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(54) **LIQUID CRYSTAL DISPLAY WITH PROTRUSIONS FORMED AT NON-DISPLAY AREA OF LIQUID CRYSTAL DISPLAY PANEL THEREOF**

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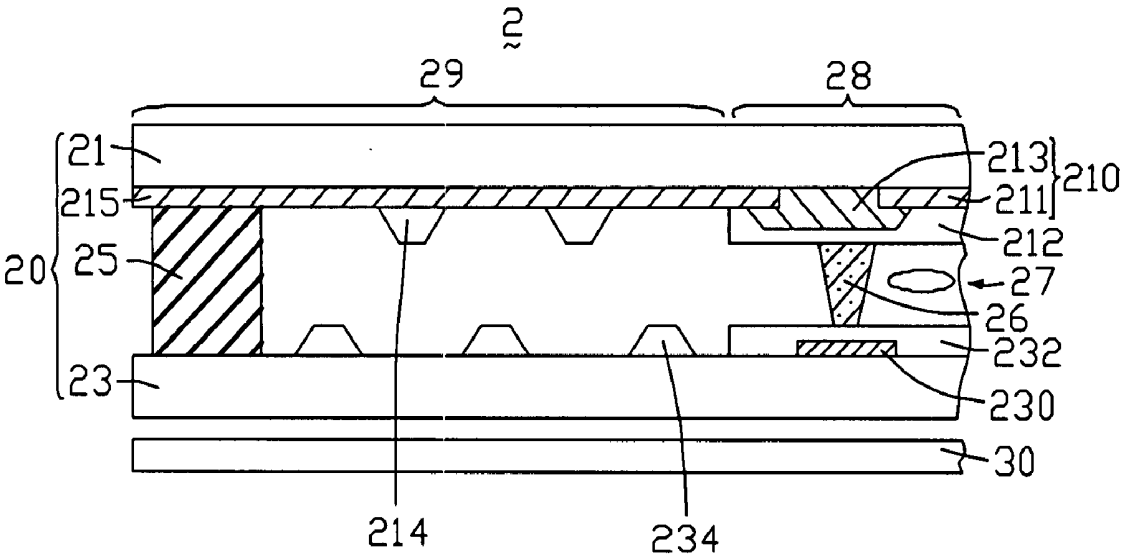
(57) **ABSTRACT**

An exemplary liquid crystal display (**2**) includes a liquid crystal display panel (**20**) defining a display area and a non-display. The liquid crystal display panel includes a first substrate (**21**), a second substrate (**23**), a sealing member (**25**) located at peripheral sides of the non-display area of the second substrate, and a liquid crystal layer (**27**). The first substrate includes first protrusions (**214**) located at the non-display area adjacent to the sealing member. The second substrate includes second protrusions (**234**) located at the non-display area adjacent to the sealing member. The first protrusions protrude toward the second substrate and the second protrusions protrude toward the first substrate. The first protrusions are alternately arranged relative to the second protrusions.



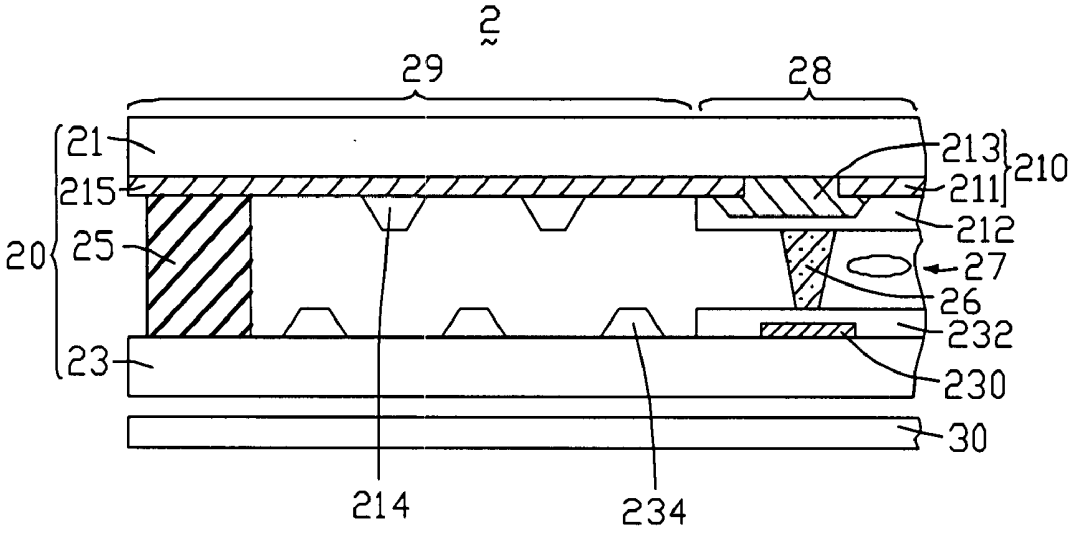

2
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FIG. 1

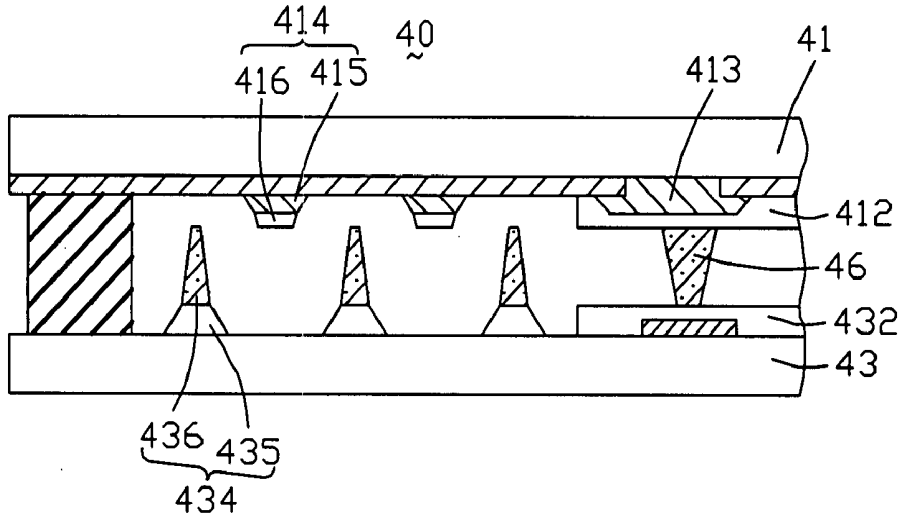
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FIG. 2

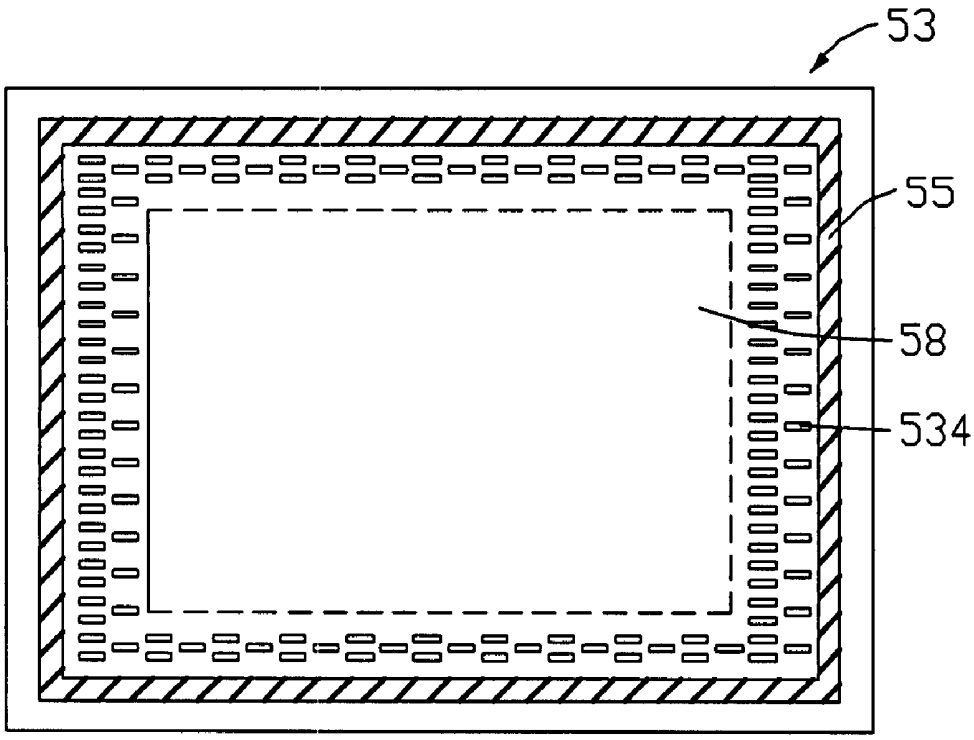

FIG. 3

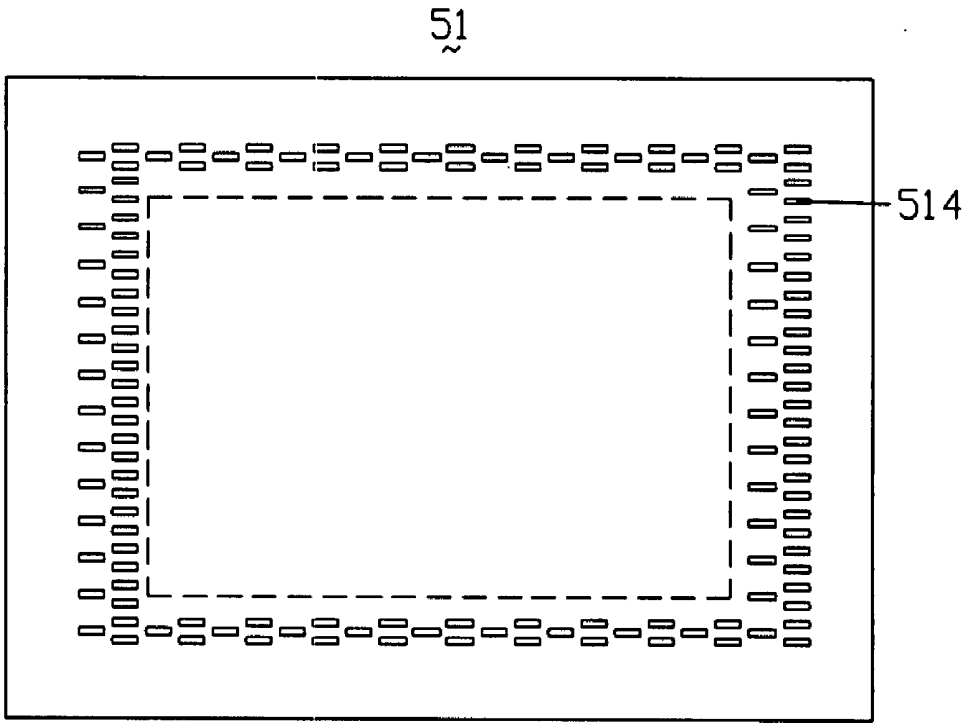

FIG. 4

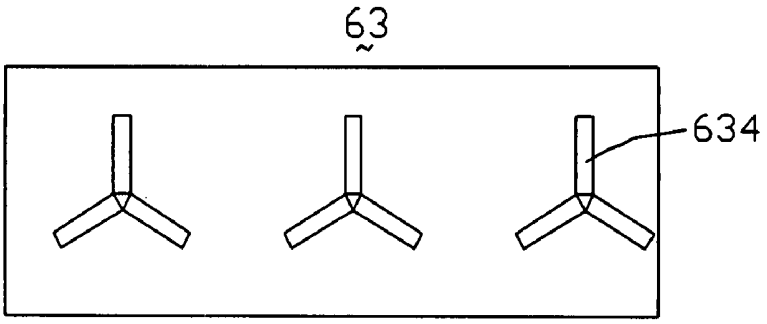

FIG. 5

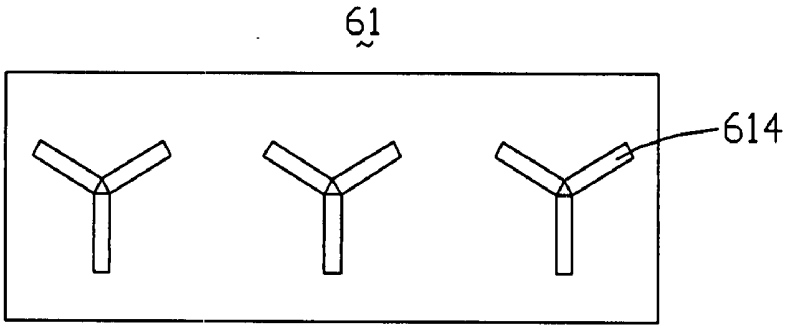

FIG. 6

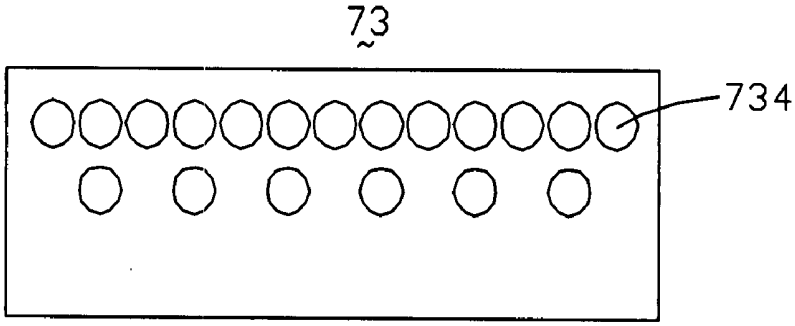

FIG. 7

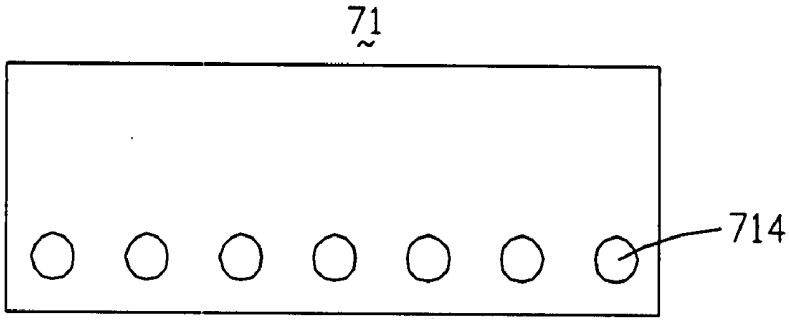

FIG. 8

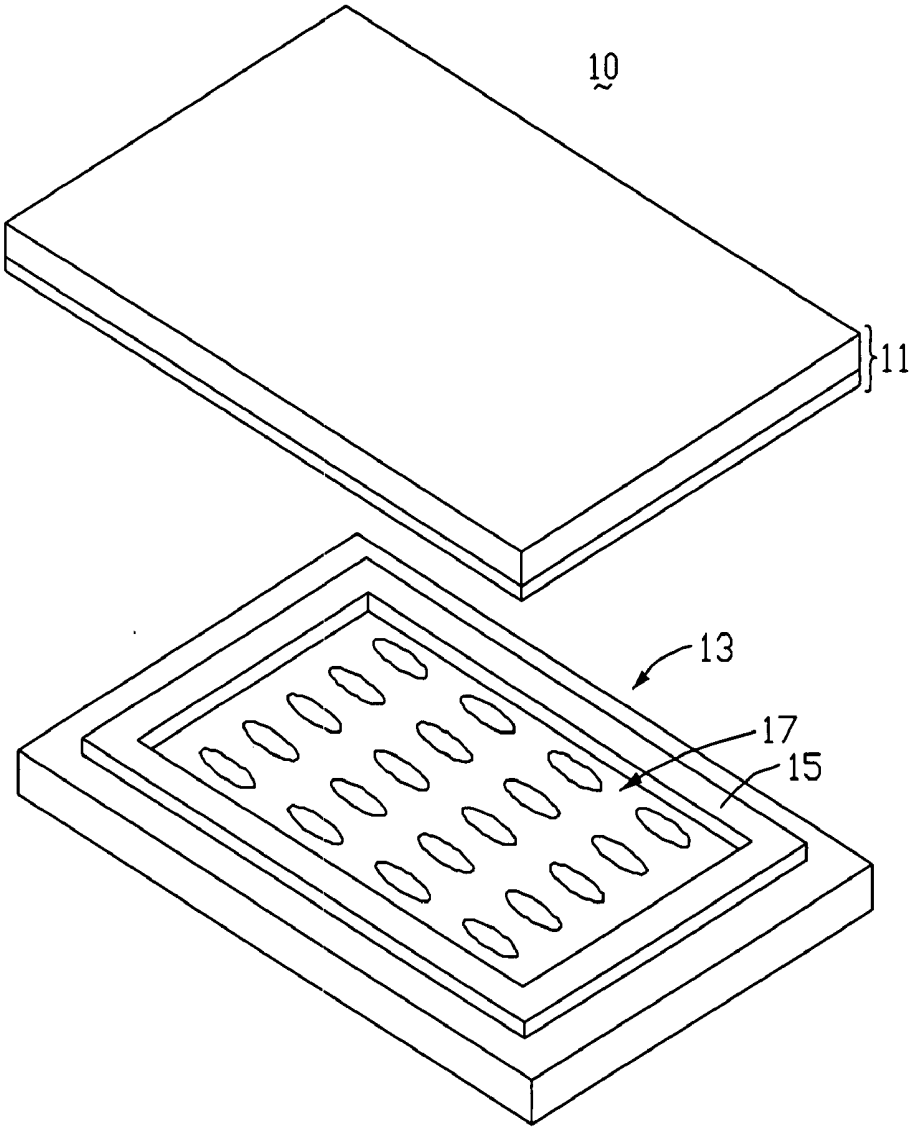

FIG. 9
(RELATED ART)

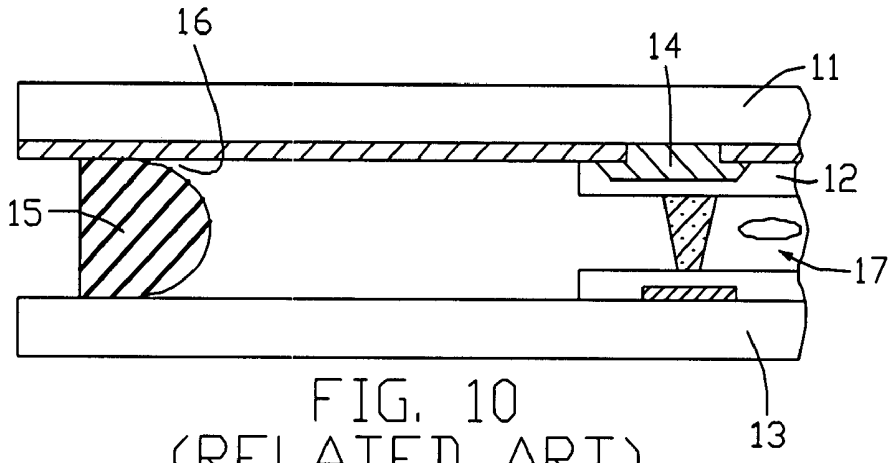

FIG. 10
(RELATED ART)

LIQUID CRYSTAL DISPLAY WITH PROTRUSIONS FORMED AT NON-DISPLAY AREA OF LIQUID CRYSTAL DISPLAY PANEL THEREOF

FIELD OF THE INVENTION

[0001] The present invention relates to liquid crystal displays (LCDs), and more particularly to a liquid crystal display with protrusions formed at a non-display area of a liquid crystal display panel employed in the liquid crystal display.

GENERAL BACKGROUND

[0002] Liquid crystal displays have the advantages of portability, low power consumption, and low radiation. Therefore, liquid crystal displays have been widely used in common daily life. Typically, a liquid crystal display includes a liquid crystal display panel.

[0003] FIG. **9** is an exploded, isometric view of a conventional liquid crystal display panel **10**. The liquid crystal display panel **10** includes a color filter substrate **11**, a thin film transistor (TFT) substrate **13** disposed generally parallel to the color filter substrate **11**, a peripheral sealant **15** located at the TFT substrate **13**, and a liquid crystal layer **17** arranged between the color filter substrate **11** and the TFT substrate **13**. The sealant **15** may be an ultraviolet light hardened-type sealant or a thermally hardened sealant.

[0004] The sealant **15** is sandwiched between the color filter substrate **11** and the TFT substrate **13**. The sealant **15** coupled with the TFT substrate **13** and the color filter substrate **11** defines a liquid crystal cell (not labeled). The liquid crystal layer **17** is sealed in the liquid crystal cell.

[0005] The liquid crystal display panel **10** may be assembled by the following steps. Firstly, the TFT substrate **13** is provided. Secondly, the unhardened sealant **15** is arranged at four peripheral sides of the TFT substrate **13** to form a four-sided frame pattern. The sealant **15** together with the TFT substrate **13** forms a space for holding liquid crystal. Afterward, liquid crystal is put into the space drop by drop. The space is thereby filled with the liquid crystal. Then the TFT substrate **13** is transferred to a vacuum chamber. The color filter substrate **11** is pressed onto the sealant **15** and thereby covers the TFT substrate **13**. Finally, the sealant **15** is hardened so as to bond the color filter substrate **11** and the TFT substrate **13** together.

[0006] Referring also to FIG. **10**, this is a side cross-sectional view of an end portion of the assembled liquid crystal display panel **10** after the liquid crystal display panel **10** has been assembled. Typically, the color filter substrate **11** includes a black matrix **14** and a coating layer **12** covered on the black matrix **14**. The black matrix **14** and the coating layer **12** protrude toward the TFT substrate **13**.

[0007] During the process of manufacturing the liquid crystal display panel **10**, the color filter substrate **11** is pressed onto the TFT substrate **13** before the sealant **15** is hardened. The black matrix **14** and the coating layer **12** of the color filter substrate **11** may protrude into the liquid crystal layer **17** and extrude some liquid crystal toward the unhardened sealant **15**. The unhardened sealant **15** is liable to be deformed by impact force exerted by the extruding liquid crystal. In particular, grooves **16** may be formed at parts of the sealant **15** that are adjacent to the TFT and color filter substrates **13**, **11**. As a result, the contacting areas between the sealant **15** and the TFT and color filter substrates **13**, **11** are reduced. That is, the color filter and TFT substrates **11**, **13** may not be strongly combined together with the sealant **15**. Therefore, when the liquid crystal display panel **10** sustains shock or vibration, the color filter substrate **11** is liable to detach from the TFT substrate **13**. When the liquid crystal display panel **10** becomes damaged in this way, it may malfunction or even fail altogether.

[0008] What is needed, therefore, is a liquid crystal display employing a liquid crystal display panel that can overcome the above-described deficiencies.

SUMMARY

[0009] In one aspect, a liquid crystal display includes a liquid crystal display panel defining a display area, and a non-display area around the display area. The liquid crystal display panel includes a first substrate, a second substrate parallel to the first substrate, a sealing member located at peripheral sides of the non-display area of the second substrate, and a liquid crystal layer. The sealing member coupled with the first and second substrates defines a liquid crystal cell. The liquid crystal layer is contained in the liquid crystal cell. The first substrate includes a plurality of first protrusions located at the non-display area adjacent to the sealing member. The second substrate includes a plurality of second protrusions located at the non-display area adjacent to the sealing member. The first protrusions protrude toward the second substrate and the second protrusions protrude toward the first substrate. The first protrusions are alternately arranged relative to the second protrusions.

[0010] In another aspect, a liquid crystal display includes a liquid crystal display panel defining a display area, and a non-display area around the display area. The liquid crystal display panel includes a first substrate, a second substrate parallel to the first substrate, a sealing member located at peripheral sides of the non-display area of the second substrate, and a liquid crystal layer. The sealing member coupled with the first and second substrates defines a liquid crystal cell. The liquid crystal layer is contained in the liquid crystal cell. The first substrate includes a plurality of first protrusions located at the non-display area adjacent to the sealing member. The second substrate includes a plurality of second protrusions located at the non-display area adjacent to the sealing member. The first protrusions protrude toward the second substrate and the second protrusions protrude toward the first substrate. The plurality of first protrusions are staggered relative to at least a plurality of the second protrusions.

[0011] Other novel features and advantages will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings. In the drawings, all the views are schematic.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIG. **1** is a side cross-sectional view of an end portion of a liquid crystal display according to a first embodiment of the present invention.

[0013] FIG. **2** is a side cross-sectional view of an end portion of a liquid crystal display panel according to a second embodiment of the present invention.

[0014] FIG. **3** is a top plan view of a second substrate of a liquid crystal display panel according to a third embodiment of the present invention.

[0015] FIG. **4** is a bottom view plan of a first substrate of the liquid crystal display panel of the third embodiment of the present invention.

[0016] FIG. **5** is a top plan view of part of a second substrate of a liquid crystal display panel according to a fourth embodiment of the present invention.

[0017] FIG. **6** is a bottom plan view of part of a first substrate of the liquid crystal display panel according to the fourth embodiment of the present invention.

[0018] FIG. **7** is a top plan view of part of a second substrate of a liquid crystal display panel according to a fifth embodiment of the present invention.

[0019] FIG. **8** is a bottom plan view of part of a first substrate of the liquid crystal display panel according to the fifth embodiment of the present invention.

[0020] FIG. **9** is an exploded, isometric view of a conventional liquid crystal display panel.

[0021] FIG. **10** is a side cross-sectional view of an end portion of the liquid crystal display panel of FIG. **9** after the liquid crystal display panel has been assembled.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0022] Reference will now be made to the drawings to describe the preferred and exemplary embodiments in detail.

[0023] FIG. **1** is a side cross-sectional view of an end portion of a liquid crystal display **2** according to a first embodiment of the present invention. The liquid crystal display **2** includes a liquid crystal display panel **20**, and a backlight module **30** disposed under the liquid crystal display panel **20**. The backlight module **30** provides flat and uniform light for illuminating the liquid crystal display panel **20**. The liquid crystal display panel **20** defines a display area **28** at a central portion thereof (only a small part of which is shown), and a peripheral non-display area **29** around the central display area **28**.

[0024] The liquid crystal display panel **20** includes a first substrate **21**, a second substrate **23** disposed parallel to the first substrate **21**, a sealant **25** located at four peripheral sides of the non-display area **29** of the second substrate **23**, a plurality of spacers **26** disposed between the first and second substrates **21**, **23**, and a liquid crystal layer **27**. In the illustrated embodiment, the first substrate **21** is a color filter substrate, and the second substrate **23** is a TFT substrate. The distance between the first substrate **21** and the second substrate **23** is about 4~6 micrometers.

[0025] The sealant **25** coupled with the first substrate **21** and the second substrate **23** defines a liquid crystal cell (not labeled). The liquid crystal layer **27** is sealed in the liquid crystal cell. The spacers **26** are located in the display area **28** between the first and second substrates **21**, **23**.

[0026] The first substrate **21** includes a color filter layer **210**, a first coating layer **212** covering the color filter layer **210**, and a light shield layer **215**. The color filter layer **210** is located in the display area **28** of the first substrate **21**. The color filter layer **210** includes a plurality of color filter units **211** and a black matrix **213**. The black matrix **213** fills gaps between the color filter units **211**.

[0027] The light shield layer **215** is located in the non-display area **29** of the first substrate **21**. The light shield layer **215** is provided to absorb light beams at the non-display area **29**. The light shield layer **215** is made of the same material as the black matrix **213**, and is simultaneously formed with the black matrix **213** in a same fabricating step.

[0028] The light shield layer **215** includes a plurality of first protrusions **214** separately arranged thereon. The first protrusions **214** are located between the display area **28** and the sealant **25**. The first protrusions **214** are made of the same material as the first coating layer **212**, and are simultaneously formed with the first coating layer **212** in a same fabricating step. Each of the first protrusions **214** has a trapezoidal cross-section. In the illustrated embodiment, the trapezoidal cross-section is an isosceles trapezoid. That is, each first protrusion **214** has a width that progressively decreases with increasing distance away from the first substrate **21**. The maximum width of the first protrusion **214** is preferably in a range up to 200 micrometers. The minimum width of the first protrusion **214** is preferably in a range down to 20 micrometers. Each of the first protrusions **214** typically has a height in the range from 1.5 micrometers to 2.5 micrometers. The first protrusions **214** can for example be frusto-conical, frusto-pyramidal, frusto-polyhedral, or dome-shaped.

[0029] The second substrate **23** includes a plurality of TFTs **230**, a second coating layer **232** covering the TFTs **230**, and a plurality of second protrusions **234**. The TFTs **230** are located on the second substrate **23** directly under corresponding portions of the black matrix **213**. Each of the spacers **26** is located between a respective one of the TFTs **230** and the corresponding portion of the black matrix **213**. Each of the second protrusions **234** has a structure similar to that of each of the first protrusions **214**. The second protrusions **234** are located in the non-display area **29** of the second substrate **23**, between the display area **28** and the sealant **25**. The second protrusions **234** are made of the same material as the second coating layer **232**, and are simultaneously formed with the second coating layer **232** in a same fabricating step. The second and first protrusions **234**, **214** are alternately arranged relative to each other. In the illustrated embodiment, the second and first protrusions **234**, **214** are aligned along a same vertical plane along a direction from the display area **28** to the sealant **25**, but are staggered relative to each other. In alternative embodiments, the second protrusions **234** can be aligned along a same vertical plane, and the first protrusions **214** can be aligned along a same vertical plane different from the vertical plane of the second protrusions **234**.

[0030] The liquid crystal display panel **20** may be assembled by the following steps. Firstly, the second substrate **23** is provided. Secondly, the unhardened sealant **25** is arranged at four peripheral sides of the second substrate **23** to form a four-sided frame pattern. The sealant **25** together with the second substrate **23** forms a space for holding liquid crystal. Afterward, liquid crystal is put into the space drop by drop. The space is thereby filled with liquid crystal. Then the second substrate **23** is transferred to a vacuum chamber. The first substrate **21** is pressed onto the sealant **25** and thereby covers the second substrate **23**. Finally, the sealant **25** is hardened so as to bond the first and second substrates **21**, **23** together.

[0031] The first and second substrates **21**, **23** include the plurality of first and second protrusions **214**, **234** located in the non-display area **29** between the display area **28** and the sealant **25**. During the process of manufacturing the liquid crystal display panel **20**, the first substrate **21** is pressed onto the second substrate **23** before the sealant **25** is hardened. The black matrix **213** and the first coating layer **212** of the first substrate **21** protrude into the liquid crystal layer **27** and extrude some of the liquid crystal toward the unhardened sealant **25**. However, the first and second protrusions **214**, **234**

block the movement of the liquid crystal. Therefore little or even no force is exerted on the unhardened sealant **25** by the extruding liquid crystal. That is, the unhardened sealant **25** sustains little or even no deformation. The contacting areas between the sealant **25** and the first and second substrates **21**, **23** remain substantially unchanged. Thus the first and second substrates **21**, **23** are strongly bonded together with the sealant **25**. As a result, even if the liquid crystal display **2** sustains shock or vibration, damage to the liquid crystal display panel **20** is avoided.

[0032] FIG. **2** is a side cross-sectional view of an end portion of a liquid crystal display panel **40** according to a second embodiment of the present invention. The liquid crystal display panel **40** has a structure similar to that of the liquid crystal display panel **20**. However, a first substrate **41** includes a plurality of first protrusions **414** at a non-display area (not labeled) thereof. Each of the first protrusions **414** includes a first portion **415**, and a second portion **416** extending from the first portion **415**. A black matrix **413** and a first coating layer **412** are provided in a display area (not labeled) of the liquid crystal display panel **40**.

[0033] The first portions **415** are made of the same material as the black matrix **413**, and are simultaneously formed with the black matrix **413** in a same fabricating step. The second portions **416** are made of the same material as the first coating layer **412**, and are simultaneously formed with the first coating layer **412** in a same fabricating step.

[0034] A second substrate **43** includes a plurality of second protrusions **434** at the non-display area thereof. Each of the second protrusions **434** includes a third portion **435**, and a fourth portion **436** extending from the third portion **435**. A second coating layer **432** is provided in the display area of the liquid crystal display panel **40**. Further, a plurality of spacers **46** are provided in the display area of the liquid crystal display panel **40**.

[0035] The third portions **435** are made of the same material as the second coating layer **432**, and are simultaneously formed with the second coating layer **432** in a same fabricating step. The fourth portions **436** are made of the same material as the spacers **46**, and are simultaneously formed with the spacers **46** in a same fabricating step.

[0036] Referring to FIG. **3**, this is a top plan view of a second substrate **53** of a liquid crystal display panel according to a third embodiment of the present invention. The liquid crystal display panel has a structure similar to that of the liquid crystal display panel **20**. However, each three adjacent second protrusions **534** at the second substrate **53** define a protrusion unit (not labeled). The three second protrusions **534** defining the protrusion unit are generally arranged in a triangle. All the protrusion units are located between a display area **58** and a sealant **55**. All the second protrusions **534** have the same size and a same uniform rectangular shape when viewed from above. Preferably, each of the second protrusions **534** has the same girth along an entire height thereof. All the triangular protrusion units have the orientation. In the illustrated embodiment, the triangular protrusion units are isosceles triangles. A base of the triangle is at the left side of each protrusion unit, and is parallel to a left side of the second substrate **53**; and a point of the triangle opposite the base points toward a right side of the second substrate **53**.

[0037] Referring to FIG. **4**, this is a bottom plan view of a first substrate **51** of the liquid crystal display panel of the third embodiment of the present invention. The first substrate **51** includes a plurality of first protrusions **514** arranged corresponding to the second protrusions **534**. Each three adjacent first protrusions **514** define a protrusion unit (not labeled). The three first protrusions **514** defining the protrusion unit are generally arranged in a triangle. However, a base of the triangle is at the right side of each protrusion unit, and is parallel to a right side of the first substrate **51**; and a point of the triangle opposite the base points toward a left side of the first substrate **51**. After the first substrate **51** is attached to the second substrate **53**, the first and second protrusions **514**, **534** are alternately located between the first and second substrates **51**, **53**. That is, the first and second protrusions **514**, **534** are staggered relative to each other.

[0038] Referring to FIGS. **5** and **6**, these are plan views respectively of parts of second protrusions **634** formed at a second substrate **63** and parts of first protrusions **614** formed at a first substrate **61** of a liquid crystal display panel (not labeled) according to a fourth embodiment of the present invention. The liquid crystal display panel has a structure similar to that of the liquid crystal display panel **20**. However, each of the first and second protrusions **614**, **634** has a 3-point star-shaped profile when viewed from above. Put another way, the profile resembles a 3-vane fan, with each vane (arm) extending from a central hub. The vanes have a same narrow uniform transverse width, and are evenly spaced apart from each other. Put yet another way, each first and second protrusion **614**, **634** is generally "Y" shaped. Preferably, each of the first and second protrusions **614**, **634** tapers from a base end thereof to a free end thereof. After the first substrate **61** is attached to the second substrate **63**, the arms of the first protrusions **614** are alternately located relative to the arms of the second protrusions **634**. That is, the first and second protrusions **614**, **634** are staggered relative to each other. Various alignments and staggering arrangements can be configured, in similar ways to at least some of the alignments and staggerings described above in relation to the first, second and third embodiments.

[0039] Referring to FIGS. **7** and **8**, these are isometric views respectively of parts of second protrusions **734** formed at a second substrate **73** and parts of first protrusions **714** formed at a first substrate **71** of a liquid crystal display panel (not labeled) according to a fifth embodiment of the present invention. The liquid crystal display panel has a structure similar to that of the liquid crystal display panel **20**. However, each of the first and second protrusions **714**, **734** has a cylindrical shape. After the first substrate **71** is attached to the second substrate **73**, the first protrusions **714** are alternately located relative to certain of the second protrusions **734** that are regularly spaced relatively far apart from each other. That is, the first protrusions **614** are staggered relative to said certain of the second protrusions **634**.

[0040] Various modifications and alterations to the above-described embodiments are possible. For example, the protrusions at the first and second substrates may have other shapes. The protrusions at the first substrate may be made of or include the same material as a common electrode provided at the first substrate. The protrusions at the second substrate may be made of or include the same material as a gate electrodes of TFTs provided at the second substrate.

[0041] It is to be further understood that even though numerous characteristics and advantages of the present embodiments have been set out in the foregoing description, together with details of the structures and functions of the embodiments, the disclosure is illustrative only, and changes may be made in detail, especially in matters of shape, size,

and arrangement of parts within the principles of the invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.

What is claimed is:

1. A liquid crystal display, comprising:

a liquid crystal display panel defining a display area, and a non-display area around the display area, the liquid crystal display panel comprising:

a first substrate;

a second substrate parallel to the first substrate;

a sealing member located at peripheral sides of the non-display area of the second substrate, the sealing member coupled with the first and second substrates defining a liquid crystal cell; and

a liquid crystal layer contained in the liquid crystal cell;

wherein the first substrate comprises a plurality of first protrusions located at the non-display area adjacent to the sealing member, the second substrate comprises a plurality of second protrusions located at the non-display area adjacent to the sealing member, the first protrusions protrude toward the second substrate, the second protrusions protrude toward the first substrate, and the first protrusions are alternately arranged relative to the second protrusions.

2. The liquid crystal display as claimed in claim **1**, wherein each of the first and second protrusions has a trapezoidal cross-section.

3. The liquid crystal display as claimed in claim **2**, wherein the trapezoidal cross-section is an isosceles trapezoid.

4. The liquid crystal display as claimed in claim **2**, wherein a maximum width of the trapezoidal cross-section is in a range up to 200 micrometers, a minimum width of the trapezoidal cross-section is in a range down to 20 micrometers.

5. The liquid crystal display as claimed in claim **2**, wherein the trapezoidal cross-section has a height varied in the range from 1.5 micrometers to 2.5 micrometers.

6. The liquid crystal display as claimed in claim **1**, wherein each of the first and second protrusions is "Y" shaped.

7. The liquid crystal display as claimed in claim **1**, wherein each of the first and second protrusions has a cylindrical shape.

8. The liquid crystal display as claimed in claim **1**, wherein the first substrate further comprises a color filter layer at the display area and a first coating layer covering the color filter layer.

9. The liquid crystal display as claimed in claim **8**, wherein the first protrusions are made of the same material as the first coating layer.

10. The liquid crystal display as claimed in claim **8**, wherein the first protrusions are simultaneously formed with the black matrix in a same fabricating step.

11. The liquid crystal display as claimed in claim **7**, wherein each of the first protrusions comprises a first portion, and a second portion extending from the first portion.

12. The liquid crystal display as claimed in claim **11**, wherein the color filter layer comprises a plurality of color filter units and a black matrix, the black matrix fills gaps between the color filter units.

13. The liquid crystal display as claimed in claim **12**, wherein the first portions of the first protrusions are made of the same material as the black matrix, the second portions are made of the same material as the first coating layer.

14. The liquid crystal display as claimed in claim **1**, wherein the second substrate further comprises a plurality of thin film transistors and a second coating layer covering the thin film transistors.

15. The liquid crystal display is claimed in claim **14**, wherein the second protrusions are made of the same material as the second coating layer.

16. The liquid crystal display as claimed in claim **14**, wherein the second protrusions are simultaneously formed with the second coating layer in a same fabricating step.

17. The liquid crystal display as claimed in claim **1**, wherein each three adjacent second protrusions define a protrusion unit, all the protrusion units have the orientation.

18. The liquid crystal display as claimed in claim **17**, wherein the three first protrusions defined the protrusion unit are arranged in a triangle.

19. The liquid crystal display as claimed in claim **18**, wherein the triangular protrusion units are isosceles triangles.

20. A liquid crystal display, comprising:

a liquid crystal display panel defining a display area and a non-display area around the display area, the liquid crystal display panel comprising:

a first substrate;

a second substrate disposed parallel to the first substrate;

a sealing member located at peripheral sides of the non-display area of the second substrate, the sealing member coupled with the first and second substrates defining a liquid crystal cell; and

a liquid crystal layer contained in the liquid crystal cell;

wherein the first substrate comprises a plurality of first protrusions located at the non-display area between the display area and the sealing member, the second substrate comprises a plurality of second protrusions located at the non-display area between the display area and the sealing member, each of the first protrusions protrudes toward the second substrate, each of the second protrusions protrudes toward the first substrate, and the plurality of first protrusions are staggered relative to at least a plurality of the second protrusions.

* * * * *

专利名称(译)	液晶显示器，其突起形成在其液晶显示板的非显示区域		
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摘要(译)

示例性液晶显示器（2）包括限定显示区域和非显示器的液晶显示板（20）。液晶显示面板包括第一基板（21），第二基板（23），位于第二基板的非显示区域的外围侧的密封构件（25），以及液晶层（27）。第一基板包括位于与密封构件相邻的非显示区域处的第一突起（214）。第二基板包括位于与密封构件相邻的非显示区域处的第二突起（234）。第一突起朝向第二基板突出，第二突起朝向第一基板突出。第一突起相对于第二突起交替布置。