SUBSTRATE HOLDING DEVICE AND WET PROCESSING APPARATUS

FIELD OF THE INVENTION

The present invention relates to the field of semiconductor manufacturing technology, and in particular, to a substrate holding device and a wet processing apparatus.

BACKGROUND

FIG. 1 is a schematic structural view of a substrate holding device; FIG. 2 is a schematic cross-sectional view of a partial structure of a substrate holding device.

According to FIG. 1 and FIG. 2, the substrate holding device comprises a plurality of clamping members 100' and a rotary chuck 200', and the plurality of clamping members 100' are disposed at the edge of the rotary chuck 200'. In a single-wafer wet process, a substrate to be wet-etched or cleaned is generally fixed above the rotary chuck 200' by the plurality of clamping members 100', and the substrate is rotated under the driving of the rotary chuck 200', while a chemical liquid is sprayed onto the upper or lower surface of the rotating substrate for process treatment.

In the above process, it is necessary to ensure that the processing liquid on the rotary chuck 200' can be smoothly thrown out under the centrifugal force when the rotary chuck 200' rotates. If the processing liquid is not discharged in time due to low-speed rotation of the rotary chuck 200', causing excessive accumulation of processing liquid on the rotary chuck 200', then as shown by the dashed arrows in FIG. 2, the processing liquid can easily seep into the interior of an intermediate channel 220' of the rotary chuck 200', which will corrode internal components and affect the service life of the internal components.

SUMMARY

The objective of the present invention is to solve the problem in the prior art that the processing liquid on the rotary chuck of a substrate holding device easily seeps into the interior of the intermediate channel.

To solve the above problem, the present application proposes a substrate holding device, comprising a rotary chuck, wherein the rotary chuck has an intermediate channel, and the rotary chuck is used to rotate about the axis of the intermediate channel;

wherein, a guide groove extending radially from inside to outside is provided on the top of the rotary chuck, the guide groove has a first side wall, a plurality of second side walls, and a bottom wall, the first side wall is disposed around the periphery of the intermediate channel, the plurality of second side walls are spaced apart along the circumferential direction at the edge of the rotary chuck, the bottom wall is connected to the first side wall and the plurality of second side walls, the first side wall, the plurality of second side walls, and the bottom wall are used to make the guide groove include an annular flow channel and a plurality of radial flow channels in communication with each other, and the annular flow channel surrounds the intermediate channel, and the plurality of radial flow channels extend from the annular flow channel to the edge.

To solve the above problem, the present application also proposes a wet processing apparatus, comprising:

the above-mentioned substrate holding device;

a megasonic device, used to spray a processing liquid onto the upper surface of a substrate to clean the substrate.

By providing the guide groove on the rotary chuck, the present application allows the processing liquid accumulated on the rotary chuck to be thrown out from the guide groove by centrifugal force, which can prevent the accumulated processing liquid from seeping into the interior of the intermediate channel of the rotary chuck, thereby preventing the seeped liquid from corroding components inside the intermediate channel.

Other features of the present invention and corresponding beneficial effects are described in the later part of the specification, and it should be understood that at least some of the beneficial effects will become apparent from the description of the

specification of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The features and performance of the present application are further illustrated by the following embodiments and the accompanying drawings of the embodiments.

FIG. 1 is a schematic structural view of a substrate holding device;

FIG. 2 is a schematic cross-sectional view of a partial structure of a substrate holding device;

FIG. 3 is a schematic structural view of a substrate holding device according to an embodiment of the present application;

FIG. 4 is a schematic cross-sectional view of a substrate holding device according to an embodiment of the present application;

FIG. 5a and FIG. 5b are schematic views of a partial structure of a guide groove according to an embodiment of the present application;

FIG. 6 is a schematic structural view of a rotary chuck according to an embodiment of the present application; and

FIG. 7 is a schematic structural view of a wet processing apparatus according to an embodiment of the present application.

PREFERRED EMBODIMENTS OF THE APPLICATION

The following specific embodiments illustrate the implementation of the present invention, and those skilled in the art can easily understand other advantages and effects of the present invention from the content disclosed in this specification. Although the description of the present invention will be introduced in conjunction with preferred embodiments, this does not mean that the features of the present invention are limited to these embodiments. On the contrary, the purpose of introducing the invention in conjunction with the embodiments is to cover other alternatives or modifications that may be extended based on the claims of the present invention. In

order to provide a deep understanding of the present invention, many specific details will be included in the following description. The present invention may also be implemented without these details. In addition, to avoid confusion or obscuring the focus of the present invention, some specific details will be omitted from the description. It should be noted that the embodiments of the present invention and the features in the embodiments can be combined with each other, provided that no conflict arises.

It should be noted that in this specification, similar reference numerals and letters denote similar items in the following accompanying drawings, and therefore, once an item is defined in one accompanying drawing, the item does not need to be further defined and explained in subsequent accompanying drawings.

The technical solutions of the present invention will be clearly and completely described below in conjunction with the accompanying drawings. Obviously, the described embodiments are some embodiments of the present invention, rather than all embodiments. Based on the embodiments of the present invention, all other embodiments obtained by those of ordinary skill in the art without making creative efforts fall within the scope of protection of the present invention.

In the description of the present invention, it should be noted that the terms "center," "upper," "lower," "left," "right," "vertical," "horizontal," "inner," "outer," etc. indicate orientations or positional relationships based on the orientations or positional relationships shown in the accompanying drawings, and are only for the convenience of describing the present invention and simplifying the description, rather than indicating or implying that the device or element referred to must have a specific orientation, be constructed and operated in a specific orientation, and therefore cannot be construed as limiting the present invention. In addition, the terms "first," "second," and "third" are used for descriptive purposes only and cannot be construed as indicating or implying relative importance.

In the description of the present invention, it should be noted that, unless otherwise explicitly specified and limited, the terms "install," "interconnect", and "connect" should be understood in a broad sense, 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. In order to further clarify the objectives, technical solutions, and advantages of the present invention, the embodiments of the present invention will be described in further detail below in conjunction with the accompanying drawings.

FIG. 3 is a schematic structural view of a substrate holding device according to an embodiment of the present application; FIG. 4 is a schematic cross-sectional view of a substrate holding device according to an embodiment of the present application; FIG. 5a and FIG. 5b are schematic partial views of a guide groove according to an embodiment of the present application.

According to FIG. 3 and FIG. 4, the substrate holding device provided by the present application comprises a plurality of clamping members 100 and a rotary chuck 200. The plurality of clamping members 100 are used to clamp a substrate and drive the substrate to rotate. The rotary chuck 200 has an intermediate channel 220, and the rotary chuck 200 is used to rotate about the axis of the intermediate channel 220, and the plurality of clamping members 100 rotate together with the rotary chuck 200. When the plurality of clamping members 100 clamp the substrate, the lower surface of the substrate faces the rotary chuck 200, and the upper surface of the substrate is opposite to the lower surface of the substrate. Wherein, a guide groove 230 extending radially from inside to outside is provided on the top of the rotary chuck 200, and the guide groove 230 has a first side wall 231, a plurality of second side walls 232, and a bottom wall 233. The first side wall 231 is disposed around the periphery of the intermediate channel 220, the plurality of second side walls 232 are spaced apart along the circumferential direction at the edge of the rotary chuck 200, the bottom wall 233 is connected to the first side wall 231 and the plurality of second side walls 232, and the first side wall 231, the plurality of second side walls 232, and the bottom wall 233 are used to make the guide groove 230 include an annular flow channel and a plurality of radial flow channels in communication with each other, wherein the annular flow channel surrounds the intermediate channel 220, and the plurality of radial flow

channels extend from the annular flow channel to the edge of the rotary chuck 200. When the rotary chuck 200 rotates, the processing liquid on the rotary chuck 200 is thrown out from the annular flow channel and the plurality of radial flow channels under centrifugal force. The dashed arrows in FIG. 3 and FIG. 4 indicate the throwing direction of the processing liquid. By providing the guide groove 230, the first side wall 231 of the guide groove 230 is annular and disposed around the periphery of the intermediate channel 220, which can block the processing liquid, so that the processing liquid in the guide groove 230 does not easily flow into the interior of the intermediate channel 220, thereby preventing corrosion of the internal components, and the processing liquid in the guide groove 230 is thrown out of the rotary chuck 200 by centrifugal force.

In some embodiments, according to FIG. 4, the upper surface of the bottom wall 233 is parallel to the horizontal plane. In other embodiments, the upper surface of the bottom wall 233 is inclined downward in the direction from the intermediate channel 220 of the rotary chuck 200 to the edge, which is conducive to the flow of the processing liquid toward the edge. In the example shown in FIG. 5a, the upper surface of the bottom wall 233 is inclined downward in the direction from the first side wall 231 to the edge of the rotary chuck 200, and the upper surface of the bottom wall 233 is a flat surface, and the angle α between the flat surface and the horizontal plane can be in the range of $0° < \alpha < 20°$. In the example shown in FIG. 5b, the upper surface of the bottom wall 233 is inclined downward in the direction from the first side wall 231 to the edge of the rotary chuck 200, and the upper surface of the bottom wall 233 is an arcuate surface.

In some embodiments, according to FIG. 3, the rotary chuck 200 includes a plurality of mounting platforms 210, the plurality of mounting platforms 210 are spaced apart along the circumferential direction of the rotary chuck 200 at the edge of the rotary chuck 200, the side walls of the plurality of mounting platforms 210 facing away from the edge are the second side walls 232, the opposing portions of two adjacent second side walls 232 are used to define one radial flow channel, and the annular space between the first side wall 231 and each second side wall 232 is the annular flow channel. Wherein, the second side walls 232 are arcuate, and in the example shown in FIG. 3, the second side wall 232 of each mounting platform 210

arches toward the first side wall 231. In the example shown in FIG. 6, a plurality of mounting platforms 210A are arranged in a circumferential annular array and are twisted by a predetermined angle along the rotation direction of a rotary chuck 200A, so that the contour shape of the side walls of the mounting platforms 210A is roughly consistent with the throwing path of the processing liquid, which is more conducive to the discharge of the processing liquid. In FIG. 6, the range defined by the two concentric dashed circles represents the annular flow channel, and the space between the side walls of every two adjacent mounting platforms 210A defines one radial flow channel.

In some embodiments, according to FIG. 4 and FIG. 7, the plurality of clamping members 100 are respectively disposed on the plurality of mounting platforms 210. Each clamping member 100 includes a base 110 and a locating pin 120. The base 110 is disposed on the mounting platform 210 and has a support portion 111. The locating pin 120 is disposed on the base 110 for clamping a substrate 500. When the substrate 500 is statically placed on the rotary chuck 200, the substrate is carried by the support portion 111. In this example, the locating pin 120 is movably disposed on the base 110, and the lower portion of the locating pin 120 has a configuration block. When the rotary chuck 200 rotates, due to centrifugal force, the lower portion of the locating pin 120 moves radially outward, and the upper portion of the locating pin 120 moves radially inward, so that the upper portion of the locating pin 120 clamps and fixes the substrate 500. In other embodiments, other existing clamping members may be used to clamp and release the substrate 500.

In some embodiments, with continued reference to FIG. 4, the substrate holding device further comprises a backside nozzle mechanism 300, a rotating shaft 400, and a driving device (not shown in the figures). The backside nozzle mechanism 300 passes through the intermediate channel 220 of the rotary chuck 200. The backside nozzle mechanism 300 is used to spray the processing liquid onto the lower surface of the substrate. The processing liquid is, for example, deionized water (DIW), a mixed liquid of hydrofluoric acid, hydrogen peroxide, and deionized water (DHF), or liquid ozone, etc. Specifically, the backside nozzle mechanism 300 includes a cover body 310 and liquid supply lines 320. The top of the cover body 310 protrudes from the rotary chuck 200. Spray nozzles 311 are provided on the cover body 310. The liquid supply lines

320 are in communication with the spray nozzles 311 and are used to supply the processing liquid to the spray nozzles 311. The spray nozzles 311 spray the processing liquid upward toward the lower surface of the substrate to clean particles and the like on the lower surface of the substrate. Wherein, the height of the upper end of the cover body 310 exceeds the first side wall 231, and the outer diameter of the cover body 310 is greater than the outer diameter of the first side wall 231, so that the processing liquid on the cover body 310 can fall smoothly into the guide groove 230. In this embodiment, the backside nozzle mechanism 300 includes three spray nozzles 311 and three liquid supply lines 320. Each liquid supply line 320 corresponds to one spray nozzle 311, and different processing liquids can be supplied to the spray nozzles 311, respectively. The number of spray nozzles 311 and liquid supply lines 320 can be determined according to actual process requirements, and this application does not impose particular limitations thereon.

The first end of the rotating shaft 400 is connected to the rotary chuck 200, and the second end of the rotating shaft 400 is connected to the driving device (not shown in the figures). The driving device drives the rotating shaft 400 to rotate at a predetermined speed. The rotating shaft 400 drives the rotary chuck 200 to rotate, and then the clamping members 100 clamp the substrate and rotate together with the substrate along with the rotary chuck 200. In addition, the rotating shaft 400 is coaxial with the intermediate channel 220 and has a hollow structure, surrounding the outer periphery of the liquid supply lines 320. When the rotating shaft 400 drives the rotary chuck 200 to rotate, the backside nozzle mechanism 300 does not rotate.

According to FIG. 7, in the embodiment of this application, the accumulated liquid on the rotary chuck 200 mainly comes from the processing liquid that falls onto the rotary chuck 200 during the lower surface treatment process of the substrate 500. The lower surface treatment process of the substrate 500 is, for example, using the backside nozzle mechanism 300 to supply the processing liquid upward to clean particles on the lower surface of the substrate 500. Optionally, while the lower surface treatment process of the substrate 500 is performed, the upper surface treatment process of the substrate 500 is also performed, for example, using a megasonic device 600 to spray the processing liquid onto the upper surface of the substrate 500 to clean particles on the upper surface of the substrate. In this megasonic technology process,

the rotary chuck 200 rotates at a low speed, typically below 50 rpm. Under low-speed rotation, the processing liquid on the rotary chuck 200 cannot be discharged in time, causing the processing liquid to accumulate more and more and leak into the interior of the intermediate channel 220. This application provides the guide groove 230 on the rotary chuck 200. In one aspect, the processing liquid on the rotary chuck 200 is thrown out from the guide groove 230 under centrifugal force; in another aspect, according to FIG. 4, during normal process operation, even if accumulated liquid is present on the rotary chuck 200, the liquid level of the accumulated liquid is also unlikely to exceed the first side wall 231 and flow into the intermediate channel 220. Therefore, the substrate holding device proposed in this application is suitable for various common wet processes, and is particularly suitable for wet processes with low rotation speeds, such as megasonic cleaning processes. The megasonic device 600 and the cleaning process using the megasonic device 600 can adopt existing technologies, and further elaboration is omitted herein.

According to FIG. 7, this application proposes a wet processing apparatus, comprising the above-mentioned substrate holding device and the megasonic device 600. When the substrate holding device drives the substrate 500 to rotate, the megasonic device 600 sprays the processing liquid onto the upper surface of the substrate 500 to clean the substrate 500. At the same time, the backside nozzle mechanism 300 in FIG. 4 can be used to spray the processing liquid onto the lower surface of the substrate 500. During this process, the processing liquid falling into the guide groove 230 is thrown outward under centrifugal force. The dashed arrows in FIG. 7 indicate the direction in which the processing liquid is thrown out.

Finally, it should be noted that the above embodiments are only used to illustrate the technical solutions of the present invention, and are not intended to limit the present invention. Although the present invention has been described in detail with reference to the foregoing embodiments, those of ordinary skill in the art should understand that they can still modify the technical solutions described in the foregoing embodiments, or make equivalent substitutions for some or all of the technical features thereof; and these modifications or substitutions do not cause the essence of the corresponding technical solutions to depart from the scope of the technical solutions of the embodiments of the present invention.

What is claimed is:

1. A substrate holding device, comprising a rotary chuck, the rotary chuck having an intermediate channel, the rotary chuck being used to rotate about the axis of the intermediate channel;

wherein, a guide groove extending radially from inside to outside is provided on the top of the rotary chuck, the guide groove has a first side wall, a plurality of second side walls, and a bottom wall, the first side wall is disposed around the periphery of the intermediate channel, the plurality of second side walls are spaced apart along the circumferential direction at the edge of the rotary chuck, the bottom wall is connected to the first side wall and the plurality of second side walls, the first side wall, the plurality of second side walls, and the bottom wall are used to make the guide groove include an annular flow channel and a plurality of radial flow channels in communication with each other, and the annular flow channel surrounds the intermediate channel, and the plurality of radial flow channels extend from the annular flow channel to the edge.

2. The substrate holding device according to claim 1, wherein the upper surface of the bottom wall is parallel to the horizontal plane.

3. The substrate holding device according to claim 1, wherein the upper surface of the bottom wall is inclined downward in the direction from the intermediate channel to the edge.

4. The substrate holding device according to claim 3, wherein the upper surface of the bottom wall is a flat surface or an arcuate surface.

5. The substrate holding device according to claim 4, wherein when the upper surface of the bottom wall is the flat surface, the angle α between the upper surface of the bottom wall and the horizontal plane is in the range of $0° < \alpha < 20°$.

6. The substrate holding device according to claim 1, wherein the rotary chuck includes a plurality of mounting platforms, the plurality of mounting platforms are spaced apart along the circumferential direction of the rotary chuck at the edge, the side walls of the plurality of mounting platforms facing away from the edge are the

second side walls, and the opposing portions of two adjacent second side walls are used to define one radial flow channel.

7. The substrate holding device according to claim 6, wherein the second side walls are arcuate.

8. The substrate holding device according to claim 6, further comprising:

a plurality of clamping members, respectively disposed on the plurality of mounting platforms.

9. The substrate holding device according to claim 1, further comprising:

a backside nozzle mechanism, disposed in the intermediate channel, used to spray a processing liquid onto the lower surface of the substrate.

10. The substrate holding device according to claim 9, wherein the backside nozzle mechanism includes a cover body and a liquid supply line, the cover body protrudes from the rotary chuck, a nozzle is provided on the cover body, and the liquid supply line is in communication with the nozzle for supplying the processing liquid to the nozzle.

11. The substrate holding device according to claim 10, wherein the height of the upper end of the cover body exceeds the first side wall, and the outer diameter of the cover body is greater than the outer diameter of the first side wall.

12. A wet processing apparatus, comprising:

the substrate holding device according to any one of claims 1 to 11;

a megasonic device, used to spray a processing liquid onto the upper surface of the substrate to clean the substrate.