walls are identical; and

[0034] wherein the active area of the CF substrate is provided with a plurality of uniformly distributed photo spacers, the fifth, sixth, and seventh light blocking walls and the photo spacers being formed through the same mask

based manufacturing process, the fifth, sixth, and seventh light blocking walls and the photo spacers being formed of the same material.

[0035] The efficacy of the present invention is that the present invention provides an ultra-slim bezel display panel, which comprises a plurality of light blocking walls formed on a peripheral area of a TFT substrate and a plurality of light blocking walls and a plurality of grooves formed on a peripheral area of the CF substrate, wherein the heights of the light blocking walls and the widths of the grooves are determined by taking an additional jet quantity resulting from precision error of a machine into consideration so that, through calculation, the laid sizes of the light blocking walls and the grooves can be correctly determined to prevent, during coating of PI liquid on the TFT substrate and the CF substrate, the PI liquid coated on an outer circumference of an active area from flowing backward into the active area and thus, improve the mura phenomenon occurring in the circumference of the active area and also, to use the light blocking walls on the inside and the outside of circumferential enclosure sealant to achieve an effect of maintaining a cell thickness of a panel around the circumferential enclosure sealant to further improve the quality of a display panel and increase yield rate. The light blocking walls that are provided on the TFT substrate and have different heights are formed through exposure by the application of a half-tone mask so that the manufacturing process of the liquid crystal display panel is simplified and manufacturing cost lowered down.

[0036] For better understanding of the features and technical contents of the present invention, reference will be made to the following detailed description of the present invention and the attached drawings. However, the drawings are provided for the purposes of reference and illustration and are not intended to impose limitations to the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0037] The technical solution, as well as other beneficial advantages, of the present invention will be apparent from the following detailed description of embodiments of the present invention, with reference to the attached drawing. In the drawing:

[0038] FIG. 1 is a schematic view illustrating a thin-film transistor (TFT) substrate of an ultra-slim bezel display panel according to the present invention;

[0039] FIG. 2 is a perspective view illustrating light blocking walls formed on the TFT substrate of FIG. 1;

[0040] FIG. 3 is a schematic view illustrating a color filter (CF) substrate of the ultra-slim bezel display panel according to the present invention; and

[0041] FIG. 4 is a perspective view illustrating light blocking walls and black matrix grooves formed on the CF substrate of FIG. 3.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0042] To further expound the technical solution adopted in the present invention and the advantages thereof, a detailed description is given to a preferred embodiment of the present invention and the attached drawings.

[0043] The present invention provides an ultra-slim bezel display panel, which can overcome, to the maximum extent,

the phenomenon of polyimide (PI) liquid backward flowing and effectively improving mura occurring in a periphery that is commonly found in ultra-slim bezels due to backward flowing of PI liquid so as to improve yield rate issues caused by PI in ultra-slim bezel designs.

[0044] Specifically, referring to FIGS. 1-4, the ultra-slim bezel display panel comprises a thin-film transistor (TFT) substrate **10** and a color filter (CF) substrate **20** that are opposite to each other and circumferential enclosure sealant **30** that hermetically connects between the TFT substrate **10** and the CF substrate **20**. The TFT substrate **10** and the CF substrate **20** each have an active area located in a central portion thereof and a peripheral area located on an outer circumference of the active area and the active areas and the peripheral areas of the TFT substrate **10** and the CF substrate **20** respectively correspond to each other. The circumferential enclosure sealant **30** is arranged between the peripheral areas of the TFT substrate **10** and the CF substrate **20**.

[0045] As shown in FIGS. 1-2, the peripheral area of the TFT substrate **10** comprises four light blocking walls formed thereon, which are respectively, in sequence from the outside of the TFT substrate **10** to the inside thereof, a first light blocking wall **11**, a second light blocking wall **12**, a third light blocking wall **13**, and a fourth light blocking wall **14**.

[0046] Specifically, color resist layers are arranged under the first, second, third, and fourth light blocking walls **11**, **12**, **13**, **14** of the TFT substrate **10**. The first, second, third, and fourth light blocking walls **11**, **12**, **13**, **14** and the color resist layers are formed through the same mask based manufacturing process. The first, second, third, and fourth light blocking walls **11**, **12**, **13**, **14** are formed of color resists.

[0047] The first and second light blocking walls **11**, **12** are respectively set on the outside and the inside of the circumferential enclosure sealant **30** and each defines a predetermined gap with respect to the circumferential enclosure sealant **30**. The second light blocking wall **12** has an inner side that defines a PI jet-printing boundary. The third and fourth light blocking walls **13**, **14** are set between a boundary of the active area and the PI jet-printing boundary.

[0048] Specifically, the first and second light blocking walls **11**, **12** provide an effect of maintaining cell thickness of the panel around the circumferential enclosure sealant **30**. The first light blocking wall **11** also provides an effect of preventing outward spilling of the circumferential enclosure sealant **30**. The second light blocking wall **12** provides an effect of preventing the circumferential enclosure sealant **30** and PI from overlapping.

[0049] Specifically, the first, second, third, and fourth light blocking walls **11**, **12**, **13**, **14** are identical in respect of width and length, where the width is designated as I_0 and length L .

[0050] Specifically, the fourth light blocking wall **14** has a height d_2 that is greater than a height d_1 of the third light blocking wall **13**. The heights, d_1 and d_2 , satisfy the following conditions:

$$d_1 = \frac{2Y \times l_1 + Y \times l_0}{2l_1},$$

$$d_2 = \frac{L \times Y \times l_0 + L \times Y \times l_2 + X}{L \times l_2},$$

[0051] where I_0 and L respectively denote the width and length of the third and fourth light blocking walls **13**, **14**; I_1 is a spacing distance between the second and third light

blocking walls **12**, **13**; I_2 is a spacing distance between the third and fourth light blocking walls **13**, **14**; X denotes precision error of a PI liquid machine; and Y denotes a thickness of a wet film formed through coating of the PI liquid.

[0052] Specifically, the rationale for calculating the heights, d_1 and d_2 , of the third and fourth light blocking walls **13**, **14** is as follows:

[0053] As shown in FIG. 2, the quantity $S1$ of PI liquid to be accommodated between the second and third light blocking walls **12**, **13** is made up of two portions: a normal coating quantity+one half ($1/2$) of the quantity sliding down from the third light blocking wall **13**, meaning $S1=I_1 \times L \times Y + (I_0 \times L \times Y/2)$; and

[0054] $S1$ is also determined by the height d_1 of the shorter third light blocking wall **13**, meaning: $S1=d_1 \times L \times I_1=I_1 \times L \times Y + (I_0 \times L \times Y/2)$, from which it is known that

$$d_1 = \frac{2Y \times I_1 + Y \times I_0}{2I_1}.$$

[0055] Similarly, the quantity $S2$ of the PI liquid to be accommodated between the third and fourth light blocking walls **13**, **14** is made up of four portions: a normal coating quantity+one half ($1/2$) of the quantity sliding down from the third light blocking wall **13**+one half ($1/2$) of the quantity sliding down from the fourth light blocking wall **14**+an additional jet quantity X resulting from precision error of the machine, meaning $S2=I_2 \times L \times Y + I_0 \times L \times Y/2 + I_0 \times L \times Y/2 + X$; and

[0056] $S2$ is also determined by the height d_2 of the fourth light blocking wall **14**, meaning $S2=d_2 \times L \times I_2=I_2 \times L \times Y + (I_0 \times L \times Y) + X$, from which it is known that

$$d_2 = \frac{L \times Y \times I_0 + L \times Y \times I_2 + X}{L \times I_2}.$$

[0057] Specifically, the heights of the first and second light blocking walls **11**, **12** are identical, both being d_0 , and the height d_0 of the first and second light blocking walls **11**, **12** is slightly greater than the height d_2 of the fourth light blocking wall **14**.

[0058] Preferably, the first, second, third, and fourth light blocking walls **11**, **12**, **13**, **14** are formed through exposure with a half-tone mask.

[0059] As shown in FIGS. 3-4, the CF substrate **20** comprises a block matrix **23** formed thereon and the portion of the block matrix **23** that is located in the peripheral area of the CF substrate **20** comprises three light blocking walls, which are respectively, in sequence from the outside of the CF substrate **20** to the inside thereof, a fifth light blocking wall **231**, a sixth light blocking wall **232**, and a seventh light blocking wall **233**.

[0060] Specifically, the active area of the CF substrate **20** is provided with a plurality of uniformly distributed photo spacers. The fifth, sixth, and seventh light blocking walls **231**, **232**, **233** and the photo spacers are formed through the same mask based manufacturing process. The fifth, sixth, and seventh light blocking walls **231**, **232**, **233** and the photo spacers are formed of the same material.

[0061] The fifth and sixth light blocking walls **231**, **232** are respectively set on the outside and the inside of the circumferential enclosure sealant **30** and each defines a predetermined gap with respect to the circumferential enclosure sealant **30**. The sixth light blocking wall **232** has an inner side that defines a PI jet-printing boundary. The seventh light blocking wall **233** is set between a boundary of the active area and the PI jet-printing boundary.

[0062] The block matrix **23** comprises, formed therein, a first groove **235** corresponding to a location between the sixth and seventh light blocking walls **232**, **233** and a second groove **236** corresponding to an inner side of the seventh light blocking wall **233**.

[0063] Specifically, a space between the sixth and seventh light blocking walls **232**, **233** and the first groove **235** collectively provide an effect of accommodating an additional jet quantity resulting from precision error of the machine and the quantity of PI liquid sliding down from the seventh light blocking wall **233**. The second groove **236** adjacent to the seventh light blocking wall **233** provides an effect of accommodating the quantity of PI liquid sliding down from the seventh light blocking wall **233**.

[0064] Further, the fifth and sixth light blocking walls **231**, **232** provide an effect of maintaining cell thickness of the panel around the circumferential enclosure sealant **30**. The fifth light blocking wall **231** also provides an effect of preventing outward spilling of the circumferential enclosure sealant **30**. The sixth light blocking wall **232** provides an effect of preventing the circumferential enclosure sealant **30** and PI from overlapping.

[0065] Specifically, the fifth, sixth, and seventh light blocking walls **231**, **232**, **233** are identical in respect of width, height, and length.

[0066] Preferably, the first groove **235** and the second groove **236** are identical in respect of width and height.

[0067] Specifically, the widths, I , of the first and second grooves **235**, **236** satisfy the following condition:

$$I \geq \frac{K \times Y \times L + 2L}{2L \times (H + h - Y)},$$

[0068] where K , H , L respectively denote the width, the height, and the length of the fifth, sixth, and seventh light blocking walls **231**, **232**, **233**; h is the height of the first and second grooves **235**, **236**; X denotes precision error of the PI liquid machine; and Y denotes a thickness of a wet film formed through coating of the PI liquid.

[0069] Specifically, the rationale for calculating the width, I , of the first groove **235** is as follows:

[0070] The quantity $S3$ of PI liquid to be accommodated in the space between the sixth and seventh light blocking walls **232**, **233** and the first groove **235** is made up of two portions: a normal coating quantity+one half ($1/2$) of the quantity sliding down from the seventh light blocking wall **233**+an additional jet quantity X resulting from precision error of the machine, meaning $S3=(L \times K \times Y)/2 + X + (Y \times L \times I)$; and

[0071] $S3$ is also determined by the width I of the first groove **235**, meaning $(H+h) \times L \times I \geq (L \times K \times Y)/2 + X + (Y \times L \times I)$, from which it is known that

$$l \geq \frac{K \times Y \times L + 2L}{2L \times (H + h - Y)}.$$

[0072] In summary, the present invention provides an ultra-slim bezel display panel, which comprises a plurality of light blocking walls formed on a peripheral area of a TFT substrate and a plurality of light blocking walls and a plurality of grooves formed on a peripheral area of the CF substrate, wherein the heights of the light blocking walls and the widths of the grooves are determined by taking an additional jet quantity resulting from precision error of a machine into consideration so that, through calculation, the laid sizes of the light blocking walls and the grooves can be correctly determined to prevent, during coating of PI liquid on the TFT substrate and the CF substrate, the PI liquid coated on an outer circumference of an active area from flowing backward into the active area and thus, improve the mura phenomenon occurring in the circumference of the active area and also, to use the light blocking walls on the inside and the outside of circumferential enclosure sealant to achieve an effect of maintaining a cell thickness of a panel around the circumferential enclosure sealant to further improve the quality of a display panel and increase yield rate. The light blocking walls that are provided on the TFT substrate and have different heights are formed through exposure by the application of a half-tone mask so that the manufacturing process of the liquid crystal display panel is simplified and manufacturing cost lowered down.

[0073] Based on the description given above, those having ordinary skills of the art may easily contemplate various changes and modifications of the technical solution and technical ideas of the present invention and all these changes and modifications are considered within the protection scope of right for the present invention.

What is claimed is:

1. An ultra-slim bezel display panel, comprising a thin-film transistor (TFT) substrate and a color filter (CF) substrate that are opposite to each other and circumferential enclosure sealant that hermetically connects between the TFT substrate and the CF substrate, the TFT substrate and the CF substrate each having an active area located in a central portion thereof and a peripheral area located on an outer circumference of the active area, the active areas and the peripheral areas of the TFT substrate and the CF substrate respectively corresponding to each other, the circumferential enclosure sealant being arranged between the peripheral areas of the TFT substrate and the CF substrate;

wherein the peripheral area of the TFT substrate comprises a plurality of light blocking walls formed thereon and the peripheral area of the CF substrate comprises a plurality of light blocking walls and a plurality of grooves formed thereon whereby when a polyimide (PI) liquid is coated on the TFT substrate and the CF substrate, the PI liquid coated on the peripheral areas is prevented from flowing backward into the active areas.

2. The ultra-slim bezel display panel as claimed in claim 1, wherein the peripheral area of the TFT substrate comprises four light blocking walls formed thereon, which are respectively, in sequence from the outside of the TFT substrate to the inside thereof, a first light blocking wall, a second light blocking wall, a third light blocking wall, and a fourth light blocking wall; and the first and second light blocking walls are respectively set on the outside and the

inside of the circumferential enclosure sealant and each defines a predetermined gap with respect to the circumferential enclosure sealant, the second light blocking wall having an inner side that defines a PI jet-printing boundary, the third and fourth light blocking walls being set between a boundary of the active area and the PI jet-printing boundary;

the CF substrate comprises a block matrix formed thereon and a portion of the block matrix that is located in the peripheral area of the CF substrate comprises three light blocking walls, which are respectively, in sequence from the outside of the CF substrate to the inside thereof, a fifth light blocking wall, a sixth light blocking wall, and a seventh light blocking wall; and the fifth and sixth light blocking walls are respectively set on the outside and the inside of the circumferential enclosure sealant and each defines a predetermined gap with respect to the circumferential enclosure sealant, the sixth light blocking wall having an inner side that defines a PI jet-printing boundary, the seventh light blocking wall being set between a boundary of the active area and the PI jet-printing boundary; and

the block matrix comprises a first groove corresponding to a location between the sixth and seventh light blocking walls and a second groove corresponding to an inner side of the seventh light blocking wall.

3. The ultra-slim bezel display panel as claimed in claim 2, wherein widths and lengths the first, second, third, and fourth light blocking walls are identical.

4. The ultra-slim bezel display panel as claimed in claim 3, wherein a height d_2 of the fourth light blocking wall is greater than a height d_1 of the third light blocking wall and the heights d_1 and d_2 satisfy the following conditions:

$$d_1 = \frac{2Y \times l_1 + Y \times l_0}{2l_1},$$

$$d_2 = \frac{L \times Y \times l_0 + L \times Y \times l_2 + X}{L \times l_2},$$

where l_0 and L respectively denote the width and length of the third and fourth light blocking walls; l_1 is a spacing distance between the second and third light blocking walls; l_2 is a spacing distance between the third and fourth light blocking walls; X denotes precision error of a liquid machine; and Y denotes a thickness of a wet film formed through coating of the PI liquid.

5. The ultra-slim bezel display panel as claimed in claim 3, wherein heights of the first and second light blocking walls are identical and the heights of the first and second light blocking walls, d_0 , is greater than a height of the fourth light blocking wall, d_2 .

6. The ultra-slim bezel display panel as claimed in claim 2, wherein the first, second, third, and fourth light blocking walls are formed through exposure by applying a half-tone mask.

7. The ultra-slim bezel display panel as claimed in claim 2, wherein color resist layers are arranged under the first, second, third, and fourth light blocking walls of the TFT substrate, the first, second, third, and fourth light blocking walls and the color resist layers being formed through the

same mask based manufacturing process, the first, second, third, and fourth light blocking walls being formed of color resists.

8. The ultra-slim bezel display panel as claimed in claim 2, wherein widths and heights of the fifth, sixth, and seventh light blocking walls are identical.

9. The ultra-slim bezel display panel as claimed in claim 8, wherein widths and heights of the first groove and the second groove are identical and the width of the first and second grooves, I, satisfies the following condition:

$$I \geq \frac{K \times Y \times L + 2L}{2L \times (H + h - Y)},$$

where K, H, L respectively denote the width, the height, and the length of the fifth, sixth, and seventh light blocking walls; h is the height of the first and second grooves; X denotes precision error of the PI liquid machine; and Y denotes a thickness of a wet film formed through coating of the PI liquid.

10. The ultra-slim bezel display panel as claimed in claim 2, wherein the active area of the CF substrate is provided with a plurality of uniformly distributed photo spacers, the fifth, sixth, and seventh light blocking walls and the photo spacers being formed through the same mask based manufacturing process, the fifth, sixth, and seventh light blocking walls and the photo spacers being formed of the same material.

11. An ultra-slim bezel display panel, comprising a thin-film transistor (TFT) substrate and a color filter (CF) substrate that are opposite to each other and circumferential enclosure sealant that hermetically connects between the TFT substrate and the CF substrate, the TFT substrate and the CF substrate each having an active area located in a central portion thereof and a peripheral area located on an outer circumference of the active area, the active areas and the peripheral areas of the TFT substrate and the CF substrate respectively corresponding to each other, the circumferential enclosure sealant being arranged between the peripheral areas of the TFT substrate and the CF substrate;

wherein the peripheral area of the TFT substrate comprises a plurality of light blocking walls formed thereon and the peripheral area of the CF substrate comprises a plurality of light blocking walls and a plurality of grooves formed thereon whereby when a polyimide (PI) liquid is coated on the TFT substrate and the CF substrate, the PI liquid coated on the peripheral areas is prevented from flowing backward into the active areas;

wherein the peripheral area of the TFT substrate comprises four light blocking walls formed thereon, which are respectively, in sequence from the outside of the TFT substrate to the inside thereof, a first light blocking wall, a second light blocking wall, a third light blocking wall, and a fourth light blocking wall; and the first and second light blocking walls are respectively set on the outside and the inside of the circumferential enclosure sealant and each defines a predetermined gap with respect to the circumferential enclosure sealant, the second light blocking wall having an inner side that defines a PI jet-printing boundary, the third and fourth light blocking walls being set between a boundary of the active area and the PI jet-printing boundary;

the CF substrate comprises a block matrix formed thereon and a portion of the block matrix that is located in the peripheral area of the CF substrate comprises three light blocking walls, which are respectively, in sequence from the outside of the CF substrate to the inside thereof, a fifth light blocking wall, a sixth light blocking wall, and a seventh light blocking wall; and the fifth and sixth light blocking walls are respectively set on the outside and the inside of the circumferential enclosure sealant and each defines a predetermined gap with respect to the circumferential enclosure sealant, the sixth light blocking wall having an inner side that defines a PI jet-printing boundary, the seventh light blocking wall being set between a boundary of the active area and the PI jet-printing boundary; and

the block matrix comprises a first groove corresponding to a location between the sixth and seventh light blocking walls and a second groove corresponding to an inner side of the seventh light blocking wall;

wherein widths and lengths the first, second, third, and fourth light blocking walls are identical;

wherein the first, second, third, and fourth light blocking walls are formed through exposure by applying a half-tone mask;

wherein color resist layers are arranged under the first, second, third, and fourth light blocking walls of the TFT substrate, the first, second, third, and fourth light blocking walls and the color resist layers being formed through the same mask based manufacturing process, the first, second, third, and fourth light blocking walls being formed of color resists;

wherein widths and heights of the fifth, sixth, and seventh light blocking walls are identical; and

wherein the active area of the CF substrate is provided with a plurality of uniformly distributed photo spacers, the fifth, sixth, and seventh light blocking walls and the photo spacers being formed through the same mask based manufacturing process, the fifth, sixth, and seventh light blocking walls and the photo spacers being formed of the same material.

12. The ultra-slim bezel display panel as claimed in claim 11, wherein a height d_2 of the fourth light blocking wall is greater than a height d_1 of the third light blocking wall and the heights d_1 and d_2 satisfy the following conditions:

$$d_1 = \frac{2Y \times I_1 + Y \times I_0}{2I_1},$$

$$d_2 = \frac{L \times Y \times I_0 + L \times Y \times I_2 + X}{L \times I_2},$$

where I_0 and L respectively denote the width and length of the third and fourth light blocking walls; I_1 is a spacing distance between the second and third light blocking walls; I_2 is a spacing distance between the third and fourth light blocking walls; X denotes precision error of a liquid machine; and Y denotes a thickness of a wet film formed through coating of the PI liquid.

13. The ultra-slim bezel display panel as claimed in claim 11, wherein heights of the first and second light blocking walls are identical and the heights of the first and second light blocking walls, d_0 , is greater than a height of the fourth light blocking wall, d_2 .

14. The ultra-slim bezel display panel as claimed in claim 11, wherein widths and heights of the first groove and the second groove are identical and the width of the first and second grooves, I, satisfies the following condition:

$$l \geq \frac{K \times Y \times L + 2L}{2L \times (H + h - Y)},$$

where K, H, L respectively denote the width, the height, and the length of the fifth, sixth, and seventh light blocking walls; h is the height of the first and second grooves; X denotes precision error of the PI liquid machine; and Y denotes a thickness of a wet film formed through coating of the PI liquid.

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专利名称(译)	超薄边框显示面板		
公开(公告)号	US20170146862A1	公开(公告)日	2017-05-25
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[标]申请(专利权)人(译)	深圳市华星光电技术有限公司		
申请(专利权)人(译)	深圳中星光电科技有限公司		
当前申请(专利权)人(译)	深圳市中国星光电科技有限公司.		
[标]发明人	MA CHAO		
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摘要(译)

本发明提供一种超薄边框显示面板，包括形成于TFT基板周边区域的多个遮光壁，多个遮光壁以及形成于CF基板周边区域的多个凹槽，其中，光阻挡壁的高度和凹槽的宽度是通过考虑由机器的精度误差引起的额外喷射量来确定的，从而通过计算，遮光壁和凹槽的铺设尺寸可以是正确地确定在TFT基板和CF基板上涂布PI液时，涂覆在活性区域外周的PI液体不会向后流入活性区域，从而改善周围发生的mura现象。活动区域，并使用周围封闭密封胶内外的挡光墙来达到m的效果在圆周封闭密封胶周围保持面板的单元厚度，以进一步改善显示面板的质量并提高成品率。通过应用半色调掩模曝光形成设置在TFT基板上并具有不同高度的挡光壁，从而简化了液晶显示面板的制造工艺并降低了制造成本。

