

WAFER RETAINING RING

Field of the invention

The present invention relates to an improved structure of chemical mechanical polishing (CMP) table and, more particularly, to an improved structure of a wafer-retaining ring in a polishing head.

Background of the invention

In the fabrication process of integrated circuits (ICs), chemical polishing has become the key to planarization of ICs. Among chemical polishing methods, chemical mechanical polishing (CMP) has become a novel technique for global planarization of wafer. In CMP, a very flat polishing pad is paved on a polishing table, a face of a wafer to be polished contacts a polishing disk, and use of polishing slurry is matched. Mechanical motion of a polishing head is utilized to let the wafer make relative motion on the polishing pad to generate friction, thereby polishing the wafer to a desired thickness or lapping uneven portions.

A general polishing head comprises mainly an air chamber. A wafer carrier is disposed below the air chamber to bear the pressure generated by the air chamber and to carry a wafer on the polishing pad to make relative motion. The wafer carrier comprises a wafer-retaining ring, which needs to be tightly pasted on the polishing pad to be used as a base face for controlling the wafer in the inner diameter thereof. As shown in Fig. 1, a conventional wafer-retaining ring 10 is completely made of engineering plastic. A plurality of screws 18 are annularly disposed on a surface thereof. A long alignment hole 19 and a circular alignment hole 19' are disposed along a diagonal direction to help positioning the wafer-retaining ring 10 on the wafer carrier, respectively. A

plurality of long trenches 22 along centrifugal directions are formed on a bottom face of the wafer-retaining ring 10. Because the material of this kind of wafer-retaining ring 10 is engineering plastic, the wafer-retaining ring 10 easily deforms when being fixedly locked on the wafer carrier. Therefore, it is necessary to planarize and lap the wafer-retaining ring, hence lengthening the required lapping time and polishing time. Moreover, the number of dummy wafers is large, hence resulting in a high cost.

As shown in Fig. 2, another wafer-retaining ring 10' is formed by joining a stainless steel ring 12 and a high molecule polishing ring 14. An annular body 16 extends upwards from an outer edge of a top face of the stainless steel ring 12. A plurality of screw holes 18 are uniformly and annularly disposed on a surface of the annular body 16. A plurality of projective structures 20 are formed on an inner edge of the top face of the stainless steel 12. Although the stainless steel ring 12 can be recycled for use when the wafer-retaining ring 10' is replaced, the fabrication process of the stainless steel ring 12 is complicated, and the cost is also high.

On the other hand, because a plane contact is formed between the wafer-retaining rings 10 or 10' and the polishing pad, prominence of the polishing pad easily arises to cause over polishing of edges of chips when the wafer-retaining ring 10 or 10' rotates and slides, hence deteriorating quality of subsequent coating and yield.

Accordingly, the present invention aims to propose an improved structure of a wafer-retaining ring to resolve the above problems.

Summary of the invention

The primary object of the present invention is to propose a wafer-retaining

ring of simple manufacture and low cost.

Another object of the present invention is to propose a wafer-retaining ring capable of preventing a polishing pad from deformation to reduce over polishing of edges of chips, hence enhancing throughput and letting quality of subsequent coating be good and the yield be high.

Yet another object of the present invention is to propose a wafer-retaining ring capable of reducing the number of dummy wafers and having a longer polishing lifetime.

According to the present invention, a wafer-retaining ring is formed by joining a high molecule polishing ring on a bottom face of a substrate having a planar ring structure. A lapping plane or a bevel structure tilting inwards is formed on a bottom face of an annular body. A plurality of trenches in centrifugal directions are formed on the lapping plane or the bevel structure. Each of the trenches penetrates two ends of an inner edge and an outer ring of the annular body to form bell-shaped expansion portions, respectively. Additionally, a circular curved surface is formed at an outside bottom edge of the annular body.

The various objects and advantages of the present invention will be more readily understood from the following detailed description when read in conjunction with the appended drawing, in which:

Brief description of the drawings:

Fig. 1 is a structure diagram of a prior art wafer-retaining ring;

Fig. 2 is a structure diagram of another prior art wafer-retaining ring;

Fig. 3 is a perspective view of the present invention;

Fig. 4 is an exploded perspective view of the present invention;

Fig. 5 is a bottom view of the present invention;

Fig. 6 is a cross-sectional view of the present invention;

Fig. 7 is a perspective view of another embodiment of the present invention;

Fig. 8 is a partly cross-sectional view of another embodiment of the present invention;

Fig. 9 is a partly cross-sectional view of yet another embodiment of the present invention;

Fig. 10 is a partly cross-sectional view of still yet another embodiment of the present invention; and

Fig. 11 is a cross-sectional view of further yet another embodiment of the present invention.

Detailed description of the preferred embodiments

As shown in Figs. 3 and 4, a wafer-retaining ring 30 is formed by joining a substrate 32 and a high molecule polishing ring 34. In the high molecule polishing ring 34, a bevel structure 40 tilting toward an inner edge is formed on a bottom face of an annular body 36 so that the inside thickness of the annular body 36 is larger than the outside thickness thereof. The substrate 32 joined on a top face of the annular body is also a ring structure 42, which is designed to match the shape and structure of the high molecule polishing ring 34. A top face of the ring structure 42 is a planar face with a plurality of screw holes 44 uniformly and annularly disposed thereon so that the ring structure 42 can be fixedly locked on a polishing head. A long alignment hole 45 and a circular alignment hole 45' are formed along a diagonal direction of the top face of the ring structure 42 to help accurately screwing screws into the screw holes 44.

As shown in Fig. 5, a plurality of trenches 46 are formed along centrifugal

directions on a bottom face of the annular body 36. Each of the trenches 46 penetrates two ends of an inner edge and an outer edge of the annular body 36 to expand toward two sides to form two bell-shaped expansion portions 48, respectively. In addition to speeding passage of polishing slurry through each of the trenches 46 to enhance polishing efficiency, the surface temperature of the wafer-retaining ring 30 and the polishing pad can be effectively reduced due to increase of receiving space of the polishing slurry. The expansion portions 48 of the above trenches 46 can also expand toward only a side face of the trenches.

Additionally, as shown in Fig. 6, a circular curved surface 50 is formed at an outside bottom edge of the annular body 36 to reduce friction between the wafer-retaining ring 30 and the polishing pad and to effectively decrease the noise.

In addition, one of the alignment holes 45 (or 45') can be replaced with a blind small circular hole disposed near an outer edge of the top face of the ring structure 42.

The ring structure 42 can be made of metallic material or high molecule material. The metallic material are generally stainless steel or alloy steel. The material of the annular body 36 can be high molecule material such as PPS, PEEK, PET-P, PBI, or polyamide-imide.

A through hole 52 penetrating an inner wall and an outer wall of the ring structure 42 is horizontally formed inside the ring structure 42 of the substrate 32 and between two of the screw holes 44, thereby providing more smooth discharge of pressure when the wafer-retaining ring 30 works.

In the present invention, owing to of the design of the bevel structure 40 on

the bottom face of the high molecule polishing ring 34, a line contact is formed between the wafer-retaining ring 30 and the polishing pad to obtain a smaller contact area, hence avoiding the problem in the prior art. Therefore, the present invention can reduce over polishing of edges of chips to let quality of subsequent coating be better and to enhance production yield. Furthermore, the design of the planar ring structure of the substrate is simpler in manufacture, hence greatly decreasing the cost.

Additionally, as shown in Fig. 8, a plurality of holes 54 are uniformly formed on the joining face of the ring structure 42 of the substrate 32, and an annular projective portion 56 is disposed on the joining face of the annular body 36 of the high molecule polishing ring 34. When the two joining faces are glued together with epoxy 58, the epoxy 58 will enter the holes 54 and fill them. When the epoxy 58 hardens, the epoxy 58 in the holes 54 will form columnar bodies, hence letting the joining of the substrate 32 and the high molecule polishing ring 34 be more robust. Moreover, shearing stress generated between the substrate 32 and the high molecule polishing ring 34 because a certain weight pressure is applied on the substrate 32 can be evenly shared when the wafer-retaining ring 30 is used. As shown in Fig. 9, an annular groove 60 can be designed on the joining face of the ring structure 42 of the substrate 32 to increase the joining area of the ring structure 42 and the epoxy 58, thereby letting the joining of the substrate 32 and the high molecule polishing ring 34 be more robust.

As shown in Fig. 10, the above holes can be omitted. Only a groove 60 corresponding to the annular projective portion 56 on the high molecule polishing ring 34 is formed on the bottom face of the ring structure 42 of the

substrate 32 so that the annular projective portion 56 and the groove 60 can be joined together when the two joining faces are glued together. The groove 60 and the annular projective portion 56 can also not correspond to each other.

On the other hand, in addition to a bevel structure, a lapping plane 62 can be formed on the bottom face of the annular body 36 of the high molecule polishing ring 34, as shown in Fig. 11. A plurality of trenches 46 are formed on the lapping plane 62. Two ends of each of the trenches 46 expand toward two sides thereof to respectively form expansion portions 48, thereby letting the polishing slurry more easily pass through the trenches 46. A circular curved surface 50 is also formed at an outside bottom edge of the annular body 36 to greatly reduce friction between the wafer-retaining ring 30 and the polishing pad and to decrease the friction noise easily generated when the wafer-retaining ring 30 works during the initial stage. Other structures are the same as above and thus will not be further described.

Although the present invention has been described with reference to the preferred embodiment thereof, it will be understood that the invention is not limited to the details thereof. Various substitutions and modifications have been suggested in the foregoing description, and other will occur to those of ordinary skill in the art. Therefore, all such substitutions and modifications are intended to be embraced within the scope of the invention as defined in the appended claims.

I claim:

1. A substrate of a wafer-retaining ring, said substrate being a ring structure, a top face and a bottom face of said ring structure being planar faces, a plurality of screw holes being uniformly disposed on the top face of said ring structure.
2. The substrate as claimed in claim 1, wherein two alignment holes are disposed on the top face of said ring structure.
3. The substrate as claimed in claim 1, wherein said ring structure is made of metallic material or high molecule material.
4. The substrate as claimed in claim 1, wherein a plurality of holes are formed on the bottom face of said ring structure.
5. The substrate as claimed in claim 1, wherein at least a trench is annularly formed on the bottom face of said ring structure.
6. The substrate as claimed in claim 1, 4, or 5, wherein a plurality of through holes horizontally penetrating to an outside of said ring structure are uniformly formed at an inner side of said ring structure.
7. A high molecule polishing ring of a wafer-retaining ring, a plurality of trenches being formed along centrifugal directions of a bottom face of an annular body, each of said trenches penetrating at least an end of an inner edge and an outer edge of said annular body to form an expansion portion.
8. The high molecule polishing ring as claimed in claim 7, wherein a bevel structure tilting toward the inner edge of said annular body is formed on the bottom face of said annular body.
9. The high molecule polishing ring as claimed in claim 7, wherein the bottom face of said annular body is a lapping plane.



10. The high molecule polishing ring as claimed in claim 7, wherein at least a projective portion is formed on a top face of said annular body.
11. The high molecule polishing ring as claimed in claim 7, 8, 9, or 10, wherein a circular curved surface is formed at an outside bottom edge of said annular body.

