of a plastic, such as polyphenylene sulfide (PPS), available from DSM Engineering Plastics of Evansville, Ind., under the trade name Techtron™. Other plastics, such as DELRIN™, available from Dupont of Wilmington, Delaware, polyethylene terephthalate (PET), polyetheretherketone (PEEK), or polybutylene terephthalate (PBT), or a composite material such as ZYMAXX™, also available from Dupont, may be suitable.

[0054] The thickness T1 of lower portion 180 should be larger than the thickness TS of substrate 10. Specifically, the lower portion should be thick enough that the substrate does not brush against the adhesive layer when the substrate is chucked by the carrier head. On the other hand, if the lower portion is too thick, the bottom surface of the retaining ring will be subject to deformation due to the flexible nature of the lower portion. The initial thickness of lower portion 180 may be about 200 to 400 mils (with grooves having a depth of 100 to 300 mils). The lower portion may be replaced when the grooves have been worn away. Thus, the thickness T1 of lower portion 180 may vary between about 400 mils (assuming an initial thickness of 400 mils) and about 100 mils (assuming that grooves 300 mils deep were worn away). If the retaining ring does not include grooves, the lower portion may be replaced when the thickness of the lower portion of the retaining ring is equal to the substrate thickness.

[0055] The bottom surface of the lower portion 180 may be substantially flat, or the bottom surface may have a plurality of channels or grooves

to facilitate the transport of slurry from outside the retaining ring to the substrate.

[0056] The upper portion 184 of retaining ring 110 is formed of a rigid material, such as a metal, e.g., stainless steel, molybdenum, or aluminum, or a ceramic, e.g., alumina, or other exemplary materials. The material of the upper portion may have an elastic modulus of about 10-50 106 psi, i.e., about ten to one hundred times the elastic modulus of the material of the lower portion. For example, the elastic modulus of the lower portion may be about 0.6 106 psi, the elastic modulus of the upper portion may be about 30 106 psi, so that the ratio is about 50:1. The thickness

CLAIMS

1. A retaining ring for a carrier head having a mounting surface for a substrate comprising: an annular body having a central opening; a channel formed in the body, wherein a first end of the channel is proximate the central opening; and a sensor disposed within the channel and proximate the first end, wherein the sensor is configured to detect acoustic and/or vibration emissions from processes performed on the substrate.

2. The retaining ring of claim 1, further comprising: a seal disposed within the channel between the sensor and the central opening.

3. The retaining ring of claim 2, wherein the seal is a silicon membrane separating the central opening from the sensor.

4. The retaining ring of claim 2, wherein the channel extends from an outer surface of the retaining ring to an inner surface of the retaining ring proximate the central opening.

5. The retaining ring of claim 2, wherein the seal is about 1 mm to about 10 mm thick.

6. The retaining ring of claim 2, further comprising: a second sensor to detect if the seal has failed, wherein the second sensor is one of a humidity sensor or a pressure sensor.

7. The retaining ring of claim 1, wherein the sensor is one of a microphone to detect acoustic emissions from processes performed on the substrate, or a micro electro-mechanical systems (MEMS) accelerometer to detect vibrations produced from processes performed on the substrate.

8. The retaining ring of claim 1, wherein the sensor is coupled to a transmitter via one or more electrical leads.

9. The retaining ring of claim 8, wherein the transmitter is a wireless transmitter configured to wirelessly transmit information associated with acoustic and/or vibration emissions obtained from the sensor.

10. The retaining ring of claim 8, wherein the transmitter is disposed on an outer surface of the retaining ring.

11. A carrier head for a chemical mechanical polishing apparatus, comprising: a base; a retaining ring connected to the base, wherein the retaining ring comprises: an annular body having a central opening, a channel formed in the body, wherein a first end of the channel is proximate the central opening, and a sensor disposed within the channel and proximate the first end, wherein the sensor is configured to detect acoustic and/or vibration emissions from chemical mechanical polishing processes; a support structure connected to the base by a flexure to be moveable independently of the base and the retaining ring; and a flexible membrane that defines a boundary of a pressurizable chamber, the membrane connected to the support structure and having a mounting surface for a substrate.

12. The carrier head of claim 11, wherein the retaining ring further includes a seal disposed within the channel between the sensor and the central opening.

13. The carrier head of claim 12, wherein the seal is a silicon membrane separating the central opening from the sensor.

14. The carrier head of claim 12, wherein the channel extends from an outer surface of the retaining ring to an inner surface of the retaining ring proximate the central opening.

15. The carrier head of claim 12, wherein the seal is about 1 mm to about 10 mm thick.

16. The carrier head of claim 11, wherein sensor is coupled to a transmitter via one or more electrical leads.

17. The retaining ring of claim 16, wherein the transmitter is a wireless transmitter configured to wirelessly transmit information associated with acoustic and/or vibration emissions obtained from the sensor.

18. The retaining ring of claim 16, wherein the transmitter is disposed on an outer surface of the base.