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Carrier for a semiconductor wafer and use of the carrier

The invention relates to a carrier for a semiconductor wafer and its use.

Semiconductor wafers are produced in large numbers of pieces and further processed to form electronic components. The production process also comprises treatments of the semiconductor wafers at temperatures of at least 200°C, for example pure heat treatments or the deposition of layers on the surface of the treated semiconductor wafer by thermal decomposition of deposition gases. Such treatments must strictly ensure that the semiconductor wafer is not contaminated by undesirable foreign metals, dopants or particles whose later removal is impossible or possibly only with substantial additional expenditure.

There are treatment stations, for example CVD reactors, in which semiconductor wafers are continuously treated at temperatures of at least 200°C. The semiconductor wafers are placed on a conveyor belt and conveyed by the latter into the treatment station. Relative movements between the semiconductor wafers and the conveyor belt and the direct contact of the semiconductor wafers with the conveyor belt increase the risk that the semiconductor wafers are damaged and are contaminated by foreign metals, which diffuse into the semiconductor material.

If the semiconductor wafers are coated, there is the danger that the growing layer produces a firm joint between the semiconductor wafers and the supporting surface on which the semiconductors are resting. It is then difficult to detach an adhering semiconductor wafer from the supporting surface without at the same time damaging or contaminating the semiconductor wafer.

The object of the present invention was to reduce the danger of damage to or contamination of semiconductor wafers, in particular silicon semiconductor wafers, during a treatment of the semiconductor wafers at

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temperatures of at least 200°C.

The invention relates to a carrier for a semiconductor wafer which has a flat front side and a flat rear side and a rounded edge, wherein the carrier has at least three protrusions on which the edge of the semiconductor wafer is supported so that the semiconductor wafer ends up essentially horizontal and the carrier does not make contact with the front side and the rear side of the semiconductor wafer, and the protrusions are shaped so that the edge of the semiconductor wafer is supported exclusively below an imaginary central plane in the center between the front side and the rear side of the semiconductor wafer.

The carrier fixes the semiconductor wafer in position and prevents the direct contact of the semiconductor wafer with a contaminated supporting surface. The danger that the semiconductor wafer continues to adhere to the carrier after a coating is substantially reduced by the shape of the carrier.

The invention is described in greater detail below by reference to figures.

Figure 1a diagrammatically shows a carrier according to an embodiment of the invention and a semiconductor wafer resting on the carrier in sectional view.

Figure 1b is an enlarged partial view of Figure 1a.

Figure 2 shows the carrier of Figure 1b according to a development of the invention.

As is to be inferred from Figure 1a, the shape of the carrier 1 is similar to the shape of a plate. The rounded edge 4 of the semiconductor wafer 2 rests on protrusions 3 which are provided on the carrier 1. In order to be able to keep the semiconductor wafer horizontal in a stable position, the carrier must have protrusions 3 at at least three positions spaced apart from one another. It is preferable that the surface of the carrier is built up to form a bead in the shape of a

ring on which the edge 4 of the semiconductor wafer rests. The bead offers a particularly large area on which the semiconductor wafer can be supported and prevents gas transport to the rear side of the semiconductor wafer.

A semiconductor wafer normally has two flat side faces which are situated parallel to one another and are adjoined by a rounded edge. In connection with the invention, that side face is described as the front side of the semiconductor wafer which points upwards away from the carrier. Correspondingly, the rear side of the semiconductor wafer is the opposite side face which points downwards.

The carrier 1 does not make contact either with the front side 5 or with the rear side 6 of the semiconductor wafer 2. The protrusions 3 are shaped in such a way that the support points with which the semiconductor wafer rests on the carrier are situated exclusively on the edge of the semiconductor wafer and, to be specific, below an imaginary center plane 7 which is situated in the center between the front side 5 and the rear side 6 of the semiconductor wafer (Figure 1b). The front side 5 of the semiconductor wafer can be coated in this way in a reactor without it being feared that the coating is impaired at the rim of the front side by the presence of the carrier.

It is particularly preferable to form the protrusions 3 of the carrier in such a way that the edge 4 of the semiconductor wafer is supported exclusively below an imaginary plane 8. The plane 8 is parallel and offset with respect to the central plane 7, its distance from the rear side 6 of the semiconductor wafer being at most 80% of the distance d which exists between the central plane 7 and the rear side 6 of the semiconductor wafer. This is of advantage, in particular, if the semiconductor wafer is to be prevented from being joined to the carrier by a growing layer during the coating of the front side of the semiconductor wafer.

According to the development of the invention shown in Figure 2, the transport of deposition gas to points at which the semiconductor wafer and the carrier make contact is made difficult by a guard ring 9. The guard ring 9 extends at constant distance from the edge 4 around the horizontal semiconductor wafer. In order to limit gas transport effectively, the height h of the guard ring should be chosen so that the guard ring extends upwards at least to the plane in which the front side 5 of the semiconductor wafer is situated.

In the embodiment shown, the guard ring is detachably joined to the carrier and can be removed before the semiconductor wafer is placed on the carrier or lifted off the carrier using a gripping tool which preferably acts only on the edge of the semiconductor wafer. The guard ring can also be formed in such a way (not shown) that it covers the edge and in this way prevents an undesirable coating of the edge.

If the guard ring 9 and the carrier 1 are nondetachably joined, it is necessary to ensure that the gripping tool is able to place the semiconductor wafer on the protrusions 3 of the carrier. This can be done, for example, by providing the ring with recesses (not shown) which offer the gripping tool the necessary space when placing or removing the semiconductor wafer.

In the view according to Figure 1a, the carrier 1 has the shape of a plate with a continuous base 10. The continuous base prevents, for example, deposition gas from being able to reach the rear side 6 of the semiconductor wafer and the rear side from being coated at the same time. If the rear side and the front side of the semiconductor wafer are to be treated in the same way, a central opening 11, which imparts the shape of a ring to the carrier and is only indicated in Figure 1a, can be provided in the base 10 of the carrier.

The carrier described is preferably used for treatments of semiconductor wafers at temperatures of at least 200°C. For the treatment of silicon semiconductor

wafers, the carrier is preferably made of glass, quartz glass, ceramic or silicon. Optionally, the carrier is additionally coated with a diffusion-inhibiting layer so that it is almost impossible for contaminants from the supporting surface or from the carrier to be able to diffuse to the semiconductor wafer and contaminate it.

Before the treatment, the semiconductor wafer is placed on the carrier using a gripping tool. The carrier may already be situated on a conveyor belt which conveys it, together with the semiconductor wafer, into the treatment station. A plurality of carriers laden with semiconductor wafers may also be stacked one above the other in a tray and the semiconductor wafers treated jointly. A carrier and a semiconductor wafer always form a unit during the treatment of the semiconductor wafer. It is therefore expedient to clean a used carrier at regular intervals and to free it of any deposited layers.

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Patent Claims

1. A carrier for a semiconductor wafer which has a flat front side and a flat rear side and a rounded edge, wherein the carrier has at least three protrusions on which the edge of the semiconductor wafer is supported so that the semiconductor wafer ends up essentially horizontal and the carrier does not make contact with the front side and the rear side of the semiconductor wafer, and the protrusions are shaped so that the edge of the semiconductor wafer is supported exclusively below an imaginary central plane in the center between the front side and the rear side of the semiconductor wafer.

2. The carrier as claimed in claim 1, wherein the protrusions of the carrier are shaped in such a way that the edge of the semiconductor wafer is supported exclusively below an imaginary plane which is in an offset manner parallel to the central plane and whose distance from the rear side of the semiconductor wafer is at most 80% of the distance which exists between the central plane and the rear side of the semiconductor wafer.

3. The carrier as claimed in claim 1 or 2, wherein a guard ring is placed around the edge of the horizontally situated semiconductor wafer at constant distance from the edge.

4. The carrier as claimed in any one of claims 1 to 3, wherein the carrier is composed of a material which is chosen from a group comprising glass, quartz glass, ceramic and silicon.

5. The carrier as claimed in any one of claims 1 to 4, wherein the carrier is coated with a protective layer which inhibits the diffusion of contaminants.

6. The carrier as claimed in any one of claims 1 to 5, wherein the surface of the carrier is built up to form a bead in the shape of a ring.

7. The carrier as claimed in any one of claims 1 to 6, wherein the carrier is formed as a ring having a

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central hole and the hole makes possible free access to the rear side of the semiconductor wafer.

8. The carrier as claimed in any one of claims 1 to 6, wherein the carrier is formed as a plate with continuous base and the base covers the rear side of the semiconductor wafer completely.

9. The use of a carrier as claimed in any one of claims 1 to 8 for the treatment of semiconductor wafers at temperatures of at least 200°C.

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