US 20160308171A1

(19) United States
(12) Patent Application Publication
(10) Pub. No.: US 2016/0308171 A1
(43) Pub. Date: Oct. 20, 2016
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(54) DEPOSITION SOURCE FOR ORGANIC LIGHT-EMITTING DISPLAY APPARATUS

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(21) Appl. No.: **14/923,869**

(22) Filed: **Oct. 27, 2015**

(30) **Foreign Application Priority Data**

Apr. 15, 2015 (KR) 10-2015-0053143

Publication Classification

(51) **Int. Cl.**
H01L 51/56 (2006.01)

(52) **U.S. Cl.**
CPC *H01L 51/56* (2013.01)

(57) **ABSTRACT**

A deposition source for an organic light-emitting display apparatus including a deposition housing. The deposition housing includes a nozzle configured to spraying a deposition material, evaporation spaces configured to evaporate the deposition material, and a separation wall configured to partition the evaporation spaces and form a transfer path of the deposition material. The deposition source also includes a storage container disposed at a side of the deposition housing, the storage container configured to store the deposition material, a heating body disposed between the deposition housing and the storage container configured to heat at least a portion of the deposition material, an evaporator disposed in the deposition housing for evaporating the deposition material heated by the heating body, and a heater provided on an outer surface of the deposition housing.

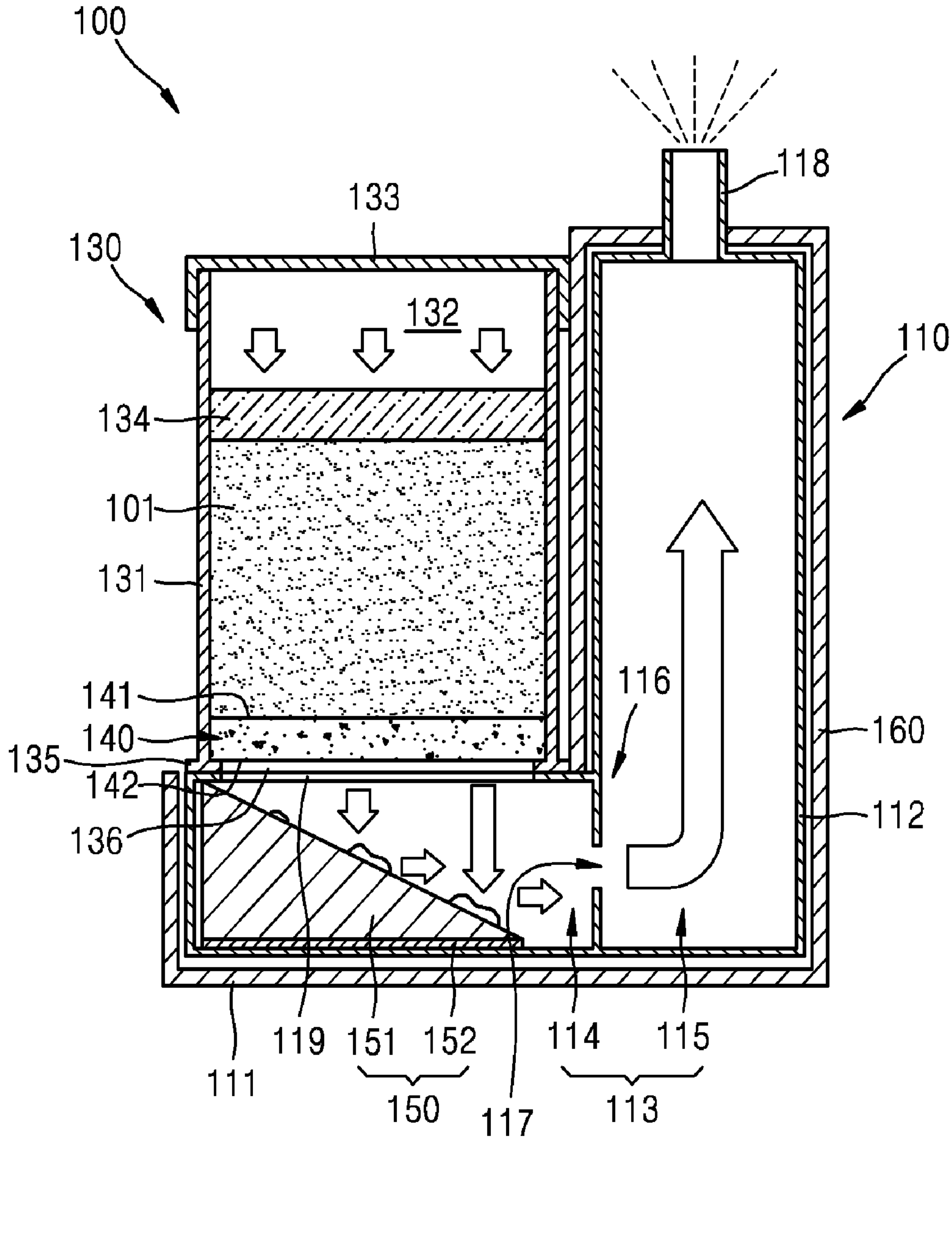

FIG. 1

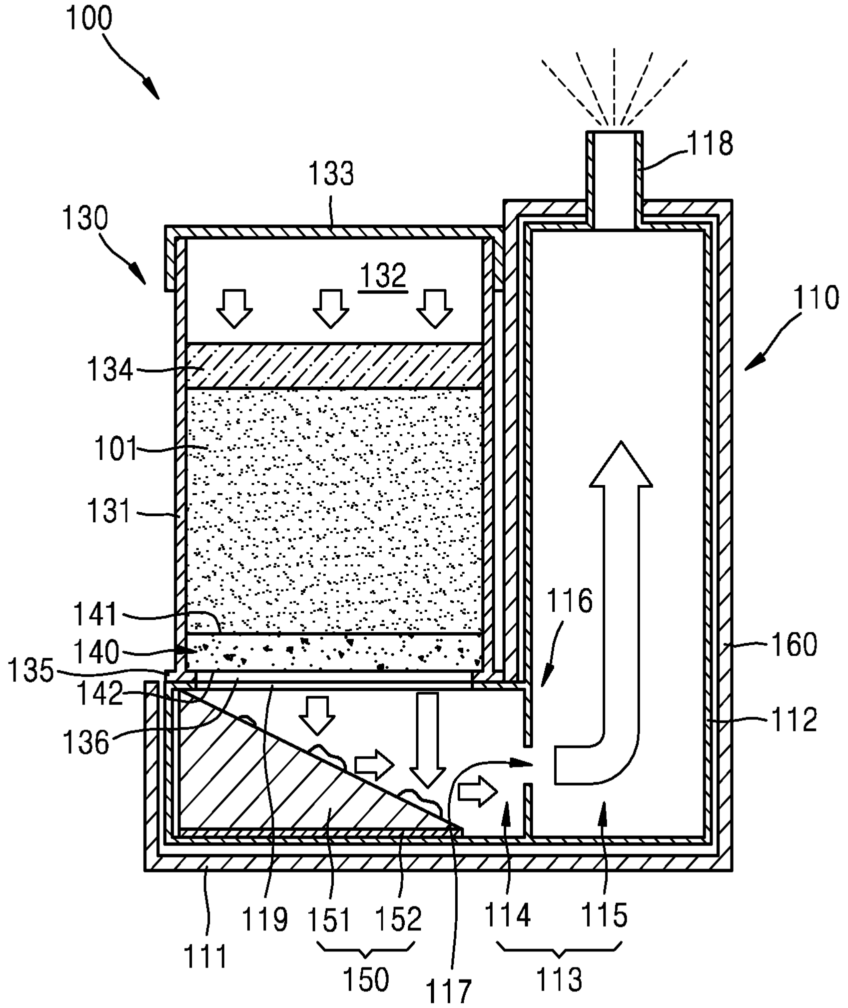
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FIG. 2

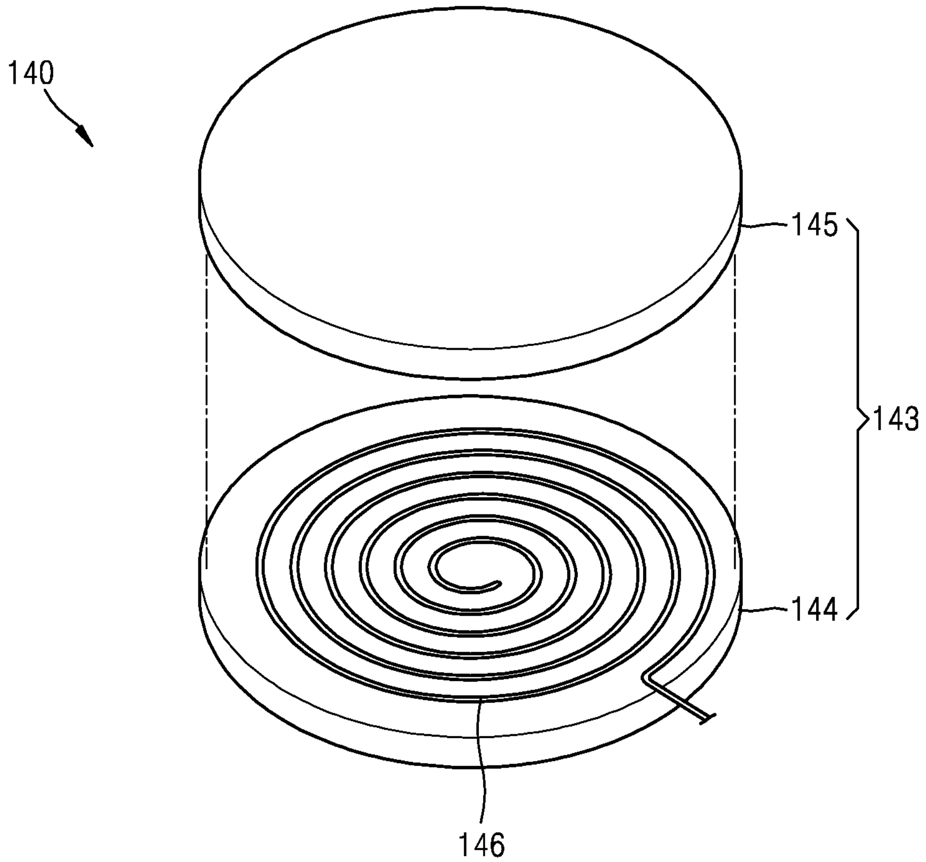

FIG. 3

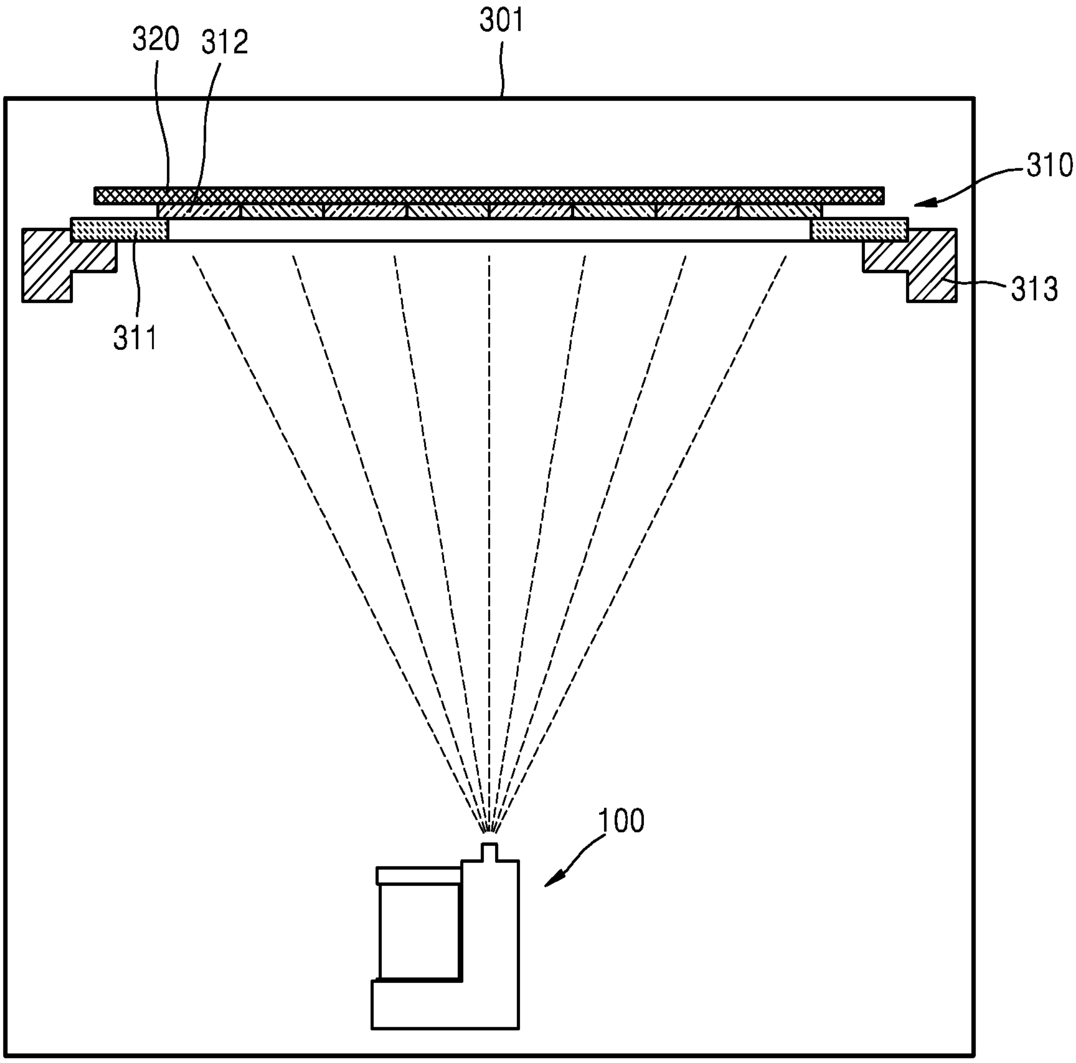

FIG. 4

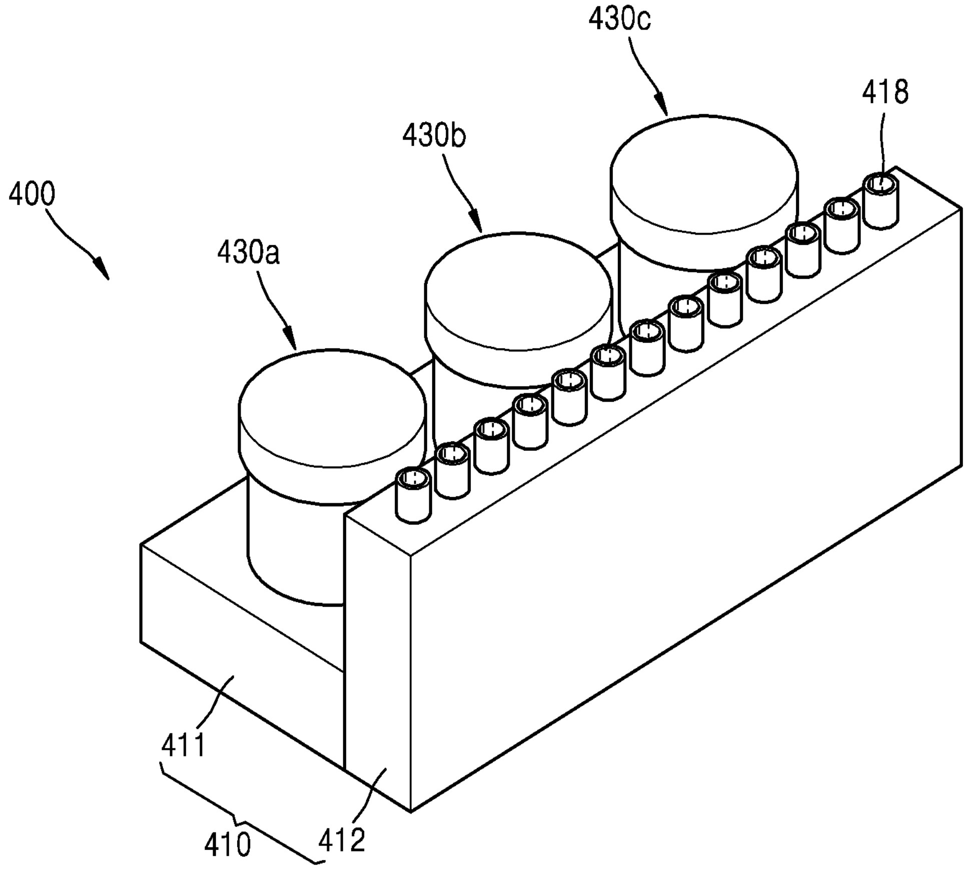

FIG. 5

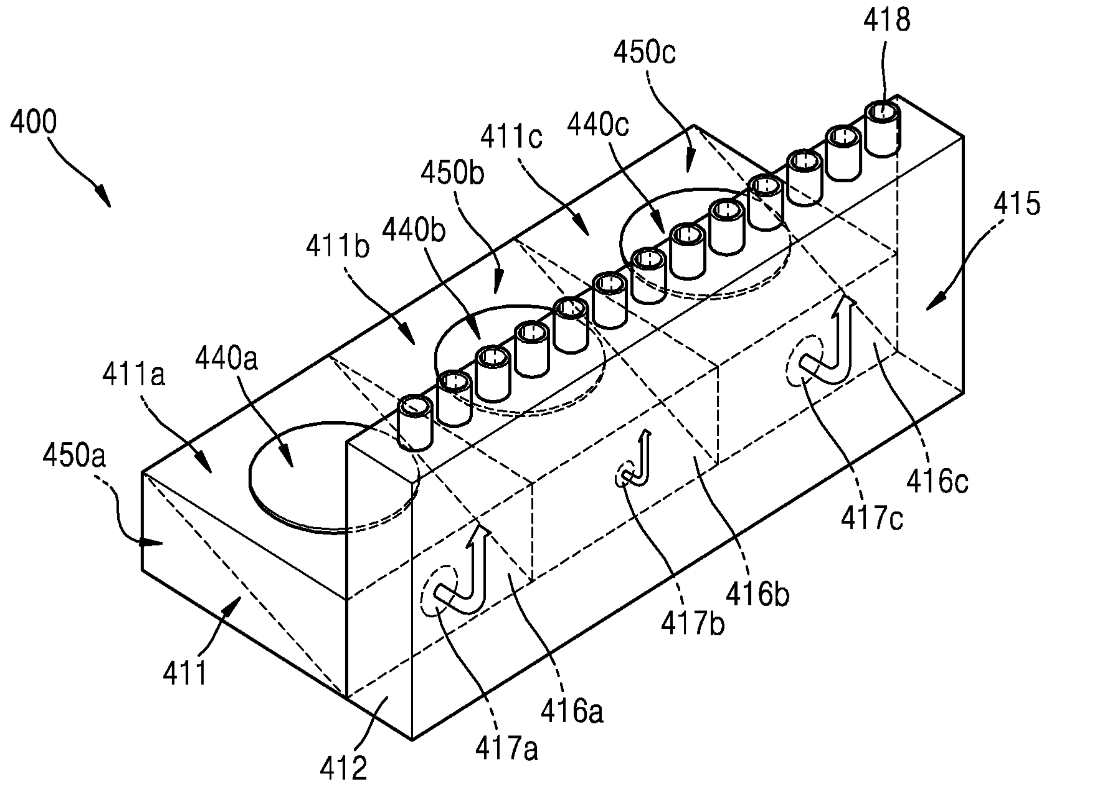

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FIG. 6

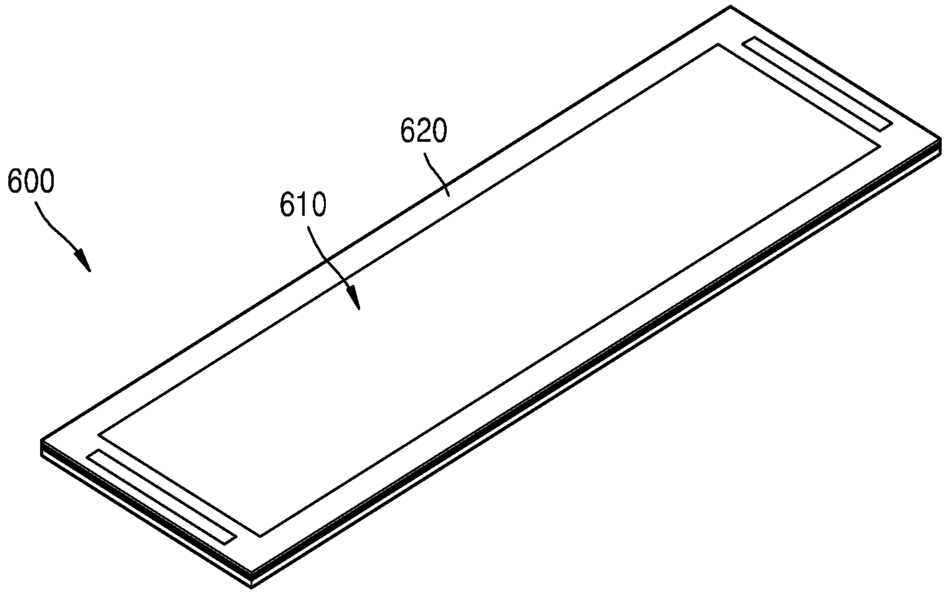


FIG. 7

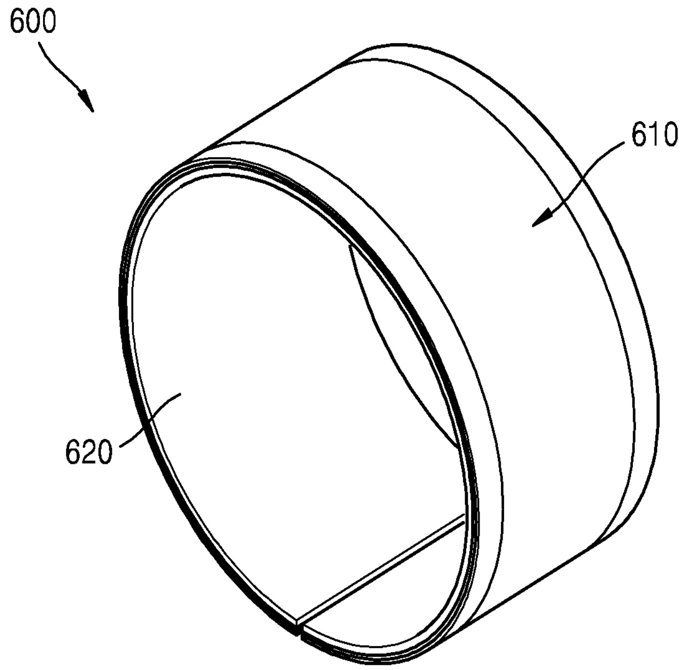
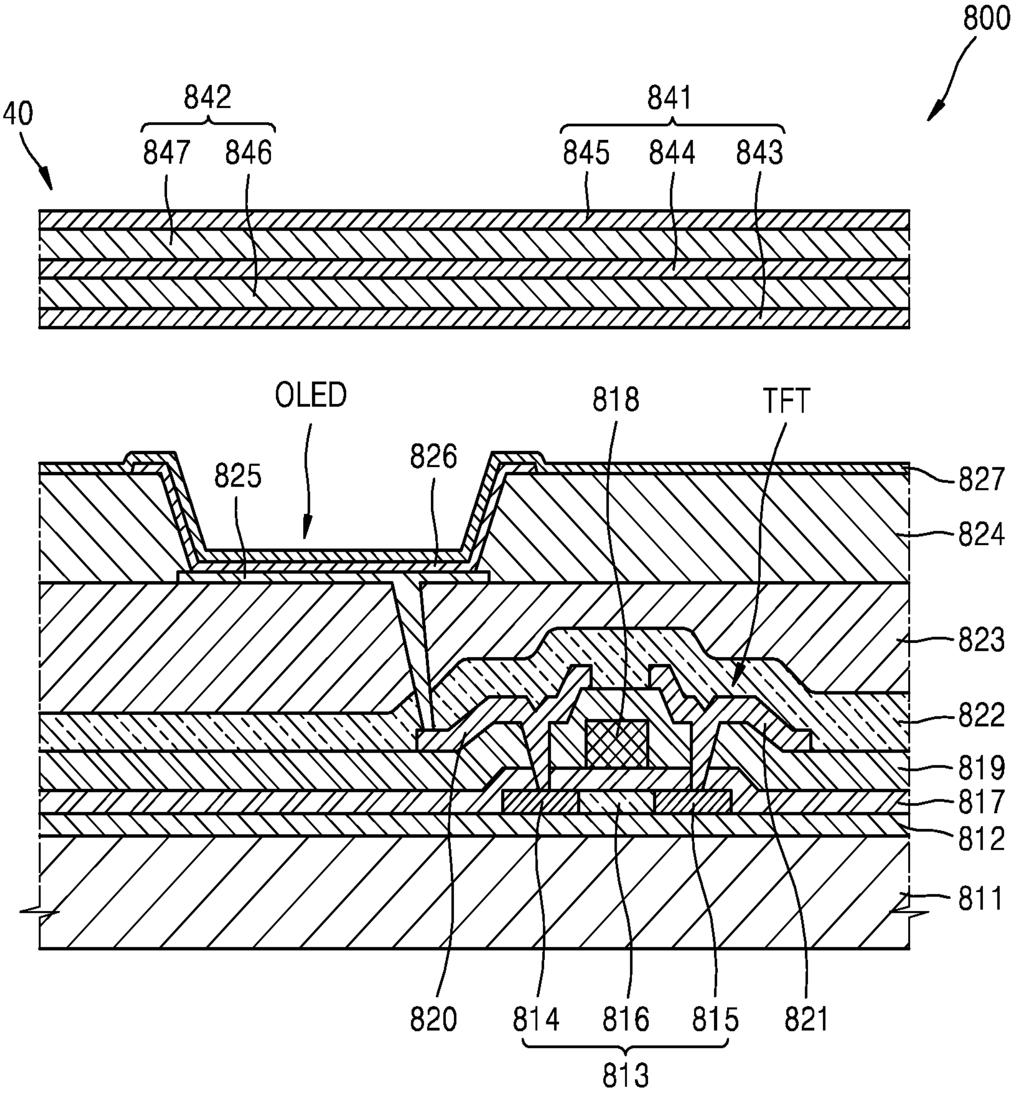


FIG. 8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DEPOSITION SOURCE FOR ORGANIC LIGHT-EMITTING DISPLAY APPARATUS

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority from and the benefit of Korean Patent Application No. 10-2015-0053143, filed on Apr. 15, 2015, which is hereby incorporated by reference for all purposes as if fully set forth herein.

BACKGROUND

[0002] 1. Field

[0003] Exemplary embodiments relate to a deposition source for an organic light-emitting display apparatus.

[0004] 2. Discussion of the Background

[0005] In general, an organic light-emitting display apparatus including a thin film transistor (TFT) may be used in a mobile device (i.e., a smartphone, a tablet personal computer (PC), a laptop, a digital camera, a camcorder, or a portable information terminal) or another electric apparatus such as a desktop computer, a television, or an outdoor billboard.

[0006] An organic light-emitting display apparatus may include an anode, a cathode, and an organic emission layer disposed between the anode and the cathode. A thin film such as an organic emission layer may be formed by a deposition process.

[0007] The above information disclosed in this Background section is only for enhancement of understanding of the background of the inventive concept, and, therefore, it may contain information that does not form the prior art that is already known in this country to a person of ordinary skill in the art.

SUMMARY

[0008] Exemplary embodiments provide a deposition source for an organic light-emitting display apparatus.

[0009] Additional aspects will be set forth in the detailed description which follows, and, in part, will be apparent from the disclosure, or may be learned by practice of the inventive concept.

[0010] An exemplary embodiment discloses a deposition source for an organic light-emitting display apparatus including a deposition housing. The deposition housing includes a nozzle configured to spraying a deposition material, evaporation spaces configured to evaporate the deposition material, and a separation wall configured to partition the evaporation spaces and form a transfer path of the deposition material. The deposition source also includes a storage container disposed at a side of the deposition housing, the storage container configured to store the deposition material, a heating body disposed between the deposition housing and the storage container configured to heat at least a portion of the deposition material, an evaporator disposed in the deposition housing for evaporating the deposition material heated by the heating body, and a heater provided on an outer surface of the deposition housing.

[0011] The foregoing general description and the following detailed description are exemplary and explanatory and are intended to provide further explanation of the claimed subject matter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The accompanying drawings, which are included to provide a further understanding of the inventive concept, and are incorporated in and constitute a part of this specification, illustrate exemplary embodiments of the inventive concept, and, together with the description, serve to explain principles of the inventive concept.

[0013] FIG. **1** is a schematic cross-sectional view of a deposition source for an organic light-emitting display apparatus according to an exemplary embodiment.

[0014] FIG. **2** is an exploded perspective view of a heater of FIG. **1**.

[0015] FIG. **3** is a schematic block diagram illustrating deposition of a thin film on a substrate by using the deposition source of FIG. **1**.

[0016] FIG. **4** is a perspective view of a deposition source for an organic light-emitting display apparatus according to an exemplary embodiment.

[0017] FIG. **5** is a diagram illustrating the inside of the deposition source of FIG. **4**.

[0018] FIG. **6** is a perspective view of an organic light-emitting display apparatus in an unfolded state according to an exemplary embodiment.

[0019] FIG. **7** is a perspective view of an organic light-emitting display apparatus of FIG. **6** in a curved state.

[0020] FIG. **8** is a cross-sectional view of a sub-pixel in an organic light-emitting display apparatus according to an exemplary embodiment.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

[0021] In the following description, for the purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of various exemplary embodiments. It is apparent, however, that various exemplary embodiments may be practiced without these specific details or with one or more equivalent arrangements. In other instances, well-known structures and devices are shown in block diagram form in order to avoid unnecessarily obscuring various exemplary embodiments.

[0022] In the accompanying figures, the size and relative sizes of layers, films, panels, regions, etc., may be exaggerated for clarity and descriptive purposes. Also, like reference numerals denote like elements.

[0023] When an element or layer is referred to as being "on," "connected to," or "coupled to" another element or layer, it may be directly on, connected to, or coupled to the other element or layer or intervening elements or layers may be present. When, however, an element or layer is referred to as being "directly on," "directly connected to," or "directly coupled to" another element or layer, there are no intervening elements or layers present. For the purposes of this disclosure, "at least one of X, Y, and Z" and "at least one selected from the group consisting of X, Y, and Z" may be construed as X only, Y only, Z only, or any combination of two or more of X, Y, and Z, such as, for instance, XYZ, XYY, YZ, and ZZ. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items.

[0024] Although the terms first, second, etc. may be used herein to describe various elements, components, regions, layers, and/or sections, these elements, components, regions, layers, and/or sections should not be limited by these terms.

These terms are used to distinguish one element, component, region, layer, and/or section from another element, component, region, layer, and/or section. Thus, a first element, component, region, layer, and/or section discussed below could be termed a second element, component, region, layer, and/or section without departing from the teachings of the present disclosure.

[0025] Spatially relative terms, such as "beneath," "below," "lower," "above," "upper," and the like, may be used herein for descriptive purposes, and, thereby, to describe one element or feature's relationship to another element(s) or feature(s) as illustrated in the drawings. Spatially relative terms are intended to encompass different orientations of an apparatus in use, operation, and/or manufacture in addition to the orientation depicted in the drawings. For example, if the apparatus in the drawings is turned over, elements described as "below" or "beneath" other elements or features would then be oriented "above" the other elements or features. Thus, the exemplary term "below" can encompass both an orientation of above and below. Furthermore, the apparatus may be otherwise oriented (e.g., rotated 90 degrees or at other orientations), and, as such, the spatially relative descriptors used herein interpreted accordingly.

[0026] The terminology used herein is for the purpose of describing particular embodiments and is not intended to be limiting. As used herein, the singular forms, "a," "an," and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. Moreover, the terms "comprises," "comprising," "includes," and/or "including," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, components, and/or groups thereof, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

[0027] Various exemplary embodiments are described herein with reference to sectional illustrations that are schematic illustrations of idealized exemplary embodiments and/or intermediate structures. As such, variations from the shapes of the illustrations as a result, for example, of manufacturing techniques and/or tolerances, are to be expected. Thus, exemplary embodiments disclosed herein should not be construed as limited to the particular illustrated shapes of regions, but are to include deviations in shapes that result from, for instance, manufacturing. For example, an implanted region illustrated as a rectangle will, typically, have rounded or curved features and/or a gradient of implant concentration at its edges rather than a binary change from implanted to non-implanted region. Likewise, a buried region formed by implantation may result in some implantation in the region between the buried region and the surface through which the implantation takes place. Thus, the regions illustrated in the drawings are schematic in nature and their shapes are not intended to illustrate the actual shape of a region of a device and are not intended to be limiting.

[0028] Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this disclosure is a part. Terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and will not be interpreted in an idealized or overly formal sense, unless expressly so defined herein.

[0029] FIG. **1** is a diagram of a deposition source **100** for an organic light-emitting display apparatus according to an exemplary embodiment.

[0030] Referring to FIG. **1**, the deposition source **100** may include a deposition housing **110** having a nozzle **118**, a storage container **130** provided at a side of the deposition housing **110** for storing a deposition material **101**, a heating body **140** provided between the deposition housing **110** and the storage container **130**, an evaporator **150** provided in the deposition housing **110**, and a heater **160** provided on an outer surface of the deposition housing **110**.

[0031] The deposition housing **110** may include a first deposition housing **111** extending in a horizontal direction, and a second deposition housing **112** connected to an end portion of the first deposition housing **111** and extending in a vertical direction. The first deposition housing **111** may be formed integrally with the second deposition housing **112**. The deposition housing **110** may include metal or ceramic.

[0032] In an exemplary embodiment, the deposition housing **110** is not limited to a particular shape provided that there is an evaporation space for evaporating the deposition material **101** in the deposition housing **110**. The deposition material **101** may be a raw material for forming an emissive layer included in an organic light-emitting diode. But the deposition material **101** is not limited to a raw material for forming an emissive layer included in an organic light-emitting diode.

[0033] An evaporation space **113** for evaporating the deposition material **101** may be disposed or otherwise formed in the deposition housing **110**. More specifically, the first deposition housing **111** may include a first evaporation space **114** and the second deposition housing **112** may include a second evaporation space **115**. The first and second evaporation spaces **114** and **115** may be connected to each other.

[0034] A separation wall **116** may be provided between the first evaporation space **114** and the second evaporation space **115**. The separation wall **116** may provide a moving passage through which the deposition material **101** moves in the evaporation space **113**.

[0035] The separation wall **116** may be a metal plate. The separation wall **116** may separate the first evaporation space **114** from the second evaporation space **115**. The separation wall **116** may be integrally formed in the deposition housing **110** with the deposition housing **110**. In an exemplary embodiment, the separation wall **116** may be separately manufactured and then coupled to the deposition housing **110**.

[0036] The separation wall **116** may include an opening **117**. The opening **117** may be disposed or otherwise formed in a center of the separation wall **116**. The opening **117** may be a transfer path of the deposition material **101** that moves from the first evaporation space **114** to the second evaporation space **115**. In an exemplary embodiment, the opening **117** may have a size that varies depending on a kind of the deposition material **101** to be deposited.

[0037] In an exemplary embodiment, the separation wall **116** may be connected to an additional driver (not shown) for varying the size of the opening **117**. For example, the size of the opening **117** may be reduced or increased in order to adjust an evaporation amount of the deposition material **101**.

[0038] The nozzle **118** (i.e., an exit for spraying the evaporating deposition material **101**) may be disposed or otherwise formed on an upper end of the second deposition housing **112**. The nozzle **118** may be connected to the second evaporation space **115**. Although only one nozzle **118** is shown in FIG. **1**, multiple nozzles **118** may be provided and separated from each other along a direction (a substantially horizontal direction) of the second deposition housing **112**. As shown in FIGS. **1** and **3**, the deposition material **101** discharged through the nozzle **118** (or nozzles) may be sprayed toward a substrate **320**.

[0039] A first deposition housing opening **119** may be disposed or otherwise formed in an upper portion of the first deposition housing **111**. The first deposition housing opening **119** may be a single opening. In addition, the first deposition housing opening **119** may be a circular opening. In an exemplary embodiment, the first deposition housing opening **119** may be multiple openings that are separate from each other.

[0040] The first deposition housing opening **119** may be disposed or otherwise formed in first deposition housing **111** and the storage container **130** may be disposed or otherwise formed on the first deposition housing **111**. The storage container **130** may have a cylindrical shape. The storage container **130** may include a storage housing **131** having an internal space **132** for storing the deposition material **101**. A cover **133** may cover an entrance of the storage housing **131**.

[0041] A storage housing opening **136** may be disposed or otherwise formed in a bottom **135** of the storage housing **131**. The storage housing opening **136** may be disposed or otherwise formed by opening at least a part of the bottom **135** of the storage housing **131**. The storage housing opening **136** may be disposed or otherwise formed to correspond to the first deposition housing opening **119**. For example, the storage housing opening **136** may have the opening area as the first deposition housing opening **119** and may be aligned with the first deposition housing opening **119**. Since the storage housing opening **136** and the first deposition housing opening **119** are disposed or otherwise formed, the internal space **132** of the storage housing **131** and the first evaporation space **114** of the first deposition housing **111** may be connected to each other.

[0042] The heating body **140** may be provided between the first deposition housing **111** and the storage container **130**. More specifically, the heating body **140** may be mounted on the bottom **135** of the storage housing **131**. The heating body **140** may completely cover the storage housing opening **136**.

[0043] The heating body **140** may be variously mounted on the bottom **135** of the storage housing **131**. For example, a flange may be disposed or otherwise formed on the bottom **135** of the storage housing **131**, and the heating body **140** may be mounted on the flange. In an alternate example, the heating body **140** may be located on the bottom **135** of the storage housing **131** and then coupled to the bottom **135** by using a bolt. However, the coupling structure is not limited to the examples listed. The coupling structure may include any structure variation so long as the heating body **140** completely covers the storage housing opening **136**.

[0044] The deposition material **101** may be filled on the heating body **140**. The deposition material **101** may be a raw material of the material that is to be deposited on the substrate **320** (i.e., a deposition target). The deposition material **101** may evaporate directly without being liquefied, or may evaporate after being liquefied when the deposition material **101** is heated.

[0045] A compression plate **134** for compressing the deposition material **101** may be provided in the storage housing **131**. In an exemplary embodiment, the compression plate **134** may be a disc type corresponding to the shape of the storage housing **131**.

[0046] The compression plate **134** may compress the deposition material **101** filled in the storage housing **131** with a predetermined pressure. Accordingly, the deposition material **101** and the heating body **140** may contact each other with a predetermined pressure applied to the deposition material **101** by the compression plate **134**.

[0047] Moreover, the compression plate **134** may prevent some of the deposition material **101** from agglomerating in advance, when the deposition material **101** evaporates. In an exemplary embodiment, the compression plate **134** may be connected to a compression unit (not shown) to adjust the pressure.

[0048] A first surface **141** of the heating body **140** may directly contact the deposition material **101**. A second surface **142** of the heating body **140**, which is opposite to the first surface **141**, may be on the first deposition housing **111** and may be connected to the first evaporation space **114**. The second surface **142** of the heating body **140** may be coupled to the first deposition housing **111** so as to cover the first deposition housing opening **119**.

[0049] The heating body **140** may be a structure that may partially heat at least a portion of the deposition material **101** (i.e., a surface of the deposition material **101** contacting the first surface **141** of the heating body **140**). The heating body **140** may include a porous plate.

[0050] Referring to FIG. **2**, the heating body **140** may include at least one porous heating plate **143** and a heating element **146** provided on the porous heating plate **143** to heat the porous heating plate **143**.

[0051] The porous heating plate **143** may include a first heating plate **144** and a second heating plate **145** coupled onto the first heating plate **144**. The size and shape of the first heating plate **144** may be substantially the same as the second heating plate **145**. In an exemplary embodiment, the first heating plate **144** and the second heating plate **145** are formed as discs corresponding to the shape of the storage housing **131**.

[0052] The first heating plate **144** and the second heating plate **145** may be manufactured by using a porous material. In particular, the first and second heating plates **144** and **145** may be porous so that the deposition material heated by the heating body **140** may pass through the heating body **140** toward the first evaporation space **114** of the first deposition housing **111**.

[0053] In an exemplary embodiment, the first and second heating plates **144** and **145** are formed of metal foam or graphite having porosity. The material for forming the first and second heating plates **144** and **145** is not limited to a particular material. Instead, any material having porosity may be used to form the first and second heating plates **144** and **145**.

[0054] In an exemplary embodiment, the first and second heating plates **144** and **145** may be porous copper (Cu) discs. The first and second heating plates **144** and **145** may have a porosity of a degree that makes particles of the deposition material **101** not pass through the heating body **140** (i.e., a porosity of 90% or greater).

[0055] In an exemplary embodiment, the first heating plate **144** and the second heating plate **145** are formed of a material having an excellent thermal conductivity.

[0056] The heating element **146** may be disposed between the first heating plate **144** and the second heating plate **145**. The heating element **146** may be disposed in a coil shape. The first heating plate **144** and the second heating plate **145** may be simultaneously heated by the heating element **146**.

[0057] The heating body **140** may have any structure, provided that the deposition material **101** is heated by the heating body **140**. For example, the porous heating body **140** may include an additional heating body so that a heating element contacts the additional heating body or an induction heating coil may be disposed under the porous heating body **140**. In this example, the porous heating body **140** may have side surfaces that are heated. In an exemplary embodiment, the heating body **140** includes a single heating plate.

[0058] The heating body **140** may be heated to a temperature that is greater than or equal to an evaporation temperature or a melting temperature of the deposition material **101**. Accordingly, the deposition material **101** contacting the heating body **140** may evaporate or melt depending on the deposition material **101**.

[0059] More specifically, the deposition material **101** that directly evaporates without being liquefied may evaporate when the temperature of the heating body **140** is maintained at a temperature that is greater than or equal to the evaporation temperature of the deposition material **101**. A temperature of the evaporator **150** and a temperature of the nozzle **118** may be also maintained to be greater than or equal to the evaporation temperature of the deposition material **101**.

[0060] In an exemplary embodiment, the deposition material **101** may be liquefied when the temperature of the heating body **140** is maintained to be greater than or equal to the melting temperature of the deposition material **101**. The temperature of the evaporator **150** and the nozzle **118** may be maintained to be greater than or equal to the evaporation temperature of the deposition material **101** such that the liquefied deposition material **101** evaporates when exposed to the heat from the evaporator **150** and the nozzle **118**.

[0061] In an exemplary embodiment, the heating body **140** may control an evaporation amount or a melting amount of the deposition material **101** by controlling the temperature of the heating body **140**, the evaporator **150**, and the nozzle **118**.

[0062] The evaporator **150** that evaporates the deposition material **101** heated by the heating body **140** may be provided in the deposition housing **110**. The evaporator **150** may be located in the first evaporation space **114** where the deposition material **101** moves from the heating body **140** to the separation wall **116**. In an exemplary embodiment, the evaporator **150** is provided under the heating body **140**.

[0063] The evaporator **150** may include an evaporation plate **151** and a heating element **152** for heating the evaporation plate **151**. The evaporation plate **151** may be provided at a location where the deposition material **101** of a liquid phase transferred from the heating body **140** may contact the evaporation plate **151**. The evaporation plate **151** may be a metal plate having an excellent thermal conductivity. In an exemplary embodiment, the evaporation plate **151** has a triangular cross-section, but is not limited to such a structure. Instead, the evaporation plate **151** may have any structure provided that the deposition material **101** of the liquid phase may contact the evaporation plate **151**.

[0064] The heating element **152** may be disposed between the evaporation plate **151** and the first deposition housing **111**. The evaporation plate **151** may be heated by the heating element **152**.

[0065] The deposition material **101** melted by the heating body **140** may evaporate on the evaporation plate **151** and proceed toward the separation wall **116**. The evaporated deposition material **101** may be sprayed to the substrate **320** (i.e. a deposition target) through the nozzle **118**.

[0066] In addition, the heater **160** may be provided on the outer surface of the deposition housing **110**. The heater **160** may be disposed or otherwise formed on the entire outer surfaces of the first deposition housing **111** and the second deposition housing **112**. However, the heater **160** may not be disposed or otherwise formed on regions of the deposition first deposition housing **11** and the second deposition housing **112** where the storage container **130** and the heating body **140** meet. The deposition housing **110** and the nozzle **118** may be simultaneously heated by the heater **160**.

[0067] Operations of the deposition source **100** having the above structure will be described below with reference to FIG. **1**, FIG. **2**, and FIG. **3**.

[0068] Referring to FIGS. **1** to **3**, a chamber **301** is prepared. In an exemplary embodiment, the chamber **301** may be a vacuum chamber for forming an organic emission layer of the organic light-emitting display apparatus.

[0069] The deposition source **100** may be provided on a lower portion of the chamber **301**.

[0070] A mask assembly **310** may be provided on an upper portion in the chamber **301**. The mask assembly **310** may include a mask frame **311** and a mask **312** including at least one stick mask mounted on the mask frame **311**. A deposition substrate **320** may be located on the mask **312**. A holder **313** for holding the mask frame **311** may be further provided at edges of the mask frame **311**.

[0071] The deposition material **101** may be sprayed from the deposition source **100** toward the substrate **320**. The evaporating deposition material **101** may be deposited at a desired deposition area on the substrate **320** after passing through slits of the mask **312**.

[0072] Spraying processes of the deposition material **101** from the deposition source **100** are as follows.

[0073] During the deposition processes, a predetermined amount electric power is applied to the heating body heating element **146**, the evaporating heating element **152**, and the outer surface heater **160** formed on the outer surface of the deposition housing **110**. Therefore, the deposition housing **110**, the nozzle **118**, the heating body **140**, and the evaporator **150** are simultaneously heated to a predetermined temperature.

[0074] When the heating plate **143** of the heating body **140** is heated, the surface of the deposition material **101** directly contacting the first surface **141** of the heating plate **143** is locally heated. The heated deposition material **101** may evaporate or melt depending on the melting point and boiling point of the particular deposition material **101**.

[0075] The deposition material **101** that evaporates without being liquefied moves to the first evaporation space **114** of the first deposition housing **111** and passes through the opening **117** of the separation wall **116** toward the second evaporation space **115** of the second deposition housing **112**. After that, the deposition material **101** is sprayed toward the substrate **320** through the nozzle **118**.

[0076] Here, the temperature of the heating plate **143** has to be maintained to be greater than or equal to the evaporation temperature of the deposition material **101**. Also, the temperatures of the evaporation plate **151** of the evaporator **150** and the nozzle **118** have to be maintained to be greater than or equal to the evaporation temperature of the deposition material **101**.

[0077] The deposition material **101** that evaporates after being liquefied moves to the first evaporation space **114** of the first deposition housing **111**. The deposition material **101** of the liquid phase may evaporate by the evaporation plate **151** in the first evaporation space **114** and then move to the second evaporation space **115** of the second deposition housing **112** after passing through the opening **117** of the separation wall **116**. After that, the deposition material **101** is sprayed toward the substrate **320** through the nozzle **118**.

[0078] Here, the temperature of the heating plate **143** is maintained to be greater than or equal to the melting temperature of the deposition material **101**. However, the temperatures of the evaporation plate **151** of the evaporator **150** and the nozzle **118** have to be maintained to be greater than or equal to the evaporation temperature of the deposition material **101**.

[0079] FIG. **4** is a perspective view of a deposition source **400** according to an exemplary embodiment. FIG. **5** is a diagram showing the inside of the deposition source **400** of FIG. **4**.

[0080] The deposition source **400** of an exemplary embodiment includes a multiple deposition sources. The functions of various elements of deposition source **400** are substantially the same as the functions of the elements included in the deposition source **100** of FIG. **1**. Thus, the detailed descriptions the substantially similar functions are omitted for brevity.

[0081] Referring to FIGS. **4** and **5**, the deposition source **400** may include a deposition housing **410** including a multiple nozzles **418**. The deposition housing **410** may include a first deposition housing **411** extending in a horizontal direction and a second deposition housing **412** connected to a side of the first deposition housing **411** and extending in a vertical direction.

[0082] Multiple first evaporation spaces **411***a*, **411***b*, and **411***c* that are independently separate from one another may be formed in the first deposition housing **411**. In an exemplary embodiment, the first deposition housing **411** is divided into three first evaporation spaces **411** a, **411***b*, and **411***c*, but the number of first evaporation spaces **411***a*, **411***b*, and **411***c* may vary depending on the deposition material. The second deposition housing **412** may include a second evaporation space **415**. The first evaporation spaces **41** la, **411***b*, and **411***c* and the second evaporation space **415** may be connected to each other.

[0083] Separation walls **416***a*, **416***b*, and **416***c* may be formed respectively between the separate first evaporation spaces **411** a, **411***b*, and **411** c and the second evaporation space **415**. The separation walls **416***a*, **416***b*, and **416***c* respectively may include openings **417***a*, **417***b*, and **417***c* that form transfer paths of the deposition material **101** (see FIG. **1**) that moves from the first evaporation spaces **411***a*, **411***b*, and **411***c* corresponding respectively to the separation walls **416***a*, **416***b*, and **416***c* and to the second evaporation space **415**.

[0084] Storage containers **430***a*, **430***b*, and **430***c* may be provided on the first deposition housing **411**. Heating bodies **440***a*, **440***b*, and **440***c* may be disposed respectively between the storage containers **430***a*, **430***b*, and **430***c* and the first deposition housing **411**. The storage containers **430***a*, **430***b*, and **430***c*, the heating bodies **440***a*, **440***b*, and **440***c*, and the first deposition housing **411** may be connected to one another, and the deposition material **101** that is heated by the heating bodies **440***a*, **440***b*, and **440***c* may move to the first evaporation spaces **411***a*, **411***b*, and **411***c* that are separate from each other.

[0085] In an exemplary embodiment, the storage containers **430***a*, **430***b*, and **430***c* are coupled to a deposition material supply apparatus (not shown) provided outside the chamber **301** to supply a deposition material continuously.

[0086] Evaporators **450***a*, **450***b*, and **450***c* that evaporate the deposition material **101** heated by the heating bodies **440***a*, **440***b*, and **440***c* may be provided in the first deposition housing **411**. The evaporators **450***a*, **450***b*, and **450***c* may be respectively formed in the first evaporation spaces **411***a*, **411***b*, and **411***c* that are separate from each other.

[0087] In an exemplary embodiment, the storage containers **430***a*, **430***b*, and **430***c* store different deposition materials **101**. For example, deposition materials **101** may be used to form a blue emission layer of the organic emission layer. The deposition materials **101** may be respectively stored in the storage containers **430***a*, **430***b*, and **430***c*.

[0088] Evaporation amounts of the deposition materials **101** that are evaporated by the heating bodies **440***a*, **440***b*, and **440***c* or the evaporators **450***a*, **450***b*, and **450***c* may be adjusted by forming the openings **417***a*, **417***b*, and **417***c* with different diameters from each other in the separation walls **416***a*, **416***b*, and **416***c*.

[0089] In an exemplary embodiment, the deposition materials **101** pass through the separation walls **416***a*, **416***b*, and **416***c* having the openings **417***a*, **417***b*, and **417***c* of different sizes from the first evaporation spaces **411***a*, **411***b*, and **411***c* that are separate from each other. Then the deposition materials **101** move to the single second evaporation space **415** to be mixed. In an embodiment, a mixing ratio of the deposition materials **101** may be adjusted.

[0090] In an exemplary embodiment, the evaporation amounts of the deposition materials **101** may be adjusted by varying the areas of the heating bodies **440***a*, **440***b*, and **440***c*.

[0091] According to the deposition source **400** having the above-described structure, the amounts of the gases that are evaporated from the heating bodies **440***a*, **440***b*, and **440***c* or the evaporators **450***a*, **450***b*, and **450***c* may be adjusted by forming the openings **417***a*, **417***b*, and **417***c* in the separation walls **416***a*, **416***b*, and **416***c* with different diameters. The gases of the deposition materials **101** may be deposited on a substrate.

[0092] FIG. **6** is a perspective view of an organic light-emitting display apparatus **600** in a curved state with an organic emission layer formed on a substrate by using the deposition source **100** of FIG. **1**. FIG. **7** is a perspective view of the organic light-emitting display apparatus **600** of FIG. **6** in a curved state.

[0093] Referring to FIGS. **6** and **7**, the organic light-emitting display apparatus **600** may include a flexible display panel **610** for displaying images, and a flexible holder **620** coupled to the flexible display panel **610**. The flexible display panel **610** may include various films such as a touch screen, a polarization plate, and a window cover, as well as a device for displaying the images. The flexible display apparatus **600** may display the images in various states (i.e., a flat state or a curved state).

[0094] In an exemplary embodiment, the organic light-emitting display apparatus **600** is a flexible apparatus, but may be applied to an organic light-emitting display apparatus that is rigid.

[0095] FIG. **8** is a cross-sectional view of a sub-pixel in an organic light-emitting display apparatus **800** where an organic emission layer is formed on a substrate by using the deposition source **100** of FIG. **1**.

[0096] Referring to FIG. **8**, the organic light-emitting display apparatus **800** may include a substrate **811** and an encapsulation **840** that is a thin film facing the substrate **811**.

[0097] The substrate **811** may be at least one of glass substrate, a polymer substrate, and a flexible film substrate. The substrate **811** may be transparent, semi-transparent, or opaque.

[0098] A barrier layer **812** may be disposed or otherwise formed on the substrate **811**. The barrier layer **812** may entirely cover an upper surface of the substrate **811**. The barrier layer **812** may include at least one of an inorganic material or an organic material. The barrier layer **812** may be formed to have a single-layered or a multi-layered structure. The barrier layer **812** may prevent oxygen and moisture from infiltrating into the substrate **811** as well as create a plane surface on the upper surface of the substrate **811**.

[0099] A thin film transistor TFT may be disposed or otherwise formed on the barrier layer **812**. In an exemplary embodiment, the thin film transistor TFT is a top gate transistor, but is not limited to a top gate transistor. Instead, the thin film transistor TFT may have any suitable structure. For example, the thin film transistor may be a bottom gate transistor.

[0100] A semiconductor active layer **813** may be disposed or otherwise formed on the barrier layer **812**.

[0101] The semiconductor active layer **813** may include a source region **814** and a drain region **815** that are formed by doping N type impurity ions or P type impurity ions. A channel region **816** (i.e., a non-doped region) may be disposed between the source region **814** and the drain region **815**. The semiconductor active layer **813** may include at least one of an organic semiconductor and inorganic semiconductor. For example, the semiconductor active layer **813** may include amorphous silicon. In an exemplary embodiment, the semiconductor active layer **813** includes an oxide semiconductor.

[0102] A gate insulating layer **817** may be disposed or otherwise formed on the semiconductor active layer **813**. The gate insulating layer **817** may include an inorganic layer. The gate insulating layer **817** may include a single-layered structure or a multi-layered structure.

[0103] A gate electrode **818** may be disposed or otherwise formed on the gate insulating layer **817**. The gate electrode **818** may include a metal material having an excellent conductivity. The gate electrode **818** may include a single-layered structure or a multi-layered structure.

[0104] An interlayer insulating layer **819** may be disposed or otherwise formed on the gate electrode **818**. The interlayer insulating layer **819** may include at least one of an inorganic layer and an organic layer.

[0105] A source electrode **820** and a drain electrode **821** may be disposed or otherwise formed on the interlayer insulating layer **819**. More specifically, contact holes may be formed by partially removing the gate insulating layer **817** and the interlayer insulating layer **819**, and the source electrode **820** may be electrically connected to the source region **814** and the drain electrode **821** may be electrically connected to the drain region **815** via the contact holes.

[0106] A passivation layer **822** may be disposed or otherwise formed on the source electrode **820** and the drain electrode **821**. The passivation layer **822** may include at least one of an inorganic layer and an organic layer. A planarization layer **823** may be disposed or otherwise formed on the passivation layer **822**. The planarization layer **823** may include an organic layer. In an exemplary embodiment, one of the passivation layer **822** and the planarization layer **823** is omitted.

[0107] The thin film transistor TFT may be electrically connected to an organic light-emitting diode OLED.

[0108] The organic light-emitting diode OLED may be disposed or otherwise formed on the planarization layer **823**. The organic light-emitting diode OLED may include a first electrode **825**, an intermediate layer **826**, and a second electrode **827**.

[0109] The first electrode **825** may function as an anode and may include any suitable conductive material. The first electrode **825** may be a transparent electrode, a reflective electrode, or some combination of a transparent electrode and reflective electrode. For example, when the first electrode **825** is used as the transparent electrode, the first electrode **825** may include a transparent conductive layer. When the first electrode **825** is used as the reflective electrode, the first electrode **825** may include a reflective layer and a transparent conductive layer formed on the reflective layer.

[0110] A pixel defining layer **824** may partially covers the planarization layer **823** and the first electrode **825**. The pixel defining layer **824** may define an emission area in each of sub-pixels by surrounding edges of the first electrode **825**. The first electrode **825** may be patterned in each of the sub-pixels.

[0111] The pixel defining layer **824** may include at least one of an organic layer and an inorganic layer. The pixel defining layer **824** may have a single-layered structure or a multi-layered structure.

[0112] The intermediate layer **826** may be disposed or otherwise formed on the first electrode **825** at a region that is exposed by etching a part of the pixel defining layer **824**. The intermediate layer **826** may be formed by deposition processes. The intermediate layer **826** may be patterned by using the deposition source **100** of FIG. **1**.

[0113] The intermediate layer **826** may include an organic emission layer. Alternately, the intermediate layer **826** includes the organic emission layer and at least one of a hole injection layer (HIL), a hole transport layer (HTL), an electron transport layer (EIL), and an electron injection layer (EIL). However, exemplary embodiments are not limited to an intermediate layer **826** including an organic emission layer or an organic emission layer and at least one of a hole injection layer (HIL), a hole transport layer (HTL), an electron transport layer (EIL), and an electron injection layer

(EIL). Instead, the intermediate layer **826** may include the organic emission layer as well as any other functional layer.

[0114] The second electrode **827** may be disposed or otherwise formed on the intermediate layer **826**.

[0115] The second electrode **827** may function as a cathode. The second electrode **827** may be a transparent electrode, a reflective electrode, or a combination of a transparent electrode and a reflective electrode. For example, when the second electrode **827** is used as the transparent electrode, the second electrode **827** may include a metal layer and a transparent conductive layer formed on the metal layer. When the second electrode **827** is used as the reflective layer, the second electrode **827** may include a metal layer.

[0116] In an exemplary embodiment, sub-pixels may be formed on the substrate **811**, and each of the sub-pixels may emit red, green, blue, or white light. However, exemplary embodiments are not limited to sub-pixels emitting red, green, blue, or white light. Instead, sub-pixels may emit any light color.

[0117] In an exemplary embodiment, the intermediate layer **826** may be disposed or otherwise formed commonly on the first electrode **825** without regard to locations of the sub-pixels. The organic emission layer may be formed by vertically stacking layers, each including an emission material emitting red, green, or blue light, or by mixing emission materials emitting red, green, and blue light.

[0118] In an exemplary embodiment, any kind of color combination may be used provided that the white light may be emitted. A color converting layer or a color filter for converting the white light into a predetermined color may be further used.

[0119] The encapsulation **840** may be formed to protect the organic light-emitting diode OLED against external moisture or oxygen. In an exemplary embodiment, the encapsulation **840** may include a structure that stacks inorganic layers **841** and organic layers **842** alternately. For example, the inorganic layers **841** may include a first inorganic layer **843**, a second inorganic layer **844**, and a third inorganic layer **845**. The organic layers **842** may include a first organic layer **846** and a second organic layer **847**.

[0120] According to exemplary embodiments, the deposition source for the organic light-emitting display apparatus may reduce degradation of the deposition material with respect to the heat, and a deposition speed may be improved.

[0121] Although certain exemplary embodiments and implementations have been described herein, other embodiments and modifications will be apparent from this description. Accordingly, the inventive concept is not limited to such embodiments, but rather to the broader scope of the presented claims and various obvious modifications and equivalent arrangements.

What is claimed is:

1. A deposition source for an organic light-emitting display apparatus, the deposition source, comprising:

a deposition housing comprising:

a nozzle configured to spraying a deposition material;

evaporation spaces configured to evaporate the deposition material; and

a separation wall configured to partition the evaporation spaces and form a transfer path of the deposition material;

a storage container disposed at a side of the deposition housing, the storage container configured to store the deposition material;

a heating body disposed between the deposition housing and the storage container configured to heat at least a portion of the deposition material;

an evaporator disposed in the deposition housing for evaporating the deposition material heated by the heating body; and

a heater provided on an outer surface of the deposition housing.

2. The deposition source of claim **1**, wherein the evaporation spaces comprise:

a first evaporation space connected to the heating body through a deposition housing opening formed in the deposition housing, and

a second evaporation space connected to the nozzle and connected to the first evaporation space.

3. The deposition source of claim **2**, wherein the separation wall is a plate disposed between the first evaporation space and the second evaporation space, and the separation wall comprises an opening that is the transfer path of the deposition material moving from the first evaporation space to the second evaporation space.

4. The deposition source of claim **2**, wherein the deposition housing comprises:

a first deposition housing extending in a first direction comprising the first evaporation space and the deposition housing opening that is connected to the heating body; and

a second deposition housing connected to an end of the first deposition housing, the second deposition housing extending in a second direction and comprising the second evaporation space.

5. The deposition source of claim **2**, wherein the storage container comprises a storage housing having an internal space for storing the deposition material and a cover for covering an entrance of the storage housing, and a storage housing opening corresponding to the deposition housing opening is formed in a bottom of the storage housing and the heating body covers the storage housing opening.

6. The deposition source of claim **5**, wherein a compression plate configured to compress the deposition material is disposed in the storage container.

7. The deposition source of claim **2**, wherein a first surface of the heating body contacts the deposition material and a second surface of the heating body is coupled to the deposition housing, the second surface of the heating body is opposite the first surface of the heating body.

8. The deposition source of claim **7**, wherein the heating body comprises a porous plate.

9. The deposition source of claim **7**, wherein the heating body comprises:

at least one porous heating plate; and

a heating element disposed on the at least one porous heating plate and configured to heat the at least one porous heating plate.

10. The deposition source of claim **9**, wherein the at least one porous heating plate comprises:

a first heating plate; and

a second heating plate,

wherein the heating element is disposed between the first heating plate and the second heating plate.

11. The deposition source of claim **7**, wherein the heating body is heated to a temperature that is greater than or equal to at least one of an evaporation temperature and a melting temperature of the deposition material.

12. The deposition source of claim **11**, wherein the deposition material that evaporates without being liquefied is evaporated by maintaining a temperature of the heating body, a temperature of the evaporator, and a temperature of the nozzle to be greater than or equal to an evaporation temperature of the deposition material.

13. The deposition source of claim **11**, wherein the deposition material that evaporates after being liquefied is evaporated by maintaining the temperature of the heating body to be greater than or equal to the melting temperature of the deposition material and maintaining the temperature of the evaporator and the temperature of the nozzle to be greater than or equal to the evaporation temperature of the deposition material.

14. The deposition source of claim **7**, wherein at least one of an evaporation amount and a melting amount of the deposition material is controlled by controlling the temperature of the heating body.

15. The deposition source of claim **1**, wherein the evaporator is located in the evaporation spaces.

16. The deposition source of claim **15**, wherein the evaporator comprises:

an evaporation plate; and

a heating element configured to heat the evaporation plate.

17. The deposition source of claim **15**, wherein the deposition material melted by the heating body is evaporated by the evaporator and transferred to the separation wall.

18. The deposition source of claim **1**, wherein the deposition housing comprises first evaporation spaces that are independently separate from each other, and a second evaporation space, wherein separation walls are disposed respectively between the first evaporation spaces and the second evaporation space,

storage containers corresponding to the first evaporation spaces are disposed at a side of the deposition housing,

heating bodies are disposed respectively between the deposition housing and the storage containers, and

evaporators corresponding to the heating bodies are disposed in the deposition housing.

19. The deposition source of claim **18**, wherein the second evaporation space is commonly connected to the first evaporation spaces.

20. The deposition source of claim **19**, wherein the separation walls have openings of different sizes from each other to adjust a mixture ratio of the deposition material moving from the first evaporation spaces to the second evaporation space.

* * * * *

专利名称(译)	用于有机发光显示装置的沉积源		
公开(公告)号	US20160308171A1	公开(公告)日	2016-10-20
申请号	US14/923869	申请日	2015-10-27
[标]申请(专利权)人(译)	三星显示有限公司		
申请(专利权)人(译)	三星DISPLAY CO.，LTD.		
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IPC分类号	H01L51/56		
CPC分类号	H01L51/56 C23C14/12 C23C14/243 H01L51/0002		
优先权	1020150053143 2015-04-15 KR		
外部链接	Espacenet USPTO		

摘要(译)

一种用于有机发光显示装置的沉积源，包括沉积壳体。沉积壳体包括被配置为喷射沉积材料的喷嘴，被配置为蒸发沉积材料的蒸发空间，以及被配置为分隔蒸发空间并形成沉积材料的传送路径的隔离壁。沉积源还包括设置在沉积壳体的一侧的存储容器，存储容器被配置为存储沉积材料，设置在沉积壳体和存储容器之间的加热体，被配置为加热沉积材料的至少一部分，设置在沉积壳体中用于蒸发由加热体加热的沉积材料的蒸发器，以及设置在沉积壳体的外表面上的加热器。