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(54) Title: DEPOSITION APPARATUS FOR DEPOSITION OF A MATERIAL ON A SUBSTRATE AND METHOD FOR DEPOSITING A MATERIAL ON A SUBSTRATE

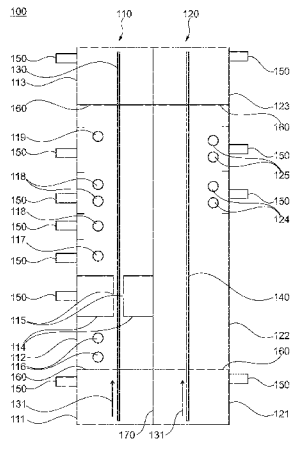


Fig. 1

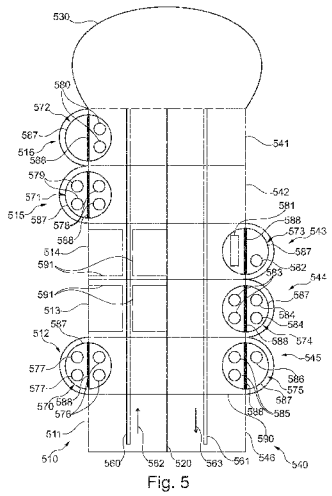


Fig. 5

(57) Abstract: A deposition apparatus (300) for deposition of a material on a substrate is provided. The deposition apparatus (300) includes two or more processing chambers including a first processing chamber (310) and a second processing chamber (320); a substrate support (330) extending at least through the first processing chamber (310) and the second processing chamber (320); and two or more deposition source assemblies including a first deposition source assembly (350) in the first processing chamber (310) and a second deposition source assembly (360) in the second processing chamber (320). Each of the two or more deposition source assemblies includes at least one deposition source support (351, 361) configured to support at least one first deposition source and at least one process device. The at least one deposition source support (351, 361) is configured to be moveable at least between a first position and a second position. In the first position, the at least one first deposition source is oriented towards the substrate support (330), and, in the second position, the at least one process device is oriented towards the substrate support (330).

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DEPOSITION APPARATUS FOR DEPOSITION OF A MATERIAL ON A SUBSTRATE AND METHOD FOR DEPOSITING A MATERIAL ON A SUBSTRATE

FIELD

[0001] Embodiments of the present disclosure relate to a deposition apparatus for deposition of a material on a substrate and to a method for depositing a material on a substrate. Embodiments of the present disclosure particularly relate to a sputtering apparatus for deposition of layer stacks on a substrate and to a method for depositing layer stacks on a substrate.

BACKGROUND

[0002] Touch panels such as touch screen panels are a particular class of electronic visual displays, which are able to detect and locate a touch within a display area. Touch panels include layer stacks or transparent bodies resulting in a functional screen (like a touch screen panel). However, an inferior sunlight readability, a colored appearance (reflectance) of the touch panel and a color change with respect to the produced picture from an underlying display, and a more or less visible pattern from the structured core layer of the functional screen (e.g. a patterned transparent conductive oxide, TCO) is often obtained.

[0003] Different layer stack concepts are used in the manufacturing of touch panels. These layer stack concepts include for example a layer stack with an antireflective coating followed by a metal layer stack such as a Black Metal stack (e.g., for Black Metal Bridges or Black Metal Meshes). The layer stack concepts also include for example a layer stack with transparent insulating layers and a patterned TCO layer, e.g. a patterned indium tin oxide (ITO) layer, such that the patterned TCO layer is invisible for a user ("invisible TCO" or "invisible (i-)ITO").

[0004] Manufacturers of touch panels have broad and changing product portfolios with the need to adapt quickly to a fast paced technological evolution. An easy and quick adaption of manufacturing equipment to different products, such as the above exemplary different layer stacks, is an aspect. As an example, in touch panel manufacturing a quick tool conversion from a layer stack with invisible TCO to a metal layer stack such as a Black Metal layer stack is beneficial. However, many of the process steps, for example in an in-line production tool, have space consuming gas separation units between adjacent process units and often separate deposition apparatuses are used for producing e.g. a layer stack with invisible TCO and a metal layer stack such as a Black Metal layer stack.

[0005] In view of the above, a deposition apparatus for deposition of a material on a substrate and a method for depositing a material on a substrate, that overcome at least some of the problems in the art are needed.

SUMMARY

[0006] In light of the above, a deposition apparatus for deposition of a material on a substrate and a method for depositing a material on a substrate are provided. Further aspects, benefits, and features of the present disclosure are apparent from the claims, the description, and the accompanying drawings.

[0007] According to an aspect of the present disclosure, a deposition apparatus for deposition of a material on a substrate is provided. The deposition apparatus includes two or more processing chambers including a first processing chamber and a second processing chamber; a substrate support extending at least through the first processing chamber and the second processing chamber; and two or more deposition source assemblies including a first deposition source assembly in the first processing chamber and a second deposition source assembly in the second processing chamber. Each of the two or more deposition source assemblies includes at least one deposition source support configured to support at least one first deposition source and at least one process device. The at least one deposition source support is configured to be moveable at least between a first position and a second position. In the first position, the at least one first deposition source is oriented towards the

substrate support, and, in the second position, the at least one process device is oriented towards the substrate support.

[0008] According to another aspect of the present disclosure, a method for depositing a material on a substrate is provided. The method includes depositing a first layer stack on a first substrate by a first deposition source assembly and a second deposition source assembly; moving at least one of the first deposition source assembly and the second deposition source assembly from a first position into a second position; and depositing a second layer stack on a second substrate.

[0009] According to still another aspect of the present disclosure, a deposition apparatus for deposition of a first layer stack on a first substrate and a second layer stack on a second substrate is provided, wherein the second layer stack is different from the first layer stack. The deposition apparatus includes two or more processing chambers including a first processing chamber and a second processing chamber; a substrate support extending at least through the first processing chamber and the second processing chamber; and two or more deposition source assemblies including a first deposition source assembly in the first processing chamber and a second deposition source assembly in the second processing chamber. Each of the two or more deposition source assemblies includes at least one deposition source support configured to support at least one first deposition source and at least one process device, wherein the at least one process device includes at least one of at least one second deposition source, a heating device and a deposition source conditioning device; and a separation wall configured for separating the at least one first deposition source from the at least one process device. The at least one deposition source support is configured to be moveable at least between a first position and a second position. In the first position, the first deposition source is oriented towards the substrate support, and, in the second position, the at least one process device is oriented towards the substrate support.

[0010] Embodiments are also directed at apparatuses for carrying out the disclosed methods and include apparatus parts for performing each described method step. These method steps may be performed by way of hardware components, a computer programmed by appropriate software, by any combination of the two or in any other manner. Furthermore, embodiments according to the disclosure are also directed at methods for

operating the described apparatus. It includes method steps for carrying out every function of the apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] So that the manner in which the above recited features of the present disclosure can be understood in detail, a more particular description of the disclosure, briefly summarized above, may be had by reference to embodiments. The accompanying drawings relate to embodiments of the disclosure and are described in the following:

FIG. 1 shows a schematic view of a deposition apparatus for deposition of a material on a substrate;

FIG. 2 shows a schematic view of another deposition apparatus for deposition of a material on a substrate;

FIG. 3 shows a schematic view of a deposition apparatus for deposition of a material on a substrate according to embodiments described herein;

FIG. 4 shows a schematic view of another deposition apparatus for deposition of a material on a substrate according to embodiments described herein;

FIG. 5 shows a schematic view of yet another deposition apparatus for deposition of a material on a substrate according to embodiments described herein; and

FIG. 6 shows a flow chart of a method for deposition of a material on a substrate according to embodiments described herein.

DETAILED DESCRIPTION OF EMBODIMENTS

[0012] Reference will now be made in detail to the various embodiments of the disclosure, one or more examples of which are illustrated in the figures. Within the following description of the drawings, the same reference numbers refer to same components. Generally, only the differences with respect to individual embodiments are described. Each example is provided by way of explanation of the disclosure and is not meant as a limitation of the disclosure. Further, features illustrated or described as part of one embodiment can be used on or in conjunction with other embodiments to yield yet a further embodiment. It is intended that the description includes such modifications and variations.

[0013] Manufacturers of touch panels have broad and changing product portfolios with the need to adapt quickly to a fast paced technological evolution. An easy and quick adaption of manufacturing equipment to different products, such as different layer stacks, is an aspect. As an example, in touch panel manufacturing a quick tool conversion from invisible ITO stacks to metal stacks such as Black Metal stacks for Black Metal Bridges or Black Metal Meshes is needed.

[0014] The present disclosure provides a deposition apparatus for deposition of a material on a substrate. The deposition apparatus includes two or more processing chambers including a first processing chamber and a second processing chamber; a substrate support extending at least through the first processing chamber and the second processing chamber; and two or more deposition source assemblies including a first deposition source assembly in the first processing chamber and a second deposition source assembly in the second processing chamber. Each of the two or more deposition source assemblies includes at least one deposition source support configured to support at least one first deposition source and at least one process device. The at least one deposition source support is configured to be moveable at least between a first position and a second position. In the first position, the at least one first deposition source is oriented towards the substrate support, and, in the second position, the at least one process device is oriented towards the substrate support.

[0015] According to some embodiments, the disclosure provides a deposition apparatus configured as a flip source type equipment configuration with deposition sources (e.g., deposition units), which allow changing the deposition source(s)/deposition material(s) (e.g., cathode(s)/cathode material(s) within a processing chamber (e.g., the deposition unit) in-situ such that one in-line system can provide for two or more layer stacks (i.e., stack concepts) with different materials with a reduced need of venting or even without the need of venting. In some implementations, e.g. for touch panels, the system can be flipped from one configuration providing for a 3 layer stack to produce ITO with pattern invisibility ("Invisible ITO") to another configuration providing a conductive antireflective coating followed by a metal stack such as a "Black Metal"-stack. Such a metal stack can be used for low-reflective, invisible "Black Metal Bridges" (OGS ("one glass solution") / TOL ("touch on lens") concept for out-cell touch screen panels (TSPs)) and contact out metal leads for on-cell type TSPs Metal Mesh based touch screen panels approaches.

[0016] The deposition source assembly (e.g., a flip unit) can provide on one side the at least one first deposition source assembly (e.g., a cathode(s) source unit) and on the other side a process device such as at least one second deposition source assembly (e.g., another cathode(s) source unit) or other functional units such as a gas separation, a heating, a conditioning or a combination thereof.

[0017] The term "substrate" as used herein shall embrace substrates, which can be used for display manufacturing, such as glass or plastic substrates. For example, substrates as described herein shall embrace substrates, which can be used for an LCD (Liquid Crystal Display), a PDP (Plasma Display Panel), and the like. Unless explicitly specified otherwise in the description, the term "substrate" is to be understood as "large area substrate" as specified herein.

[0018] According to some embodiments, large area substrates or respective carriers, wherein the carriers have one or more substrates, may have a size of at least 0.67 m². Typically, the size can be about 0.67m² (0.73x0.92m – Gen 4.5) to about 8 m², more typically about 2 m² to about 9 m² or even up to 12 m². Typically, the substrates or carriers, for which the structures and methods according to embodiments described herein are provided, are large area substrates as described herein. For instance, a large area substrate or carrier can be GEN 4.5, which corresponds to about 0.67 m² substrates (0.73x0.92m),

GEN 5, which corresponds to about 1.4 m² substrates (1.1 m x 1.3 m), GEN 7.5, which corresponds to about 4.29 m² substrates (1.95 m x 2.2 m), GEN 8.5, which corresponds to about 5.7m² substrates (2.2 m x 2.5 m), or even GEN 10, which corresponds to about 8.7 m² substrates (2.85 m × 3.05 m). Even larger generations such as GEN 11 and GEN 12 and corresponding substrate areas can similarly be implemented.

[0019] The term "substrate" as used herein shall also embrace flexible substrates such as a web or a foil.

[0020] The term "transparent" as used herein shall particularly include the capability of a structure to transmit light with relatively low scattering, so that, for example, light transmitted therethrough can be seen in a substantially clearly manner.

[0021] According to some embodiments, a layer stack is constituted by a number of layers or films formed (e.g., by deposition) one atop or over of another. In particular, embodiments herein include depositing a layer stack which may include at least one of a metal layer, a transparent insulating layer and/or a transparent conductive oxide layer such as an ITO layer. When reference is made to the term "over", i.e. one layer being over the other, it is understood that, starting from the substrate, a first layer is deposited over the substrate, and a further layer, deposited after the first layer, is thus over the first layer and over the substrate. In other words, the term "over" is used to define an order of layers, layer stacks, and/or films wherein the starting point is the substrate.

[0022] According to some embodiments, which can be combined with other embodiments described herein, the deposition apparatus is configured to deposit at least a first layer stack and a second layer stack, particularly wherein the second layer stack is different from the first layer stack. The first layer stack and the second layer stack may include different materials or material layers. In exemplary implementations, the deposition apparatus is configured to deposit the first layer stack including at least one of indium tin oxide (ITO) and Nb_yO_x, Nb_2O_5, SiO_2, TiO_2 and/or a metal, particularly Al, Mo and Cu, and/or the deposition apparatus is configured to deposit the second layer stack including at least one of $MoNbO_xN_y$, Al, AlNd and MoNb or other alloys of Mo and Al. The disclosure provides the deposition apparatus e.g. configured as one in-line system that can provide for two or more stack concepts with different materials.

[0023] Figure 1 shows a schematic view of a deposition apparatus 100 for deposition of a material on a substrate. The deposition apparatus 100 can be configured for deposition of a first layer stack including e.g. a metal layer stack such as a Black Metal stack (e.g., for Black Metal Bridges or Black Metal Meshes) and optionally an indium tin oxide (ITO) layer.

[0024] Exemplarily, in figure 1 the deposition apparatus 100 includes a first portion 110 for deposition of one or more metal layers and a second portion 120 for deposition of at least one ITO layer. The first portion 110 and the second portion 120 can be separated by a separation wall 170. The first portion 110 includes a plurality of first vacuum chambers, such as a first entry load lock chamber 111, a first processing chamber 112 and a first exit load lock chamber 113. Similarly, the second portion 120 includes a plurality of second vacuum chambers, such as a second entry load lock chamber 121, a second processing chamber 122 and a second exit load lock chamber 123. The first vacuum chambers and the second vacuum chambers can be separated from adjacent first vacuum chambers and the second vacuum chambers, respectively, by separation devices 160.

[0025] An atmosphere in one or more of the first vacuum chambers and/or in the second vacuum chambers can be individually controlled by generating a technical vacuum, for example with vacuum pumps 150 connected to at least some of the first vacuum chambers and the second vacuum chambers. As an example, the atmosphere can be individually controlled by generating a technical vacuum and/or by inserting process gases in deposition regions in the first processing chamber 112 and/or the second processing chamber 122.

[0026] A first substrate support 130, e.g. configured for transporting or conveying the substrate or a first carrier having the substrate disposed thereon, extends through the first portion 110, and a second substrate support 140, e.g. configured for transporting or conveying the substrate or a second carrier having the substrate disposed thereon, extends through the second portion 120. A transport direction of the substrate (not shown) through the first portion 110 and the second portion 120 is indicated with arrows 131.

[0027] At least one first deposition source 116, at least one second deposition source 117, at least one third deposition source 118 and at least one fourth deposition source 119

can be provided in the first processing chamber 112. The at least one first deposition source 116, the at least one second deposition source 117, the at least one third deposition source 118 and the at least one fourth deposition source 119 can be configured for deposition of the metal layer stack, e.g. including a Black Metal Bridge or a Black Metal Mesh. As an example, the at least one first deposition source 116 can include a MF twin MoNb rotary cathode, the at least one second deposition source 117 can include a DC MoNb rotary cathode, the at least one third deposition source 118 can include a DC Al rotary cathode, and the at least one fourth deposition source 119 can include a DC MoNb rotary cathode.

[0028] A gas separation shielding 114 can be provided between e.g. the at least on first deposition source 116 and the at least one second deposition source 117. The gas separation shielding 114 can have at least one opening 115 for allowing a pumping therethrough.

[0029] At least one fifth deposition source 124 and at least one sixth deposition source 125 are provided in the second processing chamber 122. The at least one fifth deposition source 124 and the at least one sixth deposition source 125 can be configured for deposition of the at least one ITO layer. At least one of the at least one fifth deposition source 124 and the at least one sixth deposition source 125 can include a DC ITO rotary cathode.

[0030] The deposition apparatus 100 can be configured for deposition of the metal layer stack including e.g. $MoNbO_xN_y$ and Al, and can be configured for deposition of the at least one ITO layer. For depositing the metal layer stack, the substrate to be processed can be inserted into the first processing chamber 112 via the first entry load lock chamber 111. The metal layers including e.g. $MoNbO_xN_y$ and Al are deposited on the substrate, and the substrate exits the deposition apparatus 100 through the first exit load lock chamber 113. Subsequently, for depositing the at least one ITO layer, the substrate having the metal layers including e.g. $MoNbO_xN_y$ and Al processed thereon is inserted into the second processing chamber 122 via the second entry load lock chamber 121. The at least one ITO layer is deposited over the substrate, and the substrate having the metal layer stack including $MoNbO_xN_y$ and Al and the at least one ITO layer processed thereon exits the deposition apparatus 100 through the second exit load lock chamber 123.

[0031] Figure 2 shows a schematic view of a deposition apparatus 200 for deposition of a second layer stack, e.g. including one or more transparent insulating layer and at least one (patterned) TCO layer, e.g. a indium tin oxide (ITO) layer, such that the (patterned) TCO layer is invisible for a user ("invisible TCO" or "invisible (i-)ITO").

[0032] Exemplarily, in figure 2 the deposition apparatus 200 includes a first portion 210 for deposition of the one or more transparent insulating layers and a second portion 220 for deposition of the at least one ITO layer. The first portion 210 and the second portion 220 can be separated by a separation wall 270. The first portion 210 includes a plurality of first vacuum chambers, such as an entry load lock chamber 211 and a first processing chamber 212. The second portion 220 includes a plurality of second vacuum chambers, such as a second processing chamber 222 and an exit load lock chamber 221. The first vacuum chambers and the second vacuum chambers can be separated from adjacent first vacuum chambers and second vacuum chambers, respectively, by separation devices 260.

[0033] The deposition apparatus 200 may include one or more further vacuum chambers such as a transfer chamber 240. The transfer chamber 240 may connect the first portion 210 and the second portion 220. The transfer chamber 240 may include substrate transport means configured for transferring or transporting the substrate from the first portion 210, particularly from the first processing chamber 212, into the second portion 220, particularly the second processing chamber 222.

[0034] An atmosphere in at least one of the first vacuum chambers, the second vacuum chambers and the further vacuum chambers such as the transfer chamber 240 can be individually controlled by generating a technical vacuum, for example with vacuum pumps 250 connected to one or more of the first vacuum chambers, the second vacuum chambers and the further vacuum chambers such as the transfer chamber 240. As an example, the atmosphere can be individually controlled by generating a technical vacuum and/or by inserting process gases in deposition regions in the first processing chamber 212 and/or in the second processing chamber 222.

[0035] A first substrate support 230, e.g. configured for transporting or conveying the substrate or a first carrier on which the substrate is disposed, extends through the first portion 210. A second substrate support 280, e.g. configured for transporting or conveying

the substrate or a second carrier on which the substrate is disposed, extends through the second portion 220. A transport direction of the substrate through the first portion 210 is indicated with arrow 231 and a transport direction of the substrate through the second portion 220 is indicated with arrow 232. In the transfer chamber 240, the substrate may be transferred from the first substrate support 230 to the second substrate support 280.

[0036] At least one first deposition source 216, at least one second deposition source 217 and at least one third deposition source 218 can be provided in the first processing chamber 212. The at least one first deposition source 216, the at least one second deposition source 217 and the at least one third deposition source 218 can be configured for deposition of the one or more transparent insulating layers. As an example, the at least one first deposition source 216 can include a MF Nb_2O_5 rotary cathode pair, the at least one second deposition source 217 can include a MF SiO_2 rotary cathode pair, and the at least one third deposition source 218 can also include a MF SiO_2 rotary cathode pair.

[0037] A gas separation shielding 214 can be provided between e.g. the at least on first deposition source 216 and the at least one second deposition source 217. The gas separation shielding 214 can have at least one opening 215 for allowing a pumping therethrough.

[0038] At least one fourth deposition source 224 and at least one fifth deposition source 225 is provided in the second processing chamber 222. The at least one fourth deposition source 224 and the at least one fifth deposition source 225 can be configured for deposition of the at least one ITO layer. At least one of the at least one fourth deposition source 224 and the at least one fifth deposition source 225 can be configured for deposition of ITO, and may e.g. include a DC ITO rotary cathode.

[0039] The deposition apparatus 200 can be configured for deposition of the second layer stack including the transparent insulating layers such as Nb_2O_5 and SiO_2 layers, and the at least one ITO layer. For depositing the second layer stack, the substrate to be processed can be inserted into the first processing chamber 212 via the entry load lock chamber 211. The transparent insulating layers such as Nb_2O_5 and SiO_2 layers are deposited on the substrate, and the substrate enters the transfer chamber 240 where it is transferred from the first substrate support 230 to the second substrate support 280. Subsequently, for

depositing the at least one ITO layer, the substrate having the transparent insulating layers such as Nb_2O_5 and SiO_2 layers processed thereon is inserted into the second processing chamber 222 from the transfer chamber 240. The at least one ITO layer is deposited over the substrate, and the substrate having the layer stack including the transparent insulating layers such as Nb_2O_5 and SiO_2 layers and the at least one ITO layer processed thereon exits the deposition apparatus 200 through the exit load lock chamber 223.

[0040] Figure 3 shows a schematic view of a deposition apparatus 300 for deposition of a material on a substrate 340 according to embodiments described herein. According to some embodiments, the deposition apparatus 300 is configured for depositing two or more different layer stacks, e.g., a first layer stack and a second layer stack with different materials.

[0041] The deposition apparatus 300 includes two or more processing chambers including a first processing chamber 310 and a second processing chamber 320; a substrate support 330 extending at least through the first processing chamber 310 and the second processing chamber 320; and two or more deposition source assemblies including a first deposition source assembly 350 in the first processing chamber 310 and a second deposition source assembly 360 in the second processing chamber 320. Each of the two or more deposition source assemblies includes at least one deposition source support configured to support at least one first deposition source and at least one process device. The at least one deposition source support is configured to be moveable at least between a first position and a second position. In the first position, the at least one first deposition source is oriented towards the substrate support 330, and, in the second position, the at least one process device is oriented towards the substrate support 330. The two or more processing chambers can be vacuum processing chambers.

[0042] According to some implementations, the substrate support 330 may include rollers to transport the substrate 340 or a carrier having the substrate 340 disposed thereon into, through and out of the first processing chamber 310 and/or the second processing chamber 320. As an example, the first processing chamber 310 and the second processing chamber 320 can be separated by a separation device 370. The separation device 370 can include a valve 371, e.g. having a valve housing and a valve unit. The separation device 370, and particularly the valve 371, may be configured as a load lock between the first

processing chamber 310 and the second processing chamber 320. The substrate support 330 may be configured for transporting the substrate 340 from the first processing chamber 310 into the second processing chamber 320 and/or for transporting the substrate 340 from the second processing chamber 320 into the first processing chamber 310 through the separation device 370.

[0043] In some implementations, the at least one process device includes at least one of at least one second deposition source, a heating device and a deposition source conditioning device. In figure 3, the first deposition source assembly 350 includes the deposition source support, e.g., a first deposition source support 351, at least one first deposition source, such as a first deposition source pair 352, and at least one process device, such as a second deposition source pair 353. The second deposition source assembly 360 includes the deposition source support, e.g., a second deposition source support 361, at least one first deposition source, such as a first single deposition source 362, and at least one process device, such as a third deposition source pair 363.

[0044] According to some embodiments, which can be combined with other embodiments described herein, the at least one deposition source support is configured to support the least one first deposition source with a first deposition material and the at least one process device including the at least one second deposition source with a second deposition material, wherein the first deposition material and the second deposition material are different.

[0045] In figure 3 the first deposing source support 351 of the first deposition source assembly 350 is in the second position and the second deposition source pair 353 is oriented towards the substrate 340 or substrate support 330. The second deposing source support 361 of the second deposition source assembly 360 is in the second position and the third deposition source pair 363 is oriented towards the substrate support 330. A second deposition material provided by the second deposition source pair 353 of the first deposition source assembly 350 can be deposited on the substrate 340 and a first deposition material provided by the first deposition source pair 352 is not deposited on the substrate 340. A fourth deposition material provided by the third deposition source pair 363 of the second deposition source assembly 360 can be deposited on the substrate 340 and a third

deposition material provided by the first single deposition source 362 is not deposited on the substrate 340.

[0046] According to some embodiments, which can be combined with other embodiments described herein, the at least one deposition source support is configured to be rotatable about a rotation axis of the at least one deposition source support, particularly wherein the rotation axis is substantially perpendicular to a transport direction of the substrate. The transport direction of the substrate, e.g. the substrate 340, is indicated with reference numeral 341. Changing a position of the at least one deposition source support from the first position into the second position or from the second position into the first position may include rotating the at least one deposition source support about 180 degrees.

[0047] As an example, the first deposing source support 351 of the first deposition source assembly 350 is configured to be rotatable about a first rotation axis 355. Changing a position of the first deposition source support 351 from the first position into the second position or from the second position into the first position may include rotating the first deposition source support 351 about 180 degrees. The second deposing source support 361 of the second deposition source assembly 360 is configured to be rotatable about a second rotation axis 365. Changing a position of the second deposition source support 361 from the first position into the second position or from the second position into the first position may include rotating the second deposition source support 361 about 180 degrees.

[0048] According to some embodiments, which can be combined with other embodiments described herein, the deposition apparatus provides two or more configurations of the orientations of the respective deposition source supports of the two or more deposition source assemblies. The deposition apparatus providing the two or more configurations allows changing the deposition source(s)/deposition material(s) (e.g., cathode(s)/cathode material(s) within a processing chamber (e.g., a deposition unit) in-situ such that one in-line system can provide for two or more layer stacks (i.e., stack concepts) with different materials with a reduced need of venting or even without the need of venting. The present disclosure is not limited to the provision of two configurations. Further configurations for deposition one or more additional layer stacks or layer stack concepts can be provided.

[0049] According to some embodiments, which can be combined with other embodiments described herein, the deposition apparatus is configured to deposit at least a first layer stack and a second layer stack, particularly wherein the second layer stack is different from the first layer stack. The deposition apparatus can be configured to deposit the first layer stack in a first configuration of the two or more deposition source assemblies, and may by configured to deposit the second layer stack in a second configuration of the two or more deposition source assemblies. The first configuration can include first orientations of the respective deposition source supports of the two or more deposition source assemblies. The second configuration can include second orientations of the respective deposition source supports of the two or more deposition source assemblies. In the following, examples for the first configuration and the second configuration are described. As a first example, the at least one deposition source support of the first deposition source assembly can be in the first position and the at least one deposition source support of the second deposition source assembly can be in the first position. As a second example, the at least one deposition source support of the first deposition source assembly can be in the second position and the at least one deposition source support of the second deposition source assembly can be in the second position. As a third example, the at least one deposition source support of the first deposition source assembly can be in the first position and the at least one deposition source support of the second deposition source assembly can be in the second position. As a fourth example, the at least one deposition source support of the first deposition source assembly can be in the second position and the at least one deposition source support of the second deposition source assembly can be in the first position.

[0050] According to some embodiments, which can be combined with other embodiments described herein at least one deposition source assembly of the two or more deposition source assemblies includes a separation wall. In some implementations, at least one of the two or more deposition source assemblies includes two or more separation walls. The separation wall may include a first separation wall 354 of the first deposition source assembly 350 and a second separation wall 364 of the second deposition source assembly 360.

[0051] In some implementations, the separation wall is configured for separating the at least one first deposition source from the at least one process device of the at least one deposition source assembly. According to embodiments, the separation wall is provided between the at least one first deposition source and the at least one process device of the at least one deposition source assembly. As an example, the first separation wall 354 of the first deposition source assembly 350 may be provided between the first deposition source pair 352 and the second deposition source pair 353. The second separation wall 364 can be provided between the first single deposition source 362 and the third deposition source pair 363.

[0052] According to some embodiments, which can be combined with other embodiments described herein, the separation wall is configured to separate at least one processing chamber of the two or more processing chambers in which the at least one deposition source assembly is provided into a first chamber portion and a second chamber portion. As an example, the first separation wall 354 is configured to separate the first processing chamber 310 into a first chamber portion 311 of the first processing chamber 310 and a second chamber portion 312 of the first processing chamber 310. The second separation wall 364 can be configured to separate the second processing chamber 320 into a first chamber portion 321 of the second processing chamber 320 and a second chamber portion 322 of the second processing chamber 320.

[0053] In some implementations, the first chamber portion (e.g., the first chamber portion 311 of the first processing chamber 310 and the first chamber portion 321 of the second processing chamber 320) and the second chamber portion (e.g., the second chamber portion 312 of the first processing chamber 310 and the second chamber portion 322 of the second processing chamber 320) are portions with different partial pressures and/or kind of gases such as process gases. According to some embodiments, the first chamber portion includes the substrate support, and the second chamber portion is a storage portion e.g. for storing the at least one first deposition source or the at least one process device when the at least one first deposition source or the at least one process device are not oriented towards the substrate support. As an example, in the first position, the at least one first deposition source is positioned in the first chamber portion and the at least one process device is in the second chamber portion, and, in the second position, the at least one process device is the

first chamber portion and the at least one first deposition source is positioned in the second chamber portion. The second chamber portion may be a storage portion.

[0054] According to some embodiments, which can be combined with other embodiments described herein, the second chamber portion can have a vacuum lock or a door. The vacuum lock or door can be opened e.g. for maintenance, repair or exchange of the at least one first deposition source or the at least one process device positioned in the second processing chamber. In some implementations, opening the vacuum lock or door for maintenance, repair or exchange of the at least one first deposition source or the at least one process device can be done during a deposition process, since the at least one first deposition source or the at least one process device positioned in the second chamber portion is inactive or not in use, while the at least one process device or the at least one first deposition source positioned in the first chamber portion can be operated. This reduces a down time of the deposition apparatus for maintenance, repair or exchange e.g. of the at least one first deposition source or the at least one process device.

[0055] In some implementations, the two or more deposition source assemblies are configured for flipping the deposition sources such as cathode(s) and for easy installation (e.g. on tracks for removing and re-positioning doors at the deposition apparatus). Exemplarily, the two or more deposition source assemblies are configured for flipping the deposition sources such as cathode(s) within a designated processing chamber, while maintaining simultaneously the capability to remove the currently not used deposition sources with a reduced need of venting or even without the need of venting the deposition apparatus or the processing chamber of the deposition apparatus (additional vacuum locks between deposition sources or process devices in the second chamber portion (e.g., external/additional cathode(s)) and deposition sources or process devices in the first chamber portion (e.g., internal cathode(s)) can be provided in the deposition apparatus.

[0056] According to some embodiments, which can be combined with other embodiments described herein, the separation wall is configured to hermetically seal the first chamber portion from the second chamber portion. In some embodiments, the separation wall is configured as a gas separation shielding. The first chamber portion and the second chamber portion may be portions with different partial pressures and/or kind of gases such as process gases. The process gases can include inert gases such as argon and/or

reactive gases such as oxygen, nitrogen, Hydrogen (H2) and ammonia (NH3), Ozone (O3), activated gases or the like.

[0057] The term "hermetically" as used herein refers to a substantially airtight sealing. The sealing may be impervious to gases such as the process gases. As an example, the first separation wall 354 is configured to hermetically seal the first chamber portion 311 of the first processing chamber 310 from the second chamber portion 312 of the first processing chamber 310. The second separation wall 364 can be configured to hermetically seal the first chamber portion 321 of the second processing chamber 320 from the second chamber portion 322 of the second processing chamber 320.

[0058] Figure 4 shows a schematic view of another deposition apparatus 400 for deposition of a material on a substrate 340 according to embodiments described herein. According to some embodiments, the deposition apparatus 400 is configured for depositing two or more different layer stacks, e.g., a first layer stack and a second layer stack with different materials.

[0059] The difference between the deposition apparatus 300 of figure 3 and the deposition apparatus 400 of figure 4 lies in the configuration of the first deposition source assembly in the first processing chamber and the second deposition source assembly in the second processing chamber. A description of the features described above with reference to figure 3 also applies to the corresponding features of the embodiment shown in figure 4 and is not repeated.

[0060] In some implementations, the at least one process device includes at least one of at least one second deposition source, a heating device and a deposition source conditioning device. In figure 4, the first deposition source assembly 450 includes the deposition source support, e.g., the first deposition source support 351, at least one first deposition source, such as a first single deposition source 452, and at least one process device, such as a first deposition source pair 453. The second deposition source assembly 460 includes the deposition source support, e.g., the second deposition source support 361, at least one first deposition source, such as a second single deposition source 462, and at least one process device, such as a heating device and/or a deposition source conditioning device.

[0061] Although in figures 3 and 4 a first processing chamber and a second processing chamber are shown, the present disclosure is not limited to the provision of two processing chambers. According to some embodiments, which can be combined with other embodiments described herein, the two or more processing chambers include one or more further processing chambers, wherein at least one further deposition source assembly is provided in at least one of the one or more further processing chambers. As an example, any number of processing chambers can be provided, for instance at least 3, and specifically at least 10 processing chambers.

[0062] According to some embodiments, which can be combined with other embodiments described herein, the deposition apparatus further includes a controller configured for controlling a movement or rotation of the at least one deposition source support between the first position and the second position. When the apparatus provides the two or more configurations of the orientations of the respective deposition source supports of the two or more deposition source assemblies, the controller can be configured to chamber between the two or more configurations. As an example, the controller can be configured to change between the first configuration for depositing the first layer stack the second configuration for depositing the second layer stack. The present disclosure is not limited to the provision of two configurations. Further configurations for deposition one or more additional layer stacks or layer stack concepts can be provided.

[0063] The deposition apparatus providing the two or more configurations allow changing the deposition source(s)/deposition material(s) (e.g., cathode(s)/cathode material(s) within a processing chamber (e.g., a deposition unit) in-situ such that one in-line system can provide for two or more layer stacks (i.e., stack concepts) with different materials with a reduced need of venting or even without the need of venting.

[0064] Figure 5 shows a schematic view of still another deposition apparatus 500 for deposition of a material on a substrate according to embodiments described herein. According to some embodiments, the deposition apparatus 500 is configured for depositing two or more different layer stacks, e.g., a first layer stack and a second layer stack with different materials.

[0065] In figure 5, the deposition apparatus 500 is in a first configuration for deposition of a first layer stack being e.g. a layer stack with one or more transparent insulating layers and at least one transparent conductive oxide layer (TCO) layer, e.g. an indium tin oxide (ITO) layer (e.g., "invisible ITO"). According to some embodiments, the at least one TCO layer can be a structured TCO layer and can be provided by e.g. depositing a TCO layer and patterning the TCO layer in order to provide the structured TCO layer. Alternatively, a mask and/or a photoresist can be provided to deposit the structured TCO layer.

[0066] According to some embodiments, which can be combined with other embodiments described herein, the at least one TCO layer can include at least one of an indium tin oxide (ITO) layer, a doped ITO layer, impurity-doped ZnO, In_2O_3, SnO_2 and CdO, ITO (In2O3:Sn), AZO (ZnO:Al), IZO (ZnO: In), GZO (ZnO:Ga), or multi-component oxides including or consisting of combinations of ZnO, In_2O_3, SnZnO and SnO_2, or combinations thereof. In the following, reference is made to ITO as an example for the at least one TCO layer.

[0067] Exemplarily, in figure 5 the deposition apparatus 500 includes a first portion 510 for deposition of the one or more transparent insulating layers of the first layer stack and a second portion 540 for deposition of the at least one ITO layer. The first portion 510 and the second portion 540 can be separated by a separation wall 520. The first portion 510 includes a plurality of first vacuum chambers and the second portion 540 includes a plurality of second vacuum chambers. According to some implementations, the first vacuum chambers and the second vacuum chambers can be separated from adjacent first vacuum chambers and second vacuum chambers, respectively, by separation devices 590. As an example, the separation device 590 can include a valve having a valve housing and a valve unit. The separation device 590 may be configured as a load lock between adjacent first vacuum chambers and adjacent second vacuum chambers.

[0068] According to some embodiments, which can be combined with other embodiments described herein, the first vacuum chambers and the second vacuum chambers may be chambers selected from the group consisting of: a buffer chamber, a heating chamber, a transfer chamber, a cycle-time-adjusting chamber, a deposition chamber, a processing chamber or the like. According to embodiments, which can be combined with other embodiments described herein, a "processing chamber" may be

understood as a chamber in which a processing device for processing a substrate is arranged. The processing device may be understood as any device used for processing a substrate. For example, the processing device may include a deposition source for depositing a layer onto the substrate. Accordingly, the vacuum chamber or processing chamber including the e.g. a deposition source assembly may also be referred to as a deposition chamber. The processing chamber may be a chemical vapor deposition (CVD) chamber or a physical vapor deposition (PVD) chamber. According to some embodiments, which can be combined with other embodiments described herein, the two or more processing chambers can be vacuum processing chambers.

[0069] At least some of the first vacuum chambers and the second vacuum chambers can be configured as processing chambers. As an example, at least some of the first vacuum chambers and the second vacuum chambers configured as processing chambers can each include at least one deposition source assembly. The at least one deposition source assembly can include at least one deposition source, such as a first deposition source and/or a second deposition source. The deposition sources can for example be rotatable cathodes having targets of the material to be deposited on the substrate. The cathodes can be rotatable cathodes with a magnetron therein. As an example, magnetron sputtering can be conducted for depositing of the layers of the layer stacks, e.g. the first layer stack and the second layer stack. As an example, the cathodes are connected to an AC power supply (not shown), such that the cathodes can be biased in an alternating manner.

[0070] As used herein, "magnetron sputtering" refers to sputtering performed using a magnet assembly, that is, a unit capable of a generating a magnetic field. As an example, such a magnet assembly consists of a permanent magnet. This permanent magnet can be arranged within a rotatable target or coupled to a planar target in a manner such that the free electrons are trapped within the generated magnetic field generated below the rotatable target surface. Such a magnet assembly may also be arranged coupled to a planar cathode.

[0071] Magnetron sputtering can be realized by a double magnetron cathode, i.e. a pair of the deposition sources, such as, but not limited to, a TwinMagTM cathode assembly. Particularly, for MF sputtering e.g. from a silicon target, target assemblies including double cathodes can be applied. According to some embodiments, the deposition sources

in a processing chamber may be interchangeable. Accordingly, the deposition sources or targets are changed after the material has been consumed.

[0072] According to some embodiments, layers such as transparent insulating layers can be deposited by sputtering, for example magnetron sputtering, of rotatable cathodes having an AC power supply. As an example, MF sputtering can be applied for depositing the transparent insulating layers. According to some embodiments, sputtering from a silicon target, e.g. a sprayed silicon target, is conducted by MF sputtering, that is middle frequency sputtering. According to embodiments herein, middle frequency is a frequency in the range 5 kHz to 100 kHz, for example, 10 kHz to 50 kHz.

[0073] Sputtering from a target for a transparent conductive oxide film such as ITO can be conducted as DC sputtering. The respective deposition sources are connected to a DC power supply (not shown) together with anodes (not shown) collecting electrons during sputtering. According to embodiments, which can be combined with other embodiments described herein, the transparent conductive oxide layers, for example, the ITO layers, can be sputtered by DC sputtering.

[0074] According to some embodiments, the first vacuum chambers of the first portion 510 can include an entry load lock chamber 511, a first processing chamber 512, a second processing chamber 513, a third processing chamber 514, a fourth processing chamber 515, and a fifth processing chamber 516. According to some embodiments, the second vacuum chambers of the second portion 540 can include a sixth processing chamber 541, a seventh processing chamber 542, an eighth processing chamber 543, a ninth processing chamber 544, a tenth processing chamber 545, and an exit load lock chamber 546.

[0075] The deposition apparatus 500 may include further vacuum chambers such as a transfer chamber 530 connecting the first portion 510 and the second portion 540. The transfer chamber 530 may include substrate transport means configured for transferring or transporting the substrate from the first portion 510, particularly from the fifth processing chamber 516, into the second portion 540, and particularly into the sixth processing chamber 541. The substrate transport means may include means for turning or rotating the substrate.

[0076] An atmosphere in one or more of the first vacuum chambers, the second vacuum chambers and/or the further vacuum chambers such as the transfer chamber 530 can be individually controlled by generating a technical vacuum, for example with vacuum pumps (not shown) connected to one or more of the first vacuum chambers, the second vacuum chambers and the further vacuum chambers such as the transfer chamber 530. As an example, the atmosphere can be individually controlled by generating a technical vacuum inside at least one of the entry load lock chamber 511, the processing chambers 512-516 and 541-545, the further vacuum chambers such as the transfer chamber 530, and the exit load lock chamber 546, and/or by inserting process gases e.g. in deposition regions of at least one of the processing chambers 512-516 and 541-545. The process gas can include inert gases such as argon and/or reactive gases such as oxygen, nitrogen, Hydrogen (H2) and ammonia (NH3), Ozone (O3), activated gases or the like.

[0077] A first substrate support 560, e.g. configured for supporting and transporting or conveying the substrate or a first carrier having the substrate disposed thereon, extends through the first portion 510, and a second substrate support 561, e.g. configured for supporting and transporting or conveying the substrate or a second carrier having the substrate disposed thereon, extends through the second portion 540. A transport direction of the substrate (not shown) through the first portion 510 is indicated with arrow 562 and a transport direction of the substrate (not shown) through the second portion 540 is indicated with arrow 563. In the transfer chamber 530, the substrate may be transferred from the first substrate support 560 to the second substrate support 561. The first substrate support 560 and the second substrate support 561 can be connected in the transfer chamber 530, e.g. by the substrate transport means.

[0078] In the first portion 510, at least one first deposition source assembly 570 can be provided in the first processing chamber 512. The first deposition source assembly 570 can be configured as any one of the deposition source assemblies described above with reference to figures 3 and 4. The first deposition source assembly 570 can include a deposition source support 587, a separation wall 588, a NbOx deposition source pair 576 and a first MoNb deposition source pair 577. The NbOx deposition source pair 576 is oriented towards the first substrate support 560 for deposition e.g. of a Nb_2O_5 layer over

the substrate, and the first MoNb deposition source pair 577 is in an inactive or stored position, e.g., in the second chamber portion of the first processing chamber 512.

[0079] At least one second deposition source assembly 571 can be provided in the fourth processing chamber 515. The second deposition source assembly 571 can be configured as any one of the deposition source assemblies described above with reference to figures 3 and 4. The second deposition source assembly 571 can include the deposition source support 587, the separation wall 588, a first Si deposition source pair 578 and a second MoNb deposition source pair 579. The first Si deposition source pair 578 is oriented towards the first substrate support 560 for deposition e.g. of a SiO_2 layer over the substrate, and the second MoNb deposition source pair 579 is in an inactive or stored position, e.g., in the second chamber portion of the fourth processing chamber 515.

[0080] At least one third deposition source assembly 572 can be provided in the fifth processing chamber 516. The third deposition source assembly 572 can be configured as any one of the deposition source assemblies described above with reference to figures 3 and 4. The third deposition source assembly 572 can include the deposition source support 587, the separation wall 588, and a second Si deposition source pair 580. The second Si deposition source pair 580 is oriented towards the first substrate support 560 for deposition e.g. of a SiO_2 layer over the substrate.

[0081] In the first portion 510, the second processing chamber 513 and the third processing chamber 514 may each have a gas separation shielding. The gas separation shielding may have a slit opening for allowing a passage of the substrate therethrough.

[0082] In the second portion 540, at least one fourth deposition source assembly 573 can be provided in the eighth processing chamber 543. The fourth deposition source assembly 573 can be configured as any one of the deposition source assemblies described above with reference to figures 3 and 4. The fourth deposition source assembly 573 can include the deposition source support 587, the separation wall 588, a process device 581 such as a heating device and/or a deposition source conditioning device, and an Al single deposition source 582. The process device 581 is oriented towards the second substrate support 561 e.g. for heating the substrate and/or layers deposited on the substrate, and the Al single

deposition source 582 is in an inactive or stored position, e.g., in the second chamber portion of the eighth processing chamber 543.

[0083] At least one fifth deposition source assembly 574 can be provided in the ninth processing chamber 544. The fifth deposition source assembly 574 can be configured as any one of the deposition source assemblies described above with reference to figures 3 and 4. The fifth deposition source assembly 574 can include the deposition source support 587, the separation wall 588, a first ITO deposition source pair 583, and an Al deposition source pair 584. The first ITO deposition source pair 583 is oriented towards the second substrate support 561 e.g. for depositing an ITO layer over the substrate, and the Al deposition source pair 584 is in an inactive or stored position, e.g., in the second chamber portion of the ninth processing chamber 544.

[0084] At least one sixth deposition source assembly 575 can be provided in the tenth processing chamber 545. The sixth deposition source assembly 575 can be configured as any one of the deposition source assemblies described above with reference to figures 3 and 4. The sixth deposition source assembly 575 can include the deposition source support 587, the separation wall 588, a second ITO deposition source pair 585, and a MoNb or Mo single deposition source 586. The second ITO deposition source pair 585 is oriented towards the second substrate support 561 e.g. for depositing an ITO layer over the substrate, and the MoNb or Mo single deposition source 586 is in an inactive or stored position, e.g., in the second chamber portion of the tenth processing chamber 545.

[0085] In this example the sixth processing chamber 541 and the seventh processing chamber 542 do each not include a deposition source assembly. However, the present disclosure is not limited thereto and further deposition sources assemblies could be provided in the sixth processing chamber 541 and the seventh processing chamber 542 in order to realize further or different layer stack concepts.

[0086] In some implementations, at least one pressure sensor (not shown) can be provided in at least one of the processing chambers 512-516 and 541-545. The at least one pressure sensor may be configured to measure a (partial) pressure of the process gas. The at least one pressure sensor may particularly be a oxygen pressure sensors or a nitrogen pressure sensor. Some of the layers as described herein can be oxide-layers, nitrite-layers,

or oxinitride-layers, and can be deposited by a reactive deposition process where the target material reacts with oxygen and/or nitrogen after the material has been released from the target. By providing the pressure sensors, an atmosphere with an appropriate processing gas and/or the appropriate degree of technical vacuum can be provided in the respective processing chambers, and particularly in the deposition areas of the respective processing chambers.

[0087] According to some embodiments, the process gases can include inert gases such as argon and/or reactive gases such as oxygen, nitrogen, Hydrogen (H2) and ammonia (NH3), Ozone (O3), activated gases or the like.

[0088] The deposition apparatus 500 with the first configuration shown in figure 5 can be configured for deposition of the first layer stack including the transparent insulating layers such as Nb_2O_5 and SiO_2 layers, and the at least one ITO layer. For depositing the first layer stack, the substrate to be processed can be inserted into the entry load lock chamber 511 and can be transported through the processing chambers 512-516 to deposit the transparent insulating layers such as Nb_2O_5 and SiO_2 layers over the substrate. Afterwards, the substrate enters the transfer chamber 530 where it is transferred from the first substrate support 560 to the second substrate support 561. Subsequently, for depositing the at least one ITO layer, the substrate having the transparent insulating layers such as Nb_2O_5 and SiO_2 layers processed thereon is inserted into the second portion 540, particularly the sixth processing chamber 541. The substrate is transported through the processing chambers 541-545 to deposit the at least one ITO layer (and optionally at least one metal layer). The substrate having the first layer stack including the transparent insulating layers such as Nb_2O_5 and SiO_2 layers, the at least one ITO layer and optionally the at least one metal layer processed thereon exits the deposition apparatus 500 through the exit load lock chamber 546.

[0089] According to some embodiments, the first configuration for depositing the first layer stack as described above can be changed into the second configuration depositing the second layer stack e.g. by moving or rotating one or more of the deposition source supports of the two or more deposition source assemblies. In the example of figure 5, in order to change from the first configuration to the second configuration, the deposition source supports of each of the first to sixth deposition source assemblies can be rotated about 180

degrees. The deposition apparatus 500 with the second configuration can be configured for deposition of the second layer stack including a metal layer stack such as e.g. a Black Metal stack (e.g., for Black Metal Bridges or Black Metal Meshes) and optionally at least one TCO layer such as an indium tin oxide (ITO) layer.

[0090] For depositing the second layer stack, the substrate to be processed can be inserted into the entry load lock chamber 511 and can be transported through the processing chambers 512-516 to deposit at least one first metal layer of the metal layer stack, such as at least one $MoNbO_xN_y$ layer, on the substrate. Afterwards, the substrate enters the transfer chamber 530 where it is transferred from the first substrate support 560 to the second substrate support 561. Subsequently, the substrate having the at least one first metal layer processed thereon is inserted into the second portion 540, particularly the sixth processing chamber 541. The substrate is transported through the processing chambers 541-547 to deposit at least one second metal layer of the metal layer stack, such as at least one Al layer and/or at least one AlNd layer, and at least one third metal layer of the metal layer stack, such as a Mo or MoNb layer. The substrate having the second layer stack processed thereon exits the deposition apparatus 500 through the exit load lock chamber 546.

[0091] According to still another aspect of the present disclosure, a deposition apparatus for deposition of a first layer stack on a first substrate and a second layer stack on a second substrate is provided, wherein the second layer stack is different from the first layer stack. The deposition apparatus includes two or more processing chambers including a first processing chamber and a second processing chamber; a substrate support extending at least through the first processing chamber and the second processing chamber; and two or more deposition source assemblies including a first deposition source assembly in the first processing chamber and a second deposition source assembly in the second processing chamber. Each of the two or more deposition source assemblies includes at least one deposition source support configured to support at least one first deposition source and at least one process device, wherein the at least one process device includes at least one of at least one second deposition source, a heating device and a deposition source conditioning device; and a separation wall configured for separating the at least one first deposition source from the at least one process device. The at least one deposition source support is

configured to be moveable at least between a first position and a second position. In the first position, the first deposition source is oriented towards the substrate support, and, in the second position, the at least one process device is oriented towards the substrate support.

[0092] Figure 6 shows a flow chart of a method 600 for deposition of a material on a substrate according to embodiments described herein.

[0093] According to some embodiments, the method 600 includes depositing a first layer stack on a first substrate by a first deposition source assembly and a second deposition source assembly (block 610); moving at least one of the first deposition source assembly and the second deposition source assembly from a first position into a second position (block 620); and depositing a second layer stack on a second substrate (block 630). The first layer stack and the second layer stack may at least in part include different materials.

[0094] According to some embodiments, each of the first deposition source assembly and the second deposition source assembly includes at least one first deposition source and at least one process device, and wherein, in the first position, the first deposition source is oriented towards the substrate, and, in the second position, the at least one process device is oriented towards the substrate.

[0095] According to embodiments described herein, the method for depositing a material on a substrate can be conducted by means of computer programs, software, computer software products and the interrelated controllers, which can have a CPU, a memory, a user interface, and input and output means being in communication with the corresponding components of the apparatus for processing a large area substrate.

[0096] According to some embodiments, the disclosure provides a deposition apparatus configured as a flip source type equipment configuration with deposition sources, e.g., deposition units, which allows changing the deposition source(s)/deposition material(s) (e.g., cathode(s)/cathode material(s) within a processing chamber (e.g., the deposition unit) in-situ such that one in-line system can provide for two or more layer stacks (i.e., stack concepts) with different materials with a reduced need of venting or even without the need of venting. In some implementations, e.g. for touch panels, the system can be shifted,

switched or flipped from one configuration providing for a 3 layer stack to produce ITO with pattern invisibility ("Invisible ITO") to another configuration providing a conductive antireflective coating followed by a metal stack such as a "Black Metal"-stack. Such a metal stack can be used for low-reflective, invisible "Black Metal Bridges" (OGS/TOL concept for out-cell touch screen panels (TSPs)) and contact out metal leads for on-cell type TSPs Metal Mesh based touch screen panels approaches. Generally, for all sequentially placed processing chambers with adjacent processes which have space consuming gas separations, this concept can be beneficial, since a space for the deposition apparatus is reduced, e.g., about 45%. Also switches can be used for adapting or changing the configuration of the deposition apparatus, and a number of power supplies is reduced, i.e., no additional power supplies need to be provided.

[0097] According to the present disclosure, the deposition apparatus is multi-functional and only one deposition apparatus is provided for multiple stack concepts. The deposition apparatus is simple and allows a fast switching between stacks to be deposited. The deposition apparatus can support PCT ("projected capacitive touch") touch screen panel technology evolution from invisible ITO (also including a Black Metal Bridge) to Black Metal Mesh. The present embodiments can be applied for systems providing for a set of various layers of different material, e.g. different metals and metal oxides. Also, a simple and fast in-situ switching between deposition sources (such as cathode(s)) is possible. The present embodiments can be applied / adjusted to different platform configurations e.g. depending on layer stack concepts. The present disclosure is e.g. usable for processing chambers for easy and fast deposition source or deposition source material exchange. Customers can be supported in product development stage with a flexible tool that can also be used for transition to HVM ("high volume manufacturing").

[0098] While the foregoing is directed to embodiments of the disclosure, other and further embodiments of the disclosure may be devised without departing from the basic scope thereof, and the scope thereof is determined by the claims that follow.

CLAIMS

1. A deposition apparatus for deposition of a material on a substrate, comprising:

two or more processing chambers including a first processing chamber and a second processing chamber;

a substrate support extending at least through the first processing chamber and the second processing chamber; and

two or more deposition source assemblies including a first deposition source assembly in the first processing chamber and a second deposition source assembly in the second processing chamber,

wherein each of the two or more deposition source assemblies comprises:

at least one deposition source support configured to support at least one first deposition source and at least one process device,

wherein the at least one deposition source support is configured to be moveable at least between a first position and a second position, and

wherein, in the first position, the at least one first deposition source is oriented towards the substrate support, and, in the second position, the at least one process device is oriented towards the substrate support.

2. The deposition apparatus of claim 1, wherein the at least one process device includes at least one of at least one second deposition source, a heating device and a deposition source conditioning device.

3. The deposition apparatus of claim 1 or 2, wherein the at least one deposition source support is configured to be rotatable about a rotation axis of the at least one deposition source support, particularly wherein the rotation axis is substantially perpendicular to a transport direction of the substrate.

4. The deposition apparatus of one of claims 1 to 3, wherein at least one deposition source assembly of the two or more deposition source assemblies includes a separation wall.

5. The deposition apparatus of claim 4, wherein the separation wall is configured for separating the at least one first deposition source from the at least one process device of the at least one deposition source assembly.

6. The deposition apparatus of claim 4 or 5, wherein the separation wall is configured to separate at least one processing chamber of the two or more processing chambers in which the at least one deposition source assembly is provided into a first chamber portion and a second chamber portion.

7. The deposition apparatus of claim 6, wherein the separation wall is configured to hermetically seal the first chamber portion from the second chamber portion.

8. The deposition apparatus of one of claims 4 to 7, wherein the separation wall is configured as a gas separation shielding.

9. The deposition apparatus of one of claims 1 to 8, wherein the at least one deposition source support is configured to support the least one first deposition source with a first deposition material and the at least one process device including the at least one second deposition source with a second deposition material, wherein the first deposition material and the second deposition material are different.

10. The deposition apparatus of one of claims 1 to 9, wherein the two or more processing chambers include one or more further processing chambers, wherein at least one further deposition source assembly is provided in at least one of the one or more further processing chambers.

11. The deposition apparatus of one of claims 1 to 10, the deposition apparatus being configured to deposit at least a first layer stack and a second layer stack, particularly wherein the second layer stack is different from the first layer stack.

12. The deposition apparatus of claim 11, the deposition apparatus being configured to deposit the first layer stack including at least one of indium tin oxide (ITO), Nb_yO_x, Nb_2O_5, SiO_2, TiO_2 and/or a metal, particularly Al, Mo and Cu, and/or the deposition apparatus is configured to deposit the second layer stack including at least one of $MoNbO_xN_y$, Al, AlNd, MoNb and one or more alloys of Mo and/or Al.

13. Method for depositing a material on a substrate, comprising:

depositing a first layer stack on a first substrate by a first deposition source assembly and a second deposition source assembly;

moving at least one of the first deposition source assembly and the second deposition source assembly from a first position into a second position; and

depositing a second layer stack on a second substrate.

14. The method of claim 13, wherein each of the first deposition source assembly and the second deposition source assembly comprises at least one first deposition source and at least one process device, and wherein, in the first position, the first deposition source is

oriented towards the substrate, and, in the second position, the at least one process device is oriented towards the substrate.

15. A deposition apparatus for deposition of a first layer stack on a first substrate and a second layer stack on a second substrate, wherein the second layer stack is different from the first layer stack, the deposition apparatus comprising:

two or more processing chambers including a first processing chamber and a second processing chamber;

a substrate support extending at least through the first processing chamber and the second processing chamber; and

two or more deposition source assemblies including a first deposition source assembly in the first processing chamber and a second deposition source assembly in the second processing chamber,

wherein each of the two or more deposition source assemblies comprises:

at least one deposition source support configured to support at least one first deposition source and at least one process device, wherein the at least one process device includes at least one of at least one second deposition source, a heating device and a deposition source conditioning device; and

a separation wall configured for separating the at least one first deposition source from the at least one process device,

wherein the at least one deposition source support is configured to be moveable at least between a first position and a second position, and

wherein, in the first position, the first deposition source is oriented towards the substrate support, and, in the second position, the at least one process device is oriented towards the substrate support.

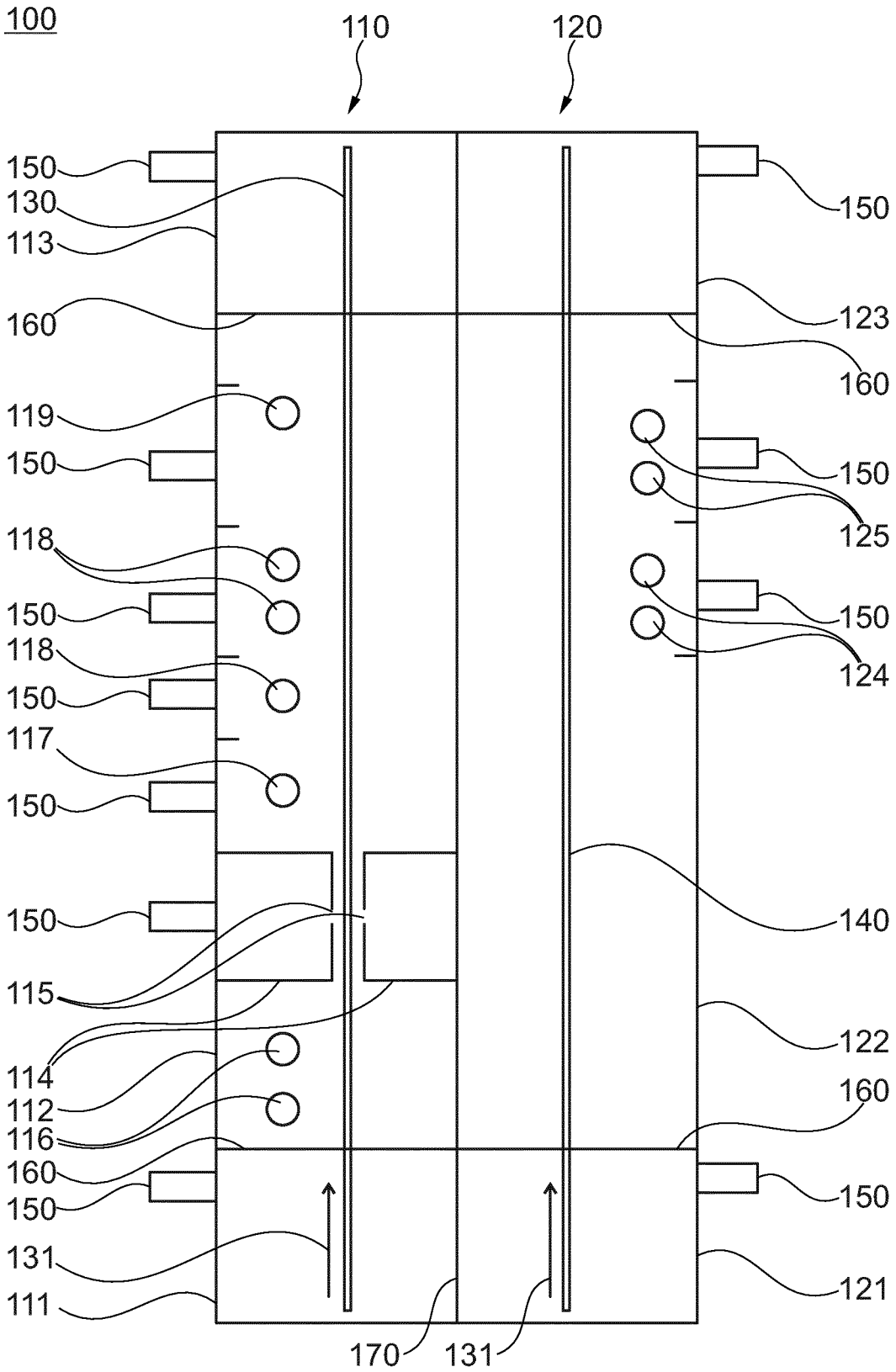

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Fig. 1

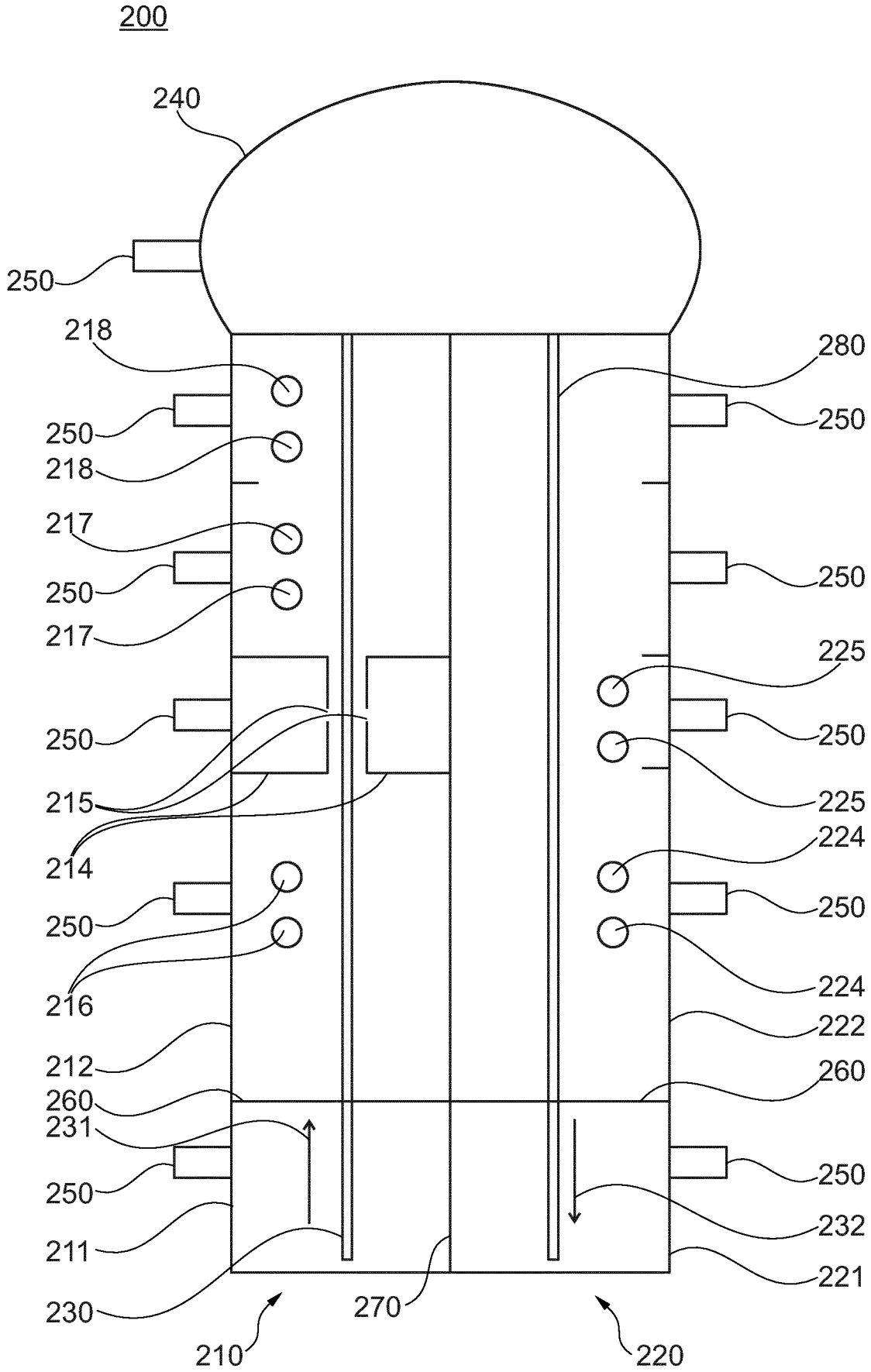

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Fig. 2

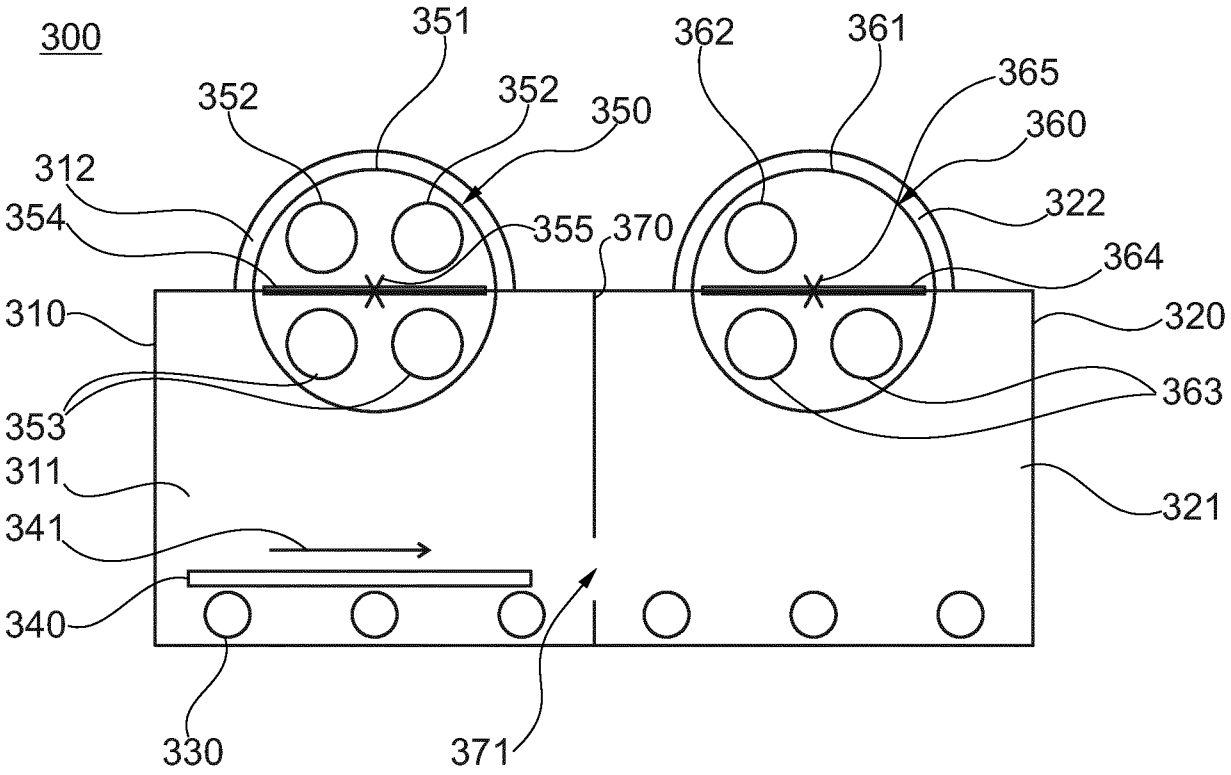

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Fig. 3

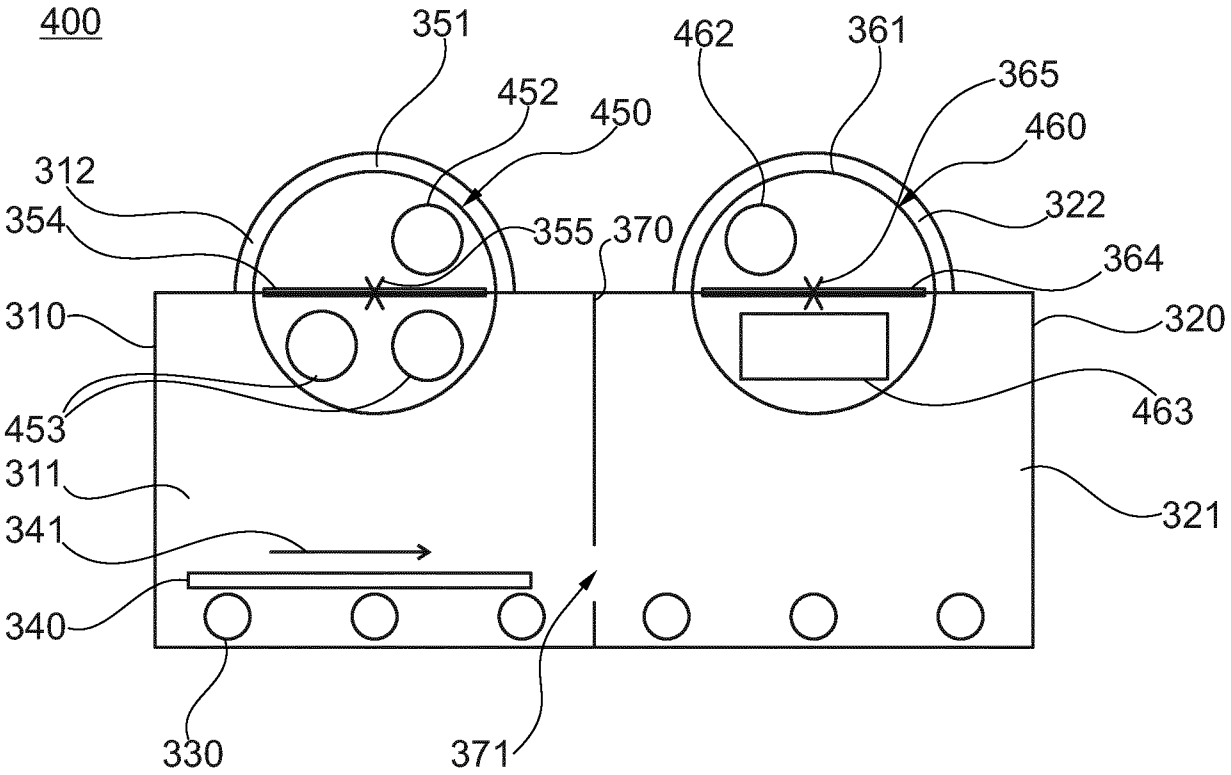

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Fig. 4

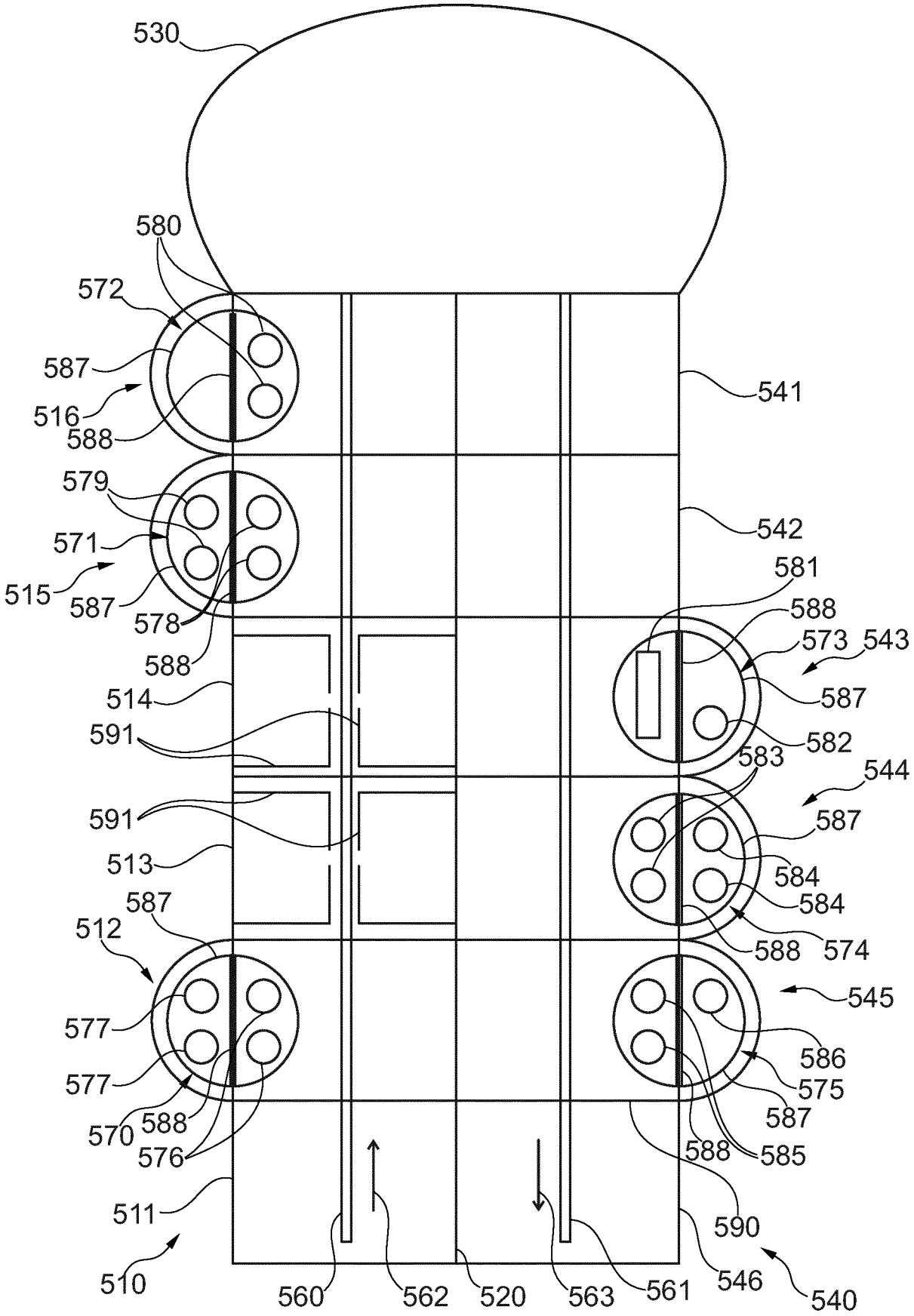

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Fig. 5

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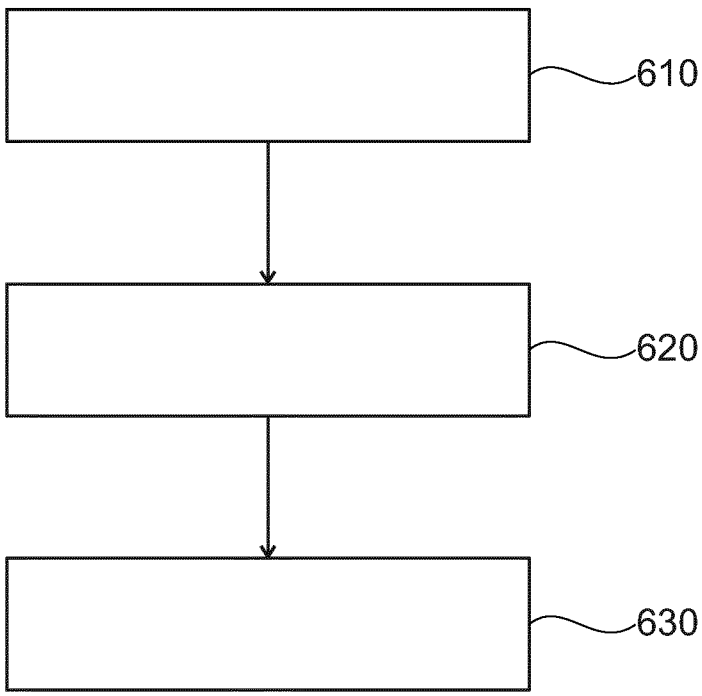


Fig. 6

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2014/060360

A. CLASSIFICATION OF SUBJECT MATTER
INV. C23C14/56 C23C14/34
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
C23C H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 2 216 831 A1 (APPLIED MATERIALS INC [US]) 11 August 2010 (2010-08-11) features 120, 131, 141, 152, 154, 162; figure 1 column 7, paragraph [0032] -----	1-12,15
X	EP 1 318 209 A1 (ANELVA CORP [JP] CANON ANELVA CORP [JP]) 11 June 2003 (2003-06-11)	13,14
Y	feature 3; column 6, paragraph [0036] features 32, 33, 34 and 2; figure 2 column 13; claim 1 paragraph [[0051]] - paragraph [[0052]] -----	1-12,15

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
5 September 2014	12/09/2014

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Martinez Miró, M

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2014/060360

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2216831 A1	11-08-2010	NONE	
EP 1318209 A1	11-06-2003	CN 1417373 A	14-05-2003
		DE 60226115 T2	02-07-2009
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		JP 2003141719 A	16-05-2003
		US 2003079984 A1	01-05-2003