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SPUTTER DEPOSITION SOURCE, SPUTTER DEPOSITION APPARATUS AND METHOD OF OPERATING A SPUTTER DEPOSITION SOURCE

TECHNICAL FIELD

[0001] The present disclosure relates to a sputter deposition source configured for two-
5 side sputter deposition. Specifically, the sputter deposition source may be configured for
coating a first substrate arranged on a first deposition side of the sputter deposition source
and for coating a second substrate arranged on a second deposition side of the sputter
deposition source. The present disclosure further relates to coating of a substrate with one
or more thin layers by sputtering as well as to methods of operating a sputter deposition
10 source. The present disclosure further relates to a deposition apparatus including a sputter
deposition source.

BACKGROUND

[0002] Forming a layer on a substrate with a high uniformity (i.e., a uniform thickness
and uniform electric properties over an extended surface) is a relevant issue in many
15 technological fields. For example, in the field of thin film transistors (TFTs), thickness
uniformity and uniformity of electrical properties may be an issue for reliably
manufacturing display channel areas. Furthermore, a uniform layer typically facilitates
manufacturing reproducibility.

[0003] One method for forming a layer on a substrate is sputtering, which has developed
20 as a valuable method in diverse manufacturing fields, for example in the fabrication of
TFTs. During sputtering, atoms are ejected from a sputter target by bombardment thereof
with energetic particles of a plasma (e.g., energized ions of an inert or reactive gas). The
ejected atoms may deposit on the substrate, so that a layer of sputtered material can be
formed on the substrate.

[0004] A sputter deposition source may include at least one cathode including a target for
25 providing the coating material to be deposited on the substrate, and at least one anode
assembly. An electric field may be applied between the cathode and the anode assembly so

that a gas located between the cathode and the anode assembly is ionized and the plasma is generated. The coating material is provided through sputtering of the target by the plasma ions.

[0005] Uniform layers of sputtered material over a large substrate surface or from substrate to substrate may be difficult to achieve, e.g. due to plasma properties that vary over time which may lead to an irregular spatial distribution of sputtered material. Sputtering speed can be increased by providing an array of cathodes. However, it may be difficult to reliably control the properties of two or more plasma clouds. Layer uniformity from substrate to substrate may vary.

[0006] Accordingly, sputter deposition sources and sputter apparatuses for facilitating highly uniform layers of sputtered material are beneficial.

SUMMARY

[0002] In light of the above, a sputter deposition source, a deposition apparatus as well as methods of operating sputter deposition sources and deposition apparatuses are provided.

[0003] According to one aspect of the present disclosure, a sputter deposition source is provided. The sputter deposition source includes at least one electrode assembly configured for two-side sputter deposition, wherein the at least one electrode assembly includes: a cathode for providing a target material to be deposited, wherein the cathode is configured for generating a first plasma on a first deposition side and a second plasma on a second deposition side opposite to the first deposition side; and an anode assembly with at least one first anode arranged on the first deposition side for influencing the first plasma and at least one second anode arranged on the second deposition side for influencing the second plasma.

[0004] According to a further aspect, a deposition apparatus is provided. The deposition apparatus includes a deposition chamber; a sputter deposition source arranged in the deposition chamber; a first substrate holding region on a first deposition side of the sputter deposition source for holding a first substrate to be coated; and a second substrate holding

region on a second deposition side of the sputter deposition source opposite to the first deposition side for holding a second substrate to be coated. The sputter deposition source includes at least one electrode assembly configured for two-side sputter deposition, wherein the at least one electrode assembly includes: a cathode for providing a target material to be deposited, wherein the cathode is configured for generating a first plasma on the first deposition side and a second plasma on the second deposition side; and an anode assembly with at least one first anode arranged on the first deposition side for influencing the first plasma and at least one second anode arranged on the second deposition side for influencing the second plasma.

[0005] According to yet another aspect, a method of operating a sputter deposition source, particularly a sputter deposition source according to embodiments described herein, is provided. The method comprises: generating a first plasma on a first deposition side of a cathode and generating a second plasma on a second deposition side of the cathode opposite to the first deposition side; influencing the first plasma with at least one first anode arranged on the first deposition side and/or influencing the second plasma with at least one second anode arranged on the second deposition side.

[0006] In some embodiments, the method may further include arranging a first substrate on the first deposition side such as to face the first plasma, and arranging a second substrate on the second deposition side such as to face the second plasma.

[0007] Further aspects, advantages, and features of the present disclosure are apparent from the dependent claims, the description, and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] 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. Some embodiments are depicted in the drawings and are detailed in the description which follows.

[0016] FIG. 1 shows a schematic sectional view of a sputter deposition source in accordance with some embodiments described herein;

[0017] FIG. 2 shows a schematic sectional view of a sputter deposition source in accordance with some embodiments described herein;

5 [0018] FIG. 3 shows a schematic sectional view of a sputter deposition source in accordance with some embodiments described herein;

[0019] FIG. 4 shows a schematic sectional view of a sputter deposition source in accordance with some embodiments described herein;

10 [0020] FIG. 5 shows a schematic sectional view of a sputter deposition source in accordance with some embodiments described herein;

[0021] FIG. 6 shows a schematic sectional view of a sputter deposition source in accordance with some embodiments described herein;

[0022] FIG. 7 shows a schematic sectional view of a sputter deposition source in accordance with some embodiments described herein;

15 [0023] FIG. 8 shows a schematic view of a deposition apparatus with a sputter deposition source in accordance with some embodiments described herein; and

[0024] FIG. 9 is a flow diagram illustrating a method of operating a sputter deposition source according to embodiments described herein.

DETAILED DESCRIPTION

20 [0025] 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. Each example is provided by way of explanation and is not meant as a limitation. For example, features illustrated or described as part of one embodiment can be used on or in conjunction with any other embodiment to yield yet a further embodiment. It is intended that the present
25 disclosure includes such modifications and variations.

[0026] Within the following description of the drawings, the same reference numbers refer to the same or to similar components. Generally, only the differences with respect to the individual embodiments are described. Unless specified otherwise, the description of a part or aspect in one embodiment applies to a corresponding part or aspect in another embodiment as well.

[0027] The process of coating a substrate with a material as described herein refers typically to thin-film applications. The term “coating” and the term “depositing” are used synonymously herein. The coating process used in embodiments described herein is sputtering.

[0028] The term “substrate” as used herein shall particularly embrace inflexible substrates, e.g., glass plates. The present disclosure is not limited thereto and the term “substrate” may also embrace flexible substrates such as a web or a foil.

[0029] Sputtering can be used in the production of displays. For example, sputtering may be used for the metallization such as the generation of electrodes or buses. Sputtering may also be used for the generation of thin film transistors (TFTs) as well as for the generation of ITO (indium tin oxide) layers. Sputtering can also be used in the production of thin-film solar cells. A thin-film solar cell includes a back contact, an absorbing layer, and a transparent and conductive oxide layer (TCO). The back contact and the TCO layer can be produced by sputtering whereas the absorbing layer may be made in a chemical vapour deposition process.

[0030] Some of the embodiments described herein can be utilized for the coating of large area substrates, e.g. for lithium battery manufacturing or electrochromic windows. As an example, a plurality of thin film batteries can be formed on a large area substrate. According to some embodiments, the substrate can be a large area substrate with a substrate surface of 0.5 m² or more, e.g. 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, which corresponds to about 5.3m² substrates (2.16 m x 2.46 m), or even GEN 10, which

corresponds to about 9.0 m² substrates (2.88 m × 3.13 m). Even larger generations such as GEN 11, GEN 12 and/or corresponding substrate areas can similarly be implemented.

[0031] FIG. 1 shows a schematic sectional view of a sputter deposition source 100 according to embodiments described herein. The sputter deposition source 100 includes at least one electrode assembly 120 configured for two-side sputtering. The electrode assembly 120 may be configured to coat a first substrate 151 arranged on a first deposition side 10 of the electrode assembly, e.g. in a first substrate holding region 153, and to coat a second substrate 152 arranged on a second deposition side 11 of the electrode assembly opposite to the first deposition side 10, e.g. in a second substrate holding region 154.

[0032] The electrode assembly 120 includes a cathode 125 which may include a sputter target comprising a target material to be deposited on the substrate. The electrode assembly 120 further includes an anode assembly 130 with at least one first anode 132 and at least one second anode 142. The at least one first anode 132 may be arranged on the first deposition side 10, and the at least one second anode 142 may be arranged on the second deposition side 11. The at least one first anode 132 may be configured for influencing a first plasma 131 generated on the first deposition side 10, and the at least one second anode 142 may be configured for influencing a second plasma 141 generated on the second deposition side 11.

[0033] The “first deposition side” as used in the present disclosure may be understood as a first space region on a first side of the electrode assembly 120, e.g. in front of the sputter deposition source in a forward-backward-direction X, which may include the first substrate holding region 153 for arranging a substrate to be coated. For example, the substrate arranged in the first substrate holding region 153 may be coated with atoms or molecules ejected from a front surface of the cathode 125 toward the first deposition side 10. A first plasma 131 may be generated on the first deposition side 10 adjacent to the front surface of the cathode which faces toward the first substrate holding region 153.

[0034] Similarly the “second deposition side” as used in the present disclosure may be understood as a second space region on a second side of the electrode assembly opposite to the first deposition side 10, e.g. on the rear side of the sputter deposition source in the

forward-backward-direction X, which may include a second substrate holding region 154 for arranging a substrate to be coated. For example, the substrate arranged in the second substrate holding region 154 may be coated with atoms or molecules ejected from a rear surface of the cathode toward the second deposition side 11. A second plasma 141 may be generated on the second deposition side 11 adjacent to the rear surface of the cathode 125 which faces toward the second substrate holding region 154.

[0035] Accordingly, in some embodiments, a first coating area for coating a first substrate may be provided on the first deposition side, e.g. adjacent to a front surface of the cathode, and a second coating area may be provided on the second deposition side 11, e.g. adjacent to a rear side of the cathode. One or more coating layers can be deposited on the first substrate 151 arranged on the first deposition side 10 in the first substrate holding region 153, and one or more coating layers can be deposited on the second substrate 152 arranged on the second deposition side 11 in the second substrate holding region 154.

[0036] In some embodiments, a center plane C may extend between the first deposition side 10 and the second deposition side 11. The center plane C may divide the first deposition side 10 from the second deposition side 11. In other words, the first space region in front of the center plane C may correspond to the first deposition side 10, and the second space region behind the center plane C may correspond to the second deposition side 11. In some embodiments, the center plane C may extend through the center of the cathode 125 in the forward-backward direction X. In some embodiments, the electrode assembly 120 may be symmetrical with respect to the center plane C. A symmetric setup of the electrode assembly may lead to a corresponding shape of the first plasma 131 and the second plasma 141.

[0037] The center plane C may extend centrally through the cathode 125, e.g. through a rotation axis A of the cathode 125. In some embodiments, also the anode assembly 130 may be configured symmetrically with respect to the center plane C. Therein, the at least one first anode 132 may be arranged on the first side of the center plane C, i.e. on the first deposition side 10, and the at least one second anode 142 may be arranged on the second side, i.e. on the other side, of the center plane C, i.e. on the second deposition side 11.

“Arranged on the first side” as used herein may mean that the geometric center of the first anode is located on the first side of the center plane C. In some embodiments, the entire first anode is located on the first side of the center plane C. Similarly, “arranged on the second side” as used herein may mean that the geometric center of the second anode is located on the second side of the center plane C. In some embodiments, the second anode is entirely located on the second side of the center plane C.

[0038] According to some embodiments, a first electric field may be applied between the cathode 125 and the at least one first anode 132, and a second electric field may be applied between the cathode 125 and the at least one second anode 142. By adjusting the first electric field, the first plasma 131 can be influenced, e.g. shaped, intensified or weakened, and by adjusting the second electric field, the second plasma 141 can be influenced, e.g. shaped, intensified or weakened. As the at least one first anode 132 is partially or entirely provided on the first deposition side 10, the first plasma 131 can be selectively influenced by the at least one first anode 132. As the at least one second anode 142 is partially or entirely provided on the second deposition side 11, the second plasma 141 can be selectively influenced by the at least one second anode 142. Accordingly, an improved plasma control on the first deposition side and on the second deposition side is possible according to embodiments described herein.

[0039] In some embodiments, the first substrate 151 and the second substrate 152 may be coated simultaneously with the sputter deposition source 100. In other words, the electrode assembly 120 of the sputter deposition source may be configured for simultaneous two-side sputter deposition on two different substrates. In this case, the first plasma 131 on the first deposition side and the second plasma 141 on the second deposition side may be generated simultaneously such that deposition in two opposite directions, e.g. into the forward direction toward the first substrate 151 and into the rearward direction toward the second substrate 152, is possible.

[0040] In some embodiments, the first substrate 151 and the second substrate 152 may be coated subsequently. In this case, the first substrate 151 and the second substrate 152 can be different substrates or can be the same substrate. For example, a first main surface of the

first substrate 151 can be coated on the first deposition side 10 by sputtering from the front surface of the cathode 125, the first substrate 151 may be transported to the second deposition side 11, and, afterward, the first substrate 151, then referred to as the second substrate 152, can be coated again on the second deposition side 11 by sputtering from the rear surface of the cathode. Therein the first main surface of the substrate can be coated again and/or the second main surface of the substrate can be coated on the second deposition side 11. Accordingly, in some embodiments, the same substrate can be coated twice on different deposition sides.

[0041] As a further possibility, the first substrate 151 can be coated on the first deposition side, and, afterward, a second substrate 152, i.e. a substrate different from the first substrate, can be coated on the second deposition side by sputtering from the rear surface of the cathode.

[0042] By providing an electrode assembly 120 which is configured for two-side sputtering, the processing speed can be increased, as both sides of the cathode may be used for simultaneous or subsequent coating of one or more substrates.

[0043] In some embodiments, which may be combined with other embodiments described herein, a first substrate holder may be provided on the first deposition side 10 in the first substrate holding region 153 for holding the first substrate 151 such as to face the first plasma 131, and a second substrate holder may be provided on the second deposition side in the second substrate holding region 154 for holding the second substrate such as to face the second plasma 141. The cathode 125 may be located substantially in a center between the first substrate holder and the second substrate holder. The substrate holders can be movable substrate holders configured for transporting the substrates into and out of the respective coating area.

[0044] The cathode can be provided as a flat cathode or as a curved cathode such as a cylindrical cathode. Further, the cathode may be configured as a static cathode or as a rotatable cathode.

[0045] In the embodiment shown in FIG. 1, the cathode 125 is a rotatable cathode which is rotatable around a rotation axis A. In particular, the cathode 125 may include a sputter target for providing the material to be deposited, wherein the sputter target may be rotatable around the rotation axis A. The sputter target may include a metallic and/or a non-metallic material to be released from the sputter target by sputtering and to be deposited on a substrate. In some embodiments, the cathode 125 may be a cylindrical cathode which has an essentially cylindrical shape. As compared to a static planar cathode, a rotatable cathode may provide the advantage that the sputter target material is reliably utilized around the whole circumference of the sputter target during sputtering, and there are no edge portions of the sputter target in a lateral direction of the sputter target, where less sputtering may occur on the sputter target surface. Thus, by utilizing rotatable cathodes, material costs can be reduced. In alternative implementations, the cathode may be a planar cathode configured for two-side sputtering. The planar cathode may be provided with one, two or more magnet assemblies which may be movable.

[0046] According to embodiments described herein, a front surface of the rotatable cathode may be directed toward the first deposition side 10, and a rear surface of the rotatable cathode may be directed toward the second deposition side 11. As the cathode may rotate during deposition, the portion of the cathode which constitutes the front surface of the cathode at a first point in time may constitute the rear surface of the cathode at a second point in time, e.g. after rotation of the cathode by an angle of 180°. The combination of two-side sputtering with a rotatable cathode may lead to an excellent utilization of sputter target material around the whole circumference of the rotatable cathode.

[0047] The sputter target may be made of or include at least one material selected from the group including: aluminum, silicon, tantalum, molybdenum, niobium, titanium, indium, gallium, zinc, tin, silver and copper. Particularly, the target material can be selected from the group including indium, gallium and zinc. The sputter target may include some or a mixture of the above mentioned materials. For example, the sputter target may be an ITO target.

[0048] In some embodiments, which may be combined with other embodiments described herein, the cathode 125 may be provided with at least one magnetron or magnet assembly. Sputtering can be undertaken as magnetron sputtering. In some embodiments, the magnet assembly is arranged inside the sputter target of the target and can be pivoted around the rotation axis of the cathode.

[0049] Magnetron sputtering is particularly advantageous in that the deposition rates are rather high. By arranging a magnet assembly or magnetron behind the target material of the sputter target, in order to trap the free electrons within the magnetic field, these electrons are forced to move within the magnetic field and cannot escape. This enhances the probability of ionizing the gas molecules typically by several orders of magnitude. This, in turn, increases the deposition rate substantially. For example, in the event of a rotatable sputter target, which may have an essentially cylindrical form, the magnet assembly can be positioned inside of the rotatable sputter target.

[0050] The term “magnet assembly” as used herein may refer to a unit capable of generating a magnetic field. Typically, the magnet assembly may consist of a permanent magnet. This permanent magnet may be arranged within the sputter target such that charged particles can be trapped within the generated magnetic field, e.g. in an area above the sputter target. In some embodiments, the magnet assembly includes a magnet yoke.

[0051] The substrate can be continuously moved during coating past the electrode assembly 120 (“dynamic coating”), or the substrate may rest essentially at a constant position during coating (“static coating”). The sputter deposition sources described in the present disclosure may relate to both static coating processes and dynamic coating processes.

[0052] In some embodiments, which may be combined with other embodiments described herein, the cathode 125 may be provided with two magnet assemblies. In particular, two magnet assemblies may be arranged inside the rotatable cathode. A first magnet assembly 171 may be configured for influencing the first plasma 131 on the first deposition side 10, and the second magnet assembly 172 may be configured for influencing the second plasma 141 on the second deposition side 11. For example, the first magnet

assembly 171 may be oriented such that the first plasma 131 may be confined around a first radial direction extending from the rotation axis A toward the first deposition side 10, and the second magnet assembly 172 may be oriented such that the second plasma 141 may be confined around a second radial direction extending from the rotation axis A toward the second deposition side 11.

[0053] In some implementations, the first magnet assembly 171 and/or the second magnet assembly 172 may be movable, e.g. pivotable, around the rotation axis A. A movement of the first magnet assembly may cause a corresponding movement of the first plasma 131 on the first deposition side 10, and a movement of the second magnet assembly may cause a corresponding movement of the second plasma 141 on the second deposition side 11. In some embodiments, the first magnet assembly may be fixed to the second magnet assembly such that the first magnet assembly is movable in correspondence with the second magnet assembly. For example, the first magnet assembly and the second magnet assembly may be rotatable together around the rotation axis A in a clockwise direction or in a counterclockwise direction. Thus, the first plasma 131 and the second plasma 141 can be shifted in correspondence by moving the first magnet assembly together with the second magnet assembly.

[0054] In some embodiments, which may be combined with other embodiments described herein, the first magnet assembly 171 may be movable independently of the second magnet assembly 172. In this case, the first plasma 131 and the second plasma 141 can be moved independently on the respective deposition side. A first sputter direction on the first deposition side can be controlled independently of a second sputter direction on the second deposition side.

[0055] In some embodiments, which may be combined with other embodiments described herein, the at least one first anode 132 may be configured as a first anode rod extending in the direction of the rotation axis A of the cathode 125, and the at least one second anode 142 may be configured as a second anode rod extending in the direction of the rotation axis A of the cathode 125. The first anode rod and the second anode rod may have a round cross-sectional shape, an oval cross-sectional shape, a circular cross-sectional

shape (as is illustratively shown in FIG. 1), a rectangular cross-sectional shape (as is illustratively shown in FIG. 2), or a polygonal cross-sectional shape. In some embodiments, a cross-sectional area of the at least one first anode and of the at least one second anode may be smaller than a cross-sectional area of the cathode 125. For example, a diameter of the cathode 125 may be larger than a diameter of the at least one first anode and/or of the at least one second anode. For instance, the diameter of the cathode may be 3 cm or more and 20 cm or less, particularly from 5 cm to 12 cm. In some implementations, the diameter of the cathode may be more than 20 cm. The diameter of the first anode and/or of the second anode may be 0.5 cm or more and 5 cm or less, particularly from 2 cm to 4 cm, e.g. 3.5 cm. Other shapes than circular shapes are possible.

[0056] In some embodiments, the shape of the at least one first anode may correspond to the shape of the at least one second anode. Further, a distance between the at least one first anode and the cathode may correspond to a distance between the at least one second anode and the cathode. In particular, the arrangement of the anode assembly may be symmetrical with respect to the central plane C. The at least one first anode and the at least one second anode may include a conductive outer surface to be set on a respective anode potential. In some implementations, a cooling channel may be provided inside the at least one first anode and/or the at least one second anode in order to cool the respective anode.

[0057] FIG. 2 shows a schematic sectional view of a sputter deposition source 200 in accordance with embodiments described herein. The sputter deposition source 200 includes at least one electrode assembly 120 configured for two-side sputter deposition. Most of the features of the sputter deposition source 200 may correspond to the respective features of the sputter deposition source 100 shown in FIG. 1 so that reference can be made to the above explanations which are not repeated here.

[0058] The sputter deposition source 200 may include a rotatable cathode for providing a target material to be deposited, wherein a first substrate 151 arranged on the first deposition side 10 and a second substrate 152 arranged on the second deposition side 11 can be coated by sputtering from opposing sides of the cathode, particularly from a front surface and from the rear surface of the cathode.

[0059] In the embodiment shown in FIG. 2, the anode assembly 130 comprises two first anodes (hereinafter referred to as left first anode 231 and right first anode 232) arranged on the first deposition side 10 and two second anodes (hereinafter referred to as left second anode 241 and right second anode 242) arranged on the second deposition side 11. In some
5 embodiments, the left first anode 231 may be arranged on a first side, e.g. on the left side, of the cathode, and the right first anode 232 may be arranged on a second side, e.g. on a side opposite to the first side, particularly on the right side, of the cathode. The cathode 125 may be provided centrally between the left first anode 231 and the right first anode 232. Similarly, in some embodiments, the left second anode 241 may be arranged on a first side,
10 e.g. on the left side, of the cathode, and the right second anode 242 may be arranged on a second side, e.g. on a side opposite to the first side, particularly on the right side, of the cathode. The cathode 125 may be arranged centrally between the left second anode 241 and the right second anode 242.

[0060] For example, the cathode may be arranged centrally between the two first anodes.
15 Further, the cathode may be arranged centrally between the two second anodes. The left-right direction as referred to herein may be a direction perpendicular to the forward-backward direction X of the electrode assembly. By providing two first anodes on the first deposition side and two second anodes on the second deposition side, the first plasma 131 can be generated between the two first anodes on the first deposition side in front of the
20 front surface of the cathode, and the second plasma 141 can be generated between the two second anodes on the second deposition side adjacent to the rear surface of the cathode. The separation of said plasmas from the plasmas generated by adjacent electrode assemblies can be improved and an individual plasma control may be provided.

[0061] In some implementations, the two first anodes and the two second anodes may be
25 arranged symmetrically with respect to the central plane C. In particular, the electrode assembly of the deposition source 200 may be symmetrical with respect to the central plane C which may intersect through the rotation axis A of the cathode 125.

[0062] In some embodiments, which may be combined with other embodiments described herein, a separation wall 160 may be arranged in the central plane C such that the

first deposition side extends on a front side of the central plane C, and the second deposition side extends on a rear side of the central plane C. For example, the separation wall 160 may be configured such that a separation between the first plasma 131 and the second plasma 141 can be improved. In particular, a first electric field applied between the cathode 125 and the at least one first anode 132 may be separated more effectively from a second electric field applied between the cathode 125 and the at least one second anode 142 due to the separation wall 160. In some embodiments, the separation wall may be made of a conductive material, e.g. a metal, which may be grounded. In other embodiments, the separation wall may be made of an insulator, e.g. a dielectric material.

[0063] The separation wall 160 may be arranged between the at least one first anode 132 and the at least one second anode 142. The separation wall 160 may include two or more wall segments. In some implementations, the cathode 125 may be arranged between a first wall segment 161 and a second wall segment 162 of the separation wall. Each wall segment may be arranged between a first anode provided on the first deposition side and a second anode provided on the second deposition side.

[0064] For example, in the embodiment of FIG.2, the separation wall 160 includes a first wall segment 161 provided on a left side of the rotatable cathode between the left first anode 231 and the left second anode 241. A second wall segment 162 of the separation wall 160 may be provided on the right side of the rotatable cathode between the right first anode 232 and the right second anode 242.

[0065] In some embodiments, more than two wall segments may be provided for separating the first deposition side from the second deposition side. In some embodiments, a minimum distance between the separation wall 160 and the cathode 125 may be 1 cm or less, particularly 5 mm or less, more particularly 1 mm or less.

[0066] As is schematically indicated in FIG. 2, the first plasma 131 generated on the first deposition side 10 may include a left plasma cloud that can primarily be influenced by the left first anode 231 and a right plasma cloud that can primarily be influenced by the right first anode 232. The second plasma 141 generated on the second deposition side 11 may include a left plasma cloud that can primarily be influenced by the left second anode 241

and a right plasma cloud that can primarily be influenced by the right second anode 242. In some embodiments, an intensity of the plasma clouds may be individually influenced by adjusting an anode potential of an anode associated to the respective plasma cloud. A spatially resolved plasma control is possible. In some implementations, the two first anodes
5 may be configured for influencing the first plasma 131, and the two second anodes may be configured for influencing the second plasma 141.

[0067] FIG. 3 shows a schematic sectional view of a sputter deposition source 300 according to embodiments described herein. Most of the features of the sputter deposition source 300 may correspond to the respective features of the sputter deposition source 200
10 of FIG. 2 such that reference can be made to the above explanations which are not repeated here.

[0068] Similar to the embodiment of FIG. 2, the electrode assembly of the sputter deposition source 300 includes a cathode 125 and an anode assembly 130 with at least one first anode 132 (e.g., a pair of first anodes) arranged on the first deposition side 10 and at
15 least one second anode 142 (e.g. a pair of second anodes) arranged on the second deposition side 11. Optionally, the at least one first anode 132 may be provided as a left first anode 231 and a right first anode 232, and the at least one second anode 142 may include a left second anode 241 and a right second anode 242, as explained above.

[0069] In some embodiments, which may be combined with other embodiments
20 described herein, a power arrangement 310 may be provided. The power arrangement 310 may be configured for powering the electrode assembly. In some embodiments, the power arrangement 310 may be configured for connecting the cathode 125 to a cathode potential P, e.g. a negative potential, for connecting the at least one first anode 132 to a first anode potential P1, e.g. a first positive potential, and for connecting the at least one second anode
25 142 to a second anode potential P2, e.g. a second positive potential. In some embodiments, the first anode potential P1 may correspond to the second anode potential P2. In some embodiments, the first anode potential P1 may be different from the second anode potential P2. In particular, at least one of the first anode potential P1 and the second anode potential P2 may be adjustable. By adjusting at least one of the first anode potential P1 and the

second anode potential P2, at least one of the first plasma 131 and the second plasma 141 may be influenced, e.g. shaped, intensified, or weakened. For example, by adjusting the first anode potential P1, an intensity of the first plasma 131 may be adjusted to correspond to an intensity of the second plasma 141.

5 [0070] For example, the power arrangement 310 may include a power supply with a first output terminal connected to the cathode 125 for applying the cathode potential P (e.g. a cathode voltage such as a negative voltage) to the cathode, a second output terminal connected to the at least one first anode 132 for applying the first anode potential P1 (e.g. a first anode voltage such as a positive voltage or a ground potential) to the at least one first
10 anode 132, and a third output terminal connected to the at least one second anode 142 for applying the second anode potential P2 (e.g. a second anode voltage such as a positive voltage or a ground potential) to the at least one second anode 142. The voltages provided by the output terminals of the power supply may be adjustable as appropriate.

15 [0071] Accordingly, in some embodiments, a first electric field can be applied between the cathode and the at least one first anode, and a second electric field can be applied between the cathode and the at least one second anode. The first electric field may be adjusted independently of the second electric field, particularly by adjusting at least one of the first anode potential P1 and the second anode potential P2.

20 [0072] In the embodiment shown in FIG. 3, two first anodes are connected to the first anode potential P1, and two second anodes are connected to the second anode potential P2. In other embodiments, the two or more first anodes may be connected to different anode potentials, respectively, and/or the two or more second anodes may be connected to different anode potentials, respectively. For example, in the embodiment shown in FIG. 8,
25 232 is connected to a right first anode potential P1/2, the left second anode 241 is connected to a left second anode potential P2/1, and/or the right second anode 242 is connected to a right second anode potential P2/2. In this case, a left plasma cloud of the first plasma may be influenced independently of a second plasma cloud of the first plasma, and a left plasma cloud of the second plasma may be influenced independently of a second

plasma cloud of the second plasma. A local plasma control becomes possible. The uniformity of the deposited layers can be locally adjusted as appropriate.

[0073] Additionally or alternatively, in some embodiments, at least one anode, e.g. the at least one first anode 132 or the at least one second anode 142 may include two or more anode segments (not shown in the figures) which may be arranged next to each other in an extension direction of the respective anode, e.g. perpendicular to the drawing planes. The two or more anode segments of the at least one anode may be individually powered. For example, each anode segment may be connected to a respective adjustable anode segment potential, and/or each anode segment may be connected to a respective anode segment potential via a variable resistor or a potentiometer such that the current flowing to the respective anode segment may be individually adjusted. Accordingly, a spatially resolved plasma control in a direction perpendicular to the drawing planes, e.g. in a length direction of the cathode such as in the direction of the rotation axis A becomes possible.

[0074] In some embodiments, an individual plasma control in the forward-backward direction (e.g., by individually controlling the first plasma 131 and the second plasma 141), in the direction of the rotation axis A (e.g., by individually controlling the anode segments of one or more anodes) and/or in the direction of the center plane C (e.g., by individually controlling the left plasma clouds and the right plasma clouds, as is depicted in FIG. 8, and/or by individually controlling the electrode assemblies of an array of electrode assemblies as illustratively shown in FIG. 7) may be possible. Layers with an excellent layer uniformity can be deposited on one or more substrates.

[0075] FIG. 4 shows a schematic sectional view of a sputter deposition source 400 according to embodiments described herein. Most of the features of the sputter deposition source 400 of FIG. 4 may correspond to the respective features of the sputter deposition source 300 of FIG. 3 so that reference can be made to the above explanations which are not repeated here.

[0076] In some embodiments, a power arrangement 310 for powering the cathode 125, the at least one first anode 132 as well as the at least one second anode 142 may be provided. The power arrangement 310 may include a first power supply 311 connectable to

the cathode 125 and to the at least one first anode 132 and a second power supply 312 connectable to the cathode 125 and to the at least one second anode 142. The first power supply 311 may be used for adjusting the first electric field applied between the cathode 125 and the at least one first anode, and the second power supply 312 may be used for
5 adjusting the second electric field applied between the cathode and the at least one second anode.

[0077] As is schematically depicted in FIG. 4, a first output terminal of the first power supply 311 and a first output terminal of the second power supply 312 may be connectable to the cathode 125, wherein both the first output terminal of the first power supply 311 and
10 the first output terminal of the second power supply 312 may be configured to provide a cathode potential P.

[0078] In some embodiments, a second output terminal of the first power supply 311 may be connected to the at least one first anode and be configured to provide the first anode potential P1, and a second output terminal of the second power supply 312 may be
15 connected to the at least one second anode and be configured to provide the second anode potential P2. The first anode potential P1 and/or the second anode potential P2 may be adjusted as appropriate for influencing the first plasma 131 and/or the second plasma 141 during sputtering. For example, at least one of the first anode potential P1 and the second anode potential P2 may be adjusted such that first plasma 131 on the first deposition side
20 10 and the second plasma 141 on the second deposition side 11 can be kept essentially equal.

[0079] FIG. 5 shows a schematic sectional view of a sputter deposition source 500 according to embodiments described herein. Most of the features of the sputter deposition source 500 of FIG. 4 may correspond to the respective features of the sputter deposition
25 source 400 of FIG. 4 so that reference can be made to the above explanations which are not repeated here.

[0080] In some embodiments, which may be combined with other embodiments described herein, a power arrangement 310 for powering the cathode 125, the at least one first anode 132, and the at least one second anode 142 may be provided. The power

arrangement 310 may include a first electric connection 313 for connecting the at least one first anode 132 to the first anode potential P1 and a second electric connection 314 for connecting the at least one second anode 142 to the second anode potential P2. The first anode potential P1 may correspond to the second anode potential P2 in some embodiments.

5 [0081] In some implementations, at least one variable resistor or potentiometer 315 may be provided for adjusting at least one of a first electric resistance of the first electric connection 313 and a second electric resistance of the second electric connection 314.

[0082] For example, the first electric connection 313 may be provided with a first variable resistor for adjusting the first electric resistance, and the second electric connection
10 314 may be provided with a second variable resistor for adjusting the second electric resistance. Accordingly, at least one of a first anode current flowing towards the at least one first anode and a second anode current flowing towards the at least one second anode can be adjusted as appropriate by varying the resistance of the first electric connection 313 and/or of the second electric connection 314. The first plasma 131 can be influenced
15 independently of the second plasma 141.

[0083] In other embodiments, e.g. in the embodiment shown in FIG. 5, a single variable resistor or potentiometer 315 may be connected between the at least one first anode 132 and the at least one second anode 142. A third terminal, e.g. a control terminal, of the variable resistor or potentiometer 315 may be connected to an output terminal of a power supply
20 which provides the first anode potential P1 and the second anode potential P2. A ratio between a first anode current flowing from the output terminal of the power supply towards the at least one first anode 132 and a second anode current flowing from the output terminal of the power supply towards the at least one second anode 142 can be adjusted via the third terminal of the variable resistor or potentiometer 315. Accordingly, a strength ratio between
25 the first plasma 131 and the second plasma 141 can be adjusted as appropriate. For example, the variable resistor or potentiometer 315 can be used to control the first plasma and the second plasma to remain essentially equal during sputtering.

[0084] In some embodiments, which may be combined with other embodiments described herein, the sputter deposition source may include a detector 320 for detecting a

deposition property and a control device 330 for controlling the power arrangement 310 in dependence of the detected deposition property.

[0085] For example, as is exemplarily depicted in FIG. 5, the detector 320 may be configured for measuring a differential current I_{DIFF} between the at least one first anode 132 and the at least one second anode 142. The control device 330 may be configured for controlling the variable resistor or potentiometer 315 in dependence of the detected differential current. For instance, a small or a vanishing differential current I_{DIFF} between the at least one first anode 132 and the at least one second anode 142 may be beneficial. In some embodiments, the variable resistor or potentiometer 315 may be adjusted, if the differential current exceeds a predetermined current threshold. Accordingly, an improved plasma control is provided.

[0086] Alternatively, for example in the embodiment shown in FIG. 3 or in FIG. 4, a control device (not shown) may be provided for adjusting at least one of the first anode potential P1 and the second anode potential P2 depending on a measured differential current between the at least one first anode 132 and the at least one second anode 142. For example, the first plasma 131 may be controlled to correspond in size and/or intensity to the second plasma 141.

[0087] In some embodiments, the detector 320 may be configured to measure a deposition property including one or more of the following: an optical property of at least one of the first plasma and the second plasma, e.g. a plasma strength, an intensity, a brightness or a color value; a shape or a location of the first plasma and/or of the second plasma; a differential current between the first anode and the second anode; at least one of a first current flow between the cathode and the at least one first anode and a second current flow between the cathode and the at least one second anode; at least one of a first electric field strength between the cathode and the at least one first anode and a second electric field strength between the cathode and the at least one second anode; a characteristic of at least one layer coated on a first substrate on the first deposition side; a characteristic of at least one layer coated on a second substrate on the second deposition side, e.g. a layer uniformity, layer thickness, a sheet resistance, or a sheet resistance uniformity.

[0088] FIG. 6 shows a schematic sectional view of a sputter deposition source 600 according to embodiments described herein. Most of the features of the sputter deposition source 600 of FIG. 6 may correspond to the respective features of the sputter deposition source 500 of FIG. 5 so that reference can be made to the above explanations which are not repeated here.

[0089] In the embodiment illustratively shown in FIG. 6, a variable resistor or potentiometer 315 is provided for adjusting at least one of the first electric resistance of the first electric connection 313 and a second electric resistance of the second electric connection 314. The variable resistor or potentiometer 315 can be controlled by a control device 330.

[0090] The control device 330 may control the variable resistor or potentiometer 315 depending on a deposition property detected by a detector 320. The detector 320 may be an optical detector configured to detect an optical property of the first plasma 131 and/or of the second plasma 141. For example, the detector 320 may be configured to measure a brightness, a plasma strength or a color value of the first plasma 131 and/or of the second plasma 141. The control device 330 may control the variable resistor or potentiometer 315 such that the measured property of the first plasma corresponds to the measured property of the second plasma. In some embodiments, a closed-loop control may be provided. For example, if a first brightness of the first plasma exceeds a second brightness of the second plasma, a current flow toward the at least one second anode 142 may be increased by reducing the second electric resistance of the second electric connection 314 via the variable resistor or potentiometer 315. Similarly, if the first brightness of the first plasma is measured to be below the second brightness of the second plasma, a current flow towards the at least one first anode 132 may be increased by reducing the first electric resistance of the first electric connection 313 via the variable resistor or potentiometer 315. An improved plasma control for two-side sputter deposition is provided.

[0091] FIG. 7 shows a schematic sectional view of a sputter deposition source 700 according to embodiments described herein. Most of the features of the sputter deposition source 700 of FIG. 7 may correspond to the respective features of the sputter deposition

source 400 of FIG. 4 so that reference can be made to the above explanations which are not repeated here.

[0092] The sputter deposition source 700 includes an array of two or more electrode assemblies arranged next to each other, e.g. in a linear arrangement or in a linear array of electrode assemblies. The deposition speed can be increased and large area substrates can be coated more quickly with a sputter deposition source 700 including an array of two or more electrode assemblies.

[0093] At least one of the electrode assemblies of the sputter deposition source 700 may be configured as an electrode assembly according to embodiments described herein, i.e. an electrode assembly configured for two-side sputtering. In some embodiments, two or more adjacent electrode assemblies may be configured as an electrode assembly according to an embodiment described herein, wherein the respective possible combinations of features are not repeated here.

[0094] For example, as is exemplarily depicted in FIG. 7, the sputter deposition source 700 may include a first electrode assembly 701 arranged next to a second electrode assembly 702. Each of the first electrode assembly 701 and the second electrode assembly 702 may be configured for two-side sputter deposition, and may include: a cathode, e.g. a rotatable cathode, configured for generating the first plasma on the first deposition side 10 and a second plasma on the second deposition side 11, and an anode assembly with at least one first anode arranged on the first deposition side and at least one second anode arranged on the second deposition side.

[0095] Therein, it is to be understood that the cathode and the anode assembly of each of the first electrode assembly 701 and the second electrode assembly 702 or of further electrode assemblies may have some or all of the features described above with reference to any of FIGS. 1 to 6. For example, the at least one first anode of the first electrode assembly 701 and the at least one second anode of the first electrode assembly 701 may be composed of a pair of anodes, respectively, which may be arranged on opposing sides of the cathode of the first electrode assembly 701, e.g. in the left-right direction. Similarly, the at least one first anode of the second electrode assembly 702 and the at least one second anode of

the second electrode assembly 702 may be composed of a pair of anodes, respectively, which may be arranged on opposing sides of the cathode of the second electrode assembly 702, e.g. in the left-right direction.

[0096] Accordingly, in some embodiments, two anodes may be arranged between adjacent cathodes on the first deposition side, and two anodes may be arranged between adjacent cathodes on the second deposition side, respectively. The first plasmas generated by adjacent electrode assemblies on the first deposition side can be better separated from each other and/or can be individually controlled, and the second plasmas generated by adjacent electrode assemblies on the second deposition side can be better separated from each other and/or can be individually controlled. This is because two anodes may be located between the first plasma of the first electrode assembly 701 and the first plasma of the second electrode assembly 702, wherein one anode may be configured for influencing the first plasma of the first electrode assembly 701 and one anode may be configured for influencing the first plasma of the second electrode assembly 702. The same may apply to the respective second plasmas generated by two adjacent electrode assemblies.

[0097] In some embodiments, which may be combined with other embodiments described herein, a power arrangement 710 may be provided for individually powering the two or more electrode assemblies. For example, the power arrangement 710 may be configured to control the first plasma of the first electrode assembly independently of the first plasma of the second electrode assembly 702, and to control the second plasma of the first electrode assembly 701 independently of the second plasma of the second electrode assembly 702.

[0098] In particular, in some embodiments, the first anode assembly of the first electrode assembly 701 and the first anode assembly of the second electrode assembly 702 may be powered individually, particularly in dependence of a deposition property which may be measured by a detector, respectively. Similarly, the second anode assembly of the first electrode assembly 701 and the second anode assembly of the second electrode assembly 702 may be powered individually, particularly depending on a deposition property which may be measured by a detector, respectively. The plasmas generated by adjacent electrode

assemblies can be individually controlled in order to achieve an improved coating result, particularly a uniform coating layer over the whole substrate and/or from substrate to substrate.

[0099] FIG. 8 shows a schematic sectional view of a deposition apparatus 800 according to embodiments described herein. Most of the features of the sputter deposition source of the deposition apparatus 800 of FIG. 8 may correspond to the respective features of the sputter deposition source 400 of FIG. 4 so that reference can be made to the above explanations which are not repeated here.

[00100] The deposition apparatus 800 may comprise a deposition chamber 801, e.g. a vacuum chamber, and a sputter deposition source of any of the embodiments described herein, wherein the sputter deposition source is arranged in the deposition chamber. The deposition chamber can be evacuated, e.g. to a pressure of 10 mbar or less, particularly 1 mbar or less.

[00101] A first substrate holding region 153, e.g. including a first substrate holder, may be provided on the first deposition side 10 of the sputter deposition source for holding a first substrate 151 to be coated, and a second substrate holding region 154, e.g. including a second substrate holder, may be provided on the second deposition side 11 opposite to the first deposition side 10 for holding a second substrate 152 to be coated. A transport system for moving the substrates into and out of the first and second substrate holding regions may be provided. For example, the substrate holders may be movable.

[00102] In the embodiment shown in FIG. 8, two first anodes (e.g. the left first anode 231 and the right first anode 232) of the anode assembly which are arranged on the first deposition side 10 can be individually powered, and two second anodes (e.g. the left second anode 241 and the right second anode 242) of the anode assembly which are arranged on the second deposition side 11 can be individually powered.

[00103] FIG. 9 is a flow diagram illustrating a method of operating a sputter deposition source in accordance with embodiments described herein. The method includes, in box 910, generating a first plasma on a first deposition side 10 of a cathode 125 and generating a

second plasma on a second deposition side 11 of the cathode opposite to the first deposition side 10. In some implementations, the first plasma and the second plasma may be ignited essentially simultaneously and/or may be burning at the same time. In box 920, the first plasma may be influenced with at least one first anode (e.g., with a pair of first anodes) arranged on the first deposition side 10 and/or the second plasma may be influenced with at least one second anode (e.g., with a pair of second anodes) arranged on the second deposition side 11. In optional box 930, a first substrate 151 may be arranged on the first deposition side 10 such as to face the first plasma 131, and a second substrate 152 may optionally be arranged on the second deposition side 11 such as to face the second plasma 141. The first substrate 151 may be coated by sputter deposition from a front surface of the cathode 125, and the second substrate 152 (which may correspond to the first substrate 151 having been moved from the first deposition side to the second deposition side) may be coated by sputter deposition from a rear surface of the cathode 125.

[00104] The time sequence of boxes 910 to 930 can be changed. For example, a substrate may be arranged on the respective deposition side before generating a plasma. The first plasma may be generated by applying a first electric field between the cathode and the at least one first anode, and the second plasma may be generated by applying a second electric field between the cathode and the at least one second anode.

[00105] In some embodiments, influencing the first plasma 131 may include adjusting the first electric field between the cathode and the at least one first anode, and influencing the second plasma 141 may include adjusting the second electric field between the cathode and the at least one second anode. The first electric field and/or the second electric field may be adjusted such as to maintain, e.g., an equal brightness, an equal intensity, or an equal color value of the first plasma and the second plasma.

[00106] In some embodiments, influencing in box 920 may include detecting a deposition property, and controlling, depending on the detected deposition property, at least one of a first anode potential P1, a second anode potential P2, a first electric resistance of a first electric connection 313 connecting the at least one first anode 132 to the first anode

potential P1, and a second electric resistance of a second electric connection 314 connecting the at least one second anode 142 to the second anode potential P2.

[00107] The method and deposition apparatus as disclosed herein can be used for depositing material on substrates. More particularly, the methods disclosed herein allow for a high uniformity of the deposited layers and can therefore be used in the production of displays such as flat panel displays, e.g., TFTs. The disclosed methods may also be used in the production of solar cells, in particular of thin-film solar cells. Given the improved uniformity, as a further effect thereof, the overall material consumption can be reduced which is particularly beneficial when using expensive materials. For instance, the proposed methods could be used for the deposition of an indium tin oxide (ITO) layer in the production of a flat panel display or a thin film solar cell.

[00108] 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 sputter deposition source (100, 200, 300, 400, 500, 600, 700) comprising at least one electrode assembly (120) configured for two-side sputter deposition, wherein the at least one electrode assembly (120) comprises:
 - 5 a cathode (125) for providing a target material to be deposited, wherein the cathode is configured for generating a first plasma (131) on a first deposition side (10) and a second plasma (141) on a second deposition side (11) opposite to the first deposition side (10); and
 - an anode assembly (130) with at least one first anode (132) arranged on the first deposition side (10) for influencing the first plasma (131) and at least one second anode (142) arranged on the second deposition side (11) for influencing the second plasma (141).
2. The sputter deposition source of claim 1, wherein the anode assembly (130) comprises two first anodes (231, 232) arranged on the first deposition side (10) for influencing the first plasma (131) and two second anodes (241, 242) arranged on the second deposition side (11) for influencing the second plasma (141).
3. The sputter deposition source of claim 2, wherein a separation wall (160) with one, two or more wall segments (161, 162) is arranged between the first deposition side (10) and the second deposition side (11), particularly between the at least one first anode (132) and the at least one second anode (142).
4. The sputter deposition source of any of claims 1 to 3, wherein the cathode (125) is a rotatable cathode, particularly a rotatable cylindrical cathode, more particularly a rotatable cathode with two magnet assemblies arranged therein.
5. The sputter deposition source of any of claims 1 or 4, further comprising:
 - a first substrate holding region on the first deposition side (10) for holding a first substrate (151) to be coated such as to face the first plasma (131); and
 - 25 a second substrate holding region on the second deposition side (11) for holding a second substrate (152) to be coated such as to face the second plasma (141),

wherein the cathode (125) is located substantially in the center between the first substrate holding region and the second substrate holding region.

6. The sputter deposition source of any of claims 1 to 5, further comprising:

a power arrangement (310) configured for powering the at least one electrode assembly (120), particularly for connecting the cathode (125) to a cathode potential (P), for connecting the at least one first anode (132) to a first anode potential (P1) and for connecting the at least one second anode (142) to a second anode potential (P2).

7. The sputter deposition source of claim 6, wherein the power arrangement (310) comprises:

a first power supply (311) connected to the cathode (125) and to the at least one first anode (132) for adjusting a first electric field to be applied between the cathode and the at least one first anode; and

a second power supply (312) connected to the cathode (125) and to the at least one second anode (142) for adjusting a second electric field to be applied between the cathode and the at least one second anode.

8. The sputter deposition source of claim 6 or 7, wherein the power arrangement (310) comprises:

a first electric connection (313) connecting the at least one first anode (132) to the first anode potential (P1);

a second electric connection (314) connecting the at least one second anode (142) to the second anode potential (P2); and

at least one variable resistor or potentiometer (315) for adjusting at least one of a first electric resistance of the first electric connection (313) and a second electric resistance of the second electric connection (314).

9. The sputter deposition source of any of claims 6 to 8, further comprising a detector (320) for detecting a deposition property and a control device (330) for controlling

the power arrangement (310) depending on the deposition property, wherein the deposition property comprises one or more of the following:

- an optical property, a location or a shape of at least one of the first plasma (131) and the second plasma (141);
- 5 • a differential current (I_{DIFF}) between the at least one first anode (132) and the at least one second anode (142);
- at least one of a first current flow between the cathode (125) and the at least one first anode (132) and a second current flow between the cathode (125) and the at least one second anode (142);
- 10 • at least one of a first electric field strength between the cathode (125) and the at least one first anode (132) and a second electric field strength between the cathode (125) and the at least one second anode (142); and
- a characteristic of at least one of a first substrate (151) coated on the first deposition side (10) and a second substrate (152) coated on the second deposition side (11).

15 10. The sputter deposition source (700) of any of claims 1 to 9, comprising an array of two or more electrode assemblies (701, 702), wherein each electrode assembly of the two or more electrode assemblies (701, 702) comprises: a cathode configured for generating a first plasma on the first deposition side (10) and a second plasma on the second deposition side (11), and an anode assembly comprising at least one first anode arranged on the first
20 deposition side (10) and at least one second anode arranged on the second deposition side (11).

11. The sputter deposition source of claim 10, further comprising a power arrangement (710) configured for individually powering the two or more electrode assemblies (701, 702), particularly for individually powering the at least one first anode and
25 the at least one second anode of the two or more electrode assemblies (701, 702) in dependence of a deposition property, respectively.

12. A deposition apparatus (800) comprising:

a deposition chamber (801);

a sputter deposition source of any of claims 1 to 11 arranged in the deposition chamber (801);

5 a first substrate holding region (153) on a first deposition side (10) of the sputter deposition source for holding a first substrate (151) to be coated; and

a second substrate holding region (154) on a second deposition side (11) of the sputter deposition source opposite to the first deposition side (10) for holding a second substrate (152) to be coated.

10 13. A method of operating a sputter deposition source, particularly a sputter deposition source of any of claims 1 to 11, comprising:

generating a first plasma (131) on a first deposition side (10) of a cathode (125) and generating a second plasma (141) on a second deposition side (11) of the cathode (125) opposite to the first deposition side (10); and

15 influencing the first plasma (131) with at least one first anode (132) arranged on the first deposition side (10) and/or influencing the second plasma (141) with at least one second anode (142) arranged on the second deposition side (11).

20 14. The method of claim 13, wherein influencing the first plasma (131) comprises adjusting a first electric field between the cathode (125) and the at least one first anode (142) and/or wherein influencing the second plasma (141) comprises adjusting a second electric field between the cathode (125) and at least one second anode (142), particularly adjusting at least one of the first electric field and the second electric field such as to maintain an equal brightness or color value of the first plasma and the second plasma.

15. The method of claim 13 or 14, wherein influencing further comprises:

25 detecting a deposition property; and

controlling, depending on the deposition property, at least one of a first anode potential

(P1), a second anode potential (P2), a first electric resistance of a first electric connection (313) connecting the at least one first anode (132) to the first anode potential (P1), and a second electric resistance of a second electric connection (314) connecting the at least one second anode (142) to the second anode potential (P2).

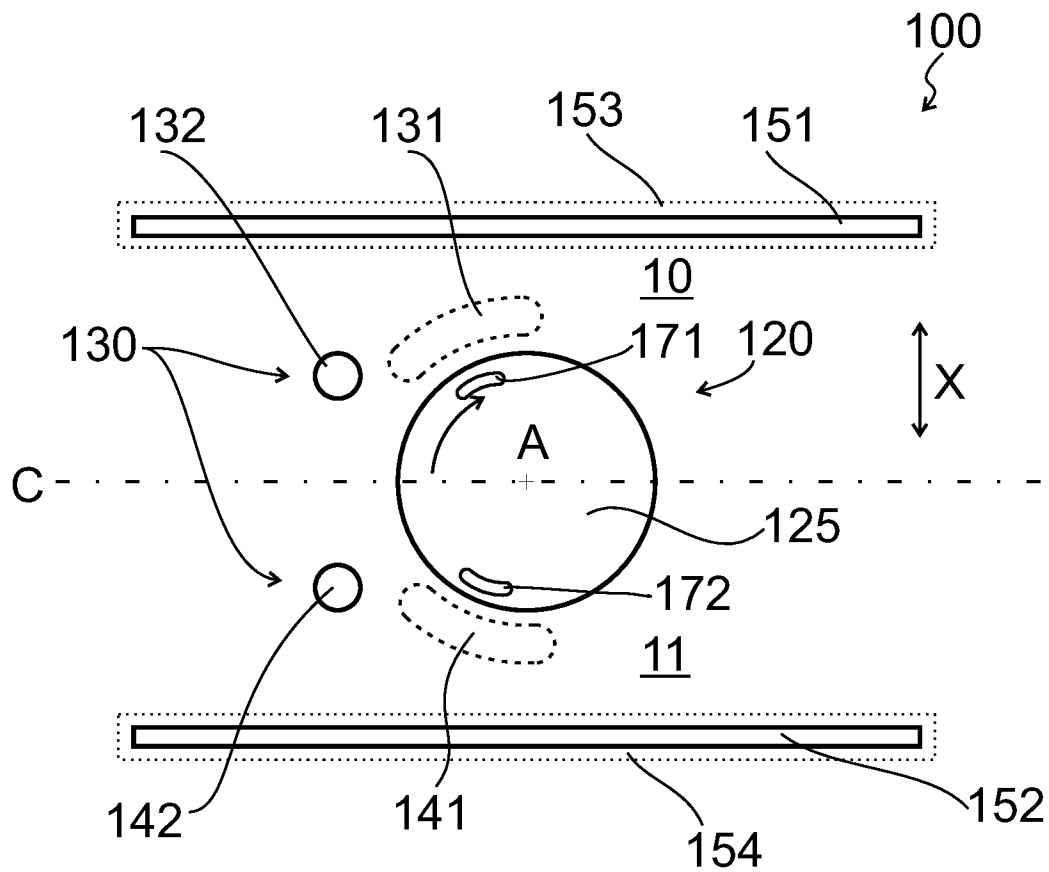


FIG.1

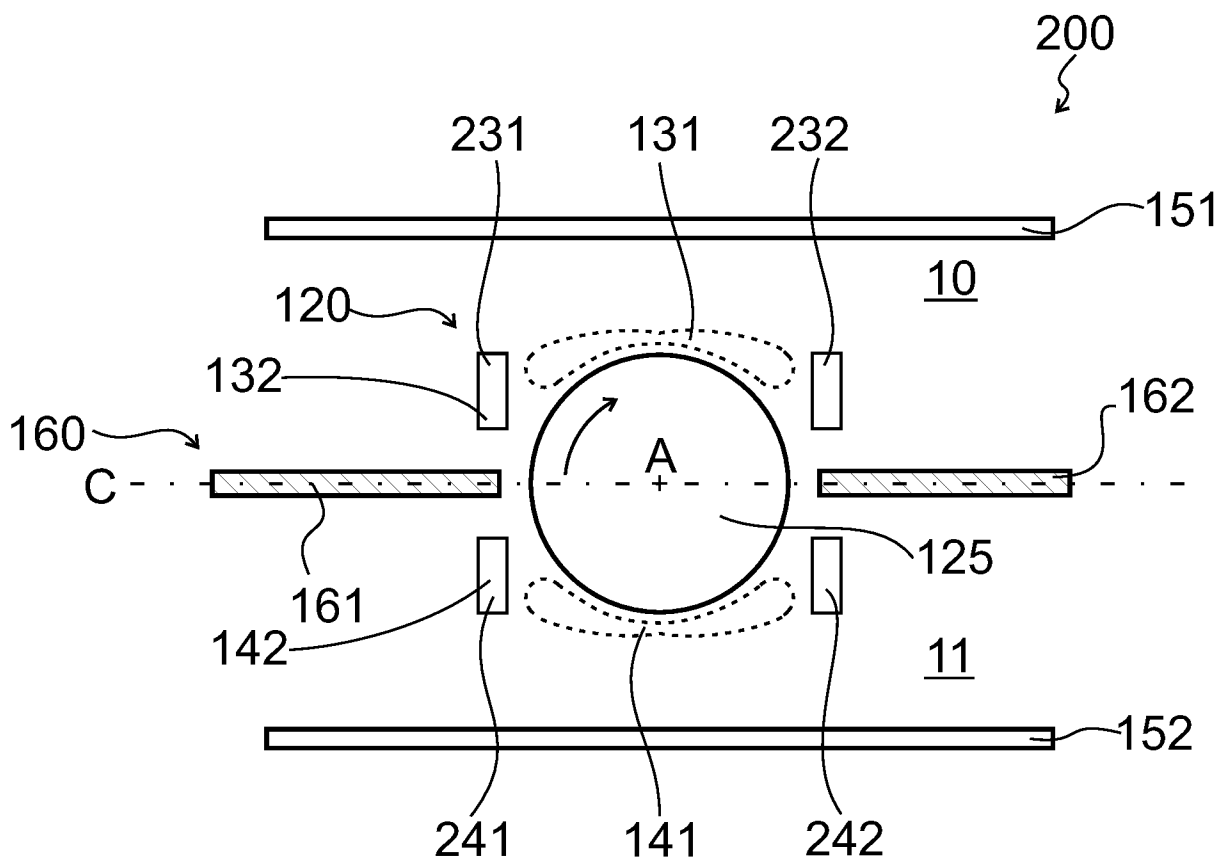


FIG.2

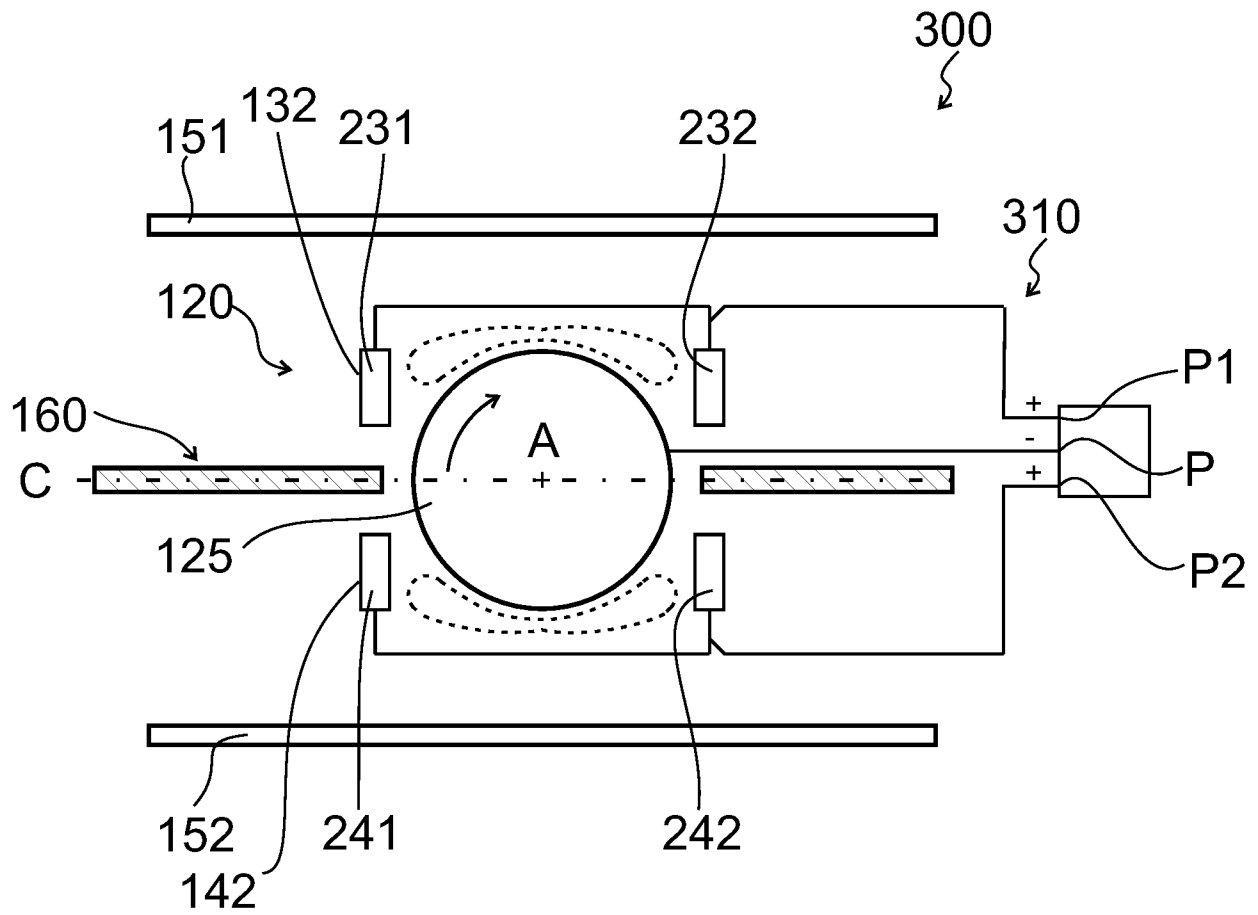


FIG.3

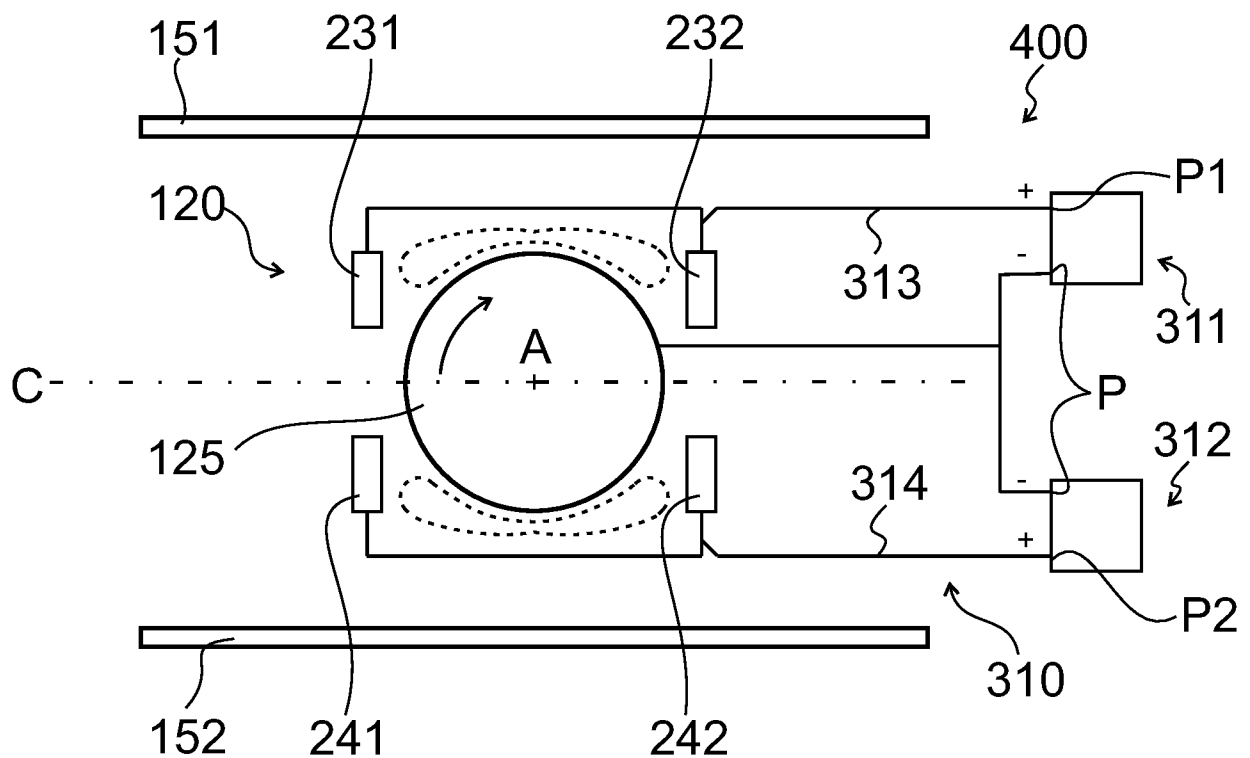


FIG.4

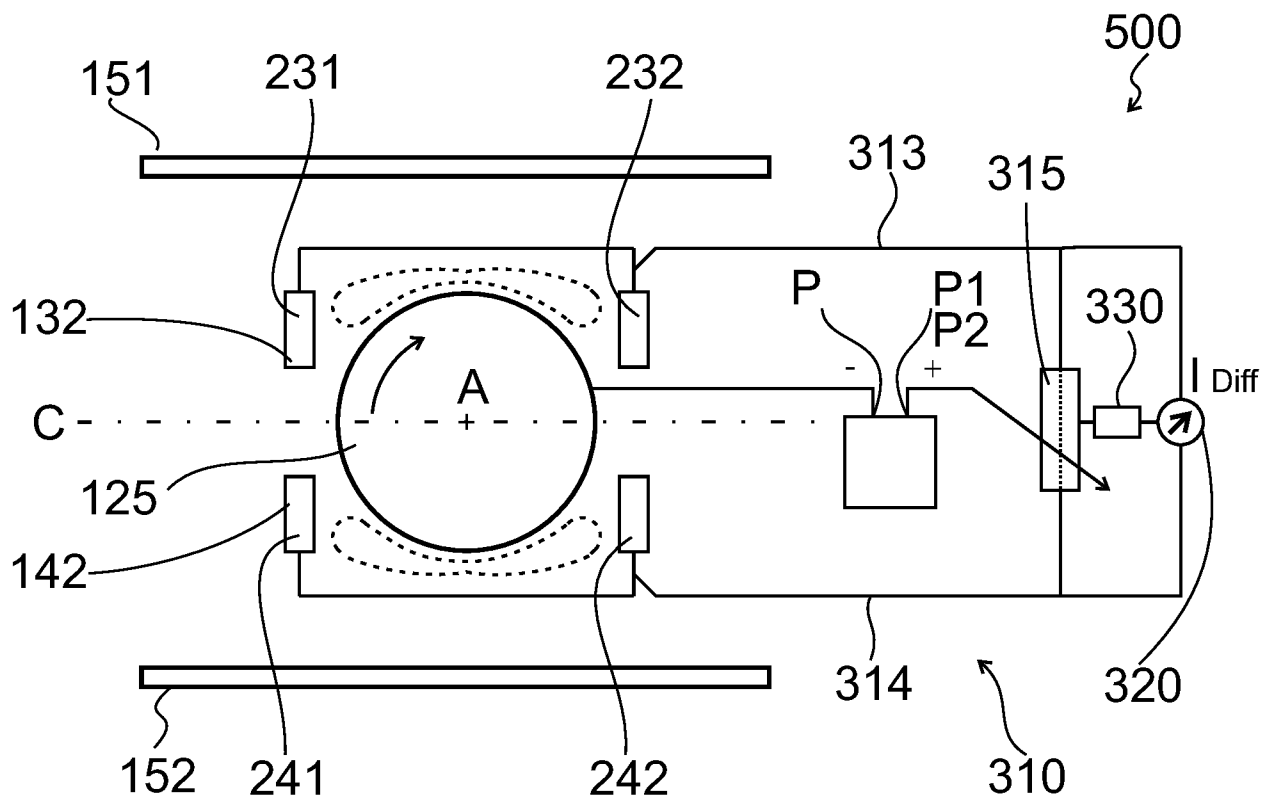


FIG. 5

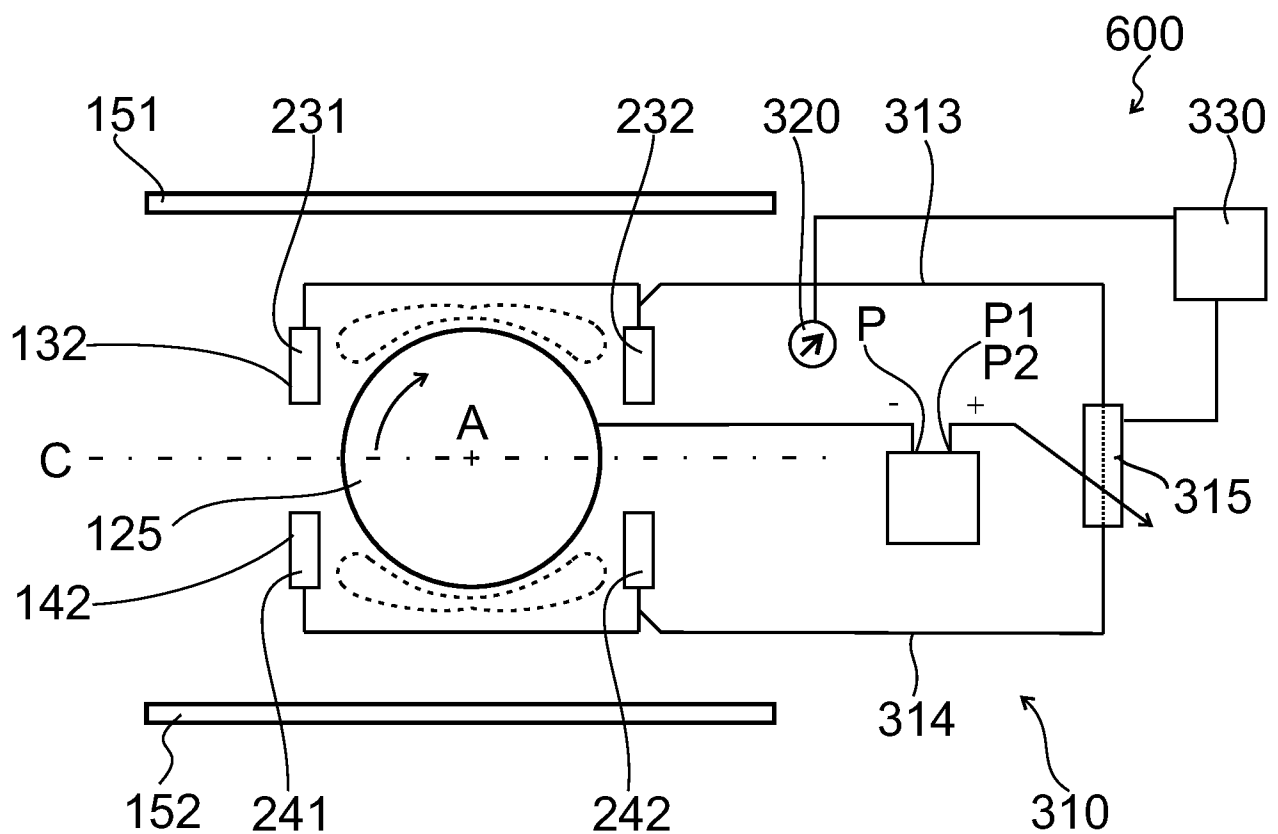


FIG. 6

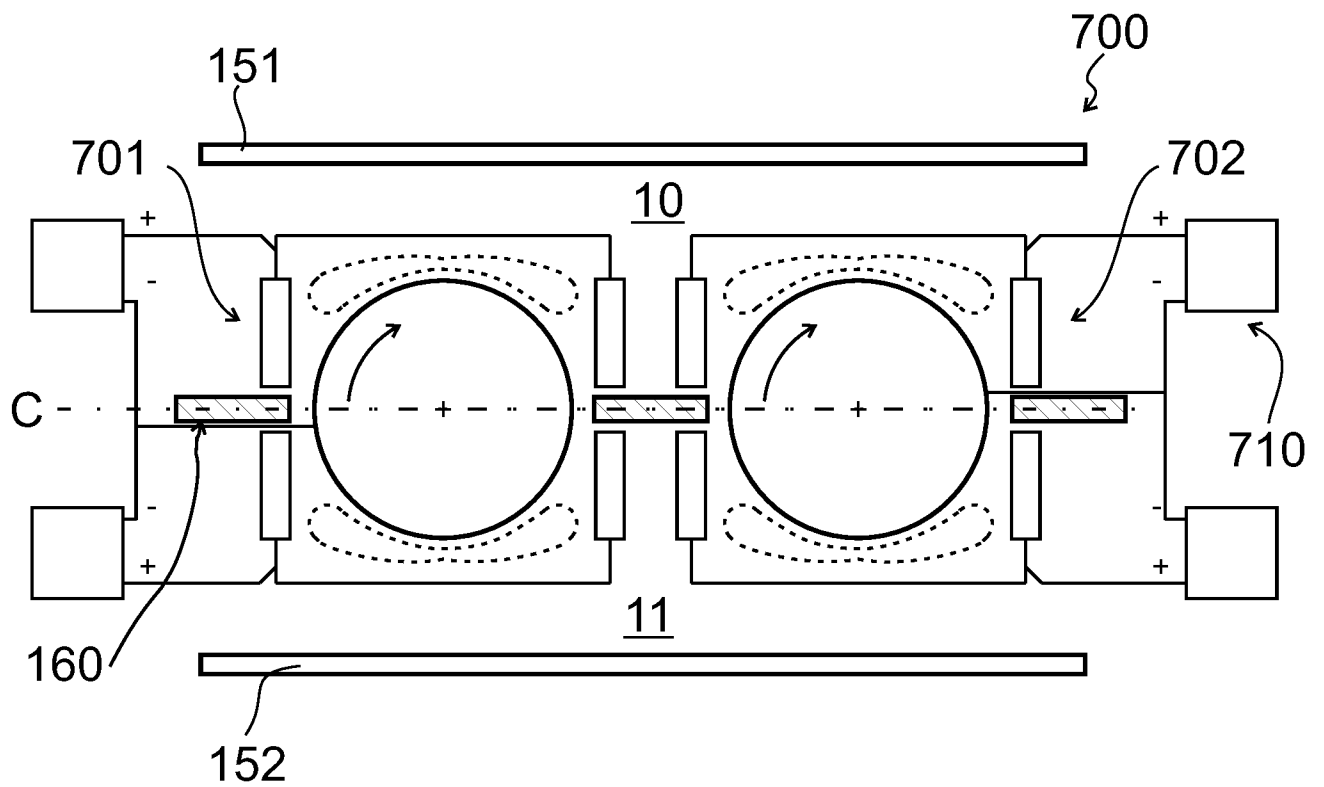


FIG. 7

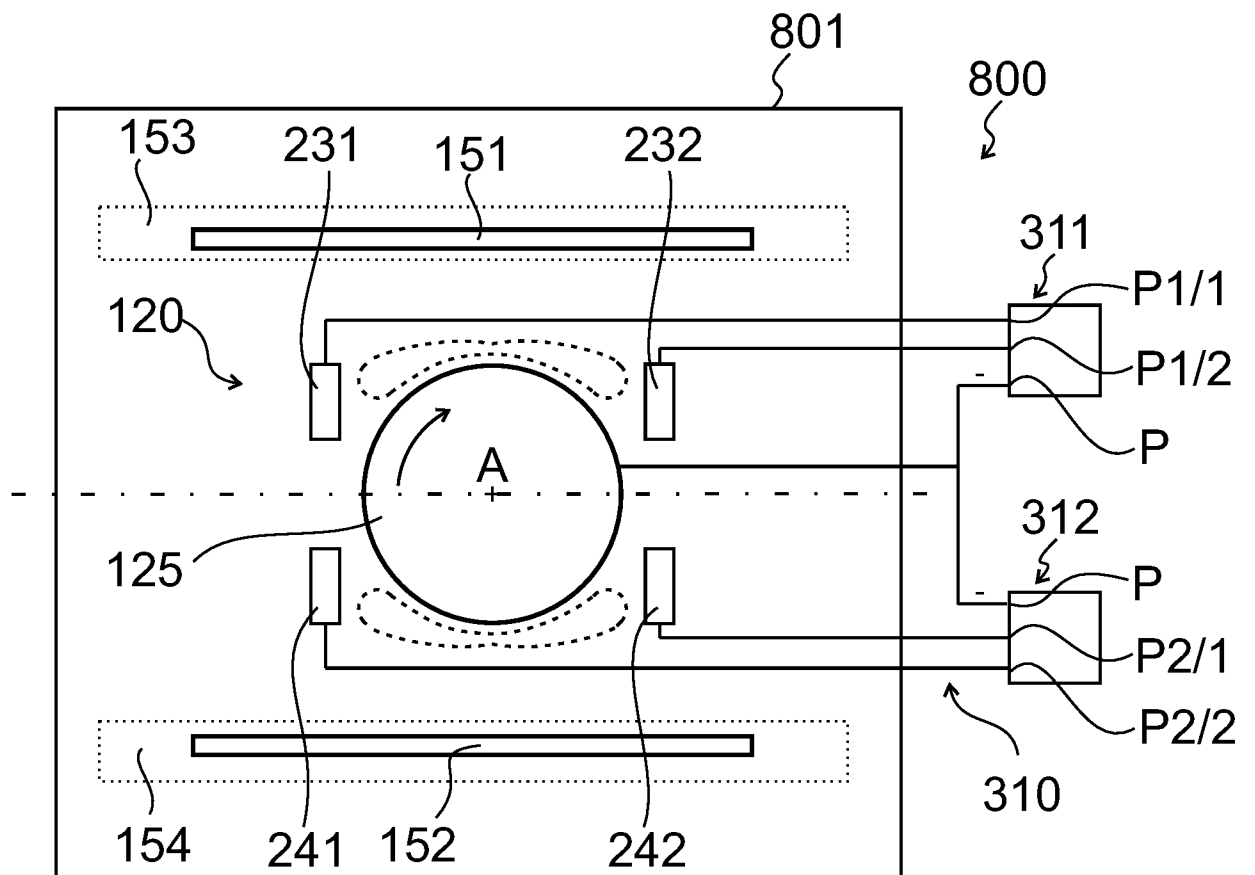


FIG. 8

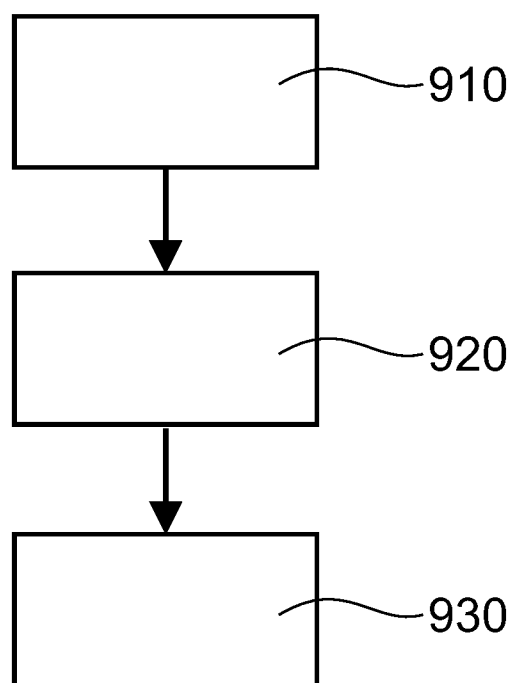


FIG.9

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2016/066551

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01J37/34
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)
H01J C23C

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.
X	GB 1 391 842 A (ELEKTROMAT VEB) 23 April 1975 (1975-04-23) page 1, line 60 - page 2, line 23 page 2, line 71 - line 110 figures 1, 2, 3, 5, 6 -----	1-3,5-15
X	DE 10 2013 206210 A1 (ARDENNE GMBH VON [DE]) 9 October 2014 (2014-10-09) paragraph [0040] - paragraph [0045] figures -----	1,4,5, 10,12,13
X	JP S55 62164 A (TOKUDA SEISAKUSHO) 10 May 1980 (1980-05-10) abstract figures -----	1,2,5, 12,13
	-/-	



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

14 February 2017

Date of mailing of the international search report

21/02/2017

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Authorized officer

Aguilar, María

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2016/066551

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