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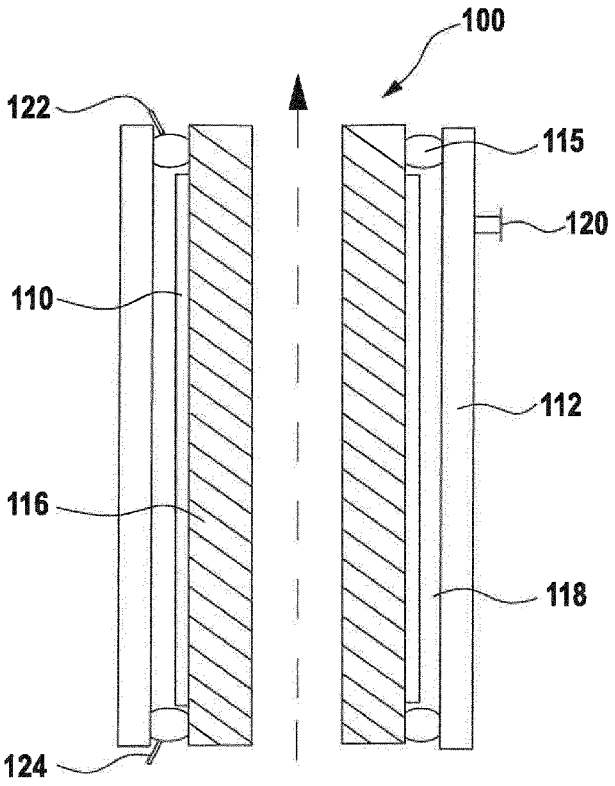
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[Continued on next page]

(54) Title: PROTECTION TUBE FOR REACTIVE TARGETS

(57) Abstract: A method for protecting a target during handling of the target is described. The method includes covering the target with a protection member and sealing the inside of the protection member in an airtight manner, such that a seal is provided between the protection member and the target.

Fig. 1



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PROTECTION TUBE FOR REACTIVE TARGETS

TECHNICAL FIELD

[0001] Embodiments described herein relate to a method for protecting a target, a protection member for a target and a system for protecting a target. Embodiments described herein particularly relate to handling of targets with alkali metals or alkaline earth metals as the target material. In particular, the present disclosure relates to targets used for deposition of alkali metals or alkaline earth metals, such as lithium.

BACKGROUND

[0002] Techniques for depositing thin layers on a substrate are, in particular, evaporating, chemical vapor deposition and sputtering deposition. For example, sputtering can be used to deposit a thin layer such as a thin layer of a metal. During the sputtering process, the coating material is transported from a sputtering target consisting of the material to be deposited on the substrate by bombarding the surface of the target with ions. During a sputtering process, a target may be electrically biased so that ions generated in a process region may bombard the target surface with sufficient energy to dislodge atoms of target material from the target surface. The sputtered atoms may deposit onto a substrate. Alternatively, the sputtered atoms may react with a gas in the plasma, for example nitrogen or oxygen, to deposit e.g. an oxide, a nitride or an oxinitride of the material onto the substrate: This can be referred to as reactive sputtering.

[0003] Modern thin film lithium batteries are, as a rule, produced in a vacuum chamber, wherein a substrate is provided with several layers, including a lithium layer. The lithium layer is formed, for example, through the deposition of lithium in a vapour state on the substrate. Further, alkali metals or alkaline earth metals,

especially lithium, can easily be oxidized in reaction with ambient surroundings, e.g., gases or materials, which passivate the surface of the target. Since lithium is highly reactive, a plurality of measures needs to be addressed to operate and maintain a deposition apparatus where lithium is used.

[0004] Common deposition apparatuses for lithium, and other alkali metals or alkaline earth metals, respectively, may utilize sputtering sources or evaporation sources and methods of operating thereof. Sputtering methods for lithium are challenging, particularly with respect to costs and manufacturability, in light of the reactivity of lithium. The high reactivity firstly influences the manufacturing of the target, which is a necessary component for sputtering, and secondly influences the handling of the resulting targets. Accordingly, shipment, installation, preventive maintenance, etc., is more difficult as compared to non-reactive targets as the target material needs to be protected from reaction with ambient air.

[0005] Non-uniformity of depositions using lithium targets is another issue. For example, the morphology of the lithium metal may be different in different areas of the target sputter surface. Attempts to clean the lithium target surface by sputtering off oxide or other passivating coatings may be incomplete in some areas and this non-uniformity is carried through to the lithium deposition to substrate process.

[0006] A particular problem derives from the fact that lithium reacts intensely with water, forming lithium hydroxide in aqueous solution and highly flammable hydrogen. The lithium-water reaction at normal temperatures is brisk but nonviolent, as the hydrogen produced will not ignite alone. Even if the lithium-water reaction may be nonviolent, the target material may be damaged if lithium contacts water. As a result, some parts of the target material, or the whole target material, might be unusable for sputtering. Contact between water and the reactive target material can occur during handling of a target. As used herein, handling may include shipment, storing, installation and removal of a target assembly. The target assembly can have fluid conduits in the interior, e.g., a cooling area with water as a cooling fluid. These fluids may contact the target material of the target assembly during handling and provoke damages on the target material.

[0007] In view of the above, there is a need for methods for protecting a target in order to ensure the quality of the target material and avoid possible risk situations.

SUMMARY

[0008] In light of the above, a method for protecting a target of the target, a protection member for a target and a system for protecting a target are provided. Further aspects, advantages, and features of the embodiments of the present disclosure are apparent from the dependent claims, the description and the accompanying drawings.

[0009] According to one aspect, a method for protecting a target of the target is provided. The method includes covering the target with a protection member; and sealing the inside of the protection member in an airtight manner, such that a seal is provided between the protection member and the target.

[0010] According to another aspect, a protection member for a target is provided. The protection member has a tube structure and is positioned to cover the target.

[0011] According to another aspect, a system for protecting a target is provided. The system includes a protection member for a target and a target comprising a target material, wherein the target material is an alkali metal or alkaline earth metal.

[0012] The disclosure is also directed to an apparatus for carrying out the disclosed methods and including apparatus parts for performing each described method features. These method features 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, the disclosure is also directed to methods describing the apparatus operation. It includes methods for carrying out every function of the apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] So that the manner in which the above recited features of embodiments of the disclosure can be understood in detail, a more particular description of the embodiments, briefly summarized above, may be had by reference to embodiments described herein. The accompanying drawings relate to embodiments of the present disclosure and are described in the following:

Fig. 1 shows a schematic cross section of a rotary target with a protection member along a rotational axis, according to embodiments described herein;

Fig. 2 shows a schematic cross sectional top view of a rotary target with a protection member, according to embodiments described herein;

Fig. 3 shows a schematic perspective view of a rotary target with a protection member, wherein the protection member is in the form of two half pipes, according to embodiments described herein;

Fig. 3A shows a schematic perspective view of a sputtering chamber comprising an array of rotary targets with a protection member, according to embodiments described herein; and

Fig. 4 shows a flow chart illustrating a method for protecting a target, according to embodiments described herein.

DETAILED DESCRIPTION OF EMBODIMENTS

[0014] Reference will now be made in detail to the various embodiments of the present 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 the same components. Generally, only the differences with respect to individual embodiments are described. Each example is provided by way of explanation of embodiments of the disclosure and is not meant as a limitation of the embodiments. 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.

[0015] A target as described herein refers to a target assembly including a backing structure, to which a reactive target material to be sputtered might be applied. The backing structure can be a plate, cylinder, tube or other structure. The term "target assembly" as used herein refers to any cathode assembly which is adapted to be mounted to a deposition apparatus and which includes a target material for being sputtered.

[0016] Embodiments described herein relate to alkali metals or alkaline earth metals when used as a target material for a sputtering process. In particular, embodiments described herein relate to lithium when used as a target material for a sputtering process. Some properties of lithium, e.g., sensitivity to moisture and/or air exposure, relatively soft and malleable, and relatively low melting point, make it a challenging material for the fabrication of lithium sputter targets and their use in sputtering processes. For example, exposure to ambient air oxidizing vapours, in particular H_2O, and contact with personnel after opening the vacuum chamber should be minimized.

[0017] Compared to other alkali metals, lithium is of particular interest since it is suitable for the production of high energy density batteries and accumulators. For instance, these batteries might be interesting for industrial transport vehicles or for batteries in laptops, phones and other electronic devices.

[0018] As described above, the high reactivity of lithium influences the handling of the resulting targets. As a result, shipment, installation, storing or preventive maintenance may be more difficult as compared to non-reactive targets. Accordingly, it is desired to protect the target material from reaction with ambient air, moisture

and the atmosphere generally. In particular, it is desired to protect the target from reacting with water.

[0019] One measure might be to apply a removable coating to the surface of the target. The removable coating may avoid the target material reacting with the atmosphere and may sputter away easily. However, a coating may not be able to protect the target material from reacting with water and may contaminate the coating chamber when sputtered away. Furthermore, the coating may be damaged during handling of the target such that the target material is exposed to the ambient air.

[0020] Accordingly, a method for protecting a reactive target during handling is needed in order to ensure the quality of the target material and avoid a burn risk.

[0021] According to embodiments described herein, to compensate for these effects, embodiments described herein relate to methods for protecting a target. The method may include covering the target with a protection member and sealing the inside of the protection member in an airtight manner, such that a seal is provided between the protection member and the target. In particular, an easy shield installation in form of a protection tube might be installed over the target. Accordingly, damage of the target material may be avoided. As a result, embodiments of the present disclosure ensure the quality of the target material and avoid a burn risk.

[0022] As used herein, the term “to cover” refers to placing an object upon the target as for protection. The object may be understood as a standalone object with firmness.

[0023] According to embodiments of the present disclosure, the target may be a rotary target. The term “rotary target” as used herein refers to any cathode assembly which is adapted to be rotatably mounted to a deposition apparatus and which includes a target structure adapted for being sputtered. Accordingly, the term “rotary target” is used herein synonymously with “rotary cathode”. According to yet further embodiments, which can be combined with other embodiments described herein, the rotary target can be cylindrical, for example such that the distance between a

substrate and the target surface is constant during rotation of the rotary target. According to yet further embodiments, which can be combined with other embodiments described herein, the rotary target may include a single target material, as compared to sputtering applications, wherein switching between different target materials is provided by a rotational movement of two or more different targets or wherein switching between different targets is provided by a rotational movement of the different targets.

[0024] Compared to a planar target, the rotary target may have the following beneficial effects: increased coater up-time thanks to a higher utilization rate of the target material, maximized coater throughput through increased sputter rates, focused sputtering flux leading to enhanced process efficiency and less target cleaning, and reduced coater down-time thanks to simple operations needed to replace the target.

[0025] Referring to FIG. 1, a schematic drawing of the cross section of a target 100 is shown. According to embodiments of the present disclosure, the target may have a target material 110 to be sputtered. The target material to be sputtered might be applied to a backing structure 116. The backing structure may be a plate, a cylinder, a tube or other structure. The target may have a cooling area (not shown) that is liquid-tightly mounted to a coolant tube for cooling the target 100. The backing structure 116 works as a barrier between the target material and the cooling area. The target material 110 may be an alkali metal or an alkaline earth metal. In particular, the target material may be lithium and the target 100 may be a lithium target. Since lithium is a reactive material such a target may be considered as a reactive target. As used herein, the term “lithium target” is used synonymously with the term “reactive target”.

[0026] As described above, the high reactivity of lithium influences the handling of the resulting targets. As shown in FIG. 1, the target 100 may be covered with a protection member 112 in order to protect the target material 110. Accordingly, contact of the target material with ambient surroundings during handling of the target may be avoided. As a result, the quality of the target material is ensured and burn risks can be avoided. The protection member of the present embodiments may be understood as a standalone object with firmness. That is, the protection member may

be an independent member from the target. Accordingly, the same protection member may be used several times for the same target or the same protection member may be used several times for different targets. The protection member may allow for a space between the inner surface of the protection member and the surface of the target material. This excludes the use of coatings or protective layers applied directly on the surface of the target material. Examples of possible protection members of the present disclosure may be a solid hollow cylinder, an inflatable hollow cylinder, a bag or a condom-like sheath.

[0027] According to embodiments described herein, the protection member may be positioned to cover the target. According to embodiments herein, the protection member might be pulled over the target to protect the target material.

[0028] According to further embodiments, which can be combined with other embodiments described herein, the protection member 112 may comprise a seal 115. According to yet further embodiments, the seal 115 may be an inflatable seal having an interior cavity. The interior cavity may be fillable with air, gas or liquid as a seal medium. As shown in FIG. 1, the seal may be placed between the inner surface of the protection member 112 and the target 100. According to embodiments of the present disclosure, a first seal may be placed at one side of the protection member and a second seal may be placed at another side of the protection member. According to further embodiments of the present disclosure, a first seal may be placed on the top part of the protection member and a second seal may be placed on the bottom part of the protection member. Accordingly, leakage or inlet of air, gas or liquid into the space 118 can be avoided even if the target is out of a vacuum deposition chamber or if the target is opened at a top part and/or a bottom part for filling or draining of the fluid conduits. As a result, the quality of the target material can be ensured and a burn risk may be avoided. Using a protection member further protects the surface of the target material against mechanical impacts that might occur during handling of the target.

[0029] As described herein, an inflatable seal may work by introduction of an inflation pressure into the cavity of the inflatable seal. This inflation pressure may cause the displacement of the seal effecting a positive seal between the inner surface

of the protection member 112 and the target 100. Once the inflation pressure of the seal is removed, the seal may return to its uninflated or relaxed position. Inflatable seals may offer versatile configurations in three different planes: radially in, radially out, and axially. According to further embodiments of the present description, the seal 115 may be made of silicone or any other rubber material.

[0030] According to different embodiments of the present disclosure, the protection member may have a tube structure. As used herein, the term "tube" is used synonymously with the term "hollow cylinder". According to further embodiments, the protection member 112 may be a soft tube. The term "soft tube" as used herein refers to a tube which gives little or no resistance to pressure or weight. That is, a soft tube might be inflated with air, gas or liquid in order to provide a structural stand. According to different embodiments herein, the soft tube may be made of synthetic rubber, polyethylene, flexible polyvinyl chloride or fiber reinforced plastic.

[0031] According to different embodiments, which can be combined with other embodiments described herein, the protection member 112 may be a solid tube. The term "solid tube" as used herein refers to a tube having firmness and resistance to pressure and weight. According to further embodiments, the material of the solid tube can be selected from the group consisting of: polymers like acrylic, polyethylene, polypropylene or polyvinyl chloride, non-reactive metals or alloys of non-reactive metals, and ceramic materials.

[0032] According to embodiments of the present disclosure, the target 100 and the protection member 112 may be concentric tubes. According to further embodiments of the present disclosure, the protection member may have a thickness between 1-20 mm. Particularly, the protection member may have a thickness of 5 mm or more, more particularly, the protection member may have a thickness of 6 mm. The thickness of the protection member refers to the wall thickness of the protection tube, described as W in FIG. 2.

[0033] According to different embodiments, which can be combined with other embodiments described herein, there might be a space 118 between the inner surface of the protection member 112 and the surface of the target material 110. The space

118 may work as an isolation channel, in order to protect the target material from degradation by contact with undesired gases, materials or fluids. According to embodiments of the present disclosure, the inner surface of the protection member may be at a distance of 2 mm or more from the surface of the target material, particularly, the inner surface of the protection member may be at a distance of 5 mm or more from the surface of the target material, more particularly, the inner surface of the protection member may be at a distance of 10 mm from the surface of the target material. As can be seen from FIG. 1, according to further embodiments, the protection member 112 may cover the complete surface of the target material 110 and part of the target 100 without target material on it.

[0034] According to embodiments of the present disclosure, the target 100 may be between 0.1 m and 5 m long, particularly, between 1 m and 5 m long, more particularly, between 2 m and 4 m long.

[0035] According to different embodiments, which can be combined with other embodiments described herein, the protection member may comprise tension bands for sealing the target. The tension bands provide an easy installation when the protection member is an inflatable hollow cylinder.

[0036] According to embodiments of the present disclosure, which can be combined with other embodiments described herein, the protection member may comprise a first gas inlet 120, a second gas inlet 122 and a third gas inlet 124. The first gas inlet may provide a protective atmosphere or vacuum to the interior of the protection member. In particular, the first gas inlet may provide a protective atmosphere to the space 118. Accordingly, the target material might be protected from degradation by contact with undesired gases, materials or fluids. As a result, the quality of the target material can be ensured. According to further embodiments, the first gas inlet may work as a pump flange or a venting flange. In particular, the first gas inlet may work as a pump flange when it is desired to provide a protective atmosphere to the interior of the protection member. On the other hand, the first gas inlet may work as a venting flange when evacuation of the interior of the protection member is desired.

[0037] According to different embodiments, which can be combined with other embodiments described herein, the protective atmosphere might be provided by an inert gas. More particularly, the protective atmosphere might be provided by Argon.

[0038] According to further embodiments, which can be combined with other embodiments described herein, the second gas inlet 122 and the third gas inlet 124 may be on the seal 115. According to embodiments herein, the second gas inlet may work as a pneumatic valve. Likewise, the third gas inlet may work as a pneumatic valve. According to further embodiments of the present description, the second gas inlet and the third gas inlet may be made of the same material as the seal 115, i.e., silicone or any other rubber material.

[0039] According to embodiments herein, the second gas inlet may allow for filling air, gas or liquid into a first seal on the top part of the protection member. The third gas inlet may allow filling air, gas or liquid into a second seal on the bottom part of the protection member. Accordingly, the top and the bottom part of the target may be sealed, such that the target material can be protected from degradation by contact with undesired gases, materials or fluids. As a result, the quality of the target material can be ensured and a burn risk may be avoided. According to different embodiments, the second gas inlet may allow for draining the air, gas or liquid from the first seal on the top part of the protection member. Likewise, the third gas inlet may allow for draining the air, gas or liquid from the second seal on the bottom part of the protection member. Accordingly, the first seal on the top part of the protection member and/or the second seal on the bottom part of the protection member may return to the uninflated or relaxed position. As a result, the protection member can be removed from the target and this allows the target material to be sputtered.

[0040] FIG. 2 shows a schematic drawing of a top view of the target of FIG. 1. According to embodiments of the present disclosure, the target 200 may have a target material 210 to be sputtered. According to present embodiments, the target material may be applied to a backing structure 216.

[0041] The target material 210 may be an alkali metal or an alkaline earth metal. In particular, the target material may be lithium and the target 200 may be a lithium

target. As shown in FIG. 2, the target 200 may be covered with a protection member 212 in order to protect the target material 210. Accordingly, contact of the target material with ambient surroundings during handling of the target may be avoided. As a result, the quality of the target material is ensured and burn risks can be avoided. Using a protection member further protects the surface of the target material against mechanical impacts that might occur during handling of the target.

[0042] According to further embodiments, the protection member 212 may be a soft tube or a solid tube. According to different embodiments, which can be combined with other embodiments described herein, there might be a space 218 between the inner surface of the protection member 212 and the surface of the target material 210. The space 218 may work as an isolation channel, in order to protect the target material from degradation by contact with undesired gases, materials or fluids.

[0043] As shown in FIG. 2, a magnetron 240 may be positioned within the hollow core of the target assembly. The magnetron 240 may be rotated. According to embodiments herein, the target assembly may have fluid conduits in the interior. For instance, a cooling fluid may cool the target assembly by flowing into a cooling area 230 between the backing structure 216 and a magnet cover tube 235. The magnet cover tube 235 may prevent the cooling fluid from interfering with the magnetron movement. According to further embodiments herein, the cooling fluid may exit the target assembly by flowing through the exit area 242 corresponding to the center axis of the target assembly. Embodiments herein provide a method for protecting a target during handling of the target in case the fluid conduits in the interior of the target remain open. Accordingly, damage of the target material may be avoided. As a result, embodiments of the present disclosure ensure the quality of the target material and avoid a burn risk.

[0044] FIG. 3 shows a schematic drawing of a perspective view of a target 300. According to embodiments of the present disclosure, the target 300 may have a target material 310 to be sputtered. The target material 310 may be an alkali metal or an alkaline earth metal. In particular, the target material may be lithium and the target may be a lithium target. As shown in FIG. 3, the target assembly may be covered with a protection member 312 in order to protect the target material. Accordingly,

contact of the target material with ambient surroundings during handling of the target may be avoided. As a result, the quality of the target material is ensured and burn risks can be avoided.

[0045] According to further embodiments, the protection member may comprise two tube sections 312a, 312b in the form of half pipes. The tube sections may be connected to each other with a lip seal 350 positioned along the longitudinal axes of the two tube sections. The term "half pipe" as used herein refers to half sections along the longitudinal axis of a pipe or tube with a concave surface. According to different embodiments, which can be combined with other embodiments described herein, the tube sections 312a, 312b may be soft tube sections. The term "soft tube section" as used herein refers to a tube section which gives little or no resistance to pressure or weight. According to further embodiments, the tube sections 312a, 312b may be solid tube sections. The term "solid tube section" as used herein refers to a tube having firmness and resistance to pressure and weight.

[0046] According to embodiments herein, the two tube sections may be connected to each other with two lip seals 350 on both end sides of the tube section. The lip seals may be pressed against the two tube sections to provide a closed tube similar to the protection member 112, 212. According to different embodiments, the two tube sections may be vulcanized to provide a closed tube. Vulcanized materials have superior mechanical properties to other materials that did not undergo such a chemical process.

[0047] As shown in FIG. 3, a further seal 115 may be placed between the inner surface of the protection member and the target 300. By placing a seal between the inner surface of the protection member and the target, air, gas or liquid leakage from the inside of the protection member can be avoided. Likewise, inlet of air, gas or liquid into the inside of the protection member might also be avoided. As a result, the quality of the target material can be ensured. The use of two tube sections in the form of half pipes as a protection member allows for a better installation. When working with long targets (e.g., targets with more than 3 m) the use of two tube sections in the form of half pipes might be desired. Accordingly, pulling the protection member over the target might be avoided. As a result, less space is needed when mounting the

protection member to the target or unmounting the protection member from the target.

[0048] FIG. 3A shows a schematic drawing of a perspective view of a sputtering chamber 355 comprising an array of rotary targets with a protection member. The target array 330 may comprise 2 or more targets 300. In particular, the target array may comprise 10 targets. According to embodiments of the present disclosure, the targets 300 may have a target material to be sputtered. In particular, the target material may be lithium and the targets may be lithium targets.

[0049] As shown in FIG. 3A, each target of the target array may be covered with a protection member 312 in order to protect the target material. Accordingly, contact of the target material with ambient surroundings during handling of the target may be avoided. As a result, the quality of the target material is ensured and burn risks can be avoided. The protection member 312 may be a protection tube covering the target material and part of the target 300.

[0050] According to further embodiments, which can be combined with other embodiments described herein, the protection member 312 may comprise a seal 115 placed between the inner surface of the protection member and the target 300. The seal 115 may be an inflatable seal having an interior cavity. The interior cavity may be fillable with air, gas or liquid as a seal medium. By placing a seal between the inner surface of the protection member and the target, air, gas or liquid leakage from the inside of the protection member can be avoided. Likewise, inlet of air, gas or liquid to the inside of the protection member might also be avoided. As a result, the quality of the target material can be ensured.

[0051] An embodiment of a method for protecting a target during handling of the target is shown as a schematic drawing in FIG. 4. The method may include covering the target with a protection member 402 and sealing the inside of the protection member in an airtight manner such that a seal is provided between the protection member and the target 404. Accordingly, damage of the target material may be avoided. As a result, embodiments of the present disclosure ensure the quality of the target material and avoid a burn risk.

[0052] According to some embodiments, which can be combined with other embodiments described herein, the method for protecting the target may further provide a protective atmosphere to the interior of the protection member. The protective atmosphere may be provided through a first gas inlet 120 after evacuating the interior of the protection member. According to different embodiments, the protective atmosphere may be provided without previous evacuation of the interior of the protection member since by pumping the protective atmosphere, the interior of the protection member may be evacuated. According to further embodiments, the method for protecting the target may evacuate the interior of the protection member. Accordingly, the target material may be protected by a vacuum from undesired gases, materials or fluids.

[0053] The embodiments described herein can be utilized for evaporation on large area substrates, for example, architectural scale windows having, e.g., electrochromic devices thereon including lithium, or lithium battery manufacturing. 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 20 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 25 (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.

[0054] According to embodiments of the present disclosure, a system for protecting a target may be provided. The system may include a protection member 112, 212, 312a, 312b and a target 100, 200, 300 comprising a target material 110, 210, 310,

wherein the target material is an alkali metal or alkaline earth metal. According to further embodiments, the target material may be lithium or lithium alloy.

[0055] According to embodiments of the present disclosure, the target may be a rotary target vertically positioned. Vertically positioned as used herein refers to a rotary target that lies in a plane, such that the axis of rotation for the rotary target is perpendicular to the ground. An advantage of a vertical arrangement is that any particles created during processing will fall towards the bottom of a chamber and not contaminate the substrate.

[0056] According to further embodiments, the target may be a target appropriate to be connected to an AC power supply or a DC power supply.

[0057] While the foregoing is directed to embodiments of the present disclosure, other and further embodiments may be devised without departing from the basic scope thereof, and the scope thereof is determined by the claims that follow.

CLAIMS

1. A method for protecting a target, said method comprising:

covering the target with a protection member; and

sealing the inside of the protection member in an airtight manner, such that a seal is provided between the protection member and the target.

2. The method of claim 1, comprising providing a protective atmosphere to the interior of the protection member and/or evacuating the interior of the protection member.

3. The method of any of the preceding claims, wherein sealing the inside of the protection member comprises sealing a top part of the protection member and sealing a bottom part of the protection member.

4. The method of claim 2, wherein the protective atmosphere is provided by an inert gas.

5. The method of claim 4, wherein the inert gas is Argon.

6. The method of any of the preceding claims, comprising opening the target at a top part and/or a bottom part, the target comprising a target material.

7. The method of any of the preceding claims, comprising pressing a lip seal against two tube sections of the protection member, wherein the tube sections are in the form of half pipes.

8. A protection member for a target, wherein the protection member is positioned to cover the target and wherein the protection member comprises a seal.

9. The protection member of claim 8, wherein the protection member has a tube structure.

10. The protection member of any of claims 8 to 9, wherein the protection member comprises a first gas inlet for providing a protective atmosphere to the interior of the protection member, a second gas inlet and a third gas inlet.

11. The protection member of claim 10, wherein the first gas inlet is a pump flange, and/or wherein the second and/or third gas inlets are pneumatic valves.

12. The protection member of any of claims 8 to 11, wherein the tube structure comprises two tube sections in the form of half pipes connected to each other with a lip seal positioned along the longitudinal axes of the two tube sections.

13. A system for protecting a target during handling of the target, said system comprising:

a protection member according to claim 8; and

a target comprising a target material, wherein the target material is an alkali metal or alkaline earth metal.

14. The system of claim 13, wherein the target material is lithium or lithium alloy.

15. The system of either of claims 13 to 14, wherein the target is a rotary target vertically positioned.

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Fig. 1

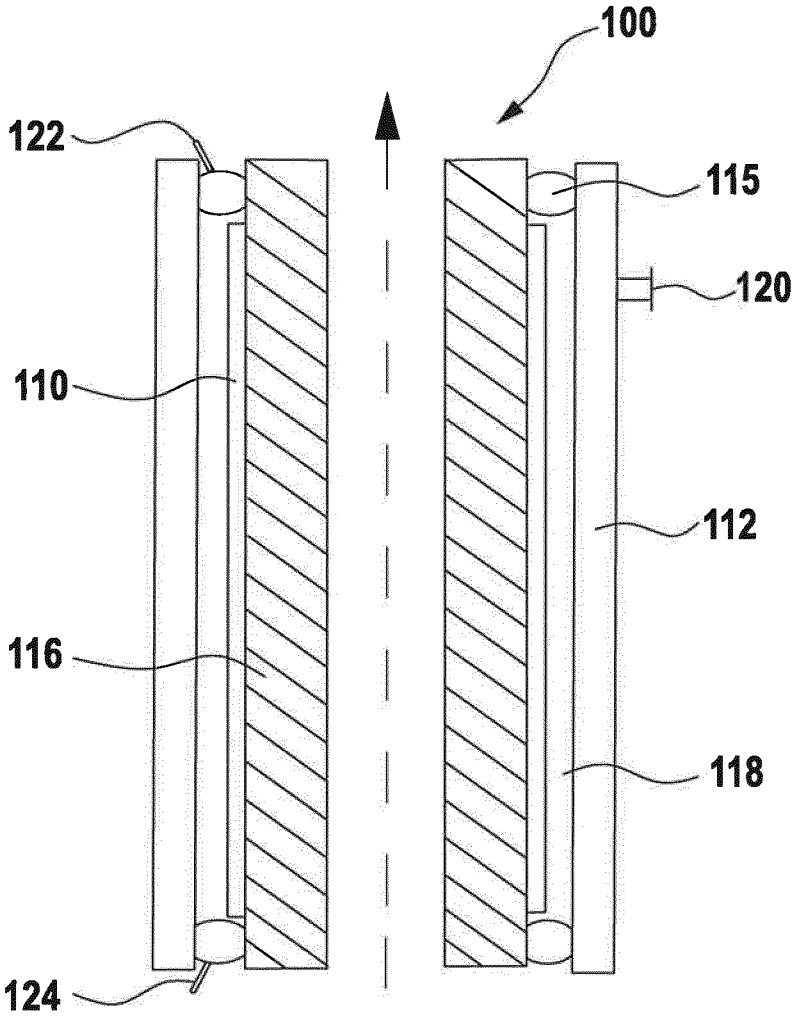

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Fig. 2

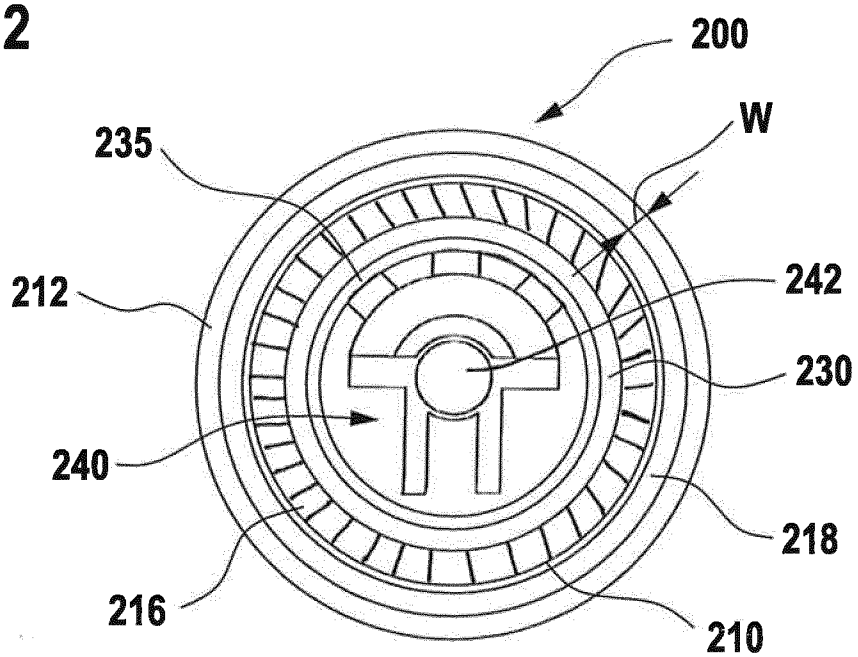

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Fig. 3

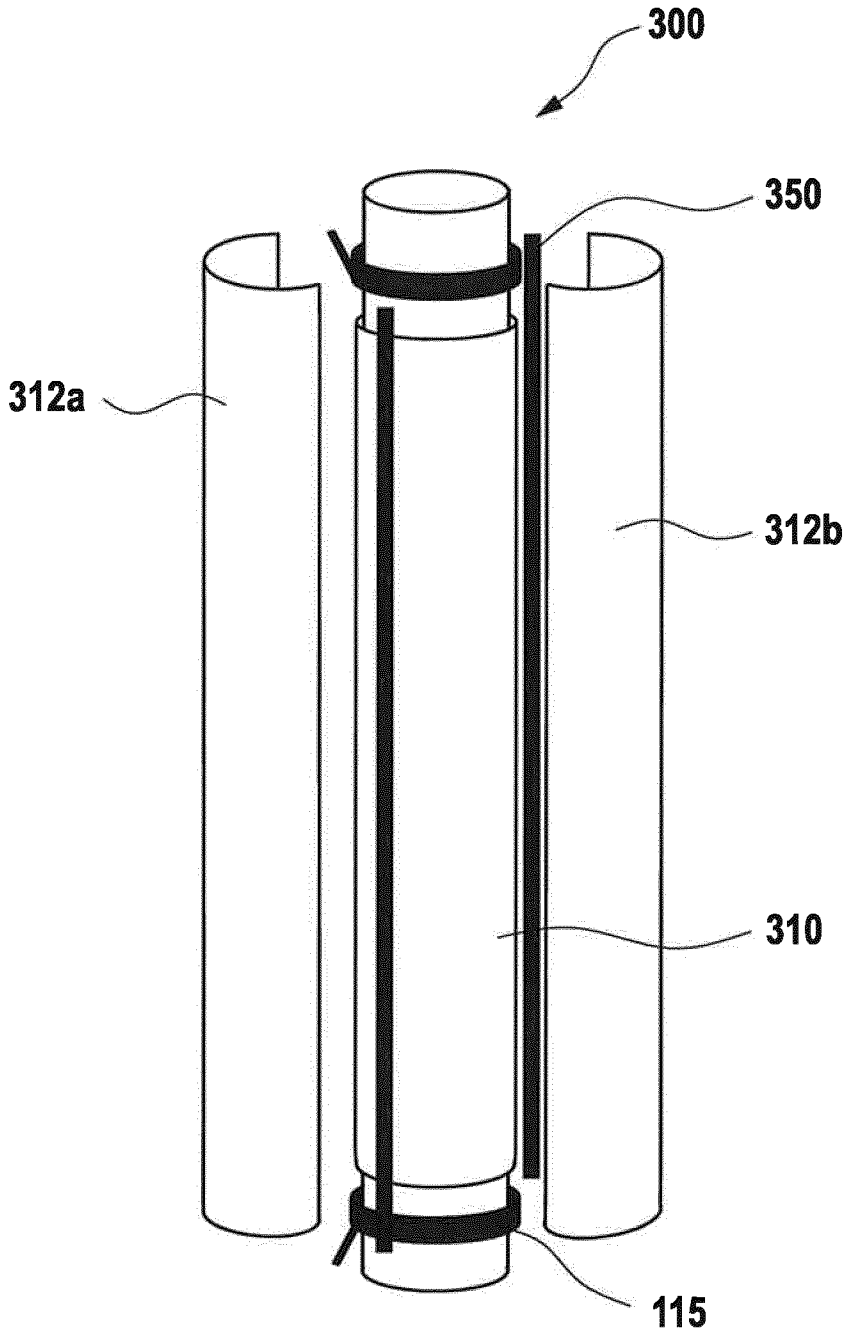


Fig. 3A

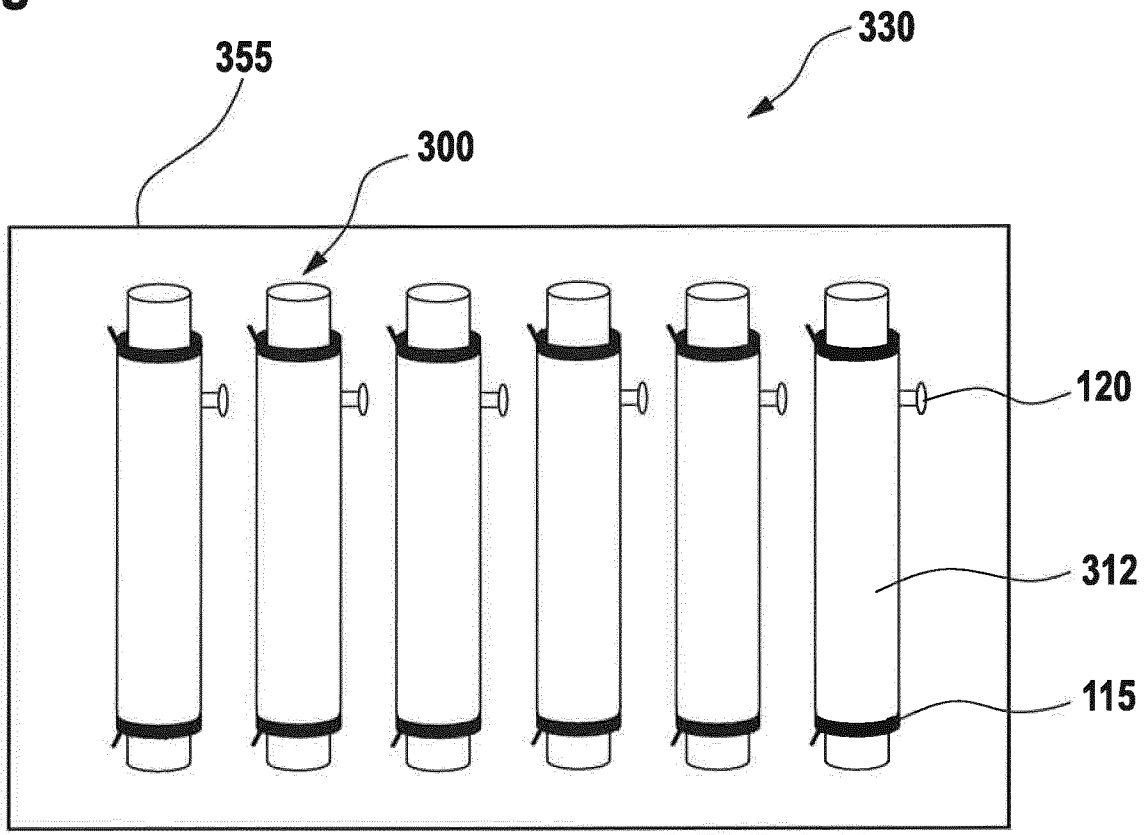
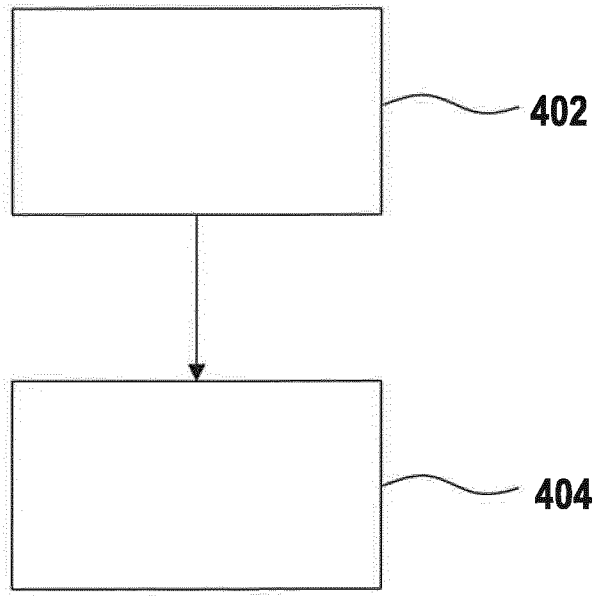


Fig. 4



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2015/060250

A. CLASSIFICATION OF SUBJECT MATTER
INV. C23C14/34 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)
C23C H01J

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, IBM-TDB

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2012/152727 A1 (KWAK BYUNG SUNG [US] ET AL) 21 June 2012 (2012-06-21) paragraphs [0018], [0021], [0022], [0037]; figures 2A, 2B	1-15
X	US 6 030 514 A (DUNLOP JOHN A [US] ET AL) 29 February 2000 (2000-02-29) col. 3, l. 20-25 col. 5, l. 36-49 col. 5, l. 64-67 col. 6, l. 4-6 col. 8, l. 16; figure 1	1-9, 12-15
X	JP 2003 089870 A (LSI LOGIC CORP) 28 March 2003 (2003-03-28) Abstract	1,8

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16 October 2015	23/10/2015

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	Peijzel, Paul

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2015/060250

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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