

BONDING METHOD OF WAFER RETAINING RING

Field of the invention

The present invention relates to a wafer retaining ring and, more particularly, to a bonding method capable of enhancing the bonding effect of a wafer
5 retaining ring.

Background of the invention

Many high-purity engineering plastics are usually used in the semiconductor industry. Engineering plastics belong to the domain of high molecular material. Therefore, high molecular material is extensively applied to mechanical
10 equipments in the semiconductor industry such as chemical mechanical retaining (CMP) machines, etch machines, wet chemical stations, and scrubbers.

The prior art CMP technique makes use of a retaining ring made of high molecular material to polish wafers. As shown in Figs. 1 to 3, the retaining ring
15 is formed by bonding a high molecular retaining ring 10 and a stainless steel substrate 12. The bonding is accomplished by applying chemical agent to the surface of the high molecular retaining ring 10 to be bonded to let the surfaces of high molecules generate free radicals, sandblasting the surface to increase its roughness and degree of crystallization, and then using epoxy 14 to adhere the
20 high molecular retaining ring 10 to the stainless steel substrate 12. A wafer retaining ring is thus formed. Because the bonding face of the stainless steel substrate 12 is rough and only an annular raised portion 16 is provided on the bonding face of the high molecular retaining ring 10, the bonding force with the epoxy 14 is limited. Therefore, three pin holes 18 are uniformly disposed on
25 the stainless steel substrate 12 so that the bonding between the stainless steel

substrate 12 and the high molecular retaining ring 10 can be more robust through a step of installing pins after they are bonded together.

However, the step of installing pins is cumbersome, and it must be manually and carefully performed. Therefore, there will be only a limited number of pins
5 installed. When the wafer retaining ring is used, a certain weight pressure will act on the stainless steel substrate. There will be shearing stress generated between the stainless steel substrate and the high molecular retaining ring. The shearing stress will easily concentrate on the pins. Because there are only a limited number of pins, each pin may suffer a shearing stress larger than its
10 bearable force, thereby easily generating breakage to let the stainless steel substrate detach from the high molecular retaining ring.

Because the bonding between the high molecular retaining ring and the stainless steel substrate in the prior art is not good, the retaining effect is limited, and they will easily detach from each other, hence resulting in sliding
15 of wafer and breakage of wafer. Therefore, the production will decrease, and the cost will increase. The highest ratio of present rejects due to bad bonding is about 90%. Therefore, the present invention aims to propose a new bonding method to improve the above drawbacks.

Summary of the invention

20 The primary object of the present invention is to propose a bonding method capable of letting a wafer retaining ring have good bonding effect and not fall off so as to increase the yield of retaining ring.

Another object of the present invention is to propose an improved wafer retaining ring to simplify the difficulty of processing and manufacturing of
25 wafer retaining ring and to decrease manufacturing procedures and time.

Yet another object of the present invention is to provide a wafer retaining ring capable of lengthening retaining time and lifespan of use.

According to the present invention, a substrate and a high molecular retaining ring processed beforehand are provided in advance. At the same time,
5 bonding faces of the substrate and the high molecular retaining ring are sandblasted and acted by dissolvent to remove lipid and oil thereon and then are wiped clean. Next, the bonding face of the high molecular retaining ring is processed using flame or plasma to generate specific reaction. Finally, a layer of epoxy is applied on the substrate and the high molecular retaining ring and
10 then thermally processed by baking to bond the substrate and the high molecular retaining ring together.

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 drawings, in which:

15 **Brief description of the drawings:**

Fig. 1 is a perspective view of a prior art wafer retaining ring;

Fig. 2 is an exploded perspective view of Fig. 1;

Fig. 3 is a cross-sectional view along the A-A' line shown in Fig. 1;

Fig. 4 is a perspective view of a finished wafer retaining ring of the present
20 invention;

Fig. 5 is an exploded perspective view of a wafer retaining ring of the present invention;

Fig. 6 is an exploded perspective view of a wafer retaining ring according to another embodiment of the present invention;

25 Fig. 7 is a bottom view of the substrate shown in Fig. 6;

Fig. 8 is a cross-sectional view of a wafer retaining ring by bonding the substrate and the high molecular retaining ring shown in Fig. 6 along the line B-B';

Fig. 9 is a view of the substrate shown in Fig. 6 according to another
5 embodiment of the present invention;

Fig. 10 is a cross-sectional view of a wafer retaining ring by bonding the high molecular retaining ring shown in Fig. 6 and the substrate shown in Fig. 9 along the line B-B'; and

Fig. 11 is a cross-sectional view of the wafer retaining ring shown in Fig. 10
10 having added holes along the line B-B'.

Detailed description of the preferred embodiments

As shown in Figs. 4 and 5, a wafer retaining ring 20 is formed by bonding a substrate 22 and a high molecular retaining ring 24. The bonding method of the wafer retaining ring 20 comprises the following steps. First, the substrate 22
15 and the high molecular retaining ring 24 polished and cut beforehand are provided. Bonding faces of the substrate 22 and the high molecular retaining ring 24 are then sandblasted to increase their roughness and degree of crystallization. Uncalled sticking objects on the faces are also removed to increase bonding effect. Next, dissolvent is used to wipe clean the bonding
20 faces of the substrate 22 and the high molecular retaining ring 24 and to remove lipid and oil thereon so as to increase bonding effect. The dissolvent is usually trichloroethylene, acetone, or butanone. An automatic flame processor is then used to process the bonding face of the high molecular retaining ring 24 to break molecular bonds thereof for generating free radicals so as to further
25 generate functional radicals such as carbonyl, carboxyl, or amide and to even

lead to cross linking between high molecular bonds. Simple thermal processing by flame generates extra ionic materials. Finally, epoxy is used to bond the bonding faces of the substrate 22 and the high molecular retaining ring 24 together. Because the originally hydro-repulsive high molecular retaining ring 5 24 becomes hydrophilic after flame processing, it will react with the epoxy. Therefore, there will be a very uniform layer of epoxy adhered on the surface of the high molecular retaining ring 24 to join the substrate 22. Thereby, a wafer retaining ring 20 is formed.

After the epoxy is applied on the surfaces of the substrate 22 and the high 10 molecular retaining ring 24 and bonds them together, a thermal step by baking can further be performed to harden high molecules and to increase retaining lifespan. Or a thermal step by vacuum baking can be performed to extract out air bubbles in the bonding interface so as to achieve better bonding effect.

The above substrate 22 is selected from metal material and high molecular 15 material. The metal material is usually stainless steel. The above high molecular retaining ring 24 is selected from high molecular material such as polyphenylene-sulfide (PPS), polyetherether-ketone (PEEK), semi-crystalline thermoplastic polyester (PET-P), polybenz-imidazole (PBI), and polyamide-imide.

20 Additionally, the thermal step by flame to the bonding face of the high molecular retaining ring 24 in the above bonding process can be replaced with another processing way, i.e., plasma processing is performed to the bonding face of the high molecular retaining ring 24. A large voltage is applied across two electrodes to let the surface material of the high molecular retaining ring 25 placed therein generate plasma action of ions, electrons, atoms, free radicals,

and ultraviolet rays so as to lead to derivative chemical reactions. Moreover, the roughness of the surface after reaction is as smooth as the previously cut and processed plane. The affected depth by plasma reaction is larger, and the bonding effect is better. Other steps are the same as above and thus will not be
5 further described.

Furthermore, to increase the bonding area of the substrate 22 and the high molecular retaining ring 24 with the epoxy so that the substrate 22 and the high molecular retaining ring can be tightly joined together, an annular projective portion 26 is formed on the bonding face of the high molecular retaining ring
10 24, as shown in Fig. 6. Please also refer to Fig. 7 for the structure of the substrate 22. A plurality of blind holes 28 are formed on the bonding face of the substrate 22 so that the epoxy 30 will enter the holes 28 to fill them when the epoxy 30 is applied on the bonding face of the substrate 22. As shown in Fig. 8, after the epoxy 30 hardens, the epoxy 30 in the hole 28 will form a
15 columnar body 32, which not only has effect of increasing bonding area, but also has the property of a prior art pin. Furthermore, the annular projective portion 26 on the high molecular retaining ring 24 is also exploited to increase the bonding area between the high molecular retaining ring 24 and the epoxy 30 to let the bonding of the substrate 22 and the high molecular retaining ring
20 24 be more robust and not fall off. If there is no annular projective portion 26 on the high molecular retaining ring 24, the bonding face of the high molecular retaining ring will be planar and will not affect the bonding force between the substrate 22 and the high molecular retaining ring 24.

In addition, at least a trench 34 can be disposed at a position on the bonding
25 face of the substrate 22 corresponding to the position of the annular projective

portion 26 on the bonding face of the high molecular retaining ring 24, as shown in Fig. 9. After the substrate 22 and the high molecular retaining ring 24 undergo the above sandblasting, dissolvent wiping, and surface processing procedures, the epoxy 30 is then used to adhere the substrate 22 to the high molecular retaining ring 24. Please also refer to Fig. 10. Because the trench 34 of the substrate 22 corresponds to the annular projective portion 26 of the high molecular ring 24, part of the annular projective portion 26 is disposed in the trench 34. After the epoxy 30 hardens, the annular projective portion 26 and the trench 34 will be joined together. The bonding area not only increases to let the bonding of the substrate 22 and the high molecular retaining ring 24 be more robust and not fall off, the joined annular projective portion 26 and trench 34 also has the property of a prior art pin. When the wafer retaining ring 20 is used, the joined annular projective portion 26 and trench 34 can uniformly share a shearing stress generated between the substrate 22 and the high molecular retaining ring 24 due to a certain weight pressure acting on the substrate 22.

In the wafer retaining ring 20 shown in Fig. 10, besides the trench 34 is annularly disposed on the high molecular retaining ring 24, a plurality of holes 28 can further be disposed thereon, as shown in Fig. 11. When the substrate 22 and the high molecular retaining ring 24 are bonded together through the epoxy 30, the epoxy 30 will enter the holes 28 to fill them. The epoxy 30 in the hole 28 will form a columnar body 32. The annular projective portion 26, the trench 34, the holes 28, and the columnar bodies 32 will be simultaneously exploited to let the substrate 22 and the high molecular retaining ring 24 be steadily and tightly joined together.

To sum up, the wafer retaining ring of the present invention has good

bonding effect and will not fall off, hence effectively increasing yield of retaining ring, preventing sliding and thus breakage of wafer, and reducing the cost. Additionally, although there are different designs of the substrate and the high molecular retaining ring in the bonding method of the present invention,
5 bonding procedures need not to be varied, and the step of installing pins after bonding can be omitted. Therefore, the present invention has the advantages of simplifying processing difficulty and reducing manufacturing procedures and time.

Although the present invention has been described with reference to the
10 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
15 claims.



I claim:

1. A bonding method of a wafer retaining ring, comprising the steps of:
providing a substrate and a high molecular retaining ring;
using dissolvent to wipe clean bonding faces of said substrate and said
5 high molecular retaining ring;
processing said bonding face of said high molecular retaining ring by
flame to let its surface molecules generate free radicals and to further
generate functional radicals; and
using epoxy to join said bonding faces of said substrate and said high
10 molecular retaining ring together.
2. The bonding method of a wafer retaining ring as claimed in claim 1,
wherein said substrate is selected from metal material and high molecular
material.
3. The bonding method of a wafer retaining ring as claimed in claim 1,
15 wherein a step of sandblasting can further be performed before said step of
wiping by dissolvent.
4. The bonding method of a wafer retaining ring as claimed in claim 1,
wherein a thermal step by baking can further be performed after said
substrate and said high molecular retaining ring are joined together.
- 20 5. The bonding method of a wafer retaining ring as claimed in claim 1,
wherein a plurality of holes are formed on said bonding face of said
substrate to be filled by said epoxy.
6. The bonding method of a wafer retaining ring as claimed in claim 1,
wherein at least a projective portion is further formed on said bonding face
25 of said high molecular retaining ring.



7. The bonding method of a wafer retaining ring as claimed in claim 1,
wherein at least a trench is disposed on said bonding face of said substrate,
and at least an annular projective portion is formed at a position on said
bonding face of said high molecular retaining ring corresponding to the
position of said trench.
8. A bonding method of a wafer retaining ring, comprising the steps of:
providing a substrate and a high molecular retaining ring;
using dissolvent to wipe clean bonding faces of said substrate and said
high molecular retaining ring;
processing said bonding face of said high molecular retaining ring by
plasma to let its surface material generate plasma reaction and to further
lead to chemical reaction; and
using epoxy to join said bonding faces of said substrate and said high
molecular retaining ring together.
9. The bonding method of a wafer retaining ring as claimed in claim 8,
wherein said substrate is selected from metal material and high molecular
material.
10. The bonding method of a wafer retaining ring as claimed in claim 8,
wherein a step of sandblasting can further be performed before said step of
wiping by dissolvent.
11. The bonding method of a wafer retaining ring as claimed in claim 8,
wherein a thermal step by baking can further be performed after said
substrate and said high molecular retaining ring are joined together.
12. The bonding method of a wafer retaining ring as claimed in claim 8,
wherein a plurality of holes are formed on said bonding face of said



substrate to be filled by said epoxy.

13. The bonding method of a wafer retaining ring as claimed in claim 8, wherein at least a projective portion is further formed on said bonding face of said high molecular retaining ring.
- 5 14. The bonding method of a wafer retaining ring as claimed in claim 8, wherein at least a trench is disposed on said bonding face of said substrate, and at least an annular projective portion is formed at a position on said bonding face of said high molecular retaining ring corresponding to the position of said trench.