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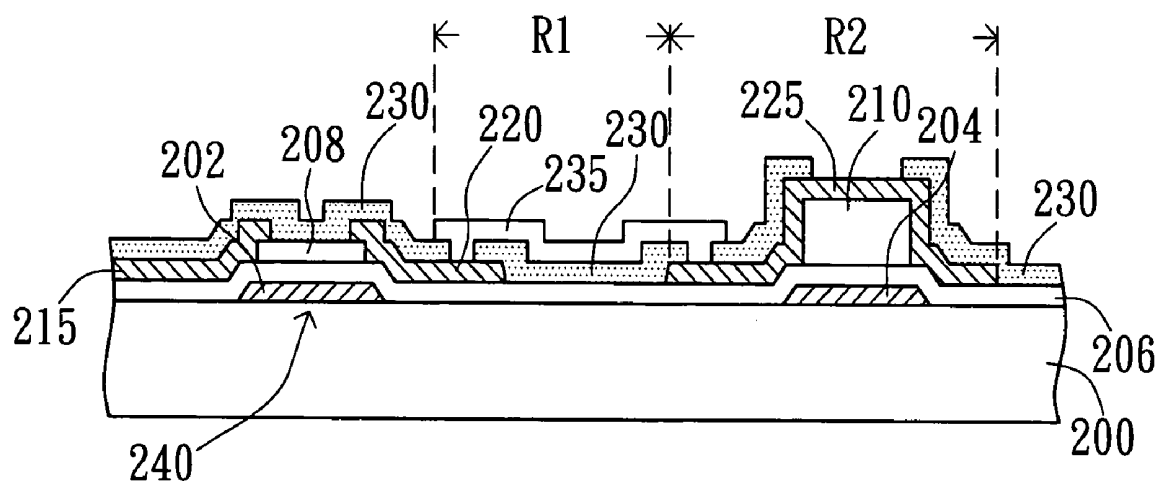
(54) **TRANSFLECTIVE THIN FILM TRANSISTOR
LIQUID CRYSTAL DISPLAY PANEL AND
MANUFACTURING METHOD THEREOF**(52) **U.S. Cl. 349/114**(76) **Inventors: Wen-Jyh Sah, Tainan County (TW);
Chung-Kuang Wei, Gangshan Jen
(TW); Cheng-Jen Chu, Ilan City (TW)**(57) **ABSTRACT**

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The invention provides a manufacturing process of trans-
flective TFT-LCD panel (transflective TFT-LCD panel)
comprising the following steps: first, form a first conductive
layer on the substrate; next, define the first conductive layer
to form a gate; after that, form a dielectric layer on the gate;
following that, form a channel over the gate; then, form a
photo-resist block; form a second conductive layer; next,
define the second conductive to form a source and a drain
over the gate, and to form a photo-reflective layer on the
photo-resist block; after that, form a protection layer
thereon; following that, define the protection layer to form
a first opening on the photo-reflective layer allowing part of
the drain to be exposed, and to form a second opening on the
photo-reflective layer allowing part of the photo-reflective
layer to be exposed; last, form a transparent electrode being
electrically connected to the drain and the photo-reflective
layer via the first and the second opening respectively.

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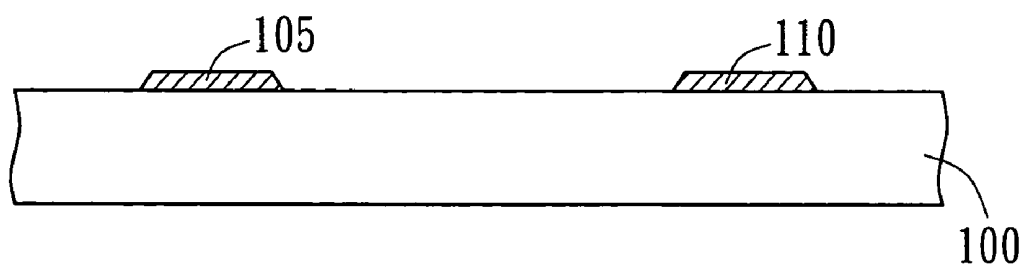


FIG. 1A

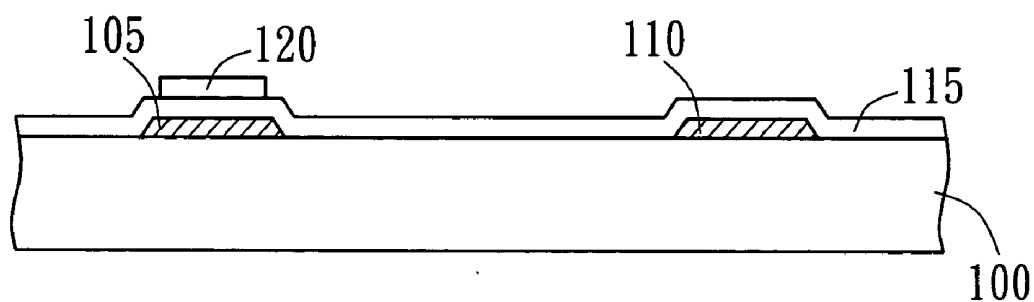


FIG. 1B

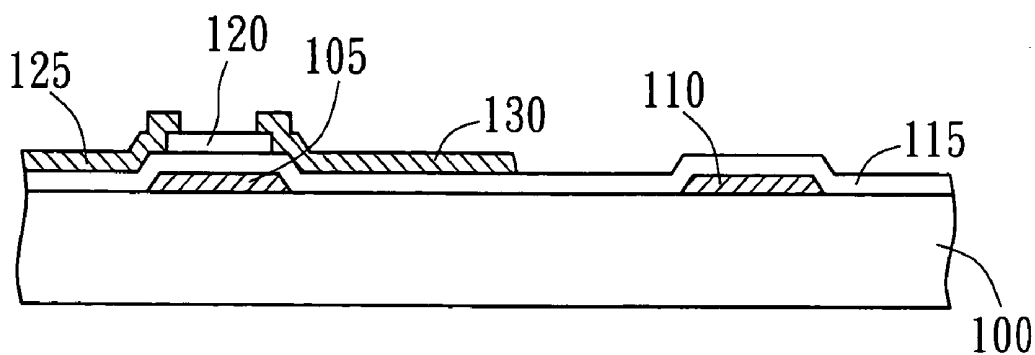


FIG. 1C

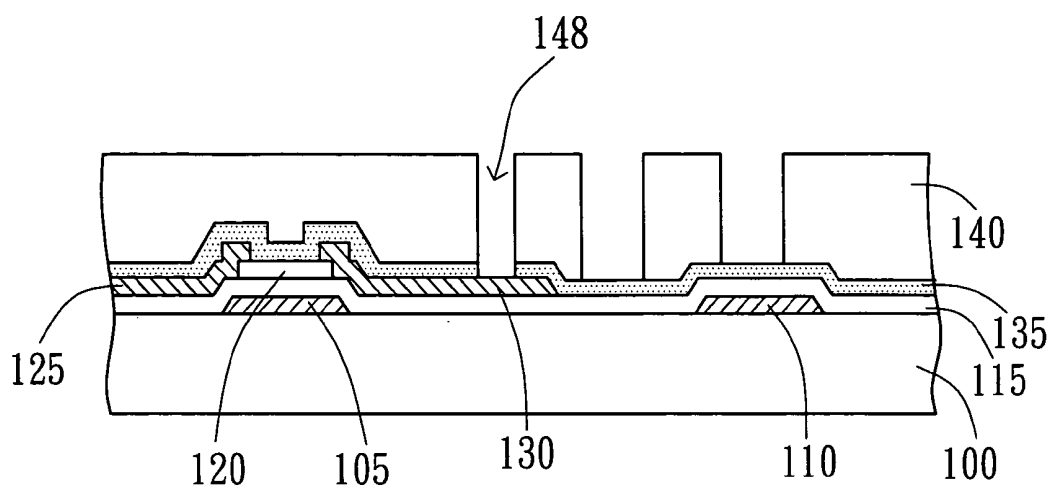


FIG. 1D

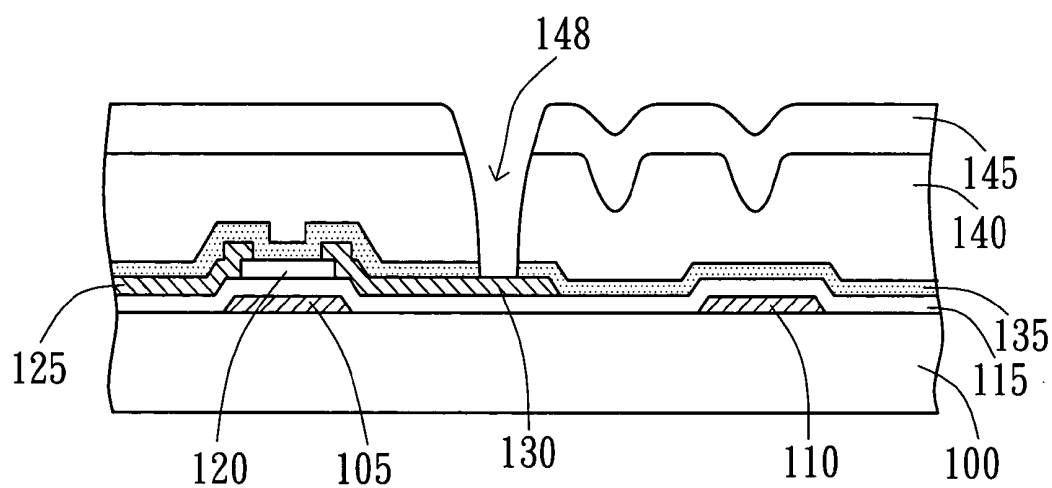


FIG. 1E

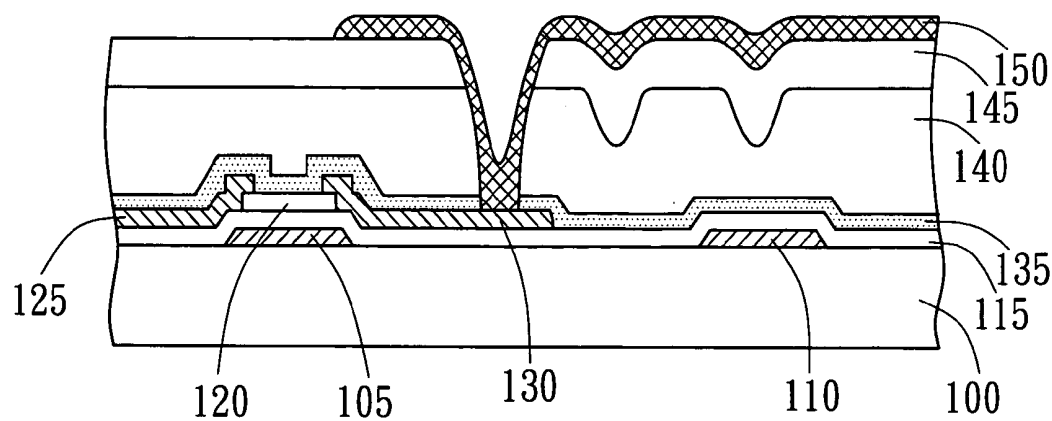


FIG. 1F

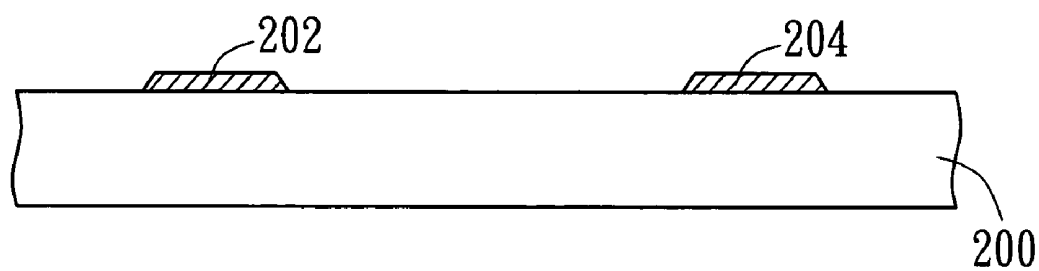


FIG. 2A

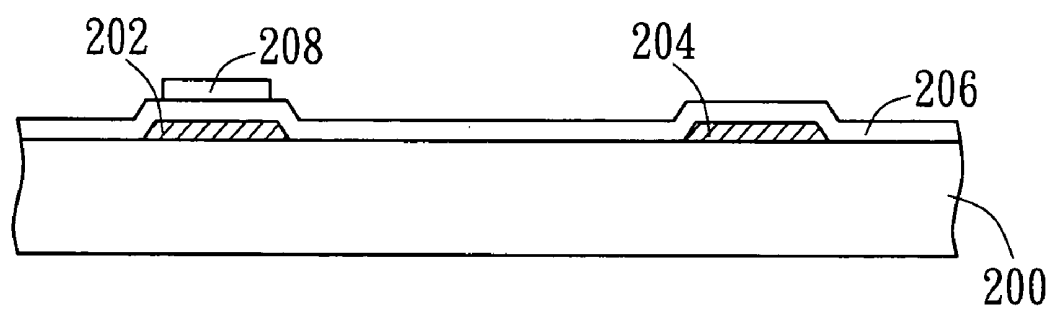


FIG. 2B

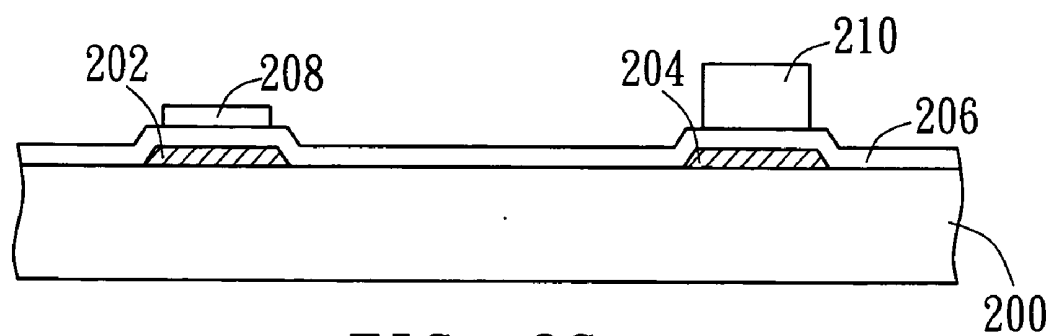


FIG. 2C

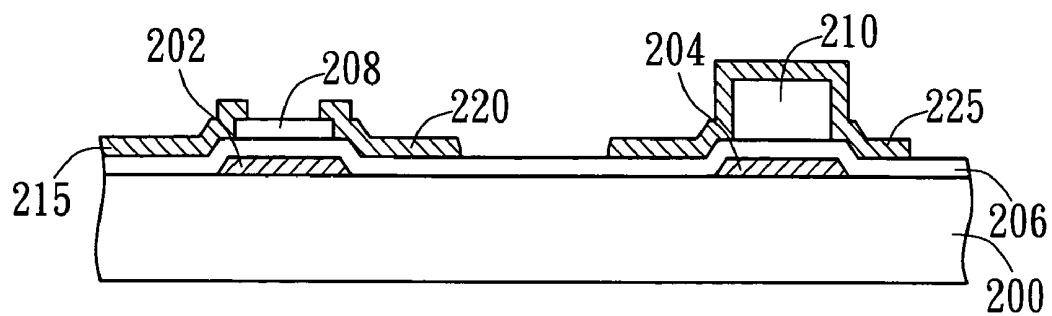


FIG. 2D

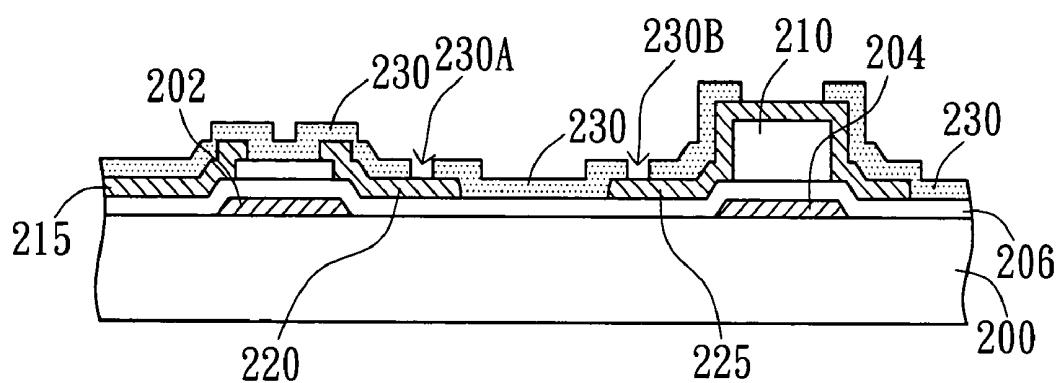


FIG. 2E

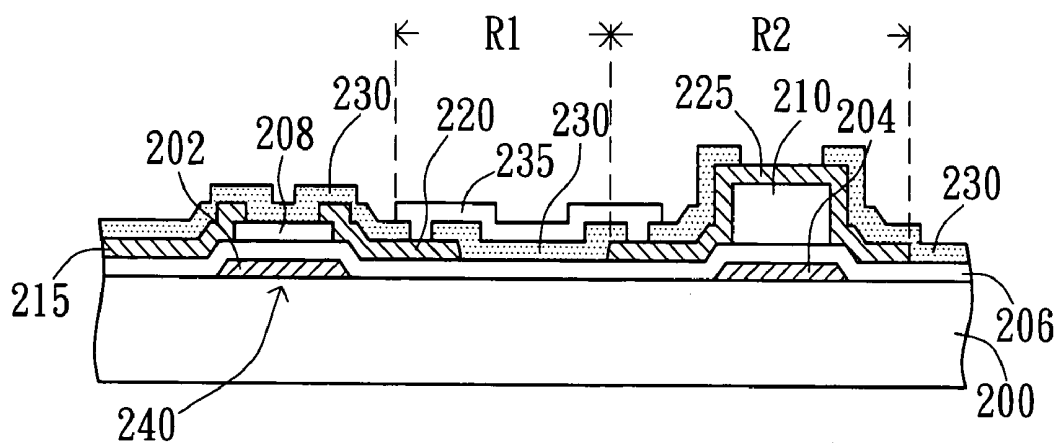


FIG. 2F

TRANSFLECTIVE THIN FILM TRANSISTOR LIQUID CRYSTAL DISPLAY PANEL AND MANUFACTURING METHOD THEREOF

[0001] This application claims the benefit of Taiwan application Ser. No. 092100063, filed Jan. 02, 2003.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The invention relates in general to a thin film transistor liquid crystal display panel (TFT-LCD panel), and more particularly to a transfective thin film transistor liquid crystal display panel (transfective TFT-LCD panel).

[0004] 2. Description of the Related Art

[0005] Along with the rapid advance in technology, the role that reflective TFT-LCD panel and transfective TFT-LCD panel has played in the market has become ever more important. In the industry of telecommunication, the transfective TFT-LCD panel can be applied to the display screen of a mobile phone, allowing the users to clearly read their display screens whatever the illumination is dark at a chamber or extreme bright in the open air.

[0006] The manufacturing process of a conventional reflective liquid crystal display panel is shown in FIG. 1A to FIG. 1F. First of all, a glass substrate 100 is provided with a first metal layer being formed thereon, wherein the first metal layer is patterned, and a gate 105 of thin film transistor and a capacitor electrode 110 of storage capacitance by means of micro-filming and etching techniques.

[0007] Please refer to FIG. 1B. Following the formation of the gate 105 and the capacitor electrode 110, a dielectric layer 115 will be applied thereon. Following that, a layer of amorphous Si is formed over the gate 105; meanwhile, a channel 120 is formed through the manufacturing process of photolithography and etching.

[0008] Please refer to FIG. 1C. A second metal layer is formed on the channel 120 and the dielectric layer 115; meanwhile, after patterning the second metal layer through the manufacturing process of micro-film and etching, a source 125 and a drain 130 will be formed thereon.

[0009] Please refer to FIG. 1D. A protection layer 135 is formed on the source 125 and the drain 130, then a photo-resist layer 140 covers on the protection layer 135. Following that, part of the photo-resist layer 140 will be removed through the manufacturing process of photolithography and etching.

[0010] Please refer to FIG. 1E. After high-temperature treatment, part of the surface of the photo-resist layer 140 will undulate. After that, another photo-resist layer 145 will be formed on the photo-resist layer 140, meanwhile, a via hole 148 will be formed through the manufacturing process of photolithography and etching, such that part of the drain 130 will be exposed.

[0011] Please refer to FIG. 1F. At last, a third metal layer is formed on the photo-resist layer 145, then a photo-reflective layer 150 will be formed by patterning the third metal layer through the manufacturing process of photolithography and etching, wherein the photo-reflective layer 150 is electrically connected to the drain 130 via the via hole 148.

[0012] During the manufacturing process of the conventional reflective TFT-LCD panel, an individual mask is needed for the respective formation of the gate 105 and the capacitor electrode 110, of the channel 120, of the source 125 and the drain 130, of the photo-resist layer 140, of the via hole 148, and of the photo-reflective layer 150. Totally, 6 masks are needed. Considering the peripheral wiring for the liquid crystal display panel, the number of masks required would amount to 8.

[0013] In terms of the conventional reflective TFT-LCD panel, an opening needs to be formed on the photo-reflective layer 150 wherein the opening is covered with a transparent electrode. In doing so, another mask will be needed. Owing to the many masks required, the manufacturing cost of the conventional transfective TFT-LCD panel could hardly be reduced.

SUMMARY OF THE INVENTION

[0014] It is therefore an object of the invention to provide a transfective TFT-LCD panel and the manufacturing process thereof, aiming to reduce the number of masks required during the manufacturing process and to effectively cut down the cost.

[0015] According to the abovementioned object, a transfective TFT-LCD panel and the manufacturing process thereof is provided in the present invention whose steps are disclosed below. First, form a first conductive layer on the substrate; next, define the first conductive layer to form a gate; after that, form a dielectric layer on the gate; following that, form a channel over the gate; then, form a photo-resist block; form a second conductive layer; next, define the second conductive to form a source and a drain over the gate, and to form a photo-reflective layer on the photo-resist block; after that, form a protection layer thereon; following that, define the protection layer to form a first opening on the photo-reflective layer allowing part of the drain to be exposed, and to form a second opening on the photo-reflective layer allowing part of the photo-reflective layer to be exposed; last, form a transparent electrode being electrically connected to the drain and the photo-reflective layer via the first and the second opening respectively.

[0016] It is therefore another object of the invention to provide a transfective TFT-LCD panel. Equipped with both a transmissive area and a reflective area, the liquid crystal display panel further comprises a substrate, a thin film transistor, a dielectric layer, a photo-resist block, a photo-reflective layer, and a transparent electrode. The thin film transistor having a source, a drain and a gate is formed on the substrate; the dielectric layer is used to cover the gate; the photo-resist block is formed on the dielectric layer; the photo-reflective layer, which is located within the reflective area and is electrically connected to the drain, is formed on the photo-resist block; the transparent, formed largely within the transmissive area, is electrically connected to the photo-reflective layer and the drain via the transparent electrode.

[0017] Other objects, features, and advantages of the invention will become apparent from the following detailed description of the preferred but non-limiting embodiments. The following description is made with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] **FIG. 1A~1F** are diagrams illustrating the manufacturing process of a conventional reflective TFT-LCD panel;

[0019] **FIG. 2A~2F** are diagrams illustrating the manufacturing process of a transfective TFT-LCD panel according to the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0020] The spirit of the present invention resides in forming a photo-reflective layer on a second metal layer omitting the formation of a third metal layer. Since the third metal layer is omitted, the number of masks required according to the invention is reduced, cutting manufacturing cost down.

[0021] The manufacturing process of the transfective TFT-LCD panel according to the invention is disclosed in **FIG. 2A~2F**. First, as shown in **FIG. 2A**, a glass substrate **200** is provided with a first metal layer being formed thereon; by patterning the first metal layer through the manufacturing process of photolithography and etching, a gate **202** of the thin film transistor and a capacitor electrode **204** of the storage capacitor will be formed.

[0022] Next, as shown in **FIG. 2B**, following the formation of the gate **202** and the capacitor electrode **204**, a dielectric layer **206** is applied thereon. Then, a layer of amorphous Si is formed; a channel **208** will be formed over the gate **202** through the manufacturing process of photolithography and etching.

[0023] After that, as shown in **FIG. 2C**, a photo-resist layer is formed. By patterning the photo-resist layer through the manufacturing process of photolithography and etching, a photo-resist block **210** located on the capacitor electrode **204** will be obtained. The photo-resist layer can be composed of positive photo-resist.

[0024] Next, as shown in **FIG. 2D**, a second metal layer **208** is formed on the channel **208** and on the photo-resist block **210**; by patterning the second metal layer through the manufacturing process of photolithography and etching, a photo-reflective layer **225**, a source **215** and a drain **220** will be formed simultaneously on the photo-resist block **210**.

[0025] After that, as shown in **FIG. 2E**, a protection layer **230** is formed. Through the manufacturing process of photolithography and etching, a first opening **230A** and a second opening **230B** are formed thereon allowing part of the drain **220** and part of the photo-reflective layer **225** to be exposed.

[0026] Last, as shown in **FIG. 2F**, the protection layer **230** will be covered with a transparent electrode **230** composed of indium-tin oxide (ITO), wherein the transparent electrode makes the drain **220** and the photo-reflective layer **225** become electrically connected via the first opening **230A** and the second opening **230B**.

[0027] In the present embodiment, the photo-resist block **210** is situated exactly on the capacitor electrode **204** while the photo-reflective layer **225** is largely formed above the capacitor electrode **204**, giving a maximum aperture ration for the TFT-LCD panel according to the invention. It is to be understood that the invention is not to be limited to the

above layout: the photo-reflective layer **225** can also be formed at somewhere else but the source **215** and the drain **220**.

[0028] Please refer to **FIG. 2F** again. The transfective TFT-LCD panel formed through the manufacturing method according to the invention has a transmissive area **R1** and a reflective area **R2**. The gate **202**, the channel **208**, the source **215** and the drain **220** together form a thin film transistor **240**. The transparent electrode **235** is formed within the transmissive area **R1** and is electrically connected to the drain **220**. The photo-reflective layer **225**, located within the reflective area **R2**, is electrically connected to the transparent electrode **235** and the drain **220**.

[0029] The feature of the invention resides in that the photo-reflective layer **225** within the reflective area **R2** and the source **215** and the drain **220** of the thin film transistor, by means of a second metal layer, are formed simultaneously. Compared with the conventional manufacturing process which requires a third metal layer, the manufacturing process according to the present invention does not need to have the third metal layer hence reducing the number of masks needed. Moreover, the manufacturing process according to the present invention is more simplified than that of the conventional one.

[0030] In the embodiment of the present invention, only five masks are needed. During the manufacturing process of the transfective TFT-LCD panel according to the invention, only one mask is required for each of the following formations, i.e., the formation of the gate **202** and the capacitor electrode **204**, the formation of the channel **208**, the formation of the source **215**, the drain **130** and the photo-reflective layer **225**, the formation of the photo-resist block **210**, and the formation of the protection layer. Totally, five masks are needed. Compared with the conventional method, the present invention has indeed simplified the manufacturing process and reduced manufacturing cost accordingly.

[0031] The transfective TFT-LCD panel disclosed in the above embodiment according to the present invention can reduce the number of masks required cutting down manufacturing cost further.

[0032] While the invention has been described by way of example and in terms of a preferred embodiment, it is to be understood that the invention is not limited thereto. On the contrary, it is intended to cover various modifications and similar arrangements and procedures, and the scope of the appended claims therefore should be accorded the broadest interpretation so as to encompass all such modifications and similar arrangements and procedures.

What is claimed is:

1. A manufacturing method of a transfective TFT-LCD panel, comprising the steps of:

- forming a first conductive layer on a substrate;
- defining the first conductive layer to form a gate;
- forming a dielectric layer thereon;
- forming a channel over the gate;
- forming a photo-resist block;
- forming a second conductive layer;

defining the second conductive to form a source and a drain over the gate, meanwhile, forming a photo-reflective layer on the photo-resist block;

forming a protection layer thereon;

defining the protection layer, forming a first opening on the drain allowing part of the drain to be exposed, and forming a second opening on the photo-reflective layer allowing part of the photo-reflective layer to be exposed; and

forming a transparent electrode electrically connected to the drain and the photo-reflective layer via the first and the second opening.

2. A manufacturing method according to claim 1, wherein a capacitor electrode set under the photo-resist block is formed during the step of defining the first conductive layer.

3. A manufacturing method according to claim 1, wherein the first conductive layer is a first metal layer.

4. A manufacturing method according to claim 1, wherein the substrate is a glass substrate.

5. A manufacturing method according to claim 1, wherein the photo-resist block is composed of positive photo-resist.

6. A manufacturing method according to claim 1, wherein the second conductive layer is a second metal layer.

7. A manufacturing method according to claim 1, wherein the transparent electrode is composed of indium-tin oxide (ITO).

8. A manufacturing method of a transfective TFT-LCD panel equipped with a transmissive area and a reflective area, comprising the steps of:

forming a thin film transistor and a capacitor electrode on the substrate, wherein a photo-reflective layer within the reflective area and a source and a drain of the thin film transistor are formed simultaneously; and

forming a transparent electrode within the transmissive area.

9. A manufacturing method according to claim 8, wherein the photo-reflective layer is formed largely above the capacitor electrode.

10. A manufacturing method according to claim 8, wherein a photo-resist block is formed on the capacitor electrode prior to the formation of the photo-reflective layer.

11. A transfective TFT-LCD panel, wherein the liquid crystal display panel, equipped with a transmissive area and a reflective area, further comprises:

a substrate,

a thin film transistor having a source, a drain and a gate formed on the substrate;

a dielectric layer utilized to cover the gate;

a photo-resist block formed on the dielectric layer;

a photo-reflective layer formed on the photo-resist block, wherein the photo-reflective layer is located within the reflective area; and

a transparent electrode through which the photo-reflective layer is electrically connected to the drain, wherein the transparent electrode is formed largely within the transmissive area.

12. A liquid crystal display panel according to claim 11, further has a capacitor electrode which is formed on the substrate and is covered by the dielectric layer while the photo-resist block and the photo-reflective layer are situated above the capacitor electrode.

* * * * *

专利名称(译)	半透半反薄膜晶体管液晶显示面板及其制造方法		
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申请号	US10/750360	申请日	2003-12-31
[标]申请(专利权)人(译)	SAH文JYH 魏重光 朱成JEN		
申请(专利权)人(译)	看到文志 魏重光 储成JEN		
当前申请(专利权)人(译)	看到文志 魏重光 储成JEN		
[标]发明人	SAH WEN JYH WEI CHUNG KUANG CHU CHENG JEN		
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外部链接	Espacenet USPTO		

摘要(译)

本发明提供一种透反式TFT-LCD面板(半透半反式TFT-LCD面板)的制造工艺,包括以下步骤:首先,在基板上形成第一导电层;接下来,定义第一导电层以形成栅极;之后,在栅极上形成介电层;然后,在门上形成一个通道;然后,形成光刻胶块;形成第二导电层;接着,定义第二导电层以在栅极上形成源极和漏极,并在光刻胶块上形成光反射层;之后,在其上形成保护层;接下来,定义保护层以在光反射层上形成第一开口,允许部分漏极暴露,并在光反射层上形成第二开口,允许部分光反射层暴露;最后,形成透明电极,分别通过第一和第二开口电连接到漏极和光反射层。

