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**Chien et al.**

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(54) **LIQUID CRYSTAL DISPLAY PANEL AND MANUFACTURING METHOD THEREOF**

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*G02F 1/1345* (2006.01)

(52) **U.S. Cl.**
USPC .......................................................... **349/149**

(58) **Field of Classification Search**
USPC .......................................................... 349/149
See application file for complete search history.

(56) **References Cited**

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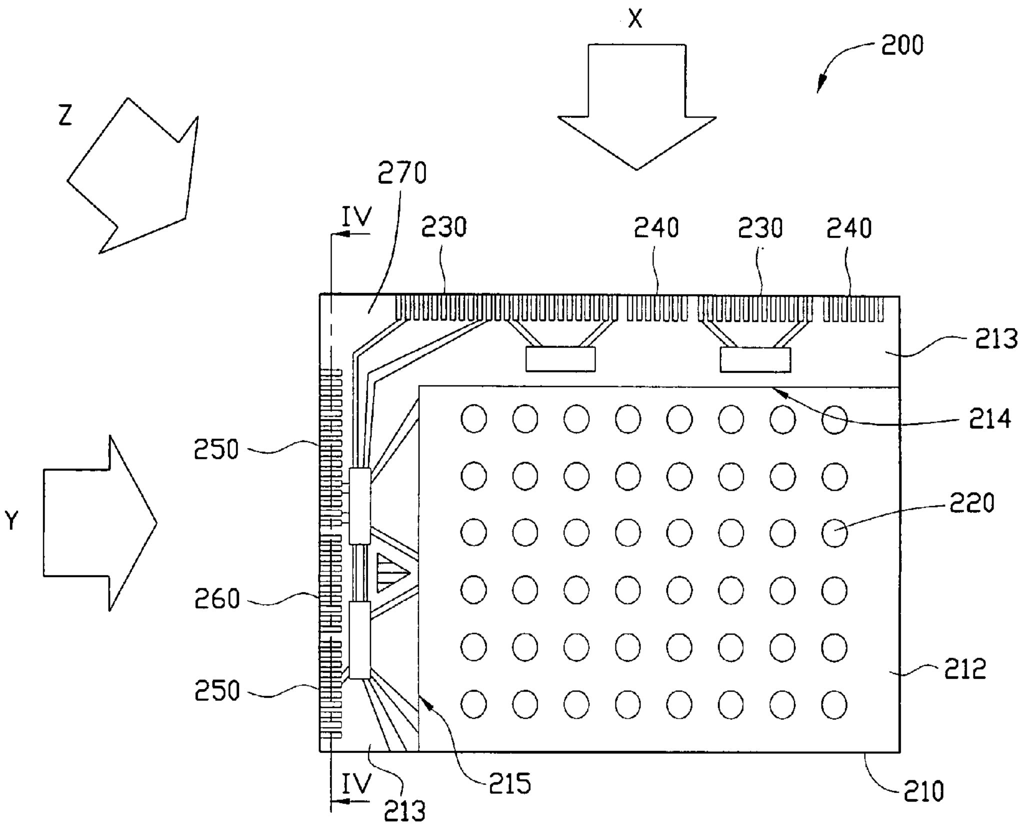
(57) **ABSTRACT**

A liquid crystal display panel includes a substrate, a thin film transistor array, a circuit, and a dummy circuit. One surface of the substrate is divided into a display region and a wiring region. The thin film transistor array is formed on the display region. The circuit and the dummy circuit are formed on the wiring region, the dummy circuit is adjacent to the circuit, and the circuit and the dummy circuit protrude from the substrate.

**14 Claims, 5 Drawing Sheets**



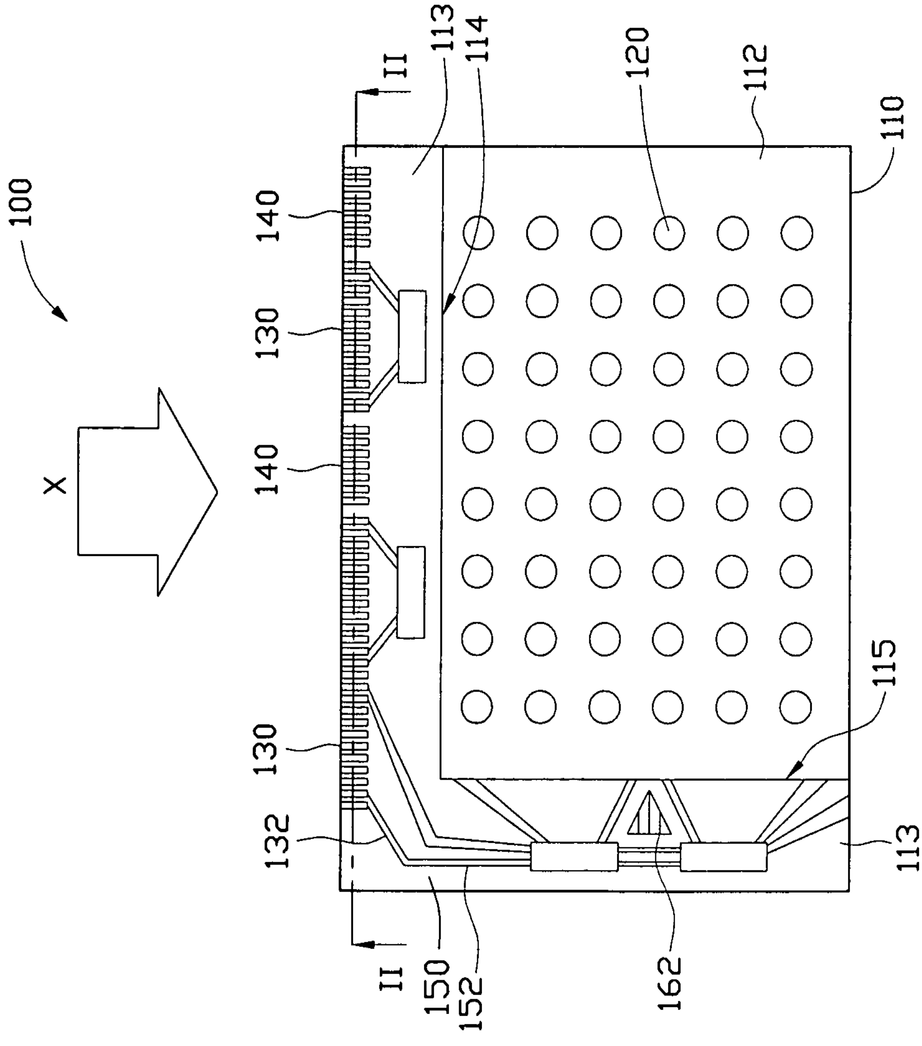
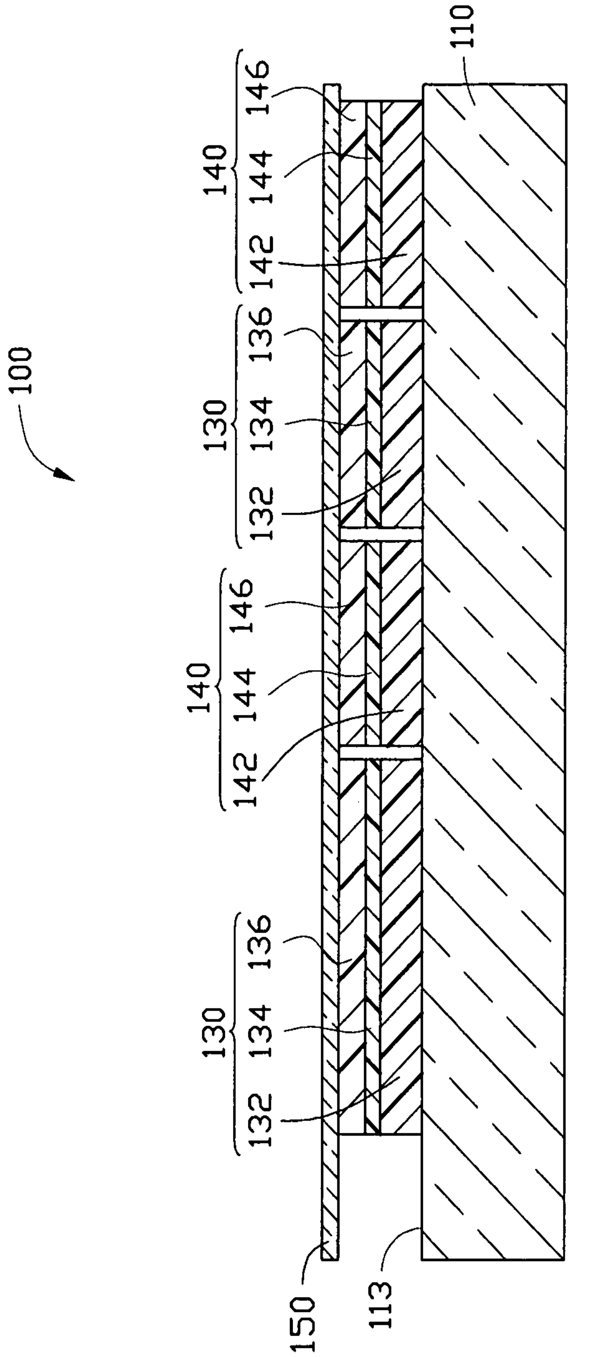

100
X
140
130
140
130
132
II
113
114
120
112
110
115
113
150
152
162
II

FIG. 1


100
110
140
146
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142
130
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134
132
140
146
144
142
130
136
134
132
150
113

FIG. 2

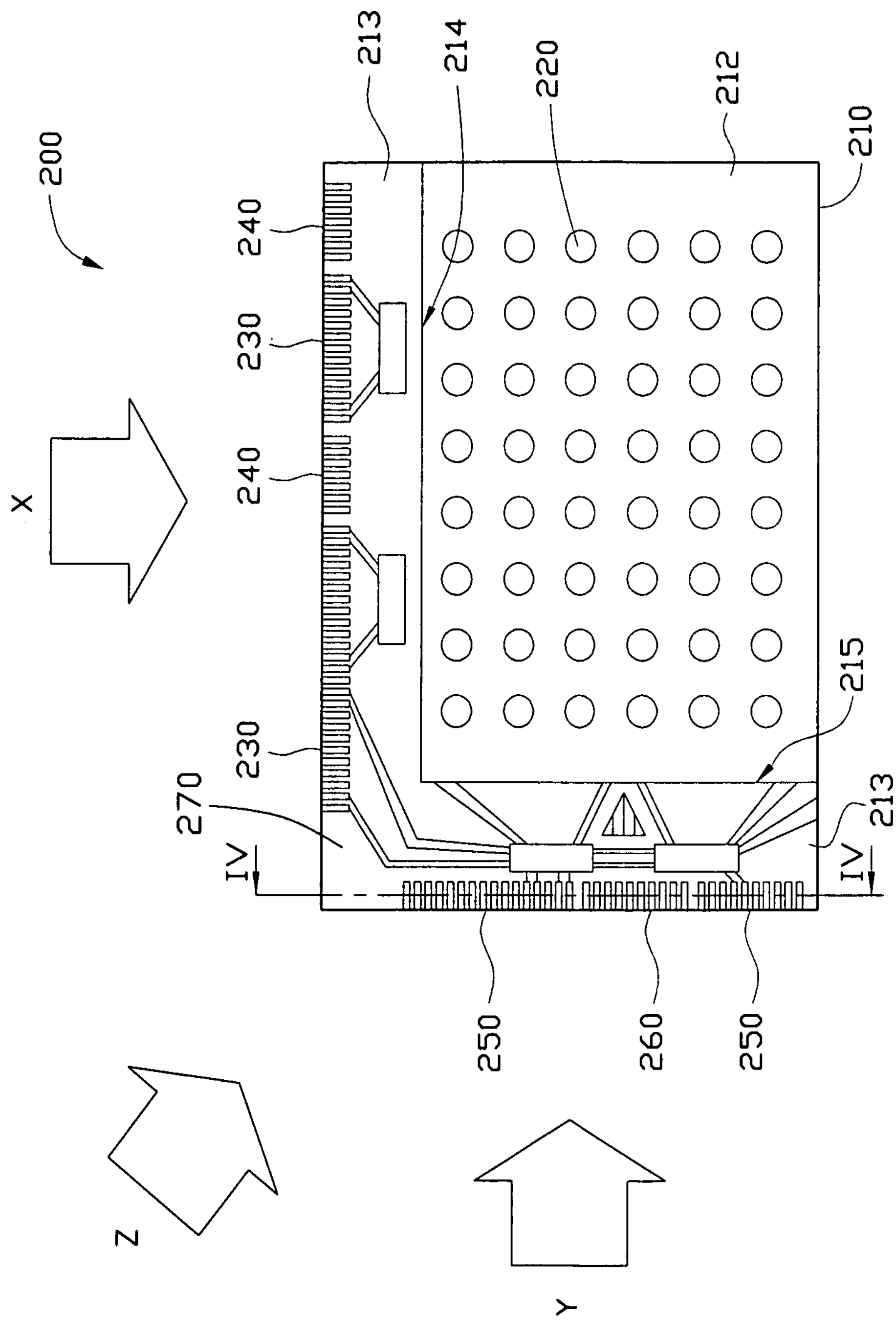
200
213
214
220
212
210
240
230
240
230
270
IV
215
213
IV
250
260
250
X
Z
Y

FIG. 3

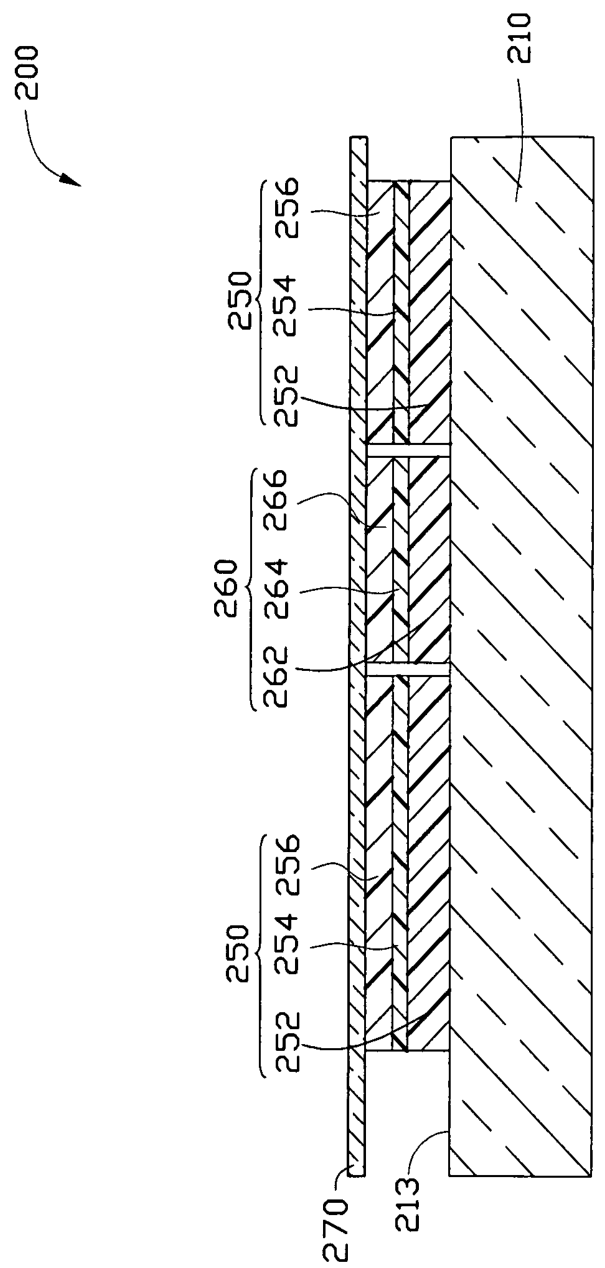


FIG. 4

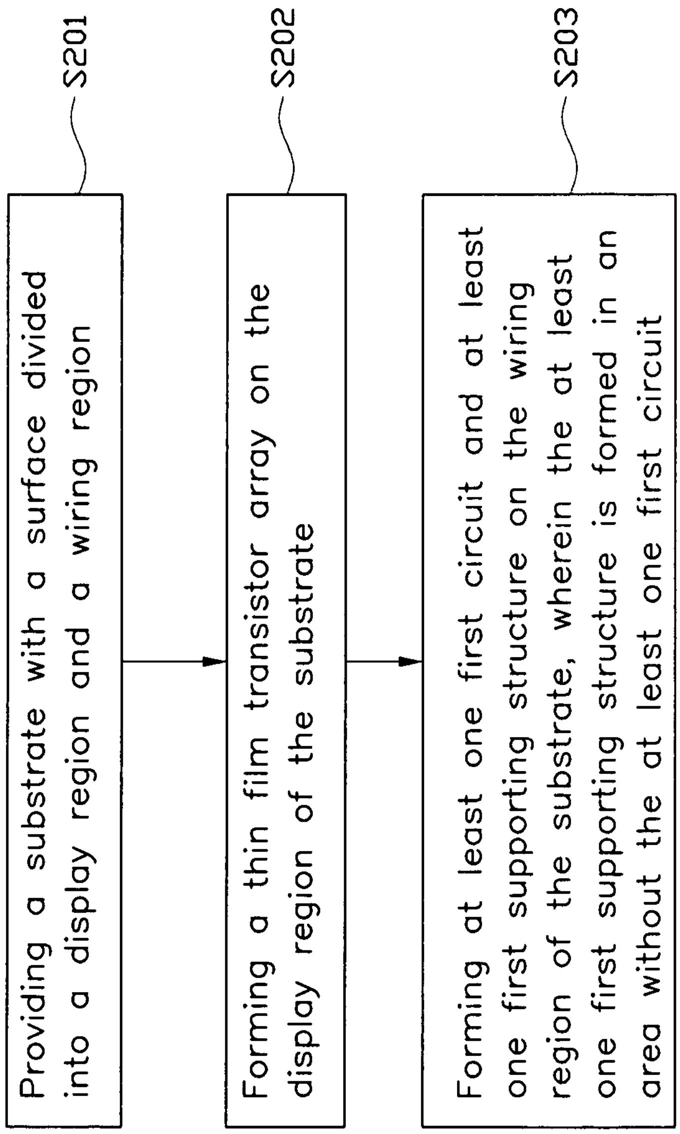
Providing a substrate with a surface divided into a display region and a wiring region
S201
Forming a thin film transistor array on the display region of the substrate
S202
Forming at least one first circuit and at least one first supporting structure on the wiring region of the substrate, wherein the at least one first supporting structure is formed in an area without the at least one first circuit
S203

FIG. 5

# LIQUID CRYSTAL DISPLAY PANEL AND MANUFACTURING METHOD THEREOF

## BACKGROUND

1. Technical Field

The present disclosure relates to a liquid crystal display panel and a manufacturing method for manufacturing the liquid crystal display panel.

2. Description of Related Art

At present, many liquid crystal display panels or liquid crystal optical assemblies include alignment films. If a substrate is covered by an alignment film, a process of rubbing follows to more orderly arrange and align the liquid crystals, such that a desirable display mode is achieved.

However, force exerted during rubbing is difficult to normalize, possibly causing thickness of the alignment film to be non-uniform. The result is occurrence of mura.

## SUMMARY

The present disclosure provides a liquid crystal display and a manufacturing method thereof.

One embodiment of the present disclosure discloses a liquid crystal display panel, which includes a substrate, a thin film transistor array, at least one circuit, and at least one supporting structure. A surface of the substrate is divided into a display region and a wiring region and the wiring region is located at the outside of the display region. The thin film transistor array is formed on the display region. The circuit is formed on the wiring region and adjacent to one edge of the display region, and the circuit is capable of transmitting signals to the thin film transistor array. The supporting structure is formed on the wiring region and adjacent to the circuit and the edge of the display region and the supporting structure is formed in an area without the circuit.

Another embodiment of the present disclosure discloses a manufacturing method for the liquid crystal display panel. First, a substrate with one surface having a display region and a wiring region is provided, and the wiring region is located at the outside of the display region. Then, a thin film transistor array is formed on the display region, and at least one circuit and at least one supporting structure are formed on the wiring region. The circuit and the supporting structure are adjacent to one edge of the display region, the circuit is electrically connected to the thin film transistor array, and the supporting structure is formed in an area without the circuit.

## BRIEF DESCRIPTION OF THE DRAWINGS

The components in the drawings are not necessarily drawn to scale, the emphasis instead being placed upon clearly illustrating the principles of the present disclosure. Moreover, in the drawings, like reference numerals designate corresponding parts throughout the several views, and all the views are schematic.

FIG. **1** is a plan view of a first embodiment of a liquid crystal display panel.

FIG. **2** is a cross-section of the liquid crystal display panel of FIG. **1**, taken along line II-II thereof.

FIG. **3** is a plan view of a second embodiment of a liquid crystal display panel.

FIG. **4** is a cross-section of the liquid crystal display panel of FIG. **3**, taken along line IV-IV thereof.

FIG. **5** is a flowchart of a manufacturing method for a liquid crystal display panel.



## DETAILED DESCRIPTION

Referring to FIGS. **1** and **2**, a first embodiment of a liquid crystal display panel **100** includes a substrate **110**, a thin film transistor array **120**, a plurality of first circuits **130**, a plurality of first support structures **140**, and an alignment film **150**. In the illustrated embodiment, the first support structures **140** are dummy circuits, for example.

A surface of the substrate **110** is divided into a display region **112** and a wiring region **113** located outside of the display region **112**. In the illustrated embodiment, the display region **112** is substantially rectangular, and the wiring region **113** encompasses two adjacent sides of the display region **112**. The display region **112** has a first edge **114** and a second edge **115** intersecting with the first edge **114**. In the illustrated embodiment, the substrate **110** is made of glass, and the first edge **114** is substantially perpendicular to the second edge **115**.

The thin film transistor array **120** is formed on the display region **112** of the substrate **110**.

The first circuits **130** and the first support structures **140** are formed on the wiring region **113** and adjacent to the first edge **114** of the display region **112**. The first support structures **140** are also formed adjacent to the first circuits **130**. The first support structures **140** and the first circuits **130** protrude from the substrate **110** correspondingly, and the first support structures **140** are formed in an area without the first circuits **130**. As an example, the first circuits **130** and the first support structures **140** can be arrayed in a line, with the first support structures **140** arrayed to fill gaps between the first circuits **130**. In the illustrated embodiment, the first circuits **130** and the first support structures **140** are arrayed in a line substantially parallel to the first edge **114** of the display region **112**. Only one first circuit **130** and only one first support structure **140** may be provided, although any number of first circuits **130** and the first support structures **140** may be employed.

Each first circuit **130** protruding from the substrate **110** includes a first pattern **132**, a first insulation layer **134**, and a first conduction layer **136**. The first pattern **132** is formed on the wiring region **113** of the first substrate **110**. The first insulation layer **134** is formed on the first pattern **132**. The first conductive layer **136** is formed on the first insulation layer **134**. The first conduction layer **136** is transparent and made of indium tin oxide (ITO).

Each first support structure **140** protruding from the substrate **110** includes a first dummy pattern **142**, a first dummy insulation layer **144**, and a first dummy conduction layer **146**. The first dummy pattern **142** is formed on the wiring region **113** of the first substrate **110** as the first pattern **132**. The first dummy insulation layer **144** is formed on the first dummy pattern **142**. The first dummy conduction layer **146** is formed on the first insulation layer **144**. In one embodiment, the first dummy conduction layer **146** is transparent and made of ITO. A thickness of each first support structure **140** protruding from the substrate **110** is substantially equal to a thickness of each first circuit **130** protruding from the substrate **110**, such that the height difference of the surface of the wiring region **113** adjacent to the first edge **114** of the display region **112** can be minimized. A rubbing process can easily direct the alignment film **150** because of the first insulation layer **134**, the first conduction layer **136**, the first dummy insulation layer **144**, and the first dummy conduction layer **146**.

The first dummy patterns **142** formed between the first patterns **132** are capable of reducing the height difference of the terrain on the substrate **110**. In one embodiment, the thickness of each first dummy pattern **142** is substantially equal to the thickness of each first pattern **132**.

The alignment film **150** exhibits excellent qualities of transparence, conduction, and heat-resistance. In the illustrated embodiment, the alignment film **150** is made of polyimide.

During fabrication of the liquid crystal display panel **100**, the alignment film **150** is covered over the substrate **110** on which the first circuits **130** and the first support structures **140** are positioned, and rubbed in a first direction X. Since the first support structures **140** are filled in gaps between the first circuits **130**, force of rubbing the alignment film in the first direction X remains uniform, in addition, mura is avoided.

When there is no mura, the thicknesses of the first support structures **140** protruding from the substrate **110** can be a little larger or smaller than the thicknesses of the first circuits **130** within a flexible range.

The liquid crystal display panel **100** further includes a plurality of other circuits **152** and other support structures **162** on a portion of the wiring region **113** adjacent to the second edge **115**. The circuits **152** are connected with and similar to the first circuit **130**, and the support structures **162** are similar to the first support structure **140**. A thickness of each circuit **152** can be substantially equal to a thickness of each support structure **162**, such that the height difference of the terrain on the wiring region **113** adjacent to the of the display region **112** can be reduced. The height difference of the surface of the wiring region **113** adjacent to the second edge **115** of the display region **112** can be minimized.

In use, if a liquid crystal display panel of a small size requires circuits formed adjacent to one side only, the support structures are formed adjacent to this one side correspondingly. If a large liquid crystal display panel requires circuits formed adjacent to two or more sides, the support structures are correspondingly formed adjacent to these sides.

In this embodiment, each first circuit **130** has an electrical connection with the thin film transistor array **120** in the display region **112**, and each first support structure **140** has no electrical connection with the thin film transistor array **120**. The first circuits **130** are capable of transmitting electrical signals from peripheral circuits (not shown) to the thin film transistor array **120**, such that the thin film transistor array **120** may be controlled by the peripheral circuits.

In this embodiment, the second patterns **150** and the second dummy patterns **160** may be omitted, as may the first support structures **140** and the second dummy patterns **160** which can be replaced by other support structures, such as blocks, protrusions, or other structures formed on the substrate **110**.

Referring to FIGS. **3** and **4**, a second embodiment of a liquid crystal display panel **200** includes a substrate **210** differing from the substrate **110** of FIG. **1**, in that the surface thereof is divided into a display region **212** and a wiring region **213**. The display region **212** has a first edge **214** and a second edge **215** intersecting the first edge **214**. In the illustrated embodiment, the first edge **214** is substantially perpendicular to the second edge **215**.

The thin film transistor array **220** is formed on the display region **212**.

The first circuits **230** and the first support structures **240** have the same structure as the first circuits **130** (referring to FIG. **1**) and the first support structures **140**, each first circuit **230** including a first pattern, and each first support structure **240** including a first dummy pattern (not shown).

The second circuits **250** and the second support structures **260** are disposed on a portion of the wiring region **213** adjacent to the second edge **215** and protrude from the substrate **210** correspondingly. Each second circuit **250** includes a second pattern **252**, a second insulation layer **254**, and a second conduction layer **256**. The second pattern **252** is formed on the substrate **210**, the second insulation layer **254** is formed on the second pattern **252**, and the second conduction layer **256** is formed on the second insulation layer **254**. The second conduction layer **256** can be transparent and made of ITO.

Each second support structure **260** includes a second dummy pattern **262**, a second dummy insulation layer **264**, and a second dummy conduction layer **266**. The second dummy pattern **262** is formed on the substrate **210**, the second dummy insulation layer **264** is formed on the second dummy pattern **262**, and the second dummy conduction layer **266** is formed on the second dummy insulation layer **264**. The second dummy conduction layer **266** is transparent and made of ITO. A thickness of each second support structure **260** protruding from the substrate **210** corresponds to each second circuit **250** protruding from the substrate **210**. In the illustrated embodiment, the thickness of each second support structure **260** is substantially equal to a thickness of each second circuit **250**.

In the liquid crystal display panel **200**, the second pattern **252** of each second circuit **250** is electrically connected with the thin film transistor array **220** on the display region **212**, and each second support structure **260** is not electrically connected with the thin film transistor array **220**. The second circuits **250** are capable of transmitting electrical signals from peripheral circuits to the thin film transistor array **220**, such that the thin film transistor array **220** may be controlled by the peripheral circuits through the second circuits **250**.

The height difference of the terrain on the wiring region **213** adjacent to both the first edge **214** and the second edge **215** is reduced, such that a force of rubbing in the first direction X or a second direction Y, while applying the alignment film **270** over the substrate **210**, remains uniform, whereby no mura is generated. In addition, the thicknesses of each second circuit **250** and each second support structure **260** are substantially equal to the thicknesses of each first circuit **230** and each first support structure **240**, such that force of rubbing in a third direction Z, while applying the alignment film **210**, remains uniform.

The alignment film **270** exhibits superior transparence, conduction, and heat-resistance. In the illustrated embodiment, the alignment film **270** is made of polyimide.

During fabrication of the liquid crystal display panel **200**, the alignment film **270** is disposed on the substrate **210** on which the second circuits **250** and the second support structures **260** are positioned, and rubbed in the second direction Y. Since the second support structures **260** fill in gaps between the second circuits **250**, the difference height of the terrain on the wiring region **213** adjacent to the second edge **215** of the display region **210** is reduced, in addition, the rubbing force remains stable and mura is avoided.

In the absence of mura, the thicknesses of the second support structures **260** protruding from the substrate **210** can deviate from those of the second circuits **250** in a flexible range.

Furthermore, the thicknesses of the first and second support structures **240**, **260** are substantially equal to the thicknesses of the first and second circuits **230**, **250**, allowing the alignment film **270** to be rubbed in a third direction Z. Moreover, the rubbing force remains uniform and mura is reduced.

As described, the liquid crystal display panel **200** may include a substrate **210**, a thin film transistor array **220**, circuits, and support structures. The circuits may include the first circuits **230** and/or the second circuits **250**, but are not limited in this respect. For instant, the circuits may be formed around the thin film transistor array **220** when enough space around the thin film transistor array **220** is provided.

The number of the first circuits **230**, the first support structures **240**, the second circuits **250**, and the second support structures **260** may be any number according to the size of the substrate **210**. The first support structures **240** and the second support structures **260** may be replaced by other support structures, such as blocks, protrusions, or other structures formed on the substrate **210**.

FIG. **5** shows a manufacturing method of the liquid crystal display panel **200**. The manufacturing method includes the following steps S**201**, S**202**, S**203**, and S**204**. The steps are not limited in the illustrated order, the adjustment of the order is allowed, and some steps may be performed simultaneously or partially simultaneously.

In step S**201**, a substrate **210** with a surface divided into the display region **212** and the wiring region **213** is provided. The wiring region **213** is located outside of the display region **212**.

In step S**202**, the thin film transistor array **220** is formed on the display region **212** of the substrate **210**.

In step S**203**, the first and second circuits **230**, **250** and the first and second support structures **240**, **260** are formed on the wiring region **213** of the substrate **210**, and the wiring region **213** is formed adjacent to at least one edge of the display region **212**. The first and second support structures **240**, **260** are formed in an area without the first and second circuits **230**, **250** adjacent to the at least one edge. The thicknesses of each first and each second circuit **230**, **240** are formed substantially equal to the thicknesses of each first and each second dummy circuit **250**, **260**. In the illustrated embodiment, the first and second circuits **230**, **240** and the first and second dummy circuits **250**, **260** are formed in an area adjacent to two edges **214**, **215** of the display region **212**.

Referring to FIGS. **3** through **5**, the manufacturing method can be described as follows.

During manufacture of the liquid display panel **200**, the substrate **210** with a surface divided into the display region **212** and the wiring region **213** is provided, and the wiring region **213** is located outside of the display region **212**. The thin film transistor array **220** is arrayed on the display region **212** of the substrate **210**. The first circuits **230** and the first support structures **240** are formed on the wiring region **213**, and the first circuits **230** are formed adjacent to the first edge **214** of the display region **212** and electrically connected to the thin film transistor array **220**. The first support structures **240** are formed in an area without the first circuit **230** but adjacent to the first circuits **230**.

While forming the first circuits **230** and the first support structures **240** on the wiring region **213** of the substrate **210**, the first support structures **240** are formed to protrude from the substrate **220** corresponding to the first circuits **230**, and the first support structures **240** are formed adjacent to the first circuits **230**. In one embodiment, the thicknesses of the first support structures **240** are substantially equal to the thicknesses of the first circuits **230**.

During formation of the first circuits **230** and the first support structures **240** on the wiring region **213** of the substrate **210**, the first circuits **230** and the first support structures **240** are formed to have the same structure as the first circuits **130** (referring to FIGS. **1** and **2**) and the first support structures **140**. The first patterns and the first dummy patterns are formed on the substrate **210**. The first insulation layers are formed on the first patterns, and the first dummy insulation layers are formed on the first dummy patterns. The first conduction layers are formed on the first insulation layers, and the first dummy conduction layers are formed on the first dummy insulation layers. The first conduction layer and the first dummy conduction layer can be made of ITO.

The second circuits **250** and the second support structures **260** are also formed on the wiring region **213** of the substrate **210** during manufacture of the liquid crystal display panel **200**. The second circuits **250** and the second support structures **260** are formed adjacent to the second edge **215** of the display region **212**. The first edge **214** and the second edge **215** are next to each other, and the second support structures **260** are formed in an area with no second circuits **250**.

During formation of the second circuits **250** and the second support structures **260** on the wiring region **213** of the substrate **210**, the second circuits **250** and the second support structures **260** are formed to protrude from the substrate **220** correspondingly, and the second support structures **260** are formed adjacent to the second circuits **250**.

During formation of the second circuits **250** and the second support structures **260** on the wiring region **213** of the substrate **210**, the second patterns **252** and the second dummy patterns **262** are first formed on the substrate **210**. In the illustrated embodiment, the second patterns **252** connect with the first patterns. In addition, the second insulation layers **254** are formed on the second patterns **252**, and the second dummy insulation layers **264** are formed on the second dummy patterns **262**. The second conduction layers **256** are formed on the second insulation layers **254**, and the second dummy conduction layers **266** are formed on the second dummy insulation layers **264**. The second conduction layers **256** and the second dummy conduction layers **266** can be made of ITO.

During formation of the second circuits **250** and the second support structures **260** on the substrate **210**, the thicknesses of the second support structures **260** are formed substantially equal to the thicknesses of the second circuits **250**. Furthermore, the thicknesses of the second circuits **250** are formed substantially equal to the thicknesses of the first circuits **230**, and the thicknesses of the second support structures **260** are formed substantially equal to the thicknesses of the first support structures **240**.

Furthermore, the alignment film **270** is formed on the first circuits **230** and the first support structures **240**, the alignment film **270** is also formed on the second circuits **240** and the second support structures **250**.

It is believed that the present embodiments and their advantages will be understood from the foregoing description, and it will be apparent that various changes may be made thereto without departing from the spirit and scope of the embodiments or sacrificing all of their material advantages.

What is claimed is:

**1**. A liquid crystal display panel, comprising:

a substrate comprising a surface divided into a display region and a wiring region located outside of the display region;

a thin film transistor array formed on the display region;

a plurality of first circuits formed on the wiring region and adjacent to a first edge of the display region, wherein the first circuits transmits signals to the thin film transistor array; and

a plurality of first support structures formed on the wiring region and adjacent to the first circuits and the first edge of the display region, wherein the first support structures are formed in an area without the first circuits, and the first circuits are arranged alternately with the first support structures, and the at least one first support structure is a first dummy circuit.

**2**. The liquid crystal display panel of claim **1**, wherein the first circuits and the first support structures protrude from the substrate.

3. The liquid crystal display panel of claim 2, wherein a thickness of the first circuits protruding from the substrate is substantially equal to a thickness of the first support structures.

4. The liquid crystal display panel of claim 3, further comprising at least one second circuit and at least one second support structure formed on the wiring region and adjacent to a second edge of the display region, wherein the first edge of the display region is next to the second edge of the display region, and the at least one second support structure is formed in another area without the at least one second circuit.

5. The liquid crystal display panel of claim 4, wherein the at least one second circuit and the at least one second support structure protrude from the substrate.

6. The liquid crystal display panel of claim 5, wherein a thickness of the at least one second circuit protruding from the substrate is substantially equal to a thickness of the at least one second support structure.

7. The liquid crystal display panel of claim 6, wherein the thicknesses of the first circuits and the first support structures protruding from the substrate is substantially equal to the thicknesses of the at least one second circuit and the at least one second support structure.

8. The liquid crystal display panel of claim 4, wherein the at least one second circuit comprises a second pattern formed on the substrate, a second insulation layer formed on the second pattern, and a second conduction layer formed on the second insulation layer; the at least one second support structure comprises a second dummy pattern formed on the substrate, a second dummy insulation layer formed on the second dummy pattern, and a second dummy conduction layer formed on the second dummy insulation layer.

9. The liquid crystal display panel of claim 8, wherein a material of the second dummy conduction layer and the second dummy conduction layer comprises indium tin oxide.

10. The liquid crystal display panel of claim 4, wherein the at least one second support structure is a second dummy circuit.

11. The liquid crystal display panel of claim 1, wherein each of the first circuit comprises a first pattern formed on the substrate, a first insulation layer formed on the first pattern, and a first conduction layer formed on the first insulation layer; each of the first support structure comprises a first dummy pattern formed on the substrate, a first dummy insulation layer formed on the first dummy pattern, and a first dummy conduction layer formed on the first dummy insulation layer.

12. The liquid crystal display panel of claim 11, wherein a material of the first conduction layer and the first dummy conduction layer comprises indium tin oxide.

13. The liquid crystal display panel of claim 1, further comprising an alignment film covered on the first circuits and the first support structures.

14. The liquid crystal display panel of claim 1, wherein the first circuits and the first support structures are arrayed in a line.

* * * * *

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|---|---|---|---|
| 专利名称(译) | 液晶显示面板及其制造方法 | | |
| 公开(公告)号 | US8570478 | 公开(公告)日 | 2013-10-29 |
| 申请号 | US12/788303 | 申请日 | 2010-05-27 |
| [标]申请(专利权)人(译) | 群创光电股份有限公司 | | |
| 申请(专利权)人(译) | 奇美群创光电 | | |
| 当前申请(专利权)人(译) | 群创光电 | | |
| [标]发明人 | CHIEN CHARLES<br>HUANG SHANG YU<br>HSIEH TSAU HUA<br>CHO HUNG SHENG | | |
| 发明人 | CHIEN, CHARLES<br>HUANG, SHANG-YU<br>HSIEH, TSAU-HUA<br>CHO, HUNG-SHENG | | |
| IPC分类号 | G02F1/1345 | | |
| CPC分类号 | G02F1/13454 H01L33/08 H01L27/124 G02F1/133308 G02F1/13439 G02F1/136286 G02F1/1368 G02F1/133345 G02F1/133784 G02F2203/28 G02F2001/13629 G02F1/13452 | | |
| 审查员(译) | 黄，ERIC | | |
| 优先权 | 200910304678.8 2009-07-22 CN | | |
| 其他公开文献 | US20110234963A1 | | |
| 外部链接 | Espacenet USPTO | | |


**摘要(译)**

液晶显示面板包括基板，薄膜晶体管阵列，电路和虚设电路。基板的一个表面分为显示区域和布线区域。薄膜晶体管阵列形成在显示区域上。电路和虚设电路形成在布线区域上，虚设电路与电路相邻，并且电路和虚设电路从基板突出。