US 20130200378A1

(19) United States
(12) Patent Application Publication
(10) Pub. No.: US 2013/0200378 A1
(43) Pub. Date: Aug. 8, 2013
Park et al.

(54) **METHOD AND APPARATUS FOR FORMING ORGANIC MATERIAL PATTERN, ORGANIC LIGHT EMITTING DISPLAY APPARATUS, AND METHOD OF MANUFACTURING ORGANIC LIGHT EMITTING DISPLAY APPARATUS**

(76) Inventors: **Jung-Tae Park**, Yongin-city (KR); **Seog-Young Lee**, Seoul (KR)

(21) Appl. No.: **13/588,789**

(22) Filed: **Aug. 17, 2012**

(30) **Foreign Application Priority Data**

Feb. 7, 2012 (KR) 10-2012-0012541

Publication Classification

(51) **Int. Cl.**
H01L 27/15 (2006.01)
H05B 3/00 (2006.01)
H01L 33/36 (2010.01)
H05B 33/10 (2006.01)

(52) **U.S. Cl.**
USPC **257/59**; 427/66; 156/60; 219/200; 257/72; 438/34; 257/E27.121; 257/E33.062

(57) **ABSTRACT**

A method and an apparatus for forming an organic material pattern in a desired pattern on a substrate to improve device durability and image quality characteristics, an organic light emitting display apparatus, and a method of manufacturing an organic light emitting display apparatus, are provided. The apparatus includes a heater overlapping with a region of the substrate different from another region of the substrate in which the organic material pattern is to be formed, a power source for applying a voltage to the heater, and wiring for electrically connecting the power source with the heater.

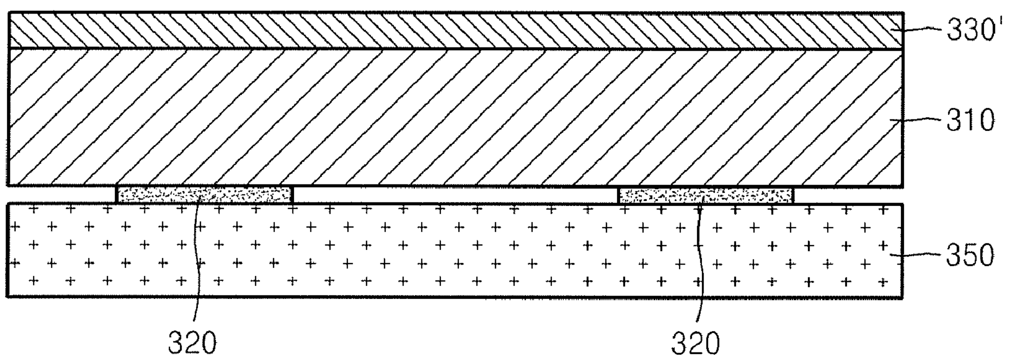


FIG. 1

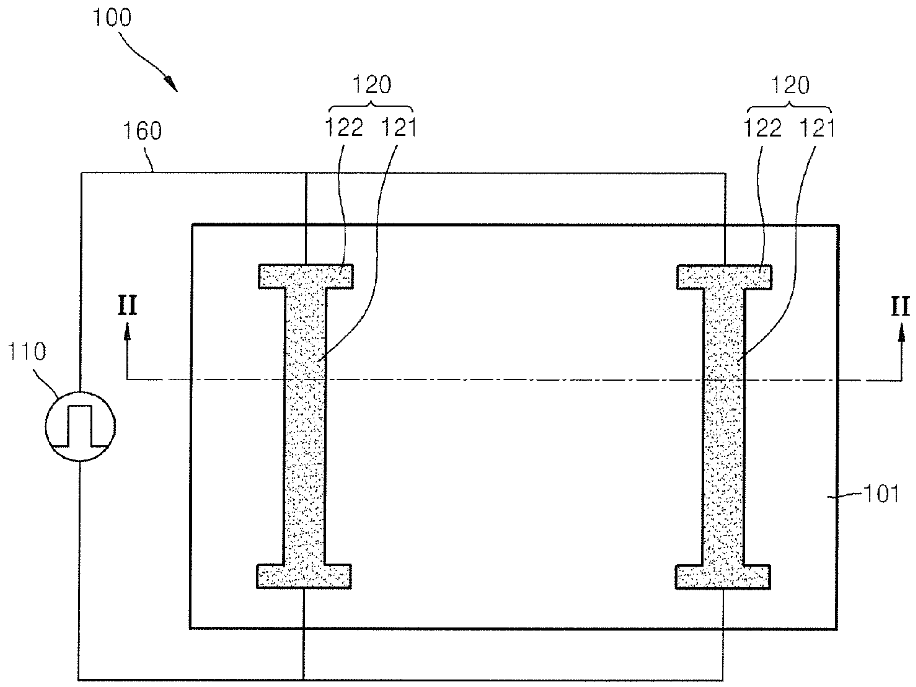


FIG. 2

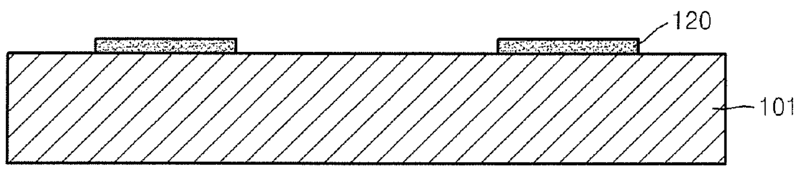


FIG. 3A

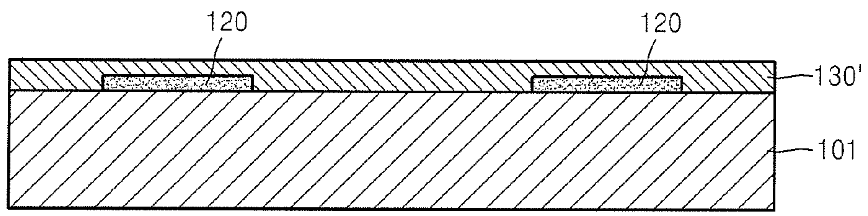


FIG. 3B

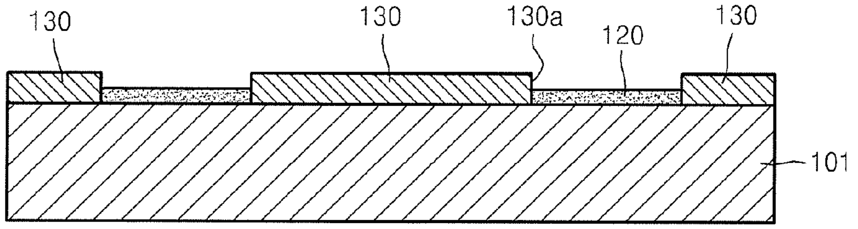


FIG. 4

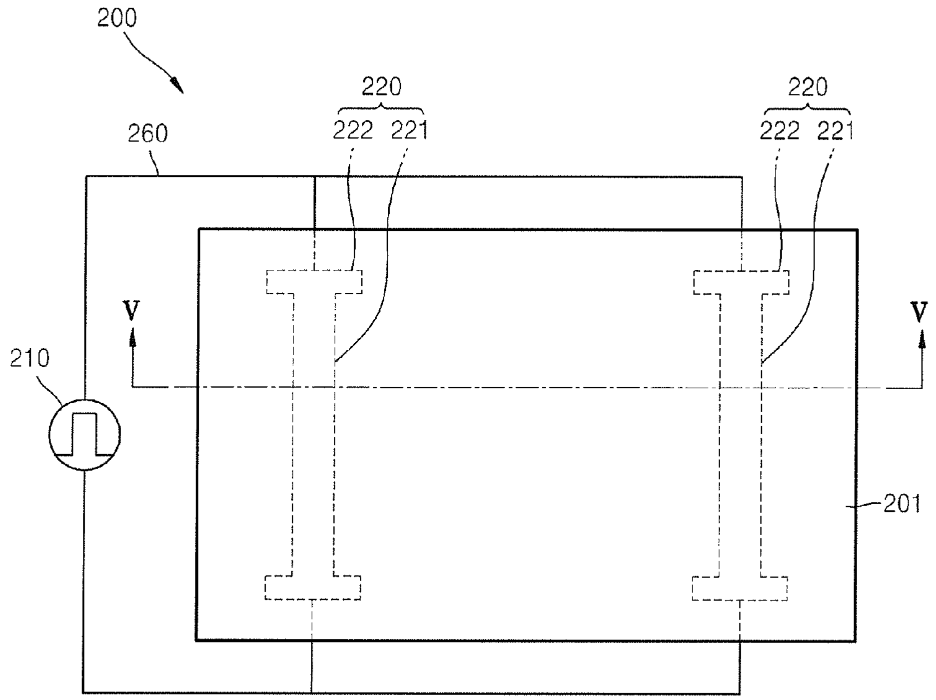


FIG. 5

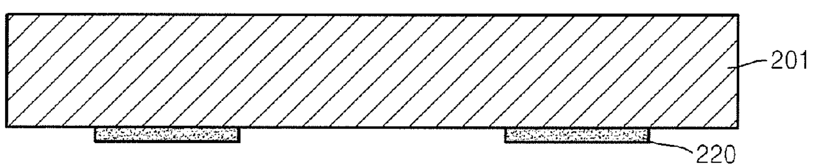


FIG. 6A

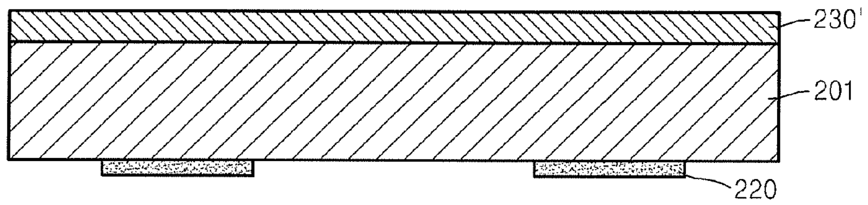


FIG. 6B

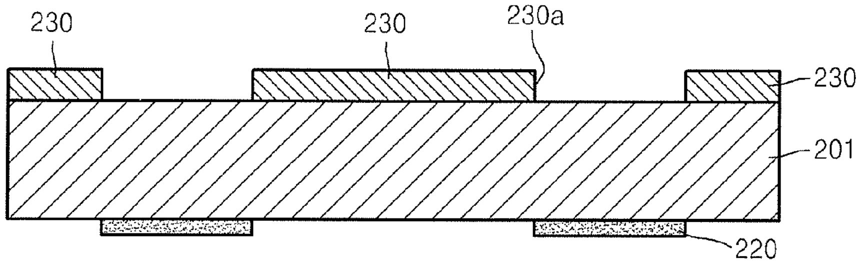


FIG. 7

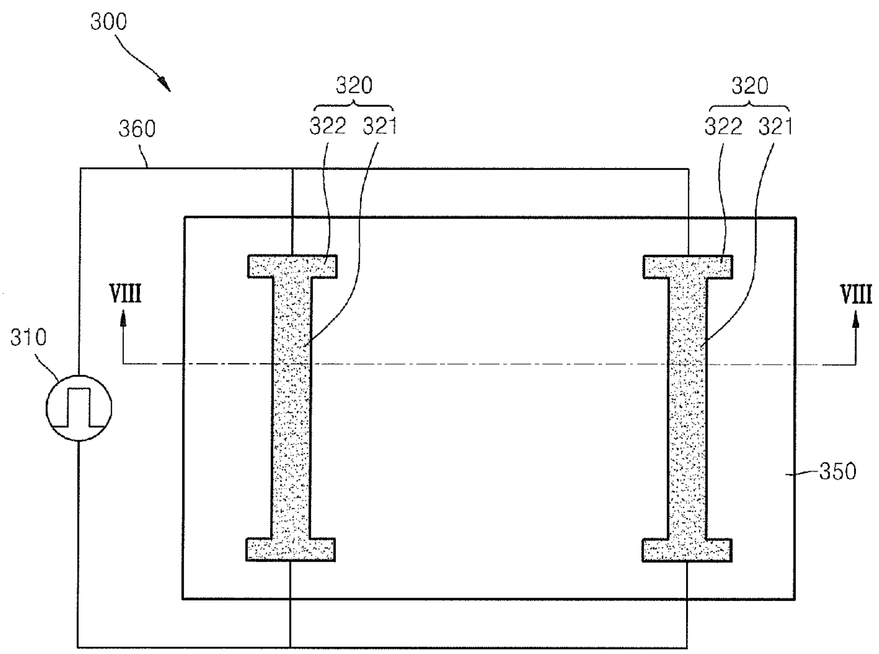


FIG. 8

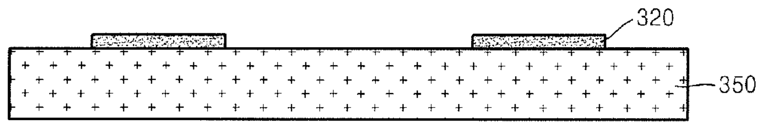


FIG. 9A

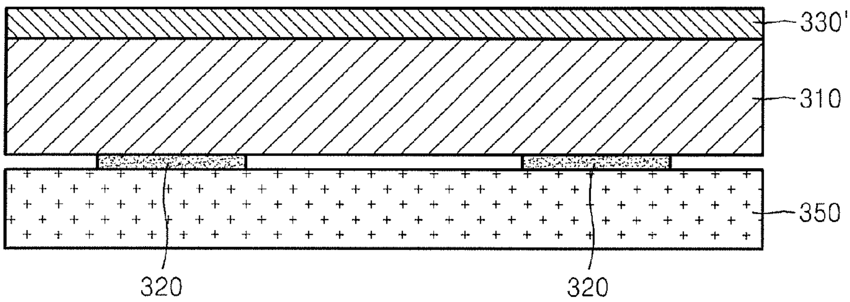


FIG. 9B

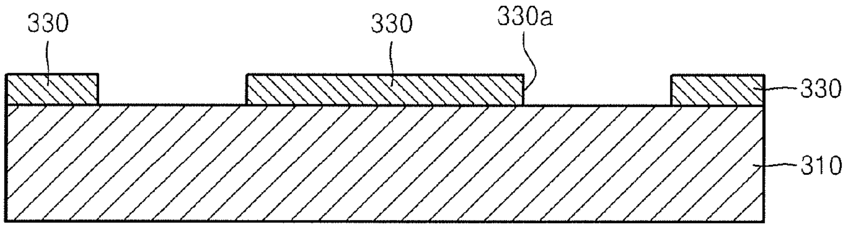


FIG. 10

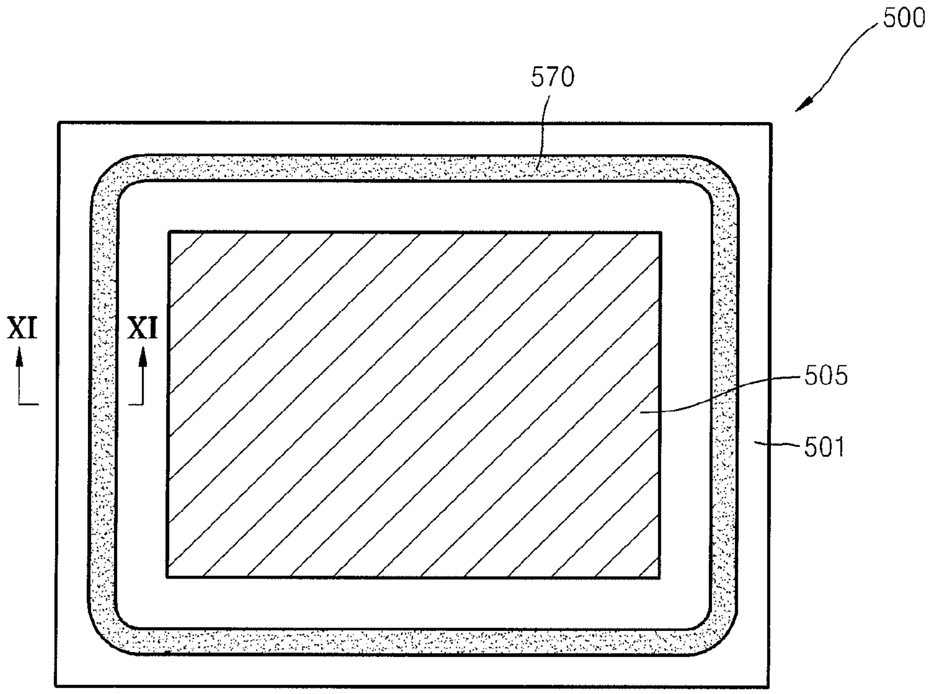


FIG. 11

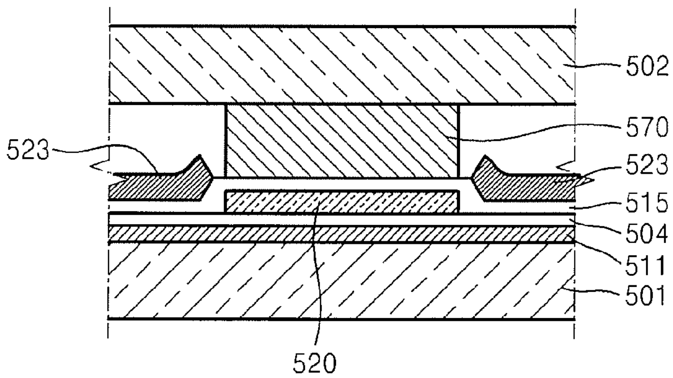


FIG. 12A

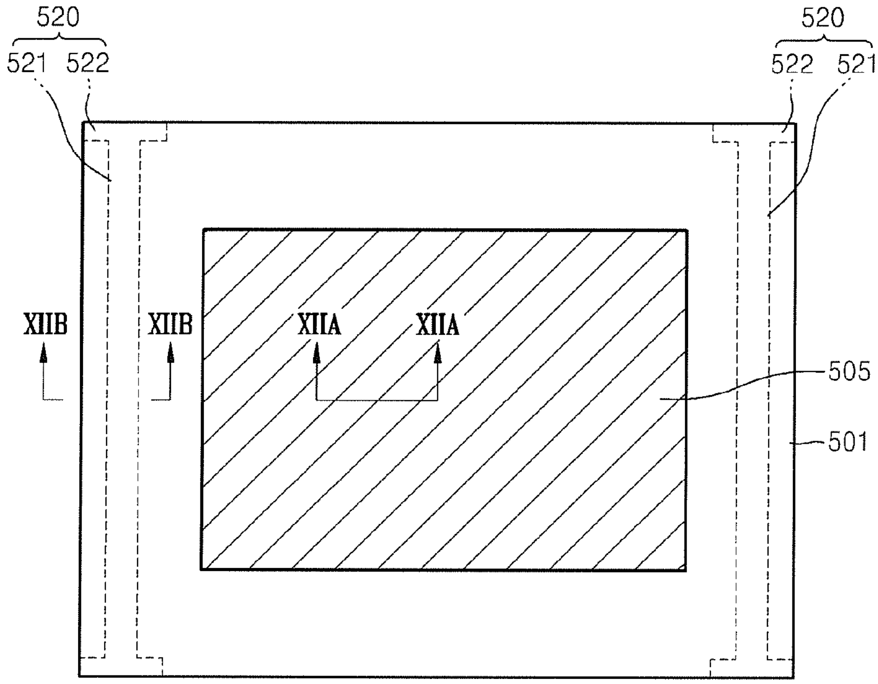


FIG. 12B

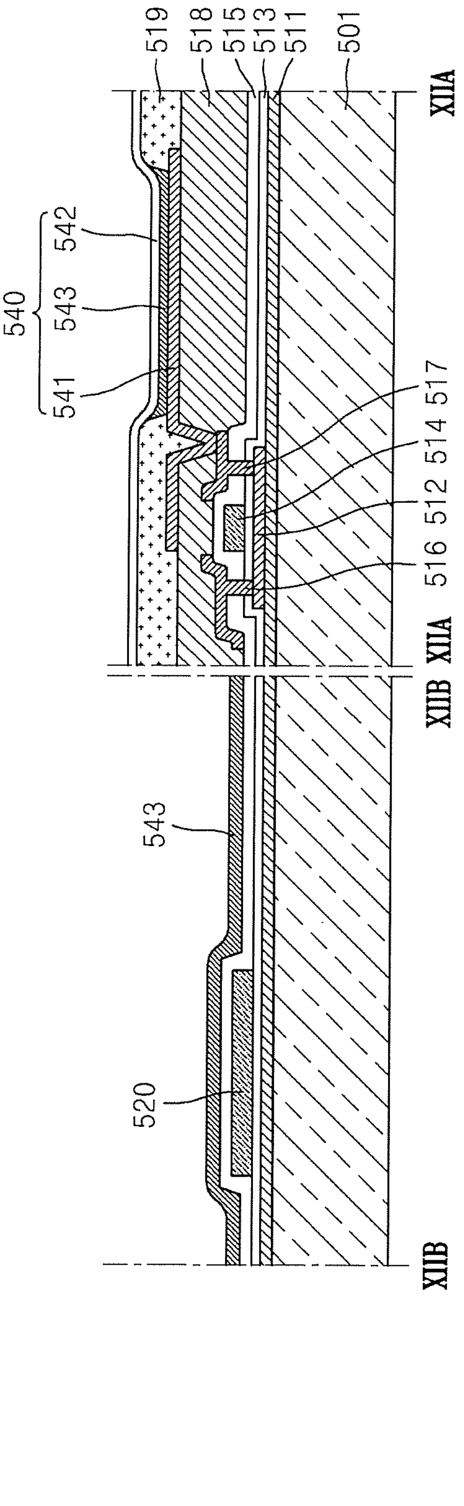

519
518
515
513
511
501
XIIA
540
542
543
541
517
514
512
516
XIIA
XIIB
543
520
XIIB

FIG. 12C

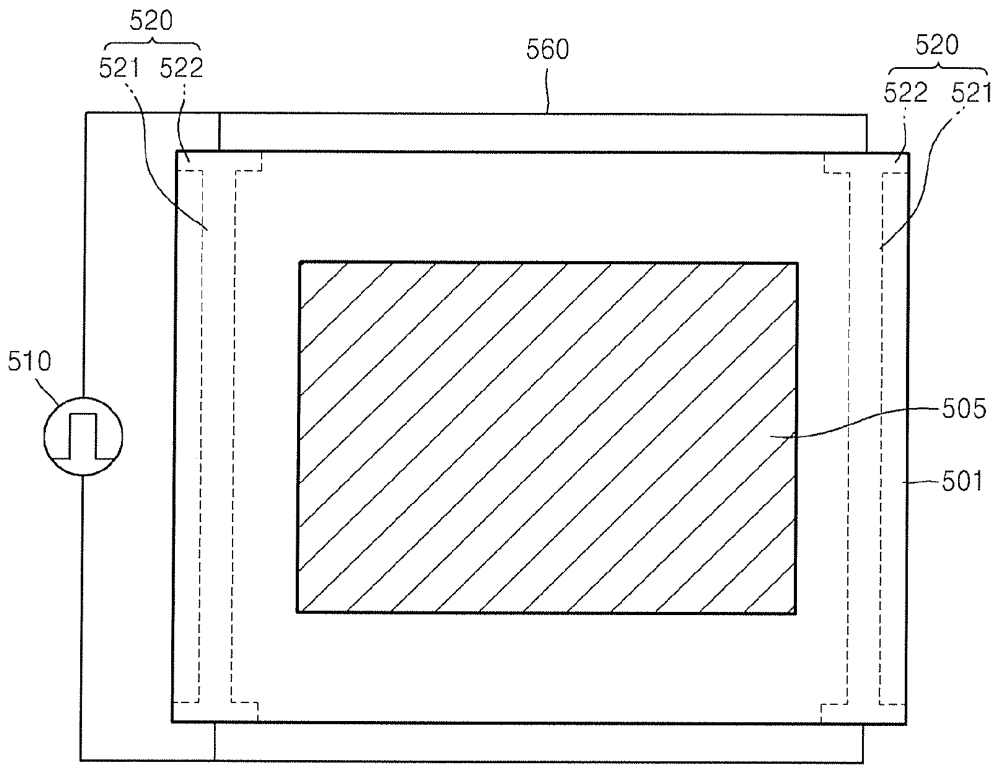


FIG. 12D

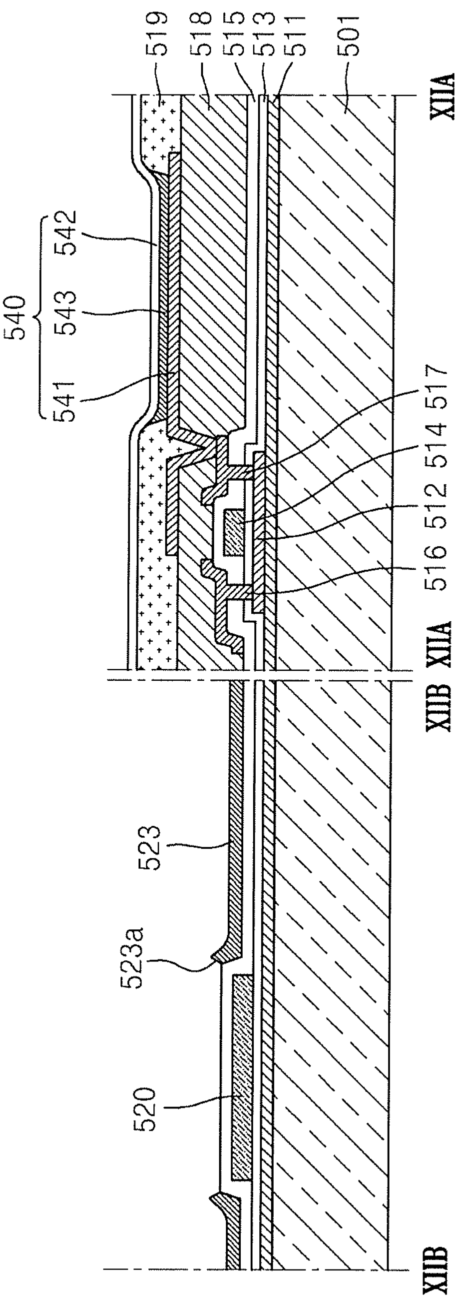
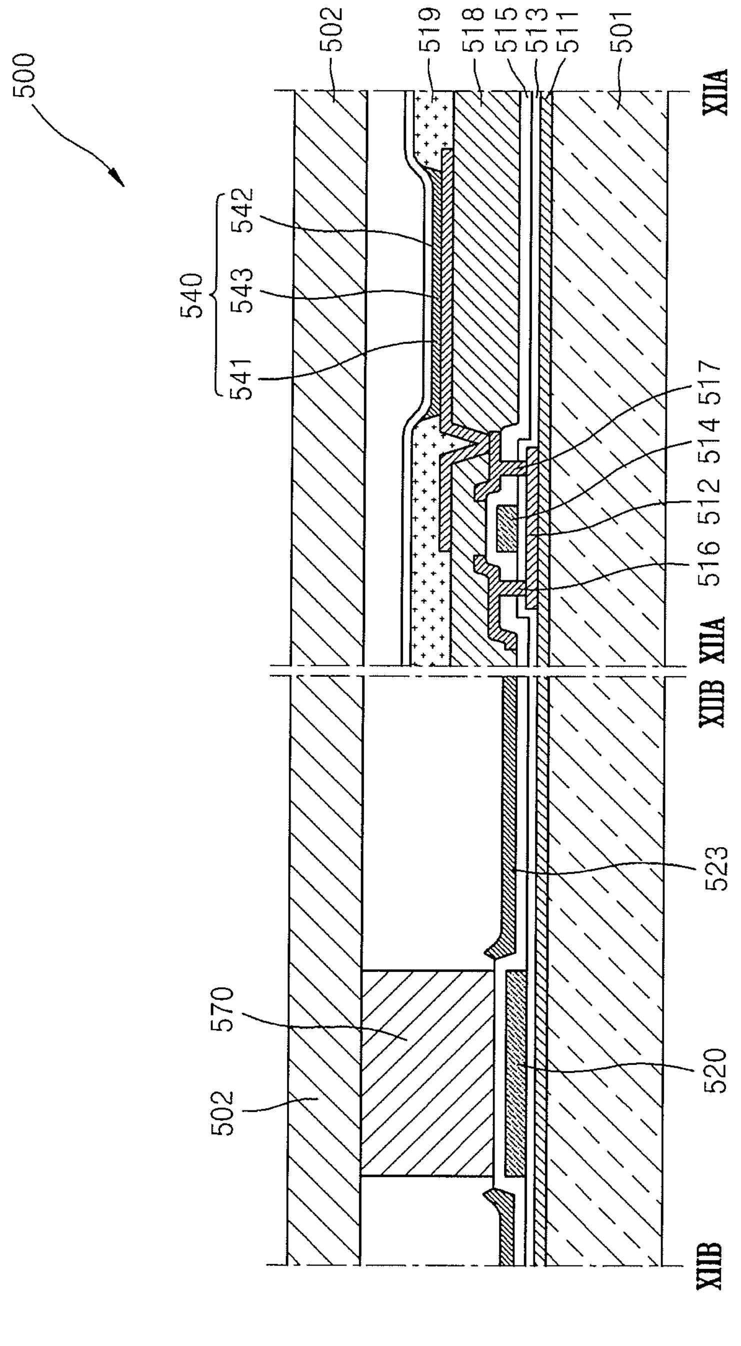

519
518
515
513
511
501
XIIA
540
542
543
541
517
514
512
516
XIIA
XIIB
523
523a
520
XIIB

FIG. 12E


500
540
541
543
542
502
519
518
515
513
511
501
517
514
512
516
XIIA
XIIA
XIIB
XIIB
523
570
502
520

METHOD AND APPARATUS FOR FORMING ORGANIC MATERIAL PATTERN, ORGANIC LIGHT EMITTING DISPLAY APPARATUS, AND METHOD OF MANUFACTURING ORGANIC LIGHT EMITTING DISPLAY APPARATUS

CROSS-REFERENCE TO RELATED PATENT APPLICATION

[0001] This application claims priority to and the benefit of Korean Patent Application No. 10-2012-0012541, filed on Feb. 7, 2012, in the Korean Intellectual Property Office, the disclosure of which is incorporated herein in its entirety by reference.

BACKGROUND

[0002] 1. Field

[0003] One or more aspects of the present invention relate to a method and apparatus for forming an organic material pattern, an organic light emitting display apparatus, and a method of manufacturing an organic light emitting display apparatus.

[0004] 2. Description of the Related Art

[0005] An organic layer pattern containing an organic material may be used for various purposes. For example, the organic layer pattern may be used in a flat panel display apparatus.

[0006] From among flat panel display apparatuses, an organic light emitting display apparatus includes an organic layer pattern. The organic light emitting display apparatus is a self-emitting display apparatus that has a larger viewing angle, better contrast characteristics, and a faster response speed as compared to other commonly used displays in the related art. Thus, the organic light emitting display apparatus has drawn attention as a next-generation display apparatus.

[0007] However, an organic layer pattern is not easy to manufacture because an organic material is vulnerable to moisture.

[0008] Thus, it is not easy to exactly manufacture an organic light emitting display apparatus with an organic layer pattern according to a desired design. Accordingly, it is desirable to improve the durability and image quality characteristics of an organic light emitting display apparatus.

SUMMARY

[0009] One or more embodiments of the present invention provide a method and an apparatus for forming an organic material pattern to improve device durability and image quality characteristics, an organic light emitting display apparatus, and a method of manufacturing an organic light emitting display apparatus.

[0010] According to an embodiment of the present invention, there is provided an apparatus for forming an organic material pattern in a desired shape on a substrate, the apparatus including a heater overlapping with a region of the substrate different from another region of the substrate in which the organic material pattern is to be formed; a power source for applying a voltage to the heater; and wiring for electrically connecting the power source and the heater.

[0011] The heater may include connection members and a body member. The connection members may respectively form both ends of the heater to be connected to the wiring, and the body member may be located between the connection members.

[0012] The heater may be formed on a surface of the substrate on which the organic material pattern is to be formed.

[0013] The heater may be formed on a surface of the substrate opposite to another surface of the substrate on which the organic material pattern is to be formed.

[0014] The apparatus may further include a base member facing a surface of the substrate opposite to another surface of the substrate on which the organic material pattern is to be formed. The heater may be formed on a surface of the base member facing the substrate.

[0015] The heater may be in contact with the substrate.

[0016] According to another embodiment of the present invention, there is provided a method of forming an organic material pattern in a desired shape on a substrate, the method including preparing a heater to overlap with a region of the substrate different from another region of the substrate in which the organic material pattern is to be formed, a power source to apply voltage to the heater, and wiring to electrically connect the power source with the heater; forming an organic material layer on the substrate, the organic material layer being a material for forming the organic material pattern; and applying a voltage to the heater from the power source to remove at least a region of the organic material layer corresponding in position to the heater by using joule heat generated by the heater.

[0017] The heater may include connection members and a body member. The connection members may respectively form both ends of the heater to be connected to the wiring. The body member may be located between the connection members.

[0018] The heater may be formed on a surface of the substrate, and the organic material layer may be formed on the surface of the substrate and cover the heater.

[0019] The heater may be formed on a surface of the substrate opposite to another surface of the substrate on which the organic material pattern is to be formed.

[0020] The method may further include preparing a base member to face a surface of the substrate opposite to another surface of the substrate on which the organic material pattern is to be formed on the substrate, wherein the heater is formed on a surface of the base member facing the surface of the substrate. The substrate may face the heating unit, and the organic material layer may be formed on the another surface of the substrate opposite to the surface of the substrate facing the heater.

[0021] The heater may be in contact with the substrate.

[0022] The organic material pattern may include an aperture corresponding in position to the heater.

[0023] According to another embodiment of the present invention, there is provided an organic light emitting display apparatus, the apparatus including a substrate; a display unit on the substrate and including an organic light emitting device, the organic light emitting device including a first electrode, a second electrode, and an intermediate layer, the intermediate layer being disposed between the first electrode and the second electrode and including an organic emission layer; a heater adjacent to the display unit; and an organic material pattern, the organic material pattern and the heater overlapping with different regions of the substrate, respectively.

[0024] The apparatus may further include a sealing substrate facing the substrate; and a sealing member between the substrate and the sealing substrate and adjacent to the display unit. A region of the heater may overlap with the sealing member.

[0025] A bottom surface of the sealing member may be spaced apart from at least the organic material pattern.

[0026] The sealing member may be spaced apart from the organic material pattern.

[0027] The apparatus may further include at least one insulating layer between the heater and the sealing member.

[0028] The apparatus may further include a thin film transistor (TFT) being electrically connected to the organic light emitting device, the TFT including an active layer, a gate electrode, a source electrode, and a drain electrode. The heater may include a material used to form at least one from among the gate electrode, the source electrode, and drain electrode.

[0029] The apparatus may further include an interlayer insulating layer between the gate electrode and the source electrode, and between the gate electrode and the drain electrode. The heater may include a material used to form the gate electrode, and the interlayer insulating layer may be formed on the heater.

[0030] The organic material pattern may include a material used to form the intermediate layer.

[0031] The organic material pattern may be connected to a region of the intermediate layer.

[0032] Ends of the heater may correspond to end portions of the substrate, respectively.

[0033] The heater may include connection members and a body member. The connection members may respectively form both ends of the heater. The body member may be located between the connection members. The connection members may be formed to respectively correspond to end portions of the substrate in such a manner that side surfaces of the connection members are exposed.

[0034] According to another embodiment of the present invention, there is provided a method of manufacturing an organic light emitting display apparatus, the method including forming a display unit on a substrate, the display unit including an organic light emitting device, the organic light emitting device including a first electrode, a second electrode, and an intermediate layer, the intermediate layer being between the first electrode and the second electrode and comprising an organic emission layer; forming a heater adjacent to the display unit; forming an organic material layer on the substrate; and applying a voltage to the heater from a power source to remove at least a region of the organic material layer corresponding in position to the heater by using joule heat generated by the heater.

[0035] If the voltage is applied to the heater from the power source to remove at least the region of the organic material layer corresponding in position to the heater by using the joule heat generated by the heater, then an organic material pattern having an aperture corresponding in position to the heater may be formed.

[0036] The power source and the heater may be electrically connected via wiring.

[0037] The organic material layer may increase a material used to form the intermediate layer during the formation of the intermediate layer.

[0038] The method may further include preparing a sealing substrate to face the substrate; and forming a sealing member between the substrate and the sealing substrate, and adjacent to the display unit. The sealing member may overlap with at least a region of the heater.

[0039] The forming of the sealing member may be performed after the heater is formed and the region of the organic material layer corresponding in position to the heater has been removed.

[0040] The sealing member may be formed to be disposed apart from the organic material layer.

[0041] The method may further include forming at least one insulating layer between the heater and the sealing member.

[0042] The method may further include forming a thin film transistor (TFT) to be electrically connected to the organic light emitting device, the TFT including an active layer, a gate electrode, a source electrode, and a drain electrode. The heater may include a material used to form at least one from among the gate electrode, the source electrode, and the drain electrode.

BRIEF DESCRIPTION OF THE DRAWINGS

[0043] The above and other features and aspects of the present invention will become more apparent by describing in detail exemplary embodiments thereof with reference to the attached drawings in which:

[0044] FIG. **1** is a schematic plan view of an apparatus for forming an organic material pattern, according to an embodiment of the present invention;

[0045] FIG. **2** is a cross-sectional view taken along the line II-II of FIG. **1**;

[0046] FIGS. **3**A and **3**B are cross-sectional views illustrating a method of forming an organic material pattern by using the apparatus illustrated in FIGS. **1** and **2**, according to an embodiment of the present invention;

[0047] FIG. **4** is a schematic plan view of an apparatus for forming an organic material pattern, according to another embodiment of the present invention;

[0048] FIG. **5** is a cross-sectional view taken along the line V-V of FIG. **4**;

[0049] FIGS. **6**A and **6**B are cross-sectional views illustrating a method of forming an organic material pattern by using the apparatus illustrated in FIGS. **4** and **5**, according to another embodiment of the present invention;

[0050] FIG. **7** is a schematic plan view of an apparatus for forming an organic material pattern, according to another embodiment of the present invention;

[0051] FIG. **8** is a cross-sectional view taken along the line VIII-VIII of FIG. **7**;

[0052] FIGS. **9**A and **9**B are cross-sectional views illustrating a method of forming an organic material pattern by using the apparatus illustrated in FIGS. **7** and **8**, according to another embodiment of the present invention;

[0053] FIG. **10** is a schematic plan view of an organic light emitting display apparatus according to an embodiment of the present invention;

[0054] FIG. **11** is a cross-sectional view taken along the line XI-XI of FIG. **10**; and

[0055] FIGS. **12**A is a schematic plan view, and FIGS. **12**B through **12**E are cross-sectional views; FIGS. **12**A through **12**E sequentially illustrate a method of manufacturing the organic light emitting display apparatus illustrated in FIGS. **10** and **11**, according to an embodiment of the present invention.

DETAILED DESCRIPTION

[0056] Hereinafter, exemplary embodiments of the present invention will be described in greater detail with reference to the accompanying drawings. Expressions such as "at least one of," when preceding a list of elements, modify the entire list of elements and do not modify the individual elements of the list.

[0057] FIG. **1** is a schematic plan view of an apparatus **100** for forming an organic material pattern, according to an embodiment of the present invention. FIG. **2** is a cross-sectional view taken along the line II-II of FIG. **1**.

[0058] Referring to FIGS. **1** and **2**, the apparatus **100** is used to form a desired organic material pattern on a substrate **101**.

[0059] To this end, heating units **120** (e.g., heaters) are disposed on the substrate **101**. The heating units **120** are electrically connected to a power source **110** via a wiring unit **160** (e.g., wirings).

[0060] The substrate **101** may be formed of a SiO_2-based transparent glass material, but the present invention is not limited thereto and the substrate **101** may be formed of a suitable heat-resistant material.

[0061] The heating units **120** are formed in a set or predetermined pattern on the substrate **101**. The heating units **120** may have any of various patterns. A pattern of the heating units **120** may be determined according to a shape of an organic material pattern to be formed on the substrate **101**.

[0062] Each of the heating units **120** includes a body member **121** and connection members **122**. The connection members **122** respectively form both ends of the heating unit **120**. The body member **121** is located between the connection members **122**. When a voltage is applied to the heating units **120** by the power source **110**, the heating units **120** generate joule heat. To this end, the heating units **120** may be formed of metal having a preselected or predetermined resistance.

[0063] The wiring unit **160** is connected to the heating units **120**. More specifically, the wiring unit **160** is connected to the connection members **122** of the heating units **120**. The wiring unit **160** is formed of a conductive material (e.g., metal).

[0064] The power source **110** is electrically connected to the wiring unit **160**. The type of the power source **110** is not limited. In other words, any of various types of devices capable of applying a suitable voltage to the heating units **120**, and controlling a level of the voltage to be applied to the heating units **120** and a period of time for applying the voltage, may be employed as the power source **110**.

[0065] FIGS. **3**A and **3**B are cross-sectional views illustrating a method of forming an organic material pattern by using the apparatus **100** illustrated in FIGS. **1** and **2**, according to an embodiment of the present invention.

[0066] First, referring to FIG. **3**A, an organic material layer **130'** that is a material for forming an organic material pattern **130** is formed on a substrate **101**. More specifically, the organic material layer **130'** is formed on a surface of the substrate **101** on which the heating units **120** are disposed. In this case, the organic material layer **130'** is formed on the entire surface of the substrate **101** on which the heating units **120** are disposed to cover the heating units **120**.

[0067] Then, referring to FIG. **3**B, a voltage is applied to the heating units **120** to form the organic material pattern **130**, as will be described in detail below.

[0068] A suitable voltage is applied to the heating units **120** by using the power source **110** of FIG. **1**. When the voltage is applied to the heating units **120**, joule heat is generated by the heating unit **120** due to a preselected or predetermined resistance of the heating units **120**. The generated joule heat is intensively delivered to regions of the organic material layer **130'** that overlap with the heating units **120**. Thus, the overlapping regions of the organic material layer **130'** are melted and substantially removed by the joule heat.

[0069] Thus, the organic material pattern **130** is formed having apertures **130***a* corresponding to the heating units **120**. That is, the heating units **120** do not overlap with the organic material pattern **130** formed from the organic material layer **130'**. In other words, the organic material pattern **130** and the heating units overlap with different regions (e.g., mutually exclusive regions) of a substrate, respectively.

[0070] In the current embodiment, the organic material pattern **130** may be formed using joule heat generated by the heating units **120** without having to use a wet process, e.g., a photolithographic process, thereby protecting the organic material pattern **130** from moisture. Accordingly, it is possible to form the organic material pattern **130** having high durability in a precise pattern.

[0071] FIG. **4** is a schematic plan view of an apparatus **200** for forming an organic material pattern, according to another embodiment of the present invention. FIG. **5** is a cross-sectional view taken along the line V-V of FIG. **4**.

[0072] Referring to FIGS. **4** and **5**, the apparatus **200** is used to form a desired organic material pattern on a substrate **201**.

[0073] To this end, heating units **220** are disposed on the substrate **201**. The heating units **220** are electrically connected to a power source **210** via a wiring unit **260**.

[0074] The substrate **201** may be formed of a SiO_2-based transparent glass material, but the present invention is not limited thereto and the substrate **201** may be formed of a material having high heat resistance and conductivity.

[0075] The heating units **220** are formed in a preselected or predetermined pattern on a bottom surface of the substrate **201**. The heating units **220** may have any of various patterns. A pattern of the heating units **220** may be determined according to a desired shape of an organic material pattern to be formed on the substrate **201**.

[0076] Each of the heating units **220** includes a body member **221** and connection members **222**. The connection members **222** respectively form both ends of the heating unit **220**. The body member **221** is located between the connection members **222**. When a voltage is applied to the heating units **220** by the power source **210**, the heating units **220** generate joule heat. To this end, the heating units **220** may be formed of metal having a preselected or predetermined resistance.

[0077] The wiring unit **260** is connected to the heating units **220**. More specifically, the wiring unit **260** is connected to the connection members **222** of the heating units **220**. The wiring unit **260** is formed of a conductive material (e.g., metal).

[0078] The power source **210** is electrically connected to the wiring unit **260**. The type of the power source **210** is not limited. In other words, any of various types of devices capable of applying a suitable voltage to the heating units **220**, and controlling a level of the voltage to be applied to the heating units **220** and a period of time for applying the voltage, may be employed as the power source **210**.

[0079] FIGS. **6**A and **6**B are cross-sectional views illustrating a method of forming an organic material pattern by using the apparatus **200** illustrated in FIGS. **4** and **5**, according to another embodiment of the present invention.

[0080] First, referring to FIG. **6**A, an organic material layer **230'** that is a material for forming an organic material pattern **230** is formed on a substrate **201**. More specifically, the organic material layer **230'** is formed on a surface of the substrate **201** opposite to another surface of the substrate **201** on which the heating units **220** are disposed. That is, the heating units **220** are formed on the bottom surface of the substrate **201**, and the organic material layer **230'** is formed on a top surface of the substrate **201**.

[0081] In this case, the organic material layer **230'** is formed to entirely cover the top surface of the substrate **201** to overlap with the heating units **220**.

[0082] Then, referring to FIG. **6**B, a voltage is applied to the heating units **220** to form the organic material pattern **230**, as will be described in detail below.

[0083] A suitable voltage is applied to the heating units **220** by using the power source **210** of FIG. **3**. When the voltage is applied to the heating units **220**, joule heat is generated by the heating unit **220** due to a preselected or predetermined resistance of the heating units **220**. The generated joule heat is intensively delivered to regions of the organic material layer **230'** corresponding to the heating units **220**, via the substrate **210**. Thus, the regions of the organic material layer **230'** overlapping the heating units **220** are melted and removed by the joule heat.

[0084] Thus, the organic material pattern **230** is formed having apertures **230*a*** corresponding to the heating units **220**.

[0085] In the current embodiment, the organic material pattern **230** may be formed using joule heat generated by the heating units **220** without having to use a wet process, e.g., a photolithographic process, thereby protecting the organic material pattern **230** from moisture. Accordingly, it is possible to form the organic material pattern **230** having high durability in a precise pattern.

[0086] In FIGS. **6**A and **6**B, the heating units **220** and the organic material layer **230'** are disposed apart from one another to not contact one another. Thus, it is possible to prevent the organic material layer **230'** from being abnormally degraded, which is caused by the contact between the heating units **220** and the organic material layer **230'** when joule heat is generated by the heating units **220**.

[0087] Furthermore, the heating units **220** may be prevented from being polluted, which can happen when the organic material layer **230'** is degraded and remains on the heating units **220**.

[0088] FIG. **7** is a schematic plan view of an apparatus **300** for forming an organic material pattern, according to another embodiment of the present invention. FIG. **8** is a cross-sectional view taken along the line VIII-VIII of FIG. **7**.

[0089] Referring to FIGS. **7** and **8**, the apparatus **300** is used to form a desired organic material pattern on a substrate (not shown).

[0090] To this end, heating units **320** are disposed on a base member **350**. The heating units **320** are electrically connected to a power source **310** via a wiring unit **360**.

[0091] The base member **350** may be formed of a SiO_2-based transparent glass material, but the present invention is not limited thereto and the base member **350** may be formed of a suitable heat-resistant material.

[0092] The heating units **320** are formed in a preselected or predetermined pattern on the base member **350**. The heating units **320** may have any of various patterns. A pattern of the heating units **320** may be determined according to a desired shape of an organic material pattern to be formed on a substrate (not shown).

[0093] Each of the heating units **320** includes a body member **321** and connection members **322**. The connection members **322** respectively form both ends of the heating unit **320**. The body member **321** is located between the connection members **322**. When a voltage is applied to the heating units **320** by the power source **310**, the heating units **320** generate joule heat. To this end, the heating units **320** may be formed of metal having a preselected or predetermined resistance.

[0094] The wiring unit **360** is connected to the heating units **320**. More specifically, the wiring unit **360** is connected to the connection members **322** of the heating units **320**. The wiring unit **360** is formed of a conductive material (e.g., metal).

[0095] The power source **310** is electrically connected to the wiring unit **360**. The type of the power source **310** is not limited. In other words, any of various types of devices capable of applying a suitable voltage to the heating units **320**, and controlling a level of the voltage to be applied to the heating units **320** and a period of time for applying the voltage, may be employed as the power source **310**.

[0096] FIGS. **9**A and **9**B are cross-sectional views illustrating a method of forming an organic material pattern by using the apparatus **300** illustrated in FIGS. **7** and **8**, according to another embodiment of the present invention.

[0097] First, referring to FIG. **9**A, a substrate **301** is disposed to face the base member **350**, and an organic material layer **330'** that is a material for forming an organic material pattern **330** is formed on the substrate **301**.

[0098] More specifically, the substrate **301** is disposed to face the surface of the base member **350** on which the heating units **320** are disposed. Thus, the heating units **320** face the substrate **301**, and the heating units **320** may contact the substrate **301**.

[0099] The organic material layer **330'** is formed on a surface of the substrate **301** opposite to a surface of the substrate **301** that faces the heating units **320**. In the example of FIG. **9**A, the organic material layer **330'** is formed on a top surface of the substrate **301** to entirely cover the top surface of the substrate **301** and to overlap with the heating units **320**.

[0100] Then, referring to FIG. **9**B, a voltage is applied to the heating units **320** to form the organic material pattern **330**, as will be described in detail below.

[0101] A suitable voltage is applied to the heating units **320** by using the power source **310** of FIG. **6**. When the voltage is applied to the heating units **320**, joule heat is generated by the heating unit **320** due to a preselected or predetermined resistance of the heating units **320**. The generated joule heat is intensively delivered to regions of the organic material layer **330'** corresponding to the heating units **320**, via the substrate **310**. Thus, the regions of the organic material layer **330'** overlapping with the heating units **320** are melted and removed by the joule heat.

[0102] Thus, the organic material pattern **330** is formed having apertures **330*a*** corresponding to the heating units **320**.

[0103] In the current embodiment, the organic material pattern **330** may be formed using joule heat generated by the heating units **320** without having to use a wet process, e.g., a photolithographic process, thereby protecting the organic material pattern **330** from moisture. Accordingly, it is possible to form the organic material pattern **330** having a precise pattern and high durability.

[0104] In particular, the heating units **320** and the organic material layer **330'** are spaced apart and not in contact one another. Thus, it is possible to prevent the organic material layer **330'** from being abnormally degraded, which is caused by the contact between the heating units **320** and the organic material layer **330'** when joule heat is generated by the heating units **320**.

[0105] Also, the heating units **320** may be prevented from being polluted, which can happen when the organic material layer **330'** is degraded and remains on the heating units **320**.

[0106] Furthermore, since the heating units **320** are formed on the base member **350** other than the substrate **301**, the heating units **320** are not present on the substrate **301** even after the organic material pattern **330** is formed on the substrate **301**, thereby increasing utility of the substrate **301**. Also, it is possible to repeatedly form the organic material pattern **330** on a plurality of substrates **301** by moving the base member **350**, thereby increasing process efficiency.

[0107] FIG. **10** is a schematic plan view of an organic light emitting display apparatus **500** according to an embodiment of the present invention. FIG. **11** is a cross-sectional view taken along the line XI-XI of FIG. **10**.

[0108] The organic light emitting display apparatus **500** includes a substrate **501**, a display unit **505**, a heating unit **520**, an organic material layer **523**, a sealing member **570**, and a sealing substrate **502**.

[0109] Although not shown, the display unit **505** includes a plurality of organic light emitting devices. Each of the organic light emitting devices includes a first electrode, an intermediate layer, and a second electrode. The display unit **505** will be described in more detail when a method of manufacturing the organic light emitting display apparatus **500** according to an embodiment of the present invention is described below.

[0110] Referring to FIGS. **10** and **11**, the heating unit **520** is formed in a region (e.g., a periphery region) of the substrate **501**.

[0111] The organic material layer **523** is formed above the heating unit **520** not to overlap with the heating unit **520**.

[0112] The sealing member **570** is disposed on the heating unit **520** to overlap with a preselected or predetermined region of the heating unit **520** and to be spaced apart from the organic material layer **523**. The sealing member **570** is disposed between the substrate **501** and the sealing substrate **502** to wrap around the display unit **505**.

[0113] However, the present invention is not limited thereto, and the organic light emitting display apparatus **500** may not include the sealing member **570** or the sealing substrate **502**.

[0114] The structure of the organic light emitting display apparatus **500** according to the current embodiment will now be described in more detail with reference to FIGS. **12**A to **12**E.

[0115] FIG. **12**A is a plan view, and FIGS. **12**B through **12**E are cross-sectional views sequentially illustrating a method of manufacturing the organic light emitting display apparatus **500** illustrated in FIGS. **10** and **11**, according to an embodiment of the present invention.

[0116] First, the method will be described with reference to FIGS. **12**A and **12**B. FIG. **12**B is a cross-sectional view taken along the lines XIIA-XIIA and XIIB-XIIB of FIG. **12**A.

[0117] Referring to FIGS. **12**A and **12**B, a display unit **505** is formed on a substrate **501**, and heating units **520** are disposed near the display unit **505**. Specifically, the heating units **520** are disposed adjacent to respective edges of the substrate **501**, e.g., left and right edges of the substrate **501**. Each of the heating units **520** includes a body member **521** and connection members **522**. The connection members **522** may correspond to side surfaces of the substrate **501**, respectively. Thus, side surfaces of the connection members **522** may be exposed.

[0118] More specifically, a buffer layer **511** is formed on the substrate **501**. The buffer layer **511** may be formed to entirely cover a top surface of the substrate **501**, including the display unit **505** on the substrate **501** and surroundings of the display unit **505**. The buffer layer **511** prevents or reduces impurity elements from penetrating via the substrate **501** and provides a substantially flat surface on the substrate **501**. The buffer layer **511** may be formed of any suitable materials for enabling the above functions.

[0119] For example, the buffer layer **511** may contain an inorganic material, e.g., a silicon oxide, a silicon nitride, a silicon oxynitride, an aluminum oxide, an aluminum nitride, a titanium oxide, a titanium nitride, an organic material (e.g., polyimide, polyester, or acryl), or a stacked structure including a combination thereof. The buffer layer **511** is not an indispensable component and may thus be omitted if needed.

[0120] The display unit **505** may include a thin film transistor (TFT) disposed on the buffer layer **511**. The TFT includes an active layer **512**, a gate electrode **514**, a source electrode **516**, and a drain electrode **517**.

[0121] First, the active layer **512** is formed in a preselected or predetermined pattern on the buffer layer **511**. The active layer **512** may be formed of an inorganic semiconductor, e.g., amorphous silicon or poly silicon, an organic semiconductor, or an oxide semiconductor. The active layer **512** includes a source region, a drain region, and a channel region.

[0122] A gate insulating layer **513** is formed on the active layer **512**. The gate insulating layer **513** may be formed to correspond to the entire substrate **501**. In other words, the gate insulating layer **513** is formed on both the display unit **505** and the surrounding of the display unit **505**. The gate insulating layer **513** insulates the active layer **512** from the gate electrode **514**, and may be formed of an organic material or an inorganic material, e.g., SiNx or SiO_2.

[0123] The gate electrode **514** is formed on the gate insulating layer **513**. The gate electrode **514** may contain gold (Au), silver (Ag), copper (Cu), nickel (Ni), platinum (Pt), palladium (Pd), aluminum (Al), molybdenum (Mo), an Al:Nd alloy, or an Mo:W alloy, but the present invention is not limited thereto, and any of other suitable materials may be used to form the gate electrode **514** according to design conditions.

[0124] The heating units **520** are formed near the display unit **505**. The heating units **520** may be formed of the material used to form the gate electrode **514**. The heating units **520** are formed near the edges of the substrate **501**. In the current embodiment, the heating units **520** are formed on a layer on which the gate electrode **514** is formed by using the material of the gate electrode **514**, but the present invention is not limited thereto. That is, the location and material of the heating units **520** on the substrate **501** are not limited. For example, the heating units **520** may be formed of a material used to form the source electrode **516** or the drain electrode **517**, as will be described below.

[0125] An interlayer insulating layer **515** is formed on the gate electrode **514**. The interlayer insulating layer **515** may be formed to correspond to all the surfaces of the substrate **501**. In other words, the interlayer insulating layer **515** is formed on both the display unit **505** and the surroundings of the display unit **505** to cover the heating units **520**.

[0126] The source electrode **516** and the drain electrode **517** are formed on the interlayer insulating layer **515**. Specifically, the interlayer insulating layer **515** and the gate insulating layer **513** are formed to expose the source and drain regions of the active layer **512**, and the source electrode **516** and the drain electrode **517** are formed to contact the exposed source and drain regions, respectively.

[0127] A passivation layer **518** is formed on the TFT. Specifically, the passivation layer **518** is formed on the source electrode **516** and the drain electrode **517**.

[0128] An organic light emitting device **540** is formed on the passivation layer **518**. The organic light emitting device **540** includes a first electrode **541**, a second electrode **542**, and an intermediate layer **543**.

[0129] In more detail, the passivation layer **518** is formed to partially cover the drain electrode **517** so that a preselected or predetermined region of the drain electrode **517** may be exposed, and the first electrode **541** is formed to be connected to the exposed region of the drain electrode **517**.

[0130] When the first electrode **541** functions as an anode, the first electrode **541** may include ITO, IZO, ZnO, or In_2O_3 having a high work function. According to various embodiments, the first electrode **541** may further include a reflective layer formed of silver (Ag), magnesium (Mg), aluminum (Al), platinum (Pt), palladium (Pd), gold (Au), nickel (Ni), neodymium (Nd), iridium (Ir), chromium (Cr), lithium (Li), ytterbium (Yb), or calcium (Ca).

[0131] A pixel defining layer **519** is formed on the first electrode **541** by using an insulating material. The pixel defining layer **519** is formed to expose a preselected or predetermined region of the first electrode **541**.

[0132] The intermediate layer **543** is formed on the first electrode **541**. In more detail, the intermediate layer **543** is formed to contact the exposed region of the first electrode **541**.

[0133] The intermediate layer **543** includes an organic emission layer (not shown) to emit visible light. The intermediate layer **543**, and particularly, the organic emission layer may be formed according to any of various methods known to those skilled in the art. For example, the organic emission layer may be formed according to a deposition process using a deposition mask. In this case, the intermediate layer **543** may remain on not only a preselected or predetermined region of the display unit **505**, but also on outer walls of the display unit **505** to overlap with the heating units **520**.

[0134] In particular, referring to FIG. **12**A, if the deposition process is continuously performed on the substrate **501** in a direction from a left end of the substrate **501** to a right end of the substrate **501** so as to form the organic emission layer of the intermediate layer **543**, then the intermediate layer **543** is also formed on regions adjacent to the left and right edges of the substrate **501**. Thus, the intermediate layer **543** may overlap with the heating units **520**.

[0135] In this case, certain regions of the intermediate layer **543**, which surround the display unit **505**, are not used for the function of the display unit **505**, but may cause an error during a subsequent process, as will be described below.

[0136] The intermediate layer **543** may be formed of a low-molecular weight organic material or a high-molecular weight organic material. If the low-molecular weight organic material is used, then the intermediate layer **543** may include a hole injection layer (HIL), a hole transport layer (HTL), an emission layer (EML), an electron transport layer (ETL), and an electron injection layer (EIL).

[0137] The HIL may be formed of a phthalocyanine compound, e.g., copper phthalocyanine (CuPc), or starburst-type amines, e.g., TCTA, m-MTDATA, or m-MTDAPB.

[0138] The HTL may be formed of N,N'-bis(3-methylphenyl)-N,N'-diphenyl[1,1-biphenyl]-4,4'-diamine (TPD), or N,N'-di(naphthalene-1-yl)-N,N'-diphenyl benzidine (α-NPD).

[0139] The EIL may be formed of LiF, NaCl, CsF, Li2O, BaO, or Liq.

[0140] The ETL may be formed of tris-8-hydroxyquinoline aluminum (Alq3).

[0141] The organic emission layer may include a host material and a dopant material.

[0142] Examples of the host material of the organic emission layer may include tris(8-hydroxy-quinolinato)aluminum (Alq3), 9,10-di(naphth-2-yl)anthracene (AND), 3-tert-butyl-9,10-di(naphth-2-yl)anthracene (TBADN), 4,4'-bis(2,2-diphenyl-ethene-1-yl)-4,4'-dimethylphenyl (DPVBi), 4,4'-bis(2,2-diphenyl-ethene-1-yl)-4,4'-dimethylphenyl (p-DMDPVBi), tert(9,9-diarylfluorene)s (TDAF), 2-(9,9'-spirobifluorene-2-yl)-9,9'-spirobifluorene(BSDF), 2,7-bis(9,9'-spirobifluorene-2-yl)-9,9'-spirobifluorene (TSDF), bis(9,9-diarylfluorene)s (BDAF), 4,4'-bis(2,2-diphenyl-ethene-1-yl)-4,4'-di-(tert-butyl)phenyl (p-TDPVBi), 1,3-bis(carbazol-9-yl)benzene (mCP), 1,3,5-tris(carbazol-9-yl)benzene (tCP), 4,4',4"-tris(carbazol-9-yl)triphenylamine (TcTa), 4,4'-bis(carbazol-9-yl)biphenyl (CBP), 4,4'-bis(9-carbazolyl)-2,2'-dimethyl-biphenyl (CBDP), 4,4'-bis(carbazol-9-yl)-9,9-dimethyl-fluorene (DMFL-CBP), 4,4'-bis(carbazol-9-yl)-9,9-bis(9-phenyl-9H-carbazol)fluorene (FL-4CBP), 4,4'-bis(carbazol-9-yl)-9,9-di-tolyl-fluorene (DPFL-CBP), 9,9-bis(9-phenyl-9H-carbazol)fluorene (FL-2CBP), and the like.

[0143] Examples of the dopant material of the organic emission layer may include 4,4'-bis[4-(di-p-tolylamino)styryl]biphenyl (DPAVBi), 9,10-di(naph-2-tyl)anthracene (ADN), 3-tert-butyl-9,10-di(naph-2-typanthracene (TBADN), and the like.

[0144] The second electrode **542** is formed on the intermediate layer **543**. When the second electrode **542** functions as a cathode, the second electrode **542** may be formed of metal, e.g., silver (Ag), magnesium (Mg), aluminum (Al), platinum (Pt), palladium (Pd), gold (Au), nickel (Ni), neodymium (Nd), iridium (Ir), chromium (Cr), lithium (Li), or calcium (Ca). Also, the second electrode **542** may include ITO, IZO, ZnO, or In_2O_3 to pass light therethrough.

[0145] When a voltage is applied across the first electrode **541** and the second electrode **542**, visible light is emitted from the organic emission layer of the intermediate layer **543** to form an image that a user can view.

[0146] Then, referring to FIGS. **12**C and **12**D, the organic material layer **523** is formed using the heating units **520**.

[0147] More specifically, referring to FIG. **12**C, a voltage is applied to the heating units **520** from a power source **510** via a wiring unit **560**. In this case, the heating units **520** may be exposed so that the heating units **520** and the wiring unit **560** may be easily connected to one another. As described above, the connection members **522** of the heating units **520** are formed to correspond to edges of the substrate **501** so that side surfaces of the connection member **522** may be exposed and the exposed side surfaces may be connected to the wiring unit **560**.

[0148] When voltage is applied to the heating units **520**, joule heat is generated by the heating unit **520** due to a preselected or predetermined resistance of the heating units

520. The regions of the intermediate layer **543** that overlap with the heating units **520** are melted and removed due to the generated joule heat. Thus, as illustrated in FIG. **12**D, the organic material pattern **523** is formed having apertures **523***a* corresponding to the heating units **520**.

[0149] In this case, the shape of the organic material pattern **523** may vary according to the sizes and shapes of the heating unit **520**, and the organic material pattern **523** may be connected to the intermediate layer **543**.

[0150] Then, referring to FIG. **12**E, a sealing member **570** and a sealing substrate **502** are disposed to complete the manufacturing of the organic light emitting display apparatus **500**.

[0151] Specifically, the sealing member **570** overlaps with at least preselected or predetermined regions of the heating units **520**. Also, a bottom surface of the sealing member **570** contacts the interlayer insulating layer **515**, but is spaced apart from the organic material pattern **523**. The sealing member **570** may be spaced apart from the organic material pattern **523**. Thus, the sealing member **570** may be prevented from being physically or chemically degraded due to the contact with the organic material pattern **523**.

[0152] The sealing member **570** is disposed near the display unit **505**, and between the substrate **501** and the sealing substrate **502** to combine the substrate **501** with the sealing substrate **502**. Thus, the organic light emitting device **540** may be protected from foreign substances, moisture, or external shocks.

[0153] In the current embodiment, the organic material pattern **523** may be formed using joule heat generated by the heating units **520** without having to use a wet process, e.g., a photolithographic process, thereby protecting the organic material pattern **523** from moisture.

[0154] Also, since the deposition process is performed on the substrate **501** toward a direction, the intermediate layer **543** remains even at the edges of the substrate **501** when the intermediate layer **543** is formed. The remnant intermediate layer **543** around the display unit **505** is not used for the function of the display unit **505**, but may cause other elements from being polluted during manufacturing of the organic light emitting display apparatus **500**. The remnant intermediate layer **543** may lower adhering strength between elements disposed at the edges of the substrate **501** and the substrate **502**, thereby lowering the durability of the organic light emitting display apparatus **500**.

[0155] In particular, the sealing substrate **502** may be disposed to face the substrate **501** to seal the display unit **505**, and the sealing member **570** may be formed to combine the substrate **501** with the sealing substrate **502**. In this case, when the sealing member **570** contacts the remnant intermediate layer **543** or is formed on the remnant intermediate layer **543**, the characteristics of the sealing member **570** may be degraded or the adhering strength between the substrate **501** and the sealing substrate **502** may be reduced, thereby preventing the display unit **505** from being precisely sealed. However, according to the current embodiment, the organic material pattern **523** may be formed by easily removing a preselected region of the remnant intermediate layer **543** by using the heating units **520**, and the sealing member **570** is formed to be disposed apart from the organic material pattern **523**. Thus, it is possible to increase the adhering strength between the substrate **501** and the sealing substrate **502**, thereby improving the durability of the organic light emitting display apparatus **500**. Also, it is possible to prevent image quality characteristics of the display unit **505** from being degraded by effectively sealing the display unit **505**.

[0156] Furthermore, the heating units **520** are formed in a layer of the TFT of the display unit **505**, i.e., on the layer on which the gate electrode **514** is formed, by using the material used to form the gate electrode **514**, thereby increasing process convenience.

[0157] In the current embodiment, the organic light emitting display apparatus **500** includes the sealing member **570** and the sealing substrate **502**, but the present invention is not limited thereto. In other words, the organic light emitting display apparatus **500** may not include the sealing member **570** and the sealing substrate **502**, and in this case, the organic material pattern **523** may also be easily formed by using the heating units **520**. Also, the organic material pattern **523** may be formed in a desired pattern by forming the heating units **520** in any of various shapes.

[0158] Also, in the current embodiment, the heating units **520** are disposed in regions adjacent to the left and right edges of the substrate **501**, but the present invention is not limited thereto, and the heating units **520** may be disposed in regions adjacent to upper and lower edges of the substrate **501**.

[0159] Furthermore, when the organic light emitting display apparatus **500** is formed, the heating units **520** may be formed on a bottom surface of the substrate **501** as illustrated in FIG. **4** or may be formed on an additional base member (not shown) as illustrated in FIG. **7**.

[0160] Accordingly, with a method and apparatus for forming an organic material pattern, an organic light emitting display apparatus, and a method of manufacturing an organic light emitting display apparatus according to various embodiments of the present invention, it is possible to easily improve durability and image quality characteristics of an organic light emitting display apparatus.

[0161] While the present invention has been particularly shown and described with reference to exemplary embodiments thereof, it will be understood by those of ordinary skill in the art that various changes in form and details may be made therein without departing from the spirit and scope of the present invention as defined by the following claims, and their equivalents.

What is claimed is:

1. An apparatus for forming an organic material pattern on a substrate, the apparatus comprising:
- a heater overlapping with a region of the substrate different from another region of the substrate in which the organic material pattern is to be formed;
- a power source for applying a voltage to the heater; and
- wiring for electrically connecting the power source with the heater.

2. The apparatus of claim **1**,
- wherein the heater comprises connection members and a body member,
- wherein the connection members respectively form both ends of the heater to be connected to the wiring, and
- wherein the body member is located between the connection members.

3. The apparatus of claim **1**, wherein the heater is on a surface of the substrate on which the organic material pattern is to be formed.

4. The apparatus of claim **1**, wherein the heater is on a surface of the substrate opposite to another surface of the substrate on which the organic material pattern is to be formed.

5. The apparatus of claim **1**, further comprising a base member facing a surface of the substrate opposite to another surface of the substrate on which the organic material pattern is to be formed, and

wherein the heater is formed on a surface of the base member facing the substrate.

6. The apparatus of claim **5**, wherein the heater is in contact with the substrate.

7. A method of forming an organic material pattern on a substrate, the method comprising:

preparing a heater to overlap with a region of the substrate different from another region of the substrate in which the organic material pattern is to be formed, a power source to apply a voltage to the heater, and wiring to electrically connect the power source with the heater;

forming an organic material layer on the substrate, the organic material layer being a material for forming the organic material pattern; and

applying a voltage to the heater from the power source to remove at least a region of the organic material layer corresponding in position to the heater by using joule heat generated by the heater.

8. The method of claim **7**, wherein the heater comprises connection members and a body member,

wherein the connection members respectively form both ends of the heater to be connected to the wiring, and

the body member is located between the connection members.

9. The method of claim **7**, wherein the heater is formed on a surface of the substrate, and

the organic material layer is formed on the surface of the substrate and covers the heater.

10. The method of claim **7**, wherein the heater is formed on a surface of the substrate opposite to another surface of the substrate on which the organic material pattern is to be formed.

11. The method of claim **7**, further comprising preparing a base member to face a surface of the substrate opposite to another surface of the substrate on which the organic material pattern is to be formed on the substrate,

wherein the heater is formed on a surface of the base member facing the surface of the substrate, and

wherein the organic material layer is formed on the another surface of the substrate opposite to the surface of the substrate facing the heater.

12. The method of claim **7**, wherein the heater is in contact with the substrate.

13. The method of claim **7**, wherein the organic material pattern comprises an aperture corresponding in position to the heater.

14. An organic light emitting display apparatus, the apparatus comprising:

a substrate;

a display unit on the substrate and comprising an organic light emitting device, the organic light emitting device comprising a first electrode, a second electrode, and an intermediate layer, the intermediate layer being disposed between the first electrode and the second electrode and comprising an organic emission layer;

a heater adjacent the display unit; and

an organic material pattern, the organic material pattern and the heater overlapping different regions of the substrate, respectively.

15. The apparatus of claim **14**, further comprising:

a sealing substrate facing the substrate; and

a sealing member between the substrate and the sealing substrate and adjacent to the display unit,

wherein a region of the heater overlaps with the sealing member.

16. The apparatus of claim **15**, wherein a bottom surface of the sealing member is spaced apart from at least the organic material pattern.

17. The apparatus of claim **15**, wherein the sealing member is spaced apart from the organic material pattern.

18. The apparatus of claim **15**, further comprising at least one insulating layer between the heater and the sealing member.

19. The apparatus of claim **14**, further comprising a thin film transistor (TFT) being electrically connected to the organic light emitting device, the TFT comprising an active layer, a gate electrode, a source electrode, and a drain electrode,

wherein the heater comprises a material used to form at least one from among the gate electrode, the source electrode, and drain electrode.

20. The apparatus of claim **19**, further comprising an interlayer insulating layer between the gate electrode and the source electrode, and between the gate electrode and the drain electrode,

wherein the heater comprises a material used to form the gate electrode, and

wherein the interlayer insulating layer is on the heater.

21. The apparatus of claim **14**, wherein the organic material pattern comprises a material used to form the intermediate layer.

22. The apparatus of claim **14**, wherein the organic material pattern is connected to a region of the intermediate layer.

23. The apparatus of claim **14**, wherein ends of the heater correspond to end portions of the substrate, respectively.

24. The apparatus of claim **14**, wherein the heater comprises connection members and a body member,

wherein the connection members respectively form both ends of the heater,

the body member is located between the connection members, and

the connection members are formed to respectively correspond to end portions of the substrate in such a manner that side surfaces of the connection members are exposed.

25. A method of manufacturing an organic light emitting display apparatus, the method comprising:

forming a display unit on a substrate, the display unit comprising an organic light emitting device, the organic light emitting device comprising a first electrode, a second electrode, and an intermediate layer, the intermediate layer being between the first electrode and the second electrode and comprising an organic emission layer;

forming a heater adjacent to the display unit;

forming an organic material layer on the substrate; and

applying a voltage to the heater from a power source to remove at least a region of the organic material layer corresponding in position to the heater by using joule heat generated by the heater.

26. The method of claim **25**, wherein, if the voltage is applied to the heater from the power source to remove at least the region of the organic material layer corresponding in position to the heater by using the joule heat generated by the heater, then an organic material pattern having an aperture corresponding in position to the heater is formed.

27. The method of claim **25**, wherein the power source and the heater are electrically connected via wiring.

28. The method of claim **25**, wherein the organic material layer comprises a material used to form the intermediate layer during the formation of the intermediate layer.

29. The method of claim **25**, further comprising:

preparing a sealing substrate to face the substrate; and

forming a sealing member between the substrate and the sealing substrate, and adjacent the display unit,

wherein the sealing member overlaps with at least a region of the heater.

30. The method of claim **29**, wherein the forming of the sealing member is performed after the heater is formed and the region of the organic material layer corresponding in position to the heater has been removed.

31. The method of claim **29**, wherein the sealing member is formed to be spaced apart from the organic material layer.

32. The method of claim **29**, further comprising forming at least one insulating layer between the heater and the sealing member.

33. The method of claim **25**, further comprising forming a thin film transistor (TFT) to be electrically connected to the organic light emitting device, the TFT comprising an active layer, a gate electrode, a source electrode, and a drain electrode,

wherein the heater comprises a material used to form at least one from among the gate electrode, the source electrode, and the drain electrode.

* * * * *

专利名称(译)	用于形成有机材料图案的方法和设备，有机发光显示设备和制造有机发光显示设备的方法		
公开(公告)号	US20130200378A1	公开(公告)日	2013-08-08
申请号	US13/588789	申请日	2012-08-17
[标]申请(专利权)人(译)	朴廷泰 LEE YOUNG SEOG		
申请(专利权)人(译)	PARK , JUNG-TAE LEE , SEOG-YOUNG		
当前申请(专利权)人(译)	三星DISPLAY CO. , LTD. ENSIL TECH CO. , LTD.		
[标]发明人	PARK JUNG TAE LEE SEOG YOUNG		
发明人	PARK, JUNG-TAE LEE, SEOG-YOUNG		
IPC分类号	H01L27/15 H05B3/00 H01L33/36 H05B33/10		
CPC分类号	H01L51/5246 H01L51/529 Y10T156/10 H01L51/0014 H01L51/56		
优先权	1020120012541 2012-02-07 KR		
外部链接	Espacenet USPTO		

摘要(译)

提供一种用于在基板上以期望图案形成有机材料图案以改善器件耐久性和图像质量特性的方法和设备，有机发光显示设备和制造有机发光显示设备的方法。该装置包括加热器，该加热器与基板的与要形成有机材料图案的基板的另一区域不同的区域重叠，用于向加热器施加电压的电源，以及用于电连接电源的布线。加热器。