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(54) **DISPLAY PANEL AND METHOD FOR MANUFACTURING THE SAME**

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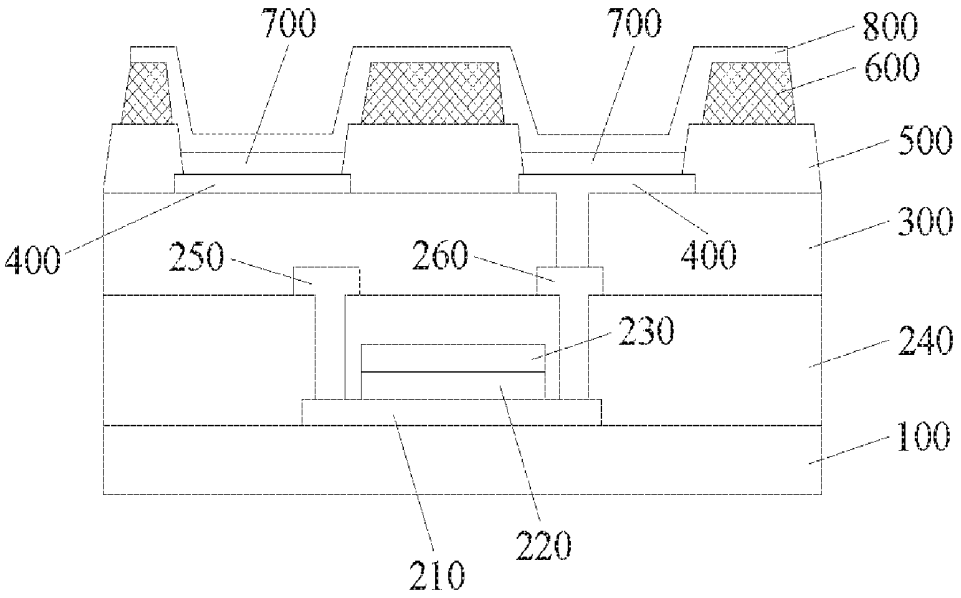
(57) **ABSTRACT**

A display panel is provided, which includes a substrate; a thin film transistor disposed on the substrate; a flat layer disposed on the thin film transistor; an anode disposed on the flat layer and penetrating the flat layer to be connected to the thin film transistor; a pixel definition layer disposed on the flat layer; a light shading layer disposed on the pixel definition layer, the light shading layer and the pixel definition layer having a pixel definition aperture exposing the anode; an OLED functional layer disposed on the exposed anode; a cathode disposed on the light shading layer and the OLED functional layer. The problem of light leakage of the pixel in the prior art can be eliminated and the display effect of the display panel can be improved.



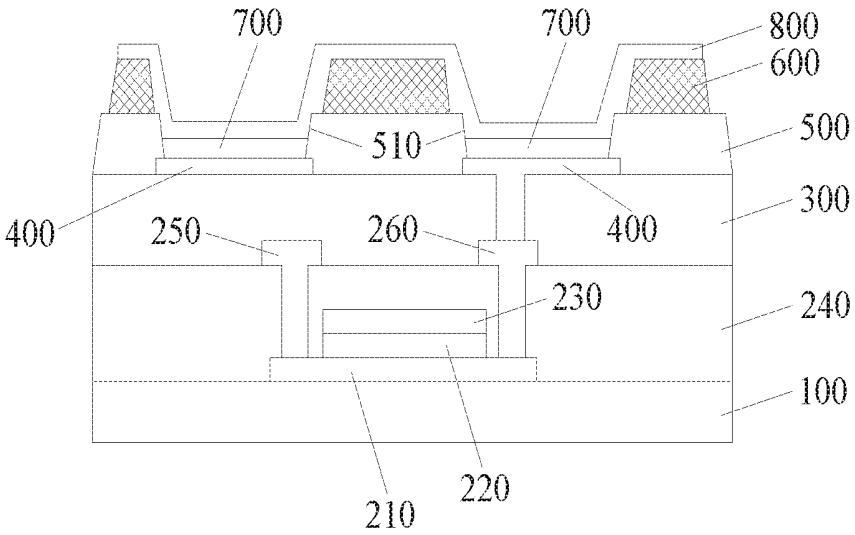


FIG. 1

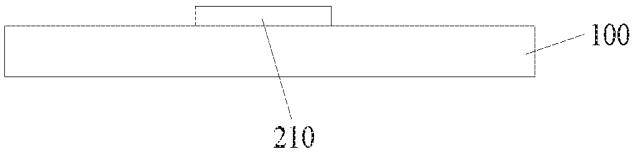


FIG. 2A

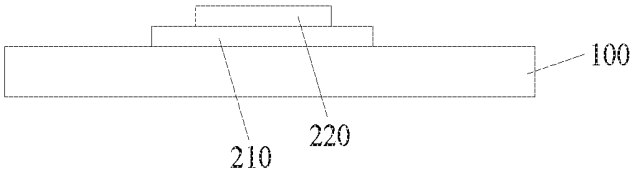


FIG. 2B

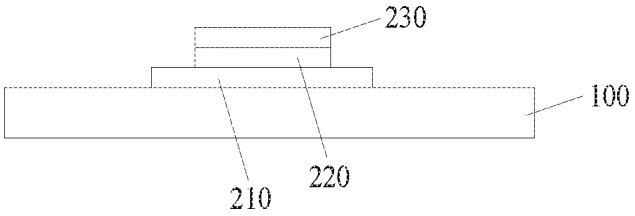


FIG. 2C

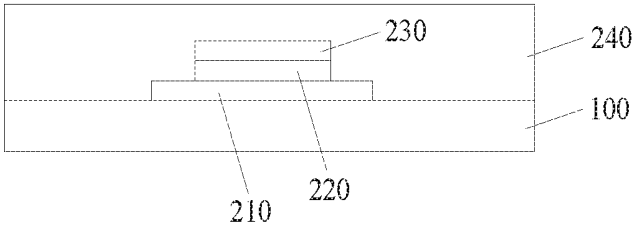


FIG. 2D

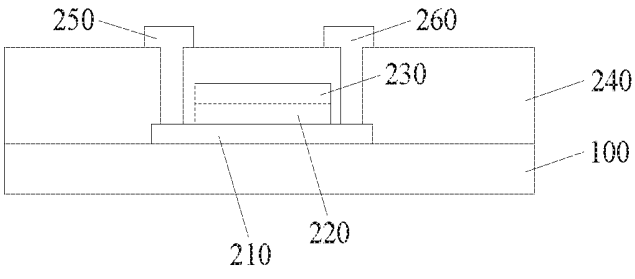


FIG. 2E

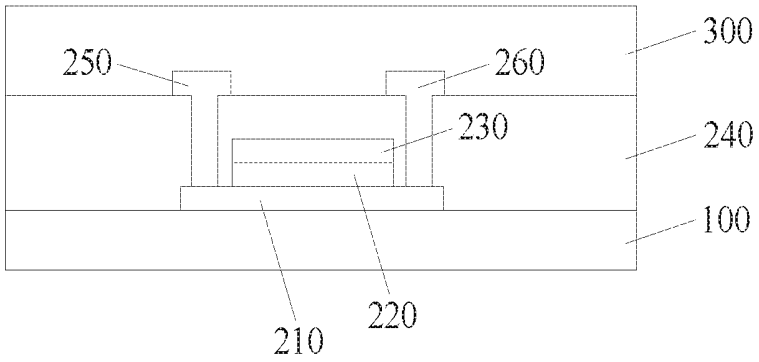

300
250
260
230
240
100
210
220

FIG. 2F

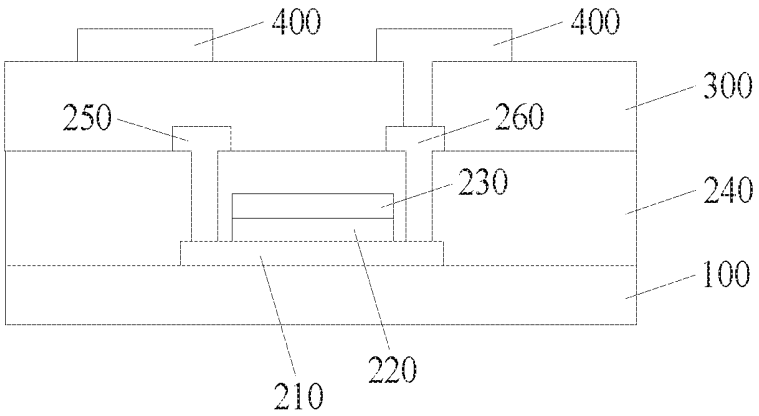

400
400
300
250
260
230
240
100
210
220

FIG. 2G

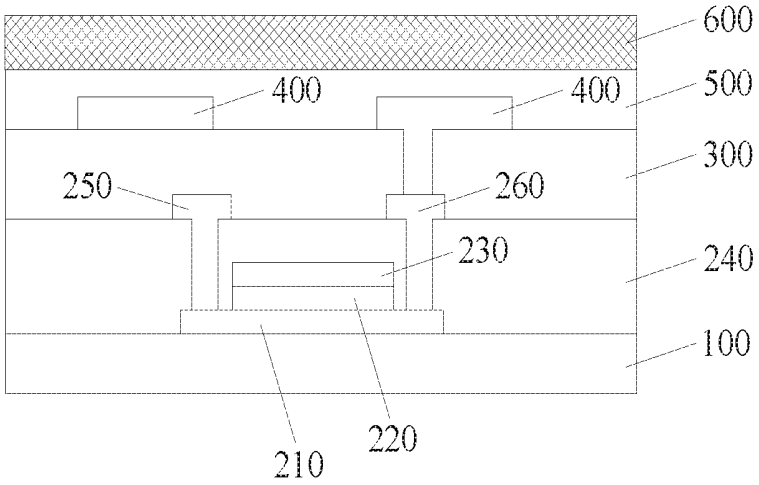

600
400
400
500
300
250
260
230
240
100
210
220

FIG. 2H

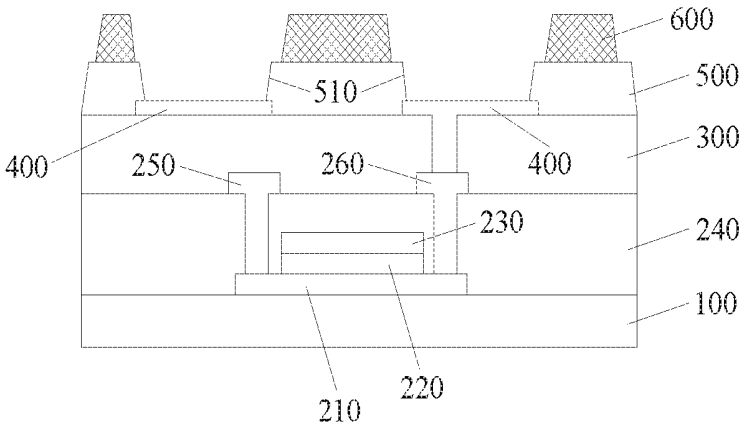

600
510
500
400
250
260
400
300
230
240
100
210
220

FIG. 2I

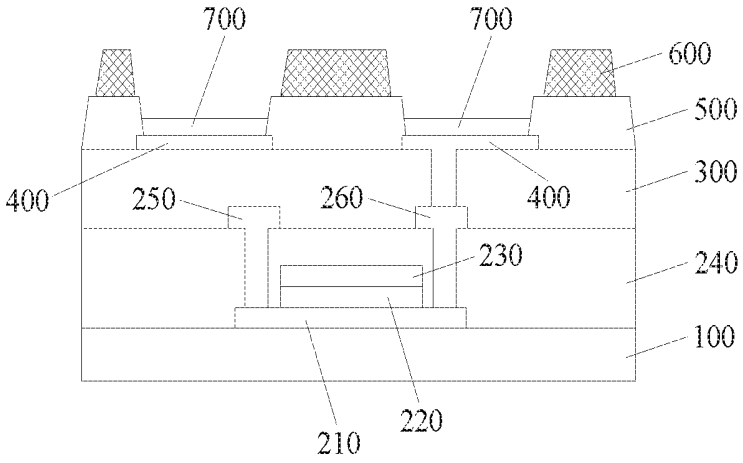

700
700
600
500
400
250
260
400
300
230
240
100
210
220

FIG. 2J

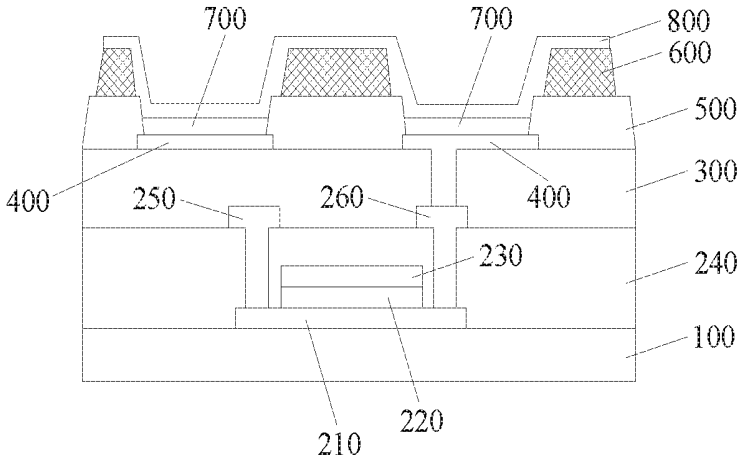

700
700
800
600
500
400
250
260
400
300
230
240
100
210
220

FIG. 2K

DISPLAY PANEL AND METHOD FOR MANUFACTURING THE SAME

RELATED APPLICATIONS

[0001] The present application is a Continuation Application of International Application Number PCT/CN2018/074095, filed Jan. 25, 2018, and claims the priority of China Application No. 201711481256.9, filed Dec. 29, 2017.

FIELD OF THE DISCLOSURE

[0002] The disclosure relates to a display technical field, and more particularly, to a display panel and a method for manufacturing the same.

BACKGROUND

[0003] In recent years, Organic Light-Emitting Diode (OLED) display panels have become very popular new flat display panel products at home and abroad, due to its characteristics of being self-luminous, wide viewing angle, short reaction time, high luminous efficiency, wide color gamut, thin thickness, large size and being flexible. The OLED display panels have simple process and the potential of low cost.

[0004] For large size and high resolution OLED display panels, the top emission structure can meet the requirement of aperture ratio. However, no matter which manufacturing process is used, there exist a problem of light leakage of the pixel (i.e. OLED functional layer), and thus the OLED display panels have a defect in displaying.

SUMMARY

[0005] In view of above problems in prior art; the present application provides a display panel and a method for manufacturing the same for eliminating the light leakage of the OLED functional layer.

[0006] According to an aspect of the present application; a display panel is provided, which comprises: a substrate; a thin film transistor disposed on the substrate; a flat layer disposed on the thin film transistor; an anode disposed on the flat layer and penetrating the flat layer to be connected to the thin film transistor; a pixel definition layer disposed on the flat layer; a light shading layer disposed on the pixel definition layer; wherein the light shading layer and the pixel definition layer have a pixel definition aperture in the light shading layer and the pixel definition layer for exposing the anode; an OLED functional layer disposed on the exposed anode; and a cathode disposed on the light shading layer and the OLED functional layer.

[0007] In an embodiment, the thin film transistor comprises: an active layer disposed on the substrate; a first insulating layer disposed on the active layer; a gate electrode disposed on the first insulating layer; a second insulating layer disposed on the gate electrode; the active layer and the substrate; a source electrode and a drain electrode disposed on the second insulating layer, each of the source electrode and the drain electrode penetrating the second insulating layer to be connected to the active layer, wherein the flat layer is disposed on the source electrode, the drain electrode and the second insulating layer, and the anode penetrates the flat layer to be connected to the drain electrode.

[0008] In an embodiment, the OLED functional layer includes in order form the anode to the cathode: a hole generation layer, a hole transport layer, an organic light emitting layer; an electron transport layer and an electron injection layer.

[0009] In an embodiment, the display panel further comprises a cover disposed on the cathode on the light shading layer.

[0010] In an embodiment, the light shading layer is made of a black resin.

[0011] According to another aspect of the present application, a method for manufacturing a display panel is provided, which comprises: forming a thin film transistor on a substrate; forming a flat layer on the thin film transistor; forming on the flat layer an anode penetrating the flat layer to be connected to the thin film transistor; forming a pixel definition layer on the flat layer and the anode; forming a light shading layer on the pixel definition layer; forming in the light shading layer and the pixel definition layer a pixel definition aperture exposing the anode; forming an OLED functional layer on the exposed anode; and forming a cathode on the light shading layer and the OLED functional layer.

[0012] In an embodiment, the formation of the thin film transistor on the substrate comprises: forming an active layer on the substrate; forming a first insulating layer on the active layer; forming a gate electrode on the first insulating layer; forming a second insulating layer on the gate electrode, the active layer and the substrate; and forming on the second insulating layer a source electrode and a drain electrode, each of the source electrode and the drain electrode penetrating the second insulating layer to be connected to the active layer, wherein the flat layer is disposed on the source electrode, the drain electrode and the second insulating layer, and the anode penetrates the flat layer to be connected to the drain electrode.

[0013] In an embodiment, the formation of the OLED functional layer on the exposed anode comprises: forming on the exposed anode a hole generation layer, a hole transport layer, an organic light emitting layer, an electron transport layer, and an electron injection layer stacked in order.

[0014] In embodiment, the method further comprises forming a cover on the cathode on light shading layer.

[0015] In embodiment, the formation of the light shading layer on the pixel definition layer comprises forming the light shading layer on the pixel definition layer with a black resin.

[0016] The adventures effect of the present application: By forming the shielding layer on the pixel definition layer, the light leakage of the OLED functional layer at the side thereof in the pixel definition aperture can be shielded. As such, the problem of light leakage of the pixel in the prior art can be eliminated and the display effect of the display panel can be improved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] Accompanying drawings are for providing further understanding of embodiments of the disclosure. The drawings form a part of the disclosure and are for illustrating the principle of the embodiments of the disclosure along with the literal description. Apparently, the drawings in the description below are merely some embodiments of the disclosure, a person skilled in the art can obtain other drawings according to these drawings without creative efforts. In the figures:

[0018] FIG. **1** is a schematic view of a display panel in an embodiment according to the present application; and

[0019] FIGS. **2**A to **2**K are schematic views illustrating a method for manufacturing a display panel in an embodiment according to the present application.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0020] In order to understand the above objectives, features and advantages of the present disclosure more clearly, the present disclosure is described in detail below with references to the accompanying drawings and specific embodiments.

[0021] For clarity, the thickness of layers and regions is exaggerated. In the description and drawings, the same or similar elements are denoted by the same reference numerals.

[0022] In should be noted that, in the case of an element, such as a layer, a film, a region or a base and the like, is "on" another element, it means "directly on without an intervening element" or "on with an intervening element."

[0023] FIG. **1** is a schematic view of a display panel in an embodiment according to the present application. Two anodes are shown in FIG. **1**, and one of the anodes is connected to the thin film transistor. It should be noted that each of the anodes in the display panel is connected to the thin film transistor.

[0024] Referring to FIG. **1**, which illustrated a display panel in an embodiment according to the present application, the display panel comprises a substrate **100**, an active layer **210**, a first insulating layer **220**, a gate electrode **230**, a second insulating layer **240**, a source electrode **250**, a drain electrode **260**, a flat layer **300**, an anode **400**, a pixel definition layer **500**, a light shading layer **600**, an OLED functional layer **700**, a cathode **800** and a cover **900**.

[0025] In an embodiment, the substrate **100** can be, such as a flexible substrate. The present application is not limited to this embodiment.

[0026] The active layer **210** is disposed on the substrate **100**. In an embodiment, the active layer **210** can be made of, such as amorphous silicon, low temperature polysilicon, IGZO and the like. The present application is not limited to this embodiment. The first insulating layer **220** is disposed on the active layer **210**. The gate electrode **230** is disposed on the first insulating layer **220**. The second insulating layer **240** is disposed on the gate electrode **230**, the active layer **210** and the substrate **100**. The source electrode **250** and the drain electrode **260** are disposed on the second insulating layer **240**, and each of the source electrode **250** and the drain electrode **260** penetrates the second insulating layer **240** to be connected to the active layer **210**.

[0027] In an embodiment, the thin film transistor includes the active layer **210**, the first insulating layer **220**, the gate electrode **230**, the second insulating layer **240**, the source electrode **250**, and the drain electrode **260**. The present application is not limited to this embodiment.

[0028] The flat layer **300** is disposed on the second insulating layer **240**, the source electrode **250** and the drain electrode **260**. The anode **400** is disposed on the flat layer **300** and protrudes the flat layer **300** to be connected to the drain electrode **260**. In an embodiment, the anode **400** has high reflectivity.

[0029] The pixel definition layer **500** is disposed on the anode **400** and the flat layer **300**. The light shading layer **600** is disposed on the pixel definition layer **500**. A pixel definition aperture **510** is in the pixel definition layer **500** and the light shading layer **600** for exposing the anode **400**.

[0030] The OLED functional layer **700** is disposed on the exposed anode **400**, In an embodiment, the OLED functional layer **700** includes, in order from the bottom: a hole generation layer, a hole transport layer, an organic emitting layer, an electron transport layer, and an electron injection layer. The present application is not limited to this embodiment.

[0031] The cathode **800** is disposed on the pixel definition layer **500**, the light shading layer **600** and the OLED functional layer **700**. In an embodiment, the cathode **800** has high transmittance. The present application is not limited to this embodiment.

[0032] FIGS. **2**A to **2**K are schematic views illustrating a method for manufacturing a display panel in an embodiment according to the present application.

[0033] In an embodiment according to the present application, the method for manufacturing a display panel comprises steps as following.

[0034] Step 1: referring FIG. **2**A, an active layer **210** is formed on the substrate **100**. In an embodiment, the active layer **210** can be made of, such as amorphous silicon, low temperature polysilicon, IGZO and the like. The present application is not limited to this embodiment.

[0035] Step 2: referring FIG. **2**B, a first insulating layer **220** is formed on the active layer **210**.

[0036] Step 3: referring FIG. **20**, a gate electrode **230** is formed on the first insulating layer **220**.

[0037] Step 4: referring to FIG. **20**, a second insulating layer **240** is formed on the gate electrode **230**, the active layer **210** and the substrate **100**.

[0038] Step 5: referring to FIG. **2**E, a source electrode **250** and a drain electrode **260** are formed on the second insulating layer **240**, Each of the source electrode **250** and the drain electrode **260** penetrates the second insulating layer **240** to be connected to the active layer **210**.

[0039] In an embodiment, the thin film transistor is formed by above steps **1** to **5**. The present application is not limited to this embodiment.

[0040] Step 6: referring to FIG. **2**F, a flat layer **300** is formed on the second insulating layer **240**, the source electrode **250** and the drain electrode **260**.

[0041] Step 7: referring to FIG. **2**G, an anode **400** is formed on the flat layer **300** and penetrates the flat layer **300** to be connected to the drain electrode **260**. In an embodiment, the anode **400** has high reflectivity.

[0042] Step 8: referring to FIG. **2**H, a pixel definition layer **500** and a light shading layer **600** stacked thereon are formed on the anode **400** and the flat layer **300**.

[0043] Step 9: referring to FIG. **2**I, a pixel definition aperture **510** is formed in the pixel definition layer **500** and the light shading layer **600** for exposing the node **400**.

[0044] Step 10: referring to FIG. **2**J, an OLED functional layer **700** is disposed on the exposed anode **400**. In an embodiment, a method of the formation of the OLED functional layer **700** comprises: a hole generation layer, a hole transport layer, an organic light emitting layer, an electron transport layer, and an electron injection layer are formed on the exposed anode **400** in order. The present application is not limited to this embodiment.

[0045] Step 11: referring to FIG. **2**K, a cathode **800** is formed on the pixel definition layer **500**, the light shading

layer **600** and the OLED functional layer **700**. In an embodiment, the cathode **800** has high transmittance. The present application is not limited to this embodiment.

[0046] From the foregoing, in embodiments according to the present application, by forming the shielding layer on the pixel definition layer, the light leakage of the OLED functional layer at the side thereof in the pixel definition aperture can be shielded. As such, the problem of light leakage of the pixel in the prior art can be eliminated and the display effect of the display panel can be improved.

[0047] The foregoing contents are detailed description of the disclosure in conjunction with specific preferred embodiments and concrete embodiments of the disclosure are not limited to these description. For the person skilled in the art of the disclosure, without departing from the concept of the disclosure, simple deductions or substitutions can be made and should be included in the protection scope of the application.

What is claimed is:

1. A display panel, comprising:
- a substrate;
- a thin film transistor disposed on the substrate;
- a flat layer disposed on the thin film transistor;
- an anode disposed on the flat layer and penetrating the flat layer to be connected to the thin film transistor;
- a pixel definition layer disposed on the flat layer;
- a light shading layer disposed on the pixel definition layer, wherein the light shading layer and the pixel definition layer have a pixel definition aperture in the light shading layer and the pixel definition layer for exposing the anode;
- an OLED functional layer disposed on the exposed anode; and
- a cathode disposed on the light shading layer and the OLED functional layer.

2. The display panel according to claim **1**, wherein the thin film transistor comprises:
- an active layer disposed on the substrate;
- a first insulating layer disposed on the active layer;
- a gate electrode disposed on the first insulating layer;
- a second insulating layer disposed on the gate electrode, the active layer and the substrate; and
- a source electrode and a drain electrode disposed on the second insulating layer, each of the source electrode and the drain electrode penetrating the second insulating layer to be connected to the active layer, wherein the flat layer is disposed on the source electrode, the drain electrode and the second insulating layer, and the anode penetrates the flat layer to be connected to the drain electrode.

3. The display panel according to claim **1**, wherein the OLED functional layer includes in order form the anode to the cathode: a hole generation layer, a hole transport layer, an organic light emitting layer, an electron transport layer and an electron injection layer.

4. The display panel according to claim **2**, wherein the OLED functional layer includes in order form the anode to the cathode: a hole generation layer, a hole transport layer, an organic light emitting layer, an electron transport layer and an electron injection layer.

5. The display panel according to claim **1**, further comprises a cover disposed on the cathode on the light shading layer.

6. The display panel according to claim **1**, wherein the light shading layer is made of a black resin.

7. A method for manufacturing a display panel, comprising:
- forming a thin film transistor on a substrate;
- forming a flat layer on the thin film transistor;
- forming on the flat layer an anode penetrating the flat layer to be connected to the thin film transistor;
- forming a pixel definition layer on the flat layer and the anode;
- forming a light shading layer on the pixel definition layer;
- forming in the light shading layer and the pixel definition layer a pixel definition aperture exposing the anode;
- forming an OLED functional layer on the exposed anode; and
- forming a cathode on the light shading layer and the OLED functional layer.

8. The method according to claim **7**, wherein the formation of the thin film transistor on the substrate comprises:
- forming an active layer on the substrate;
- forming a first insulating layer on the active layer;
- forming a gate electrode on the first insulating layer;
- forming a second insulating layer on the gate electrode, the active layer and the substrate; and
- forming on the second insulating layer a source electrode and a drain electrode, each of the source electrode and the drain electrode penetrating the second insulating layer to be connected to the active layer,
- wherein the flat layer is disposed on the source electrode, the drain electrode and the second insulating layer, and the anode penetrates the flat layer to be connected to the drain electrode.

9. The method according to claim **7**, wherein the formation of the OLED functional layer on the exposed anode comprises: forming on the exposed anode a hole generation layer, a hole transport layer, an organic light emitting layer, an electron transport layer, and an electron injection layer stacked in order.

10. The method according to claim **8**, wherein the formation of the OLED functional layer on the exposed anode comprises: forming on the exposed anode a hole generation layer, a hole transport layer, an organic light emitting layer, an electron transport layer, and an electron injection layer stacked in order.

11. The method according to claim **7**, further comprises forming a cover on the cathode on light shading layer.

12. The method according to claim **7**, wherein the formation of the light shading layer on the pixel definition layer comprises forming the light shading layer on the pixel definition layer with a black resin.

* * * * *

专利名称(译)	显示面板及其制造方法		
公开(公告)号	US20190206963A1	公开(公告)日	2019-07-04
申请号	US15/945381	申请日	2018-04-04
[标]申请(专利权)人(译)	深圳市华星光电技术有限公司		
[标]发明人	ZHANG LIANGFEN IM JANGSOON		
发明人	ZHANG, LIANGFEN IM, JANGSOON		
IPC分类号	H01L27/32 H01L51/52 H01L51/56		
CPC分类号	H01L27/3262 H01L27/3258 H01L27/3248 H01L27/3246 H01L27/3272 H01L51/5253 H01L51/56 H01L51/5284 H01L2227/323 H01L27/1248 H01L27/1262 H01L2251/5315 H01L51/5218		
优先权	201711481256.9 2017-12-29 CN		
外部链接	Espacenet USPTO		

摘要(译)

提供一种显示面板，包括基板;薄膜晶体管设置在基板上;设置在薄膜晶体管上的平坦层;阳极设置在平坦层上并穿透平坦层以连接到薄膜晶体管;像素定义层设置在平坦层上;设置在像素限定层上的遮光层，遮光层和像素限定层具有暴露阳极的像素定义孔; OLED功能层设置在暴露的阳极上;阴极设置在遮光层和OLED功能层上。可以消除现有技术中像素漏光的问题，提高显示面板的显示效果。