

SUBSTRATE SUPPORTING STRUCTURE

FIELD OF THE INVENTION

The present invention relates to the field of semiconductor electroplating equipment, and in particular to a substrate supporting structure.

BACKGROUND

Semiconductor electroplating refers to a process in chip manufacturing where metal ions in an electroplating solution are electroplated onto the surface of a substrate to form a metal interconnect.

Currently, in the semiconductor electroplating process, typically, a manipulator moves the substrate to be electroplated from a transfer pod into a pre-wetting chamber. In the pre-wetting chamber, through-silicon vias are wetted by immersing the substrate in a fill solution or by spraying pre-wetting vapor; the manipulator then moves the substrate to be electroplated into an electroplating chamber, where the substrate is immersed in the electroplating solution and plating current is applied to perform electroplating; the manipulator then moves the substrate into a cleaning chamber, where the substrate is cleaned by spraying deionized water onto the surface of the substrate to remove residual chemical solution on the surface of the substrate. After the cleaning process is completed, the manipulator moves the substrate out of the cleaning chamber.

During the above process, the substrate needs to be transferred to the pre-wetting chamber, the electroplating chamber, and the cleaning chamber in sequence. The substrate must remain level in each chamber. The levelness of the substrate not only affects the electroplating process results, but also relates to the safety of the substrate during rotation.

FIG. 1 and FIG. 2 show a schematic view of a conventional substrate supporting apparatus for a pre-wetting chamber. The apparatus comprises a base 101, and a plurality of rubber pads 102 and a plurality of guide posts 103 fixed on the surface of the base 101. The rubber pads 102 are located beneath the substrate 10 for supporting the substrate 10, and the guide posts 103 are disposed along the edge of the substrate

10 for laterally constraining the substrate 10. When the substrate 10 is placed on the substrate supporting apparatus, the position of the substrate 10 is adjusted and constrained by the guide posts 103.

Typically, if the substrate 10 is normally placed on the substrate supporting apparatus, as shown in FIG. 2, the substrate 10 will be oriented horizontally, and through the adjustment of the guide posts 103, the center of the substrate 10 can be aligned with the center of the base 101. The relatively high friction force of the rubber pads 102 can ensure that the substrate 10 does not slide during rotation.

However, the above substrate supporting apparatus occasionally experiences situations where the substrate 10 rests on a guide post 103 and cannot slide down smoothly. As shown in FIG. 3, in some cases, when the manipulator places the substrate 10 on the substrate supporting apparatus, the substrate 10 is not stably supported on the rubber pads 102, but instead tilts, one end elevated, and spans between a guide post 103 and a rubber pad 102. This phenomenon occurs because one side of the substrate 10 rests on a rubber pad 102, and the relatively high friction force of the rubber pad 102 prevents the substrate 10 from sliding into a horizontal orientation. Once this situation occurs, the equipment where the apparatus is located will detect the problem and issue an alarm, and the chamber will stop operation, which affects the throughput of the substrate manufacturer and consumes manpower to handle the alarm.

Therefore, the present patent aims to solve the technical problem of how to improve the guiding capability of the substrate supporting apparatus.

SUMMARY

In view of the above technical problem, the objective of the present invention is to improve the guiding capability of the substrate supporting apparatus so that a substrate can be supported in a level orientation on the substrate supporting apparatus. To achieve this objective, the present invention provides a substrate supporting structure.

In some embodiments, the substrate supporting structure comprises: a base, the surface of the base having a support region for supporting a substrate; a plurality of

support members, disposed on a first circumference of the support region, each of the support members having a support surface on the top of the support member for supporting the substrate; a plurality of guide members, disposed on a second circumference at the periphery of the support region, the first circumference and the second circumference being concentric circles centered at the center of the support region, and the guide members being higher than the support members for laterally constraining the substrate; and a plurality of sliding guide members, disposed in the support region, each of the sliding guide members being entirely or partially located between the first circumference and the second circumference, the sliding guide members being no higher than the support members, each of the sliding guide members having a sliding guide surface on the top of the sliding guide member, and the coefficient of friction of the sliding guide surface being smaller than the coefficient of friction of the support surface.

Compared with the prior art, the present invention has the following beneficial effects:

By adding the sliding guide members between the first circumference and the second circumference, configuring the coefficient of friction on the top of the sliding guide members to be smaller than the coefficient of friction on the top of the support members, and making the support members slightly higher than the sliding guide members, the present invention ensures that even if a substrate is not stably supported on the support members during the placement of the substrate and instead tilts, one end elevated, and spans between a guide post and a sliding guide member, the edge of the substrate can still slide relative to the top of the sliding guide member under the substrate's own weight, allowing the substrate to slide into a horizontal orientation. Furthermore, after the substrate is adjusted to a horizontal orientation, the support members can still provide a relatively high friction force on the bottom surface of the substrate, preventing the substrate from sliding during rotation.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments will now be described in a clear and understandable manner with reference to the accompanying drawings to further clarify the above characteristics, technical features, advantages, and embodiments of the present

invention.

FIG. 1 is a top view of a conventional substrate supporting apparatus;

FIG. 2 is a cross-sectional view along the line a-a in FIG. 1 with the substrate oriented horizontally;

FIG. 3 is a cross-sectional view along the line a-a in FIG. 1 with the substrate settled at an oblique angle to a horizontal plane;

FIG. 4 is a top view of an embodiment of the substrate supporting structure in the present invention;

FIG. 5 is a cross-sectional view along the line b-b in FIG. 4 with the substrate oriented horizontally;

FIG. 6 is a cross-sectional view along the line b-b in FIG. 4 with the substrate settled at an oblique angle to a horizontal plane;

FIG. 7 is a top view of another embodiment of the substrate supporting structure in the present invention;

FIG. 8 is a top view of another embodiment of the substrate supporting structure in the present invention;

FIG. 9 is a top view of another embodiment of the substrate supporting structure in the present invention;

FIG. 10 is a cross-sectional view along the line c-c in FIG. 9 with the substrate oriented horizontally;

FIG. 11 is a cross-sectional view along the line c-c in FIG. 9 with the substrate settled at an oblique angle to a horizontal plane;

FIG. 12 is a top view of another embodiment of the substrate supporting structure in the present invention;

FIG. 13 is a cross-sectional view along the line d-d in FIG. 12 with the substrate oriented horizontally;

FIG. 14 is a cross-sectional view along the line d-d in FIG. 12 with the substrate settled at an oblique angle to a horizontal plane;

FIG. 15 is a cross-sectional view of another embodiment of the substrate supporting structure in the present invention;

FIG. 16 is a cross-sectional view of another embodiment of the substrate supporting structure in the present invention;

FIG. 17 is a top view of another embodiment of the substrate supporting structure in the present invention;

FIG. 18 is a cross-sectional view along the line e-e in FIG. 17 with the substrate oriented horizontally; and

FIG. 19 is a top view of another embodiment of the substrate supporting structure in the present invention.

DETAILED EMBODIMENTS OF THE INVENTION

To more clearly illustrate the embodiments of the present invention or the technical solutions in the prior art, specific embodiments of the present invention will be described below with reference to the accompanying drawings. It is obvious that the drawings described below are only some embodiments of the present invention, and for those of ordinary skill in the art, other accompanying drawings and embodiments can be obtained based on these accompanying drawings without creative efforts.

To simplify the drawings, only the parts related to the invention are schematically shown in each drawing, and the parts do not represent the actual structure of a product. Furthermore, for clarity and ease of understanding of the drawings, in some drawings, only one of the components with the same structure or function is schematically illustrated or marked. Herein, "one" can mean not only "one" but also "more than one."

Herein, it should be noted that unless otherwise clearly specified and defined, terms "mount," "interconnect," and "connect" should be interpreted broadly, for example, the connection can be a fixed connection, a detachable connection, or an integral connection; the connection can be a mechanical connection or an electrical connection; the connection can be a direct connection, an indirect connection through an intermediate medium, or an internal connection between two elements. For those of ordinary skill in the art, the specific meanings of the above terms in the present invention can be understood according to specific circumstances.

Additionally, in the description of the present application, terms such as "first" and "second" are used for distinguishing description only, and should not be construed as indicating or implying relative importance.

The present application discloses a substrate supporting structure, and the structure is applicable to a pre-wetting chamber or other chambers of electroplating equipment to enhance the guiding capability of the substrate supporting structure for the substrate 10 during the placement of the substrate 10 into a chamber by a manipulator.

As shown in FIG. 4 and FIG. 5, the substrate supporting structure comprises: a base 20, and a plurality of support members 30, a plurality of sliding guide members 40, and a plurality of guide members 50 mounted on the surface of the base 20. Wherein, the surface of the base 20 has a support region for supporting the substrate 10; the support members 30 are disposed on a first circumference 31 of the support region, and each support member 30 has a support surface 32 on the top of the support member for supporting the substrate 10; the guide members 50 are disposed on a second circumference 51 at the periphery of the support region, the first circumference 31 and the second circumference 51 are concentric circles centered at the center of the support region, and the guide members 50 are higher than the support members 30 for laterally constraining the substrate 10; the sliding guide members 40 are disposed in the support region, each sliding guide member 40 is entirely or partially located between the first circumference 31 and the second circumference 51, the sliding guide members 40 are no higher than the support members 30, each sliding guide member 40 has a sliding guide surface 42 on the top of the sliding guide member, and the coefficient of friction of the sliding guide surface 42 is smaller than the coefficient of

friction of the support surface 32. In practical applications, the support members 30 can be made of rubber, and the sliding guide members 40 can be made of plastic.

It should be noted that the support region coincides with the orthographic projection region of the substrate 10 on the surface of the base 20. In addition, the support region, the first circumference 31, the second circumference 51, and a third circumference 41 mentioned hereinafter are all proposed concepts and are intended to define the positional relationship of the relevant components only.

As shown in FIG. 6, if the substrate 10 is not oriented horizontally during the placement of the substrate 10, since each sliding guide member 40 is entirely or partially located between the first circumference 31 and the second circumference 51, one side of the edge of the substrate 10 will rest on the side wall of a guide member 50, and the other side will preferentially contact the sliding guide surface 42 on the top of a sliding guide member 40. At this time, due to the relatively low coefficient of friction of the sliding guide surface 42, the static friction force between the sliding guide surface 42 and the edge of the substrate 10 is insufficient to maintain the substrate 10 at an oblique angle to a horizontal plane, causing sliding friction between the substrate 10 and the sliding guide surface 42 under the substrate 10's own weight until the substrate 10 slides into a horizontal orientation.

Furthermore, the fact that the sliding guide members 40 are no higher than the support members 30 helps the support members 30 to effectively support the substrate 10 after the substrate 10 is supported in a level orientation. In a preferred embodiment, the support members 30 are configured to be slightly higher than the sliding guide members 40, for example, the support members 30 are 0.1 mm to 2 mm higher than the sliding guide members 40. Since the sliding guide members 40 are lower than the support members 30, the sliding guide members 40 do not hinder the sufficient contact between the support members 30 and the substrate 10. When the substrate supporting structure drives the substrate 10 to rotate, the support members 30 will provide sufficient friction force to ensure that the substrate 10 does not slide.

Specifically, the support members 30, the guide members 50, and the sliding guide members 40 can be arranged independently, or at least two of the support member 30, the guide member 50, and the sliding guide member 40 can be integrally formed. For

example, the sliding guide members 40 and the support members 30 can be integrally formed, or the sliding guide members 40 and the guide members 50 can be integrally formed, or all of the support members 30, the guide members 50, and the sliding guide members 40 can be integrally formed.

FIG. 4 is a top view of a substrate supporting structure of an embodiment in the present application. FIG. 5 is a cross-sectional view along the line b-b in FIG. 4 with the substrate oriented horizontally. FIG. 6 is a cross-sectional view along the line b-b in FIG. 4 with the substrate settled at an oblique angle to a horizontal plane.

According to FIG. 4, FIG. 5, and FIG. 6, the sliding guide members 40 are disposed on a third circumference 41 of the support region, and the third circumference 41 is centered at the center of the support region and located between the first circumference 31 and the second circumference 51. The substrate supporting structure comprises three guide members 50, three sliding guide members 40, and three support members 30 that are independently arranged. In addition, the guide members 50, the sliding guide members 40, and the support members 30 are evenly spaced along the circumferential direction of the respective circumferences of the guide members 50, the sliding guide members 40, and the support members 30. In a preferred embodiment, the support members 30, the sliding guide members 40, and the guide members 50 are arranged in a one-to-one relationship and are arranged in sequence along the same straight lines, and the straight lines are consistent with the radial direction of the first circumference 31.

FIG. 7 is a top view of a substrate supporting structure of another embodiment in the present application. This embodiment changes the cross-sectional shape of the sliding guide members 40 based on the substrate supporting structure shown in FIG. 4. In practical applications, the cross-section of the slide guiding members 40 can be circular or polygonal. When the cross-section of the slide guiding members 40 is polygonal, one side of each polygon is configured to face the support members 30. For example, in the embodiment shown in FIG. 7, the cross-sectional shape of the sliding guide members 40 is changed from circular in FIG. 4 to an isosceles triangle, with the bases of the isosceles triangles close to the support members 30 and the apex angles of the isosceles triangles facing the guide members 50. This can further reduce the friction force of the sliding guide members 40 on the edge of the substrate 10 when the

substrate 10 is settled at an oblique angle to a horizontal plane, making it easier for the substrate 10 settled at an oblique angle to a horizontal plane to slide down and be adjusted to a horizontal orientation.

FIG. 8 is a top view of a substrate supporting structure of another embodiment in the present application. This embodiment changes the number and position of the sliding guide members 40 based on the substrate supporting structure shown in FIG. 4. The number of the sliding guide members 40 is increased from three in FIG. 4 to six, and in the embodiment shown in FIG. 8, the sliding guide members 40 are arranged on both sides of the straight lines where the support members 30 and the guide members 50 are located, with the straight lines being consistent with the radial direction of the first circumference 31.

In the above embodiments where the support members 30, the guide members 50, and the sliding guide members 40 are arranged independently, the cooperation among the guide members 50, the sliding guide members 40, and the support members 30 achieves lateral constraint, tilt adjustment, and support for the substrate 10. In the following embodiments where at least two of the support member 30, the guide member 50, and the sliding guide member 40 are integrally formed, a design approach similar to the design approach in the above embodiments is adopted, which can achieve the same technical effects as the above embodiments and also facilitate production and assembly.

FIG. 9 is a top view of a substrate supporting structure of another embodiment in the present application. FIG. 10 is a cross-sectional view along the line c-c in FIG. 9 with the substrate oriented horizontally. FIG. 11 is a cross-sectional view along the line c-c in FIG. 9 with the substrate settled at an oblique angle to a horizontal plane.

As shown in FIG. 9, FIG. 10, and FIG. 11, this embodiment changes the integration method among the support members 30, the sliding guide members 40, and the guide members 50 based on the substrate supporting structure shown in FIG. 4. The support members 30 and the sliding guide members 40 are changed from being independently arranged in FIG. 4 to being integrally formed. Specifically, the sliding guide members 40 are of a top-opened tubular structure, the sliding guide members 40 surround the outer periphery of the support members 30, and the sliding guide

members 40 are no higher than the support members 30. As shown in FIG. 9 and FIG. 11, if the substrate 10 is not oriented horizontally during the placement of the substrate 10, since each sliding guide member 40 is partially located between the first circumference 31 and the second circumference 51, one side of the edge of the substrate 10 will rest on the side wall of a guide member 50, and the other side will preferentially contact the sliding guide surface 42 of a sliding guide member 40 located between the first circumference 31 and the second circumference 51, thereby performing the sliding guide function of the sliding guide members 40.

FIG. 12 is a top view of a substrate supporting structure of another embodiment in the present application. FIG. 13 is a cross-sectional view along the line d-d in FIG. 12 with the substrate oriented horizontally. FIG. 14 is a cross-sectional view along the line d-d in FIG. 12 with the substrate settled at an oblique angle to a horizontal plane.

As shown in FIG. 12, FIG. 13, and FIG. 14, this embodiment changes the integration method between the support members 30 and the sliding guide members 40 based on the substrate supporting structure shown in FIG. 9. Specifically, the sliding guide members 40 are of a columnar structure located between the first circumference 31 and the second circumference 51, and the sliding guide members 40 are fixed to the sides of the support members 30 that are away from the center of the support region. As shown in FIG. 14, if the substrate 10 is not oriented horizontally during the placement of the substrate 10, since each sliding guide member 40 is entirely located between the first circumference 31 and the second circumference 51, one side of the edge of the substrate 10 will rest on the side wall of a guide member 50, and the other side will preferentially contact the sliding guide surface 42, thereby performing the sliding guide function of the sliding guide members 40.

FIG. 15 is a cross-sectional view of a substrate supporting structure of another embodiment in the present application. The view of FIG. 15 is similar to the view of FIG. 13. This embodiment changes the integration method among the support members 30, the sliding guide members 40, and the guide members 50 based on the substrate supporting structure shown in FIG. 13. The sliding guide members 40 are changed from being integrated with the support members 30 in FIG. 12 to being integrated with the guide members 50.

FIG. 16 is a cross-sectional view of a substrate supporting structure of another embodiment in the present application. The view of FIG. 16 is similar to the view of FIG. 13. This embodiment changes the integration method among the support members 30, the sliding guide members 40, and the guide members 50 based on the substrate supporting structure shown in FIG. 13. The sliding guide members 40 are changed from being integrated with the support members 30 in FIG. 12 to being integrated with the support members 30 and the guide members 50. The sliding guide members 40 are at least partially sandwiched between the support members 30 and the guide members 50.

FIG. 17 is a top view of a substrate supporting structure of another embodiment in the present application. FIG. 18 is a cross-sectional view along the line e-e in FIG. 17 with the substrate oriented horizontally.

As shown in FIG. 17 and FIG. 18, the substrate supporting structure of this embodiment further includes a plurality of fixed mounts 60 on the basis of the substrate supporting structure shown in FIG. 4. Each fixed mount 60 is provided with at least one support member 30, at least one sliding guide member 40, and at least one guide member 50. In FIG. 18, the substrate supporting structure includes three fixed mounts 60, each fixed mount 60 is provided with one guide member 50, one sliding guide member 40, and one support member 30. The fixed mounts 60 are mounted on the base 20 and are located at a circumference centered at the center of the support region. By integrating the support member 30, the sliding guide member 40, and the guide member 50 on a fixed mount 60, installation and replacement of the components are facilitated.

FIG. 19 is a top view of a substrate supporting structure of another embodiment in the present application. The substrate supporting structure of this embodiment further includes a plurality of clamping members 70 on the basis of the substrate supporting structure shown in FIG. 4. The clamping members 70 are disposed on the base 20 and located at a circumference centered at the center of the support region for clamping the edge of the substrate 10. It should be noted that the plurality of clamping members 70 disposed on the base 20 can be directly disposed on the base 20 or indirectly disposed on the base 20, for example, the plurality of clamping members 70 can be disposed on the base 20 via the fixed mounts 60.

It should be noted that for the various embodiments of the substrate supporting structure described above, those skilled in the art should understand that the technical features of the above-described embodiments can be combined in any way. To simplify the description, all possible combinations of the technical features in the above-described embodiments have not been described. However, as long as there is no contradiction in the combinations of these technical features, the combinations should be considered to be within the scope of the present specification. For example, the substrate supporting structures shown in FIG. 7, FIG. 8, FIG. 9, FIG. 12, and FIG. 17 can also be configured with the clamping members 70.

It should be noted that the above embodiments are only preferred embodiments of the present invention. For those of ordinary skill in the art, a plurality of improvements and modifications can be made without departing from the principles of the present invention, such as modifying the size, quantity, position, and specific material of each columnar member. These improvements and modifications should also be regarded as falling within the scope of protection of the present invention.

What is claimed is:

1. A substrate supporting structure, comprising:

a base, the surface of the base having a support region for supporting a substrate;

a plurality of support members, disposed on a first circumference of the support region, each of the support members having a support surface on the top of the support member for supporting the substrate;

a plurality of guide members, disposed on a second circumference at the periphery of the support region, the first circumference and the second circumference being concentric circles centered at the center of the support region, and the guide members being higher than the support members for laterally constraining the substrate;

a plurality of sliding guide members, disposed in the support region, each of the sliding guide members being entirely or partially located between the first circumference and the second circumference, the sliding guide members being no higher than the support members, each of the sliding guide members having a sliding guide surface on the top of the sliding guide member, and the coefficient of friction of the sliding guide surface being smaller than the coefficient of friction of the support surface.

2. The substrate supporting structure according to claim 1, wherein,

the support members are made of rubber, and the sliding guide members are made of plastic.

3. The substrate supporting structure according to claim 1, wherein,

the support members are 0.1 mm to 2 mm higher than the sliding guide members.

4. The substrate supporting structure according to claim 1, wherein,

the support members, the guide members, and the sliding guide members are arranged independently, the sliding guide members are disposed on a third circumference of the support region, and the third circumference is centered at the

center of the support region and located between the first circumference and the second circumference.

5. The substrate supporting structure according to claim 4, wherein,

the guide members, the sliding guide members, and the support members are evenly spaced along the circumferential direction of the respective circumferences of the guide members, the sliding guide members, and the support members located.

6. The substrate supporting structure according to claim 4, wherein,

the cross-section of the sliding guide member is circular or polygonal, and when the cross-section is polygonal, one side of polygon is configured to face the support member.

7. The substrate supporting structure according to claim 1, wherein,

at least two of the support member, the sliding guide member, and the guide member are integrally formed.

8. The substrate supporting structure according to claim 1, comprising:

a plurality of fixed mounts, each fixed mount being provided with at least one of the support members, at least one of the sliding guide members, and at least one of the guide members, and the fixed mounts being mounted on the base and located at a circumference centered at the center of the support region.

9. The substrate supporting structure according to claim 8, wherein,

the support members, the sliding guide members, and the guide members are arranged independently.

10. The substrate supporting structure according to claim 8, wherein,

at least two of the support member, the sliding guide member, and the guide member are integrally formed.

11. The substrate supporting structure according to any one of claims 1 to 10, comprising:

a plurality of clamping members, disposed on the base and located at a circumference centered at the center of the support region for clamping the edge of the substrate.