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(54) **IN-CELL TOUCH DISPLAY PANEL STRUCTURE**

(71) Applicant: **SUPERC-TOUCH CORPORATION**, New Taipei City (TW)

(72) Inventor: **Hsiang-Yu LEE**, New Taipei City (TW)

(73) Assignee: **SuperC-Touch Corporation**, New Taipei City (TW)

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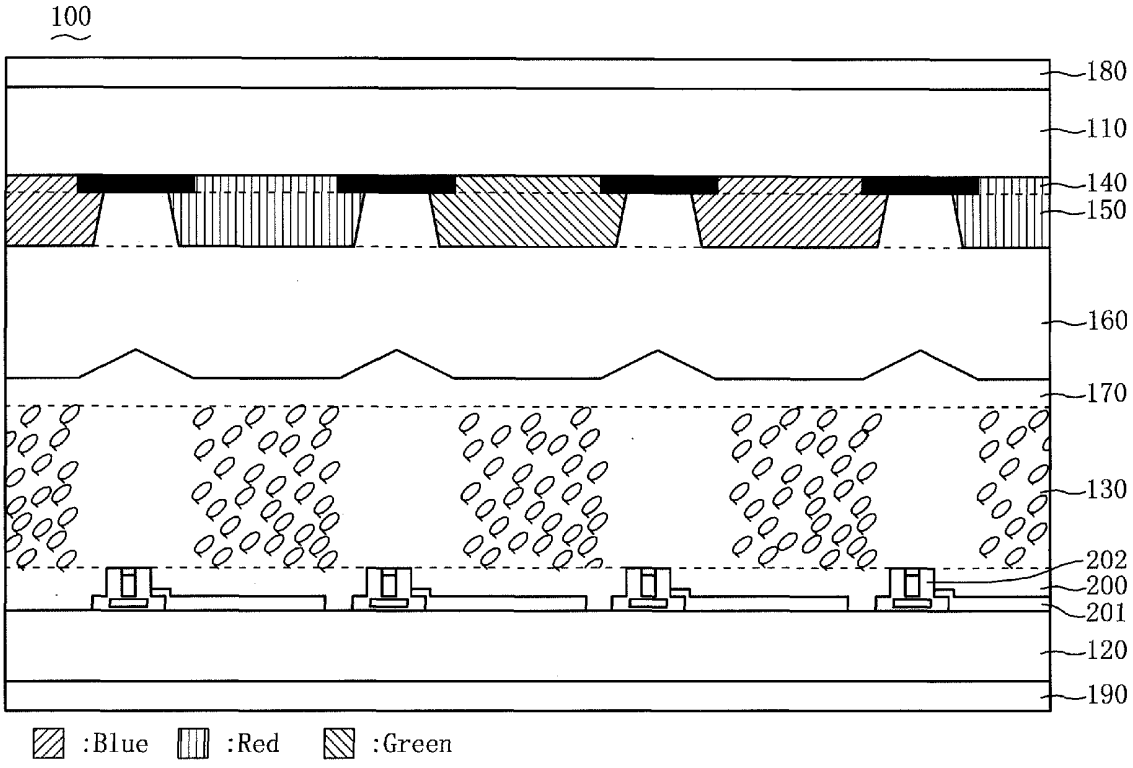
(57) **ABSTRACT**

An in-cell touch display panel includes a first substrate, a second substrate parallel to the first substrate, a liquid crystal layer configured between the first and second substrates, and a black matrix layer disposed at a surface of the first substrate facing to the liquid crystal layer. The black matrix includes a plurality of opaque conductive lines. The opaque conductive lines are divided into a first group, a second group and a third group of opaque conductive lines. The second group of opaque conductive lines is formed with N polygonal regions where N is a positive integer. The opaque conductive lines in any one of the polygonal regions are electrically connected together while any two polygonal regions are not electrically connected.



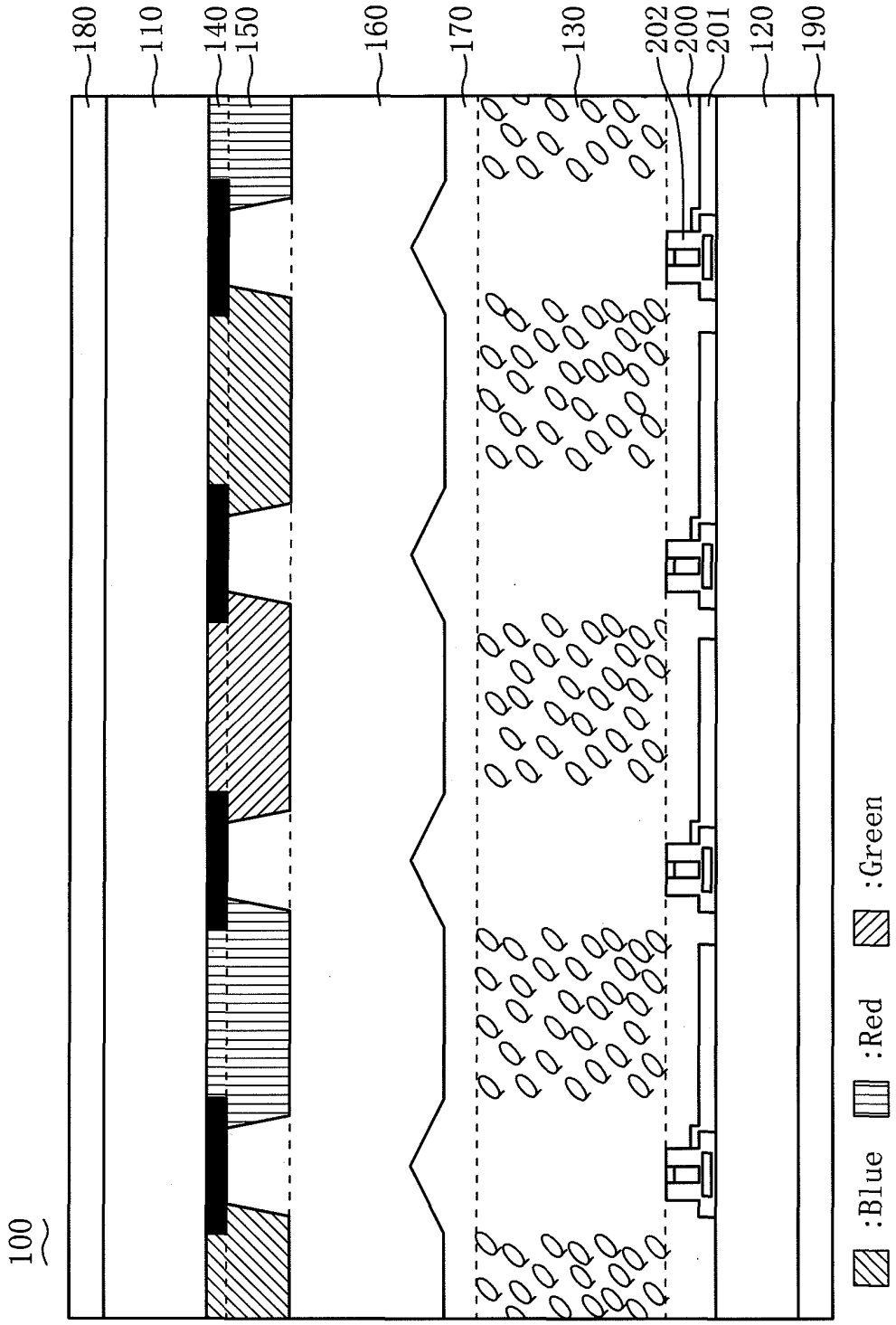

180
110
140
150
160
170
130
202
200
201
120
190
100
:Blue
:Red
:Green

FIG. 1

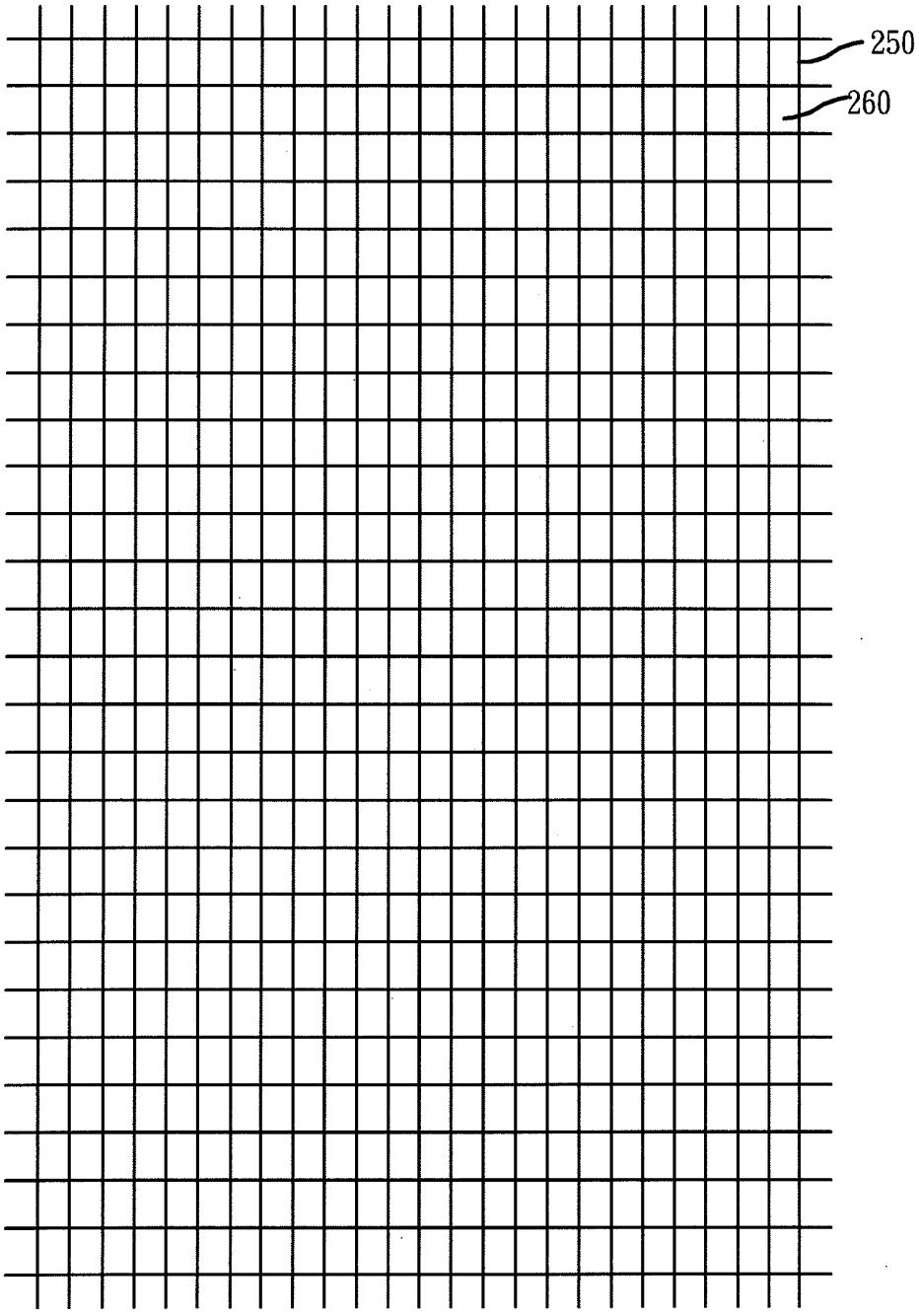


FIG. 2 (Prior art)

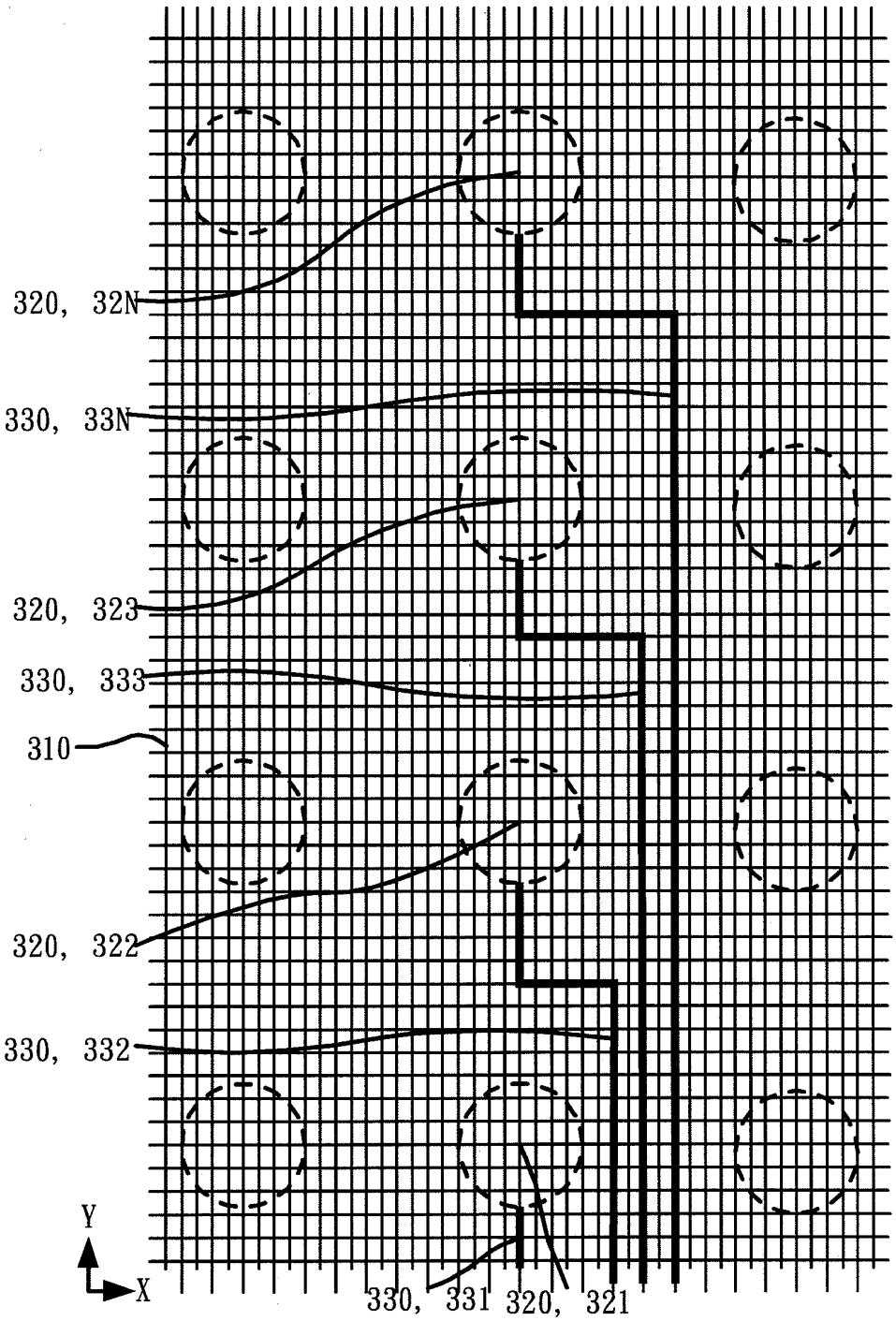

320, 32N
330, 33N
320, 323
330, 333
310
320, 322
330, 332
Y
X
330, 331
320, 321

FIG. 3

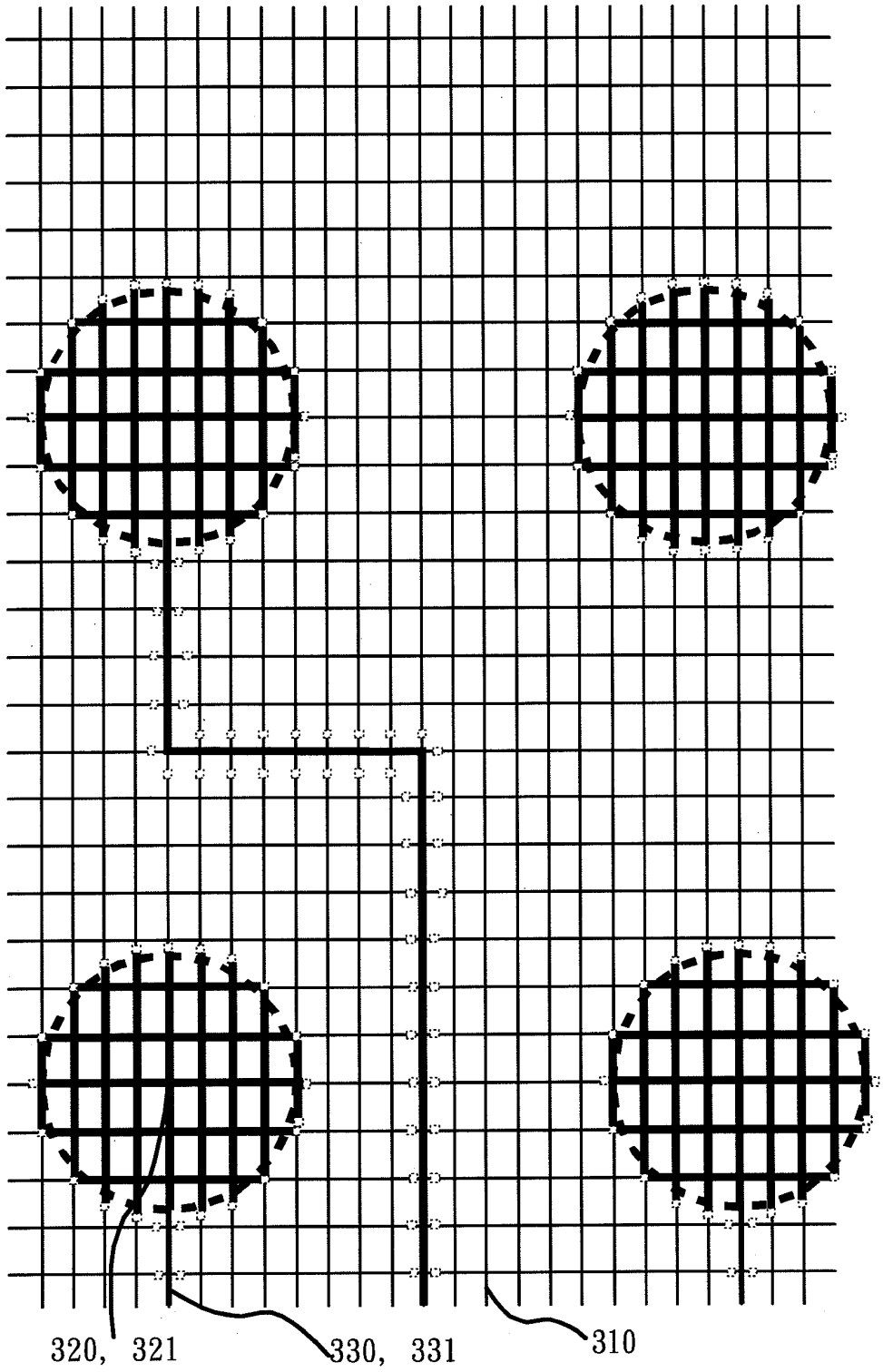


FIG. 4

IN-CELL TOUCH DISPLAY PANEL STRUCTURE

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a structure of touch display panel and, more particularly, to an in-cell touch display panel structure.

[0003] 2. Description of Related Art

[0004] A conventional touch display panel includes a touch panel and a display unit overlapped with the touch panel. The touch panel is configured as an operation interface. The touch panel is transparent so that an image generated by the display unit can be viewed directly by a user without being sheltered by the touch panel. Such well known skill of the touch panel may increase additional weight and thickness of the touch display panel, and may further reduce the light penetration rate of the touch display panel.

[0005] On-cell and in-cell touch technology were invented to overcome the drawbacks of traditional touch technology described above. The on-cell technology is to dispose a sensor on the back side of a color filter substrate to form a completed color filter substrate. One of the on-cell touch technologies is provided to dispose a touch sensor on a thin film and then bond the thin film onto the upper one of the two substrates.

[0006] The in-cell technology is to dispose the sensor within the LCD cell structure. Currently, there are resistive, capacitive and optical three primary in-cell touch technologies, wherein the resistive touch technology employs two conductive substrates and the voltage variation of a common layer between the two substrates for determining a touch position on the touch display panel.

[0007] The in-cell touch technology is provided to integrate the touch sensor within the display unit so that the display unit is provided with the ability of the touch panel. Therefore, the touch display panel does not need to be bonded with an additional touch panel so as to simplify the assembly procedure. Such skill is generally developed by TFT LCD manufactures.

[0008] There is older touch control technology known as out-cell, which is typically applied to the resistive and capacitive touch panels. The out-cell touch technology is provided to add a touch module onto a display module. The touch module and the display module can be manufactured by the two separated parties.

[0009] However, for all the in-cell, on-cell and out-cell touch technologies, they all need a sensing layer to be configured on an upper or lower glass substrate, which not only increases the manufacturing cost but also complicates the manufacturing process. Therefore, it desired for the aforementioned touch display panel structure to be improved.

SUMMARY OF THE INVENTION

[0010] The object of the present invention is to provide an in-cell touch display panel structure for greatly decreasing the weight and thickness of a TFT touch LCD panel and also significantly reducing the material and manufacturing cost.

[0011] To achieve the object, there is provided an in-cell touch display panel structure, which includes a first substrate, a second substrate, a liquid crystal layer and a conducted black matrix. The second substrate is parallel to the first substrate. The liquid crystal layer is configured between the first and second substrates. The black matrix is disposed at a surface of the first substrate opposite to the liquid crystal layer. The black matrix was formed by three elements, each being a group of plurality opaque conductive lines. The plurality opaque conductive lines are divided into a first group of opaque conductive lines, a second group of opaque conductive lines and a third group of opaque conductive lines. The second group of opaque conductive lines is formed with N polygonal regions, where N is a positive integer. The opaque conductive lines in any one of the polygonal regions are electrically connected together while any two polygonal regions are not electrically connected, so as to form a single-layered touch pattern on the black matrix layer.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIG. **1** shows an in-cell touch display panel structure in accordance with a preferred embodiment of the present invention;

[0013] FIG. **2** shows a prior black matrix layer;

[0014] FIG. **3** is a pattern diagram of the black matrix layer in accordance with the present invention; and

[0015] FIG. **4** is a detail view of the black matrix layer in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0016] As shown in FIG. **1**, there is shown an in-cell touch display panel structure **100** in accordance with a preferred embodiment of the present invention. The in-cell touch display panel structure **100** includes a first substrate **110**, a second substrate **120**, a liquid crystal layer **130**, a black matrix layer **140**, a color filter layer **150**, an over coating layer **160**, a common electrode (Vcom) layer **170**, a first polarizer layer **180**, a second polarizer layer **190**, and a thin film transistor (TFT) layer **200**.

[0017] The first substrate **100** and the second substrate **120** are preferably glass substrates and are parallel to each other. The liquid crystal layer **130** is disposed between the first and second substrates **110**, **120**.

[0018] The black matrix layer **140** is between substrate **110** and liquid crystal layer **130** and is disposed right next to the first substrate **110**, The black matrix layer **140** is composed of a plurality of opaque conductive lines.

[0019] FIG. **2** shows a prior black matrix layer **250**. As shown in FIG. **2**, the prior black matrix layer **250** is composed of lines of insulating material that are black and opaque. The lines of black insulating material are arranged as a checkerboard pattern and a color filter **260** is disposed among the lines of black insulating material.

[0020] In the present invention, the opaque black insulating material of the black matrix layer **250** are replaced by opaque conductive material, and a touch sensing pattern structure is formed on the black matrix layer. Therefore, there is no need to dispose a sensing electrode layer (ITO) on the upper glass substrate or lower glass substrate of the LCD panel, thereby saving the manufacturing cost simplifying the assembly procedure, and further improving the panel yield.

[0021] FIG. **3** is a patent diagram of the black matrix layer **140** in accordance with the present invention. As shown in FIG. **3**, the black matrix layer **140** is composed of a plurality of opaque conductive lines. The opaque conductive lines of the black matrix layer **140** are arranged in vertical and horizontal direction and they are across each other.

[0022] The opaque conductive lines of the black matrix **140** are made of material having characteristics of opaque and electric conduction. In this embodiment, the opaque conductive lines are made of black conductive material.

[0023] The plurality of opaque conductive lines are divided into a first group opaque conductive lines **310**, a second group opaque conductive lines **320**, and a third group of opaque conductive lines **330**.

[0024] The second group of opaque conductive lines **320** is formed with N polygonal regions denoted by numerals **321-32**N, where N is a positive integer. The opaque conductive lines in any one of the polygonal regions are electrically connected together, while any two polygonal regions are not electrically connected, so as to form a single-layered touch sensing pattern on the black matrix **140**. Each of the polygonal regions **321-32**N may be formed in a triangle, square, rhombus, hexagon, octagon, or round shape. In this embodiment, the polygonal regions **321-32**N are formed in round shapes that are deemed as the polygonal regions with infinite number of edges.

[0025] The third group of opaque conductive lines **330** is formed with N conductive traces denoted by numerals **331-33**N, where N is a positive integer. Each of the N conductive traces is electrically connected to a corresponding polygonal region **321-32**N, i.e., the conductive traces **331-33**N are electrically connected to the polygonal regions **321-32**N, respectively, while any two conductive traces **331-33**N are not electrically connected.

[0026] FIG. **4** is a detail view of the black matrix layer **140** in accordance with the present invention. As shown in FIG. **4**, the first group of opaque conductive lines **310** is spaced apart from (i.e., not electrically connected to) the second group of opaque conductive lines **320** and the third group of opaque conductive lines **330**. In other words, the first group of opaque conductive lines **310** and the second groups of opaque conductive lines **320** are not connected by cutting off opaque conductive lines, as indicated by small circles in FIG. **4**, in the prior black matrix layer. Similarly, the first group of opaque conductive lines **310** and third group of opaque conductive lines **330** are not connected by cutting off conductive lines, as indicated by small circles in FIG. **4**, in the prior black matrix layer. Therefore, the second group of opaque conductive lines **320** can be formed with a single-layered touch sensing pattern on the black matrix layer **140**. It is noted that cutting the conductive lines herein does not mean to first form the prior black matrix layer **250** shown in FIG. **2** and then cut off corresponding conductive lines. Instead, when proceeding with mask layout of the black matrix **140**, the first group of opaque conductive lines **310** and the second group of opaque conductive lines **320** are formed by using layout tools, such as Laker or Virtuso, to allow the mask to be capable of spacing the first group of opaque conductive lines **310**, the second group of opaque conductive lines **320** and the third group of opaque conductive lines **330** from one another. Accordingly, there is no additional procedure required in the LCD manufacturing process.

[0027] The color filter layer **150** is disposed among the plurality of opaque conductive lines of the black matrix layer **140** and on the surface of the plurality of opaque conductive lines.

[0028] The over coating layer **160** is disposed on the surface of the color filter layer **150**.

[0029] The common electrode layer **170** is disposed between the first substrate **110** and the second substrate **120**. Preferably, the common electrode layer **170** is disposed on the surface of the over coating layer **160**.

[0030] The first polarizer layer **180** is disposed at one surface of the first substrate **110** opposite to the other surface of the first substrate **110** facing the liquid crystal layer **130**.

[0031] The second polarizer layer **190** is disposed at one surface of the second substrate **120** opposite to the other surface of the second substrate **120** facing the liquid crystal layer **130**.

[0032] The thin film transistor (TFT) layer **200** is disposed at the surface of the second substrate **120** facing the liquid crystal layer **130**. The TFT layer **200** is composed of TFTs **202** and transparent electrodes **201**.

[0033] In view of the foregoing, it is known that the present invention is capable of forming a single-layered touch pattern on the black matrix layer **140**, so as to have the following advantages:

[0034] 1. there is no need to have a sensing electrode layer formed on the upper glass substrate or lower glass substrate of the LCD panel, thereby lowering the cost and decreasing the number of manufacturing steps; and

[0035] 2. because there is no additional touch sensing electrode layer, the manufacturing process can be greatly simplified, so as to significantly save material cost and processing cost.

[0036] Although the present invention has been explained in relation to its preferred embodiment, it is to be understood that many other possible modifications and variations can be made without departing from the spirit and scope of the invention as hereinafter claimed.

What is claimed:

1. An in-cell touch display panel structure, comprising:

a first substrate;

a second substrate parallel to the first substrate,

a liquid crystal layer configured between the first substrate and the second substrates, and

a black matrix layer disposed at one surface of the first substrate and facing the liquid crystal layer;

wherein the black matrix layer is composed of a plurality of opaque conductive lines, and the plurality of opaque conductive lines are divided into a first group of opaque conductive lines, a second group of opaque conductive lines, and a third group of opaque conductive lines, the second group of opaque conductive lines being formed with N polygonal regions, where N is a positive integer, the opaque conductive lines in any one of the polygonal regions being electrically connected together while any two polygonal regions are not electrically connected, so as to form a single-layered touch pattern on the black matrix layer.

2. The in-cell touch display panel structure as claimed in claim **1**, wherein the third group of opaque conductive lines is formed with N conductive traces, each of the N conductive traces, being electrically connected to a corresponding polygonal region, while any two conductive traces are not electrically connected.

3. The in-cell touch display panel structure as claimed in claim **2**, wherein the first group of opaque conductive lines is not connected to the second group of opaque conductive lines and the third group of opaque conductive lines.

4. The in-cell touch display panel structure as claimed in claim **3**, wherein the plurality of opaque conductive lines of the black matrix layer is arranged in a first direction and a second direction.

5. The in-cell touch display panel structure as claimed in claim **4**, wherein the first direction is vertical with the second direction.

6. The in-cell touch display panel structure as claimed in claim **5**, further comprising a color filter layer that is disposed among the plurality of opaque conductive lines of the black matrix layer and on a surface of the plurality of opaque conductive lines.

7. The in-cell touch display panel structure as claimed in claim **6**, further comprising an over coating layer disposed on a surface of the color filter.

8. The in-cell touch display panel structure as claimed in claim **7**, further comprising a common electrode layer disposed between the first substrate and the second substrate.

9. The in-cell touch display panel structure as claimed in claim **8**, further comprising:

a first polarizer layer disposed at one surface of the first substrate opposite to the other surface of the first substrate facing the liquid crystal layer;

a second polarizer layer disposed at one surface of the second substrate opposite to the other surface of the second substrate facing the liquid crystal layer,

a thin film transistor (TFT) layer disposed at the surface of the second substrate facing the liquid crystal layer.

10. The in-cell touch display panel structure as claimed in claim **9**, wherein each of the polygonal regions is formed in a triangle, square, rhombus, hexagon, octagon, or round shape.

* * * * *

专利名称(译)	内嵌触摸显示面板结构		
公开(公告)号	US20130242211A1	公开(公告)日	2013-09-19
申请号	US13/795788	申请日	2013-03-12
[标]申请(专利权)人(译)	速博思股份有限公司		
申请(专利权)人(译)	SUPERC-TOUCH CORPORATION		
当前申请(专利权)人(译)	SUPERC-TOUCH CORPORATION		
[标]发明人	LEE HSIANG YU		
发明人	LEE, HSIANG-YU		
IPC分类号	G02F1/1333		
CPC分类号	G06F3/0412 G02F1/13338 G06F3/044		
优先权	101204479 2012-03-13 TW		
其他公开文献	US9459481		
外部链接	Espacenet USPTO		

摘要(译)

内嵌式触控显示面板包括第一基板，平行于第一基板的第二基板，配置于第一基板与第二基板之间的液晶层，以及设置于第一基板的面向液体的表面的黑矩阵层水晶层。黑矩阵包括多条不透明导线。不透明导电线分为第一组，第二组和第三组不透明导电线。第二组不透明导线由N个多边形区域形成，其中N是正整数。任何一个多边形区域中的不透明导线电连接在一起，而任何两个多边形区域没有电连接。