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(54) **ORGANIC LAYER DEPOSITION ASSEMBLY, ORGANIC LAYER DEPOSITION APPARATUS, ORGANIC LIGHT-EMITTING DISPLAY APPARATUS AND METHOD OF MANUFACTURING THE SAME**

(71) Applicant: **SAMSUNG DISPLAY CO., LTD.**, Yongin-City (KR)

(72) Inventors: **Myung-Ki Lee**, Yongin-City (KR); **Sung-Bong Lee**, Yongin-City (KR); **Dong-Seob Jeong**, Yongin-City (KR); **Mu-Hyun Kim**, Yongin-City (KR)

(73) Assignee: **SAMSUNG DISPLAY CO., LTD.**, Yongin-City, Gyeonggi-Do (KR)

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CPC ***H01L 51/56*** (2013.01); ***H01L 51/52*** (2013.01)

USPC **257/40**; 438/46; 118/720; 118/719

(57) **ABSTRACT**

An organic layer deposition assembly, an organic layer deposition apparatus, an organic light-emitting display apparatus, and a method of manufacturing the organic light-emitting display apparatus, in order to improve a characteristic of a deposited layer, the organic layer deposition assembly including a deposition source for discharging a deposition material; a deposition source nozzle unit disposed at a side of the deposition source, and including a plurality of deposition source nozzles; and a patterning slit sheet disposed while facing the deposition source nozzle unit, and including a plurality of patterning slits and one or more alignment confirmation pattern slits that are formed at edge portions of the plurality of patterning slits, wherein the deposition material that is discharged from the deposition source passes through the patterning slit sheet and then is formed on the substrate, while a deposition process is performed.

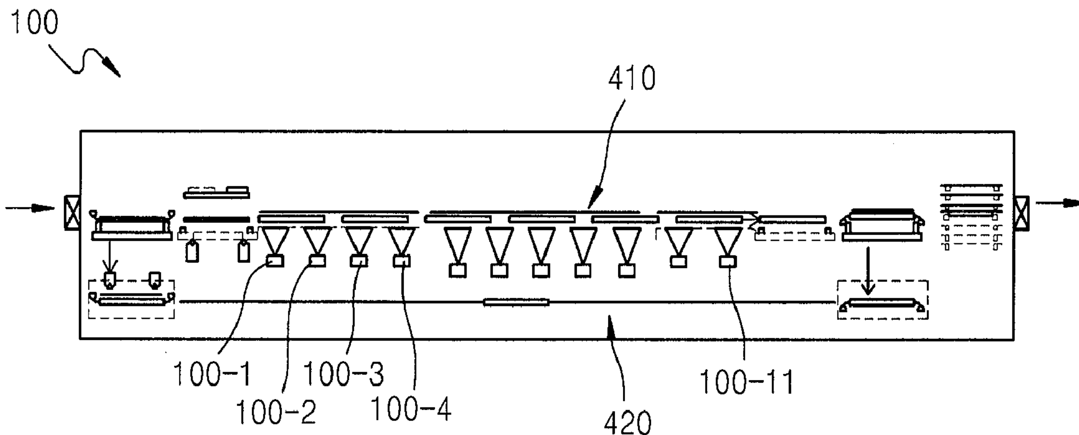


FIG. 1

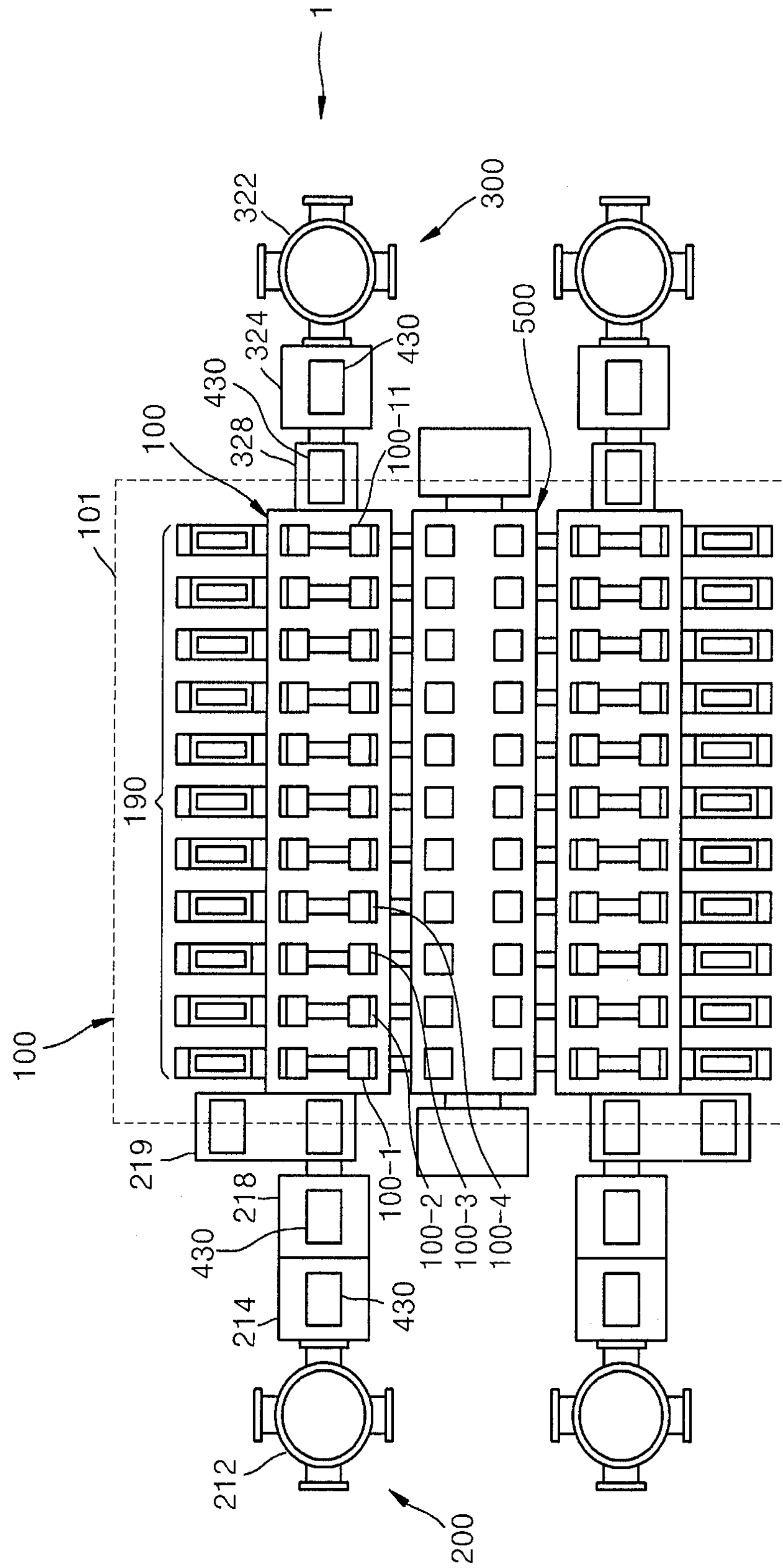


FIG. 2

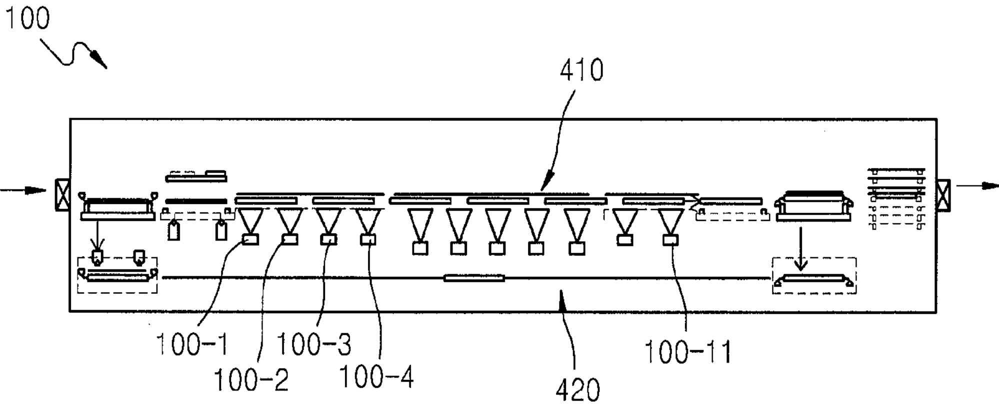


FIG. 3

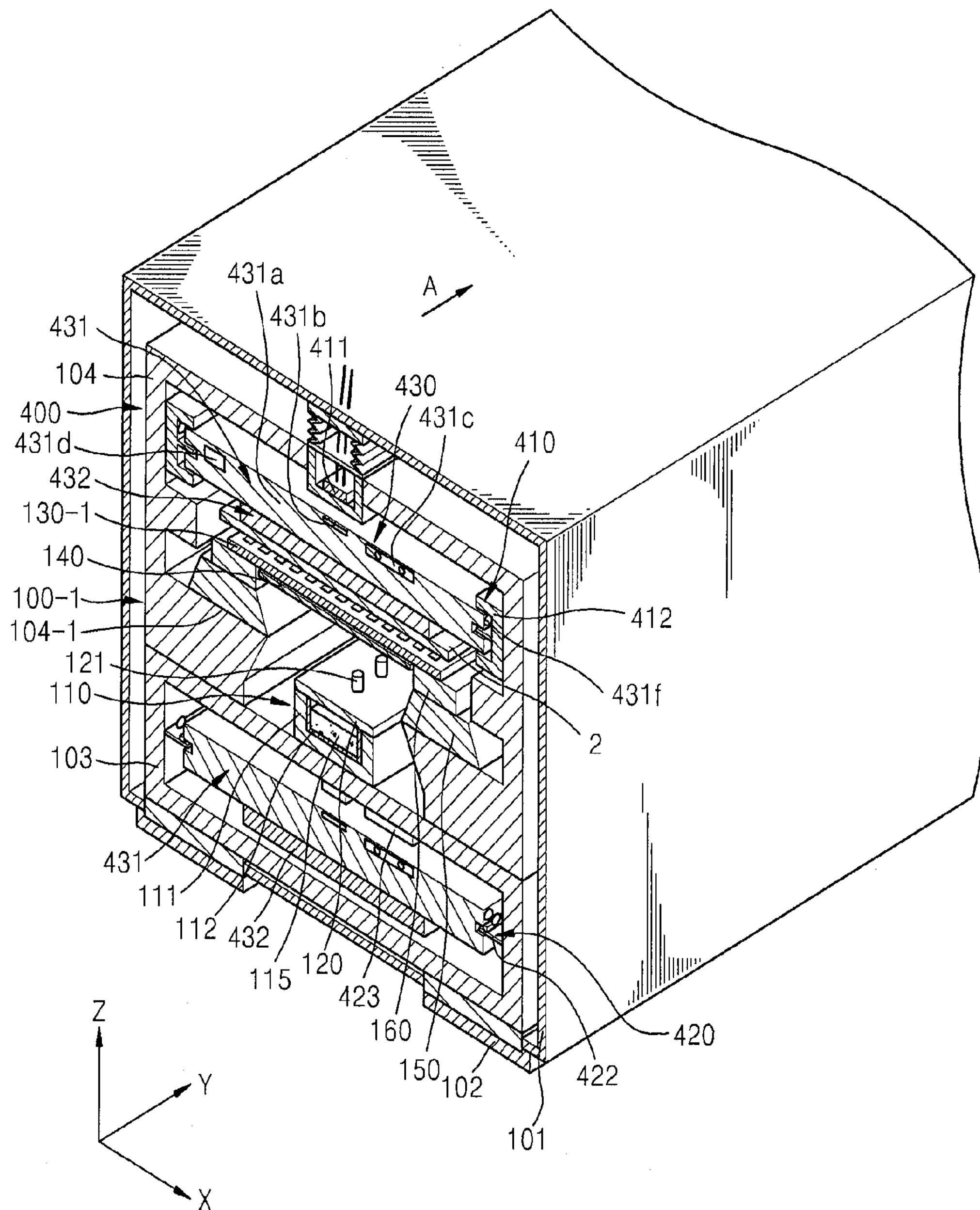


FIG. 4

FIG. 5A

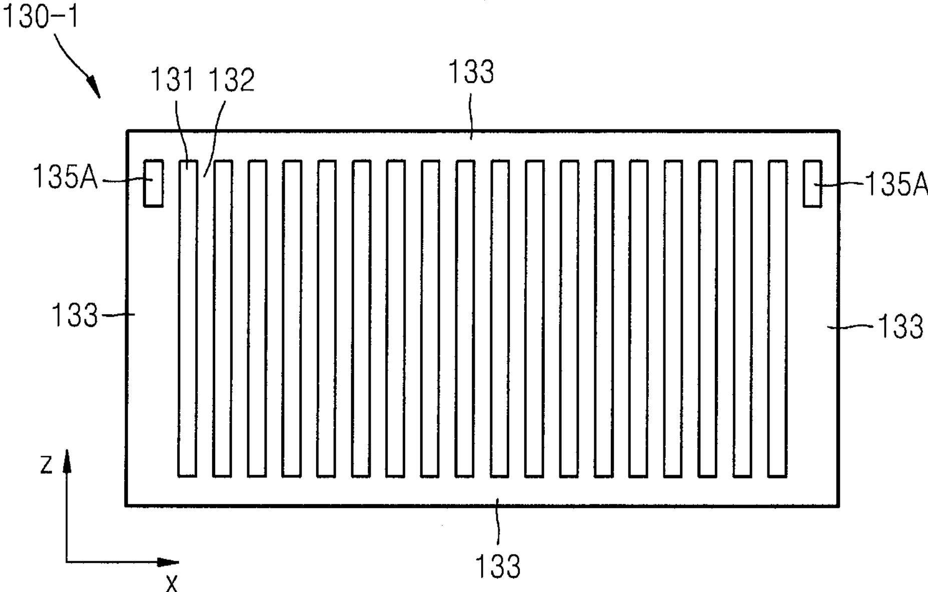


FIG. 5B

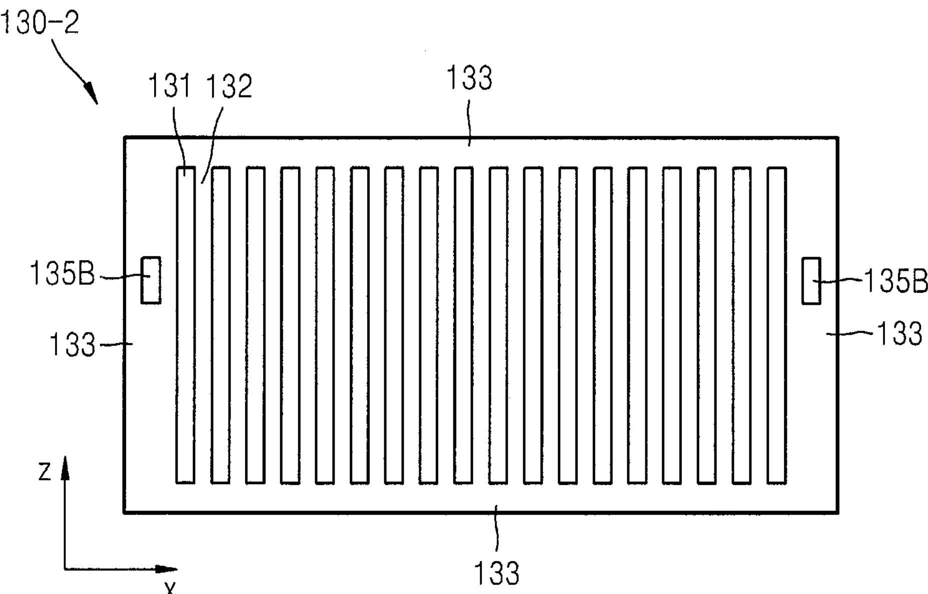


FIG. 5C

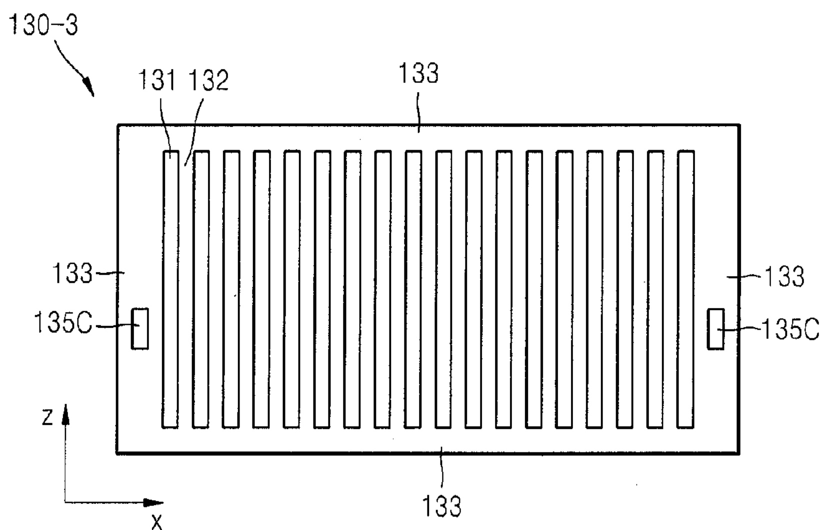


FIG. 5D

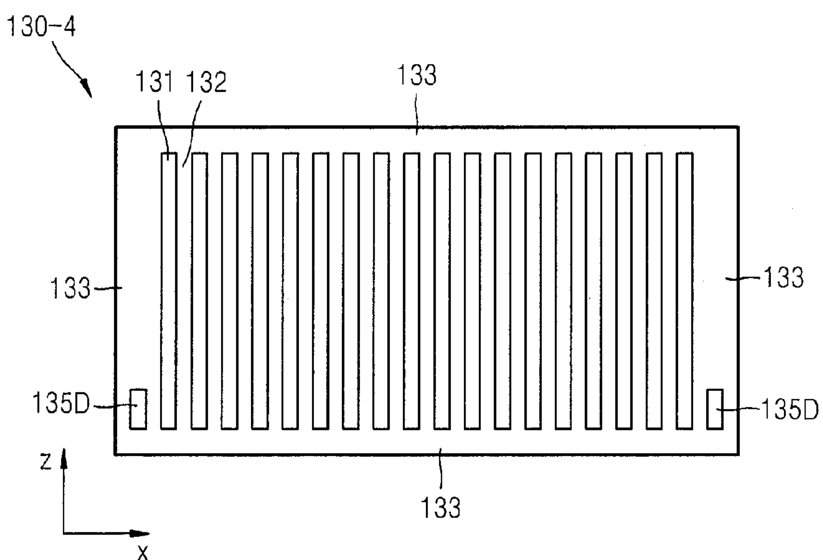


FIG. 6

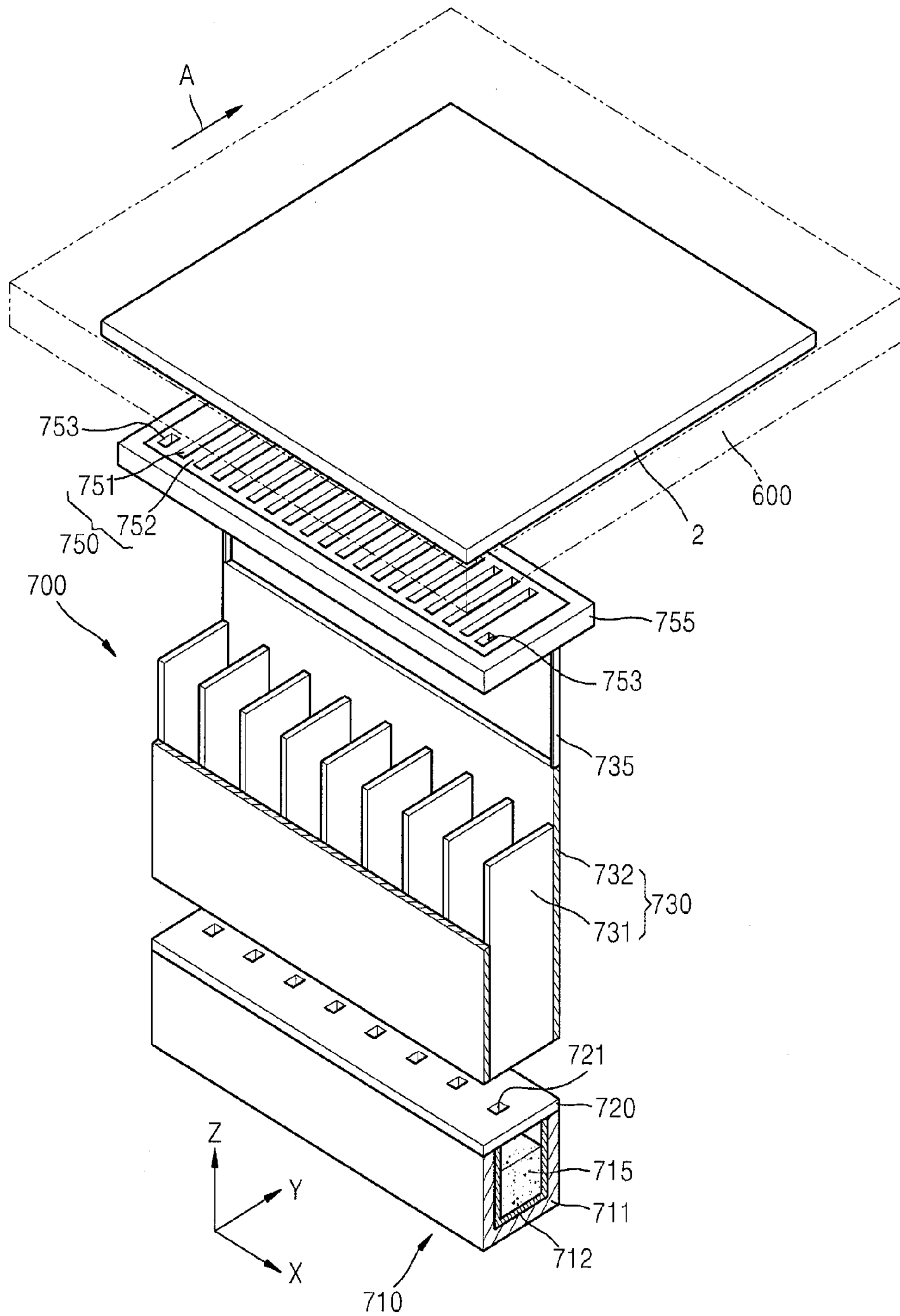


FIG. 7

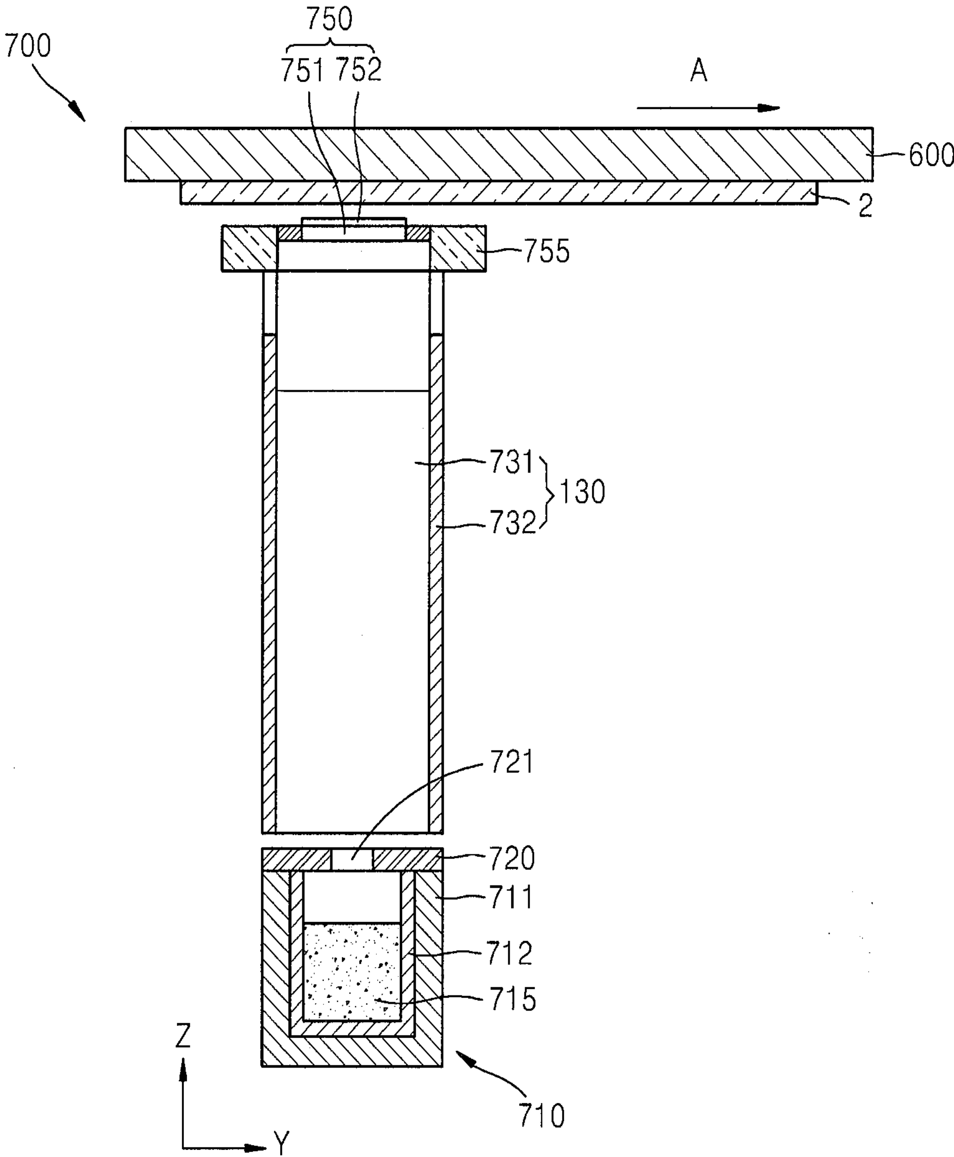


FIG. 8

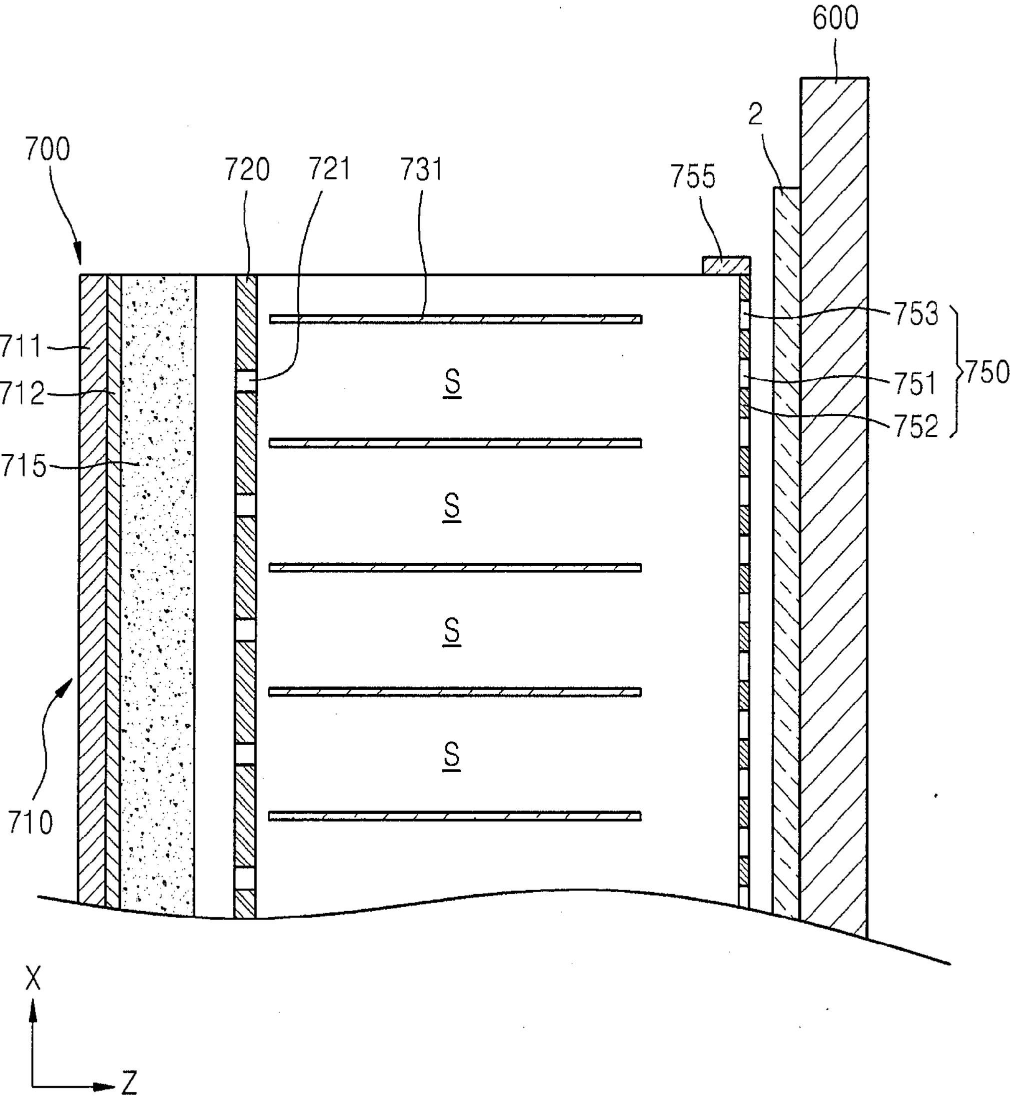


FIG. 9

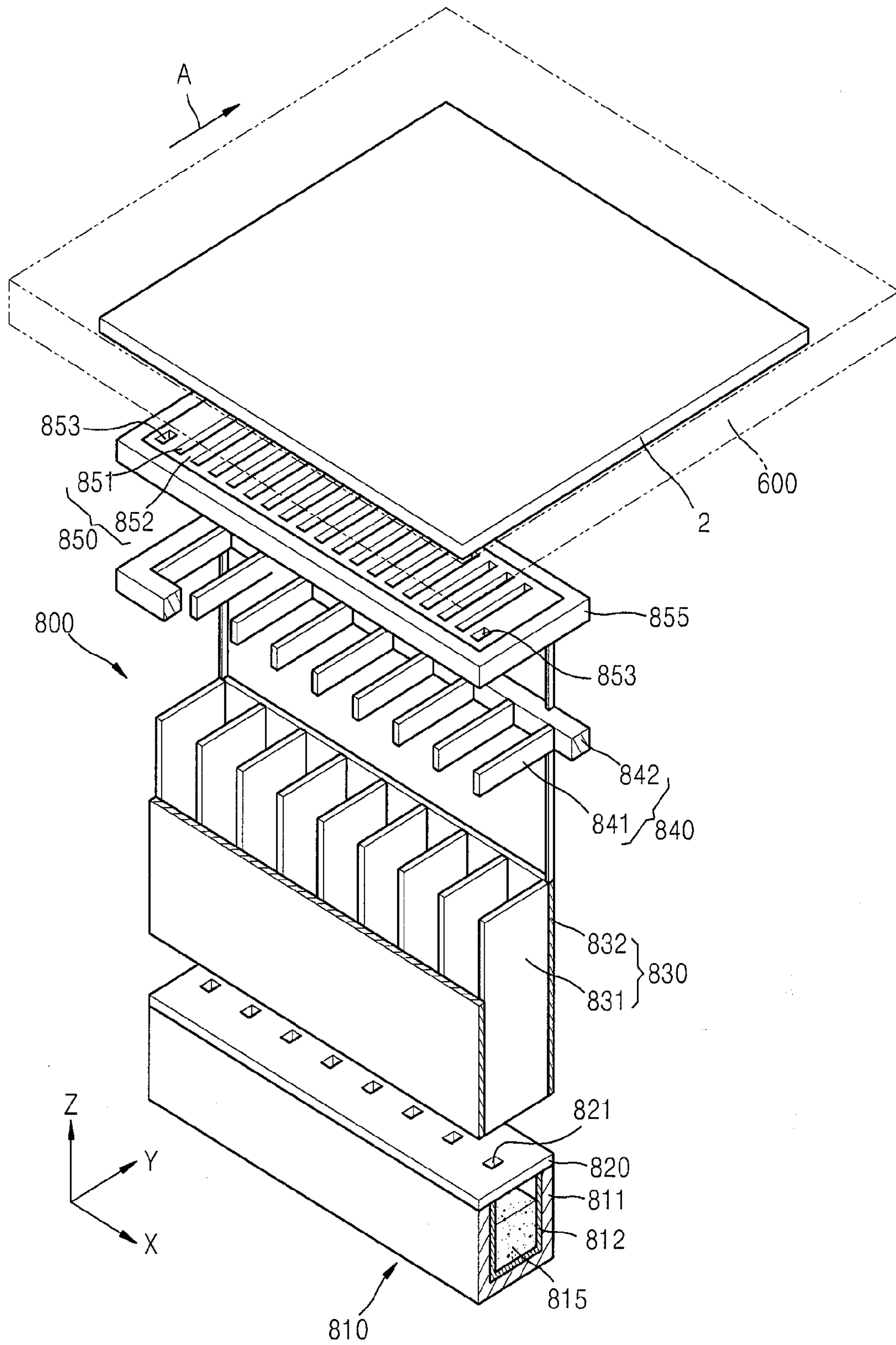


FIG. 10

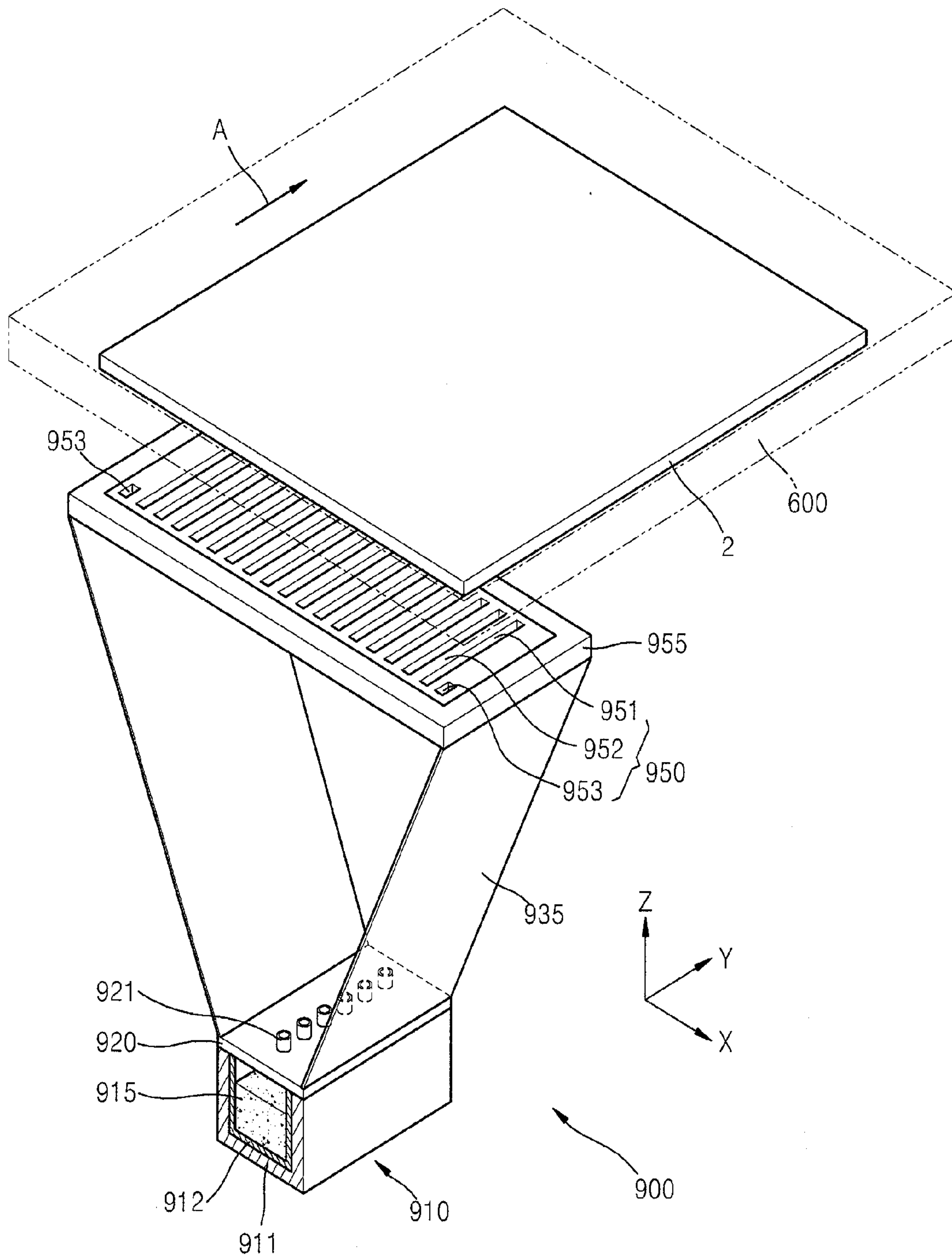
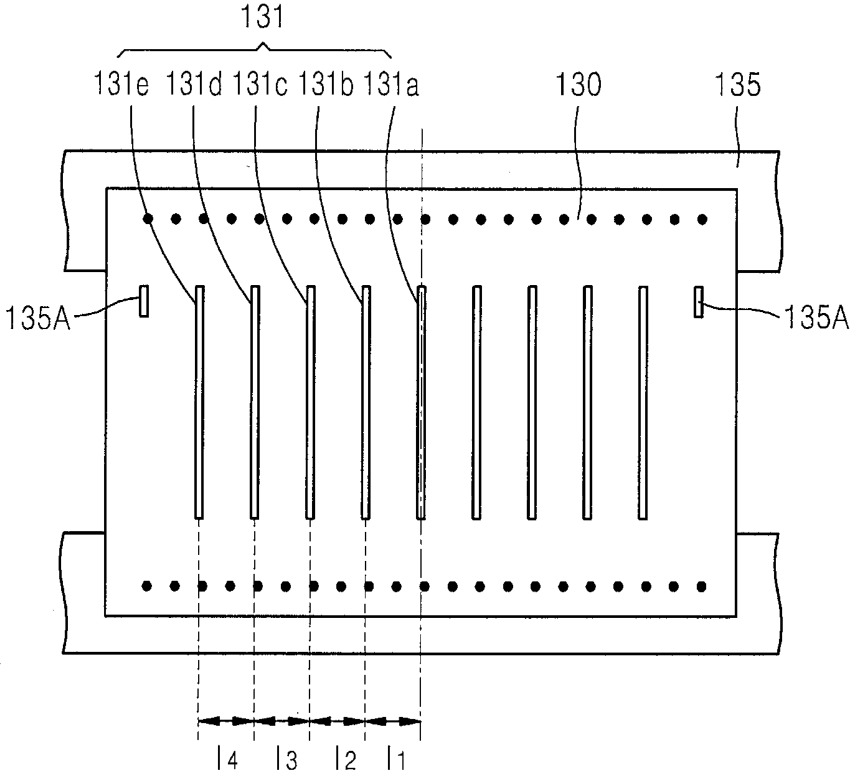


FIG. 11



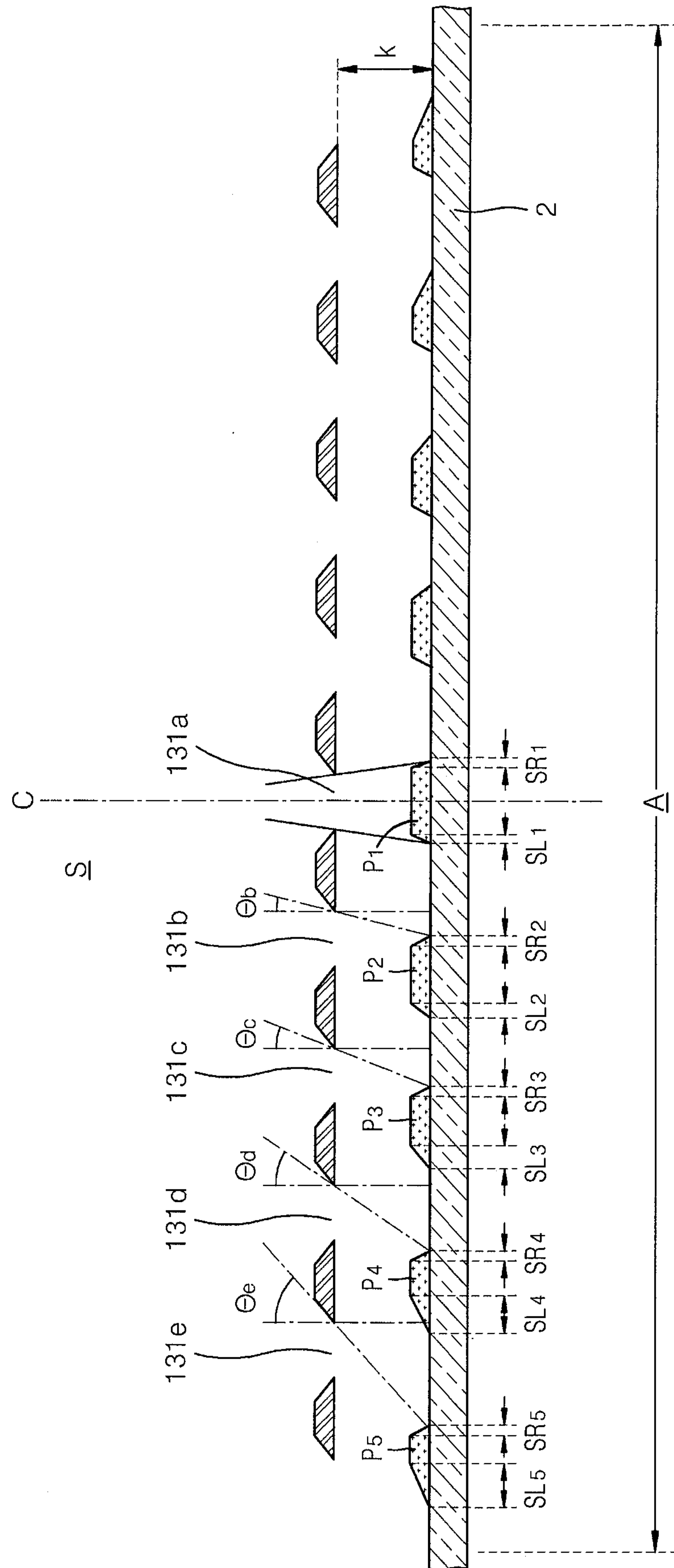


FIG. 12
C
S
131a
131b
131c
131d
131e
P1
P2
P3
P4
P5
Θb
Θc
Θd
Θe
SR1
SL1
SR2
SL2
SR3
SL3
SR4
SL4
SR5
SL5
k
2
A

FIG. 13

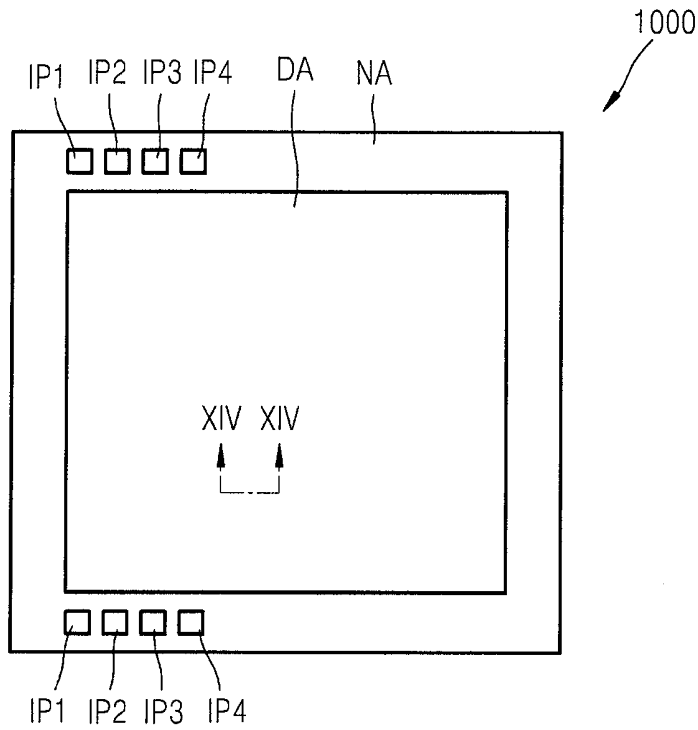
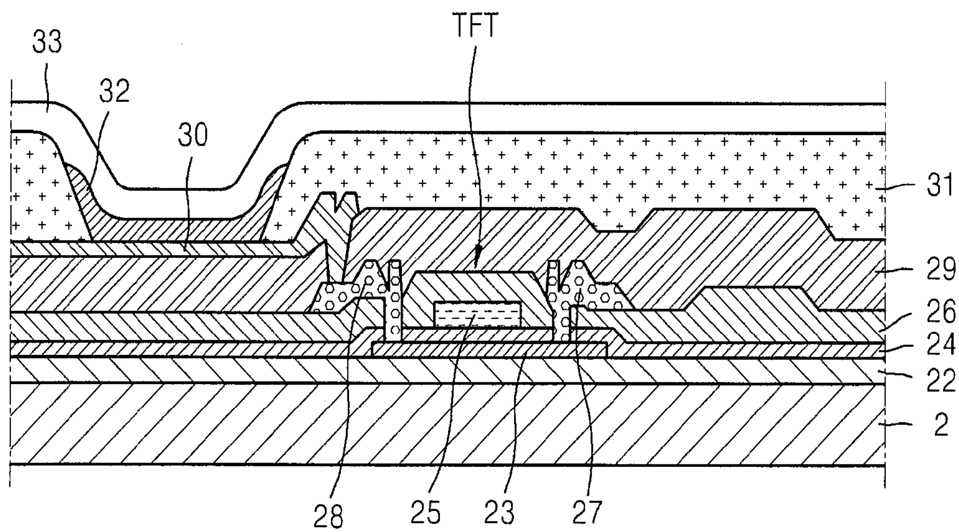


FIG. 14



ORGANIC LAYER DEPOSITION ASSEMBLY, ORGANIC LAYER DEPOSITION APPARATUS, ORGANIC LIGHT-EMITTING DISPLAY APPARATUS AND METHOD OF MANUFACTURING THE SAME

CROSS-REFERENCE TO RELATED PATENT APPLICATION

[0001] This application claims priority to and the benefit of Korean Patent Application No. 10-2012-0085389, filed on Aug. 3, 2012, in the Korean Intellectual Property Office, the disclosure of which is incorporated herein in its entirety by reference.

BACKGROUND

[0002] 1. Field

[0003] The following description relates to an organic layer deposition assembly, an organic layer deposition apparatus, an organic light-emitting display apparatus and a method of manufacturing the organic light-emitting display apparatus, and more particularly, to an organic layer deposition assembly, an organic layer deposition apparatus, an organic light-emitting display apparatus, and a method of manufacturing the organic light-emitting display apparatus, in order to improve a characteristic of a deposited layer.

[0004] 2. Description of the Related Art

[0005] Recently, display apparatuses have been replaced with portable thin flat panel display apparatuses. Among the flat panel display apparatuses, organic light-emitting display apparatuses are self-emissive display devices having wide viewing angles and excellent contrast ratios, and high response speeds, and thus, are regarded as next-generation display apparatuses.

[0006] An organic light-emitting display apparatus includes an intermediate layer, a first electrode, a second electrode, and various thin layers. The intermediate layer includes an organic emission layer (EML), and when a voltage is applied to the first and second electrodes, visible rays are generated by the organic EML.

[0007] In order to form the intermediate layer and the various thin layers included in the organic light-emitting display apparatus, a deposition process may be used. In this regard, a deposition mask is generally used to form a specific pattern on a substrate via the deposition process.

[0008] However, it is difficult to form a fine and minute pattern in the deposition process using the deposition mask. In particular, as a size of the organic light-emitting display apparatus increases, it is difficult to perform an alignment between the substrate and the deposition mask, which makes it difficult to control a characteristic of a deposited layer, i.e., a minute pattern of the deposited layer.

[0009] As a result, there is a limit in the improvement of the characteristic of the deposited layer.

SUMMARY OF THE INVENTION

[0010] Aspects of embodiments of the present invention are directed toward an organic layer deposition assembly, an organic layer deposition apparatus, an organic light-emitting display apparatus, and a method of manufacturing the organic light-emitting display apparatus, in order to easily improve a characteristic of a deposited layer.

[0011] According to an embodiment of the present invention, there is provided an organic layer deposition assembly for depositing an organic layer on a substrate, the organic layer deposition assembly including a deposition source for discharging a deposition material; a deposition source nozzle unit disposed at a side of the deposition source, and including a plurality of deposition source nozzles; and a patterning slit sheet disposed while facing the deposition source nozzle unit, and including a plurality of patterning slits and one or more alignment confirmation pattern slits that are formed at edge portions of the plurality of patterning slits, wherein the deposition material that is discharged from the deposition source passes through the patterning slit sheet and then is formed on the substrate, while a deposition process is performed.

[0012] The patterning slit sheet may include an intermediate region that is formed between adjacent patterning slits from among the plurality of patterning slits, and an outer region that surrounds the plurality of patterning slits, and the one or more alignment confirmation pattern slits may be formed at portions of the outer region.

[0013] The patterning slit sheet may be formed smaller than the substrate in one direction.

[0014] The plurality of deposition source nozzles may be formed at the deposition source nozzle unit along a first direction, the plurality of patterning slits may be formed along the first direction, and the organic layer deposition assembly may further include a shielding plate assembly including a plurality of shielding plates that are disposed along the first direction between the deposition source nozzle unit and the patterning slit sheet and that partition a space between the deposition source nozzle unit and the patterning slit sheet into a plurality of deposition spaces.

[0015] Each of the plurality of shielding plates may extend along a second direction that is substantially perpendicular to the first direction.

[0016] The shielding plate assembly may include a first shielding plate assembly including a plurality of first shielding plates, and a second shielding plate assembly including a plurality of second shielding plates.

[0017] Each of the plurality of first shielding plates and each of the plurality of second shielding plates may extend along a second direction that is substantially perpendicular to the first direction, and may partition the space between the deposition source nozzle unit and the patterning slit sheet into the plurality of deposition spaces.

[0018] The plurality of deposition source nozzles may be formed at the deposition source nozzle unit along a first direction, and the plurality of patterning slits may be formed along a second direction that is substantially perpendicular to the first direction.

[0019] The deposition source, the deposition source nozzle unit, and the patterning slit sheet may be integrally combined by using connection members.

[0020] The connection members may guide a flow path of the deposition material.

[0021] The connection members may seal spaces among the deposition source, the deposition source nozzle unit, and the patterning slit sheet from the outside.

[0022] According to another embodiment of the present invention, there is provided an organic layer deposition apparatus including a plurality of organic layer deposition assemblies for depositing deposition materials on a substrate, each of the plurality of organic layer deposition assemblies including a deposition source for discharging a deposition material of the deposition materials; a deposition source nozzle unit disposed at a side of the deposition source, and including a

plurality of deposition source nozzles; and a plurality of patterning slit sheets disposed while facing the deposition source nozzle unit, and including a plurality of patterning slits and one or more alignment confirmation pattern slits that are formed at edge portions of the plurality of patterning slits, wherein the deposition material that is discharged from the deposition source passes through the plurality of patterning slit sheets and then is formed on the substrate, while a deposition process is performed.

[0023] In one embodiment, when the plurality of patterning slit sheets are aligned with respect to the substrate so as to deposit the deposition material on the substrate, the one or more alignment confirmation pattern slits, which are formed at the plurality of patterning slit sheets, respectively, do not overlap with each other.

[0024] While the substrate sequentially passes through the plurality of organic layer deposition assemblies, different deposition materials may be deposited on the substrate via the plurality of patterning slit sheets, respectively, and alignment confirmation patterns may be formed on the substrate via the one or more alignment confirmation pattern slits formed at the plurality of patterning slit sheets, respectively.

[0025] The organic layer deposition apparatus may further include a conveyer unit including a transfer unit configured to fix the substrate thereto and to move along with the substrate, a first conveyer unit for moving in a first direction the transfer unit on which the substrate is fixed, and a second conveyer unit for moving in a direction opposite to the first direction the transfer unit from which the substrate is separated after deposition has been completed; a loading unit for fixing the substrate on the transfer unit; a chamber maintained in a vacuum state and in which the plurality of organic layer deposition assemblies are disposed; and an unloading unit for separating, from the transfer unit, the substrate on which the deposition has been completed while passing through the plurality of organic layer deposition assemblies, wherein the transfer unit is configured to cyclically move between the first conveyer unit and the second conveyer unit, and wherein the substrate fixed on the transfer unit is configured to be spaced apart from the plurality of organic layer deposition assemblies by a set distance while being transferred by the first conveyer unit.

[0026] The first conveyer unit and the second conveyer unit may pass through the plurality of organic layer deposition assemblies in the chamber.

[0027] The first conveyer unit and the second conveyer unit may be arranged above and below each other.

[0028] The first conveyer unit may sequentially convey the transfer unit to the loading unit, the chamber, and the unloading unit.

[0029] The second conveyer unit may sequentially convey the transfer unit to the unloading unit, the chamber, and the loading unit.

[0030] According to another embodiment of the present invention, there is provided a method of manufacturing an organic light-emitting display apparatus by using an organic layer deposition apparatus including a plurality of organic layer deposition assemblies for depositing deposition materials on a substrate, each of the plurality of organic layer deposition assemblies including a deposition source for discharging a deposition material of the deposition materials; a deposition source nozzle unit disposed at a side of the deposition source, and including a plurality of deposition source nozzles; and a plurality of patterning slit sheets disposed while facing the deposition source nozzle unit, and including a plurality of patterning slits and one or more alignment confirmation pattern slits that are formed at edge portions of the plurality of patterning slits, wherein the deposition material that is discharged from the deposition source passes through the plurality of patterning slit sheets and then is formed on the substrate, whereby a deposition process is performed, wherein the organic light-emitting display apparatus includes a plurality of thin films that include a first electrode, an intermediate layer including an organic emission layer (organic EML), and a second electrode, and wherein, when at least one organic layer of the organic light-emitting display apparatus is formed, the method including operations of forming the at least one organic layer by using the organic layer deposition apparatus; and forming alignment confirmation patterns on the substrate via the one or more alignment confirmation pattern slits when the at least one organic layer is formed.

[0031] The at least one organic layer that is formed by using the organic layer deposition apparatus may be one of layers included in the intermediate layer.

[0032] While the substrate sequentially passes through the plurality of organic layer deposition assemblies, different deposition materials may be deposited on the substrate via the plurality of patterning slit sheets, respectively, and the alignment confirmation patterns may be formed on the substrate via the one or more alignment confirmation pattern slits formed at the plurality of patterning slit sheets, respectively.

[0033] The operation of forming the at least one organic layer may include operations of fixing the substrate to a transfer unit by using a loading unit; moving the transfer unit on which the substrate is fixed to a chamber, by using a first conveyer unit mounted to pass through the chamber; when the plurality of organic layer deposition assemblies are formed in the chamber, and the substrate and the plurality of organic layer deposition assemblies in the chamber are spaced apart by a set distance, forming the at least one organic layer in a manner that, while the substrate relatively moves with respect to the plurality of organic layer deposition assemblies, deposition materials discharged from the plurality of organic layer deposition assemblies are deposited on the substrate; separating, from the transfer unit, the substrate on which the deposition has been completed, by using an unloading unit; and moving the transfer unit, from which the substrate is separated, to the loading unit by using a second conveyer unit mounted to pass through the chamber.

[0034] While the substrate passes through the plurality of organic layer deposition assemblies, the deposition may be sequentially performed on the substrate.

[0035] According to another embodiment of the present invention, there is provided an organic light-emitting display apparatus formed by using an organic layer deposition apparatus, the organic light-emitting display apparatus including a substrate on which a display area and a non-display area are partitioned; a plurality of organic layer alignment confirmation patterns disposed in the non-display area, and formed by using the organic layer deposition apparatus; a first electrode formed in the display area; an intermediate layer including at least one organic layer formed on the first electrode and including an organic emission layer (organic EML); and a second electrode formed on the intermediate layer, wherein the at least one organic layer included in the intermediate layer on the substrate is formed by using the organic layer deposition apparatus, and is a linear pattern.

[0036] In each of the organic layers that are formed on the substrate by using the organic layer deposition apparatus and that are formed farther from the center of the deposition region, a slanted side (hypotenuse) farther from the center of the deposition region may be larger than the other slanted side (hypotenuse).

[0037] Slanted sides (hypotenuses) of the organic layer that is formed on the substrate by using the organic layer deposition apparatus and that is disposed at the center of the deposition region may have substantially the same length.

[0038] The organic layers that are formed on the substrate by using the organic layer deposition apparatus may be symmetrically arranged with respect to the center of the deposition region.

[0039] The substrate may have a size of 40 inches or more.

[0040] The organic layers formed by using the organic layer deposition apparatus may include the organic EML.

[0041] The organic layers formed by using the organic layer deposition apparatus may include an auxiliary emission layer.

[0042] The organic layers formed by using the organic layer deposition apparatus may have a non-uniform thickness.

BRIEF DESCRIPTION OF THE DRAWINGS

[0043] The above and other features and advantages 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 illustrating a structure of a plurality of organic layer deposition assemblies and an organic layer deposition apparatus including the organic layer deposition assemblies according to an embodiment of the present invention;

[0045] FIG. **2** is a schematic side view illustrating the organic layer deposition assemblies of the organic layer deposition apparatus of FIG. **1**;

[0046] FIG. **3** is a schematic perspective view illustrating the organic layer deposition assembly of the organic layer deposition apparatus of FIG. **1**;

[0047] FIG. **4** is a schematic cross-sectional view illustrating the organic layer deposition assembly of FIG. **3**;

[0048] FIGS. **5**A through **5**D illustrate alignment confirmation pattern slits with respect to a plurality of patterning slit sheets;

[0049] FIG. **6** is a schematic perspective view of an organic layer deposition assembly according to an embodiment of the present invention;

[0050] FIG. **7** is a cross-sectional side view of the organic layer deposition assembly of FIG. **6**;

[0051] FIG. **8** is a cross-sectional plan view of the organic layer deposition assembly of FIG. **6**;

[0052] FIG. **9** is a schematic perspective view of an organic layer deposition assembly according to another embodiment of the present invention;

[0053] FIG. **10** is a schematic perspective view of an organic layer deposition assembly according to another embodiment of the present invention;

[0054] FIG. **11** is a diagram illustrating the patterning slit sheet of the organic layer deposition apparatus of FIG. **1** in which the patterning slits are arranged at equal intervals;

[0055] FIG. **12** is a diagram illustrating organic layers formed on a substrate by using the patterning slit sheet of FIG. **11**, according to an embodiment of the present invention;

[0056] FIG. **13** is a plane view of an organic light-emitting display apparatus manufactured by using the organic layer deposition apparatus, according to an embodiment of the present invention; and

[0057] FIG. **14** is a cross-sectional view of the organic light-emitting display apparatus, taken along a line XIV-XIV of FIG. **13**.

DETAILED DESCRIPTION

[0058] Hereinafter, the present invention will be described in more detail by explaining exemplary embodiments of the invention with reference to the attached drawings.

[0059] FIG. **1** is a schematic plan view illustrating a structure of a plurality of organic layer deposition assemblies **100-1** through **100-11** and an organic layer deposition apparatus **1** including the organic layer deposition assemblies **100-1** through **100-11** according to an embodiment of the present invention. FIG. **2** is a schematic side view illustrating the organic layer deposition assemblies **100-1** through **100-11** of the organic layer deposition apparatus **1** of FIG. **1**. FIG. **3** is a schematic perspective view illustrating the organic layer deposition assembly **100-1** of the organic layer deposition apparatus **1** of FIG. **1**. FIG. **4** is a schematic cross-sectional view illustrating the organic layer deposition assembly **100-1** of FIG. **3**.

[0060] Referring to FIGS. **1** through **4**, the organic layer deposition apparatus **1** includes the organic layer deposition assemblies **100-1** through **100-11**. That is, the organic layer deposition apparatus **1** includes the organic layer deposition assembly **100-1**, the organic layer deposition assembly **100-2**, the organic layer deposition assembly **100-3**, and the organic layer deposition assemblies **100-4** through **100-11** which are sequentially disposed. Although not illustrated, the number of organic layer deposition assemblies in the organic layer deposition apparatus **1** may vary.

[0061] Also, the organic layer deposition apparatus **1** includes a deposition unit **100**, a loading unit **200**, an unloading unit **300**, and a conveyer unit **400** (refer to FIGS. **3** and **4**).

[0062] The loading unit **200** may include a first rack **212**, a transport chamber **214**, a first inversion chamber **218**, and a buffer chamber **219**.

[0063] A plurality of substrates **2** (refer to FIGS. **3** and **4**) onto which a deposition material has not yet been applied are stacked up on the first rack **212**. A transport robot included in the transport chamber **214** picks up one of the substrates **2** from the first rack **212**, disposes it on a transfer unit **430** transferred by a second conveyer unit **420**, and moves the transfer unit **430** on which the substrate **2** is disposed into the first inversion chamber **218**.

[0064] The first inversion chamber **218** is disposed adjacent to the transport chamber **214**. The first inversion chamber **218** includes a first inversion robot that inverts the transfer unit **430** and then loads it on a first conveyer unit **410** of the deposition unit **100**.

[0065] Referring to FIG. **1**, the transport robot of the transport chamber **214** places one of the substrates **2** on a top surface of the transfer unit **430**, and the transfer unit **430** on which the substrate **2** is disposed is then transferred into the first inversion chamber **218**. The first inversion robot of the first inversion chamber **218** inverts the first inversion chamber **218** so that the substrate **2** is turned upside down in the deposition unit **100**.

[0066] The unloading unit **300** is configured to operate in an opposite manner to the loading unit **200** described above.

Specifically, a second inversion robot in a second inversion chamber **328** inverts the transfer unit **430**, which has passed through the deposition unit **100** while the substrate **2** is disposed on the transfer unit **430**, and then moves the transfer unit **430** on which the substrate **2** is disposed into an ejection chamber **324**. Then, an ejection robot takes the transfer unit **430** on which the substrate **2** is disposed out of the ejection chamber **324**, separates the substrate **2** from the transfer unit **430**, and then loads the substrate **2** on a second rack **322**. The transfer unit **430**, separated from the substrate **2**, is returned to the loading unit **200** via the second conveyer unit **420**.

[0067] However, the present invention is not limited to the above example. For example, when disposing the substrate **2** on the transfer unit **430**, the substrate **2** may be fixed onto a bottom surface of the transfer unit **430** and then moved into the deposition unit **100**. In such an embodiment, for example, the first inversion robot of the first inversion chamber **218** and the second inversion robot of the second inversion chamber **328** may be omitted.

[0068] The deposition unit **100** may include at least one chamber **101** for deposition. In the chamber **101**, the organic layer deposition assemblies **100-1**, **100-2**, . . . , **100-*n*** are disposed. Referring to FIG. **1**, **11** organic layer deposition assemblies, i.e., a first organic layer deposition assembly **100-1**, a second organic layer deposition assembly **100-2**, . . . , an eleventh organic layer deposition assembly **100-11**, are disposed in the chamber **101**, but the number of organic layer deposition assemblies may vary with a desired deposition material and deposition conditions. The chamber **101** is maintained in vacuum during the deposition process.

[0069] The transfer unit **430** with the substrate **2** fixed thereon may be moved at least to the deposition unit **100** or may be moved sequentially to the loading unit **200**, the deposition unit **100**, and the unloading unit **300**, by the first conveyer unit **410**, and the transfer unit **430** that is separated from the substrate **2** in the unloading unit **300** may be moved back to the loading unit **200** by the second conveyer unit **420**.

[0070] The first conveyer unit **410** passes through the chamber **101** when the transfer unit **430** passes through the deposition unit **100**, and the second conveyer unit **420** conveys the transfer unit **430** from which the substrate **2** is separated.

[0071] The organic layer deposition apparatus **1** is configured in such a manner that the first conveyer unit **410** and the second conveyer unit **420** are respectively disposed above and below so that after the transfer unit **430**, on which deposition has been completed while passing through the first conveyer unit **410**, is separated from the substrate **2** in the unloading unit **300**, the transfer unit **430** is returned to the loading unit **200** via the second conveyer unit **420** formed below the first conveyer unit **410**, whereby the organic layer deposition apparatus **1** may have an improved space utilization efficiency.

[0072] The deposition unit **100** may further include a deposition source replacement unit **190** disposed at a side of each organic layer deposition assembly. Although not particularly illustrated in the drawings, the deposition source replacement unit **190** may be formed as a cassette-type that may be drawn to the outside from each organic layer deposition assembly. Thus, a deposition source **110** (refer to FIG. **3**) of the organic layer deposition assembly **100-1** may be easily replaced.

[0073] FIG. **1** illustrates the organic layer deposition apparatus **1** in which two sets of structures each including the loading unit **200**, the deposition unit **100**, the unloading unit **300**, and the conveyer unit **400** are arranged in parallel. That is, it can be seen that two organic layer deposition apparatuses **1** are respectively arranged at one side and another side of the organic deposition apparatus **1** (above and below in FIG. **1**). In such an embodiment, a patterning slit sheet replacement unit **500** may be disposed between the two organic layer deposition apparatuses **1**. That is, due to this configuration of structures, the two organic layer deposition apparatuses **1** share the patterning slit sheet replacement unit **500**, resulting in improved space utilization efficiency, as compared to a case where each organic layer deposition apparatus **1** includes the patterning slit sheet replacement unit **500**.

[0074] Referring to FIGS. **3** and **4**, the deposition unit **100** of the organic layer deposition apparatus **1** according to the present embodiment includes at least one organic layer deposition assembly **100-1** and a conveyer unit **400**.

[0075] Hereinafter, an overall structure of the deposition unit **100** will be described.

[0076] The chamber **101** may be formed as a hollow box type and accommodate the at least one organic layer deposition assembly **100-1** and the conveyer unit **400**. In another descriptive manner, a foot **102** is formed so as to fix the deposition unit **100** on the ground, a lower housing **103** is disposed on the foot **102**, and an upper housing **104** is disposed on the lower housing **103**. The chamber **101** accommodates both the lower housing **103** and the upper housing **104**. In this regard, a connection part of the lower housing **103** and the chamber **101** is sealed so that the inside of the chamber **101** is completely isolated from the outside. Due to the structure in which the lower housing **103** and the upper housing **104** are disposed on the foot **102** fixed on the ground, the lower housing **103** and the upper housing **104** may be maintained in a fixed position even though the chamber **101** is repeatedly contracted and expanded. Thus, the lower housing **103** and the upper housing **104** may serve as a reference frame in the deposition unit **100**.

[0077] The organic layer deposition assembly **100-1** and the first conveyer unit **410** of the conveyer unit **400** are disposed in the upper housing **104**, and the second conveyer unit **420** of the conveyer unit **400** is disposed in the lower housing **103**. While the transfer unit **430** is cyclically moving between the first conveyer unit **410** and the second conveyer unit **420**, a deposition process may be continuously performed.

[0078] Hereinafter, constituents of the organic layer deposition assembly **100-1** are described in detail.

[0079] The first organic layer deposition assembly **100-1** includes the deposition source **110**, a deposition source nozzle unit **120**, the patterning slit sheet **130**, a shielding member **140**, a first stage **150**, a second stage **160**, an image-capturing member **170**, and a sensor **180**. In this regard, all the elements illustrated in FIGS. **3** and **4** may be arranged in the chamber **101** maintained in an appropriate vacuum state. This structure is needed to achieve the linearity of a deposition material.

[0080] In particular, in order to deposit a deposition material **115** that has been discharged from the deposition source **110** and passed through the deposition source nozzle unit **120** and the patterning slit sheet **130**, onto the substrate **2** in a desired pattern, it is desirable to maintain the chamber (not shown) in the same vacuum state as that used in a deposition method of an FMM. In addition, the temperature of the patterning slit sheet **130** should be sufficiently lower than that of the deposition source **110** because thermal expansion of the

patterning slit sheet **130** is minimized when the temperature of the patterning slit sheet **130** is sufficiently low.

[0081] The substrate **2** on which the deposition material **115** is to be deposited is arranged in the chamber **101**. The substrate **2** may be a substrate for a flat panel display device. For example, a large substrate, such as a mother glass having a size of 40 inches or more, for manufacturing a plurality of flat panel displays, may be used as the substrate **2**.

[0082] According to the present embodiment, the deposition process may be performed with the substrate **2** being moved relative to the organic layer deposition assembly **100-1**.

[0083] In a conventional deposition method using an FMM, the size of the FMM needs to be the same as that of a substrate. Thus, as the size of the substrate increases, the FMM also needs to be large in size. Due to these problems, it is difficult to fabricate the FMM and to align the FMM in a precise pattern by elongation of the FMM.

[0084] To solve these problems, in the organic layer deposition assembly **100-1** according to the present embodiment, deposition may be performed while the organic layer deposition assembly **100-1** and the substrate **2** are moved relative to each other. In other words, deposition may be continuously performed while the substrate **2**, which faces the organic layer deposition assembly **100-1**, is moved in a Y-axis direction. That is, deposition is performed in a scanning manner while the substrate **2** is moved in a direction of arrow A illustrated in FIG. **3**. Although the substrate **2** is illustrated as being moved in the Y-axis direction in the chamber **101** in FIG. **3** when deposition is performed, the present invention is not limited thereto. For example, deposition may be performed while the organic layer deposition assembly **100-1** is moved in the Y-axis direction and the substrate **2** is held in a fixed position.

[0085] Thus, in the organic layer deposition assembly **100-1**, the patterning slit sheet **130** may be much smaller than an FMM used in a conventional deposition method. In other words, in the organic layer deposition assembly **100-1**, deposition is continuously performed, i.e., in a scanning manner while the substrate **2** is moved in the Y-axis direction. Thus, at least one of the lengths of the patterning slit sheet **130** in X-axis and Y-axis directions may be much less than a length of the substrate **2**. Since the patterning slit sheet **130** may be formed much smaller than the FMM used in a conventional deposition method, it is easy to manufacture the patterning slit sheet **130**. That is, the small patterning slit sheet **130** is more advantageous in the manufacturing processes, including etching followed by precise elongation, welding, transferring, and washing processes, than the FMM used in a conventional deposition method. In addition, this is more advantageous for manufacturing a relatively large display device.

[0086] In order to perform deposition while the organic layer deposition assembly **100-1** and the substrate **2** are moved relative to each other as described above, the organic layer deposition assembly **100-1** and the substrate **2** may be spaced apart from each other by a certain distance. This is described below in more detail.

[0087] The deposition source **110** that contains and heats the deposition material **115** is disposed at a side opposite to (facing) a side in which the substrate **2** is disposed in the chamber. As the deposition material **115** contained in the deposition source **110** is vaporized, deposition is performed on the substrate **2**.

[0088] The deposition source **110** includes a crucible **111** that is filled with the deposition material **115** and a heater **112** that vaporizes the deposition material **115**.

[0089] The deposition source nozzle unit **120** is disposed at a side of the deposition source **110** facing the substrate **2**. Here, in the organic layer deposition assembly **100-1**, deposition source nozzles may be differently formed for deposition to form a common layer and a pattern layer. That is, in the deposition source nozzle unit **120**, to form the pattern layer, a plurality of deposition source nozzles **121** may be formed in the Y-axis direction, i.e., a scanning direction of the substrate **2**. Thus, in the present embodiment, the deposition source nozzles **121** are formed such that only one line of the deposition source nozzles **121** is formed in the X-axis direction, to significantly reduce the occurrence of shadows. On the other hand, although not illustrated, in the deposition source nozzle unit **120**, to form the common layer, the deposition source nozzles **121** may be formed in the X-axis direction. By doing so, a thickness uniformity of the common layer may be improved.

[0090] The patterning slit sheet **130** is disposed between the deposition source **110** and the substrate **2**. The patterning slit sheet **130** may be attached to a frame (not shown) having a shape similar to a window frame.

[0091] The patterning slit sheet **130** includes a plurality of patterning slits **131** arranged in the X-axis direction. The deposition material **115** that has been vaporized in the deposition source **110** passes through the deposition source nozzle unit **120** and the patterning slit sheet **130** and is then deposited onto the substrate **2**. In this regard, the patterning slit sheet **130** may be formed using the same method as that used to form an FMM, in particular, a stripe-type mask, e.g., etching. In this regard, a total number of patterning slits **131** may be more than a total number of deposition source nozzles **121**.

[0092] The patterning slit sheet **130** includes an alignment confirmation pattern slit **135**. FIGS. **5**A through **5**D illustrate alignment confirmation pattern slits **135**A through **135**D with respect to a plurality of patterning slit sheets **130-1** through **130-4**.

[0093] FIG. **5**A illustrates the patterning slit sheet **130-1** of the organic layer deposition assembly **100-1**. The patterning slit sheet **130-1** includes a plurality of patterning slits **131**. An intermediate region **132** that does not allow a deposition material to pass therethrough is formed between each of the adjacent patterning slits **131**, and an outer region **133** surrounds the patterning slits **131** in the outside of the patterning slits **131**. That is, the outer region **133** is formed at each of lower, upper, left, and right sides with respect to the patterning slits **131** of the patterning slit sheet **130-1**. The alignment confirmation pattern slit **135**A is formed in the outer region **133**. In more detail, the alignment confirmation pattern slit **135**A is formed in each of the outer regions **133** at the left and right sides of the patterning slits **131**. Although not illustrated, the number of the alignment confirmation pattern slit **135**A may be one or may be at least three. Also, the alignment confirmation pattern slit **135**A may be formed in the outer region **133** at the upper or lower side of the patterning slits **131**.

[0094] FIG. **5**B illustrates the patterning slit sheet **130-2** of the organic layer deposition assembly **100-2**. The patterning slit sheet **130-2** includes a plurality of patterning slits **131**. An intermediate region **132** is formed between each of the adjacent patterning slits **131**, and an outer region **133** surrounds the patterning slits **131** in the outside of the patterning slits

131. That is, the outer region **133** is formed at each of lower, upper, left, and right sides with respect to the patterning slits **131** of the patterning slit sheet **130-2**. The alignment confirmation pattern slit **135**B is formed in the outer region **133**. In more detail, the alignment confirmation pattern slit **135**B is formed in each of the outer regions **133** at the left and right sides of the patterning slits **131**. Although not illustrated, the number of the alignment confirmation pattern slit **135**B may be one or may be at least three. Also, the alignment confirmation pattern slit **135**B may be formed in the outer region **133** at the upper or lower side of the patterning slits **131**.

[0095] In particular, the alignment confirmation pattern slit **135**B does not overlap with the alignment confirmation pattern slit **135**A of the patterning slit sheet **130-1**. That is, when a deposition process is performed while the substrate **2** sequentially passes through the organic layer deposition assembly **100-1** and the organic layer deposition assembly **100-2**, a deposition pattern formed via the alignment confirmation pattern slit **135**A and a deposition pattern formed via the alignment confirmation pattern slit **135**B do not overlap with each other on the substrate **2** in a normal alignment status.

[0096] FIG. **5**C illustrates the patterning slit sheet **130-3** of the organic layer deposition assembly **100-3**. The patterning slit sheet **130-3** includes a plurality of patterning slits **131**. An intermediate region **132** is formed between each of the adjacent patterning slits **131**, and an outer region **133** surrounds the patterning slits **131** in the outside of the patterning slits **131**. That is, the outer region **133** is formed at each of lower, upper, left, and right sides with respect to the patterning slits **131** of the patterning slit sheet **130-3**. The alignment confirmation pattern slit **135**C is formed in the outer region **133**. In more detail, the alignment confirmation pattern slit **135**C is formed in each of the outer regions **133** at the left and right sides of the patterning slits **131**. Although not illustrated, the number of the alignment confirmation pattern slit **135**C may be one or may be at least three. Also, the alignment confirmation pattern slit **135**C may be formed in the outer region **133** at the upper or lower side of the patterning slits **131**.

[0097] In particular, the alignment confirmation pattern slit **135**C does not overlap with the alignment confirmation pattern slit **135**A of the patterning slit sheet **130-1** and the alignment confirmation pattern slit **135**B of the patterning slit sheet **130-2**. That is, when a deposition process is performed while the substrate **2** sequentially passes through the organic layer deposition assembly **100-1**, the organic layer deposition assembly **100-2**, and the organic layer deposition assembly **100-3**, a deposition pattern formed via the alignment confirmation pattern slit **135**A, a deposition pattern formed via the alignment confirmation pattern slit **135**B, and a deposition pattern formed via the alignment confirmation pattern slit **135**C do not overlap with each other on the substrate **2** in a normal alignment status.

[0098] FIG. **5**D illustrates the patterning slit sheet **130-4** of the organic layer deposition assembly **100-4**. The patterning slit sheet **130-4** includes a plurality of patterning slits **131**. An intermediate region **132** is formed between each of the adjacent patterning slits **131**, and an outer region **133** surrounds the patterning slits **131** in the outside of the patterning slits **131**. That is, the outer region **133** is formed at each of lower, upper, left, and right sides with respect to the patterning slits **131** of the patterning slit sheet **130-4**. The alignment confirmation pattern slit **135**D is formed in the outer region **133**. In more detail, the alignment confirmation pattern slit **135**D is formed in each of the outer regions **133** at the left and right sides of the patterning slits **131**. Although not illustrated, the number of the alignment confirmation pattern slit **135**D may be one or may be at least three. Also, the alignment confirmation pattern slit **135**D may be formed in the outer region **133** at the upper or lower side of the patterning slits **131**.

[0099] In particular, the alignment confirmation pattern slit **135**D does not overlap with the alignment confirmation pattern slit **135**A of the patterning slit sheet **130-1**, the alignment confirmation pattern slit **135**B of the patterning slit sheet **130-2**, and the alignment confirmation pattern slit **135**C of the patterning slit sheet **130-3**. That is, when a deposition process is performed while the substrate **2** sequentially passes through the organic layer deposition assembly **100-1**, the organic layer deposition assembly **100-2**, the organic layer deposition assembly **100-3**, and the organic layer deposition assembly **100-4**, a deposition pattern formed via the alignment confirmation pattern slit **135**A, a deposition pattern formed via the alignment confirmation pattern slit **135**B, a deposition pattern formed via the alignment confirmation pattern slit **135**C, and a deposition pattern formed via the alignment confirmation pattern slit **135**D do not overlap with each other on the substrate **2** in a normal alignment status.

[0100] In the present embodiment, a deposition process is performed while the substrate **2** and the organic layer deposition assemblies **100-1** through **100-11** move with respect to each other, so that it is required for the substrate **2** and the patterning slit sheet **130** to be exactly aligned with respect to each other. In particular, when each of the organic layer deposition assemblies **100-1** through **100-11** deposits at least two different organic layers, it is required for the substrate **2** and the patterning slit sheet **130** of each of the organic layer deposition assemblies **100-1** through **100-11** to be exactly aligned with respect to each other. In the present embodiment, the alignment confirmation pattern slit **135**A is formed in the patterning slit sheet **130-1**, so that an alignment pattern for a check of alignment between the substrate **2** and the patterning slit sheet **130** is formed in a region other than a region of the substrate **2** to which the deposition process is actually performed.

[0101] By doing so, after the deposition process is performed while the substrate **2** passes through the organic layer deposition assemblies **100-1** through **100-4**, it is possible to check an alignment status between the patterning slit sheets **130-1** through **130-4** and the substrate **2**, and then after the alignment status is checked and positions of the patterning slit sheets **130-1** through **130-4** are corrected, a deposition process may then be accurately performed on the substrate **2**.

[0102] The deposition source **110** (and the deposition source nozzle unit **120** that is coupled with the deposition source **110**), and the patterning slit sheet **130** may be separated from each other by a set or predetermined distance.

[0103] As described above, the organic layer deposition assembly **100-1** performs deposition while relatively moving with respect to the substrate **2**, and in order to allow the organic layer deposition assembly **100-1** to relatively move with respect to the substrate **2**, the patterning slit sheet **130** is separated from the substrate **2** by a set or predetermined distance.

[0104] In more detail, according to the conventional deposition method using the FMM, a deposition process is performed while a mask is adhered to a substrate so as to prevent occurrence of a shadow on the substrate. However, when the mask is adhered to the substrate, a defect may be incurred due

to a contact between the substrate and the mask. Also, since the mask cannot move with respect to the substrate, a size of the mask has to be equal to a size of the substrate. However, when a display apparatus becomes large, the size of the mask has to be increased, but it is difficult to form such a large mask.

[0105] To solve the aforementioned problem, in the organic layer deposition assembly **100-1** according to the present embodiment, the patterning slit sheet **130** is separated from the substrate **2**, which is a deposition target, by a set predetermined distance. That is, the deposition process is performed while the patterning slit sheet **130** that is smaller than the substrate **2** moves with respect to the substrate **2**, so that it becomes easy to manufacture the patterning slit sheet **130**, is possible to fundamentally prevent a defect due to a contact between the substrate **2** and the patterning slit sheet **130**, and is not required to arrange a time to adhere the substrate **2** and the patterning slit sheet **130**, so that the manufacturing speed may be improved.

[0106] Hereinafter, particular disposition of each element of the upper housing **104** will be described.

[0107] The deposition source **110** and the deposition source nozzle unit **120** are disposed on a bottom portion of the upper housing **104**. Accommodation portions **104-1** are respectively formed on both sides of the deposition source **110** and the deposition source nozzle unit **120** to have a protruding shape. The first stage **150**, the second stage **160**, and the patterning slit sheet **130** are sequentially formed on the accommodation portions **104-1** in this order.

[0108] In this regard, the first stage **150** is formed to move in X-axis and Y-axis directions so that the first stage **150** aligns the patterning slit sheet **130** in the X-axis and Y-axis directions. That is, the first stage **150** includes a plurality of actuators so that the first stage **150** is moved in the X-axis and Y-axis directions with respect to the upper housing **104**.

[0109] The second stage **160** is formed to move in a Z-axis direction so as to align the patterning slit sheet **130** in the Z-axis direction. That is, the second stage **160** includes a plurality of actuators and is formed to move in the Z-axis direction with respect to the first stage **150**.

[0110] The patterning slit sheet **130** is disposed on the second stage **160**. The patterning slit sheet **130** is disposed on the first stage **150** and the second stage **160** so as to move in the X-axis, Y-axis, and Z-axis directions, and thus, an alignment, in particular, a real-time alignment, between the substrate **2** and the patterning slit sheet **130** may be performed.

[0111] Here, as described above, it is possible to check patterns of the deposition material on the substrate **2** and to exactly align the patterning slit sheet **130** on a desired position, by using the alignment confirmation pattern slits **135**A through **135**D.

[0112] Also, the upper housing **104**, the first stage **150**, and the second stage **160** may guide a flow path of the deposition material **115** such that the deposition material **115** discharged through the deposition source nozzles **121** is not dispersed outside the flow path. That is, the flow path of the deposition material **115** is sealed by the upper housing **104**, the first stage **150**, and the second stage **160**, and thus, the movement of the deposition material **115** in the X-axis and Y-axis directions may be thereby concurrently or simultaneously guided.

[0113] The shielding member **140** may be disposed between the patterning slit sheet **130** and the deposition source **110**. In particular, an electrode pattern is formed on an edge portion of the substrate **2** and is used as a terminal for inspecting a product or in manufacturing a product. If an organic material is applied on a region of the substrate **2**, the electrode pattern cannot normally operate. Thus, the edge portion of the substrate **2** has to be formed as a non-film-forming region on which an organic material or the like is not applied. As described above, however, in the organic layer deposition apparatus, deposition is performed in a scanning manner while the substrate **2** is moved relative to the organic layer deposition apparatus, and thus, it is not easy to prevent the organic material from being deposited on the non-film-forming region of the substrate **2**.

[0114] In the present embodiment, to prevent the organic material from being deposited on the non-film-forming region of the substrate **2**, the shielding member **140** may be further disposed on the edge portion of the substrate **2**. Although not illustrated, the shielding member **140** may include two adjacent plates.

[0115] When the substrate **2** does not pass through the organic layer deposition assembly **100-1**, the shielding member **140** screens the deposition source **110**, and thus, the deposition material **115** discharged from the deposition source **110** does not reach the patterning slit sheet **130**. When the substrate **2** enters into the organic layer deposition assembly **100-1** with the shielding member **140** screening the deposition source **110**, a front part of the shielding member **140** which screens the deposition source **110** moves along with the movement of the substrate **2**, and thus, the flow path of the deposition material **115** is opened and the deposition material **115** discharged from the deposition source **110** passes through the patterning slit sheet **130** and is deposited on the substrate **2**. Also, while the substrate **2** is passing through the organic layer deposition assembly **100-1**, a rear part of the shielding member **140** moves along with the movement of the substrate **2** to screen the deposition source **110** so that the flow path of the deposition material **115** is closed. Accordingly, the deposition material **115** discharged from the deposition source **110** does not reach the patterning slit sheet **130**.

[0116] As described above, the non-film-forming region of the substrate **2** is screened by the shielding member **140**, and thus, it may be easy to prevent the organic material from being deposited on the non-film-forming region of the substrate **2** without using a separate structure.

[0117] Hereinafter, the conveyer unit **400** that conveys the substrate **2**, on which the deposition material **115** is to be deposited, is described in more detail. Referring to FIGS. **3** and **4**, the conveyer unit **400** includes the first conveyer unit **410**, the second conveyer unit **420**, and the transfer unit **430**.

[0118] The first conveyer unit **410** conveys in an in-line manner the carrier **431**, the transfer unit **430** including an electrostatic chuck **432** attached to the carrier **431**, and the substrate **2** attached to the transfer unit **430**, so that an organic layer may be formed on the substrate **2** by the organic layer deposition assembly **100-1**. The first conveyer unit **410** includes a coil **411**, guide members **412**, upper magnetically suspended bearings (not shown), side magnetically suspended bearings (not shown), and gap sensors (not shown).

[0119] The second conveyer unit **420** returns to the loading unit **200** the transfer unit **430** from which the substrate **2** has been separated in the unloading unit **300** after one deposition cycle is completed while the transfer unit **430** is passing through the deposition unit **100**. The second conveyer unit **420** includes a coil **421**, roller guides **422**, and a charging track **423**.

[0120] The transfer unit **430** includes the carrier **431** that is conveyed along the first conveyer unit **410** and the second

conveyer unit **420** and the electrostatic chuck **432** that is combined on a surface of the carrier **431** and to which the substrate **2** is attached.

[0121] Hereinafter, each element of the conveyer unit **400** will be described in more detail.

[0122] First, the carrier **431** of the transfer unit **430** will now be described in more detail.

[0123] The carrier **431** includes a main body part **431***a*, a magnetic rail **431***b*, a contactless power supply (CPS) module **431***c*, and a power supply unit **431***d*.

[0124] The main body part **431***a* constitutes a base part of the carrier **431** and may be formed of a magnetic material such as iron. In this regard, due to a repulsive force between the main body part **431***a* and the respective upper and side magnetically suspended bearings (not shown), which are described below, the carrier **431** may be maintained spaced apart from the guide members **412** by a certain distance.

[0125] As illustrated, set or predetermined guide grooves may be respectively formed at both sides of the main body part **431***a* and each may accommodate a guide protrusion of the guide member **412**. The magnetic rail **431***b* may be formed along a center line of the main body part **431***a* in a direction where the main body part **431***a* proceeds. The magnetic rail **431***b* and the coil **411**, which are described below in more detail, may be combined with each other to constitute a linear motor, and the carrier **431** may be conveyed in an arrow direction A by the linear motor.

[0126] The CPS modules **431***c* and the power supply unit **431***d* may be respectively formed on both sides of the magnetic rail **431***b* in the main body part **431***a*. The power supply unit **431***d* includes a battery (e.g., a rechargeable battery) that provides power so that the electrostatic chuck **432** can chuck the substrate **2** and maintains operation. The CPS modules **431***c* are wireless charging modules that charge the power supply unit **431***d*. In particular, the charging track **423** formed in the second conveyer unit **420**, which are described below, is connected to an inverter (not shown), and thus, when the carrier **431** is transferred into the second conveyer unit **420**, a magnetic field is formed between the charging track **423** and the CPS modules **431***c* so as to supply power to the CPS module **431***c*. The power supplied to the CPS modules **431***c* is used to charge the power supply unit **431***d*.

[0127] The electrostatic chuck **432** may include an electrode embedded in a main body formed of ceramic, wherein the electrode is supplied with power. The substrate **2** is attached onto a surface of the main body of the electrostatic chuck **432** as a high voltage is applied to the electrode.

[0128] Hereinafter, an operation of the transfer unit **430** is described in more detail.

[0129] The magnetic rail **431***b* of the main body part **431***a* and the coil **411** may be combined with each other to constitute an operation unit. In this regard, the operation unit may be a linear motor. The linear motor has a small frictional coefficient, little position error, and a very high degree of position determination, as compared to a conventional slide guide system. As described above, the linear motor may include the coil **411** and the magnetic rail **431***b*. The magnetic rail **431***b* is linearly disposed on the carrier **431**, and a plurality of the coils **411** may be disposed at an inner side of the chamber **101** by a certain distance so as to face the magnetic rail **431***b*. Since the magnetic rail **431***b* is disposed on the carrier **431** instead of the coil **411**, the carrier **431** may be operable without power being supplied thereto.

[0130] In this regard, the coil **411** may be formed in an atmosphere (ATM) box in an atmospheric state, and the magnetic rail **431***b* is attached to the carrier **431**, so that the carrier **431** may be moved in the chamber **101** maintained in vacuum.

[0131] Hereinafter, the first conveyer unit **410** and the transfer unit **430** are described in more detail.

[0132] The first conveyer unit **410** conveys the electrostatic chuck **432** that fixes the substrate **2** and conveys the carrier **431** that conveys the electrostatic chuck **432**.

[0133] The coil **411** and the guide members **412** are formed inside the upper housing **104**. In more detail, the coil **411** is formed in an upper portion of the upper housing **104**, and the guide members **412** are respectively formed on both inner sides of the upper housing **104**. The guide members **412** guide the carrier **431** to move in a direction. In this regard, the guide members **412** are formed to pass through the deposition unit **100**.

[0134] The side magnetically suspended bearings (not shown) are each disposed in the guide member **412** so as to respectively correspond to both sides of the carrier **431**. The side magnetically suspended bearings cause a distance between the carrier **431** and the guide member **412** so that the carrier **431** is moved along the guide members **412** in non-contact with the guide members **412**.

[0135] Each upper magnetically suspended bearing (not shown) may be disposed in the guide members **412** so as to be above the carrier **431**. The upper magnetically suspended bearings enable the carrier **431** to be moved along the guide members **412** with a constant distance maintained therebetween.

[0136] Although not illustrated, the guide members **412** may further include gap sensors (not shown) so as to measure distances between the carrier **431** and the respective guide member **412**. Also, gap sensors (not shown) may be disposed in the aforementioned upper and side magnetically suspended bearings. The distances between the carrier **431** and the respective guide members **412** may be adjusted in real time according to values measured by the gap sensors. That is, a precise transfer of the carrier **431** may be feedback controlled using the upper and side magnetically suspended bearings and the gap sensors.

[0137] Hereinafter, the second conveyer unit **420** and the transfer unit **430** are described in more detail.

[0138] The second conveyer unit **420** returns the electrostatic chuck **432** from which the substrate **2** has been separated in the unloading unit **300** and the carrier **431** that carries the electrostatic chuck **432** to the loading unit **200**. In this regard, the second conveyer unit **420** includes the coil **421**, the roller guides **422**, and the charging track **423**.

[0139] In particular, the coil **421**, the roller guides **422**, and the charging track **423** may be positioned inside the lower housing **103**. The coil **421** and the charging track **423** may be disposed on a top inner surface of the lower housing **103**, and the roller guides **422** may be disposed on both inner sides of the lower housing **103**. Although not illustrated, the coil **421** may be disposed in an ATM box, as the coil **411** of the first conveyer unit **410**.

[0140] Like the first conveyer unit **410**, the second conveyer unit **420** may include the coil **421**. Also, the magnetic rail **431***b* of the main body part **431***a* of the carrier **431** and the coil **421** are combined with each other to constitute an operation unit. In this regard, the operation unit may be a linear motor.

The carrier **431** may be moved by the linear motor along a direction opposite to the direction of arrow A illustrated in FIG. **3**.

[0141] The roller guides **422** guide the carrier **431** to move in a direction. In this regard, the roller guides **422** are formed to pass through the deposition unit **100**. As a result, the second conveyer unit **420** is used in a process of returning the carrier **431** from which the substrate **2** has been separated and not in a process of depositing an organic material on the substrate **2**, and thus, position accuracy thereof is not needed as by the first conveyer unit **410**. Therefore, magnetic suspension is applied to the first conveyer unit **410** that requires high position accuracy, thereby obtaining position accuracy, and a conventional roller method is applied to the second conveyer unit **420** that requires relatively low position accuracy, thereby reducing manufacturing costs and simplifying a structure of the organic layer deposition apparatus. Although not illustrated, the magnetic suspension may also be applied to the second conveyer unit **420** as in the first conveyer unit **410**.

[0142] The organic layer deposition assembly **100-1** of the organic layer deposition apparatus **1** according to the present embodiment may further include the image-capturing member **170** and the sensor **180** for an aligning process. In more detail, the image-capturing member **170** may align in real time a first alignment mark (not shown) formed in a frame (not shown) combined with the patterning slit sheet **130-1**, and a second alignment mark (not shown) formed on the substrate **2**. In this regard, the image-capturing member **170** is disposed to more accurately view in the chamber **101** maintained in vacuum during deposition. For this, the image-capturing member **170** may be installed in a camera accommodation unit **171** in an atmospheric state.

[0143] In the present embodiment, since the substrate **2** and the patterning slit sheet **130** are spaced apart from each other by a certain distance, distances to the substrate **2** and the patterning slit sheet **130** that are disposed at different positions both need to be measured using the image-capturing member **170**. For this operation, the organic layer deposition assembly **100-1** of the organic layer deposition apparatus **1** may include the sensor **180**. In this regard, the sensor **180** may be a confocal sensor. The confocal sensor may scan an object to be measured by using laser beams that rotate at high speed by using a scanning mirror and measure a distance to the object by using fluorescent or reflected rays emitted by the laser beams. The confocal sensor may measure a distance by sensing a boundary interface between different media.

[0144] Since a distance between the substrate **2** and the patterning slit sheet **130** is measurable in real time using the image-capturing member **170** and the sensor **180**, the substrate **2** may be aligned with the patterning slit sheet **130** in real time, whereby position accuracy of a pattern may be significantly improved.

[0145] In the organic layer deposition apparatus **1** including the organic layer deposition assemblies **100-1** through **100-11** according to the present embodiment, the deposition process is performed while the organic layer deposition assemblies **100-1** through **100-11** and the substrate **2** move with respect to each other. Accordingly, alignment between the substrate **2** and the respective patterning slit sheets **130-1** through **130-4** for deposition patterns is important. In particular, the organic layer deposition apparatus **1** may include the organic layer deposition assemblies **100-1** through **100-11**, and at least some of the organic layer deposition assemblies **100-1** through **100-11** may deposit deposition layers having different patterns. Thus, the alignment between the substrate **2** and the respective patterning slit sheets **130-1** through **130-4** to form different deposition patterns affects a characteristic of a deposited layer. For example, when the different deposition patterns are formed in an undesired manner and thus overlap with each other, the characteristic of the deposited layer may significantly deteriorate. In the present embodiment, the alignment confirmation pattern slits **135**A through **135**D are formed in the patterning slit sheets **130-1** through **130-4** in the outer regions **133** of the patterning slits **131**, so that it is easy to check the alignment between the substrate **2** and the respective patterning slit sheets **130-1** through **130-4** and is possible to correct the alignment when the alignment is not correct.

[0146] That is, when the deposition patterns are formed by using the patterning slits **131** while the substrate **2** sequentially passes through the organic layer deposition assemblies **100-1** through **100-11** in the organic layer deposition apparatus **1**, the alignment between the substrate **2** and the respective patterning slit sheets **130-1** through **130-4** may be easily checked at a time prior to pattern deposition by using alignment confirmation patterns that are formed in the outside of the deposition patterns by using the alignment confirmation pattern slits **135**A through **135**D.

[0147] By doing so, the deposition process may be performed after checking and correcting a misaligned patterning slit from among the patterning slit sheets **130-1** through **130-4**, so that the deposition patterns may be precisely formed on the deposited layer on the substrate **2**, and as a result, the characteristic of the deposited layer may be improved.

[0148] FIG. **6** is a schematic perspective view of an organic layer deposition assembly **700** according to an embodiment of the present invention. FIG. **7** is a cross-sectional side view of the organic layer deposition assembly **700** of FIG. **6**. FIG. **8** is a cross-sectional plan view of the organic layer deposition assembly **700** of FIG. **6**. For convenience of description, the present embodiment is described in terms of features different from those of the previous embodiment.

[0149] Referring to FIGS. **6** through **8**, the organic layer deposition assembly **700** includes a deposition source **710**, a deposition source nozzle unit **720**, a shielding plate assembly **730**, and a patterning slit sheet **750**.

[0150] The patterning slit sheet **750** is disposed between the deposition source **710** and a substrate **2**. The patterning slit sheet **750** is combined with a frame **755** having a shape similar to a window frame. The patterning slit sheet **750** includes a plurality of patterning slits **751** arranged in an X-axis direction. An intermediate region **752** is formed between the adjacent patterning slits **751**, and alignment confirmation pattern slits **753** are formed in the outside of the patterning slits **751**.

[0151] The patterning slit sheet **750** is equal to the aforementioned patterning slit sheet **130** and thus detailed descriptions thereof are omitted here.

[0152] A deposition material **715** that has been vaporized in the deposition source **710** passes through the deposition source nozzle unit **720** and the patterning slit sheet **750** and then moves toward the substrate **2** that is a deposition target.

[0153] The deposition source **710** includes a crucible **711** that is filled with the deposition material **715** and a heater **712** that heats the crucible **711** so as to vaporize the deposition material **715** included in the crucible **711** toward the deposition source nozzle unit **720**. The deposition source nozzle unit **720** is disposed at a side of the deposition source **710**, and a

plurality of deposition source nozzles **721** are formed on the deposition source nozzle unit **720** along the X-axis direction.

[0154] The shielding plate assembly **730** is arranged at a side of the deposition source nozzle unit **720**. The shielding plate assembly **730** includes a plurality of shielding plates **731** and a shielding plate frame **732** disposed on an outer side of the shielding plates **731**. The shielding plates **731** may be disposed in parallel to each other along the X-axis direction. Here, the shielding plates **731** may be disposed at regular intervals. Also, each of the shielding plates **731** may extend along Y-Z planes and may have a rectangular shape. The shielding plates **731** that are disposed in the aforementioned manner partition a space between the deposition source nozzle unit **720** and the patterning slit sheet **750** into a plurality of deposition spaces S as illustrated in FIG. **8**, so that a deposition material that is exhausted from one deposition source nozzle **721** is not mixed with deposition materials that are exhausted from other deposition source nozzles **721**, but passes through the patterning slit **751** and then is deposited onto the substrate **2**. That is, each of the shielding plates **731** functions to guide a movement path of the deposition material, so that the deposition material exhausted from each of the deposition source nozzles **721** goes straight in a Z-axis direction without spreading.

[0155] As described above, a linearity of the deposition material is achieved by arrangement of the shielding plates **731**, so that a size of shadows formed on the substrate **2** may be significantly reduced, and thus the organic layer deposition assembly **700** and the substrate **2** may be spaced apart from each other by a certain distance.

[0156] Also, a deposition process may proceed while the substrate **2** that is fixed onto an electrostatic chuck **600** moves with respect to the organic layer deposition assembly **700**.

[0157] Although not illustrated, a plurality of the organic layer deposition assemblies **700** may be arranged, and a deposition process may proceed while the substrate **2** sequentially passes through the plurality of the organic layer deposition assemblies **700**. Also, as in the aforementioned embodiment, the patterning slit sheet **750** of each of the organic layer deposition assemblies **700** in an organic layer deposition apparatus may include the alignment confirmation pattern slits **753** that are disposed while not overlapping with each other.

[0158] FIG. **9** is a schematic perspective view of an organic layer deposition assembly **800** according to another embodiment of the present invention. For convenience of description, the present embodiment is described in terms of features different from those of the previous embodiment.

[0159] Referring to FIG. **9**, the organic layer deposition assembly **800** includes a deposition source **810**, a deposition source nozzle unit **820**, a first shielding plate assembly **830**, a second shielding plate assembly **840**, and a patterning slit sheet **850**.

[0160] The patterning slit sheet **850** is disposed between the deposition source **810** and a substrate **2**. The patterning slit sheet **850** is combined with a frame **855** having a shape similar to a window frame. The patterning slit sheet **850** includes a plurality of patterning slits **851** arranged in an X-axis direction. An intermediate region **852** is formed between the adjacent patterning slits **851**, and alignment confirmation pattern slits **853** are formed in the outside of the patterning slits **851**.

[0161] The patterning slit sheet **850** is equal to the aforementioned patterning slit sheet **130** and thus detailed descriptions thereof are omitted here.

[0162] Also, features of the deposition source **810** and the first shielding plate assembly **830** are the same as features of the previous embodiment of FIG. **6** and thus detailed descriptions thereof are omitted here. The present embodiment is different from the previous embodiment of FIG. **6** in that the second shielding plate assembly **840** is arranged at a side of the first shielding plate assembly **830**.

[0163] In more detail, the second shielding plate assembly **840** includes a plurality of second shielding plates **841** and a second shielding plate frame **842** disposed on an outer side of the second shielding plates **841**. The second shielding plates **841** may be disposed in parallel with each other along the X-axis direction. Also, the second shielding plates **841** may be disposed at regular intervals. Also, each of the second shielding plates **841** may extend along Y-Z planes, i.e., may be perpendicular to the X-axis direction.

[0164] A plurality of first shielding plates **831** and the second shielding plates **841**, which are disposed in the aforementioned manner, partition a space between the deposition source nozzle unit **820** and the patterning slit sheet **850**. That is, the present embodiment is characterized in that deposition spaces are partitioned respectively with respect to a plurality of deposition source nozzles **821** that spray deposition material, due to the first shielding plates **831** and the second shielding plates **841**.

[0165] Here, the first shielding plates **831** and the second shielding plates **841** may be disposed to correspond to each other. In other words, the first shielding plates **831** may align with the second shielding plates **841**, respectively, and thus may be in parallel with each other. That is, the first shielding plate **831** and the second shielding plate **841** that correspond to each other may be positioned on the same plane. Referring to FIG. **9**, a length of each first shielding plate **831** is equal to an X-axis direction width of each second shielding plate **841** but aspects of the present invention are not limited thereto. That is, the second shielding plates **841** that are required to be accurately aligned with the adjacent patterning slits **851** may be relatively thin whereas the first shielding plates **831** that are not accurately aligned with the adjacent patterning slits **851** may be relatively thick for ease of manufacturing.

[0166] Also, a deposition process may proceed while the substrate **2** that is fixed onto an electrostatic chuck **600** moves with respect to the organic layer deposition assembly **800**.

[0167] Although not illustrated, a plurality of the organic layer deposition assemblies **800** may be arranged, and a deposition process may proceed while the substrate **2** sequentially passes through the plurality of the organic layer deposition assemblies **800**. Also, as in the aforementioned embodiment, the patterning slit sheet **850** of each of the organic layer deposition assemblies **800** in an organic layer deposition apparatus may include the alignment confirmation pattern slits **853** that are disposed while not overlapping with each other.

[0168] FIG. **10** is a schematic perspective view of an organic layer deposition assembly **900** according to another embodiment of the present invention. For convenience of description, the present embodiment is described in terms of features different from those of the previous embodiment.

[0169] Referring to FIG. **10**, the organic layer deposition assembly **900** includes a deposition source **910**, a deposition source nozzle unit **920**, and a patterning slit sheet **950**.

[0170] The patterning slit sheet **950** is disposed between the deposition source **910** and a substrate **2**. The patterning slit sheet **950** is combined with a frame **955** having a shape similar to a window frame. The patterning slit sheet **950** includes a plurality of patterning slits **951** arranged in an X-axis direction. An intermediate region **952** is formed between the adjacent patterning slits **951**, and alignment confirmation pattern slits **953** are formed in the outside of the patterning slits **951**.

[0171] The patterning slit sheet **950** is equal to the aforementioned patterning slit sheet **130** and thus detailed descriptions thereof are omitted here.

[0172] The deposition source **910** includes a crucible **911** that is filled with a deposition material **915** and a heater **912** that heats the crucible **911** so as to vaporize a deposition material **915** included in the crucible **911** toward the deposition source nozzle unit **920**. The deposition source nozzle unit **920** is disposed at a side of the deposition source **910**, and a plurality of deposition source nozzles **921** are formed on the deposition source nozzle unit **920** along a Y-axis direction.

[0173] The deposition source **910**, the deposition source nozzle unit **920**, and the patterning slit sheet **950** are combined by using connection members **935**.

[0174] A plurality of deposition source nozzles **921** are formed on the deposition source nozzle unit **920** along the Y-axis direction, i.e., a scanning direction of the substrate **2**. Here, the deposition source nozzles **921** may be disposed at regular intervals. The deposition material **915** that has been vaporized in the deposition source **910** passes through the deposition source nozzle unit **920** and then moves toward the substrate **2** that is a deposition target. As a result, in the organic layer deposition assembly **900**, the deposition source nozzles **921** are formed along the scanning direction of the substrate **2**. In this regard, only one deposition source nozzle **921** is formed in the X-axis direction, and thus the occurrence of shadows may be significantly reduced. Also, since the deposition source nozzles **921** are formed along the scanning direction of the substrate **2**, a difference in flux occurring between the deposition source nozzles **121** may be compensated for and deposition uniformity may be maintained constant.

[0175] Also, a deposition process may proceed while the substrate **2** that is fixed onto an electrostatic chuck **600** moves with respect to the organic layer deposition assembly **900**.

[0176] Although not illustrated, a plurality of the organic layer deposition assemblies **900** may be arranged, and a deposition process may proceed while the substrate **2** sequentially passes through the plurality of the organic layer deposition assemblies **900**. Also, as in the aforementioned embodiment, the patterning slit sheet **950** of each of the organic layer deposition assemblies **900** in an organic layer deposition apparatus may include the alignment confirmation pattern slits **953** that are disposed while not overlapping with each other.

[0177] FIG. **11** is a diagram illustrating the patterning slit sheet **130** of the organic layer deposition apparatus **1** of FIG. **1** in which the patterning slits **131** are arranged at equal intervals. FIG. **12** is a diagram illustrating organic layers formed on a substrate by using the patterning slit sheet **130** of FIG. **11**, according to an embodiment of the present invention.

[0178] FIGS. **11** and **12** illustrate the patterning slit sheet **130** in which the patterning slits **131** are arranged at equal intervals. That is, in FIG. **11**, the patterning slits **131** satisfy the following condition: $I_1=I_2=I_3=I_4$.

[0179] In this embodiment, an incident angle of a deposition material discharged along a center line C of a deposition space S is substantially perpendicular to the substrate **2**. Thus, an organic layer P1 formed using the deposition material that has passed through a patterning slit **131*a*** has a minimum size of a shadow, and a right-side shadow SR_1 and a left-side shadow SL_1 are formed symmetrical to each other. Here, the deposition space S indicates a space in which a deposition pattern is formed on the substrate **2** by using the patterning slits **131** and not a space in which a pattern deposited by using an alignment confirmation pattern slit **135** is formed.

[0180] However, a critical incident angle θ of the deposition material that passes through patterning slits disposed farther from the center line C of the deposition space S gradually increases, and thus, the critical incident angle θ of the deposition material that passes through the outermost patterning slit **131*e*** is approximately 55°.

[0181] Accordingly, the deposition material is incident at an inclination with respect to the patterning slit **131*e***, and an organic layer P_5 formed using the deposition material that has passed through the patterning slit **131*e*** has the largest shadow. In particular, a left-side shadow SL_5 is larger than a right-side shadow SR_5.

[0182] That is, as the critical incident angle θ of the deposition material increases, the size of the shadow also increases. In particular, the size of the shadow at a position farther from the center line C of the deposition space S increases. In addition, the critical incident angle θ of the deposition material increases as a distance between the center line C of the deposition space S and the respective patterning slits increases. Thus, organic layers formed using the deposition material that passes through the patterning slits disposed farther from the center line C of the deposition space S have a larger shadow size. In particular, of the shadows on both sides of the respective organic layers, the size of the shadow at a position farther from the center line C of the deposition space S is larger than that of the other.

[0183] That is, referring to FIG. **12**, the organic layers formed on the left side of the center line C of the deposition space S have a structure in which a left hypotenuse (left slanted side) is larger than a right hypotenuse (right slanted side), and the organic layers formed on the right side of the center line C of the deposition space S have a structure in which a right hypotenuse (right slanted side) is larger than a left hypotenuse (left slanted side).

[0184] Also, in the organic layers formed on the left side of the center line C of the deposition space S, the length of the left hypotenuse of the organic layers disposed farther from the center line C increases towards the left. In the organic layers formed on the right side of the center line C of the deposition space S, the length of the right hypotenuse of the organic layers disposed farther from the center line C increases towards the right. Consequently, the organic layers formed in the deposition space S may be formed symmetrical to each other about the center line C of the deposition space S.

[0185] In other words, the critical incident angles satisfy the following condition: $\theta_b<\theta_c<\theta_d<\theta_e$, and thus, the sizes of the shadows of the organic layers also satisfy the following condition: $SL_1<SL_2<SL_3<SL_4<SL_5$.

[0186] FIG. **13** is a plane view of an organic light-emitting display apparatus **1000** manufactured by using the organic layer deposition apparatus **1**, according to an embodiment of

the present invention. FIG. **14** is a cross-sectional view of the organic light-emitting display apparatus **1000**, taken along a line XIV-XIV of FIG. **13**.

[0187] Referring to FIGS. **13** and **14**, the organic light-emitting display apparatus **1000** includes the substrate **2** that is partitioned by a display area DA and a non-display area NA.

[0188] The display area DA includes a plurality of pixels (not shown) to realize an image by emitting a visible ray. Also, as illustrated in FIG. **14**, each of the pixels includes a first electrode **30**, an intermediate layer **32** including an organic emission layer (organic EML), and a second electrode **33** which are formed on the substrate **2** (detailed descriptions will be provided).

[0189] The non-display area NA includes a plurality of alignment confirmation patterns IP1, IP2, IP3, and IP4. The alignment confirmation patterns IP1, IP2, IP3, and IP4 are formed at one time while the substrate **2** passes through the organic layer deposition assemblies **100-1** through **100-4** in the organic layer deposition apparatus **1** of FIG. **1**. That is, the alignment confirmation patterns IP1, IP2, IP3, and IP4 are formed by using the alignment confirmation pattern slits **135**A through **135**D that are formed in the patterning slit sheets **130-1** through **130-4**, respectively, as illustrated in FIGS. **5**A through **5**D. Also, the alignment confirmation patterns IP1, IP2, IP3, and IP4 may be formed by using the organic layer deposition assemblies **700**, **800**, and **900** according to the aforementioned other embodiments.

[0190] As described above, the alignment confirmation pattern slits **135**A through **135**D are formed while not overlapping with each other. By doing so, it is possible to easily check whether the patterning slit sheets **130-1** through **130-4** are correctly aligned with respect to the substrate **2**. For example, when the alignment confirmation patterns IP1, IP2, IP3, and IP4 overlap with each other or are formed in undesired positions, the patterning slit sheets **130-1** through **130-4** may be realigned by adjusting positions of the patterning slit sheets **130-1** through **130-4** and then a deposition process may then proceed.

[0191] The display area DA of the organic light-emitting display apparatus **1000** will now be described with reference to FIG. **14**.

[0192] A buffer layer **22** is formed on a substrate **2**. The substrate **2** may be formed by using a glass material, a flexible plastic material, or other various materials. The buffer layer **22** prevents penetration of foreign substances into the substrate **2**, and provides a planar surface on the substrate **2**. The buffer layer **22** may be formed of various materials capable of performing the aforementioned functions. However, the buffer layer **22** is not an essential element and thus may be omitted.

[0193] An active layer **23** having a predetermined pattern is formed on the buffer layer **22**. The active layer **23** may be formed of an inorganic semiconductor, such as amorphous silicon or polysilicon, or an organic semiconductor. The active layer **23** may include a source region, a drain region, and a channel region. The source region and the drain region of the active layer **23** may be formed by doping amorphous silicon or polysilicon with Group III impurities or Group V impurities.

[0194] A gate insulating layer **24** is formed on the active layer **23**, and a gate electrode **25** is formed on a set or predetermined region on the gate insulating layer **24**. The gate insulating layer **24** that insulates the active layer **23** from the gate electrode **25** may be formed of an organic material or an inorganic material, such as SiNx or SiO2.

[0195] The gate electrode **25** may be formed of a metal selected from the group consisting of Au, Ag, Cu, Ni, Pt, Pd, Al, and Mo, or may be formed of a metal alloy, such as Al—Nd alloy, Mo—W alloy, and the like. However, the gate electrode **25** is not limited thereto, and may be formed by using various materials in consideration of adhesion, planarization, electrical resistance, formability, or the like with respect to adjacent layers.

[0196] An interlayer insulating layer **26** is formed on the gate electrode **25**. The interlayer insulating layer **26** and the gate insulating layer **24** may expose the source region and the drain region of the active layer **23**, and a source electrode **27** and a drain electrode **28** are formed to respectively contact the exposed source and drain regions of the active layer **23**.

[0197] The source electrode **27** and the drain electrode **28** may be formed by using various conductive materials and may have a single-layered structure or a mufti-layered structure.

[0198] A passivation layer **29** is formed on a thin-film transistor (TFT). In more detail, the passivation layer **29** is formed on the source electrode **27** and the drain electrode **28**.

[0199] The passivation layer **29** does not cover an entire region of the drain electrode **28** but exposes a predetermined region of the drain electrode **28**, and then a first electrode **30** is connected to the exposed region of the drain electrode **28**.

[0200] A pixel-defining layer (PDL) **31** is formed on the first electrode **30**. The PDL **31** exposes a set or predetermined region of the first electrode **30**, and an intermediate layer **32**, including an organic EML that contacts the exposed region of the first electrode **30**, is formed. Afterward, a second electrode **33** is formed to be connected to the intermediate layer **32**.

[0201] The intermediate layer **32**, including the organic EML, may be formed as a small-molecule organic layer or a polymer organic layer. When the organic EML includes a small-molecule organic layer, a hole injection layer (HIL), a hole transport layer (HTL), an electron transport layer (ETL), an electron injection layer (EIL), or the like may be singularly or multiply stacked with the organic EML.

[0202] Here, the intermediate layer **32**, including the organic EML, may be formed by using the apparatus or assemblies shown in FIGS. **1** through **10**.

[0203] That is, after the first electrode **30** and the PDL **31** are formed on the substrate **2**, the intermediate layer **32** may be formed by using the organic layer deposition apparatus **1** or the organic layer deposition assemblies **700**, **800**, and **900**.

[0204] For example, in a case where the organic layer deposition apparatus **1** of FIG. **1** is used, a red organic EML, a green organic EML, a blue organic EML, and an auxiliary EML may be sequentially deposited onto the first electrode **30** on the substrate **2** by respectively using the organic layer deposition assemblies **100-1**, **100-2**, **100-3**, and **100-4**. Here, it is possible to easily form desired deposition patterns on the substrate **2** by easily checking alignment between the substrate **2** and the respective patterning slit sheets **130-1** through **130-4** of the organic layer deposition assemblies **100-1** through **100-4** by using the alignment confirmation patterns IP1, IP2, IP3, and IP4 that are formed by using the alignment confirmation pattern slits **135**A through **135**D.

[0205] The first electrode **30** may include indium tin oxide (ITO), indium zinc oxide (IZO), zinc oxide (ZnO), or indium oxide (In_2O_3). Alternatively, the first electrode **30** may

include silver (Ag), magnesium (Mg), aluminum (Al), platinum (Pt), palladium (Pd), gold (Au), nickel (Ni), neodymium (Nd), iridium (Ir), chromium (Cr) or a compound thereof.

[0206] A second electrode **33** may include lithium (Li), calcium (Ca), lithium fluoride/calcium (LiF/Ca), lithium fluoride/aluminum (LiF/Al), aluminum (Al), silver (Ag), magnesium (Mg), or a compound thereof. Alternatively, the second electrode **62** may include ITO, IZO, ZnO, In_2O_3, or the like.

[0207] An encapsulation member (not shown) may be disposed on the second electrode **33**. The encapsulation member may function to protect the intermediate layer **32** and other layers against external moisture or oxygen. The encapsulation member may be formed of a plastic material or may have a structure in which an organic material and an inorganic material are stacked.

[0208] An organic layer deposition assembly, an organic layer deposition apparatus, an organic light-emitting display apparatus and a method of manufacturing the organic light-emitting display apparatus, according to the one or more embodiments of the present invention, may easily improve a characteristic of a deposited layer.

[0209] 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 partitioned by the following claims, and equivalents thereof.

What is claimed is:

1. An organic layer deposition assembly for depositing an organic layer on a substrate, the organic layer deposition assembly comprising:

a deposition source for discharging a deposition material;

a deposition source nozzle unit at a side of the deposition source, and comprising a plurality of deposition source nozzles; and

a patterning slit sheet facing the deposition source nozzle unit, and comprising a plurality of patterning slits and one or more alignment confirmation pattern slits at edge portions of the plurality of patterning slits,

wherein the deposition source is configured to discharge the deposition material to pass through the patterning slit sheet and then on the substrate, while a deposition process is performed.

2. The organic layer deposition assembly of claim **1**, wherein the patterning slit sheet comprises:

an intermediate region between adjacent patterning slits from among the plurality of patterning slits, and

an outer region surrounding the plurality of patterning slits; and

the one or more alignment confirmation pattern slits are at portions of the outer region.

3. The organic layer deposition assembly of claim **1**, wherein the patterning slit sheet is smaller than the substrate in at least one direction.

4. The organic layer deposition assembly of claim **1**, wherein the plurality of deposition source nozzles are formed at the deposition source nozzle unit along a first direction,

the plurality of patterning slits are formed along the first direction, and

the organic layer deposition assembly further comprises a shielding plate assembly comprising a plurality of shielding plates disposed along the first direction between the deposition source nozzle unit and the patterning slit sheet and partitioning a space between the deposition source nozzle unit and the patterning slit sheet into a plurality of deposition spaces.

5. The organic layer deposition assembly of claim **4**, wherein each of the plurality of shielding plates extends along a second direction substantially perpendicular to the first direction.

6. The organic layer deposition assembly of claim **4**, wherein the shielding plate assembly comprises a first shielding plate assembly comprising a plurality of first shielding plates, and a second shielding plate assembly comprising a plurality of second shielding plates.

7. The organic layer deposition assembly of claim **6**, wherein each of the plurality of first shielding plates and each of the plurality of second shielding plates extend along a second direction substantially perpendicular to the first direction, and partition the space between the deposition source nozzle unit and the patterning slit sheet into the plurality of deposition spaces.

8. The organic layer deposition assembly of claim **1**, wherein the plurality of deposition source nozzles are formed at the deposition source nozzle unit along a first direction, and

the plurality of patterning slits are formed along a second direction substantially perpendicular to the first direction.

9. The organic layer deposition assembly of claim **1**, wherein the deposition source, the deposition source nozzle unit, and the patterning slit sheet are integrally combined by using connection members.

10. The organic layer deposition assembly of claim **9**, wherein the connection members are configured to guide a flow path of the deposition material.

11. The organic layer deposition assembly of claim **9**, wherein the connection members seal spaces among the deposition source, the deposition source nozzle unit, and the patterning slit sheet from the outside.

12. An organic layer deposition apparatus comprising a plurality of organic layer deposition assemblies for depositing deposition materials on a substrate, each of the plurality of organic layer deposition assemblies comprising:

a deposition source for discharging a deposition material of the deposition materials;

a deposition source nozzle unit at a side of the deposition source, and comprising a plurality of deposition source nozzles; and

a plurality of patterning slit sheets facing the deposition source nozzle unit, and comprising a plurality of patterning slits and one or more alignment confirmation pattern slits at edge portions of the plurality of patterning slits,

wherein the deposition source is configured to discharge the deposition material to pass through the plurality of patterning slit sheets and then on the substrate, while a deposition process is performed.

13. The organic layer deposition apparatus of claim **12**, wherein, when the plurality of patterning slit sheets are aligned with respect to the substrate so as to deposit the deposition material on the substrate,

the one or more alignment confirmation pattern slits, which are formed at the plurality of patterning slit sheets, respectively, do not overlap with each other.

14. The organic layer deposition apparatus of claim **12**, wherein, while the substrate sequentially passes through the plurality of organic layer deposition assemblies, the plurality

of patterning slit sheets are configured to deposit different deposition materials on the substrate, respectively, and

wherein the one or more alignment confirmation pattern slits at the plurality of patterning slit sheets are configured to form alignment confirmation patterns on the substrate, respectively.

15. The organic layer deposition apparatus of claim **12**, further comprising:

a conveyer unit comprising a transfer unit configured to fix the substrate thereto and to move along with the substrate, a first conveyer unit for moving in a first direction the transfer unit on which the substrate is fixed, and a second conveyer unit for moving in a direction opposite to the first direction the transfer unit from which the substrate is separated after deposition has been completed;

a loading unit for fixing the substrate on the transfer unit;

a chamber maintained in a vacuum state and in which the plurality of organic layer deposition assemblies are disposed; and

an unloading unit for separating, from the transfer unit, the substrate on which the deposition has been completed while passing through the plurality of organic layer deposition assemblies,

wherein the transfer unit is configured to cyclically move between the first conveyer unit and the second conveyer unit, and

wherein the substrate fixed on the transfer unit is configured to be spaced apart from the plurality of organic layer deposition assemblies by a set distance while being transferred by the first conveyer unit.

16. The organic layer deposition apparatus of claim **15**, wherein the first conveyer unit and the second conveyer unit pass through the plurality of organic layer deposition assemblies in the chamber.

17. The organic layer deposition apparatus of claim **15**, wherein the first conveyer unit and the second conveyer unit are arranged above and below each other.

18. The organic layer deposition apparatus of claim **15**, wherein the first conveyer unit is configured to sequentially convey the transfer unit to the loading unit, the chamber, and the unloading unit.

19. The organic layer deposition apparatus of claim **15**, wherein the second conveyer unit is configured to sequentially convey the transfer unit to the unloading unit, the chamber, and the loading unit.

20. A method of manufacturing an organic light-emitting display apparatus by using an organic layer deposition apparatus comprising a plurality of organic layer deposition assemblies for depositing deposition materials on a substrate, each of the plurality of organic layer deposition assemblies comprising a deposition source for discharging a deposition material of the deposition materials; a deposition source nozzle unit disposed at a side of the deposition source, and comprising a plurality of deposition source nozzles; and a plurality of patterning slit sheets disposed while facing the deposition source nozzle unit, and comprising a plurality of patterning slits and one or more alignment confirmation pattern slits that are formed at edge portions of the plurality of patterning slits, wherein the deposition material that is discharged from the deposition source passes through the plurality of patterning slit sheets and then is formed on the substrate, while a deposition process is performed,

wherein the organic light-emitting display apparatus comprises a plurality of thin films that comprise a first electrode, an intermediate layer comprising an organic emission layer (organic EML), and a second electrode, and

wherein, when at least one organic layer of the organic light-emitting display apparatus is formed, the method comprising:

forming the at least one organic layer by using the organic layer deposition apparatus; and

forming alignment confirmation patterns on the substrate via the one or more alignment confirmation pattern slits when the at least one organic layer is formed.

21. The method of claim **20**, wherein the at least one organic layer that is formed by using the organic layer deposition apparatus is one of layers comprised in the intermediate layer.

22. The method of claim **20**, wherein, while the substrate sequentially passes through the plurality of organic layer deposition assemblies, different deposition materials are deposited on the substrate via the plurality of patterning slit sheets, respectively, and

wherein the alignment confirmation patterns are formed on the substrate via the one or more alignment confirmation pattern slits formed at the plurality of patterning slit sheets, respectively.

23. The method of claim **20**, wherein the forming of the at least one organic layer comprises:

fixing the substrate to a transfer unit by using a loading unit;

moving the transfer unit on which the substrate is fixed to a chamber, by using a first conveyer unit mounted to pass through the chamber;

when the plurality of organic layer deposition assemblies are formed in the chamber, and the substrate and the plurality of organic layer deposition assemblies in the chamber are spaced apart by a set distance, forming the at least one organic layer in a manner that, while the substrate relatively moves with respect to the plurality of organic layer deposition assemblies, deposition materials discharged from the plurality of organic layer deposition assemblies are deposited on the substrate;

separating, from the transfer unit, the substrate on which the deposition has been completed, by using an unloading unit; and

moving the transfer unit, from which the substrate is separated, to the loading unit by using a second conveyer unit mounted to pass through the chamber.

24. The method of claim **20**, wherein, while the substrate passes through the plurality of organic layer deposition assemblies, the deposition is sequentially performed on the substrate.

25. An organic light-emitting display apparatus formed by using an organic layer deposition apparatus, the organic light-emitting display apparatus comprising:

a substrate on which a display area and a non-display area are partitioned;

a plurality of organic layer alignment confirmation patterns disposed in the non-display area, and formed by using the organic layer deposition apparatus;

a first electrode formed in the display area;

an intermediate layer comprising at least one organic layer formed on the first electrode and comprising an organic emission layer (organic EML); and

a second electrode formed on the intermediate layer,

wherein the at least one organic layer comprised in the intermediate layer on the substrate is formed by using the organic layer deposition apparatus, and is a linear pattern.

26. The organic light-emitting display apparatus of claim **25**, wherein in each of the organic layers that are formed on the substrate by using the organic layer deposition apparatus and that are formed farther from the center of the deposition region, a slanted side farther from the center of the deposition region is larger than the other slanted side.

27. The organic light-emitting display apparatus of claim **25**, wherein a length of a slanted side of one of the organic layers, which are formed on the substrate by using the organic layer deposition apparatus, farther from a center of a deposition region is larger than lengths of slanted sides of those other organic layers formed closer to the center of the deposition region.

28. The organic light-emitting display apparatus of claim **25**, wherein slanted sides of the organic layer that is formed on the substrate by using the organic layer deposition apparatus and that is disposed at the center of the deposition, region have substantially the same length.

29. The organic light-emitting display apparatus of claim **25**, wherein the organic layers that are formed on the substrate by using the organic layer deposition apparatus are symmetrically arranged with respect to the center of the deposition region.

30. The organic light-emitting display apparatus of claim **25**, wherein the substrate has a size of 40 inches or more.

31. The organic light-emitting display apparatus of claim **25**, wherein the organic layers formed by using the organic layer deposition apparatus comprise the organic EML.

32. The organic light-emitting display apparatus of claim **25**, wherein the organic layers formed by using the organic layer deposition apparatus comprise an auxiliary emission layer.

33. The organic light-emitting display apparatus of claim **25**, wherein the organic layers formed by using the organic layer deposition apparatus have a non-uniform thickness.

* * * * *

patsnap

专利名称(译)	有机层沉积组件，有机层沉积设备，有机发光显示设备及其制造方法		
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[标]发明人	LEE MYUNG KI LEE SUNG BONG JEONG DONG SEOB KIM MU HYUN		
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摘要(译)

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