

This object is achieved by the features of the independent claims. Advantageous developments form the subject matter of the dependent claims, the description and the drawings.

5 In a first aspect, the present disclosure relates to a positioning device for positioning a substrate, in particular a wafer, comprising a process chamber, a base body; a carrier element which comprises a support for supporting the substrate, the carrier element being arranged above the base body and formed movable in terms of distance from the base body, and a holder for an additional
10 substrate, in particular an additional wafer or a mask, the holder being arranged opposite the carrier element. Between the base body and the carrier element, a sealed-off cavity is provided to which a pressure, in particular a negative pressure, can be applied so as to prevent undesired movement of the carrier element as a result of the action of an external force. This achieves the advantage that undesired movement of the substrate, for example during a
15 sudden change in pressure above the substrate, can be efficiently prevented, and the process result can thus be improved. There is, between the carrier element and the holder, a process cavity, the size of which is set at least in part by the distance between the carrier element and the holder.

20 The substrate may be a wafer. The substrate may be disc-shaped, and may have a substantially round periphery having a diameter of 2, 3, 4, 5, 6, 8, 12 or 18 inches. The substrate may further be substantially planar, and may have a thickness of between 50 and 3000 μm . The substrate may have a straight edge (flat) and/or at least one groove (notch). The substrate may further be polygonal, in particular square or rectangular, in form.

25 The substrate may be formed from a semiconductor material, for example silicon (Si) or gallium arsenide (GaAs), a glass, for example quartz glass, a plastics material or a ceramic. The substrate may be formed from a monocrystalline, polycrystalline or amorphous material. Further, the substrate may in each case comprise a plurality of composited materials. The substrate
30 may be coated with a coating, for example a polymer such as a photoresist or an adhesive, on at least one face. Further, the substrate may comprise a metal

coating, for example a structured chromium layer.

The substrate may comprise structures, in particular regularly arranged structures, on at least one substrate surface. The structures may form elevations and/or cavities on the substrate surface. The structures may comprise electrical

substrate. Subsequently, a lithography process, a bonding process and/or an imprinting process may be carried out.

The base body, the carrier element and the holder can be arranged within the process chamber.

5 In an example, the sealed-off cavity comprises a pressure terminal, via which the pressure in the cavity can be controlled. By means of the pressure terminal, the pressure in the cavity can be kept at and/or brought to a desired value during the process, meaning that the position of the carrier element can be controlled very efficiently in a very simple manner.

10 In an example, an adjustment element, in particular a lifting element, is arranged between the base body and the carrier element so as to adjust the distance of the carrier element from the base body. This achieves the advantage that the substrate can efficiently be positioned at a fixed distance from the base body. The adjustment or lifting element may comprise a number of pins which are
15 received at least in part in the base body. The pins may be extensible and retractable, so as to vary the distance of the carrier element from the base body. The lifting elements may comprise piezo elements.

 The adjustment element may be electrically and/or pneumatically actuatable to adjust the distance of the carrier element from the base body. The adjustment
20 element may further be actuatable by way of control commands.

 In an example, the positioning device comprises a restoring element, in particular a spring, which acts between the base body and the carrier element. This achieves the advantage that the carrier element can be restored to a particular initial position if for example the pressure is not being applied to the
25 cavity. Further, the restoring element can additionally assist in the pneumatic fixing of the carrier element.

 In an example, a number of support elements, which set a minimum distance of the carrier element from the base body, are arranged between the base body and the carrier element. This achieves the advantage that by setting a minimum
30 distance between the carrier element and the base

body a minimum size of the cavity can also be set. Further, by means of the support elements, the

position of the carrier element can be fixed if there is a negative pressure in the cavity.

5 In an example, the positioning device comprises a guide for guiding the movement of the carrier element. The guide may be arranged between the base body and the carrier element. In a simple manner, the guide prevents undesired lateral displacement of the carrier element, such as might occur for example as a result of the resilience of seals which are present between the carrier element and the base body to delimit the cavity. The guide may be formed as a solid body guide.

10 In an example, the carrier element comprises a fixing device, by means of which the substrate positioned on the support can be fixed, in particular mechanically, pneumatically and/or electrostatically. This ensures that the substrate is not displaced during the process, for example by the external forces acting during the process.

15 For this purpose, the support and/or the carrier element may comprise means for fixing the substrate, for example brackets and/or suction openings.

20 In an example, a further pressure, in particular an overpressure, can be applied to the sealed-off cavity so as to move the carrier element towards the mounting in a targeted manner. This achieves the advantage that the distance between the substrates is adjustable pneumatically by apply pressure to the cavity. The overpressure can be set by way of a positive pressure difference from a pressure in a process chamber, a process cavity in the positioning device, and/or from an ambient pressure.

25 In an example, the holder is formed to orientate a surface of the further substrate towards the substrate positioned on the support. This achieves the advantage that the further substrate can be arranged efficiently with respect to the substrate positioned on the support.

30 As disclosed in the first aspect, there is, between the carrier element and the holder, a process cavity, the size of which is set at least in part by the distance between the carrier element and the holder.

The process cavity can be part of the process chamber or the process cavity forms the process chambers.

The process cavity may further comprise a pressure terminal.

5 In an example, the positioning device comprises sealing means, in particular an inflatable sealing lip, for sealing off the process cavity. This achieves the advantage that the process cavity can be sealed off efficiently, for example so as to maintain an overpressure or negative pressure in the process cavity.

10 In an example, an overpressure or a negative pressure can be applied to the process cavity and/or it can be evacuated, or the process cavity is provided with a gas terminal through which a gas can be introduced, in particular helium. This achieves the advantage that the substrates can be processed in a controlled environment, for example a vacuum. The external force effect can be set by way of a pressure difference between the cavity and the process cavity.

15 Evacuating the process cavity makes it possible to establish vacuum contact between the substrate and the further substrate. For this purpose, the cavity between the substrates is for example initially evacuated. Subsequently, the positioning device can move the substrate towards the further substrate and bring the two substrates into contact. Cavities on the surface of the substrate and/or of the further substrate can thus be evacuated before the substrates are contacted.

20 When the process cavity is evacuated, this can result in a negative pressure. This negative pressure may act on the carrier element or the substrate positioned thereon as an external force, and this may lift the carrier element or the substrate and press the substrates onto one another before evacuation is complete. To counter this external force, the cavity between the carrier element and the base
25 body can now also be evacuated, resulting in a second force, which counters the external force and fixes the carrier element. After the process cavity between the substrates is completely evacuated, the adjustment element can move the carrier element towards the holder in a targeted manner so as to bring the two substrates together.

30 In an example, the positioning device comprises a spacer, in

particular a wedge or a wedge spacer, which is insertable between the base body and the holder so as to adjust and/or fix a distance between the base body and the

holder. This achieves the advantage that a movement of the holder towards the base body due to an external force, for example due to the negative pressure in the process cavity, can be efficiently prevented.

5 In a second aspect, the present disclosure relates to a method for bringing a substrate, in particular a wafer, together with a further substrate, in particular a further wafer or a mask, the method comprising the following method steps: fixing the substrate with respect to the further substrate; evacuating a sealed-off cavity below the substrate so as to prevent undesired movement of the substrate due to the action of an external force; and moving the substrate towards the further
10 substrate in a controlled manner, the substrate and the further substrate being located in a process cavity, the size of which is set at least in part by the distance between the substrates, it being possible to apply an overpressure or negative pressure to the process cavity and/or to evacuate it, or it being possible to fill the process cavity with a gas, in particular helium. This achieves the advantage that
15 undesired movement of the substrate, for example before the substrates are brought together in a targeted manner, can be efficiently prevented. Immediately before or after the pressure is applied to the cavity, process conditions which bring about the external force on the substrate can be adjusted. For example, a negative pressure is generated between the substrates. Furthermore, this
20 achieves the advantage that the substrates can be processed in a controlled environment, for example a vacuum. The external action of force can be set by way of a pressure difference between the cavity and the process cavity.

25 Evacuating the process cavity makes it possible for example to establish vacuum contact between the substrate and the further substrate. For this purpose, in an additional method step the cavity between the substrates may initially be evacuated. Subsequently, the substrate may be moved towards the further substrate, and the two substrates may be brought into contact. Cavities on the surface of the substrate and/or of the further substrate can thus be evacuated before the wafer is contacted.

30 The substrate and/or the further substrate may each be a wafer, in particular

a glass or semiconductor wafer. The further substrate may further be a mask, in particular a photolithography mask, or a stamp, in particular a nanoimprint or microimprint stamp.

The substrate and/or the further substrate may be substantially the same size, in particular having a substantially equal periphery. The further substrate may be formed as a lid and/or cover for the substrate. The further substrate may be formed transparent to light.

- 5 Fixing the substrate may comprise fixing to a carrier element, in particular to a support of the carrier element. The carrier element may comprise a fixing device for this purpose. The further substrate may in turn be fixed to a holder opposite the carrier element.

- 10 In an example, the method further comprises connecting, in particular bonding, the substrates. This achieves the advantage that particularly efficient wafer bonding can be made possible. The cavity to which negative pressure is applied prevents the two substrates from being able to come into contact prematurely, for example. It can thus be ensured that optimum process conditions are present before the substrates are contacted.

- 15 In an example, moving the carrier element towards the holder in a controlled manner comprises applying a further pressure, in particular an overpressure, to the cavity. This achieves the advantage that the substrates can be brought together efficiently by applying pressure to the cavity.

- 20 The positioning device in accordance with the first aspect of the present disclosure may be formed to carry out the method in accordance with the second aspect of the present disclosure.

Further embodiments are explained in greater detail with reference to the accompanying drawings, in which:

Fig. 1 is a schematic drawing of part of a positioning device for a substrate;

- 25 Fig. 2 is a schematic drawing of a positioning device in accordance with a further embodiment;

Fig. 3 is a flow chart of a method for bringing a substrate together with a further substrate; and

- 30 Fig. 4a-g are schematic drawings of the positioning device of Fig. 2, which is being used for connecting two substrates.

CLAIMS

1. Positioning device for positioning a substrate, in particular a wafer, comprising:

a process chamber;

5 a base body;

a carrier element which comprises a support for supporting the substrate, the carrier element being arranged above the base body and formed movable in terms of distance from the base body; and

10 a holder for an additional substrate, in particular an additional wafer or a mask, the holder being arranged opposite the carrier element;

wherein there is, between the base body and the carrier element, a sealed-off cavity to which a pressure, in particular a negative pressure, can be applied so as to prevent undesired movement of the carrier element as a result of the action of an external force; and

15 wherein there is, between the carrier element and the holder, a process cavity, the size of which is set at least in part by the distance between the carrier element and the holder.

2. Positioning device according to claim 1, wherein the sealed-off cavity comprises a pressure terminal, via which the pressure in the cavity can be controlled.

3. Positioning device according to any of the preceding claims, wherein an adjustment element, in particular a lifting element, is arranged between the base body and the carrier element so as to adjust the distance of the carrier element from the base body.

25 4. Positioning device according to any of the preceding claims, wherein the positioning device comprises a restoring element, in particular a spring, which acts between the base body and the carrier element.

5. Positioning device according to any of the preceding claims, wherein a number of support elements, which set a minimum distance of the carrier element from the base body, are arranged between the base body and the carrier element.

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6. Positioning device according to any of the preceding claims, wherein the positioning device comprises a guide for guiding the movement of the carrier element.

5 7. Positioning device according to any of the preceding claims, wherein the carrier element comprises a fixing device, by means of which the substrate positioned on the support can be fixed, in particular mechanically, pneumatically and/or electrostatically.

8. Positioning device according to claim 1, wherein the process cavity is part of the process chamber or defines the process chamber.

10 9. Positioning device according to any of the preceding claims, wherein the positioning device comprises sealing means, in particular an inflatable sealing lip, for sealing off the process cavity.

15 10. Positioning device according to any of the preceding claims, wherein an overpressure or a negative pressure can be applied to the process cavity and/or it can be evacuated, or wherein the process cavity is provided with a gas terminal through which a gas can be introduced, in particular helium.

20 11. Positioning device according to any of the preceding claims, wherein the positioning device comprises at least one spacer, in particular a wedge, which is insertable between the base body and the holder so as to adjust and/or fix a distance between the base body and the holder.

12. Method for bringing a substrate, in particular a wafer, together with a further substrate, in particular a further wafer, wherein the method comprises the following method steps:

fixing the substrate with respect to the further substrate;

25 evacuating a sealed-off cavity below the substrate so as to prevent undesired movement of the substrate due to the action of an external force;

moving the substrate towards the further substrate in a controlled manner;
and

30 the further substrate being located in a process cavity, the size of which is set at least in part by the distance between the substrates, it being possible to apply

an overpressure or negative pressure to the process cavity and/or to evacuate it, or it being possible to fill the process cavity with a gas, in particular helium.

13. Method according to claim 12, wherein the method further comprises connecting, in particular bonding, the substrates.

- 5 14. Method according to either claim 12 or claim 13, wherein the controlled movement comprises applying a further pressure, in particular an overpressure, to the cavity.