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(54) Title: CARRIER FOR SUBSTRATES

(57) Abstract: A carrier (100) for supporting a substrate (101) in a substrate processing chamber (600) for vacuum processing is described. The carrier includes at least two holders (120), wherein each holder includes a fixed portion (122), which is configured to be attached to a carrier body having a fixed position with respect to the carrier body, a floating portion (123), which is movable relative to the fixed portion along at least one direction (140), and a fixing mechanism, which is provided in a fixed position relative to the floating portion and which is configured to clamp the substrate in the holder. Moreover, the floating portion is movable along at least one direction from a first end position to a second end position, and said floating portion further comprises a force arrangement (130) configured to center or to pull the substrate in the carrier in the at least one direction.

Fig. 2A
TECHNICAL FIELD

[0001] Embodiments of the present invention relate to carriers for substrate processing, e.g., for layer deposition. Embodiments of the present invention particularly relate to carriers for supporting a large area substrate with a thin thickness in a substrate processing machine and apparatuses for processing a large area substrate.

BACKGROUND

[0002] Several methods are known for depositing a material on a substrate. For instance, substrates may be coated by a physical vapor deposition (PVD) process, a chemical vapor deposition (CVD) process, a plasma enhanced chemical vapor deposition (PECVD) process etc. Typically, the process is performed in a process apparatus or process chamber, where the substrate to be coated is located. A deposition material is provided in the apparatus. A plurality of materials, but also oxides, nitrides or carbides thereof, may be used for deposition on a substrate. Further, other processing actions like etching, structuring, annealing, or the like can be conducted in processing chambers.

[0003] Coated materials may be used in several applications and in several technical fields. For instance, an application lies in the field of microelectronics, such as generating semiconductor devices. Also, substrates for displays are often coated by a PVD process. Further applications include insulating panels, organic light emitting diode (OLED) panels, substrates with TFT, color filters or the like.

[0004] Particularly for areas such as display production, manufacturing of thin-film solar cells and similar applications, large area glass substrates processed. In the past, there has been a continuous increase in substrate sizes which is still to be continued.
The increasing size of glass substrates makes the handling, supporting and processing thereof, without sacrificing the throughput by glass breakage, increasingly challenging.

[0005] Typically, glass substrates can be supported on carriers during processing thereof. A carrier drives the glass or the substrate through the processing machine. The carriers typically form a frame or a plate, which supports a surface of the substrate along the periphery thereof or, in the latter case, supports the surface as such. Particularly, a frame shaped carrier can also be used to mask a glass substrate, wherein the aperture in the carrier, which is surrounded by the frame, provides an aperture for coating material to be deposited on the exposed substrate portion or an aperture for other processing actions acting on the substrate portion, which is exposed by the aperture.

[0006] The tendency to larger and also thinner substrates can result in bulging of the substrates, in particular due to stress applied to the substrate during deposition of the layers, where bulging can, in turn, cause problems due to the increasing likelihood of breakage. Moreover, bulging can reduce quality, e.g., uniformity, of the material layers deposited. Accordingly, there is a need to reduce bulging and to enable a carrier to transport bigger and thinner substrates without breakage, and to improve the quality of the coated material layers.

[0007] In view of the above, it is beneficial to provide a carrier, particularly a carrier having at least two holders, that overcomes at least some of the problems in the art and a holder for carrier.

SUMMARY

[0008] In light of the above, a holder configured to be attached to a carrier body for holding a substrate according to independent claim 1 is provided. According to another embodiment, a carrier according to claim 10 is provided. Further aspects, advantages, and features are apparent from the dependent claims, the description, and the accompanying drawings.
According to one embodiment, a holder configured to be attached to a carrier body for holding a substrate in a substrate processing chamber is provided. The holder includes: a fixed portion, which is configured to be attached to the carrier body having a fixed position with respect to the carrier body; a floating portion, which is movable relative to the fixed portion along at least one direction; and an fixing mechanism, which is provided in a fixed position relative to the floating portion and which is configured to clamp the substrate in the holder.

According to a further embodiment, a method for fixing a substrate in a carrier is provided. The method includes: loading a substrate on the carrier, moving at least a holder relative to a carrier body in at least one direction, from a middle position towards a first end position or a second end position, wherein the holder is attached to the carrier body, and clamping the substrate with at least two holders, wherein at least one holder of the at least two holders is positioned out of its middle position.

According to another aspect, an apparatus for depositing a layer on a large area glass substrate is provided, including: a vacuum chamber adapted for layer deposition therein, a transport system adapted for transportation of a carrier, wherein the carrier includes at least two holders. The holder configured to be attached to a carrier body for holding a substrate includes a fixed portion, which is configured to be attached to the carrier body having a fixed position with respect to the carrier body; a floating portion, which is movable relative to the fixed portion along at least one direction; and an fixing mechanism, which is provided in a fixed position relative to the floating portion and which is configured to clamp the substrate in the holder. The apparatus further includes a deposition source for depositing material forming the layer.

BRIEF DESCRIPTION OF THE DRAWINGS

So that the manner in which the above recited features of embodiments of the present invention can be understood in detail, a more particular description, briefly summarized above, may be had by reference to embodiments. The accompanying drawings relate to embodiments of the invention and are described in the following:
FIGS. 1A, 1B, 1C and 1D illustrate carriers according to embodiments described herein, each having holders, and with a substrate provided in a substrate area of the carrier;

FIGS. 2A, 2B, 2C shows an example of a holder attachable to a carrier and according to embodiments described herein;

FIG. 3 shows another example of a holder attachable to a carrier body and according to embodiments described herein;

FIG. 4 shows a view of an apparatus for depositing a layer of material on a substrate utilizing a carrier according to embodiments described herein.

DETAILED DESCRIPTION OF EMBODIMENTS

[0013] Reference will now be made in detail to the various embodiments of the invention, one or more examples of which are illustrated in the figures. Within the following description of the drawings, the same reference numbers refer to same components. Generally, only the differences with respect to individual embodiments are described. Each example is provided by way of explanation of the invention and is not meant as a limitation of the invention. 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.

[0014] According to embodiments, described herein a carrier including at least two holders is provided. The at least two holders are configured to reduce bending or bulging of the substrate due to stress, particularly stress introduced by depositing layers on the substrate, or stress introduced by thermal expansions of the substrate or the carrier; or stress introduced by the weight of the substrate. The holder provides a two-part body having a fixed portion and a floating portion. The two-part body provides a
reduced bending of the substrate by a sufficient tension, e.g. per unit length of the substrate edge.

[0015] According to embodiments described herein, the carrier includes at least two holders. The at least two holders can be distributed around the perimeter of the substrate to effectively avoid or reduce bending or bulging of the substrate. Each holder includes a fixed portion, which is configured to be attached to a carrier body having a fixed position with respect to the carrier body; a floating portion, which is movable relative to the fixed portion along at least one direction, and an fixing mechanism, which is provided in a fixed position relative to the floating portion and which is configured to clamp the substrate in the holder or at the carrier body. The relative movement of the floating portion with respect to the fixed portion provides one aspect to be considered for reducing the bending of the substrate. Further, a force arrangement, e.g. at least one spring or at least one pneumatic cylinder, or the like, is provided and is configured to pull the substrate in the carrier in the at least one direction. The force arrangement and the relative movement of the floating portion with respect to the fixed portion provide, in combination, a tension in the substrate to avoid bending or bulging of the substrate.

[0016] According to typical embodiments, which can be combined with other embodiments described herein, the substrate thickness can be from 0.1 to 1.8 mm and the holders can be adapted for such substrate thicknesses. However, particularly beneficial is if the substrate thickness is about 0.9 mm or below, such as 0.7 mm, 0.5 mm or 0.3 mm and the holders are adapted for such substrate thicknesses.

[0017] According to some embodiments, large area substrates may have a size of at least 0.174 m². Typically the size can be about 1.4 m² to about 8 m², more typically about 2 m² to about 9 m² or even up to 12 m². Typically, the rectangular substrates, for which the mask structures, apparatuses, and methods according to embodiments described herein are provided, are large area substrates as described herein. For instance, a large area substrate can be GEN 5, which corresponds to about 1.4 m² substrates (1.1 m x 1.3 m), GEN 7.5, which corresponds to about 4.39 m² substrates (1.95 m x 2.25 m), GEN 8.5, which corresponds to about 5.5 m² substrates (2.2 m x 2.5 m), or even GEN 10, which corresponds to about 8.7 m² substrates (2.85 m x 3.05 m).
Even larger generations such as GEN 11 and GEN 12 and corresponding substrate areas can similarly be implemented. Embodiments of the present invention are particularly beneficial with a substrate thickness of about 0.3 mm, and a large area substrate GEN 8.5.

[0018] FIG. 1A shows a carrier 100. The carrier 100 is configured for supporting a large and thin area substrate 101. As shown in FIG. 1A, the substrate 101 is provided in a position within the carrier 100, particularly when processed in a processing chamber. The carrier 100 includes a frame or carrier body 160 defining a window or aperture. According to typical implementations, the frame provides a substrate receiving surface. Typically, the substrate receiving surface is configured to be in contact with a perimeter portion of the substrate during operation, i.e. when the substrate is loaded.

[0019] Typically, the substrate 101 may be made from any material suitable for material deposition. For instance, the substrate may be made from a material selected from the group consisting of glass (for instance soda-lime glass, borosilicate glass etc.), metal, polymer, ceramic, compound materials or any other material or combination of materials which can be coated by a deposition process. The bulging, which might also affect the processing of the substrate, can be reduced by the carriers according to embodiments described herein. Particularly for glass substrates or ceramic substrates, where breakage is a further concern, the carriers can also significantly reduce substrate breakage, which reduces the productivity of the production process due to the increased loss.

[0020] According to some embodiments, the frame 160 can be made of aluminum, aluminum alloys, titanium, alloys thereof, stainless steel or the like. For comparably small large area substrates, e.g. GEN 5 or below, the frame 160 can be manufactured from a single piece, i.e. the frame is integrally formed. However, according to some embodiments, which can be combined with other embodiments described herein, the frame 160 can include two or more elements such as a top bar, sidebars and a bottom bar. Particularly for very large area substrates, the carrier or carrier body can be manufactured having several portions. These portions of the carrier body are assembled to provide the frame 160 for supporting the substrate 101. The frame 160 is particularly configured for receiving the substrate 101 in the substrate area.
[0021] The carrier 100 shown in FIG. 1A further includes holders. In the example shown in FIG. 1A two holders 120 are provided at the top side of the frame or carrier body 160. According to some embodiments, the floating portions of said two holders 120 at the top side of the frame 160 are movable relative to the fixed position in one direction, wherein said direction is parallel to the edge of the substrate as indicated by the arrows. According to some embodiments, the two holders could also be provided at the middle of the left and right sides of the carrier. According to some embodiments, the direction of movement of the floating portion 123 with respect to the fixed portion 122 could alternatively or additionally also be perpendicular to the edge of the substrate and in a plane essentially parallel of the substrate 101.

[0022] Although two holders 120 at the top side of the frame 160 are shown in FIG. 1A, the present invention is not limited thereto. More than two holders 120 could be provided at the top side of the frame 160. Further, more than one holder 120 could be provided on one or more sides of the substrate 101, as described in more details with respect to FIG. IB.

[0023] The carrier 100 shown in FIG. 1A provides the floating portions of the two holders movable along said first direction and a force arrangement configured to pull the substrate in said direction. Expansion or other movements of the substrate can be compensated for by one or more of the holders having the floating portion, which is movable relative to the fixed portion, e.g. in a plane substantially parallel to the surface of the carrier body and/or substrate. A position of the substrate 101 within the substrate area defined by the frame 160 can be precisely adjusted and centered. The holders according to embodiments described herein, enable expansion of the substrate at the respective sides and/or to the bottom. According to some embodiments, which can be combined with other embodiments described herein, the carriers described herein and the apparatuses for utilizing the carriers described herein, are for vertical substrate processing. The term vertical substrate processing is understood to distinguish over horizontal substrate processing. That is, vertical substrate processing relates to an essentially vertical orientation of the carrier and the substrate during substrate processing, wherein a deviation of a few degrees, e.g. up to 10° or even up to 15°, from an exact vertical orientation is still considered as vertical substrate processing. A
vertical substrate orientation with a small inclination can for example result in a more stable substrate handling or reduced risk of particles contaminating a deposited layer.

[0024] According to embodiments described herein, and as described in more details with respect to FIGS. 2 and 3, the holder provides a tension in at least one direction to reduce bending of the substrate in the perimeter region thereof. Additionally, the holder can provide holding or supporting forces for supporting the substrate stably in the carrier. The tension of the holder is provided by the relative movement of the floating portion with respect to the fixed portion, and by the force arrangement configured to pull the substrate in the at least one direction. This provides a beneficial tension reducing the bending or bulging of the substrate.

[0025] FIG. 1B shows another example of a carrier 100 according to some embodiments. The embodiment shown in FIG. 1B is similar to the embodiment shown in FIG. 1A. The carrier 100 of FIG. 1B includes four holders 120, wherein each holder is positioned at each corner of the carrier or carrier body. According to some embodiments, four holders could also be provided at the middle of each side of the carrier or carrier body. According to some embodiments, one or more of the floating portions of the at least four holders 120 are also moveable along a second direction, wherein this second direction is perpendicular to the first direction in a plane essentially parallel of to the substrate, as indicated by the arrows.

[0026] According to some embodiments, which can be combined with other embodiments described herein, at least a holder is provided on at least two sides of the frame 160 and optionally even on each side of the frame 160.

[0027] According to further embodiments, which can additionally or alternatively be implemented, the positions at which the holders are fixed to the substrate are distributed around the perimeter of the substrate for example uniformly distributed. For example, a holder can be provided every 300 mm to every 1000 mm, such as every 300 to 800 mm around the edge of the substrate. Typically, the holders can also be provided in pairs of positions. For example, a GEN8.5 substrate might be reduced in bending by holders at 24 positions or 12 pairs of positions respectively.
FIG. 1C shows another example of a carrier 100. According to some embodiments, which can be combined with other embodiments described herein, the carrier 100 includes first positioning elements 151 and second positioning elements 152 for positioning the substrate 101 in the substrate area. The first positioning elements 151 may be fixedly attached to the frame 160. One or more first positioning elements 151 may be provided. The second position elements 152 may be movable substantially parallel to the substrate area, i.e. substantially parallel to the surfaces of the substrate, and parallel to a respective edge of the substrate 101, as indicated by the arrows.

For example, the first and second positioning elements 151, 152 may include clamps or guiding means. According to some embodiments, positioning elements 151, 152 as exemplarily shown on FIG. 1C, e.g. at the side or bottom, may be designed such that the positioning elements do not essentially contribute to the compensation of forces resulting from bending or bulging of the substrate. Rather, the positioning elements are adapted to avoid free movement of the substrate 101 and/or are provided to hold more than 50% of the weight of the substrate in the substrate receiving surface of the frame 160.

The carrier 100 further includes at least two holders 120, e.g. on a top side or upper side of the frame 160. Two holders 120 for reducing bending of the substrate are illustrated in FIG. 1C. However, the number of holders and corresponding fixation positions can be adapted according to the embodiments described herein. According to some embodiments, two or more holders 120 are provided. Particularly, two or more holders 120 can be provided on one or more sides of the substrate, as for instance shown in FIG. 1B.

FIG. 1D shows a further carrier 100. The carrier 100 is configured for supporting a large area substrate. The carrier of FIG. 1D includes first positioning elements 151 for positioning the substrate 101 in the substrate area and is configured to provide for a predetermined substrate position. The first positioning elements 151 may be fixedly attached to the frame 160. According to some embodiments, which can be combined with other embodiments described herein, one or more first positioning elements 151, which are fixedly attached to the frame 160. According to some embodiments, which can be combined with other embodiments described herein, three
first position elements 151 are provided. For example, two fixedly connected first positioning elements are provided at the bottom portion of the frame and one first positioning element is provided at one side portion of the frame. The first positioning element can have a gap for substrate insertion or other means for arranging the substrate in the first positioning element, wherein an edge contacting surface configured for contacting the edge of the substrate and defining a contact position is provided. The contact position defines the predetermined substrate position in the carrier.

[0032] The carrier 100 shown in FIG. 1D further includes holders 120, which are movable with respect to the perimeter of the carrier frame or carrier body, i.e. parallel to the surface of a substrate received in the carrier. These holders are described in more detail with respect to FIGS. 2 and 3. According to typical embodiments, which can be combined with other embodiments described herein, the holders are provided and/or distributed along the sides of the frame 160.

[0033] According to some embodiments, which can be combined with other embodiments described herein, further holders 220 can be provided at the frame. These holders are comparable to those described with respect to FIGS. 2 and 3; however with the difference that the holders do not have a protrusion configured for contacting the edge of the substrate. That is, the protrusions 121 shown in FIGS. 2 and 3, respectively, are either omitted or are displaced towards the frame (away from the substrate receiving area) such that no contact with the edge of the substrate is provided. According to typical embodiments, which can be combined with other embodiments described herein, the further holders 220 are provided and/or distributed along the sides of the frame 160, which are the same sides as the sides at which a first positioning element is provided. The omission of the protrusion for the further holders 220 result in a predetermined position of the substrate defined by the first positioning elements 151.

[0034] As shown in FIGS. 2A, 2B and 2C, according to embodiments described herein, a holder 120 includes a fixed portion 122 and a floating portion 123, wherein the fixed portion has a fixed position with respect to the carrier body and wherein the floating portion is movable with respect to the fixed portion along one direction. The floating portion 123 has a substantially flat or planar first surface 124 for contacting a first substrate surface 102 of the substrate 101. The fixing mechanism 150 has a lever
arm 152, wherein the lever arm includes a substantially flat or planar second surface 125 for contacting a second substrate surface 103 of the substrate 101 opposing the first surface 102. According to some embodiments, the first surface 124 and the second surface 125 are essentially parallel to each other. The second surface 125 can also be the surface of a rubber-like part 125a fixed to the lever arm, as shown, e.g. in FIG. 2C.

According to embodiment described herein, the fixing mechanism can be an actuator, a clamp, a lever arm, a knee lever system, a clamp having one or more springs, or another element to clamp the substrate the floating portion 123.

[0035] During operation, i.e. when the substrate is carried by the carrier, the substrate 101 is interposed or sandwiched between the first surface 124 and the second surface 125. An edge, e.g. a lateral side, of the substrate 101 can contact a protrusion 121 of the floating portion 123, wherein said protrusion extends in a first direction parallel to said substrate edge. According to some embodiments, which can be combined with other embodiments described herein, the direction of movement of the floating portion 123 is parallel to said first direction along which the protrusion extends. The protrusion can also be the surface of a stopper element provided in the holder. According to some embodiments, the direction of movement of the floating portion 123 with respect to the fixed portion 122 could alternatively or additionally also be perpendicular to the direction wherein the protrusion 121 extends and in a plane essentially parallel of the substrate 101.

[0036] A force arrangement 130 provides a tension 140 in the substrate in at least one direction. The tension 140 is for firmly holding the substrate 101 to reduce or even avoid bulging of the substrate 101, particularly during a deposition process.

[0037] The force arrangement 130 is configured to provide together with the relative movement of the floating portion 123 with respect to the fixed portion 122 a sufficient tension to reduce bending in the substrate, e.g. due to the deposition of a layer. Accordingly, the force arrangement 130 is configured to maintain a substrate orientation, particularly at an outer substrate perimeter region, which is parallel to the carrier body. That is, a stress, which tends to generate substrate bending, cannot result in in bending or bulging, because the holder can move parallel to the edge of the substrate to e.g. compensate for expansion of the substrate. In the event the force
arrangement is pre-loaded before clamping the substrate, the substrate can further be tensioned.

[0038] The relative movement of the floating portion 123 with respect to the fixed portion 122 provides in combination with the force arrangement 130, a tension in the substrate along at least the direction of movement of the floating portion 123 with respect to the fixed portion 122.

[0039] In other words, when a moment 141 due to stress (e.g., forces) applied to the substrate 101 occurs, a tension defined by the relative movement of the floating portion 123 with respect to the fixed portion 122 and by the force arrangement 130 results in a lower bending. A force arrangement 130 may be selected differently depending on at least one of a type of substrate (material, thickness, area size, etc.), a number of layers to be deposited on the substrate 101, a kind of material(s) to be deposited, thickness of the layer(s) to be deposited, kind of process chamber, process time, etc.

[0040] Although a holder 120 including a floating portion, which is movable relative to the fixed portion along one direction as shown e.g. in FIG.2A, the present invention is not limited thereto. A holder 120 could also include a floating portion which is movable relative to the fixed portion along at least two directions, as described e.g. in more details with respect to FIG. 3.

[0041] FIG. 3 shows another example of a holder 120 according to some embodiments. The embodiment shown in FIG. 3 is similar to the embodiment shown in FIG. 2. The floating portion of the holder 120 of FIG. 3 is also movable along a second direction, wherein said second direction is perpendicular to the first direction and in a plane essentially parallel of to the substrate. Moreover, a further force arrangement 130a provides a tension 140a in said second direction for the substrate. The tension 140a is for firmly holding the substrate 101 in said second direction to reduce or even avoid bulging of the substrate 101 particularly during a deposition process.

[0042] According to some embodiments, as for example shown in FIGS. 1a, 1b and 1c, one or more holders 120 provide a tension to be e.g. 0.1 N to 10 N per substrate edge unit length [lm] or above. An edge length unit may be a length of an edge of the
substrate, e.g., a side of a substantially rectangular substrate. Thus, a normalization of the tension to the length of the substrate perimeter can be conducted such that the values of the tension can be normalized per 1 meter of the substrate perimeter length. Regarding FIGS. 1a, 1b and 1c, a number of the holders 120 for each side of the substrate 101 can be determined based on a total tension to be applied to the substrate 101 (or a tension per substrate edge length unit). Moreover, according to some embodiments, a distribution of the holders 120 over the substrate sides can be selected to improve a reduction of bulging of the substrate 101.

[0043] According to some embodiments, at least the floating portions of two holders are movable relative to the fixed portions along one direction and in the plane of the substrate. A force arrangement 130 is configured to provide together with the relative movement in said direction of the floating portion 123 with respect to the fixed portion 122, the tension 140 for the substrate 101.

[0044] According to some embodiments described herein, one or more force arrangements 130 provide the tension 140 to the floating portion 123, which is movable, to tension the substrate 101.

[0045] Alternatively, the floating portion 123 is moveable with respect to the fixed portion in two directions. In such a case, the one or more force arrangements 130, 130a can provide the tension 140, 140a to the substrate in at least two directions.

[0046] According to some embodiments, which can be combined with other embodiments described herein, the force arrangement 130 includes at least one spring element. However, the invention is not limited to spring elements, and other elements suitable for generating a tension might be used. Examples include, but are not limited to, levers, compression springs, piezoelectric devices and pneumatic devices.

[0047] According to different embodiments, a carrier 100 can be utilized for PVD deposition processes, CVD deposition processes, substrate structuring edging, heating (e.g. annealing) or any kind of substrate processing. Embodiments of carriers as described herein and methods for utilizing such carriers are particularly useful for non-stationary, i.e. continuous substrate processing. Typically, the carriers are provided for
processing vertically oriented large area glass substrates. Non-Stationary processing typically requires that the carrier also provides masking elements for the process.

[0048] FIG. 4 shows a schematic view of a deposition chamber 600 according to embodiments. The deposition chamber 600 is adapted for a deposition process, such as a PVD or CVD process. A substrate 101 is shown being located within or at a carrier on a substrate transport device 620. A deposition material source 630 is provided in chamber 612 facing the side of the substrate to be coated. The deposition material source 630 provides deposition material 635 to be deposited on the substrate.

[0049] In FIG. 4, the source 630 may be a target with deposition material thereon or any other arrangement allowing material to be released for deposition on substrate 101. Typically, the material source 630 may be a rotatable target. According to some embodiments, the material source 630 may be movable in order to position and/or replace the source. According to other embodiments, the material source may be a planar target.

[0050] According to some embodiments, the deposition material 635 may be chosen according to the deposition process and the later application of the coated substrate. For instance, the deposition material of the source may be a material selected from the group consisting of: a metal, such as aluminum, molybdenum, titanium, copper, or the like, silicon, indium tin oxide, and other transparent conductive oxides. Typically, oxide-, nitride- or carbide-layers, which can include such materials, can be deposited by providing the material from the source or by reactive deposition, i.e. the material from the source reacts with elements like oxygen, nitride, or carbon from a processing gas.

[0051] Typically, the substrate 101 is provided within or at the carrier 100, which can also serve as an edge exclusion mask, particularly for non-stationary deposition processes. Dashed lines 665 show exemplarily the path of the deposition material 635 during operation of the chamber 600. According to other embodiments, which can be combined with other embodiments described herein, the masking can be provided by a separate edge exclusion mask, which is provided in the chamber 612. A carrier according to embodiments described herein can be beneficial for stationary processes and also for non-stationary processes.
According to embodiments, which can be combined with other embodiments described herein, a fixation assembly firmly holds edges of a substrate particularly during a deposition process. Embodiments can provide a decrease in substrate breakage, particularly in light of the fact that the substrates are getting bigger in length and height, however, the thickness of the substrates decreases. The bulging, which might also affect the processing of the substrate, can be reduced by the carriers according to embodiments described herein.

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

1. A holder configured to be attached to a carrier body for holding a substrate, the holder comprising:
   a fixed portion, which is configured to be attached to the carrier body having a fixed position with respect to the carrier body;
   a floating portion, which is movable relative to the fixed portion along at least one direction; and
   a fixing mechanism, which is provided in a fixed position relative to the floating portion and which is configured to clamp the substrate in the holder.

2. The holder according to claim 1, wherein the floating portion is movable along the at least one direction from a first end position to a second end position and wherein said floating portion further comprises a force arrangement configured to center floating portion with respect to the fixed portion in the at least one direction.

3. The holder according to claim 2, wherein the force arrangement is selected from the group consisting of at least one spring or at least one pneumatic cylinder.

4. The holder according to any of the preceding claims, wherein the floating portion has a protrusion which is configured to contact a substrate edge, wherein said protrusion extends in a first direction parallel to said substrate edge, and wherein the at least one direction of movement of the floating portion is parallel to said first direction.
5. The holder according to any of the preceding claims, wherein the fixing mechanism comprises a lever arm, particularly a knee lever system which includes the lever arm, and wherein said lever arm is configured to fix the substrate to the floating portion.

6. The holder according to claim 5, wherein the fixing mechanism further comprises a rubber-like part fixed to the lever arm and wherein said rubber-like part is configured to contact the substrate.

7. The holder according to any of the preceding claims, wherein the floating portion is movable along at least a second direction, wherein said second direction is perpendicular to the at least one direction in a plane essentially parallel of to the substrate.

8. The holder according to claim 7, wherein the floating portion is movable along the second direction from a first end position to a second end position and wherein said floating portion comprises a further force arrangement configured to pull the substrate in the second direction.

9. The holder according to claim 8, wherein the further force arrangement is selected from the group consisting of at least one spring or at least one pneumatic cylinder.

10. A carrier comprising at least two holders according to any of the preceding claims.

11. A carrier according to claim 10, further comprising at least a clamp attached to the carrier body having a fixed position with respect to a carrier body and configured to hold more than 50% of the weight of the substrate.
12. A carrier according to claims 10 and 11, wherein said carrier body is rectangular and wherein possible configurations of the at least two holders relative to the carrier body are: the at least two holders, wherein each holder is positioned at the topside of the carrier body; the at least two holders, wherein each holder is positioned at the middle of the left and right sides of the carrier body; wherein the at least two holders are at least four holders, wherein each holder is positioned at each corner of the carrier body; the at least four holders, wherein each holder is positioned at the middle of each side of the carrier body; or any configuration which includes any combination of the above.

13. A method for fixing a substrate in a carrier having a carrier body, comprising:

   loading a substrate on the carrier

   moving at least a holder relative to the carrier body in at least one direction, from a middle position towards a first end position or a second end position, wherein the holder is attached to the carrier body; and

   clamping the substrate with at least two holders, wherein at least one holder of the at least two holders is positioned out of its middle position.

14. The method of claim 13, wherein a force arrangement pulls at least the holder to its middle position.

15. A carrier comprising:

   a carrier body

   at least a clamp attached to the carrier body having a fixed position with respect to the carrier body;
at least two holders, wherein each holder comprises:

a fixed portion, which is configured to be attached to the carrier body having a fixed position with respect to the carrier body;

a floating portion, which is movable relative to the fixed portion along at least one direction, wherein the floating portion has a protrusion which is configured to contact a substrate edge, wherein said protrusion extends in a first direction parallel to said substrate edge, and wherein the at least one direction of movement of the floating portion is parallel to said first direction; and

an fixing mechanism, which is provided in a fixed position relative to the floating portion and which is configured to clamp the substrate in the holder, wherein the floating portion is movable along the at least one direction from a first end position to a second end position and wherein said floating portion further comprises a force arrangement configured to center the substrate in the fixed portion in the at least one direction.
**INTERNATIONAL SEARCH REPORT**

**International application No:**
PCT/EP2014/057919

**A. CLASSIFICATION OF SUBJECT MATTER**

INV. H01J37/32 H01L21/687 C23C16/458 C23C14/50 G03F7/20

**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 H01L C23C G03F

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, COMPENDEX, IBM-TDB

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

<table>
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<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<td>X A</td>
<td>EP 2 423 350 A1 (APPLIED MATERIALS INC [US]) 29 February 2012 (2012-02-29) abstract; figures 1,6 paragraphs [0001], [0002], [0038], [0041], [0051] - [0055]</td>
<td>1-3,13,</td>
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Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:
  
  *A* document defining the general state of the art which is not considered to be of particular relevance
  
  *E* earlier application or patent but published on or after the international filing date
  
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**A** document member of the same patent family

**Date of the actual completion of the international search**

27 November 2014

**Date of mailing of the international search report**

05/12/2014

**Name and mailing address of the ISA/Authorized officer**

European Patent Office, P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk
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Remy, Jerome
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<td>WO 2013/044941 A1 (APPLIED MATERIALS INC [US]; BRUENING ANDRE [DE]; HEIMEL OLIVER [DE]; H) 4 April 2013 (2013-04-04) figures 1,2,5,6 paragraphs [0001], [0014] - [0043]</td>
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