US 20140235003A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2014/0235003 A1**

(43) **Pub. Date: Aug. 21, 2014**

Jung et al.

(54) **VAPOR DEPOSITION APPARATUS, DEPOSITION METHOD, AND METHOD OF MANUFACTURING ORGANIC LIGHT-EMITTING DISPLAY APPARATUS BY USING THE SAME**

(71) Applicant: **Samsung Display Co., Ltd.**, Yongin-City (KR)

(72) Inventors: **Suk-Won Jung**, Yongin-City (KR); **Myung-Soo Huh**, Yongin-City (KR); **Choel-Min Jang**, Yongin-City (KR)

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

(21) Appl. No.: **13/944,847**

(22) Filed: **Jul. 17, 2013**

(30) **Foreign Application Priority Data**

Feb. 18, 2013 (KR) 10-2013-0016977

Publication Classification

(51) **Int. Cl.**

H01L 27/32 (2006.01)

C23C 16/50 (2006.01)

(52) **U.S. Cl.**

CPC ***H01L 27/32*** (2013.01); ***C23C 16/50*** (2013.01)

USPC ..... **438/34**; 118/723 R; 427/569

(57) **ABSTRACT**

Provided is a vapor deposition apparatus including: a plasma generator configured to change at least a portion of a first raw material gas into a radical form; a corresponding surface corresponding to the plasma generator; a reaction space between the plasma generator and the corresponding surface; and an insulating member separated from, and surrounding the plasma generator.

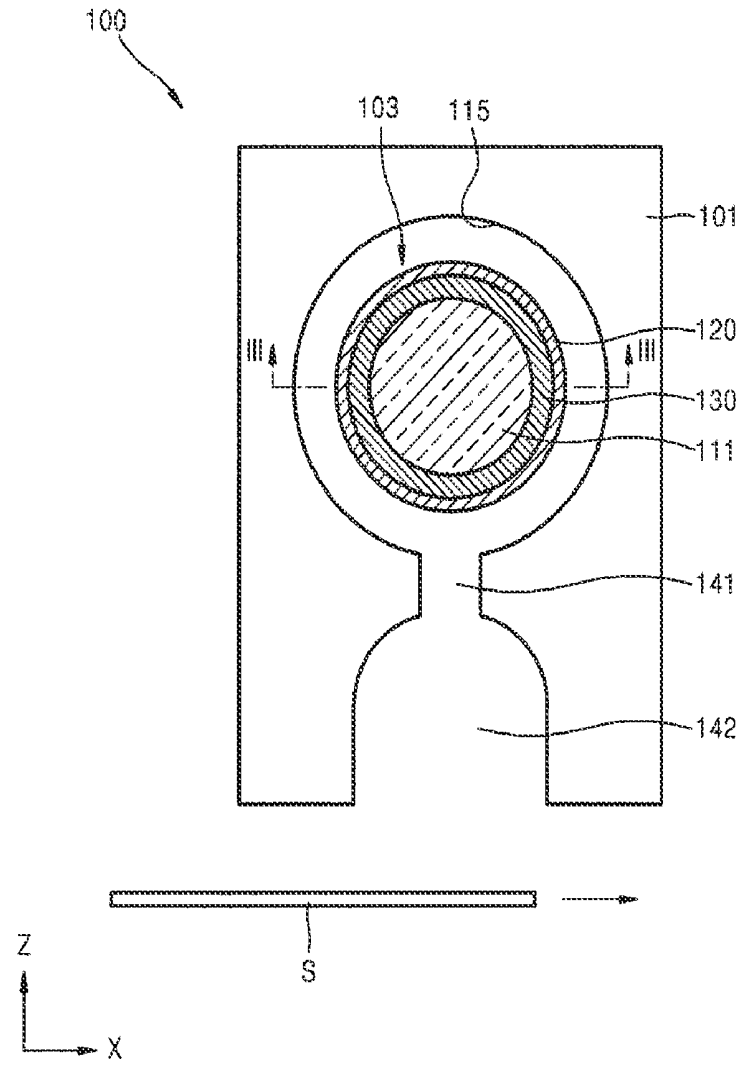


FIG. 1

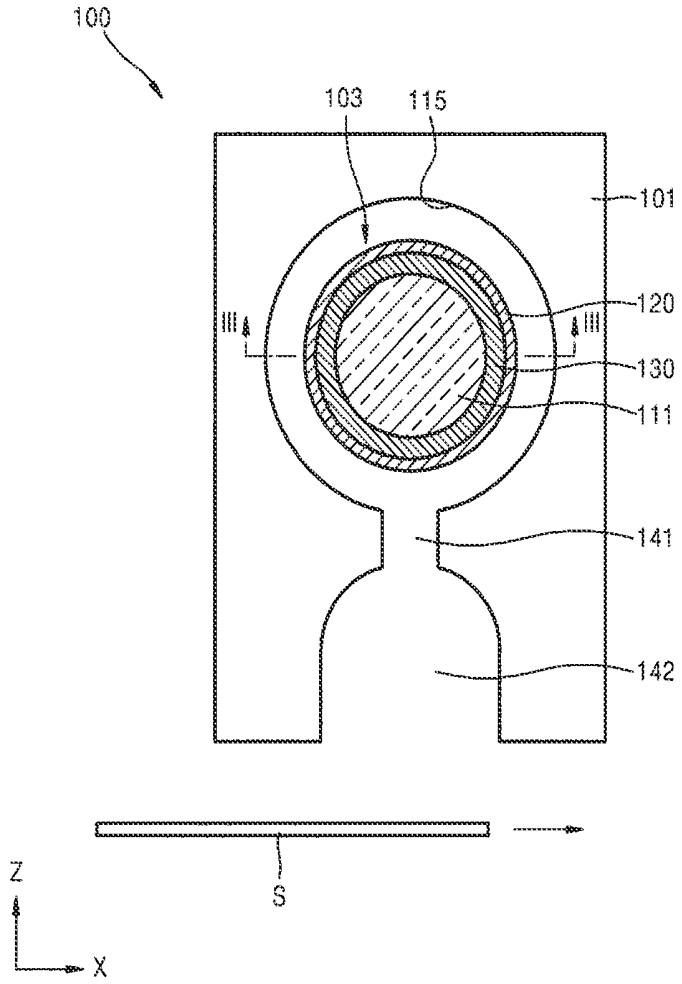


FIG. 2

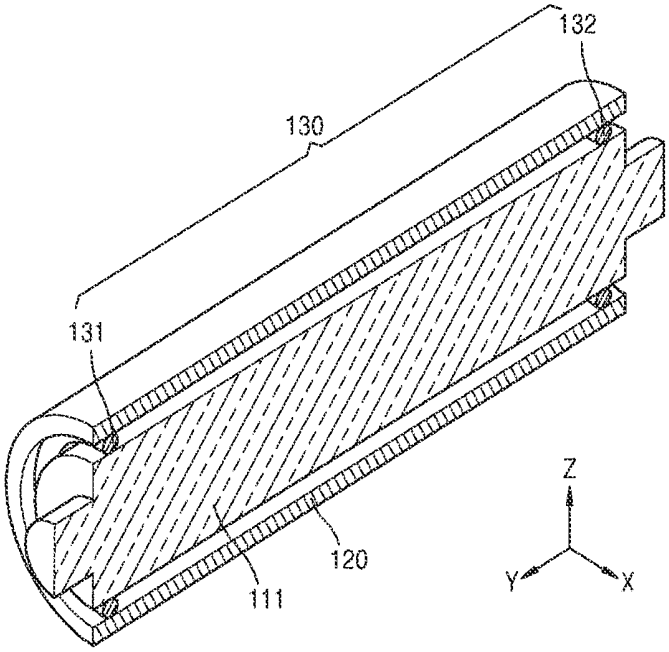


FIG. 3

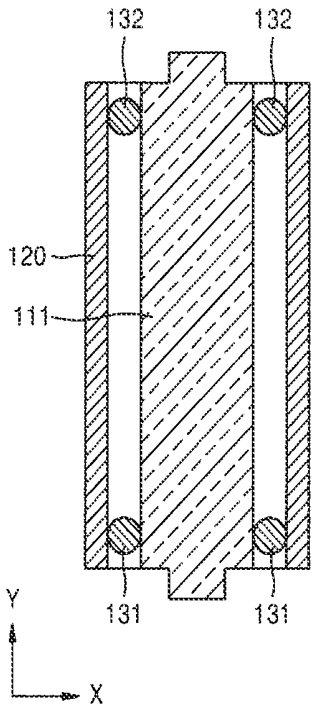


FIG. 4

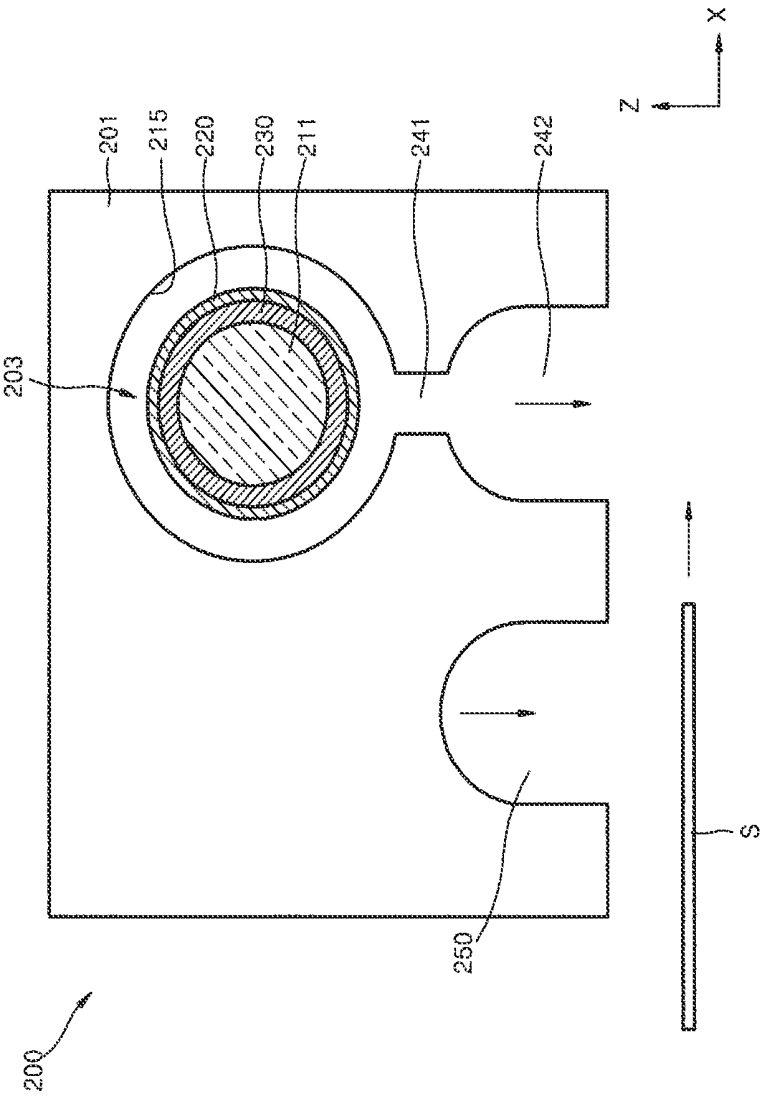


FIG. 5

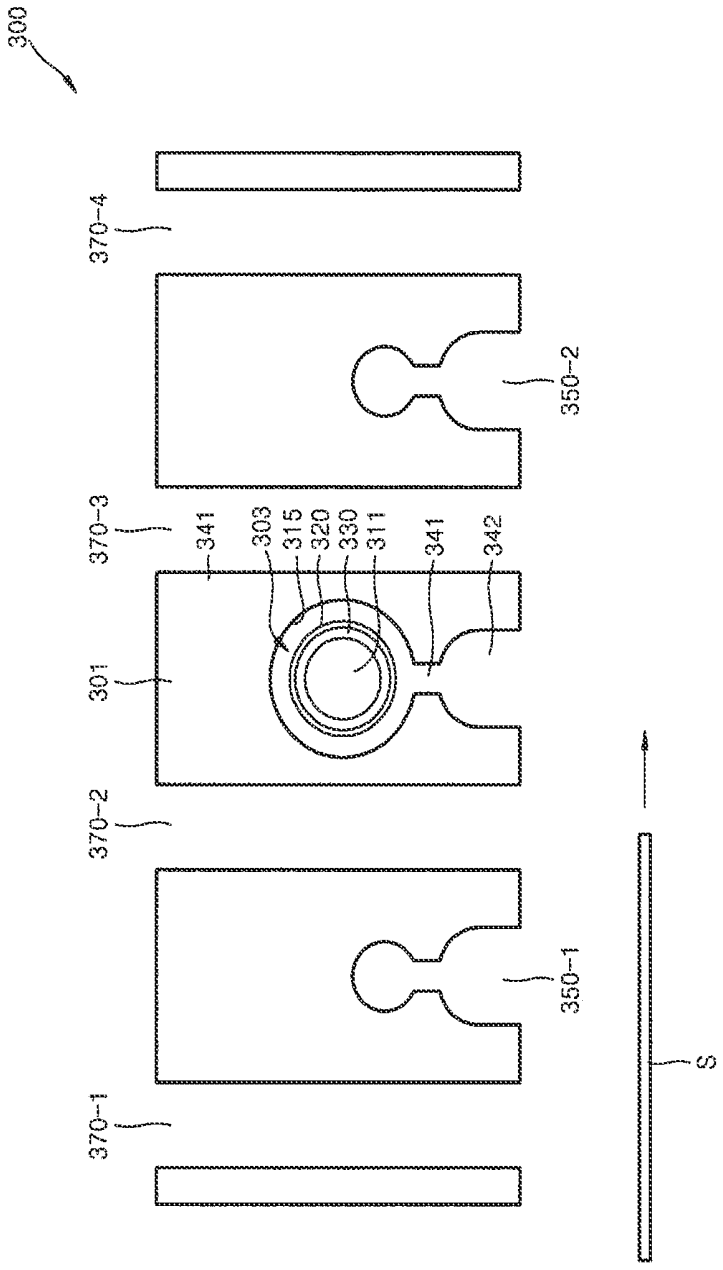

300
370-4
350-2
370-3
341
303
315
320
330
311
341
342
301
370-2
350-1
370-1
S

FIG. 6

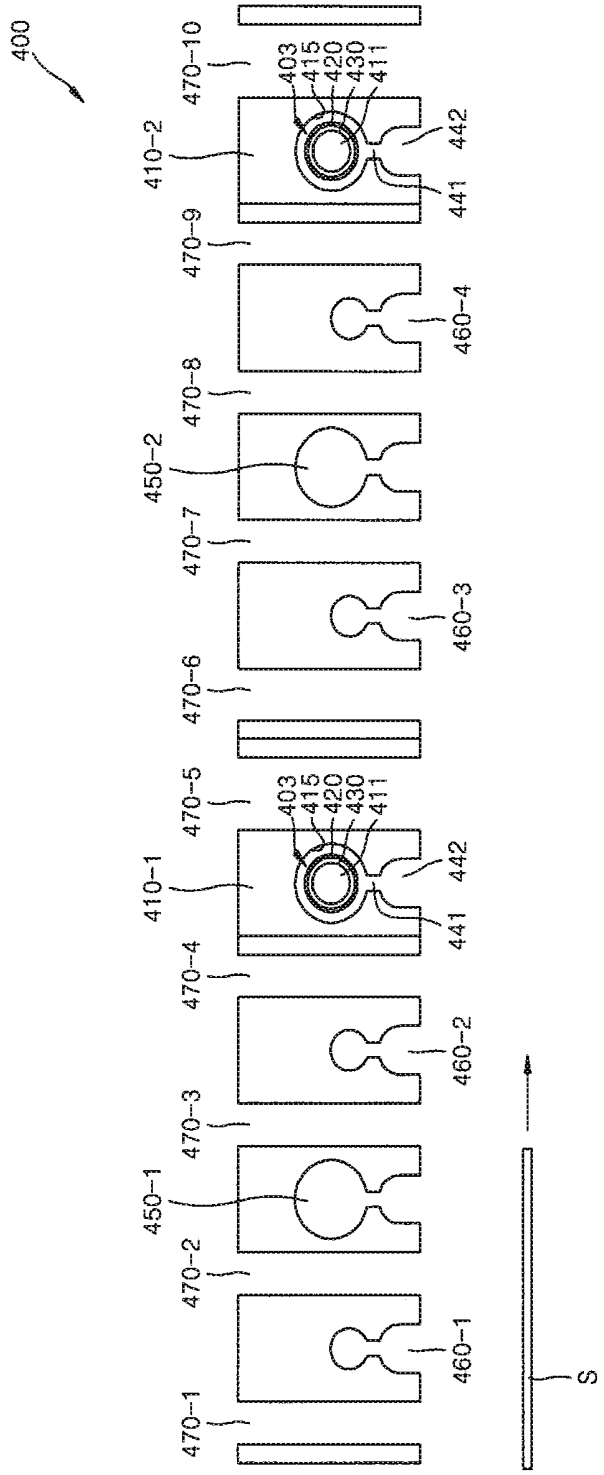

400
410-1
410-2
450-1
450-2
460-1
460-2
460-3
460-4
470-1
470-2
470-3
470-4
470-5
470-6
470-7
470-8
470-9
470-10
403
415
420
430
411
441
442
S

FIG. 7

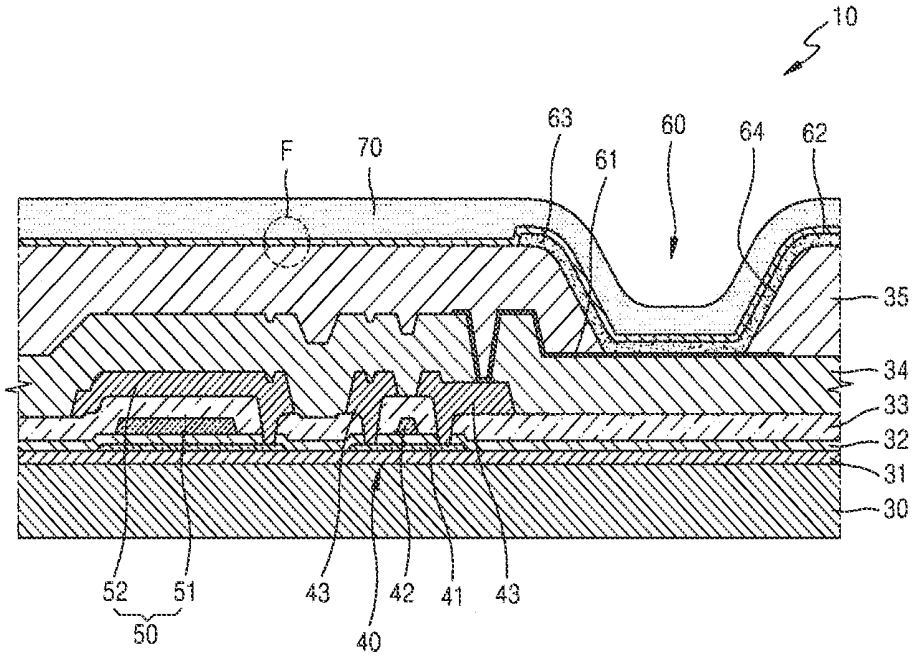
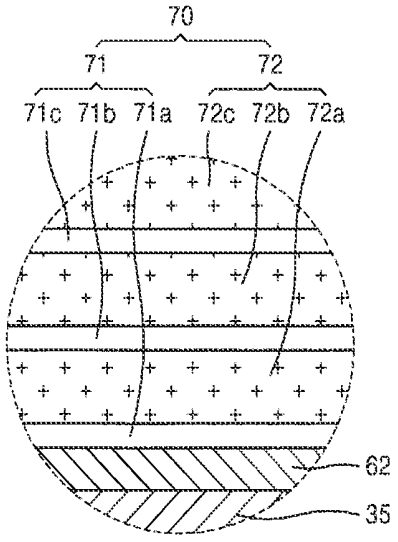

10
F
70
63
61
60
64
62
35
34
33
32
31
30
52
51
50
43
40
42
41
43

FIG. 8


70
71
72
71c
71b
71a
72c
72b
72a
62
35

VAPOR DEPOSITION APPARATUS, DEPOSITION METHOD, AND METHOD OF MANUFACTURING ORGANIC LIGHT-EMITTING DISPLAY APPARATUS BY USING THE SAME

CROSS-REFERENCE TO RELATED PATENT APPLICATION

[0001] This application claims priority to and the benefit of Korean Patent Application No. 10-2013-0016977, filed on Feb. 18, 2013, in the Korean Intellectual Property Office, the disclosure of which is incorporated herein in its entirety by reference.

BACKGROUND

[0002] 1. Field

[0003] Embodiments of the present invention relate to a vapor deposition apparatus and a method of manufacturing an organic light-emitting display apparatus.

[0004] 2. Description of the Related Art

[0005] A semiconductor device, a display apparatus, and other electronic devices include a plurality of thin films. There are various methods of forming such a plurality of thin films. One of such various methods is a vapor deposition method.

[0006] The vapor deposition method employs one or more gases as a raw material for forming a thin film. The vapor deposition method includes various methods such as chemical vapor deposition (CVD) or atomic layer deposition (ALD).

[0007] With regard to the ALD method, one raw material is injected and purged/pumped. Then, a single molecular layer or a multiple molecular layer is adsorbed onto a substrate. Then, another raw material is injected and purged/pumped. Thus, a desired single atomic layer is formed or multiple atomic layers are formed.

[0008] An organic light-emitting display apparatus, as compared to other types of display apparatuses, provides a rapid response, as well as a wide view angle and an excellent contrast. Thus, the organic light-emitting display apparatus is drawing attention as a next-generation display apparatus.

[0009] The organic light-emitting display apparatus includes an intermediate layer having an organic light-emitting layer between a first electrode and a second electrode which face each other, and further includes one or more various thin films. A deposition process may be used in order to form the one or more thin films in the organic light-emitting display apparatus.

[0010] However, as the size of the organic light-emitting display apparatus increases, it becomes more difficult to deposit large-sized thin films while maintaining desired characteristics such as high resolution. Additionally, there is a limit on improving an efficiency of a process of forming such thin films.

SUMMARY

[0011] One or more embodiments of the present invention provide a vapor deposition apparatus for efficiently preventing or substantially preventing contamination of a deposition space and improving characteristics of a deposition layer, a deposition method, and a method of manufacturing an organic light-emitting display apparatus.

[0012] According to an aspect of the present invention, there is provided a vapor deposition apparatus for forming a deposition layer on a substrate, the vapor deposition apparatus including: a plasma generator configured to change at least a portion of a first raw material gas into a radical form; a corresponding surface corresponding to the plasma generator; a reaction space between the plasma generator and the corresponding surface; and an insulating member separated from, and surrounding the plasma generator.

[0013] The insulating member may be separated from the plasma generator by an inserting member located between the plasma generator and the insulating member.

[0014] A space between the plasma generator and the insulating member may be substantially sealed by the inserting member.

[0015] The inserting member may include a first inserting member adjacent one end of the plasma generator, and a second inserting member adjacent an opposing end of the plasma generator, and wherein a space between the first inserting member and the second inserting member, between the plasma generator and the insulating member, may be substantially sealed by the first inserting member and the second inserting member.

[0016] The inserting member may have elasticity.

[0017] The inserting member may be an O-ring.

[0018] The plasma generator may be an electrode.

[0019] The plasma generator may have a generally column shape.

[0020] The insulating member may be a hollow column.

[0021] The insulating member may include a quartz or ceramic material.

[0022] The insulating member may surround an entire external surface of the plasma generator.

[0023] A first injector may be coupled to the reaction space and configured to inject a deposition raw material onto the substrate, the deposition raw material including a radical form of the first raw material gas.

[0024] A connection unit may be between the reaction space and the first injector, the connection unit having a narrower width than the first injector.

[0025] A second injector may be adjacent the first injector, the second injector being separated from the first injector.

[0026] The second injector may be configured to inject a second raw material or a purge gas toward a direction of the substrate for forming the deposition layer.

[0027] A second injector and a third injector may be adjacent to and separated from the first injector, and respectively on opposing sides of the first injector.

[0028] The second injector and the third injector may be respectively configured to inject one selected from the group consisting of a purge gas, a second raw material, and a third raw material, in a direction toward the substrate.

[0029] A plurality of exhausts may be adjacent to each of the first injector, the second injector, and the third injector.

[0030] The plurality of exhausts may include a first exhaust between the first injector and the second injector, and a second exhaust between the first injector and the third injector.

[0031] The substrate and the vapor deposition apparatus may be configured to move with respect to each other.

[0032] According to another embodiment of the present invention, there is provided a vapor deposition apparatus for forming a deposition layer on a substrate, the vapor deposition apparatus including: a plurality of first regions, a plurality of second regions, and a plurality of purge units, wherein

each of the plurality of first regions includes: a plasma generator configured to change at least a portion of a first raw material gas into a radical form; a surface corresponding to the plasma generator; a reaction space between the plasma generator and the corresponding surface; and an insulating member separated from, and surrounding the plasma generator; wherein each of the plurality of second regions is configured to inject a second raw material in a direction toward the substrate; and wherein the purge units are configured to inject a purge gas in a direction toward the substrate.

[0033] Each purge unit, among the plurality of purge units, may be between the first region and the second region.

[0034] A plurality of exhaust units may be adjacent the first regions, the second regions, and the purge units.

[0035] According to another aspect of the present invention, there is provided a method of forming a deposition layer on a substrate, the method including: supplying a first raw material gas from a supply unit to a reaction space; changing at least a portion of the first raw material gas into a radical form, by generating a plasma using a plasma generator in the reaction space; and injecting a first raw depositing material onto the substrate, the first raw depositing material including a radical form, wherein the changing of at least a portion of the first raw material gas into a radical form includes substantially preventing electrons or ions, which are generated when the plasma is generated, from accelerating and colliding with the plasma generator using an insulating member separate from and surrounding the plasma generator.

[0036] The substrate and the vapor deposition apparatus may be configured to move with respect to each other and execute a deposition process.

[0037] According to another aspect of the present invention, there is provided a method of manufacturing an organic light-emitting display apparatus by using a vapor deposition apparatus, wherein the organic light-emitting display apparatus includes a first electrode, an intermediate layer which includes an organic light-emitting layer, a second electrode, and an encapsulation layer, wherein forming at least one thin film of the organic light-emitting display apparatus includes: positioning a substrate to correspond to the vapor deposition apparatus; supplying a first raw material gas from a supply unit of the vapor deposition apparatus to a reaction space; changing at least a portion of the first raw material gas into a radical form, by generating a plasma using a plasma generator in the reaction space; and injecting a first raw depositing material into the substrate, the first raw depositing material including a radical form, wherein the changing at least a portion of the first raw material gas into a radical form includes substantially preventing electrons or ions, which are generated when the plasma is generated, from accelerating and colliding with the plasma generator using an insulating member separated from and surrounding the plasma generator.

[0038] The forming of the thin film of the organic light-emitting display may include forming the encapsulation layer on the second electrode.

[0039] The forming of the thin film of the organic light-emitting display may include forming an insulating layer.

[0040] The forming of the thin film of the organic light-emitting display may include forming a conductive layer.

BRIEF DESCRIPTION OF THE DRAWINGS

[0041] The above and other features and aspects of the present invention will become more apparent by describing in detail exemplary embodiments thereof with reference to the attached drawings in which:

[0042] FIG. **1** is a schematic diagram illustrating a vapor deposition apparatus, according to an embodiment of the present invention;

[0043] FIG. **2** is an exploded oblique view illustrating a plasma generation unit and an insulating member of FIG. **1**;

[0044] FIG. **3** is a cross-sectional view of the vapor deposition apparatus taken along the line III-III of FIG. **1**;

[0045] FIG. **4** is a schematic plan view illustrating a vapor deposition apparatus, according to another embodiment of the present invention;

[0046] FIG. **5** is a schematic plan view illustrating a vapor deposition apparatus, according to another embodiment of the present invention;

[0047] FIG. **6** is a schematic plan view illustrating a vapor deposition apparatus, according to another embodiment of the present invention;

[0048] FIG. **7** is a schematic cross-sectional view illustrating an organic light-emitting display apparatus which is manufactured by using a method of manufacturing an organic light-emitting display apparatus, according to an embodiment of the present invention; and

[0049] FIG. **8** is an expanded view of a portion F of FIG. **7**.

DETAILED DESCRIPTION

[0050] Hereinafter, the present invention will be described in detail by explaining embodiments of the invention with reference to the attached drawings.

[0051] FIG. **1** is a schematic diagram illustrating a vapor deposition apparatus, according to an embodiment of the present invention. FIG. **2** is an exploded oblique view illustrating a plasma generation unit and an insulating member of FIG. **1**. FIG. **3** is a cross-sectional view of the vapor deposition apparatus taken along the line of FIG. **1**

[0052] Referring to FIGS. **1** through **3**, the vapor deposition apparatus **100** includes a housing **101**, a supply unit (not illustrated), a plasma generation unit (or plasma generator) **111**, a corresponding surface **115**, a reaction space **103**, an insulating member **120**, and an injection unit (or injector) **142**.

[0053] The housing **101** is formed of a durable material so as to maintain the entire shape and appearance of the vapor deposition apparatus **100**. The housing **101** may be formed in a shape similar to a rectangular parallelepiped. However, this is only an example, and the housing **101** may be formed in various shapes.

[0054] The supply unit (not illustrated) is coupled to the housing **101**. For example, the supply unit may be formed on an upper surface of the housing **101**, and may have a shape of a through hole so that one or more raw material gases may be supplied. The number of the supply unit (not illustrated) may be determined variously according to a size of a deposition target on which a deposition process is to be performed.

[0055] The plasma generation unit **111** is located inside the housing **101**. The plasma generation unit **111** may be an electrode to which a voltage is applied. Additionally, a terminal unit, which has a protruding shape, may be formed at both sides of the plasma generation unit **111**, as illustrated in FIGS.

2 and 3. However, the present invention is not limited thereto, and the terminal unit may not be provided.

[0056] The plasma generation unit **111** may have a form of a column. Alternatively, the plasma generation unit **111** may have a form such as a cylinder.

[0057] The corresponding surface **115** is a surface which corresponds to the plasma generation unit **111**. Additionally, the corresponding surface **115** may be an electrode which corresponds to the plasma generation unit **111**. For example, the corresponding surface **115** may be a ground electrode.

[0058] Thus, a plasma is generated from a space between the plasma generation unit **111** and the corresponding surface **115** that is the reaction space **103**. The reaction space **103** will be described later. A raw material gas, which flows through the supply unit (not illustrated), is changed into a radical form in the reaction space **103** between the plasma generation unit **111** and the corresponding surface **115**. Thus, deposition characteristics of the raw material gas are improved.

[0059] The reaction space **103** is defined as a space (e.g., a predetermined space) inside the housing **101**. Specifically, the reaction space **103** is a space between the plasma generation unit **111** and the corresponding surface **115**. The reaction space **103** may be coupled to the supply unit (not illustrated) which is described above. Thus, a raw material gas may be changed into a radical form in the reaction space **103**.

[0060] The insulating member **120** surrounds the plasma generation unit **111**. That is, the insulating member **120** is located in the reaction space **103**, to separate the plasma generation unit **111** from the corresponding surface **115**. Additionally, the insulating member **120** may have a form or shape of a hollow column to surround the plasma generation unit **111**. For example, the insulating member **120** may have a form of a hollow cylinder to correspond to the plasma generation unit **111**. The insulating member **120** is formed of a quartz or ceramic material. For example, the insulating member **120** may contain an aluminum oxide such as alumina (Al_2O_3).

[0061] Additionally, the insulating member **120** may correspond to or surround (e.g., cover) an entire external surface around the circumference or periphery of the plasma generation unit **111**. That is, a length of the insulating member **120** may correspond to or be greater than a length of the plasma generation unit **111**.

[0062] The insulating member **120** surrounds, but does not contact, the plasma generation unit **111**. To achieve this, an inserting member **130** is positioned between the insulating member **120** and the plasma generation unit **111**.

[0063] The inserting member **130** is formed of an elastic material. The inserting member **130** may be an O-ring. The inserting member **130** includes a first inserting member **131** and a second inserting member **132**. The first inserting member **131** is adjacent to one end of the plasma generation unit **111**, and the second inserting member **132** is adjacent to another end of the plasma generation unit **111**. Thus, an enclosed space is formed between the plasma member **111** and the insulating member **120**.

[0064] The injection unit **142** is formed to be coupled to the reaction space **103**. The raw material gas, which flows from the supply unit (not illustrated), is changed into a radical form in the reaction space **103**, and transmitted to the injection unit **142**. Then, the raw material gas reacts with a deposition target at the injection unit **142**, and thus, a deposition process is performed on a surface of the deposition target. The injection unit **142** is coupled to the reaction space **103** by using a connection unit or connector **141**. The connection unit **141** may have a narrower width than the injection unit **142** and the reaction space **143**.

[0065] Thus, the raw material gas is induced to remain for a sufficiently long time in the reaction space **103**, so that an amount of the raw material gas, changed into a radical form, may increase. Thus, the raw material of deposition may be effectively transmitted to the injection unit **142**.

[0066] A method of deposition, by using the vapor deposition apparatus **100** in the current embodiment, is briefly described.

[0067] When a substrate S, which is a deposition target, corresponds to (e.g., is positioned within a suitable distance relative to) the injection unit **142** of the vapor deposition apparatus **100**, a deposition process may be performed on the substrate S. Then, the substrate S and the vapor deposition apparatus **100** may move with respect to each other, and to perform the deposition process. That is, the substrate S may move in an X direction shown in FIG. **1**, and a deposition process is consecutively performed. Conversely, the vapor deposition apparatus **100** may move and a deposition process is performed. Additionally, the present invention is not limited thereto, and the substrate S may be fixed to the vapor deposition apparatus **100**, and a deposition process is performed.

[0068] First, through the supply unit (not illustrated), one or more raw material gases flows into the reaction space **103**. Then, a plasma is generated from or within the reaction space **103** between the plasma generation unit **111** and the corresponding surface **115**. At least a portion of the raw material gases, which flows into the reaction space **103**, is changed into a radical form. The raw material in the radical form reaches the substrate **5**, and thus, a deposition layer which includes the raw material is formed.

[0069] Ions and electrons, generated when the plasma is generated, may accelerate and collide with the plasma generation unit **111**. In such a case, particles may be generated from a surface of the plasma generation unit **111**, and thus, the plasma generation unit **111** may be damaged. Additionally, such particles may contaminate a deposition layer. However, in the current embodiment, the insulating member **120** surrounds the plasma generation unit **111**, so as to prevent the accelerating ions and electrons from colliding with the surface of the plasma generation unit **111**, and thus, prevent generation of particles. For example, the inserting member, such as an O-ring, is located between the insulating member **120** and the plasma generation unit **111**, so as to enclose a space between the insulating member **120** and the plasma generation unit **111**. Thus, accelerating ions and electrons may be completely prevented from colliding with the plasma generation unit **111**.

[0070] Additionally, the plasma generation unit **111** and the insulating member **120** are separated from each other, so that generation of additional particles from the insulating member **120** is prevented or substantially prevented. That is, if the plasma generation unit **111** and the insulating member **120** contact each other, heat generated from the plasma generation unit **111** may increase phonon in the insulating member **120**, and thus, high heat is generated on the insulating member **120**. Additionally, such high heat may cause particles from a surface of the insulating member **120** to be generated. However, in the current embodiment, the plasma generation unit **111** and the insulating member **120** are separated from each other, and thus, transmission of the heat, generated from the

plasma generation unit **111**, to the insulating member **120** is effectively prevented or substantially prevented. Therefore, generation of additional particles may be effectively prevented or substantially prevented.

[0071] As such, the vapor deposition apparatus **100**, in the current embodiment, may relatively easily form a high-purity deposition layer by keeping inside of the reaction space **103** uncontaminated or substantially uncontaminated.

[0072] FIG. **4** is a schematic plan view illustrating a vapor deposition apparatus, according to another embodiment of the present invention.

[0073] Referring to FIG. **4**, a vapor deposition apparatus **200** includes a housing **201**, a supply unit (not illustrated), a plasma generation unit (or plasma generator) **211**, a corresponding surface **215**, a reaction space **203**, an insulating member **220**, a first injection unit (or first injector) **242**, and a second injection unit (or second injector) **250**.

[0074] The housing **201** is formed of a durable material so as to maintain an entire shape and appearance of the vapor deposition apparatus **200**. The housing **201** may be formed in a shape similar to a rectangular parallelepiped. However, this is only an example, and the housing **201** may be formed in various shapes.

[0075] The supply unit (not illustrated) is located on an upper portion of the housing **201**. The supply unit has a shape of a through hole, so as to supply a first raw material gas into the reaction space **203**, and a second raw material gas into the second injection unit **250**. The number of supply units (not illustrated) may be determined variously according to a size of a deposition target on which a deposition process is to be executed.

[0076] The plasma generation unit **211** is located inside the housing **201**. The plasma generation unit **211** may have be an electrode to which a voltage is applied. The reaction space **203** is defined as a space (e.g., a predetermined space) inside the housing **201**. Specifically, the reaction space **203** is a space between the corresponding surface **215** and the plasma generation unit **211**. An insulating member **220** surrounds the plasma generation unit **211**, but does not contact the plasma generation unit **211**. To achieve this, an inserting member **230** is located between the insulating member **220** and the plasma generation unit **211**. The inserting member **230** is formed of an elastic material. For example, the inserting member **230** may be an **0**-ring. Similar to the embodiment shown in FIGS. **1-3**, the inserting member **230** may include a first inserting member and a second inserting member. Configurations of the plasma generation unit **211**, the insulating member **220**, and the inserting member **230** are substantially the same as or substantially similar to those of the plasma generation unit, the insulating member, and the inserting member in the previous embodiment described above. Thus, their repeated description is not provided here.

[0077] The first injection unit **242** is formed to be coupled to the reaction space **203**. A first raw material gas, which flows from the supply unit (not illustrated), is changed into a radical form in the reaction space **203**, and transmitted to the first injection unit **242**. Then, the first raw material gas reacts with a deposition target at the first injection unit **242**, and thus, a deposition process is performed on a surface of the deposition target. The first injection unit **242** is coupled to the reaction space **203** by using a connection unit or connector **241**. The connection unit **241** may have a narrower width than the injection unit **242** and the reaction space **203**.

[0078] The second injection unit **250** is formed to be adjacent to the reaction space **242**. Additionally, the second injection unit **250** may be separated from the first injection unit **242**. The second injection unit **250** injects a second raw material, to be deposited on the substrate S, in a direction toward the substrate S. Though not illustrated, the second injection unit **250** is coupled to the supply unit (not illustrated) so as to be supplied with the second raw material. The second injection unit **250** may be formed separately from the supply unit (not illustrated) for supplying the first raw material that flows into the reaction space **203**.

[0079] A deposition method of using the vapor deposition apparatus **200**, in the current embodiment, is briefly described.

[0080] When the substrate S, which is a deposition target, corresponds to the second injection unit **250** of the vapor deposition apparatus **200**, the second injection unit **250** injects a second raw material, for example, a second raw material in a gas state in a direction toward the substrate S.

[0081] Then, when the substrate **5**, which is a deposition target, moves along an X direction shown in FIG. **4**, that is, a direction of an arrow, and thus, corresponds to the first injection unit **242**, a first raw material gas flows into the reaction space **203**. Then, the substrate S and the vapor deposition apparatus **200** may relatively move with respect to each other, and a deposition process may be performed. That is, the substrate S may move in an X direction as shown in FIG. **4**, and then, a deposition process may be consecutively executed. Conversely, the vapor deposition apparatus **200** may move, and a deposition process may be performed. Additionally, the present invention is not limited thereto, and the substrate S may be fixed to the vapor deposition apparatus **200**, and a deposition process may be executed.

[0082] Through the supply unit (not illustrated), a second raw material gas may flow into the reaction space **203**. Then, a plasma is generated within the reaction space **203** between the plasma generation unit **211** and the corresponding surface **215**. At least a portion of the raw material gases, which flows into the reaction space **203**, is changed into a radical form. The raw material, changed into the radical form, reaches the substrate S via the first injection unit **242**. Resultantly, a deposition layer, which contains the first raw material and the second raw material, is formed on the substrate S. For example, a single-layered deposition layer, which contains the first raw material and the second raw material, may be formed on the substrate S.

[0083] The insulating member **220** surrounds the plasma generation unit **211**, and thus, generation of particles, which may be generated from a surface of the plasma generation unit **211**, may be prevented. For example, the inserting member **230**, such as an O-ring, is located between the insulating member **220** and the plasma generation unit **211**, so as to enclose a space between the insulating member **220** and the plasma generation unit **211**. Thus, ions and electrons, which are generated when a plasma is generated, may be completely prevented or substantially prevented from colliding with the plasma generation unit **211**.

[0084] Additionally, the plasma generation unit **211** and the insulating member **220** are separated from each other, and thus, generation of additional particles may be prevented or substantially prevented. That is, if the plasma generation unit **211** and the insulating member **220** contact each other, heat generated from the plasma generation unit **211** may increase phonon in the insulating member **220**, and thus, a relatively

high heat may be generated from the insulating member **220**. Additionally, such high heat may cause generation of particles from a surface of the insulating member **220**. However, in the current embodiment, the plasma generation unit **211** and the insulating member **220** are separated from each other. Therefore, transmission of the heat, generated from the plasma generation unit **211**, to the insulating member **220** may be effectively prevented, substantially prevented, or reduced.

[0085] As a result, the vapor deposition apparatus **200**, in the current embodiment, may easily form a relatively high-purity deposition layer by keeping the inside of the reaction space **203** uncontaminated or substantially uncontaminated.

[0086] FIG. **5** is a schematic plan view illustrating a vapor deposition apparatus **300**, according to another embodiment of the present invention.

[0087] Referring to FIG. **5**, the vapor deposition apparatus **300** includes a housing **301**, a supply unit (not illustrated), a plasma generation unit (or plasma generator) **311**, a reaction space **303**, a corresponding surface **315**, an insulating member **320**, a first injection unit (or first injector) **342**, a second injection unit (or second injector) **350-1**, and a third injection unit (or third injector) **350-2**. Additionally, the vapor deposition apparatus **300** further includes exhaust units (or exhausts) **370-1** through **370-4**.

[0088] The housing **301** is formed of a durable material so as to maintain an entire shape and appearance of the vapor deposition apparatus **300**.

[0089] The supply unit (not illustrated) is located in the housing **301**. For example, the supply unit may be formed on an upper portion of the housing **301**, and may include shapes of a plurality of through holes, so as to supply a first raw material gases into the reaction space **303**, and supply a plurality of gases into the second injection unit **350-1** and the third injection unit **350-2**.

[0090] The plasma generation unit **311** is located inside the housing **301**. The plasma generation unit **311** may be an electrode to which a voltage is applied. The corresponding surface **315** is a surface which corresponds to the plasma generation unit **311**. The reaction space **303** is defined as a predetermined space inside the housing **301**. Specifically, the reaction space **103** is a space between the corresponding surface **315** and the plasma generation unit **311**. An insulating member **320** surrounds, but does not contact the plasma generation unit **311**. To achieve this, an inserting member **330** is between the insulating member **320** and the plasma generation unit **311**. The inserting member **330** is formed of an elastic material. The inserting member **330** may be an O-ring. Similar to the embodiment shown in FIGS. **1-3**, the inserting member **330** may include a first inserting member and a second inserting member. Configurations of the plasma generation unit **311**, the insulating member **320**, and the inserting member **330** are substantially the same as or substantially similar to those of the plasma generation unit, the insulating member, and the inserting member in the previous embodiment described above. Thus, their repeated description is not provided here.

[0091] The first injection unit **342** is formed to be coupled to the reaction space **303**. That is, the response space **303** is between the supply unit (not illustrated) and the first injection unit **342**. A first raw material gas, which flows from the supply unit (not illustrated), is changed into a radical form in the reaction space **303**, and then, transmitted to the first injection unit **242**. Then, the first raw material gas reacts with a deposition target at the first injection unit **342**, and thus, a deposition process is executed on a surface of the deposition target. The first injection unit **342** is coupled to the reaction space **303** by using a connection unit or connector **341**. The connection unit **341** may have a narrower width than the injection unit **342** and the reaction space **303**.

[0092] The second injection unit **350-1** is formed to be adjacent to the first injection unit **342**. Additionally, the second injection unit **350-1** may be separated from the first injection unit **342**. The second injection unit **350-1** injects a purge gas into the substrate **5**, in a direction toward the substrate S. The purge gas includes an inert gas. Additionally, the present invention is not limited thereto, and the second injection unit **350-1** may inject a second raw material, to be deposited on the substrate **5**, in a direction toward the substrate S. Though not illustrated, the second injection unit **350-1** is coupled to the supply unit (not illustrated) so as to be supplied with the purge gas or the second raw material. The second injection unit **350-1** may be formed to be separated from the supply unit (not illustrated) for supplying the first raw material that flows into the reaction space **203**.

[0093] The third injection unit **350-2** is formed to be adjacent to the first injection unit **342**. Additionally, the third injection unit **350-2** may be separated from the first injection unit **342**. Specifically, the first injection unit **342** is between the second injection unit **350-1** and the third injection unit **350-2**.

[0094] The third injection unit **350-2** injects a purge gas into the substrate S, in a direction toward the substrate S. The purge gas includes an inert gas. Additionally, the present invention is not limited thereto, and the third injection unit **350-2** may inject the second raw material, to be deposited on the substrate S, in a direction toward the substrate S. Additionally, the second injection unit **350-1** may inject a third raw material, to be deposited on the substrate S, in a direction toward the substrate S.

[0095] Additionally, the exhaust unit **370-2** is between the first injection unit **342** and the second injection unit **350-1**. The exhaust unit **370-3** is between the first injection unit **342** and the third injection unit **350-2**. Additionally, the exhaust unit **370-1** and the exhaust unit **370-4** are respectively adjacent to edges of the second injection unit **350-1** and the third injection unit **350-2**.

[0096] The exhaust units **370-1** through **370-4** are adjacent to the first injection unit **342**, the second injection unit **350-1**, and the third injection unit **350-2**. When a deposition process is performed via the first injection unit **342**, the second injection unit **350-1**, and the third injection unit **350-2**, the exhaust units **370-1** through **370-4** may relatively easily exhaust a remaining material, and thus, characteristics of a deposition layer may be improved.

[0097] The substrate S and the vapor deposition apparatus **300** may move with respect to each other, and thus, a deposition process may be performed. That is, as illustrated in FIG. **5**, the substrate S may move in an X direction, and thus, a deposition process may be consecutively performed. Conversely, the vapor deposition apparatus **300** may move, and thus, a deposition process may be performed. Additionally, the present invention is not limited thereto, and the substrate S may be fixed to the vapor deposition apparatus **100**, and thus, a deposition process may be performed.

[0098] Additionally, in the current embodiment, the second and third injection units **350-1** and **350-2**, for injecting a purge gas, are included. Thus, when a deposition process is

performed via the first injection unit **342**, a foreign object or an impure gas may be easily prevented or substantially prevented from flowing into an area of a deposition process,

[0099] Additionally, the insulating member **320** surrounds the plasma generation unit **311**, and thus, generation of particles, which may be generated from a surface of the plasma generation unit **311** due to acceleration of electrons, may be prevented or substantially prevented. For example, the inserting member **330**, such as an O-ring, is located between the insulating member **320** and the plasma generation unit **311**, so as to enclose a space between the insulating member **320** and the plasma generation unit **311**. Thus, ions and electrons, which are generated when a plasma is generated, may be completely prevented or substantially prevented from colliding with the plasma generation unit **311**.

[0100] Additionally, the plasma generation unit **311** and the insulating member **320** are separated from each other, so as to prevent generation of additional particles. That is, if the plasma generation unit **311** and the insulating member **320** contact each other, heat generated from the plasma generation unit **311** may increase phonon in the insulating member **320**, and thus, a relatively high heat may be generated from the insulating member **320**. Additionally, such high heat may cause generation of particles from a surface of the insulating member **320**. However, in the current embodiment, the plasma generation unit **311** and the insulating member **320** are separated from each other. Thus, transmission of the heat, generated from the plasma generation unit **311**, to the insulating member **320** is effectively prevented, substantially prevented, or reduced.

[0101] As a result, the vapor deposition apparatus **300**, in the current embodiment, may relatively easily form a high-purity deposition layer by keeping the inside of the reaction space **303** uncontaminated or substantially uncontaminated.

[0102] FIG. **6** is a schematic plan view illustrating a vapor deposition apparatus, according to another embodiment of the present invention.

[0103] Referring to FIG. **6**, the vapor deposition apparatus **400** includes a plurality of first regions **410-1** and **410-2**, a plurality of second regions **450-1** and **450-2**, a plurality of purge units **460-1** through **460-4**, and a plurality of exhaust units (or exhausts) **470-1** through **470-10**.

[0104] The first regions **410-1** and **410-2** respectively include a housing **401**, a supply unit (not illustrated), a plasma generation unit (or plasma generator) **411**, a reaction space **403**, an insulating member **420**, and a first injection unit (or first injector) **442**.

[0105] The housing **401** may be formed of a durable material so as to maintain an entire shape and appearance of the vapor deposition apparatus **400**, as well as those of the first region **410-1**.

[0106] That is, the housing **401** may be formed to respectively correspond to the first regions **410-1** and **410-2**. However, the housing **401** may be formed to correspond to the vapor deposition apparatus **400**.

[0107] The first regions **410-1** and **410-2** have the same configuration. Thus, only the configuration of the first region **410-1** will be described here.

[0108] The supply unit (not illustrated) is located in the housing **401**. For example, the supply unit may be located on an upper portion of the housing **401**. The supply unit supplies a first raw material gas into the reaction space **403**.

[0109] The plasma generation unit **411** is located inside the housing **401**. The plasma generation unit **411** may be an electrode to which a voltage is applied. The corresponding surface **415** is a surface which corresponds to the plasma generation unit **411**. The reaction space **403** is defined as a space (e.g., a predetermined space) inside the housing **401**. Specifically, the reaction space **403** is a space between the corresponding surface **415** and the plasma generation unit **411**. An insulating member **420** surrounds, but does not contact the plasma generation unit **411**. To achieve this, an inserting member **430** is between the insulating member **420** and the plasma generation unit **411**. The inserting member **430** is formed of an elastic material. The inserting member **430** may be an O-ring. Similar to the embodiment shown in FIGS. **1-3**, the inserting member **430** includes a first inserting member and a second inserting member. Configurations of the plasma generation unit **411**, the insulating member **420**, and the inserting member **430** are substantially the same as or substantially similar to those of the plasma generation unit, the insulating member, and the inserting member in the previous embodiments described above. Thus, their repeated description is not provided here.

[0110] The first injection unit **442** is formed to be coupled to the reaction space **403**. That is, the response space **403** is between the supply part (not illustrated) and the first injection unit **442**. A first raw material gas, which flows via the supply unit (not illustrated), is changed into a radical form in the reaction space **403**, and then, transmitted to the first injection unit **442**. Then, the first raw material gas reacts with a deposition target at the first injection unit **442**, and thus, a deposition process is performed on a surface of the deposition target. The first injection unit **442** is coupled to the reaction space **403** by using a connection unit **441**. The connection unit **441** may have a narrower width than the injection unit **442** and the reaction space **403**.

[0111] The plurality of second regions **450-1** and **450-2** are separated from the first regions **410-1** and **410-2**. Additionally, the second regions **450-1** and **450-2** respectively inject a second raw material into the substrate S, to be deposited on the substrate S, in a direction toward the substrate S.

[0112] The plurality of purge units **460-1** through **460-4** are located adjacently with respect to the first regions **410-1** and **410-2** and the second regions **450-1** and **450-2**.

[0113] Specifically, the purge unit **460-2** is located between the first region **410-1** and the second region **450-1**, the purge unit **460-3** is located between the first region **410-1** and the second region **450-2**, and the purge unit **460-4** is located between the first region **410-2** and the second region **450-2**.

[0114] Additionally, the purge unit **460-1** are located adjacent to the second region **450-1**. The plurality of purge units **460-1** through **460-4**, which contain an inert gas, inject a purge gas in a direction of the substrate S.

[0115] Each of the plurality of exhaust units **470-1** through **470-10** are located respectively adjacent to the plurality of first regions **410-1** and **410-2**, the plurality of second regions **450-1** and **450-2**, and the plurality of purge units **460-1** through **460-4**.

[0116] That is, the plurality of exhaust units **470-1** through **470-10** are respectively between the plurality of first regions **410-1** and **410-2**, and the plurality of second regions **450-1** and **450-2**. FIG. **7** illustrates the two exhaust units **470-5** and **470-6** which are located between the first region **410-1** and the purge unit **460-3**. However, the present invention is not limited thereto, and one of the two exhaust units **470-5** and **470-6** may not be provided.

[0117] A deposition method of using the vapor deposition apparatus **400**, in the current embodiment, is briefly described. As a specific example, a method of forming AlxOy on the substrate by using the vapor deposition apparatus **400** is described.

[0118] When the substrate S, which is a deposition target, corresponds to the second region **450-1** of the vapor deposition apparatus **400**, the second region **450-1** may inject a second raw material, for example, a gas which contains aluminum (Al), such as trimethyl aluminum (TMA) in a gas state, in a direction of the substrate S. Thus, an absorption layer, which contains Al, is formed on an upper surface of the substrate S. Specifically, a chemical absorption layer and a physical absorption layer are formed on the upper surface of the substrate S.

[0119] The physical absorption layer which has a weak molecular binding force, among absorption layers formed on the upper surface of the substrate S, is separated from the substrate S by using a purge gas, which is injected by the purge unit **460-1** or the purge unit **460-2**. Then, the physical absorption layer is effectively removed from the substrate S by pumping the exhaust units **470-2** and **470-3**. Thus, a purity of a deposition layer, to be formed on the substrate S, is eventually improved.

[0120] Then, when the substrate **5**, which is a deposition target, moves along an X direction shown in FIG. **6**, that is, a direction of an arrow, and thus corresponds to the first injection unit **442** in the first region **410-1** of the vapor deposition apparatus **400**, a first raw material gas flows into the reaction space **403**. Specifically, the first raw material gas contains oxygen, for example, water (H_2O), oxygen (O_2), nitrous oxide (N_2O).

[0121] A plasma is generated from between the plasma generation unit **411** and the corresponding surface **415** of the reaction space **403**. At least a part of an oxygen in the raw material gases, which flows into the reaction space **403**, is changed into a radical form.

[0122] Ions and electrons, accelerating in the reaction space **403**, may be prevented or substantially prevented from colliding with a surface of the plasma generation unit **411** by using the insulating member **420**. As a result, generation of particles, which may be generated from a surface of the plasma generation unit **411**, is prevented or substantially prevented. For example, an inflow of particles from the surface of the plasma generation unit **411** through the inserting member **430** is completely prevented or substantially prevented. Additionally, the insulating member **420** and the plasma generation unit **411** are separated from each other, so as to effectively prevent, substantially prevent, or reduce heat, generated from the plasma generation unit **411**, from being transmitted to the insulating member **420**. Thus, damage on the insulating member **420** is prevented or substantially prevented, and for example, generation of particles, which may be generated from a surface of the insulating member **400** due to an increase in phonon in the insulating member **420**, is prevented or substantially prevented.

[0123] Thus, a high-purity material in a radical form may exist in the reaction space **403**. Such a material in a radical form reaches a surface of the substrate S, and thus, a desired deposition layer is formed.

[0124] That is, a first raw material gas in the radical form reacts with a chemical absorption layer, formed of a second raw material which is already absorbed in the substrate S, or substitutes a part of the chemical absorption layer. Thus, AlxOy, which is a desired deposition layer, is formed on the substrate S. An excessive amount of the first raw material forms the physical absorption layer, and remains on the substrate S.

[0125] A purge gas is injected from the purge unit **460-2** or **460-3** in a direction toward the substrate S. Thus, the physical absorption layer of the first raw material, which remains on the substrate S, is separated from the substrate S and is effectively removed or substantially removed from the substrate S by pumping the exhaust unit **470-4** and **470-5**. Therefore, a purity of a deposition layer, to be formed on the substrate S, is eventually improved.

[0126] As a result, a deposition layer, which contains the first raw material and the second raw material, is formed on the substrate S. Specifically, a single atomic layer, which contains AlxOy, is formed on the substrate S.

[0127] Then, the substrate S sequentially moves to correspond to the second region **450-2** and the first region **410-2**. Thus, a deposition layer may be further formed sequentially as desired.

[0128] Then, the substrate S and the vapor deposition apparatus **400** may move with respect to each other, and perform a deposition process. That is, as illustrated in FIG. **6**, the substrate S may move in an X direction shown in FIG. **6**, and thus, a deposition process may be consecutively performed. Conversely, the vapor deposition apparatus **400** may move, and thus, a deposition process may be performed. The present invention is not limited thereto, and a deposition process may also be performed when the substrate S is fixed to the vapor deposition apparatus **400**.

[0129] The vapor deposition apparatus **400**, in the current embodiment, may easily form a high-purity deposition layer by keeping the inside of the reaction space **403** uncontaminated or substantially uncontaminated.

[0130] FIG. **7** is a schematic cross-sectional view illustrating an organic light-emitting display apparatus which is manufactured by using a method of manufacturing an organic light-emitting display apparatus, according to an embodiment of the present invention. FIG. **8** is an extended view of a portion F of FIG. **7**.

[0131] Specifically, FIGS. **7** and **8** illustrate an organic light-emitting display apparatus **10** which is manufactured by using one of the vapor deposition apparatuses **100** through **400**, described above.

[0132] The organic light-emitting display apparatus **10** is formed on a substrate **30**. The substrate **30** may be formed of glass, plastic, or metal.

[0133] A buffer layer **31**, which contains an insulating material, is formed on the substrate **30**, in order to prevent moisture or a foreign material from penetrating into the substrate **30** and to provide a planarization surface on an upper portion of the substrate **30**.

[0134] A thin-film transistor (TFT) **40**, a capacitor **50**, an organic light-emitting device **60** are formed on the buffer layer **30**. The TFT **40** includes an active layer **41**, a gate electrode **42**, and source/drain electrodes **43**. The organic light-emitting device **60** includes a first electrode **61**, a second electrode **62**, and an intermediate layer **63**.

[0135] The capacitor **50** includes a first capacitor electrode **51** and a second capacitor electrode **52**.

[0136] Specifically, the active layer **41**, formed to have a pattern (e.g., a predetermined pattern), is located on the buffer layer **31**. The active layer **41** may contain an inorganic semiconductor material such as silicon, an organic semiconductor

material, or an oxide semiconductor material. The active layer **41** may be formed by injecting a p-type dopant or an n-type dopant. The first capacitor electrode **51** is formed on the same layer as the active layer **41**. The first capacitor electrode **51** may be formed of the same material as the active layer **41**.

[0137] A gate insulating layer **32** is formed on an upper portion of the active layer **41**. The gate electrode **42** is formed on an upper portion of the gate insulating layer **32**, to correspond to the active layer **41**. An interlayer insulating layer **33** is formed to cover the gate electrode **42**. The source/drain electrodes **43** are formed on the interlayer insulating layer **33**, so as to contact a predetermined area of the active layer **41**. The second capacitor electrode **52** is formed on the same layer as the source/drain electrodes **43**. The second capacitor electrode **52** may be formed of the same material as the source/drain electrodes **43**.

[0138] A passivation layer **34** is formed to cover the source/drain electrodes **43**. An additional insulating layer may be further formed on the passivation layer **34** so as to planarize the TFT **40**.

[0139] The first electrode **61** is formed on the passivation layer **34**. The first electrode **61** is formed to be electrically coupled to either of the source/drain electrodes **43**. Additionally, a pixel-defining layer **35** is formed to cover the first electrode **61**. A predetermined opening **64** is formed on the pixel-defining layer **35**. Then, the intermediate layer **63**, which includes an organic light-emitting layer, is formed within an area defined by the opening **64**. The second electrode **62** is formed on the intermediate layer **63**.

[0140] An encapsulation layer **70** is formed on the second electrode **62**. The encapsulation layer **70** may contain an organic or inorganic material. The encapsulation layer **70** may also be a structure in which an organic material and an inorganic material are alternately stacked.

[0141] The encapsulation layer **70** may be formed by using one of the vapor deposition apparatuses described herein. That is, a desired layer may be formed on the substrate **30**, on which the second electrode **62** is formed, by passing through the vapor deposition apparatus described herein.

[0142] For example, the encapsulation layer **70** may include an inorganic layer **71** and an organic layer **72**. The inorganic layer **71** includes a plurality of layers **71***a* through **71***c*. The organic layer **72** includes a plurality of layers **72***a* through **72***c*. The plurality of layers **71***a* through **71***c*, included in the inorganic layer **71**, may be formed by using the vapor deposition apparatus according to the present invention.

[0143] However, the present invention is not limited thereto. That is, the buffer layer **31**, the gate insulating layer **32**, the interlayer insulating layer **33**, the passivation layer **34**, the pixel-defining layer **35**, and other insulating layers may be formed by using the vapor deposition apparatus in the present invention.

[0144] Additionally, the active layer **41**, the gate electrode **42**, the source/drain electrodes **43**, the first electrode **61**, the intermediate layer **63**, the second electrode **62**, and other various thin films may also be formed by using the vapor deposition apparatus in the present invention.

[0145] As describe above, when the vapor deposition apparatus in the present invention is used, characteristics of a deposition layer, formed on the organic light-emitting display apparatus **10**, may be improved. Resultantly, electrical and image quality characteristics of the organic light-emitting display apparatus **10** may also be improved.

[0146] A vapor deposition apparatus, a deposition method of using the same, and a method of manufacturing an organic light-emitting display apparatus may efficiently prevent or substantially prevent contamination of a deposition space, and improve characteristics of a deposition layer.

[0147] While the present invention has been particularly shown and described with reference to exemplary embodiments thereof, it will be understood by those of ordinary skill in the art that various changes in form and details may be made therein without departing from the spirit and scope of the present invention as defined by the following claims, and their equivalents.

What is claimed is:

1. A vapor deposition apparatus for forming a deposition layer on a substrate, the vapor deposition apparatus comprising:

a plasma generator configured to change at least a portion of a first raw material gas into a radical form;

a corresponding surface corresponding to the plasma generator;

a reaction space between the plasma generator and the corresponding surface; and

an insulating member separated from, and surrounding the plasma generator.

2. The vapor deposition apparatus of claim **1**, wherein the insulating member is separated from the plasma generator by an inserting member located between the plasma generator and the insulating member.

3. The vapor deposition apparatus of claim **2**, wherein a space between the plasma generator and the insulating member is substantially sealed by the inserting member.

4. The vapor deposition apparatus of claim **3**, wherein the inserting member comprises a first inserting member adjacent one end of the plasma generator, and a second inserting member adjacent an opposing end of the plasma generator, and

wherein a space between the first inserting member and the second inserting member, between the plasma generator and the insulating member, is substantially sealed by the first inserting member and the second inserting member.

5. The vapor deposition apparatus of claim **2**, wherein the inserting member has elasticity.

6. The vapor deposition apparatus of claim **2**, wherein the inserting member is an O-ring.

7. The vapor deposition apparatus of claim **1**, wherein the plasma generator is an electrode.

8. The vapor deposition apparatus of claim **1**, wherein the plasma generator has a generally column shape.

9. The vapor deposition apparatus of claim **1**, wherein the insulating member has a form of a hollow column.

10. The vapor deposition apparatus of claim **1**, wherein the insulating member comprises a quartz or ceramic material.

11. The vapor deposition apparatus of claim **1**, wherein the insulating member surrounds an entire external surface of the plasma generator.

12. The vapor deposition apparatus of claim **1**, further comprising a first injector coupled to the reaction space and configured to inject a deposition raw material onto the substrate, the deposition raw material comprising a radical form of the first raw material gas.

13. The vapor deposition apparatus of claim **12**, further comprising a connection unit between the reaction space and the first injector, the connection unit having a narrower width than the first injector.

14. The vapor deposition apparatus of claim **12**, further comprising a second injector adjacent to the first injector, the second injector being separated from the first injector.

15. The vapor deposition apparatus of claim **14**, wherein the second injector is configured to inject a second raw material or a purge gas toward a direction of the substrate for forming the deposition layer.

16. The vapor deposition apparatus of claim **12**, further comprising a second injector and a third injector adjacent to and separated from the first injector, and respectively on opposing sides of the first injector.

17. The vapor deposition apparatus of claim **16**, wherein the second injector and the third injector are respectively configured to inject one selected from the group consisting of a purge gas, a second raw material, and a third raw material, in a direction toward the substrate.

18. The vapor deposition apparatus of claim **16**, further comprising a plurality of exhausts adjacent to each of the first injector, the second injector, and the third injector.

19. The vapor deposition apparatus of claim **18**, wherein the plurality of exhausts comprise a first exhaust between the first injector and the second injector, and a second exhaust between the first injector and the third injector.

20. The vapor deposition apparatus of claim **1**, wherein the substrate and the vapor deposition apparatus are configured to move with respect to each other.

21. A vapor deposition apparatus for forming a deposition layer on a substrate, the vapor deposition apparatus comprising:

a plurality of first regions, a plurality of second regions, and a plurality of purge units,

wherein each of the plurality of first regions comprises:

a plasma generator configured to change at least a portion of a first raw material gas into a radical form;

a corresponding surface corresponding to the plasma generator;

a reaction space between the plasma generator and the corresponding surface; and

an insulating member separated from, and surrounding the plasma generator;

wherein each of the plurality of second regions is configured to inject a second raw material in a direction toward the substrate; and

wherein the purge units are configured to inject a purge gas in a direction toward the substrate.

22. The vapor deposition apparatus of claim **21**, wherein each purge unit, among the plurality of purge units, is between the first region and the second region.

23. The vapor deposition apparatus of claim **21**, further comprising a plurality of exhaust units adjacent to the first regions, the second regions, and the purge units.

24. A method of forming a deposition layer on a substrate using a vapor deposition apparatus, the method comprising:

supplying a first raw material gas from a supply unit to a reaction space;

changing at least a portion of the first raw material gas into a radical form, by generating a plasma using a plasma generator in the reaction space; and

injecting a first raw depositing material onto the substrate, the first raw depositing material comprising a radical form,

wherein the changing of at least a portion of the first raw material gas into a radical form comprises substantially preventing electrons or ions, which are generated when the plasma is generated, from accelerating and colliding with the plasma generator using an insulating member separate from and surrounding the plasma generator.

25. The method of claim **24**, wherein the substrate and the vapor deposition apparatus are configured to move with respect to each other and execute a deposition process.

26. A method of manufacturing an organic light-emitting display apparatus by using a vapor deposition apparatus, wherein the organic light-emitting display apparatus comprises a first electrode, an intermediate layer which comprises an organic light-emitting layer, a second electrode, and an encapsulation layer,

wherein forming at least one thin film of the organic light-emitting display apparatus comprises:

positioning a substrate to correspond to the vapor deposition apparatus;

supplying a first raw material gas from a supply unit of the vapor deposition apparatus to a reaction space;

changing at least a portion of the first raw material gas into a radical form, by generating a plasma using a plasma generator in the reaction space; and

injecting a first raw depositing material into the substrate, the first raw depositing material comprising a radical form,

wherein the changing at least a portion of the first raw material gas into a radical form comprises substantially preventing electrons or ions, which are generated when the plasma is generated, from accelerating and colliding with the plasma generator using an insulating member separated from and surrounding the plasma generator.

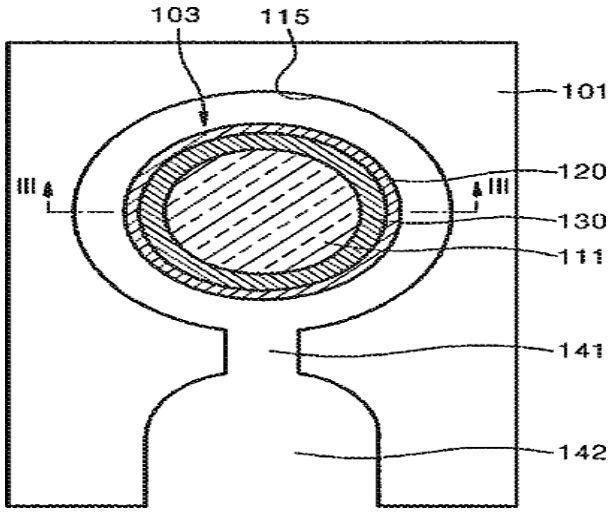
27. The method of claim **26**, wherein the forming of the thin film of the organic light-emitting display comprises forming the encapsulation layer on the second electrode.

28. The method of claim **26**, wherein the forming of the thin film of the organic light-emitting display comprises forming an insulating layer.

29. The method of claim **26**, wherein the forming of the thin film of the organic light-emitting display comprises forming a conductive layer.

* * * * *

专利名称(译)	气相沉积设备，沉积方法和通过使用其制造有机发光显示设备的方法		
公开(公告)号	US20140235003A1	公开(公告)日	2014-08-21
申请号	US13/944847	申请日	2013-07-17
[标]申请(专利权)人(译)	三星显示有限公司		
申请(专利权)人(译)	三星DISPLAY CO.，LTD.		
当前申请(专利权)人(译)	三星DISPLAY CO.，LTD.		
[标]发明人	JUNG SUK WON HUH MYUNG SOO JANG CHOEL MIN		
发明人	JUNG, SUK-WON HUH, MYUNG-SOO JANG, CHOEL-MIN		
IPC分类号	H01L27/32 C23C16/50		
CPC分类号	C23C16/50 H01L27/32 C23C16/4401 C23C16/452 C23C16/45542 C23C16/45551 H01J37/32357 H01J37/3244 H01J37/32467 H01J37/32513 H01J37/32541 H01J37/32834 H01L51/56 H05H1/2406 H05H2001/2418 H05H2001/2431 C23C16/513 H01L21/205 H01L27/3274 H01L51/0002 H01L51/0008 H01L51/5012 H01L51/524 H01L2251/56		
优先权	1020130016977 2013-02-18 KR		
其他公开文献	US9318535		
外部链接	Espacenet USPTO		

摘要(译)

本发明提供一种蒸镀装置，其包括：等离子体发生器，其构造成将第一原料气体的至少一部分变成自由基形式;对应于等离子体发生器的相应表面;等离子体发生器与相应表面之间的反应空间;绝缘构件与等离子体发生器分离并围绕等离子体发生器。