Mounting Apparatus for Mounting of a Structured Wafer

Specification

The invention relates to a mounting apparatus for mounting of a substrate, especially of a wafer, on one structure side of the substrate, which side has structures.

These mounting apparatus are used as "chucks" in the semiconductor industry, especially for handling of wafers in the production of electrical components in various process steps. The wafers which are provided with individual component groups (structures) are also called product wafers. In each process step what is important is that the wafers are quickly, reliably and easily detachably fixed on the mounting apparatus so that handling of the wafers is not a disruption factor for the processing of the wafers. The fixing of the product wafers which have structures is more difficult the thinner they are and the more pronounced and higher the topography of the components on the product wafers. Any stress in the wafer is to be avoided as much as possible so that to some extent the very expensive structures which are present on the product wafer are not damaged. While there are different approaches to fixing of a product wafer on the unstructured, therefore flat side, in the fixing of a product wafer on its structured side there are a host of technical problems. Thus for example electrostatic fixing is problematic since the electrical circuits of the structures can be destroyed by possible voltage peaks.

Furthermore it is to be possible to handle the electrical structures as free of contamination as possible and without impurity (for example by adhesive).

Embodiments of this invention provide a mounting apparatus for mounting and

handling as well as fixing of a substrate in which rapid, safe and careful as well as reversible and easily controllable mounting and fixing of the substrate are enabled.

According to a first aspect of the present invention, there is provided a mounting apparatus for mounting and holding one structure side of a substrate, the one structure side having structures thereon and the structures having an upper surface that is displaced from the structure side of the substrate such that a structure gap is formed between the upper surface of the structures and the structure side of the substrate, said mounting apparatus comprised of: a mounting element having a substantially circular mounting surface, the mounting surface having suction channels that are formed through the mounting surface and located on an outer ring surface of the mounting surface, the mounting surface being formed as a planar flat mounting surface for supporting the structures on said one structure side, the suction channels opening at suction holes such that when the substrate is mounted and held by the mounting apparatus the structures are in contact with the mounting surface and the suction holes are located at least partially radially outward from the structures relative to a rotational center of the mounting surface, the suction holes being displaced from the structure side of the substrate such that a ring gap is formed between the structure side of the substrate and the suction holes, and the ring gap being formed such that a continuous fluid flow through the ring gap and the suction channels is maintained while the substrate is being held by the mounting apparatus.

According to a second aspect of the present invention, there is provided a method for mounting and holding one structure side of a substrate using a mounting apparatus, the one structure side having structures thereon and the structures having an upper surface that is displaced from the structure side of the substrate such that a structure gap is formed between the upper surface of the structures and the structure side of the substrate, said method comprised of: effecting a continuous and controllable flow through suction channels of the mounting apparatus, mounting and holding the substrate to the mounting apparatus using the continuous and controllable flow through the suction channels of the mounting apparatus, the mounting apparatus having a mounting element having a substantially circular mounting surface, the suction channels being formed through the mounting surface and located on an outer ring surface of the mounting surface, the mounting surface being formed as a planar flat mounting surface for supporting the structures on said one structure side, the suction channels opening at suction holes such that when the substrate is

mounted and held by the mounting apparatus the structures are in contact with the mounting surface and the suction holes are located at least partially radially outward from the structures relative to a rotational center of the mounting surface, the suction holes being displaced from the structure side of the substrate such that a ring gap is formed between the structure side of the substrate and the suction holes, and

the continuous and controllable flow passing through the ring gap and the suction channels such that the continuous and controllable flow is maintained while the substrate is being held by the mounting apparatus.

All combinations of at least two of the features given in the specification, the claims and/or the figures also fall within the framework of the invention. At the given value ranges values which lie within the indicated limits are also to be considered disclosed and claimed in any combination.

Embodiments of the invention are based on the idea of developing known vacuum chucks such that structures of the substrate are incorporated at the same time into the fluid flow which suctions the substrates such that a uniform suction action (suction pressure) as homogeneous as possible over the entire structure side of the substrate is enabled. In other words, the mounting apparatus as per embodiments of the invention enables an especially linearly variable, homogeneous surface force on the product wafer so that the substrate can be mounted on the vacuum sample holder (mounting apparatus) with the desired surface force. Preferably the surface force acting on the substrate can be controlled by changing the suction pressure in a linear relationship. The surface force is defined by the suction area F_2.

In contrast to vacuum chucks from the prior art, in embodiments of this invention there is no blanket pressure application along the substrate, but suction applies only in the region of an outer ring surface of the mounting surface of the mounting apparatus. It has been ascertained that the configuration as per embodiments of the invention yields an extremely homogenous pressure distribution along the mounting surface of the mounting apparatus, especially also outside of the suction area.

According to one advantageous embodiment of the invention it is provided that the outer

To the extent the suction area F_2 is adjustable, especially by at least partially closing a part of the suction channels, the mounting apparatus can be used for different product substrates with different structures/dimensions (especially the height H of the structures is relevant). The suction channels can be closed especially by preferably individually triggerable valves on/in the suction channels. Alternatively it is conceivable as per embodiments of the invention to provide a rotating disk with openings in the region of the suction channels (corresponding to the outer ring surface) on the end of the suction channels which is facing away from the suction area F_2. In this way the suction channels can be adjusted continuously from fully open to fully closed by rotating the rotary disk. In this way all suction channels can be continuously adjusted at the same time.

Here it is moreover advantageous if the fluid chamber is formed by a fluid chamber element which is sealed to the mounting element, and by the mounting element. Thus the fluid chamber can be easily produced, especially by milling of a trough shape into the fluid chamber element. The trough shape encompasses an especially round cylinder-shaped recess with a diameter which is larger than the maximum distance between the suction channels on their end facing the fluid chamber. The fluid chamber element thus consists especially of a ring-shaped peripheral wall and an upper wall which border the fluid chamber. The fluid chamber element is sealed to the mounting element by connecting elements, especially screws. The seal is preferably a circular ring-shaped seal with a diameter which is larger than the diameter of the fluid chamber on the periphery of the fluid chamber between the fluid chamber element and the mounting element.

In another advantageous embodiment of the invention it is provided that the flow channel in the region of the fluid chamber has a flow cross section of at least the same size, which is especially

By a first group of especially at least 10, preferably at least 50, even more preferably at least 100, suction channels on a common first circle on the outer ring surface lying especially equidistantly to one another, the suction is further homogenized. This is because a uniform fluid flow, especially between the mounting surface and the substrate as far as to the middle M of the mounting surface, is effected by a concentric arrangement of the suction channels to the middle M of the suction surface or rotationally symmetrically to the mounting element.

According to another embodiment of this invention the distance between the suction channels is smaller than 1 mm, especially smaller than 500 μm, preferably smaller than 250 μm, even more preferably smaller than 150 μm.

Here it is especially advantageous if there is a second group of especially at least 10, preferably at least 20 suction channels, especially offset to the suction channels of the first group, on a common second circle with a smaller radius than the first circle on the outer ring surface, especially concentrically to the middle M and/or equidistantly to one another. In this way, on the outer ring surface more suction channels can be accommodated and the more suction channels there are, the smaller they can be made and the more uniformly and more carefully suction of the substrate takes place. At the same time, arranging at least two groups on the outer ring surface yields higher stability of the mounting element. The number of suction channels is consequently limited only upward by the minimum diameter of the suction channels and the dimensions of the mounting element. The offset bores are thus a replacement for a slot which would act disadvantageously on the mechanical stability of the wafer on the edge.

According to another embodiment of this invention the inflow surface Z is conceivable by changing, especially controlling, the diameter D_{2i} of each suction channel.

To the extent method features have been disclosed, they are to be considered and claimed as disclosed as the method as per embodiments of the invention.

Other advantages, features and details of the invention will become apparent from the following description of preferred exemplary embodiments and using the drawings.

Figure 1a shows a plan view of a mounting apparatus as claimed in the invention from underneath with a cutting line A-A,

Figure 1b shows a cross sectional view according to cutting line A-A from Figure 1a,

Figure 2a shows a view according to Figure 1b with a structured substrate which is mounted on the mounting apparatus,

Figure 2b shows a detailed view from Figure 2a and

Figures 2c shows a detailed view from Figure 2a.

Figure 3 shows a contour plot view of the pressure distribution of the surface 3o, computed with a fluid simulation program

Figure 4 shows an enlargement of the contour plot view of the pressure distribution of the surface 3o, computed with a fluid simulation program.

The same components or components with the same action are identified with the same reference numbers in the figures.

Figure 1a shows a mounting apparatus 1 which consists of a fluid chamber element 2 and a mounting element 3. The fluid chamber 2 consists of a ring-shaped peripheral wall 2w which is formed by out-milling a circular cylinder and an upper wall 2o which covers the ring-shaped peripheral wall 2w. The upper wall 2o at the same time forms the bottom of the milled-out cylinder. For fixing of the mounting element 3 on the fluid chamber element 2, in the production of the fluid