US008354980B2

(12) United States Patent
Kwak

(10) Patent No.: US 8,354,980 B2
(45) Date of Patent: Jan. 15, 2013

(54) **ORGANIC LIGHT EMITTING DISPLAY**

(75) Inventor: **Won-Kyu Kwak**, Suwon-si (KR)

(73) Assignee: **Samsung Display Co., Ltd.**, Yongin-si (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 310 days.

(21) Appl. No.: **12/564,004**

(22) Filed: **Sep. 21, 2009**

(65) **Prior Publication Data**

US 2010/0097295 A1 Apr. 22, 2010

(30) **Foreign Application Priority Data**

Oct. 17, 2008 (KR) 10-2008-0101947

(51) **Int. Cl.**
G09G 3/30 (2006.01)
G09G 3/32 (2006.01)

(52) **U.S. Cl.** **345/76**; 345/82; 313/506

(58) **Field of Classification Search** .... None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,812,523	B2	10/2010	Jung et al.	
2004/0263441	A1	12/2004	Tanaka et al.	
2005/0212413	A1*	9/2005	Matsuura et al.	313/504
2006/0124950	A1	6/2006	Park et al.	
2006/0158095	A1	7/2006	Imamura	
2006/0273712	A1	12/2006	Yaegashi	
2007/0108899	A1	5/2007	Jung et al.	

FOREIGN PATENT DOCUMENTS

CN	1578571	A	2/2005
CN	1967864	A	5/2007
JP	2003-068472		3/2003
JP	2004-281399		10/2004
JP	2005-011793		1/2005
JP	2005-268062		9/2005
JP	2006-059796		3/2006
JP	2006-201421		8/2006
JP	2006-318776		11/2006
JP	2007095518		4/2007
JP	2007-141844		6/2007
JP	2007-273261		10/2007
KR	1020020029159	A	4/2002
KR	10-2003-0013700		2/2003
KR	20060030437	A	4/2006

(Continued)

OTHER PUBLICATIONS

SIPO Office Action dated Jan. 19, 2011 in corresponding Chinese patent application No. CN 200910179535.9, 7 pps.

(Continued)

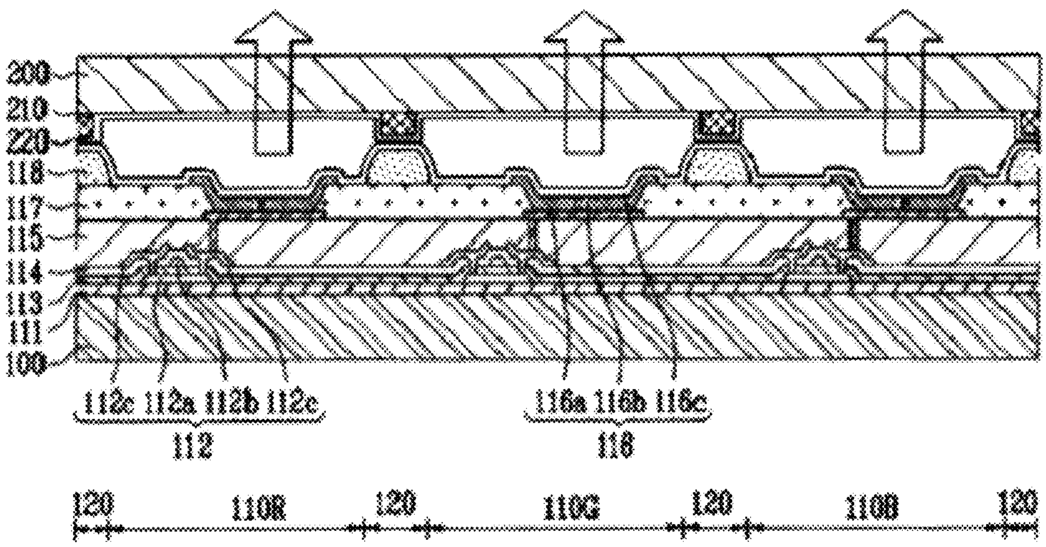
Primary Examiner — Andrew L Sniezek

(74) *Attorney, Agent, or Firm* — Christie, Parker & Hale, LLP

(57) **ABSTRACT**

An organic light emitting display is capable of reducing or preventing IR drop in a cathode electrode. An organic light emitting display includes a first substrate and a second substrate. The first substrate has a plurality of pixels located thereon, each of the pixels comprising an organic light emitting diode, wherein a cathode electrode of the organic light emitting diode including a transparent material is located on substantially an entire area of the pixels. The second substrate has a mesh type auxiliary electrode located thereon at a side facing the pixels, the mesh-type auxiliary electrode corresponding to non-emission regions between the pixels and electrically connected to the cathode electrode.

14 Claims, 3 Drawing Sheets



FOREIGN PATENT DOCUMENTS

KR	10-0662557	12/2006
KR	10-2008-0025500	3/2008

OTHER PUBLICATIONS

European Search Report dated Feb. 9, 2010, for corresponding European patent application 09173041.6, noting listed references in this IDS.

Japanese Office action dated Jan. 4, 2011 for Japanese Patent Application No. 2009-100002, which claims priority of the corresponding Korean priority application No. 10-2008-0101947, noting the listed references in this IDS.

KIPO Office action dated May 31, 2010, for priority Korean Patent Application No. 10-2008-0101947, noting the listed references in this IDS, as well as KR 100662557, KR 1020030013700 and KR 1020080025500 previously filed in an IDS dated Jan. 28, 2010.

KIPO Office action dated Dec. 23, 2009, for priority Korean application 10-2008-0101947, noting listed references in this IDS.

Japanese Office action dated Apr. 3, 2012, for corresponding Japanese Patent application 2009-100002, (3 pages).

* cited by examiner

FIG. 1

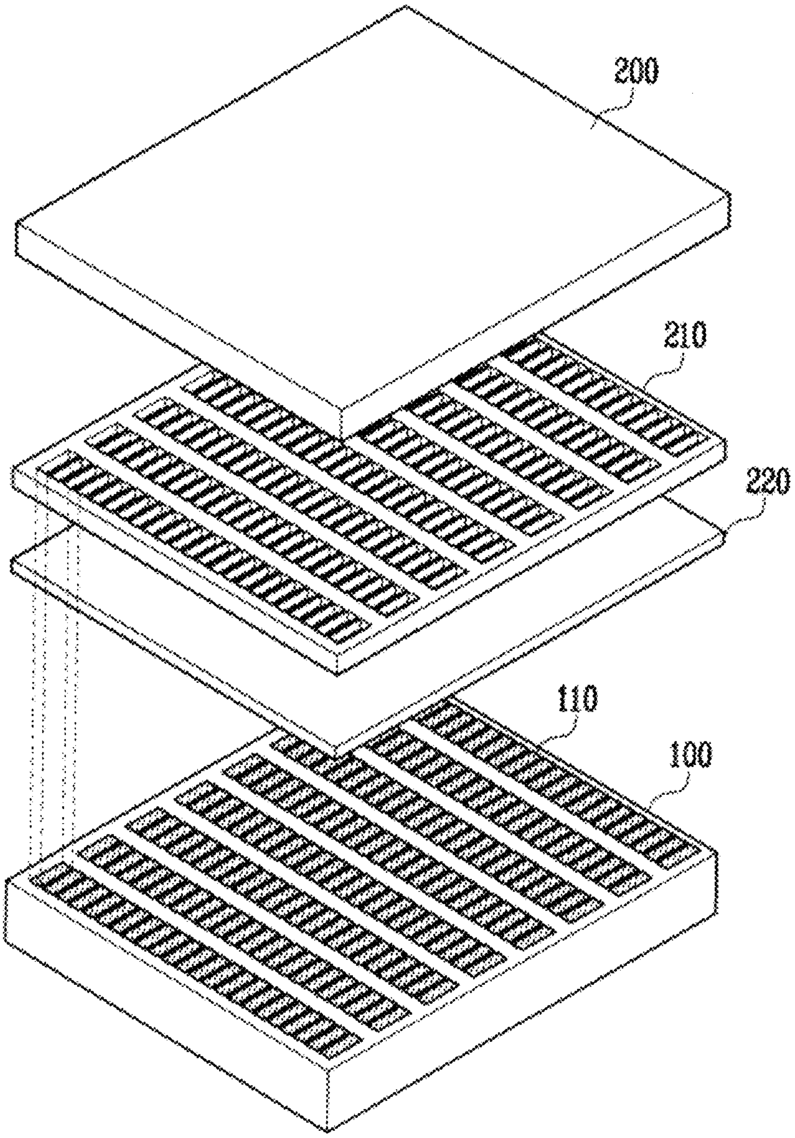


FIG. 2

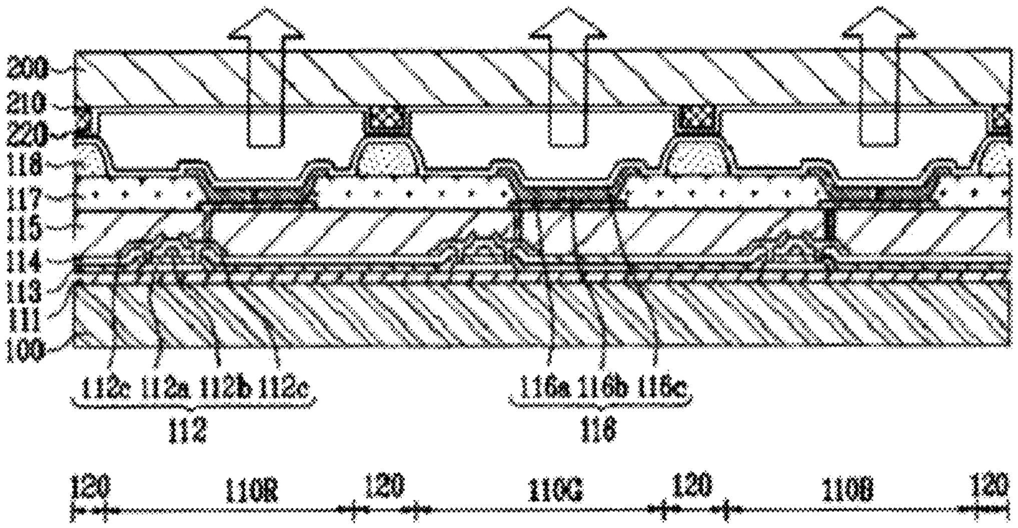
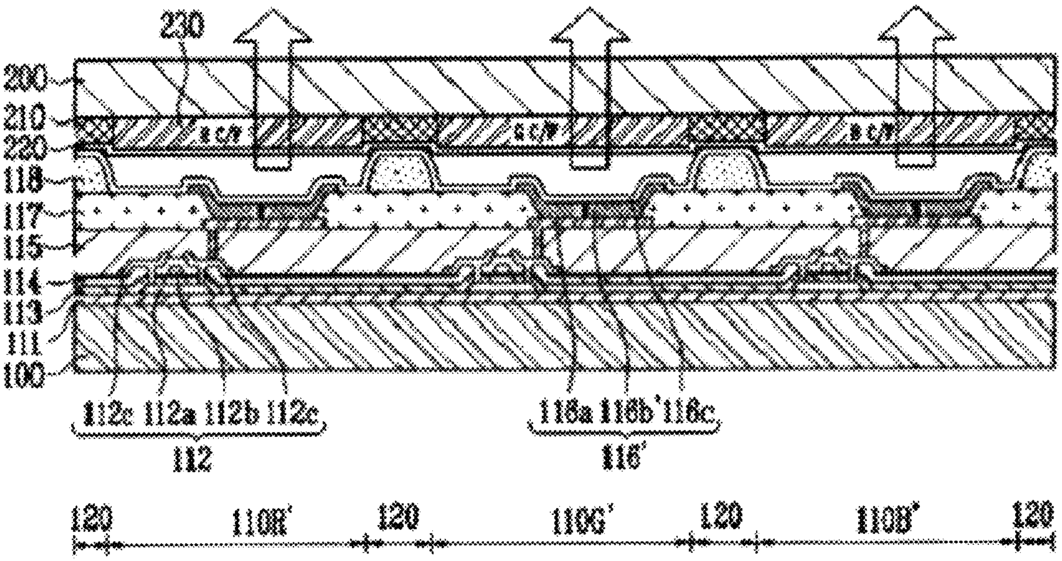

200
210
220
118
117
115
114
113
111
100
112c 112a 112b 112c
112
116a 116b 116c
116
120
110R
120
110G
120
110B
120

FIG. 3


230
200
210
220
118
117
115
114
113
111
100
112c 112a 112b 112c
112
116a 116b' 116c
116'
120
110R'
120
110G'
120
110B'
120

ORGANIC LIGHT EMITTING DISPLAY

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority to and the benefit of Korean Patent Application No. 10-2008-0101947, filed on Oct. 17, 2008, in the Korean Intellectual Property Office, the entire content of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an organic light emitting display, and more particularly, to an organic light emitting display in which IR drop (i.e., voltage drop) in a cathode electrode is prevented or reduced.

2. Description of the Related Art

Recently, various flat panel displays (FPDs) that are light and thin in comparison to cathode ray tubes (CRTs) have been developed. Among the FPDs, organic light emitting displays using organic compound as phosphor to have excellent brightness and color purity are in the spotlight.

Since the organic light emitting displays are thin and light and capable of being driven with low power consumption, they are suitable for portable displays in addition to applications in larger size FPDs.

The organic light emitting displays are typically classified as a top emission organic light emitting display or a bottom emission organic light emitting display according to light emission directions. Further, a dual-side emission organic light emitting display has combined features of the top emission organic light emitting display and the bottom emission organic light emitting display.

A conventional bottom emission organic light emitting display has disadvantages of a low aperture ratio because thin film transistors for driving OLEDs cannot be positioned at light emitting regions.

On the contrary, the top emission organic light emitting display can achieve a desired aperture ratio regardless of whether or not the thin film transistors are located under the OLEDs.

However, in the top emission organic light emitting display, as light generated from an emission layer of the OLED is emitted out through a cathode electrode, the cathode electrode is required to be transparent. Therefore, the cathode electrode is made of a transparent conductive material such as ITO, or MgAg having a sufficiently small thickness to be transparent.

However, the transparent conductive material such as ITO has a high resistance, and MgAg can only have a limited thickness. Thus, resistance of the cathode electrode is high so that a relatively high IR drop (i.e., voltage drop) occurs. Particularly, as a display panel becomes larger in size, IR drop in the cathode electrode is greatly increased so that image quality and display characteristics may not be uniform.

SUMMARY OF THE INVENTION

Accordingly, it is an aspect according to embodiments of the present invention to provide an organic light emitting display in which IR drop in a cathode electrode can be reduced or prevented.

In order to achieve the foregoing and/or other aspects of the present invention, according to a first embodiment of the present invention, an organic light emitting display including a first substrate and a second substrate is provided. The first substrate has a plurality of pixels located thereon, each of the pixels including an organic light emitting diode, wherein a cathode electrode of the organic light emitting diode including a transparent material is located on substantially an entire area of the pixels. The second substrate has a mesh type auxiliary electrode located thereon at a side facing the pixels, the mesh-type auxiliary electrode corresponding to non-emission regions between the pixels and electrically connected to the cathode electrode.

Here, the auxiliary electrode may include a conductive black matrix material.

The auxiliary electrode may include a material with a lower specific resistance than a material for the cathode electrode.

The organic light emitting display further includes a transparent conductive layer on substantially an entire area of the auxiliary electrode and contacting the cathode electrode to electrically connect the auxiliary electrode to the cathode electrode. The transparent conductive layer contacts the cathode electrodes at the non-emission regions between the pixels.

Accordingly, in organic light emitting displays according to embodiments of the present invention, since an auxiliary electrode, electrically connected to a cathode electrode on a lower substrate and having resistance lower than the cathode electrode, is on an upper substrate, IR drop in the cathode electrode can be reduced or prevented.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, together with the specification, illustrate exemplary embodiments of the present invention, and, together with the description, serve to explain the principles of the present invention.

FIG. **1** is an exploded perspective view illustrating an organic light emitting display according to an embodiment of the present invention;

FIG. **2** is a sectional view illustrating main parts of the organic light emitting display as shown in FIG. **1**; and

FIG. **3** is a sectional view illustrating main parts of an organic light emitting display according to another embodiment of the present invention.

DETAILED DESCRIPTION

Hereinafter, certain exemplary embodiments according to the present invention will be described with reference to the accompanying drawings. Here, when a first element is described as being coupled to a second element, the first element may be directly coupled to the second element or may be indirectly coupled to the second element via a third element. Further, some of the elements that are not essential to a complete understanding of the invention are omitted for clarity. Also, like reference numerals refer to like elements throughout.

Hereinafter, exemplary embodiments of the present invention will be described in detail with reference to the accompanying drawings, namely, FIGS. **1** to **3**.

FIG. **1** is an exploded perspective view illustrating an organic light emitting display according to an embodiment of the present invention, and FIG. **2** is a sectional view illustrating main parts of the organic light emitting display as shown in FIG. **1**.

Referring to FIG. **1**, an organic light emitting display according to an embodiment of the present invention includes a lower substrate **100** on which a plurality of pixels **110** respectively including organic light emitting diodes (OLEDs) are formed, an upper substrate **200** on which a mesh-type auxiliary electrode **210** is located at the side facing the pixels **110**. A transparent conductive layer **220** is formed on substantially an entire area of the auxiliary electrode **210** at the side facing the pixels **110**. While the auxiliary electrode **210** is primarily described herein as a single electrode formed as a mesh as shown in FIG. **1**, the auxiliary electrode can also be viewed as a plurality of auxiliary electrodes that are electrically connected together in a form of a mesh.

Each of the pixels **110**, as illustrated in FIG. **2**, includes a thin film transistor **112** and an OLED **116** which are formed on the lower substrate **100**.

Each of the thin film transistors **112** includes a semiconductor layer **112***a* formed on a buffer layer **111**, which is on the lower substrate **100**, a gate electrode **112***b* formed on the semiconductor layer **112***a*, where an insulating layer **113** is interposed between the gate electrode **112***b* and the semiconductor layer **112***a*, and source/drain electrodes **112***c* formed on the gate electrode **112***b*, where an interlayer insulating layer **114** is interposed between the source/drain electrodes **112***c* and the gate electrode **112***b*. The source/drain electrodes **112***c* are electrically connected to the semiconductor layer **112***a*.

An insulating planarization layer **115** is formed on the thin film transistor **112**. An OLED **116** connected to the thin film transistor **112** through a via-hole is formed on the planarization layer **115**.

The OLED **116** is formed on the planarization layer **115**. The OLED **116** includes an anode electrode **116***a* electrically connected to the thin film transistor **112** through the via-hole formed in the planarization layer **115**, a light emission layer **116***b* formed on the anode electrode **116***a* at an area exposed by a pixel definition layer **117** which is formed on the planarization layer **115** to overlap with an upper portion of an edge of the anode electrode **116***a*, and a cathode electrode **116***c* formed on the light emission layer **116***b* and made of transparent material. The cathode electrode layer **116***c* is formed over substantially an entire upper side of the pixels **110**.

Here, the light emission layer **116***b* may be formed in the form of a red light emission layer R, a green light emission layer G, or a blue light emission layer B, independently deposited using a fine metal mask (FMM). According to kind of the light emission layer **116***b*, the pixels **110** may be classified as a red pixel **110**R, a green pixel **110**G, or a blue pixel **110**B.

Each of the pixels **110** includes the cathode electrode **116***c* made of a transparent material to emit light toward the cathode electrode **116***c*. Accordingly, the organic light emitting display may be implemented as a top emission (or a dual-side emission) organic light emitting display. In the described embodiment, the cathode electrode is a common electrode shared by all of the pixels. However, each pixel can also be viewed as having its own cathode electrode that is electrically connected to cathode electrodes of other pixels.

Since the cathode electrode **116***c* should transmit light in a top emission or dual-side emission organic light emitting display, the cathode electrode **116***c* is made of a transparent conductive layer. To this end, the cathode electrode **116***c* is made of a transparent conductive material such as ITO, or MgAg having a thickness that is small enough to be transparent. Here, the thickness of MgAg is determined within a range of guaranteeing transparency greater than a predetermined transparency with respect to light. The term transparency or transparent in the present application refers to translucency greater than a desired transparency (e.g., predetermined transparency) or substantial transparency, as well as a transparency of 100%.

In non-emission regions **120** between the pixels **110**, spacers **118** are provided to maintain a gap (e.g., a predetermined gap) between the first substrate **100** and the second substrate **200**.

Each of the spacers **118** is formed between the pixel definition layer **117** of the non-emission region **120** and the cathode electrode **116***c*. In other words, the cathode electrode **116***c* is formed in a region including an upper portion of the spacer **118** of the non-emission region **120**, that is, is positioned on the top of the lower substrate **100**.

The auxiliary electrode **210** is formed at a side of the upper substrate **200** facing the pixels **110** to correspond to the non-emission region **120** between the pixels **110** in the form of a mesh, and is electrically connected to the cathode electrode **116***c* of the lower substrate **100** by a transparent conductive layer **220**.

The auxiliary electrode **210** may function as a black matrix containing conductive black matrix material. The conductive black matrix material may be at least one selected from the group consisting of chrome (Cr), chrome alloys, molybdenum (Mo), molybdenum alloys, oxides thereof (CrOx, MoOx), and combinations thereof. For example, the auxiliary electrode **210** may be formed of a single chrome layer, or may include a dual chrome layer/chrome oxide layer or a dual molybdenum layer/molybdenum oxide layer for effective light interception.

Moreover, even if the auxiliary electrode **210** does not completely function as a black matrix, since it is formed in the non-emission region **120**, it does not necessarily have to be transparent. Thus, the thickness of the auxiliary electrode **210** has less restriction than that of the cathode electrode **116***c*. Therefore, the auxiliary electrode **210** may be formed with a thickness relatively greater than that of the cathode electrode **116***c*.

When the cathode electrode **116***c* is formed as a transparent electrode made of ITO, for example, the auxiliary electrode **210** may be made of one of a variety of materials having a specific resistance lower than the material for the cathode electrode **116***c*.

That is, the auxiliary electrode **210** has a resistance lower than that of the cathode electrode **116***c* and is electrically connected thereto so as to prevent or reduce IR drop in the cathode electrode **116***c*.

The transparent conductive layer **220** is formed on substantially an entire area of the auxiliary electrode **210** and contacts the cathode electrode **116***c* at the non-emission regions **120** between the pixels **110** to electrically connect the auxiliary electrode **210** to the cathode electrode **116***c*.

The transparent conductive layer **220** performs a function of preventing or reducing IR drop in the cathode electrode **116***c* together with the auxiliary electrode **210**, and may be made of indium tin oxide (ITO) such that light can be transmitted therethrough. In other embodiments of the present invention, the transparent conductive layer **220** may not be provided, and the auxiliary electrode **210** may directly contact the cathode electrode **116***c* when the transparent electrode **220** is not used.

As described above, according to embodiments of the present invention, the auxiliary electrode **210** and/or the transparent conductive layer **220** to be electrically connected to the cathode electrode **116***c* on the lower substrate **100**, are formed on the upper substrate **200**. Then, the two substrates **100** and **200** are bonded to each other. Accordingly, IR drop in the cathode electrode **116***c* can be prevented or reduced.

FIG. **3** is a sectional view illustrating main parts of an organic light emitting display according to another embodiment of the present invention. In FIG. **3**, same reference numerals are assigned to the same elements as those in FIG. **2** and their description will be omitted.

Referring to FIG. **3**, in an organic light emitting display according to another embodiment of the present invention, each of OLEDs **116**' or a red pixel **110**R', a green pixel **110**G', and a blue pixel **110**B' includes white light emitting layer W.

Between the auxiliary electrode **210** of the upper substrate **200**, color filters **230** corresponding to the pixels **110**R', **110**G', and **110**B' are provided. Here, color filters are located at openings of the mesh-type auxiliary electrode **210**. That is, red color filters R C/F, green color filters G C/F, and blue color filters B C/F are formed on the red pixels **110**R', the green pixels **110**G', and the blue pixels **110**B', respectively. Using the color filters, the organic light emitting display displays an image with full colors.

Although not shown in the drawings, when unit pixels include a red pixel, a green pixel, a blue pixel, and a white pixel to display an image with full colors, the white pixel may not include a color filter or may include a filter for adjusting the amount of transmitted light.

This way, in another embodiment, the transparent conductive layer **220** is formed on substantially an entire area of the auxiliary electrode **210** and color filters **230** and contacts the cathode electrodes **116***c* to electrically connect the auxiliary electrode **210** to the cathode electrodes **116***c*.

While the present invention has been described in connection with certain exemplary embodiments, it is to be understood that the invention is not limited to the disclosed embodiments, but, on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims, and equivalents thereof.

What is claimed is:

1. An organic light emitting display comprising:

a first substrate having a plurality of pixels located thereon, each of the pixels comprising an organic light emitting diode, wherein a cathode electrode of the organic light emitting diode comprising a transparent material is located on substantially an entire area of the pixels;

a second substrate having a mesh-type auxiliary electrode located thereon at a side facing the pixels, the mesh-type auxiliary electrode corresponding to non-emission regions between the pixels and electrically connected to the cathode electrode; and

a transparent conductive layer contacting an entire area of the second substrate exposed by the auxiliary electrode and contacting the cathode electrode to electrically connect the auxiliary electrode to the cathode electrode.

2. The organic light emitting display as claimed in claim **1**, wherein the auxiliary electrode comprises a conductive black matrix material.

3. The organic light emitting display as claimed in claim **1**, wherein the auxiliary electrode comprises at least one material selected from the group consisting of chrome (Cr), a chrome alloy, molybdenum (Mo), a molybdenum alloy, a chrome oxide (CrOx), a molybdenum oxide (MoOx), and combinations thereof

4. The organic light emitting display as claimed in claim **1**, wherein the auxiliary electrode comprises a material with a lower specific resistance than a material for the cathode electrode.

5. The organic light emitting display as claimed in claim **1**, wherein the transparent conductive layer comprises indium tin oxide (ITO).

6. The organic light emitting display as claimed in claim **1**, wherein the transparent conductive layer contacts the cathode electrode at the non-emission regions between the pixels.

7. The organic light emitting display as claimed in claim **1**, wherein the organic light emitting diode comprises a light emission layer for emitting a red light, a green light, or a blue light.

8. The organic light emitting display as claimed in claim **1**, wherein the organic light emitting diode comprises a light emission layer for emitting a white light.

9. The organic light emitting display as claimed in claim **8**, further comprising red color filters, green color filters, and blue color filters respectively located at openings of the auxiliary electrode to correspond to the pixels.

10. An organic light emitting display comprising:

a first substrate having a plurality of pixels located thereon, each of the pixels comprising an organic light emitting diode comprising a light emission layer for emitting a white light, wherein a cathode electrode of the organic light emitting diode comprising a transparent material is located on substantially an entire area of the pixels;

a second substrate having a mesh-type auxiliary electrode located thereon at a side facing the pixels, the mesh-type auxiliary electrode corresponding to non-emission regions between the pixels and electrically connected to the cathode electrode;

red color filters, green color filters, and blue color filters respectively located at openings of the auxiliary electrode to correspond to the pixels; and

a transparent conductive layer on the auxiliary electrode and the color filters and contacting the cathode electrode to electrically connect the auxiliary electrode to the cathode electrode,

wherein the transparent conductive layer contacts substantially an entire area of the auxiliary electrode and the color filters facing the first substrate.

11. An organic light emitting display comprising:

a first substrate;

a second substrate facing the first substrate with a gap therebetween;

a plurality of organic light emitting diodes (OLEDs) on the first substrate, the OLEDs sharing a common electrode comprising a substantially transparent material, each of the OLEDs comprising a pixel electrode and a light emission layer between the pixel electrode and the common electrode;

a plurality of thin film transistors on the first substrate and electrically connected to the OLEDs;

an auxiliary electrode on the second substrate at non-emission regions between the OLEDs and electrically connected to the common electrode to reduce a resistance across the common electrode; and

a transparent conductive layer contacting an entire area of the second substrate exposed by the auxiliary electrode and contacting the common electrode to electrically connect the auxiliary electrode to the common electrode.

12. The organic light emitting display of claim **11**, wherein the auxiliary electrode is a mesh-type electrode having openings corresponding to the OLEDs.

13. The organic light emitting display of claim **12**, further comprising a plurality of color filters at the openings of the mesh-type electrode.

14. The organic light emitting display of claim **11**, wherein the transparent conductive layer is between the auxiliary electrode and the common electrode.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO.	: 8,354,980 B2
APPLICATION NO.	: 12/564004
DATED	: January 15, 2013
INVENTOR(S)	: Won-Kyu Kwak

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the Claims

Column 5, Claim 3, line 57 — Delete "thereof"
Insert -- thereof. --

Signed and Sealed this
Fifteenth Day of July, 2014

Michelle K. Lee
Deputy Director of the United States Patent and Trademark Office

专利名称(译)	有机发光显示器		
公开(公告)号	US8354980	公开(公告)日	2013-01-15
申请号	US12/564004	申请日	2009-09-21
[标]申请(专利权)人(译)	KWAK WON KYU		
申请(专利权)人(译)	KWAK WON-KYU		
当前申请(专利权)人(译)	三星DISPLAY CO.，LTD.		
[标]发明人	KWAK WON KYU		
发明人	KWAK, WON-KYU		
IPC分类号	G09G3/30 G09G3/32		
CPC分类号	H01L51/5234 H01L27/322 H01L51/5036 H01L51/5228 H01L51/524 H01L51/525 H01L51/5284		
优先权	1020080101947 2008-10-17 KR		
其他公开文献	US20100097295A1		
外部链接	Espacenet USPTO		

摘要(译)

有机发光显示器能够减少或防止阴极中的IR降。有机发光显示器包括第一基板和第二基板。第一基板上具有多个像素，每个像素包括有机发光二极管，其中包括透明材料的有机发光二极管的阴极位于像素的基本上整个区域上。第二基板在面对像素的一侧具有位于其上的网格型辅助电极，网格型辅助电极对应于像素之间的非发光区域并且电连接到阴极电极。