US009570533B2

(12) **United States Patent**
Zhang et al.

(10) **Patent No.: US 9,570,533 B2**
(45) **Date of Patent: Feb. 14, 2017**

(54) **ORGANIC LIGHT EMITTING DIODE ARRAY SUBSTRATE, ITS MANUFACTURING METHOD, AND DISPLAY DEVICE**

(71) Applicant: **BOE TECHNOLOGY GROUP CO., LTD.**, Beijing (CN)

(72) Inventors: **Can Zhang**, Beijing (CN); **Libin Liu**, Beijing (CN)

(73) Assignee: **BOE TECHNOLOGY GROUP CO., LTD.**, Beijing (CN)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **14/758,135**

(22) PCT Filed: **Jan. 16, 2015**

(86) PCT No.: **PCT/CN2015/070882**
§ 371 (c)(1),
(2) Date: **Jun. 26, 2015**

(87) PCT Pub. No.: **WO2016/045269**
PCT Pub. Date: **Mar. 31, 2016**

(65) **Prior Publication Data**

US 2016/0254341 A1 Sep. 1, 2016

(30) **Foreign Application Priority Data**

Sep. 23, 2014 (CN) 2014 1 0491588

(51) **Int. Cl.**
H01L 27/32 (2006.01)
H01L 51/52 (2006.01)
H01L 51/56 (2006.01)

(52) **U.S. Cl.**
CPC ***H01L 27/3279*** (2013.01); ***H01L 27/32*** (2013.01); ***H01L 27/3246*** (2013.01); ***H01L 51/52*** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC H01L 27/3279; H01L 27/329; H01L 27/3246; H01L 27/32; H01L 27/3225; H01L 27/3244; H01L 27/3237; H01L 27/3281; H01L 27/3283; H01L 2251/566; H01L 2227/323; H01L 2227/32; H01L 2924/301; H01L 2924/30101; H01L 51/56; H01L 51/50; H01L 2251/301; H01L 2251/56
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2007/0194307 A1 8/2007 Kim et al.
2008/0252201 A1* 10/2008 Pearce H01L 51/0015 313/504
(Continued)

FOREIGN PATENT DOCUMENTS

CN 1964056 A 5/2007
CN 102110685 A 6/2011
(Continued)

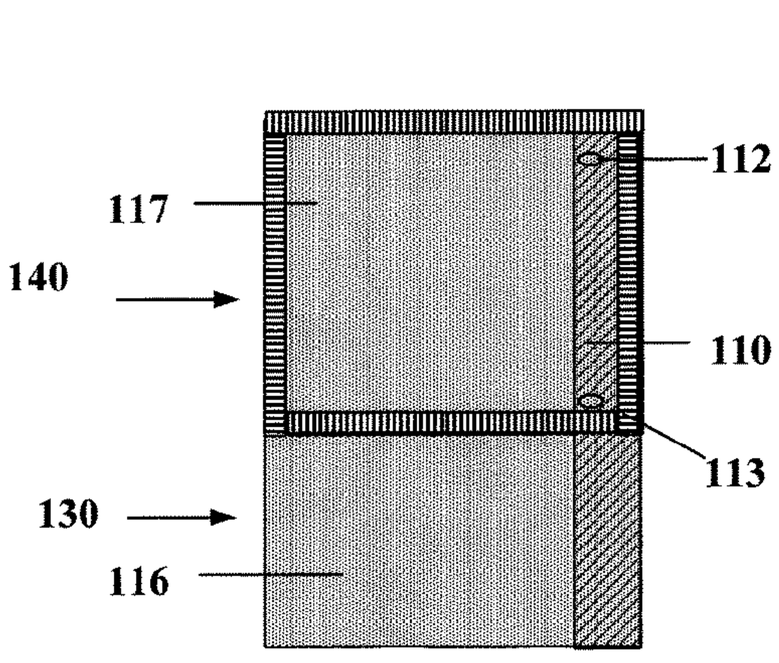
OTHER PUBLICATIONS

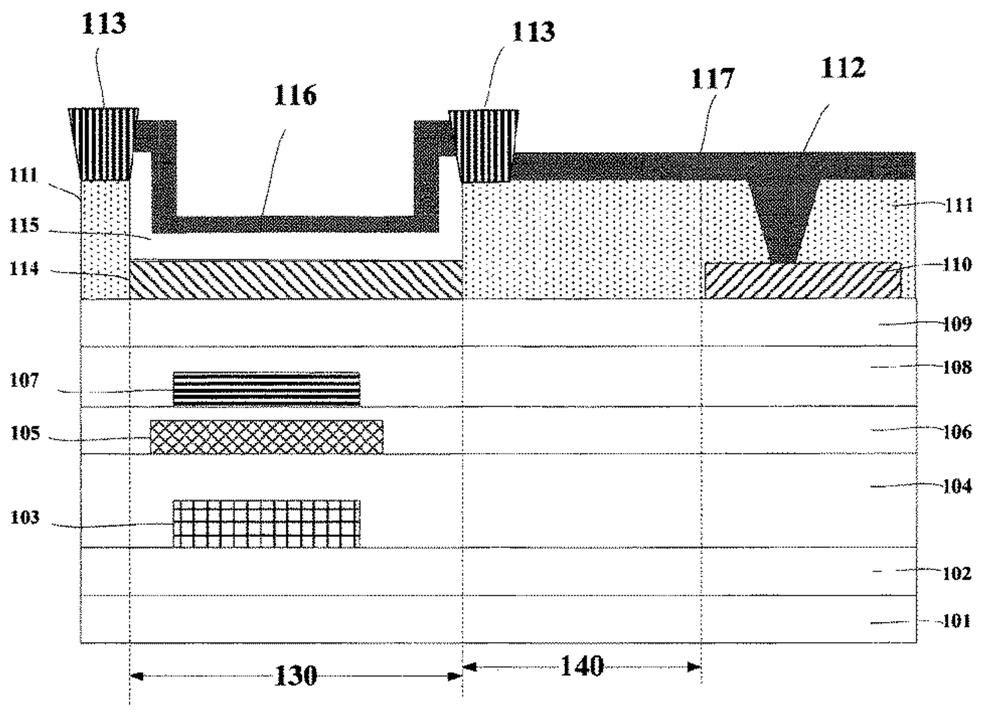
First Office Action regarding Chinese application No. 201410491588.5, dated Aug. 1, 2016. Translation provided by Dragon Intellectual Property Law Firm.
(Continued)

Primary Examiner — Galina Yushina
(74) *Attorney, Agent, or Firm* — Harness, Dickey & Pierce, P.L.C.

(57) **ABSTRACT**

The present disclosure provides an organic light emitting diode array substrate and its manufacturing method, as well as a display device. The organic light emitting diode array substrate includes: gate lines, data lines, and a plurality of pixel units defined by the gate lines and the data lines. Each pixel unit comprises a first region which emits light and a second region which does not emit light. The first region is
(Continued)





provided with an organic light emitting diode, and the second region is provided with a conductive unit which is electrically connected in parallel with the data line and created from the same layer from which a cathode of the organic light emitting diode is created.

20 Claims, 3 Drawing Sheets

(52) **U.S. Cl.**
CPC ***H01L 51/5234*** (2013.01); ***H01L 51/56*** (2013.01); *H01L 2227/323* (2013.01); *H01L 2251/301* (2013.01); *H01L 2924/0002* (2013.01)

(56) **References Cited**

U.S. PATENT DOCUMENTS

2011/0273410	A1*	11/2011	Park	H01L 25/167 345/204
2012/0050235	A1*	3/2012	Park	H01L 27/3276 345/204
2012/0169699	A1*	7/2012	Shin	H01L 27/3279 345/211
2013/0200399	A1*	8/2013	Jin	H01L 27/3276 257/88

FOREIGN PATENT DOCUMENTS

CN	102376896	A	3/2012
CN	103247619	A	8/2013
CN	103700675	A	4/2014
CN	104253148	A	12/2014

OTHER PUBLICATIONS

Written Opinion of the International Searching Authority for international application No. PCT/CN2015/070882.

* cited by examiner

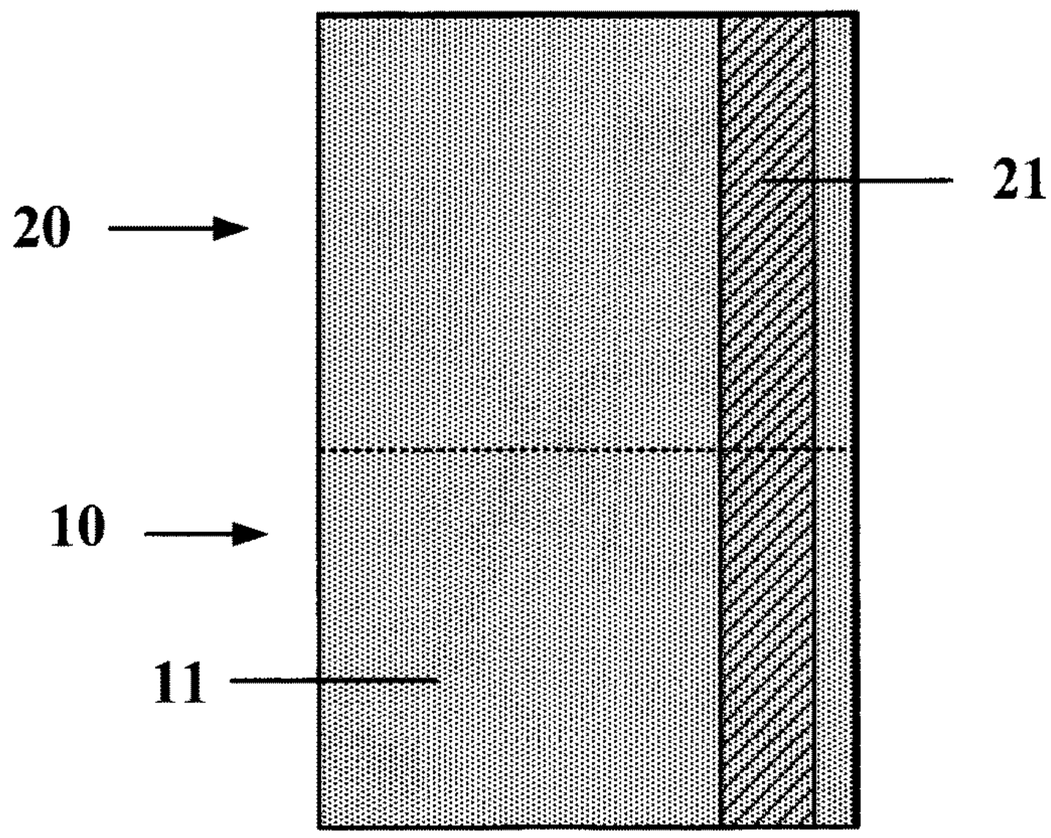


Fig.1
--Prior Art--

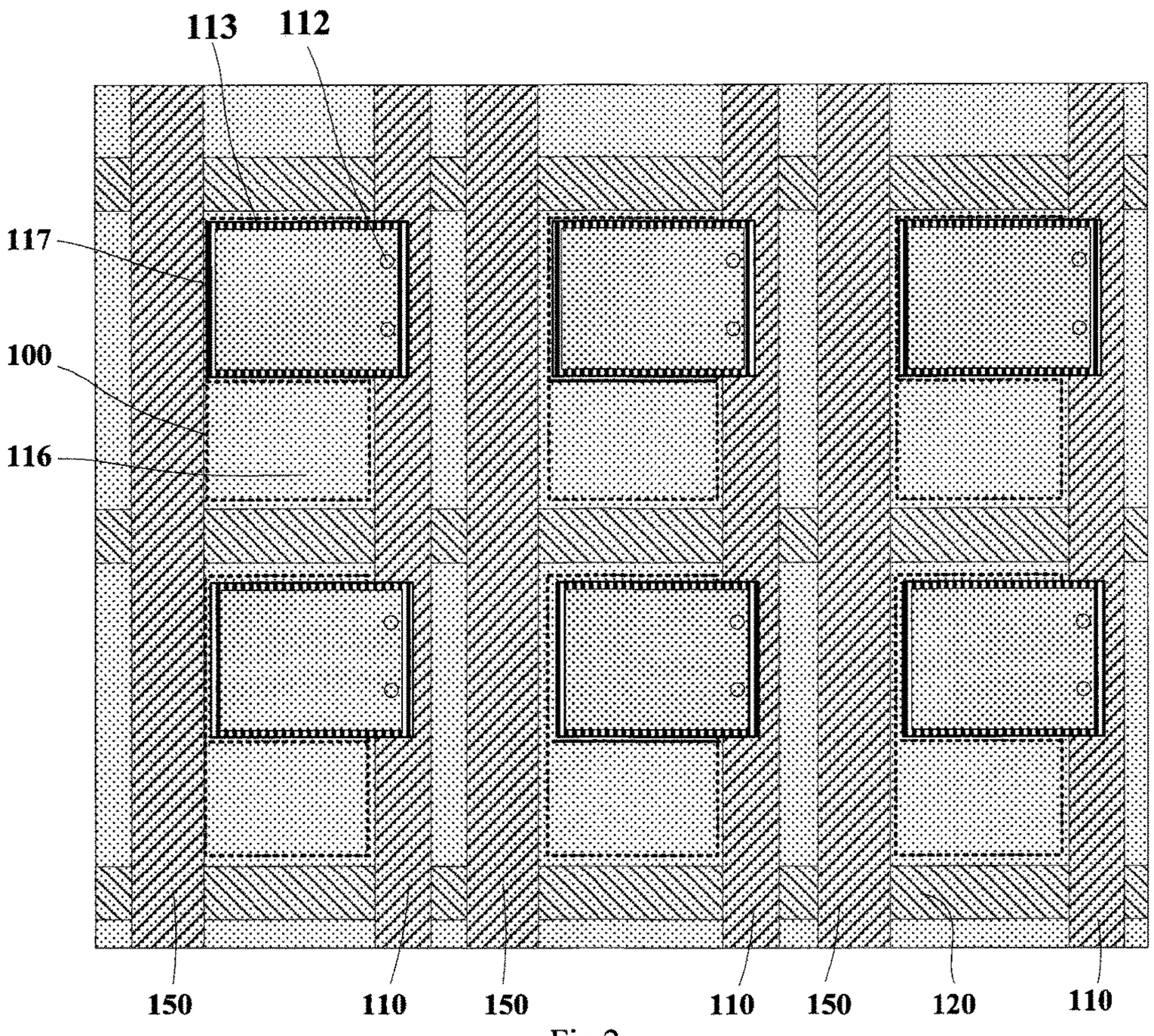


Fig.2

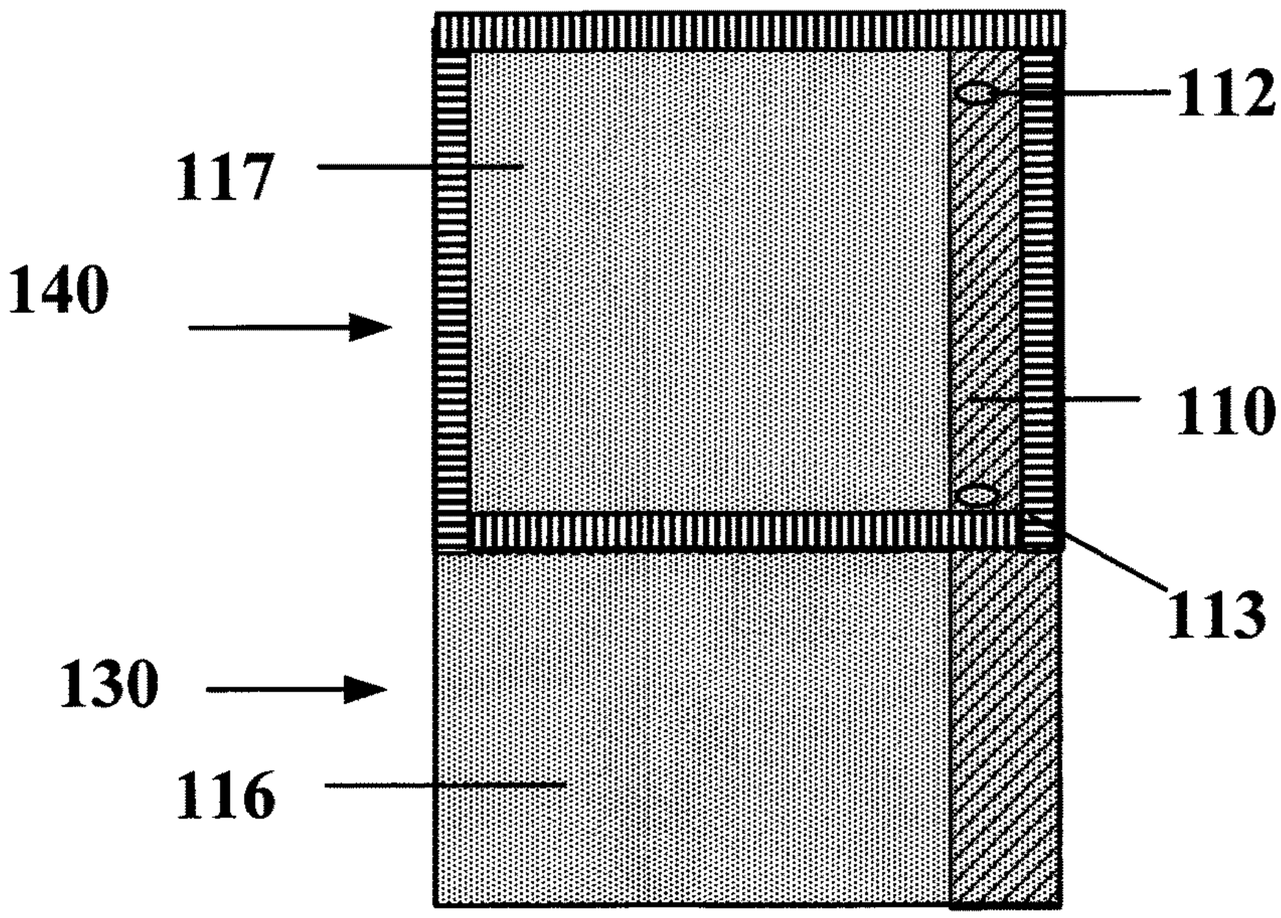

112
117
140
110
113
130
116

Fig.3

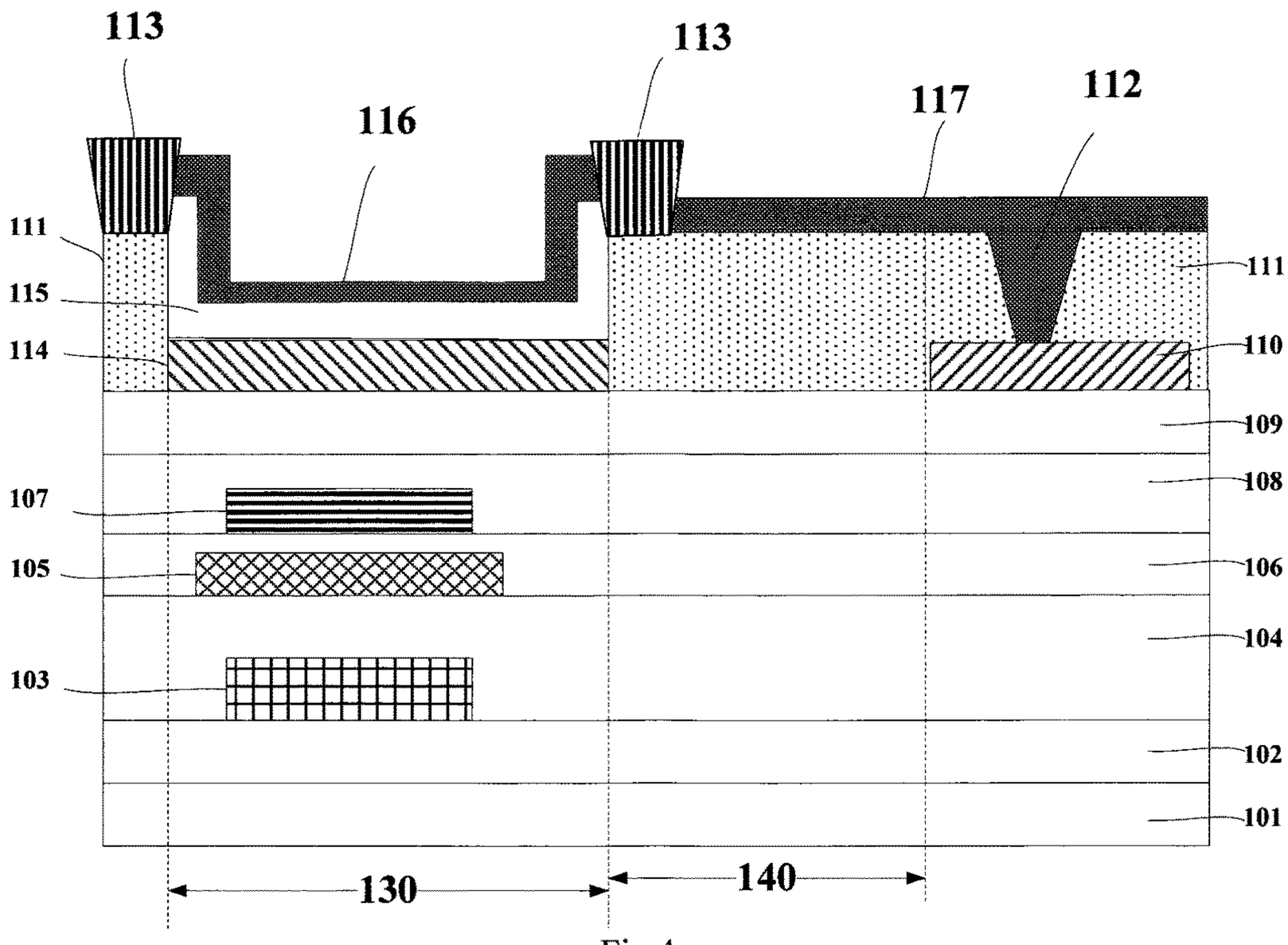

113
113
116
117
112
111
111
115
114
110
109
108
107
106
105
104
103
102
101
130
140

Fig.4

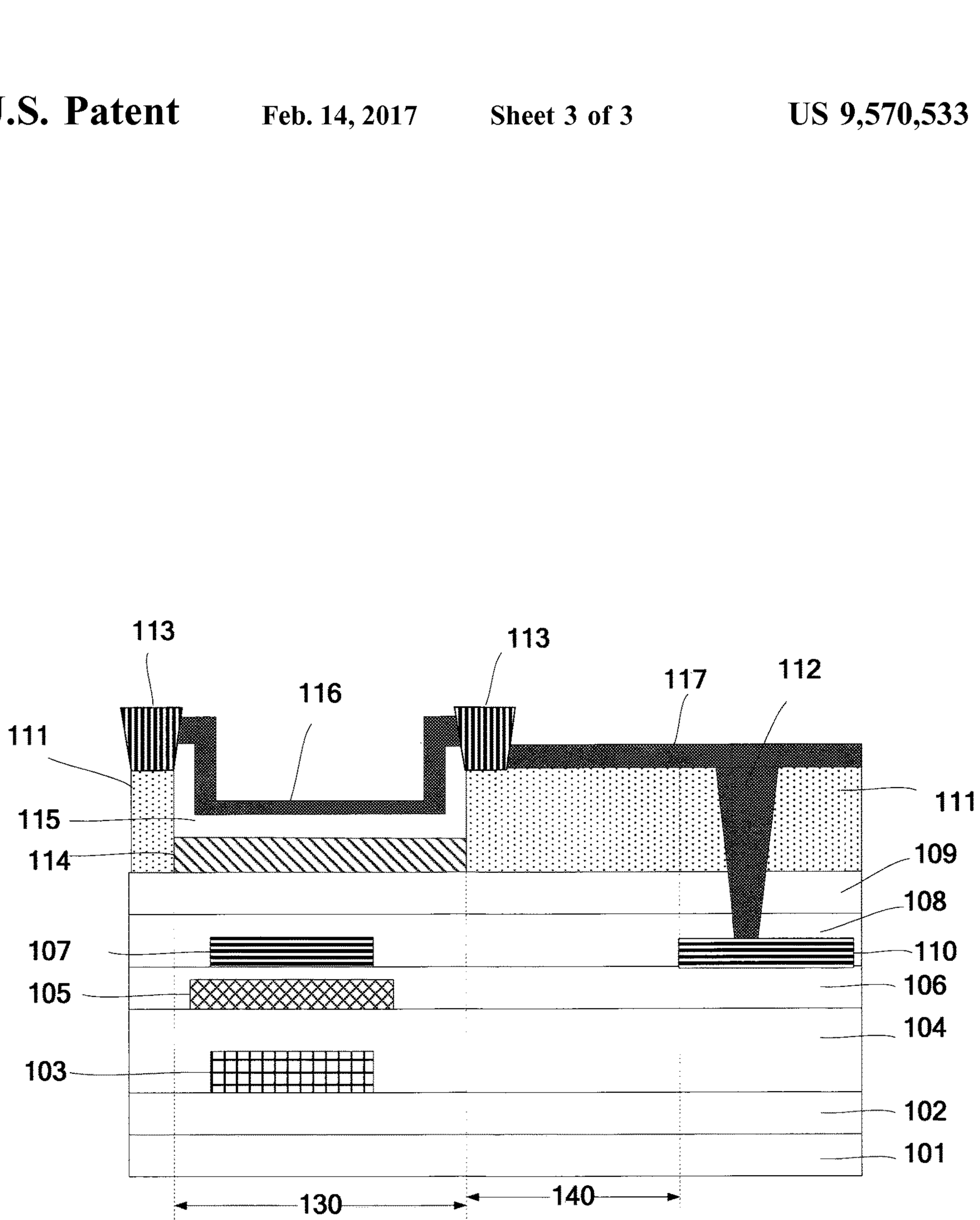

113
113
116
117
112
111
111
115
114
109
108
107
110
105
106
104
103
102
101
130
140

Fig.5

ORGANIC LIGHT EMITTING DIODE ARRAY SUBSTRATE, ITS MANUFACTURING METHOD, AND DISPLAY DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is the U.S. national phase of PCT Application No. PCT/CN2015/070882 filed on Jan. 16, 2015, which claims a priority of the Chinese Patent Application No. 201410491588.5 filed on Sep. 23, 2014, the disclosures of which are incorporated in their entirety by reference herein.

TECHNICAL FIELD

The present disclosure relates to the field of organic light emitting diode (OLED) display, in particular to an organic light emitting diode array substrate and its manufacturing method, as well as a display device.

BACKGROUND

As a new display technology, a transparent display may allow a viewer to observe a background behind a display screen. Such a novel display effect broadens the application field of display, which may be applied to display devices such as a mobile phone, a laptop PC, a display window, a refrigerator door, an on-board monitor and an advertising board.

Referring to FIG. **1**, which is a schematic view showing a pixel structure of a transparent OLED display panel in the related art, the pixel structure includes: a luminous region **10** and a nonluminous transparent region **20**, wherein a non-transparent thin film transistor (TFT) and an organic light emitting diode (not shown in FIG. **1**) are arranged at the luminous region. A cathode layer **11** is a semitransparent cathode, and located at both the luminous region **10** and the nonluminous region **20**. A metal data line **21**, which decreases the light transmittance of the transparent OLED display panel, is arranged longitudinally at the nonluminous transparent region **20**. A width of the metal data line **21** may be reduced, or a data line may be made of a transparent metallic oxide (e.g., indium tin oxide (ITO)) instead of the metal material, so as to increase the light transmittance of the transparent OLED display panel. However, when the width of the metal data line is reduced or the data line is made of the transparent metallic oxide, it will lead to an increased resistance. As a result, it is able to lead to an increase in an IR drop of the OLED display device, thereby to adversely affect a display effect of the OLED display panel.

SUMMARY

An object of the present disclosure is to provide an organic light emitting diode (OLED) array substrate, its manufacturing method, and a display device, so as to reduce a resistance of a data line in the transparent OLED array substrate.

In one aspect, the present disclosure provides in embodiments an OLED array substrate, including gate lines, data lines, and a plurality of pixel units defined by the gate lines and the data lines. Each pixel unit comprises a first region which emits light and a second region which does not emit light. The first region is provided with an organic light emitting diode, and the second region is provided with a conductive unit, which is electrically connected in parallel with the data line and created from the same layer from which a cathode of the organic light emitting diode is created.

In some embodiments, the data line is electrically connected in parallel with the conductive unit through at least two via holes.

In some embodiments, the OLED array substrate further includes a separating portion, through which the cathode is insulated and separated from the conductive unit.

In some embodiments, the separating portion is of a rectangle frame-like shape, and the conductive unit is arranged within the separating portion.

In some embodiments, a top of the separating portion is higher than those of the cathode and the conductive unit.

In some embodiments, the top of the separating portion is 2 μm to 5 μm higher than those of the cathode and the conductive unit.

In some embodiments, the separating portion is columnar and of a cross section in an inverted trapezoidal shape.

In some embodiments, the conductive unit and the cathode of the organic light emitting diode are each made of a translucent metal material.

In some embodiments, the translucent metal material is Ag, Mg or Al, or an alloy thereof.

In some embodiments, the conductive unit or the cathode of the organic light emitting diode is of a thickness of 10 nm to 30 nm.

In another aspect, the present disclosure provides in embodiments a method for manufacturing an OLED array substrate, including steps of forming gate lines and data lines, and forming a plurality of pixel units defined by the gate lines and the data lines. Each pixel unit comprises a first region which emits light and a second region which does not emit light. The first region is provided with an organic light emitting diode, and the second region is provided with a conductive unit which is electrically connected in parallel with the data line and created from the same layer from which a cathode of the organic light emitting diode is created.

In some embodiments, the step of forming the plurality of pixel units includes:

providing a base substrate;

forming an anode of the organic light emitting diode and a pixel-defined layer on the base substrate, and forming a via hole penetrating the pixel-defined layer at a position corresponding to the data line;

forming an organic layer of the organic light emitting diode on the anode;

forming a separating portion on the pixel-defined layer; and

forming a cathode metal layer having a top lower than that of the separating portion and divided by the separating portion into two parts, one part serving as the cathode of the organic light emitting diode and the other part serving as the conductive unit which is electrically connected to the data line through the via hole.

In yet another aspect, the present disclosure provides in embodiments an OLED display device, including the above-mentioned OLED array substrate.

The present disclosure has the following advantageous effects. According to embodiments of the present disclosure, the conductive unit arranged at the nonluminous region of the pixel unit is electrically connected in parallel with the data line. As a result, it is able to reduce the resistance of the data line, thereby to reduce an adverse effect caused by an IR drop on the organic light emitting diode.

Furthermore, according to embodiments of the present disclosure, the cathode metal layer may be insulated and separated by the separating portion, so that one part located at the luminous region of the pixel unit serves as the cathode of the organic light emitting diode, and the other part located at the nonluminous region of the pixel unit serves as the conductive unit. As a result, it is able to achieve the OLED array substrate in a simpler manner, and to reduce the production cost thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic view showing a pixel structure of an OLED display panel in the related art;

FIG. **2** is a top view of an OLED array substrate according to an embodiment of the present disclosure;

FIG. **3** is an enlarged, top view of a pixel unit according to an embodiment of the present disclosure;

FIG. **4** is a sectional view of an OLED array substrate according to an embodiment of the present disclosure; and

FIG. **5** is another sectional view of an OLED array substrate according to an embodiment of the present disclosure.

DETAILED DESCRIPTION

In order to make the objects, the technical solutions and the advantages of the present disclosure more apparent, the present disclosure will be described hereinafter in conjunction with the drawings and embodiments.

To solve a problem that a data line in a transparent OLED array substrate is of a large resistance in the related art, as shown in FIGS. **2** and **3**, the present disclosure provides in embodiments an OLED array substrate, including: a power line **150**, a gate line **120**, a data line **110**, and a plurality of pixel units **100** defined by the gate lines **120** and the data lines **110**. Each pixel unit **100** includes: a first region **130** which emits light and a second region **140** which does not emit light. The first region **130** is provided with an organic light emitting diode (only a cathode **116** of the organic light emitting diode is shown in the drawings), and the second region **140** is provided with a conductive unit **117** which is electrically connected in parallel with the data line **110** and created from the same layer from which the cathode **116** of the organic light emitting diode is created. The power line **150** is used to supply power to an anode of the organic light emitting diode.

According to embodiments of the present disclosure, the conductive unit **117**, arranged at the nonluminous region of the pixel unit **100**, is electrically connected in parallel with the data line **110**. As a result, it is able to reduce a resistance of the data line **110**, thereby to reduce an adverse effect caused by an IR drop on the organic light emitting diode.

In an embodiment of the present disclosure, the pixel unit may further include a thin film transistor arranged at the first region **130** which emits light, electrically connected to the organic light emitting diode, and configured to drive the organic light emitting diode to emit light.

Further, the OLED array substrate according to embodiments of the present disclosure may further include a pixel-defined layer.

In the present embodiment, the data line **110** is electrically connected in parallel with the conductive unit **117** through at least two via holes **112**.

The cathode **116** and the conductive unit **117** are created from the same layer and made of an identical material, usually a metal material. In some embodiments, the cathode **116** and the conductive unit **117** may be made of a semi-transparent metal material, so that the second region **140** which does not emit light is a semitransparent region, thereby to achieve transparent display. To be specific, the cathode **116** and the conductive unit **117** may each be made of Ag, Mg or Al, or an alloy thereof, and they may each be of a thickness of 10 nm to 30 nm.

To improve the light transmittance of the transparent OLED array substrate, in some embodiments, the data line **110** may be made of a transparent metallic oxide, such as indium tin oxide (ITO) or indium zinc oxide (IZO). The data line made of the transparent metallic oxide may be created from the same layer from which the anode of the organic light emitting diode is created. When the anode is of a multi-layer structure including a metallic oxide layer and a metallic reflecting layer, the data line may also be formed at the same time with the metallic oxide layer of the anode by a single patterning process.

In addition, the data line may also be made of a metal material. In some embodiments, the data line may be formed at the same time with a source/drain electrode of the thin film transistor by a single patterning process, i.e., the data line is made of a metal material identical to the source/drain electrode of the thin film transistor. At this time, the data line and the source/drain electrode of the thin film transistor are arranged at the same layer.

According to the embodiments of the present disclosure, the OLED array substrate may further include: a separating portion, through which the cathode **116** and the conductive unit **117** are insulated and separated from each other.

In some embodiments, as shown in FIGS. **2** and **3**, the separating portion **113** is of a rectangle frame-like shape, and the conductive unit **117** is arranged within the separating portion **113**, i.e., the conductive unit **117** is surrounded by the separating portion **113**.

In some embodiments, a top of the separating portion **113** is higher than that of the cathode **116** and that of the conductive unit **117**, and the top of the separating portion **113** is 2 μm to 5 μm higher than that of the cathode **116** and that of the conductive unit **117**.

According to the embodiments of the present disclosure, the separating portion **113** may be formed prior to the formation of a cathode metal layer by an open mask (a co-layer metal mask) process. As the cathode metal layer has the top lower than that of the separating portion **113**, the metal layer can be insulated and separated by the separating portion **113**, so that the cathode **116** of the organic light emitting diode is formed at the first region **130** of the pixel unit **100**, and the conductive unit **117** is formed at the second region **140** of the pixel unit **100**. In some embodiments, the separating portion **113** is columnar and of a cross section in an inverted trapezoidal shape.

Because a part of the existing cathode layer, i.e., the conductive unit, is used to reduce the resistance of the data line **110**, it is able to achieve the OLED array substrate in a simpler manner and reduce the production cost thereof.

Of course, in the other embodiments of the present disclosure, the cathode and the conductive unit which are insulated and separated from each other may also be formed by a patterning process.

Referring to FIG. **4**, which is a sectional view of an OLED array substrate according to an embodiment of the present disclosure, the OLED array substrate includes:

a base substrate **101**;

a buffer layer **102** covering the base substrate **101**;

an active layer **103** arranged on the buffer layer **102**;

a gate insulating layer **104** covering the active layer **103**;

a gate electrode **105** arranged on the gate insulating layer **104**;

an interlayer insulating layer **106** covering the gate electrode **105**;

a source/drain electrode **107** arranged on the interlayer insulating layer **106**;

a passivation layer **108** covering the source/drain electrode **107**;

a planarization layer **109** covering the passivation layer **108**;

a data line **110** arranged on the planarization layer **109**;

a pixel-defined layer **111** arranged on the data line **110** and having at least two via holes **112**;

a separating portion **113** which is arranged on the pixel-defined layer **111**, is of a rectangle frame-like shape and has a cross section in a columnar and inverted trapezoidal shape;

an anode **114** arranged on the planarization layer **109** and at the same layer with the data line **110**;

an organic layer **115** arranged on the anode **114**;

a cathode **116** arranged on the organic layer **115**; and

a conductive unit **117** created from the same layer from which the cathode is created and made of an identical material to the cathode **116**, and arranged on the pixel-defined layer **111**, the cathode **116** and the conductive unit **117** being insulated and separated from each other by the separating portion **113**, and the conductive unit **117** being electrically connected in parallel with the data line **110** through the via hole **112** penetrating the pixel-defined layer **111**.

The thin film transistor of the pixel unit consists of the active layer **103**, the gate insulating layer **104**, the gate electrode **105**, the interlayer insulating layer **106** and the source/drain electrode **107**. The organic light emitting diode of the pixel unit consists of the anode **114**, the organic layer **115** and the cathode **116**.

Referring to FIG. **5**, which is another sectional view of the OLED array substrate according to an embodiment of the present disclosure, the OLED array substrate includes:

a base substrate **101**;

a buffer layer **102** covering the base substrate **101**;

an active layer **103** arranged on the buffer layer **102**;

a gate insulating layer **104** covering the active layer **103**;

a gate electrode **105** arranged on the gate insulating layer **104**;

an interlayer insulating layer **106** covering the gate electrode **105**;

a source/drain electrode **107** arranged on the interlayer insulating layer **106**;

a data line **110** arranged on the interlayer insulating layer **106** and at the same layer with and made of an identical material to the source/drain electrode **107**;

a passivation layer **108** covering the source/drain electrode **107** and the data line **110**;

a planarization layer **109** covering the passivation layer **108**;

a pixel-defined layer **111** arranged on the planarization layer **109**;

a separating portion **113** which is arranged on the pixel-defined layer **111**, is of a rectangle frame-like shape and has a cross section in a columnar and inverted trapezoidal shape;

an anode **114** arranged on the planarization layer **109**;

an organic layer **115** arranged on the anode **114**;

a cathode **116** arranged on the organic layer **115**; and

a conductive unit **117** created from the same layer from which the cathode is created and made of an identical material to the cathode **116**, and arranged on the pixel-defined layer **111**, the cathode **116** and the conductive unit **117** being insulated and separated from each other by the separating portion **113**, and the conductive unit **117** being electrically connected in parallel with the data line **110** through the via hole **112** penetrating the pixel-defined layer **111**, the planarization layer **109** and the passivation layer **108**.

The thin film transistor of the pixel unit consists of the active layer **103**, the gate insulating layer **104**, the gate electrode **105**, the interlayer insulating layer **106** and the source/drain electrode **107**. The organic light emitting diode of the pixel unit consists of the anode **114**, the organic layer **115** and the cathode **116**.

In the above two embodiments, the thin film transistor is of a top-gate structure. In the other embodiments of the present disclosure, the thin film transistor may also be of a bottom-gate structure.

The present disclosure further provides in embodiments an OLED display device, including the above-mentioned OLED array substrate.

The present disclosure further provides in embodiments a method for manufacturing an OLED array substrate, including steps of gate lines and data lines, and forming a plurality of pixel units defined by the gate lines and the data lines. Each pixel unit includes a first region which emits light and a second region which does not emit light. The first region is provided with an organic light emitting diode, and the second region is provided with a conductive unit which is electrically connected in parallel with the data line and created from the same layer from which a cathode of the organic light emitting diode is created.

According to embodiments of the present disclosure, the conductive unit, arranged at the nonluminous region of the pixel unit, is electrically connected in parallel with the data line. As a result, it is able to reduce the resistance of the data line, thereby to reduce the adverse effect caused by the IR drop on the organic light emitting diode.

In some embodiments, the step of forming the plurality of pixel units further includes:

providing a base substrate;

forming an anode of an organic light emitting diode and a pixel-defined layer on the base substrate, and forming a via hole penetrating the pixel-defined layer at a position corresponding to the data line;

forming an organic layer of the organic light emitting layer on the anode;

forming a separating portion on the pixel-defined layer;

forming a cathode metal layer having a top lower than that of the separating portion and divided by the separating portion into two parts, one part of the cathode metal layer serving as the cathode of the organic light emitting diode, and the other part of the cathode metal layer serving as a conductive unit which is electrically connected to the data line through the via hole.

According to embodiments of the present disclosure, a part of the existing cathode layer is used to reduce the resistance of the data line. As a result, it is able to achieve the OLED array substrate in a simpler manner and reduce the production cost thereof

In one embodiment, the step of forming the plurality of pixel units includes:

S**11**: providing a base substrate;

S**12**: forming a thin film transistor on the base substrate;

S**13**: forming a data line and an anode of an organic light emitting diode on the base substrate with the thin film transistor;

S14: forming a pixel-defined layer and a separating portion, and forming at least two via holes penetrating the pixel-defined layer at a position corresponding to the data line;

S15: forming an organic layer of the organic light emitting diode on the anode; and

S16: forming a cathode metal layer divided into two parts by the separating portion, one part of the cathode metal layer serving as the cathode of the organic light emitting diode, and the other part being electrically connected in parallel with the data line through the via hole.

In the present embodiment, the data line may be made of a transparent metallic oxide.

In another embodiment, the step of forming the plurality of pixel units includes:

S21: providing a base substrate;

S22: forming a thin film transistor and a data line on the base substrate, the data line and a source/drain electrode of the thin film transistor being formed by a single patterning process;

S23: forming a passivation layer and a planarization layer covering the thin film transistor and the data line;

S24: forming an anode of the organic light emitting diode;

S25: forming a pixel-defined layer and a separating portion, and forming at least two via holes penetrating the pixel-defined layer, the planarization layer and the passivation layer at a position corresponding to the data line;

S26: forming an organic layer of the organic light emitting diode above the anode;

S27: forming a cathode metal layer divided into two parts by the separating portion, one part of the cathode metal layer serving as the cathode of the organic light emitting diode, and the other part being electrically connected in parallel with the data line through the via hole.

In the present embodiment, the data line and the source/drain electrode of the thin film transistor are made of an identical metal material.

The above are merely the preferred embodiments of the present disclosure. It should be appreciated that, a person skilled in the art may make further modifications and improvements without departing from the principle of the present disclosure, and these modifications and improvements shall also fall within the scope of the present disclosure.

What is claimed is:

1. An organic light emitting diode (OLED) array substrate, comprising: gate lines, data lines, and a plurality of pixel units defined by the gate lines and the data lines,

wherein each pixel unit comprises a first region which emits light and a second region which does not emit light,

the first region is provided with an organic light emitting diode, and

the second region is provided with a conductive unit, which is electrically connected in parallel with a corresponding data line and created from a same layer from which a cathode of the organic light emitting diode is created.

2. The OLED array substrate according to claim 1, wherein the data line is electrically connected in parallel with the conductive unit through at least two via holes.

3. The OLED array substrate according to claim 1, further comprising a separating portion, through which the cathode is insulated and separated from the conductive unit.

4. The OLED array substrate according to claim 3, wherein the separating portion is of a rectangle frame-like shape, and the conductive unit is arranged inside the separating portion.

5. The OLED array substrate according to claim 3, wherein a top of the separating portion is higher than those of the cathode and the conductive unit.

6. The OLED array substrate according to claim 5, wherein the top of the separating portion is 2 μm to 5 μm higher than those of the cathode and the conductive unit.

7. The OLED array substrate according to claim 5, wherein the separating portion is columnar and of a cross section in an inverted trapezoidal shape.

8. The OLED array substrate according to claim 1, wherein the conductive unit and the cathode of the organic light emitting diode are each made of a translucent metal material.

9. The OLED array substrate according to claim 8, wherein the translucent metal material is Ag, Mg or Al, or an alloy thereof.

10. The OLED array substrate according to claim 1, wherein the conductive unit and the cathode of the OLED are each of a thickness of 10 nm to 30 nm.

11. A method for manufacturing an organic light emitting diode (OLED) array substrate, comprising the following steps:

forming gate lines and data lines, and forming a plurality of pixel units defined by the gate lines and the data lines,

wherein each pixel unit comprises a first region which emits light and a second region which does not emit light, the first region is provided with an OLED, and the second region is provided with a conductive unit which is electrically connected in parallel with a corresponding data line and created from a same layer from which a cathode of the OLED is created.

12. The method according to claim 11, wherein the step of forming the plurality of pixel units comprises:

providing a base substrate;

forming an anode of the organic light emitting diode and a pixel-defined layer on the base substrate, and forming a via hole penetrating the pixel-defined layer at a position corresponding to the data line;

forming an organic layer of the OLED on the anode;

forming a separating portion on the pixel-defined layer; and

forming a cathode metal layer having a top lower than that of the separating portion and divided into two parts by the separating portion, one part of the cathode metal layer serving as the cathode of the OLED and another part of the cathode metal serving as the conductive unit which is electrically connected to the data line through the via hole.

13. An organic light emitting diode (OLED) display device, comprising the OLED array substrate according to claim 1.

14. The OLED display device according to claim 13, wherein the data line is electrically connected in parallel with the conductive unit through at least two via holes.

15. The OLED display device according to claim 13, further comprising a separating portion, through which the cathode is insulated and separated from the conductive unit.

16. The OLED display device according to claim 15, wherein the separating portion is of a rectangle frame-like shape, and the conductive unit is arranged inside the separating portion.

17. The OLED display device according to claim **15**, wherein a top of the separating portion is higher than those of the cathode and the conductive unit.

18. The OLED display device according to claim **17**, wherein the top of the separating portion is 2 μm to 5 μm higher than those of the cathode and the conductive unit.

19. The OLED display device according to claim **17**, wherein the separating portion is columnar and of a cross section in an inverted trapezoidal shape.

20. The OLED display device according to claim **13**, wherein the conductive unit and the cathode of the organic light emitting diode are each made of a translucent metal material.

* * * * *