

Flexible Membrane for Chemical Mechanical Polishing Apparatus

BACKGROUND OF THE INVENTION

The present invention relates to a flexible membrane for a chemical mechanical polishing apparatus. The flexible membrane contacts a surface of a wafer and supports
5 the wafer for stable and continuous operation during a polishing process of the wafer.

Planarization is one of important processes for processing wafers in the electronic industry for obtaining surface flatness. A chemical mechanical polishing process can meet strict flatness requirements for wafers. Therefore, the surfaces of wafers are generally polished first by a chemical mechanical polishing apparatus to
10 remove impurities and to obtain excellent surface flatness before subsequent processes such as deposition of conductive, semiconductive, or insulating layers. The chemical mechanical polishing apparatus generally includes at least one carrier which is utilized to vacuum chuck a wafer to be polished to a polishing pad and to support the wafer to prevent it from disengaging from the carrier during the polishing process. In addition,
15 the carrier applies an even, appropriate, downward pressure to the wafer during the polishing process so that the resultant wafer can obtain a surface with a high flatness, which is critical in the subsequent processes.

A flexible membrane is mounted to the carrier for contacting the wafer, allowing the carrier of the chemical mechanical polishing apparatus to vacuum chuck or
20 press against the wafer. Typical flexible membranes are generally in the form of circular disks made of neoprene, because neoprene has the properties of resistance to oil and chemicals as well as excellent friction. A detailed operation procedure of the carrier of conventional chemical mechanical polishing apparatus is disclosed in Taiwanese Patent Publication No. 373811 entitled "AIR TIGHTNESS MEASURING DEVICE FOR
25 WAFER HOLDER OF CHEMICAL MECHANICAL POLISHING APPARATUS".

Specifically, the flexible membrane is provided in the carrier and separates an interior of the carrier into several airtight chambers. Air is filled into or exhausted out of each airtight chamber via at least one duct to control deformation of the flexible membrane. When air is exhausted, the flexible membrane flexes upward to vacuum chuck a wafer.

5 When air is filled, the flexible membrane flexes downward to press against the wafer and can apply an appropriate, even pressure to the wafer during the polishing process.

However, there are still problems in the widely used neoprene flexible membrane. Specifically, during the polishing process of wafers, the environment must be under extreme control, for the quality of polishing is liable to be adversely affected by

10 unexpected impurities. However, the flexible membrane made of neoprene produces larger pollution to the environment during the polishing process. Specifically, particles generated during the polishing process due to friction of the flexible membrane made of neoprene adversely affect the quality of polishing. Further, even though the contact surface of the flexible membrane provides excellent friction, slip of wafers occurred in

15 actual practice. The yield is, thus, reduced.

Thus, a need exists for a flexible membrane for a chemical mechanical polishing apparatus that can reduce environmental pollution while avoiding the wafer from slipping during the polishing process of the wafer.

BRIEF SUMMARY OF THE INVENTION

20 It is a main objective of the present invention to reduce environmental pollution and to avoid the wafer from slipping during polishing processes.

To achieve afore-mentioned objective, the present invention provides a novel flexible membrane for a chemical mechanical polishing apparatus. The flexible membrane is generally in the form of a circular disk made of silicone with high

25 cleanliness. The flexible membrane includes a plane portion for contacting or pressing against a wafer. The flexible membrane further includes a coupling portion extending

upward from the plane portion. Further, a layer of poly-para-xylylene is coated on a lower side of the plane portion by vacuum micro coating to form a wafer contact surface.

The flexible membrane of the present invention produces lower pollution to the wafers polishing environment and provides excellent friction to prevent wafers from slipping. Further, the contact surface formed by the layer of poly-para-xylylene increases the erosion resistance and durability of the flexible membrane.

The present invention will become clearer in light of the following detailed description of illustrative embodiment of this invention described in connection with the drawings.

DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a schematic, cross sectional view of a flexible membrane according to the present invention mounted to a carrier for a chemical mechanical polishing apparatus.

FIG. 2 is a perspective view of the flexible membrane according to the present invention.

FIG. 3 is a cross sectional view of the flexible membrane according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

FIG. 1 shows a schematic view of a carrier 1 for a chemical mechanical polishing apparatus. A flexible membrane 3 according to the present invention is mounted to carrier 1 for contacting a wafer 4 to be polished in a polishing process.

Carrier 1 includes a body 11 which is engaged with a rotating shaft 12 through a quick-release coupler 13. An elastic member 111 is provided in an interior of body 11. Flexible membrane 3 of the present invention is mounted in the interior of body 11 and engaged in elastic member 111. During the polishing process, body 11 of carrier 1 presses against a polishing pad 21 on a polishing table 2. A first airtight chamber 112 and

a second airtight chamber 113 are defined in a space between body 11 and polishing pad 21 and separated by flexible membrane 3 and elastic member 111. A third airtight chamber 114 is defined by a coupling portion 131 of quick-release coupler 13, body 11 and a resilient member 132 mounted between coupling portion 131 and body 11. A first duct 115 and a second duct 116 are extended into body 11 of carrier 1. Second duct 116 is in communication with second airtight chamber 113. A third duct 117 is in communication with third airtight chamber 114.

During the polishing process, air in third airtight chamber 114 is exhausted via third duct 117 so that body 11 of carrier 1 is lifted due to upward pressure. Meanwhile, wafer 4 to be polished is placed into body 11 and below flexible membrane 3. Thereafter, flexible membrane 3 flexes upward to vacuum chuck wafer 4 by pressure difference between first and second airtight chambers 112 and 113 generated in body 11 while exhausting air via second duct 116. Then, carrier 1 is moved to a position above polishing pad 21. Next, air is filled into first duct 115 such that a lower portion 118 of first duct 115 expands to press against flexible membrane 3, allowing flexible membrane 3 to apply an even and appropriate pressure against wafer 4. When either carrier 1 or polishing table 2 is rotated, wafer 4 is polished.

The present invention is characterized in the structure of flexible membrane 3. Referring to FIGS 1 to 3, flexible membrane 3 of the present invention is in the form of a circular disk made of silicone with high cleanliness. Flexible membrane 3 includes a plane portion 31 and a coupling portion 32 extending upward from plane portion 31. It is noted that there are various types of chemical mechanical polishing apparatuses and carriers. Although one embodiment of coupling portion 32 of flexible membrane 3 is shown in the drawings, coupling portion 32 of flexible membrane 3 of the present invention can include various outlines in response to different chemical mechanical polishing apparatuses and carriers. By vacuum micro coating, at least one layer of

poly-para-xylylene is coated on a lower side of plane portion 31 of flexible membrane 3 of the present invention to form a coating layer 33. Coating layer 33 forms a contact surface 311 for contacting with a side of wafer 4 opposite to the other side of wafer 4 to be polished.

5 Since contact surface 311 of flexible membrane 3 of the present invention made of silicone with high cleanliness has more excellent friction, the wafer slip problem in the polishing process is eliminated through contact of the contact surface 311 with wafer 4. Further, poly-para-xylylene coating layer 33 has excellent properties of erosion resistance, thus effectively reducing the erosion of flexible membrane 3 and increasing
10 durability of flexible membrane 3. Furthermore, flexible membrane 3 formed of silicone material with high cleanliness causes lower pollution to the polishing environment. Thus, the yield of the polishing process is increased.

 Thus since the invention disclosed herein may be embodied in other specific forms without departing from the spirit or general characteristics thereof, some of which
15 forms have been indicated, the embodiments described herein are to be considered in all respects illustrative and not restrictive. The scope of the invention is to be indicated by the appended claims, rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are intended to be embraced therein.

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CLAIMS

1. A flexible membrane for a chemical mechanical polishing apparatus comprising a plane portion and a coupling portion extending upward from the plane portion, with the coupling portion of the flexible membrane being adapted to be engaged to a carrier of the chemical mechanical polishing apparatus,

characterized in that:

the flexible membrane is made of silicone with high cleanliness, and at least one layer of poly-para-xylylene is coated on a lower side of the flexible membrane by vacuum micro coating to form a surface adapted for contacting a wafer to be polished by the chemical mechanical polishing apparatus.

2. The flexible membrane for a chemical mechanical polishing apparatus as claimed in claim 1, with the coating layer being formed on a lower side of the plane portion of the flexible membrane.