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(54) **METHOD FOR PREVENTING SHORT CIRCUIT BETWEEN METAL WIRES IN ORGANNIC LIGHT EMITTING DIODE DISPLAY DEVICE**

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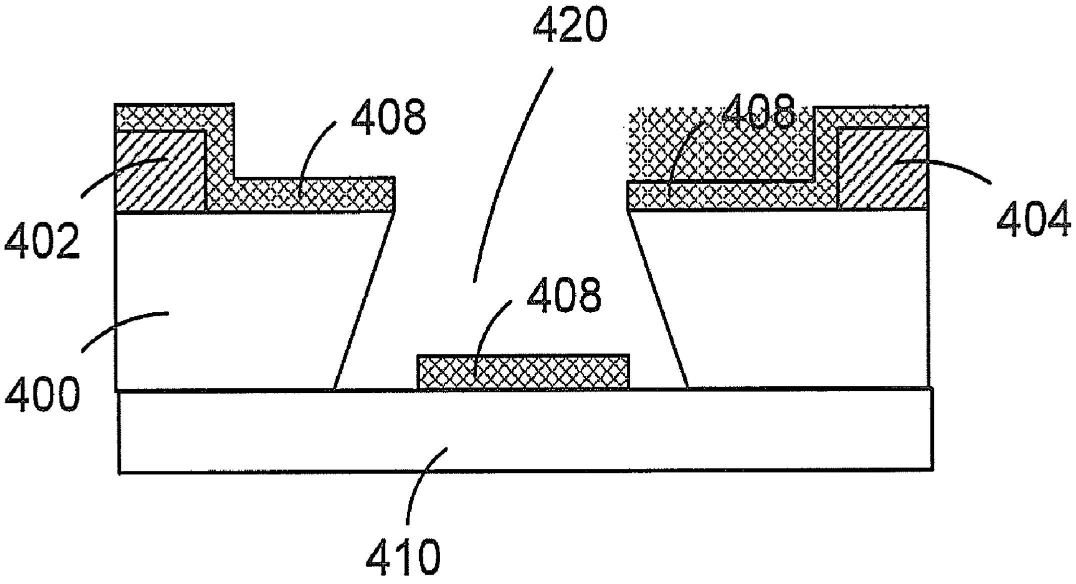
USPC **438/34**

(57) **ABSTRACT**

Disclosed is a method for preventing a short circuit between metal wires in an organic light emitting diode display device. The method includes: forming an inorganic layer on a substrate; forming an opening in the inorganic layer for exposing a part of the substrate; forming a metal layer on the inorganic layer, the metal layer including two metal wires respectively positioned at two sides of the opening; forming an organic layer on the two metal wires of the metal layer; and forming an indium tin oxide layer on the organic layer. The present invention can ensure that the short circuit does not occur between the metal wires by forming the opening in the inorganic layer.



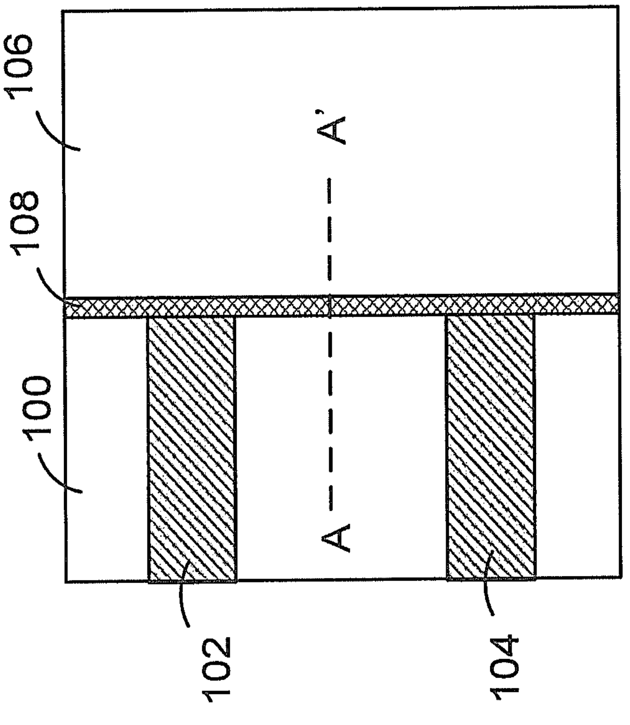


FIG. 1 (PRIOR ART)

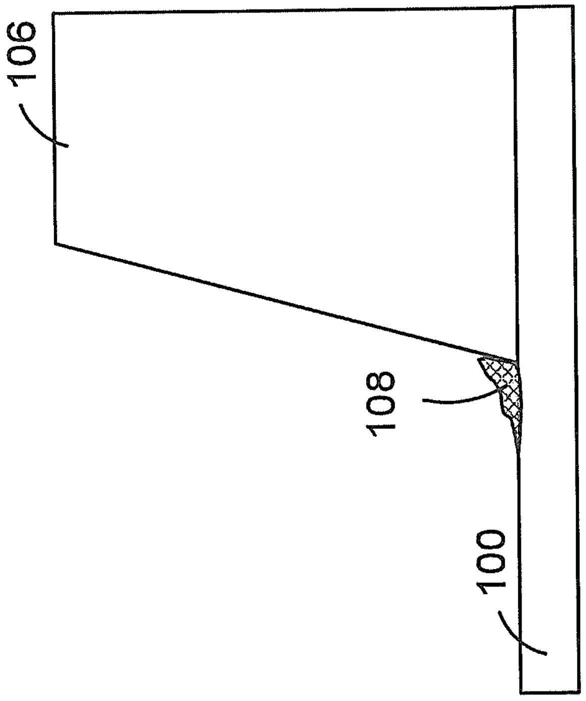


FIG. 2 (PRIOR ART)

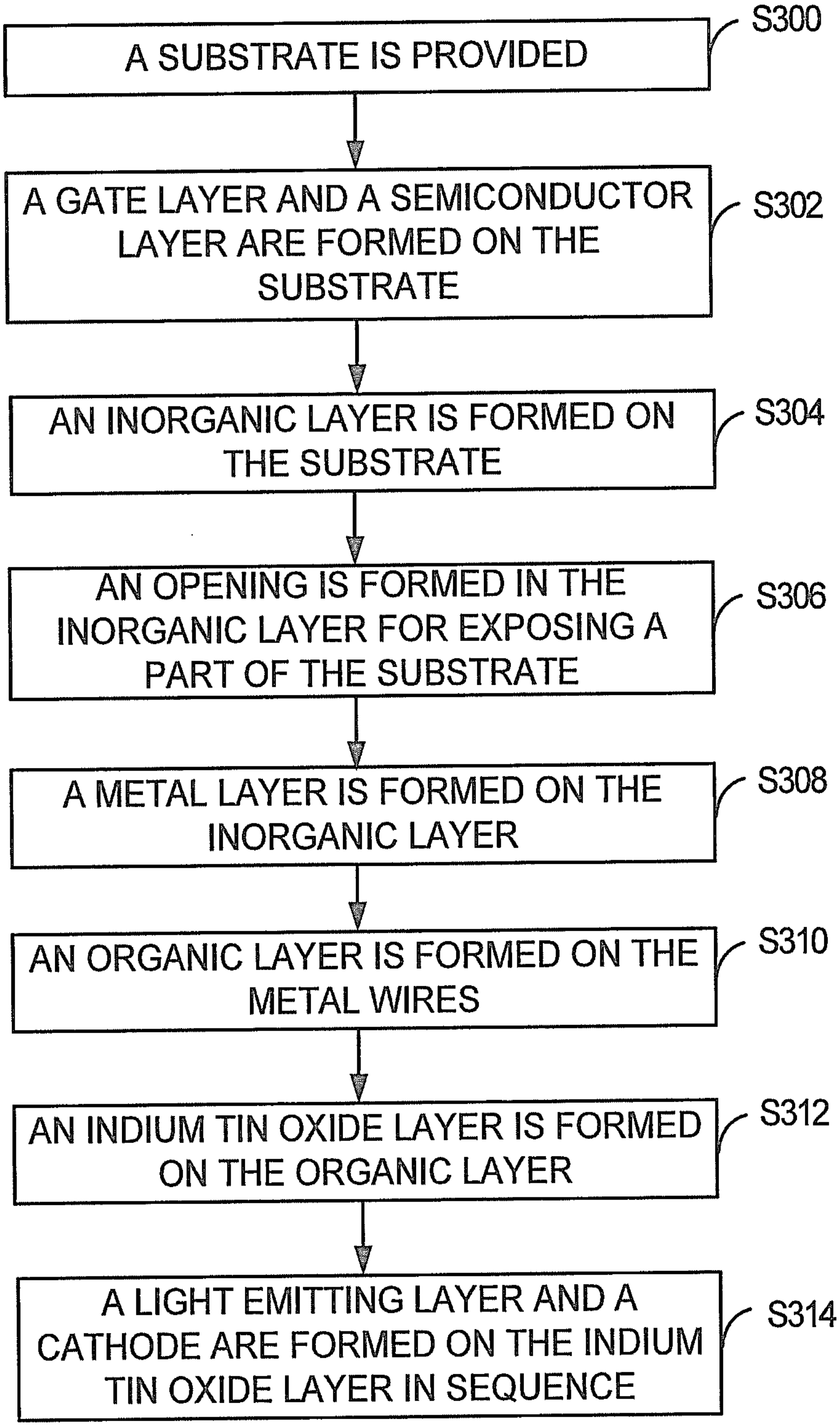

A SUBSTRATE IS PROVIDED
S300
A GATE LAYER AND A SEMICONDUCTOR LAYER ARE FORMED ON THE SUBSTRATE
S302
AN INORGANIC LAYER IS FORMED ON THE SUBSTRATE
S304
AN OPENING IS FORMED IN THE INORGANIC LAYER FOR EXPOSING A PART OF THE SUBSTRATE
S306
A METAL LAYER IS FORMED ON THE INORGANIC LAYER
S308
AN ORGANIC LAYER IS FORMED ON THE METAL WIRES
S310
AN INDIUM TIN OXIDE LAYER IS FORMED ON THE ORGANIC LAYER
S312
A LIGHT EMITTING LAYER AND A CATHODE ARE FORMED ON THE INDIUM TIN OXIDE LAYER IN SEQUENCE
S314

FIG. 3

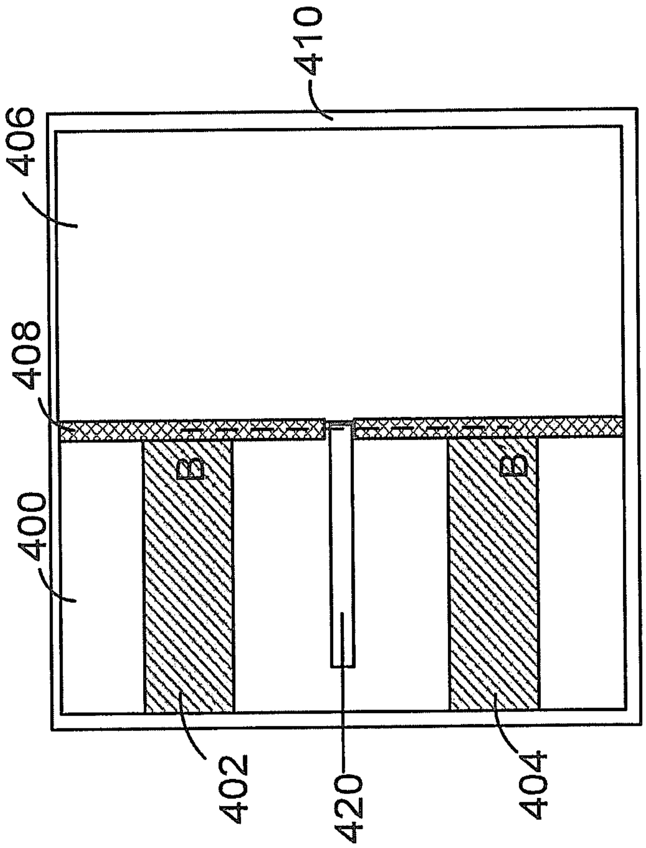


FIG. 4

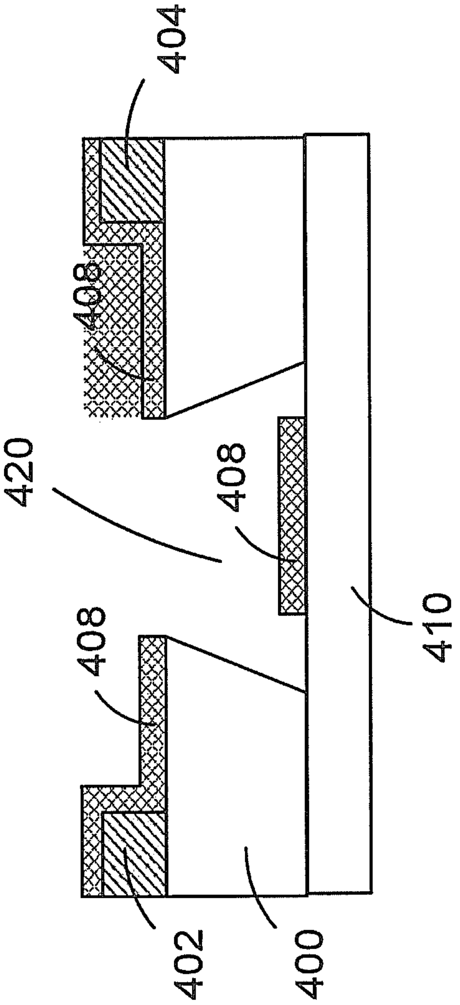
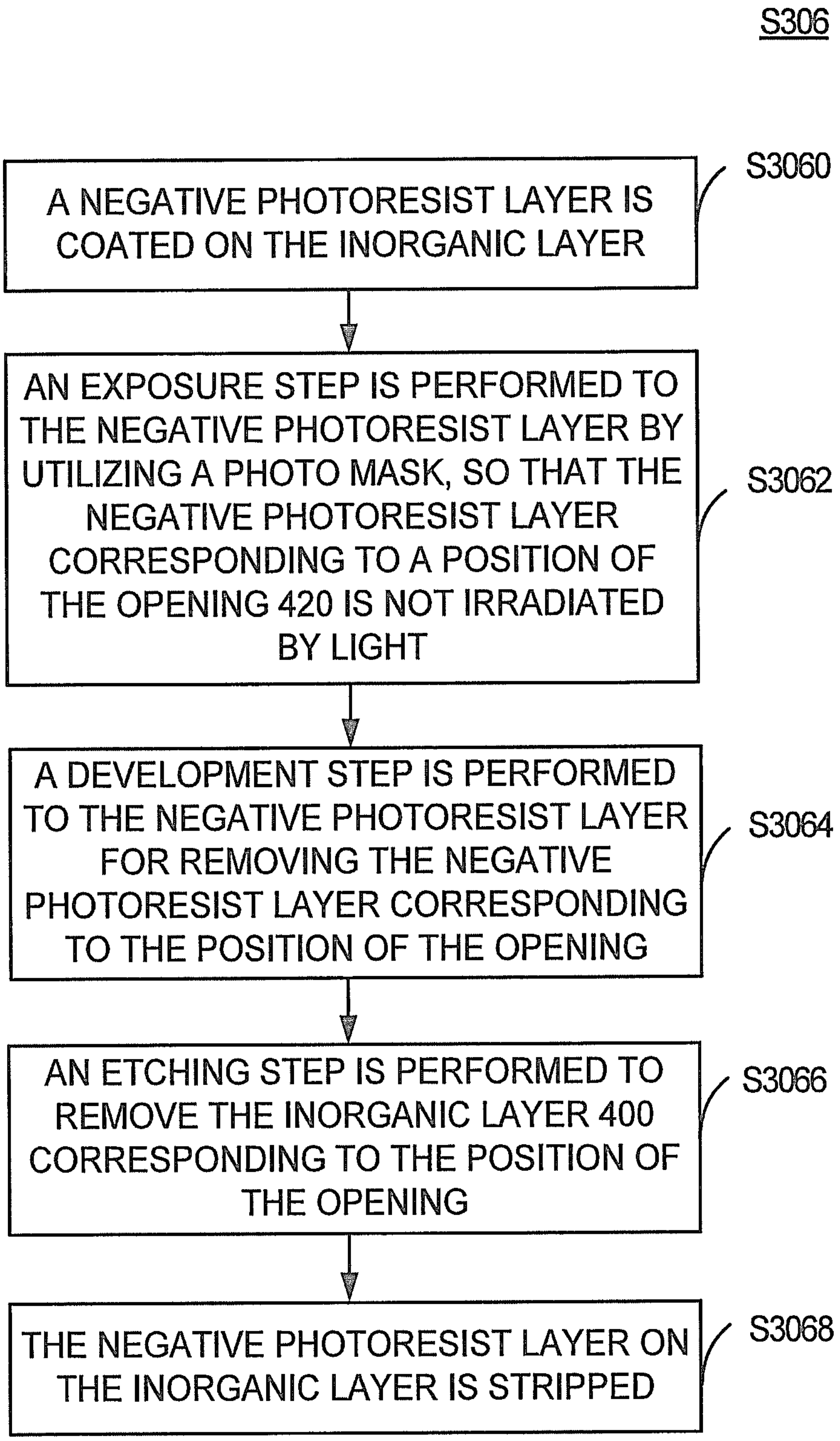


FIG. 5



A NEGATIVE PHOTORESIST LAYER IS COATED ON THE INORGANIC LAYER

AN EXPOSURE STEP IS PERFORMED TO THE NEGATIVE PHOTORESIST LAYER BY UTILIZING A PHOTO MASK, SO THAT THE NEGATIVE PHOTORESIST LAYER CORRESPONDING TO A POSITION OF THE OPENING 420 IS NOT IRRADIATED BY LIGHT

A DEVELOPMENT STEP IS PERFORMED TO THE NEGATIVE PHOTORESIST LAYER FOR REMOVING THE NEGATIVE PHOTORESIST LAYER CORRESPONDING TO THE POSITION OF THE OPENING

AN ETCHING STEP IS PERFORMED TO REMOVE THE INORGANIC LAYER 400 CORRESPONDING TO THE POSITION OF THE OPENING

THE NEGATIVE PHOTORESIST LAYER ON THE INORGANIC LAYER IS STRIPPED

FIG. 6

METHOD FOR PREVENTING SHORT CIRCUIT BETWEEN METAL WIRES IN ORGANNIC LIGHT EMITTING DIODE DISPLAY DEVICE

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention generally relates to an organic light emitting diode display device field, and more particularly to a method for preventing a short circuit between metal wires in an organic light emitting diode display device.

[0003] 2. Description of Prior Art

[0004] An organic light emitting diode (OLED) display device has advantages of self-luminescent, lower power consumption, and wide viewing angle, and thus the organic light emitting diode display device is regarded as a display device with high development potential in the future.

[0005] Please refer to FIG. **1** and FIG. **2**. FIG. **1** illustrates a top view of some elements of a conventional organic light emitting diode display device. FIG. **2** illustrates a cross-sectional view along a line AA' in FIG. **1**.

[0006] In a manufacturing process of the organic light emitting diode display device, a plurality of thin film transistors which are served as switch elements are manufactured on a substrate (not shown) firstly, and then organic light emitting diodes which are served as light emitting elements are manufactured.

[0007] Manufacturing the thin film transistors and the light emitting diodes comprises the following steps. Firstly, a gate layer (not shown) and a semiconductor layer (not shown) are formed on the substrate (not shown). Then, an inorganic layer **100** is formed, and a metal layer is formed on the inorganic layer **100**. The metal layer comprises metal wires **102** and **104** for respectively transmitting independent signals, that is, for transmitting different signals. An organic layer **106** is formed on the metal wires **102** and **104**. An indium tin oxide (ITO) layer **108** is formed on the organic layer **106**. The indium tin oxide layer **108** is utilized as an anode of an organic light emitting diode. Finally, a light emitting layer (now shown) and a cathode (not shown) are formed on the indium tin oxide layer **108**.

[0008] However, in the manufacturing process of the organic light emitting diode display device, a photoresist layer (not shown) is formed on the indium tin oxide layer **108** after the indium tin oxide layer **108** is deposited. During an exposure step, a top of the organic layer **106** masks out a bottom of the indium tin oxide layer **108** because the organic layer **106** is too thick. Accordingly, the bottom of the indium tin oxide layer **106** cannot be irradiated by light. That is, the organic layer **106** generates shadowing effect. As a result, after an etching step is performed and the photoresist layer (not shown) is removed, a fraction of the indium tin oxide layer **108** is left as shown in FIG. **2**, so that a short circuit occurs between the metal wires **102** and **104**.

[0009] Consequently, there is a need to solve the problem that the short circuit occurs between the metal wires **102** and **104** because the fraction of the indium tin oxide layer **108** is left.

SUMMARY OF THE INVENTION

[0010] An objective of the present invention is to provide a method for preventing a short circuit between metal wires in an organic light emitting diode display device capable of solving the problem that a short circuit occurs between metal wires because an indium tin oxide layer is left.

[0011] To solve the above-mentioned problem, a method for preventing a short circuit between metal wires in an organic light emitting diode display device provided by the present invention comprises:

[0012] forming an inorganic layer on a substrate;

[0013] forming an opening in the inorganic layer for exposing a part of the substrate, the opening having a shape with narrow top and wide bottom;

[0014] forming a metal layer on the inorganic layer, the metal layer comprising two metal wires respectively positioned at two sides of the opening;

[0015] forming an organic layer on the two metal wires of the metal layer, the organic layer at least covering a part of the two metal wires; and

[0016] forming an indium tin oxide layer on the organic layer.

[0017] In the method for preventing the short circuit between the metal wires in the organic light emitting diode display device of the present invention, the step of forming the opening in the inorganic layer for exposing the part of the substrate comprises:

[0018] coating a negative photoresist layer on the inorganic layer;

[0019] performing an exposure step to the negative photoresist layer by utilizing a photo mask, so that the negative photoresist layer corresponding to a position of the opening is not irradiated by light;

[0020] performing a development step to the negative photoresist layer for removing the negative photoresist layer corresponding to the position of the opening; and

[0021] performing an etching step to remove the inorganic layer corresponding to the position of the opening.

[0022] After the step of performing the etching step to remove the inorganic layer corresponding to the position of the opening, the method for preventing the short circuit between the metal wires in the organic light emitting diode display device of the present invention further comprises a step of:

[0023] stripping the negative photoresist layer on the inorganic layer.

[0024] In the method for preventing the short circuit between the metal wires in the organic light emitting diode display device of the present invention, the two metal wires are utilized as sources.

[0025] In the method for preventing the short circuit between the metal wires in the organic light emitting diode display device of the present invention, the two metal wires are utilized as drains.

[0026] In the method for preventing the short circuit between the metal wires in the organic light emitting diode display device of the present invention, the two metal wires are formed by a wet etching method.

[0027] To solve the above-mentioned problem, a method for preventing a short circuit between metal wires in an organic light emitting diode display device provided by the present invention comprises:

[0028] forming an inorganic layer on a substrate;

[0029] forming an opening in the inorganic layer for exposing a part of the substrate;

[0030] forming a metal layer on the inorganic layer, the metal layer comprising two metal wires respectively positioned at two sides of the opening;

[0031] forming an organic layer on the two metal wires of the metal layer; and

[0032] forming an indium tin oxide layer on the organic layer.

[0033] In the method for preventing the short circuit between the metal wires in the organic light emitting diode display device of the present invention, the step of forming the opening in the inorganic layer for exposing the part of the substrate comprises:

[0034] coating a negative photoresist layer on the inorganic layer;

[0035] performing an exposure step to the negative photoresist layer by utilizing a photo mask, so that the negative photoresist layer corresponding to a position of the opening is not irradiated by light;

[0036] performing a development step to the negative photoresist layer for removing the negative photoresist layer corresponding to the position of the opening; and

[0037] performing an etching step to remove the inorganic layer corresponding to the position of the opening.

[0038] After the step of performing the etching step to remove the inorganic layer corresponding to the position of the opening, the method for preventing the short circuit between the metal wires in the organic light emitting diode display device of the present invention further comprises a step of:

[0039] stripping the negative photoresist layer on the inorganic layer.

[0040] In the method for preventing the short circuit between the metal wires in the organic light emitting diode display device of the present invention, the two metal wires are utilized as sources.

[0041] In the method for preventing the short circuit between the metal wires in the organic light emitting diode display device of the present invention, the two metal wires are utilized as drains.

[0042] In the method for preventing the short circuit between the metal wires in the organic light emitting diode display device of the present invention, the organic layer at least covers a part of the two metal wires.

[0043] In the method for preventing the short circuit between the metal wires in the organic light emitting diode display device of the present invention, the two metal wires are formed by a wet etching method.

[0044] Compared with the prior arts, the method for preventing the short circuit between the metal wires in the organic light emitting diode display device of the present invention can ensure that the short circuit does not occur between the metal wires by forming the opening in the inorganic layer.

[0045] For a better understanding of the aforementioned content of the present invention, preferable embodiments are illustrated in accordance with the attached figures for further explanation:

BRIEF DESCRIPTION OF THE DRAWINGS

[0046] FIG. **1** illustrates a top view of some elements of a conventional organic light emitting diode display device;

[0047] FIG. **2** illustrates a cross-sectional view along a line AA' in FIG. **1**;

[0048] FIG. **3** illustrates a flow chart of a method for preventing a short circuit between metal wires in an organic light emitting diode display device in accordance with an embodiment of the present invention;

[0049] FIG. **4** illustrates a top view of some elements of the organic light emitting diode display device in accordance with the embodiment of the present invention;

[0050] FIG. **5** illustrates a cross-sectional view along a line BB' in FIG. **4**; and

[0051] FIG. **6** illustrates specific steps of step S**306** in FIG. **5**.

DETAILED DESCRIPTION OF THE INVENTION

[0052] The following descriptions for the respective embodiments are specific embodiments capable of being implemented for illustrations of the present invention with referring to appended figures. For example, the terms of up, down, front, rear, left, right, interior, exterior, side, etcetera are merely directions of referring to appended figures. Therefore, the wordings of directions are employed for explaining and understanding the present invention but not limitations thereto.

[0053] Please refer to FIG. **3** to FIG. **5**. FIG. **3** illustrates a flow chart of a method for preventing a short circuit between metal wires in an organic light emitting diode display device in accordance with an embodiment of the present invention. FIG. **4** illustrates a top view of some elements of the organic light emitting diode display device in accordance with the embodiment of the present invention. FIG. **5** illustrates a cross-sectional view along a line BB' in FIG. **4**.

[0054] In step S**300**, a substrate **410** is provided.

[0055] In step S**302**, a gate layer (not shown) and a semiconductor layer (not shown) are formed on the substrate **410**.

[0056] It is noted that since formation methods of the gate layer (not shown) and the semiconductor layer (not shown) are the same as those in the prior arts and are not key points of the present invention, they are not shown in FIG. **4** and FIG. **5**.

[0057] In step S**304**, an inorganic layer **400** is formed on the substrate **410**. It is noted that an area of the inorganic layer **400** formed on the substrate **410** is different from an area of the gate layer (not shown) and the semiconductor layer (not shown) formed on the substrate **410**.

[0058] In step **306**, an opening **420** is formed in the inorganic layer **400** for exposing a part of the substrate **410**.

[0059] Please refer to FIG. **6**. FIG. **6** illustrates specific steps of step S**306** in FIG. **5**.

[0060] In step S**3060**, a negative photoresist layer is coated on the inorganic layer **400**.

[0061] In step S**3062**, an exposure step is performed to the negative photoresist layer by utilizing a photo mask, so that the negative photoresist layer corresponding to a position of the opening **420** is not irradiated by light.

[0062] In step S**3064**, a development step is performed to the negative photoresist layer for removing the negative photoresist layer corresponding to the position of the opening **420**.

[0063] In step S**3066**, an etching step is performed to remove the inorganic layer **400** corresponding to the position of the opening **420**.

[0064] In step **3068**, the negative photoresist layer on the inorganic layer **400** is stripped.

[0065] Since the negative photoresist layer is utilized, the opening **420** has a shape with narrow top and wide bottom as shown in FIG. **5**, i.e. has a mushroom structure.

[0066] Please refer back to FIG. **3** to FIG. **5**. Step S**308** is performed after the above-mentioned step S**306**. In step S**308**, a metal layer is formed on the inorganic layer **400**. The metal layer comprises at least two metal wires **402** and **404** which are served as sources or drains. The metal wires **402** and **404** are respectively positioned at two sides of the opening **420** for transmitting independent signals, that is, for transmitting different signals.

[0067] The two metal wires **402** and **404** are, for example, but are not limited to, formed by a wet etching method.

[0068] In step S**310**, an organic layer **406** is formed on the metal wires **402** and **404**. The organic layer **406** at least covers a part of the metal wire **402** and a part of the metal wire **404**. The organic layer **406** and the inorganic layer **400** are utilized as insulating layers and have a flat function for improving quality of manufacturing an organic light emitting diode in the following process.

[0069] In step S**312**, an indium tin oxide (ITO) layer **408** is formed on the organic layer **406**. The indium tin oxide layer **408** is utilized as an anode of the organic light emitting diode.

[0070] It is noted that a position of the light emitting diode is formed in a light emitting area (not shown) of the substrate **410**, and FIG. **4** and FIG. **5** illustrates a thin film transistor area. The indium tin oxide layer **408** (utilized as the anode of the light emitting diode) is required to be formed only in the light emitting area (not shown), and the indium tin oxide layer **408** is not required to be formed in the thin film transistor area. Accordingly, the indium tin oxide layer **408** in the thin film transistor area is required to be removed. However, due to the shadowing effect in the prior arts, the indium tin oxide layer **408** in the thin film transistor area cannot be completely removed after the exposure step, the development step, and the etching step, so that a fraction of the indium tin oxide layer **408** between a border of the inorganic layer **400** and the organic layer **406** is left (as shown in FIG. **2**) and a short circuit occurs between the metal wires **402** and **404**. In the present invention, the opening **420** is formed in the inorganic layer **400** (step S**306**). As a result, when the indium tin oxide layer **408** is formed (step S**312**), the indium tin oxide layer **408** has a disconnect structure formed in the position of the opening **420**. That is, the indium tin oxide layer **408** in FIG. **5** is not a continuous wire. Accordingly, even if the indium tin oxide layer **408** is not completely etched so that the fraction of the indium tin oxide layer **408** is left between the border of the inorganic layer **400** and the organic **406** (as shown in FIG. **2**), it can be ensured that the short circuit between the metal wires **402** and **404** does not occur.

[0071] In step S**314**, a light emitting layer (not shown) and a cathode (now shown) are formed on the indium tin oxide layer in the light emitting area (not shown) in sequence for finishing the manufacturing of the organic light emitting diode.

[0072] It is noted that since formation methods of the light emitting layer (not shown) and the cathode (not shown) are not key points of the present invention, they are not shown in FIG. **4** and FIG. **5**.

[0073] As is understood by a person skilled in the art, the foregoing preferred embodiments of the present invention are illustrative rather than limiting of the present invention. It is intended that they cover various modifications and similar arrangements be included within the spirit and scope of the appended claims, the scope of which should be accorded the broadest interpretation so as to encompass all such modifications and similar structure.

What is claimed is:

1. A method for preventing a short circuit between metal wires in an organic light emitting diode display device, comprising:

forming an inorganic layer on a substrate;

forming an opening in the inorganic layer for exposing a part of the substrate, the opening having a shape with narrow top and wide bottom;

forming a metal layer on the inorganic layer, the metal layer comprising two metal wires respectively positioned at two sides of the opening;

forming an organic layer on the two metal wires of the metal layer, the organic layer at least covering a part of the two metal wires; and

forming an indium tin oxide layer on the organic layer.

2. The method for preventing the short circuit between the metal wires in the organic light emitting diode display device of claim **1**, wherein the step of forming the opening in the inorganic layer for exposing the part of the substrate comprises:

coating a negative photoresist layer on the inorganic layer;

performing an exposure step to the negative photoresist layer by utilizing a photo mask, so that the negative photoresist layer corresponding to a position of the opening is not irradiated by light;

performing a development step to the negative photoresist layer for removing the negative photoresist layer corresponding to the position of the opening; and

performing an etching step to remove the inorganic layer corresponding to the position of the opening.

3. The method for preventing the short circuit between the metal wires in the organic light emitting diode display device of claim **2**, further comprising a step of stripping the negative photoresist layer on the inorganic layer after the step of performing the etching step to remove the inorganic layer corresponding to the position of the opening.

4. The method for preventing the short circuit between the metal wires in the organic light emitting diode display device of claim **1**, wherein the two metal wires are utilized as sources.

5. The method for preventing the short circuit between the metal wires in the organic light emitting diode display device of claim **1**, wherein the two metal wires are utilized as drains.

6. The method for preventing the short circuit between the metal wires in the organic light emitting diode display device of claim **1**, wherein the two metal wires are formed by a wet etching method.

7. A method for preventing a short circuit between metal wires in an organic light emitting diode display device, comprising:

forming an inorganic layer on a substrate;

forming an opening in the inorganic layer for exposing a part of the substrate;

forming a metal layer on the inorganic layer, the metal layer comprising two metal wires respectively positioned at two sides of the opening;

forming an organic layer on the two metal wires of the metal layer; and

forming an indium tin oxide layer on the organic layer.

8. The method for preventing the short circuit between the metal wires in the organic light emitting diode display device of claim **7**, wherein the step of forming the opening in the inorganic layer for exposing the part of the substrate comprises:

coating a negative photoresist layer on the inorganic layer;

performing an exposure step to the negative photoresist layer by utilizing a photo mask, so that the negative photoresist layer corresponding to a position of the opening is not irradiated by light;

performing a development step to the negative photoresist layer for removing the negative photoresist layer corresponding to the position of the opening; and

performing an etching step to remove the inorganic layer corresponding to the position of the opening.

9. The method for preventing the short circuit between the metal wires in the organic light emitting diode display device of claim **8**, further comprising a step of stripping the negative photoresist layer on the inorganic layer after the step of performing the etching step to remove the inorganic layer corresponding to the position of the opening.

10. The method for preventing the short circuit between the metal wires in the organic light emitting diode display device of claim **7**, wherein the two metal wires are utilized as sources.

11. The method for preventing the short circuit between the metal wires in the organic light emitting diode display device of claim **7**, wherein the two metal wires are utilized as drains.

12. The method for preventing the short circuit between the metal wires in the organic light emitting diode display device of claim **7**, wherein the organic layer at least covers a part of the two metal wires.

13. The method for preventing the short circuit between the metal wires in the organic light emitting diode display device of claim **7**, wherein the two metal wires are formed by a wet etching method.

* * * * *

专利名称(译)	防止有机发光二极管显示装置中的金属线之间短路的方法		
公开(公告)号	US20150050766A1	公开(公告)日	2015-02-19
申请号	US14/235804	申请日	2013-11-28
[标]申请(专利权)人(译)	深圳市华星光电技术有限公司		
申请(专利权)人(译)	深圳市中国星光电科技有限公司.		
当前申请(专利权)人(译)	深圳市中国星光电科技有限公司		
[标]发明人	KO KAI YUAN		
发明人	KO, KAI-YUAN		
IPC分类号	H01L51/56 H01L27/32		
CPC分类号	H01L51/56 H01L2251/5392 H01L27/3276 H01L27/3248		
优先权	201310361665.0 2013-08-19 CN		
其他公开文献	US9012251		
外部链接	Espacenet USPTO		

摘要(译)

公开了一种用于防止有机发光二极管显示装置中的金属线之间的短路的方法。该方法包括：在基板上形成无机层;在无机层中形成开口，用于暴露部分衬底;在无机层上形成金属层，金属层包括分别位于开口两侧的两根金属线;在金属层的两根金属线上形成有机层;在有机层上形成氧化铟锡层。本发明可以通过在无机层中形成开口来确保在金属线之间不发生短路。