GIMBAL JOINT AND POLISHING HEAD HAVING THE SAME

TECHNICAL FIELD

The present disclosure relates to the technical field of semiconductor polishing, in particular to a gimbal joint and a polishing head having the same.

BACKGROUND

The integrated circuit manufacturing process usually refers to the deposition of conductors, semiconductors, and insulating layers on a specific substrate, such as a silicon-based wafer, in a certain process sequence. During the manufacturing process, CMP (Chemical Mechanical Polishing) equipment is mainly used to globally planarize the microscopically rough surface of the silicon-based wafer after the film deposition process, in which the multi-zone polishing head plays a key role. Subject to the installation accuracy between the polishing head installed on the polishing spindle of the machine and the polishing pad below and their own processing technique, there is a certain non-parallel error between the two. The polishing head usually uses a rotating seal ring and a gimbal joint to compensate the non-parallel error, thereby reducing the impact on the process output.

However, most of the gimbal joints of the existing polishing heads have an integrated inverted "T"-shaped thin-walled structure. Once a large deformation occurs during use, the root of the gimbal joint will be plastically deformed or even cracked, causing failure of rebounding to the original shape of the gimbal joint, or causing air leakage, or even leading to failure of the polishing head.

SUMMARY

Therefore, the technical problem to be solved by the present disclosure is that most of the gimbal joints of the existing polishing heads have an integrated inverted "T"-shaped thin-walled structure; and once a large deformation occurs during use, the root of the gimbal joint will be plastically deformed or even cracked, causing the gimbal joint to fail to return to its original shape, or causing air leakage, or even leading to failure of the polishing head. Thus, there is provided a gimbal joint and a polishing head having the same.

In order to solve the above problems, the following technical solutions of the present disclosure are provided.

A gimbal joint, at least comprises: a guide shaft; and an engagement disk at one end of the guide shaft, wherein a disk surface of the engagement disk is perpendicular to the guide shaft; wherein the engagement disk, on a side facing away from the guide shaft, comprises, from inside to outside along a radial direction, at least two levels of stepped surfaces, so as to allow an elastic deformation of the disk surface for balancing a parallelism error between a polishing head and a polishing pad.

Optionally, each level of the stepped surfaces is formed by inward depression of the disk surface of the engagement disk, and each level of the stepped surfaces is an annular stepped surface concentric with the engagement disk.

Optionally, the engagement disk, on a side facing the guide shaft, comprises a groove, and the groove is an annular groove concentric with the engagement disk.

Optionally, an inner sidewall of the groove coincides with the outer side wall of the guide shaft, and the guide shaft comprises rounded corners at its journal.

Optionally, a distance between a groove bottom of the groove and the side of the engagement disk facing away from the guide shaft is not less than 4mm.

Optionally, the stepped surfaces include two levels, and the two levels of the stepped surfaces from inside to outside along the radial direction of the engagement disk are denoted as a first stepped surface and a second stepped surface, respectively.

Optionally, a transition surface between the first stepped surface and the disk surface of the engagement disk is an inclined surface.

Optionally, a groove bottom of the groove is inclined relative to the disk surface of the engagement disk, and the groove bottom of the groove is at a same inclination angle as the inclined surface.

Optionally, a transition surface between the first stepped surface and the disk surface of the engagement disk is a first arc surface.

Optionally, a groove bottom of the groove is at least partly a second arc surface, and a distance between the second arc surface and the first arc surface remains constant.

A polishing head, comprises a gimbal joint as described above.

The technical solutions of the present disclosure have the following benefits:

The gimbal joint provided by the present disclosure has at least two levels of stepped surfaces on the disk surface of the engagement disk, so that the engagement disk has the function of a disk spring, and the engagement disk may be deformed elastically when balancing the parallelism error between the polishing head and the polishing pad, avoiding plastic deformation or cracking of the engagement disk during use, thereby preventing air leakage and avoiding failure of the polishing head.

BRIEF DESCRIPTION OF DRAWINGS

In order to more clearly illustrate embodiments of the present disclosure or the technical solutions in the prior art, the following will briefly describe the drawings used in the description of the embodiments or the prior art. Clearly, the drawings of the following descriptions are some embodiments of the present disclosure. Those of ordinary skill in the art may obtain other drawings based on these drawings without creative effort.

Fig. 1 is a schematic diagram of a gimbal joint in an embodiment of the present disclosure;

Fig. 2 is a cross-sectional view of Fig. 1;

Fig. 3 is a schematic diagram of a gimbal joint in another embodiment of the present disclosure;

Fig. 4 is a schematic diagram of a gimbal joint in another embodiment of the present disclosure;

Fig. 5 is a schematic diagram of a gimbal joint in another embodiment of the present disclosure;

Fig. 6 is a schematic diagram of a gimbal joint in another embodiment of the present disclosure;

Fig. 7 is a schematic diagram of a polishing head in an embodiment of the present disclosure.

1. Guide shaft; 2. Engagement disk; 3. First stepped surface;

4. Second stepped surface; 5. Groove; 6. Inclined surface;

7. First arc surface; 8. Second arc surface; 9. Connection plate;

10. Sealing ring; 11. Carrier base; 12. Airbag;

13. Wafer; 14. Platen.

DETAILED DESCRIPTION

The technical solutions of the present disclosure will be more clearly and completely described below with reference to the drawings. Clearly, the described embodiments are only some of the embodiments of the present disclosure, not all of the embodiments. Based on the embodiments in the present disclosure, all other embodiments obtainable by those of ordinary skill in the art without creative efforts shall fall within the protection scope of the present disclosure.

In the description of the present disclosure, it should be noted that orientation or positional relationship indicated by the terms "centre", "upper", "lower", "left", "right", "vertical", "horizontal", "inner", "outer", etc. is based on the orientation or positional relationship as shown in the drawings, only for the convenience of describing and simplifying the description, and does not indicate or imply that the referred apparatus or element must have a specific orientation, or constructed or operated in a specific orientation. Thus, it should not be construed as a limitation of the present disclosure. Further, the terms "first", "second", "third" are only used for descriptive purposes only and cannot be construed as indicating or implying relative importance.

In the description of the present disclosure, it should be noted that, unless otherwise expressly specified and limited, the terms "install", "connect" and "connection" should be construed in a broad sense. For example, it may be a fixed connection or a detachable connection, or integral connection. It may be mechanical connection or electrical connection. It may be direct connection, or indirect connection through an intermediate medium, or internal communication between two components. For those of ordinary skill in the art, the specific meanings of the above terms in the present disclosure can be understood in specific situations.

In addition, the technical features involved in the different embodiments of the present disclosure described below can be combined with each other as long as they do not conflict with each other.

Fig. 1 is a schematic diagram of a gimbal joint in an embodiment of the present disclosure. Fig. 2 is a cross-sectional view of Fig. 1. As shown in Fig. 1 and Fig. 2, the embodiment provides a gimbal joint, at least comprising: a guide shaft 1; an engagement disk 2, arranged at one end of the guide shaft 1, where the disk surface of

the engagement disk 2 is perpendicular to the guide shaft 1; wherein the engagement disk 2, on a side facing away from the guide shaft 1, comprises, from inside to outside along a radial direction, at least two levels of stepped surfaces, so as to allow an elastic deformation of the disk surface for balancing a parallelism error between a polishing head and a polishing pad. The stepped surface on the engagement disk 2 may be of two levels or steps , or three or more levels, which may be selected according to the needs of the actual use scenario. The multi-level stepped surface makes the engagement disk 2 as a whole having the function of a disk spring, which can strengthen elastic deformation capacity of the disk surface. In some embodiments, the disk surface of the engagement disk 2 may be defined as the flat bottom surface of the engagement disk 2, or defined as a flat surface on the engagement disk 2 that is most distant from the guide shaft along its longitudinal direction.

The gimbal joint provided by the embodiment has at least two levels of stepped surfaces on the disk surface of the engagement disk 2, so that the engagement disk 2 may function as a disk spring, and the engagement disk 2 may be deformed elastically when balancing the parallelism error between the polishing head and the polishing pad, avoiding plastic deformation or cracking of the engagement disk 2 during use, thereby preventing air leakage and avoiding failure of the polishing head.

Each level of the stepped surfaces is formed by inward depression of the disk surface of the engagement disk 2, and each level of the stepped surfaces is an annular stepped surface concentric with the engagement disk 2.

The engagement disk 2, on a side facing the guide shaft 1, comprises a groove 5, and the groove 5 is an annular groove 5 concentric with the engagement disk 2. This configuration may not only ensure the functional elastic deformation of the engagement disk 2, but also reasonably reduce the weight of the engagement disk 2.

An inner sidewall of the groove 5 coincides with the outer side wall of the guide shaft 1, and the guide shaft 1 comprises rounded corners at its journal. For example, the dimension of the rounded corner may be 2 mm. This configuration may reduce stress concentration, and thus not only ensures the structural strength of the gimbal joint during use, but also reasonably improves the machinability of the parts and reduces the difficulty of processing.

A distance between a groove bottom of the groove 5 and the side of the engagement disk 2 facing away from the guide shaft 1 is not less than 4 mm, so that the engagement disk 2 may elastically deform under force while still having a certain rigidity, thereby improving the issue of insufficient local strength due to the structure.

The stepped surfaces include two levels, and the two levels of the stepped surfaces from inside to outside along the radial direction of the engagement disk 2 are denoted as a first stepped surface 3 and a second stepped surface 4, respectively.

Fig. 3 is a schematic diagram of a gimbal joint in another embodiment of the present disclosure. As shown in Fig. 3, for example, the transition surface between the first stepped surface 3 and the disk surface of the engagement disk 2 is an inclined surface 6. This configuration is beneficial to improve the strength of the engagement disk 2.

Fig. 4 is a schematic diagram of a gimbal joint in another embodiment of the present disclosure. As shown in Fig. 4, for example, the groove bottom of the groove 5 is inclined relative to the disk surface of the engagement disk 2, and the groove bottom of the groove 5 is at the same inclination angle as the inclined surface 6. This configuration is beneficial to improve the structural elasticity of the engagement disk 2.

Fig. 5 is a schematic diagram of a gimbal joint in another embodiment of the present disclosure. As shown in Fig. 5, for example, a transition surface between the first stepped surface 3 and the disk surface of the engagement disk 2 is a first arc surface 7. This configuration is beneficial to improve the strength of the engagement disk 2.

Fig. 6 is a schematic diagram of a gimbal joint in another embodiment of the present disclosure. As shown in Fig. 6, for example, a groove bottom of the groove 5 is at least partly a second arc surface 8, and the distance between the second arc surface 8 and the first arc surface 7 remains constant. This configuration is beneficial to improve the structural elasticity of the engagement disk 2.

Fig. 7 is a schematic diagram of a polishing head in an embodiment of the present disclosure. As shown in Fig. 7, the polishing head is provided in the embodiment, comprising a gimbal joint as described above. The polishing head includes a connection plate 9, a carrier base 11, a sealing ring 10 and an airbag 12. The connection plate 9 and the carrier base 11 are connected by the sealing ring 10, and the guide shaft 1 of the gimbal joint is slidably inserted in a central hole of the connecting plate 9. The

engagement disk 2 of the gimbal joint is fixed in a receiving cavity of the carrier base 11, and a supporting platform matching the second stepped surface 4 is arranged in the receiving cavity of the carrier base 11, to facilitate the installation of the engagement disk 2. The airbag 12 is installed on a side of the carrier base 11 facing away from the connection plate 9 for picking up the wafer 13. A platen 14 is provided under the carrier base 11, and a polishing pad is provided on a side of the platen 14 facing the carrier base 11.

In use, after the wafer 13 is picked up by the airbag 12, the wafer 13 is driven to rotate by the rotation of the connection plate 9. The wafer 13 is ground and polished by the polishing pad. When the sealing ring 10 is inflated, the guide shaft 1 moves downward relative to the connection plate 9; when the sealing ring 10 shrinks in vacuum, the guiding shaft 1 moves upward relative to the connection plate 9. When there is a parallelism error between the side of the connection plate 9 facing away from the carrier base 11 and the side of the platen 14 facing the carrier base 11, the engagement disk 2 is deformed to offset the parallelism error between the planes of the two sides, thereby ensuring the polishing effect of the wafer 13. Since the engagement disk 2 is capable of elastic deformation, it may protect the gimbal joint from large external forces, thereby avoiding phenomena such as cracking and plastic deformation, improving the yield of products in the process, and ensuring production efficiency.

In summary, in the gimbal joint of the present disclosure, controllable elastic deformation structure is added to the engagement disk 2, to meet design requirements for adaptable controllable levelling structure of the polishing head and the polishing pad.

The gimbal joint in the present disclosure may improve the issue of insufficient local strength caused by the structure.

The gimbal joint in the present disclosure may reduce the effect of local force and local stress.

The gimbal joint in the present disclosure may avoid the problem of air leakage when the components are in use.

The gimbal joint in the present disclosure may optimize the problems that the parts are prone to damage in use, difficult to produce, costly, difficult to assemble, and prone to wear and tear.

Clearly, the above embodiments are only examples for clear description, and are not intended to limit the scope of the disclosure. For those of ordinary skill in the art, there are other variations or changes that can be made in different forms based on the above description. It is not necessary or possible to exhaust all embodiments here. The obvious variations or changes derived therefrom are within the protection scope of the present disclosure.

CLAIMS

1. A gimbal joint, comprising:

a guide shaft; and

an engagement disk at one end of the guide shaft, wherein a disk surface of the engagement disk is perpendicular to the guide shaft;

wherein the engagement disk, on a side facing away from the guide shaft, comprises, from inside to outside along a radial direction, at least two levels of stepped surfaces, so as to allow an elastic deformation of the disk surface for balancing a parallelism error between a polishing head and a polishing pad.

2. The gimbal joint according to claim 1, wherein,

each level of the stepped surfaces is formed by inward depression of the disk surface of the engagement disk, and each level of the stepped surfaces is an annular stepped surface concentric with the engagement disk.

3. The gimbal joint according to claim 1, wherein,

the engagement disk, on a side facing the guide shaft, comprises a groove, and the groove is an annular groove concentric with the engagement disk.

4. The gimbal joint according to claim 3, wherein,

an inner sidewall of the groove coincides with the outer side wall of the guide shaft, and the guide shaft comprises rounded corners at its journal.

5. The gimbal joint according to claim 3, wherein,

a distance between a groove bottom of the groove and the side of the engagement disk facing away from the guide shaft is not less than 4mm.

6. The gimbal joint according to claim 3, wherein,

the stepped surfaces include two levels, and the two levels of the stepped surfaces from inside to outside along the radial direction of the engagement disk are denoted as a first stepped surface and a second stepped surface, respectively.

7. The gimbal joint according to claim 6, wherein,

a transition surface between the first stepped surface and the disk surface of the engagement disk is an inclined surface.

8. The gimbal joint according to claim 7, wherein,

a groove bottom of the groove is inclined relative to the disk surface of the engagement disk, and the groove bottom of the groove is at a same inclination angle as the inclined surface.

9. The gimbal joint according to claim 6, wherein,

a transition surface between the first stepped surface and the disk surface of the engagement disk is a first arc surface.

10. The gimbal joint according to claim 9, wherein,

a groove bottom of the groove is at least partly a second arc surface, and a distance between the second arc surface and the first arc surface remains constant.

11. A polishing head, comprising a gimbal joint according to any one of claims 1-10.