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(54) **CMP APPARATUS AND METHOD**

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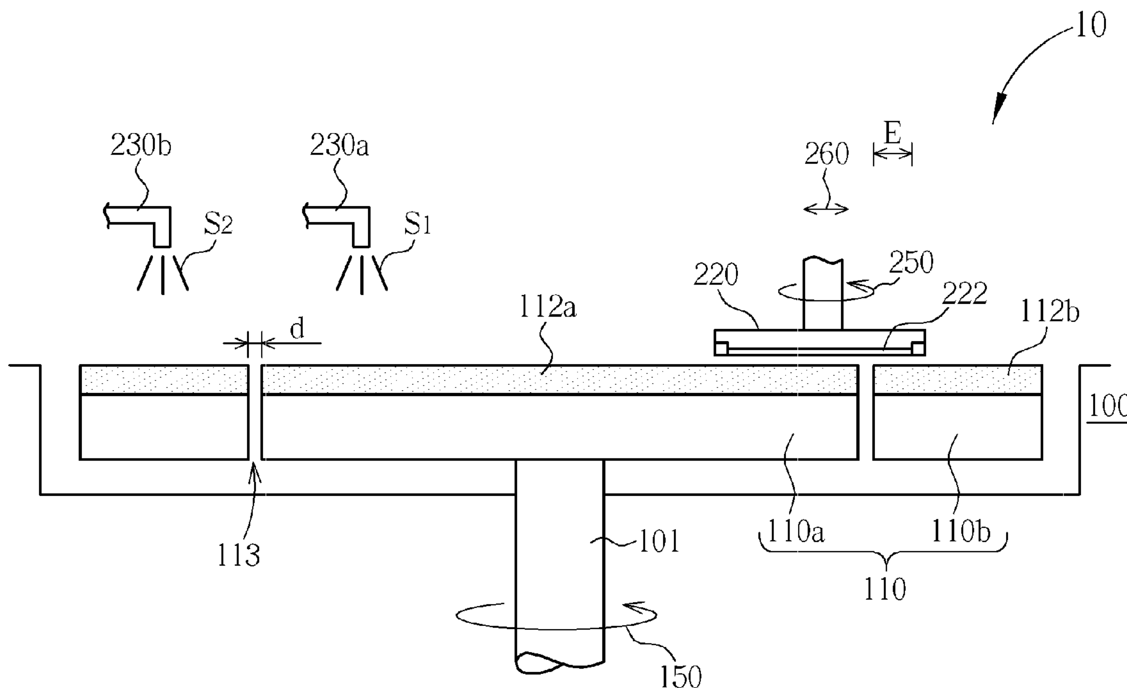
(57) **ABSTRACT**

A CMP apparatus includes an enclosure; a platen disposed within the enclosure, and a carrier for holding and rotating a wafer. The platen consists of a central, circular-shaped segment and a peripheral, annular-shaped segment with a gap formed therebetween. A first polishing pad is mounted on the central, circular-shaped segment. A second polishing pad is mounted on the peripheral, annular-shaped segment. In polishing, the carrier rotates between the first and second polishing pads, such that an annular edge region of the wafer is in direct contact with the second polishing pad.



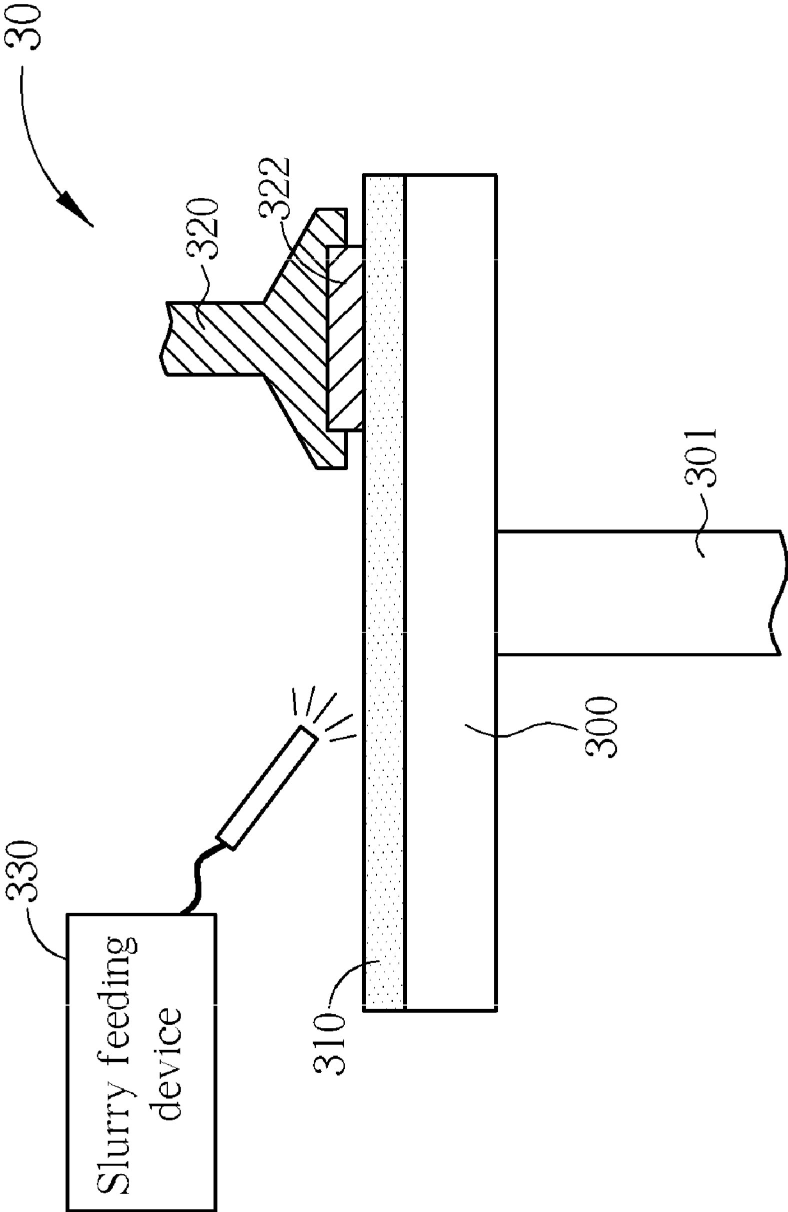


FIG. 1 PRIOR ART

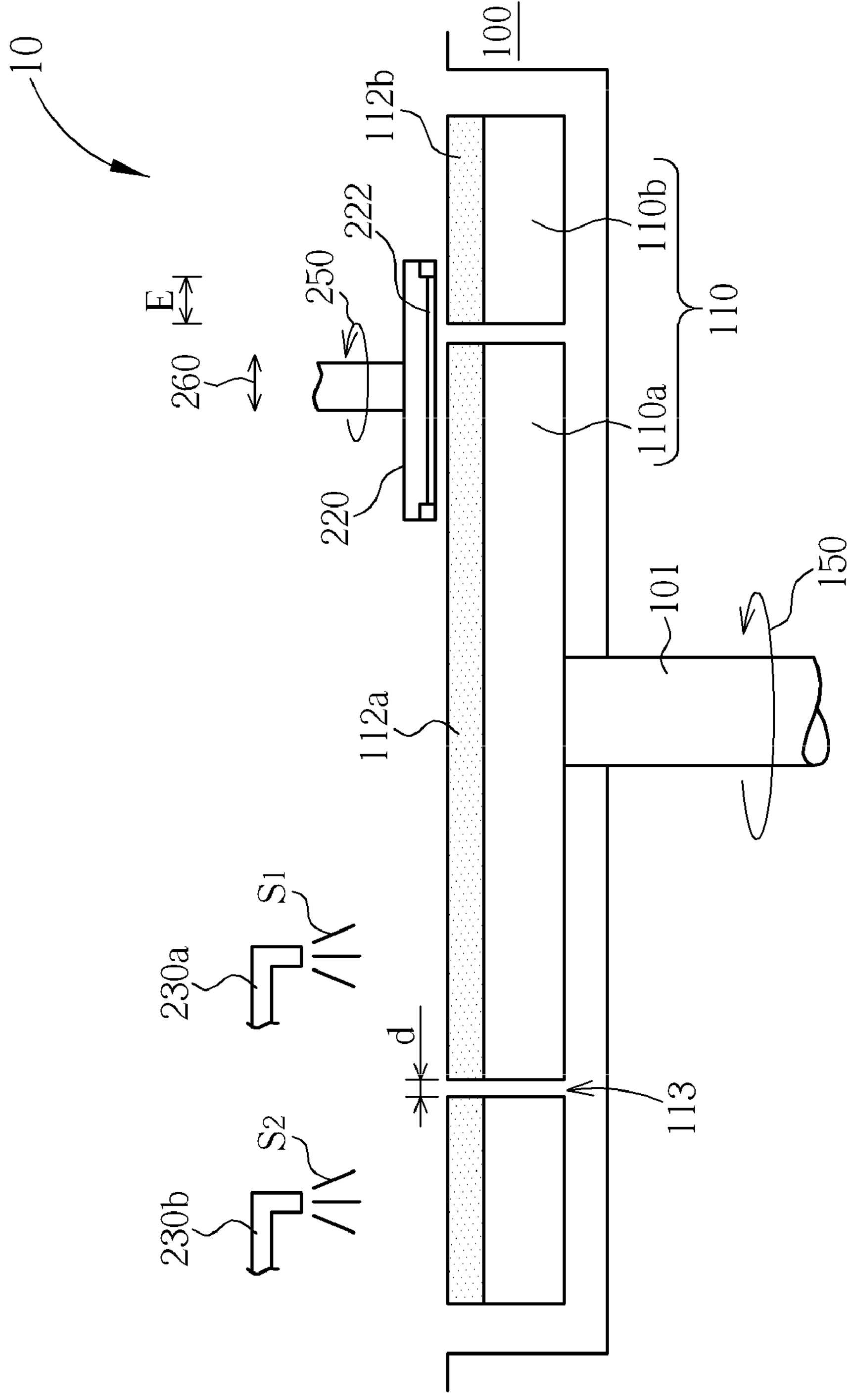


FIG. 2

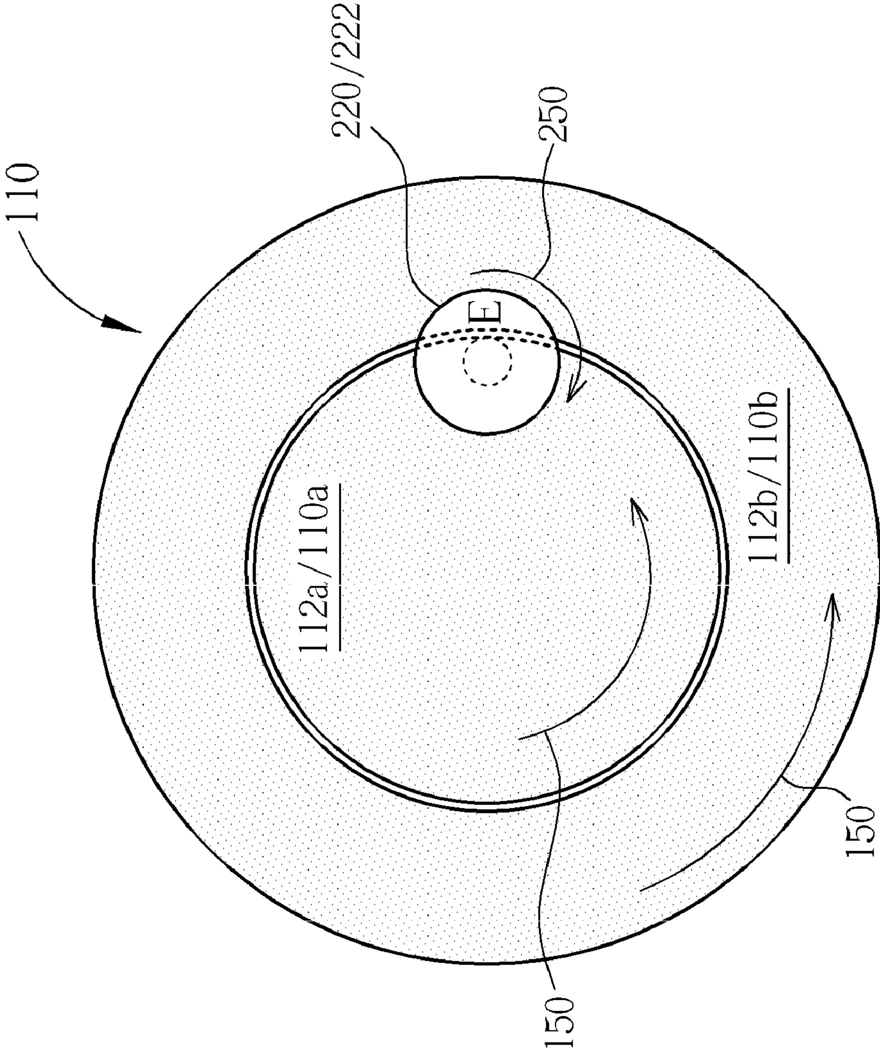


FIG. 3

CMP APPARATUS AND METHOD

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates generally to the field of chemical mechanical polishing or chemical mechanical planarization (CMP) techniques. More particularly, the present invention relates to an improved CMP apparatus and a CMP method capable of precisely controlling the polishing uniformity in the CMP process.

[0003] 2. Description of the Prior Art

[0004] As known in the art, mechanical polishing or chemical mechanical planarization (CMP) is essential to the semiconductor fabrication to achieve a high degree of planarity on the surface of a semiconductor wafer. In a CMP process, the wafer is typically pressed against a rotating polishing pad. The wafer may rotate and oscillate over the surface of the polishing pad covered with slurry to improve polishing effectiveness.

[0005] FIG. **1** illustrates a conventional CMP polishing unit. As shown in FIG. **1**, the CMP polishing unit **30** may comprise a platen **300** connected to a shaft **301** for rotating the platen **300** about its central axis during polishing. A polishing pad **310** is mounted on the platen **300**. A wafer **322** is held and rotated by a carrier **320**. In polishing, slurry is sprayed onto the polishing pad **310** by a slurry feeding device **330**. The rotating wafer **322** is pressed against the polishing pad **310** by the carrier **320** to cause relative movement between the polishing surface of the polishing pad **310** and the wafer **322**, thereby producing a combined mechanical and chemical effect on the surface of the wafer. The polishing pad **310** is typically made several times the diameter of the wafer **322**. The wafer **322** is kept off-center on the rotating polishing pad **310** during the polishing process.

[0006] One problem associated with the conventional CMP techniques is the difficulty in controlling polishing rates at different locations on a wafer surface. Since the polishing rate applied to a wafer surface is generally proportional to the relative rotational velocity of the polishing pad, the polishing rate at a specific point on the wafer surface depends on the distance from the axis of rotation. It is desirable to control the uniformity in the CMP process because it enables the subsequent use of a high-resolution lithographic process to fabricate the next level circuit. The accuracy of a high resolution lithographic process can be achieved only when the process is carried out on a substantially flat surface.

SUMMARY OF THE INVENTION

[0007] It is one object of the present invention to provide an improved CMP apparatus in order to solve the above-described problems.

[0008] To these ends, according to one aspect of the present invention, there is provided a CMP apparatus comprising: an enclosure; a platen disposed within the enclosure, wherein the platen consists of a central, circular-shaped segment and a peripheral, annular-shaped segment encircling the central, circular-shaped segment with a gap therebetween; a carrier for holding and rotating a wafer; a first polishing pad mounted on the central, circular-shaped segment; and a second polishing pad mounted on the peripheral, annular-shaped segment. A first nozzle is provided for supplying a first slurry onto the first polishing pad. A second nozzle is provided for supplying a second slurry onto the second polishing pad. The first slurry and the second slurry may be supplied at different flow rates.

[0009] These and other objectives of the present invention will no doubt become obvious to those of ordinary skill in the art after reading the following detailed description of the preferred embodiment that is illustrated in the various figures and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The accompanying drawings are included to provide a further understanding of the invention, and are incorporated in and constitute a part of this specification. The drawings illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention. In the drawings:

[0011] FIG. **1** is a schematic diagram showing a conventional CMP polishing unit;

[0012] FIG. **2** is a schematic, cross-sectional diagram illustrating a CMP apparatus in accordance with one embodiment of this invention; and

[0013] FIG. **3** is a schematic plan view showing the relative position of the polished wafer and the polishing pads in accordance with one embodiment of this invention.

[0014] It should be noted that all the figures are diagrammatic. Relative dimensions and proportions of parts of the drawings have been shown exaggerated or reduced in size, for the sake of clarity and convenience in the drawings. The same reference signs are generally used to refer to corresponding or similar features in modified and different embodiments.

DETAILED DESCRIPTION

[0015] In the following description, numerous specific details are given to provide a thorough understanding of the invention. However, it will be apparent to one skilled in the art that the invention may be practiced without these specific details. In order to avoid obscuring the present invention, some well-known system configurations and process steps are not disclosed in detail.

[0016] Likewise, the drawings showing embodiments of the apparatus are semi-diagrammatic and not to scale and, particularly, some of the dimensions are for the clarity of presentation and are shown exaggerated in the figures. Also, where multiple embodiments are disclosed and described having some features in common, for clarity and ease of illustration and description thereof like or similar features one to another will ordinarily be described with like reference numerals.

[0017] FIG. **2** is a schematic, cross-sectional diagram illustrating a CMP apparatus in accordance with one embodiment of this invention. As shown in FIG. **2**, the CMP apparatus **10** comprises an enclosure **100**, a platen **110** disposed within the enclosure **100**, and a carrier **220** for holding and rotating a wafer **222**. The platen **110** is connected to a shaft **101** for rotating the platen **110** about its central axis during polishing. According to one embodiment of the invention, the platen **110** consists of a central, circular-shaped segment **110*a*** and a peripheral, annular-shaped segment **110*b*** encircling the central, circular-shaped segment **110*a*** with a gap **113** therebetween. The central, circular-shaped segment **110*a*** and the peripheral, annular-shaped segment **110*b*** are concentric. According to the embodiment of this invention, the gap **113** has a width d of about 0.5-5 mm.

[0018] A first polishing pad **112***a* is mounted on the central, circular-shaped segment **110***a*. A second polishing pad **112***b* is mounted on the peripheral, annular-shaped segment **110***b*. The material used for the first polishing pad **112***a* and the material used for the second polishing pad **112***b* may be the same or different. A first slurry S**1** is provided onto the first polishing pad **112***a* via a first nozzle **230***a*. A second slurry S**2** is provided onto the second polishing pad **112***b* via a second nozzle **230***b*. The flow rate and the concentration settings of the first slurry S**1** and the flow rate and the concentration settings of the second slurry S**2** may be the same or different.

[0019] FIG. **3** is a schematic plan view showing the relative position of the polished wafer and the polishing pads in accordance with one embodiment of this invention. As shown in FIG. **3**, the central, circular-shaped segment **110***a* and the peripheral, annular-shaped segment **110***b* rotate in the same direction **150**, for example, both in counter-clockwise direction, but at different rotation speeds. According to the embodiment of this invention, the rotation speed of the peripheral, annular-shaped segment **110***b* is slower than that of the central, circular-shaped segment **110***a*. A differential gear (not shown) may be installed to provide such different rotation speeds.

[0020] In polishing, the rotating wafer **222**, which is rotated, for example, in a direction **250** opposite to the direction **150**, is pressed against the first and second polishing pads **112***a* and **112***b* by the carrier **220** to cause relative movement between the polishing surfaces of the first and second polishing pads **112***a* and **112***b* and the wafer **222**. According to the embodiment of this invention, the location of the carrier **220** is adjustable along the direction **260**. According to the embodiment of this invention, the carrier **220** rotates between the first and second polishing pads **112***a* and **112***b*, such that an annular edge region E of the wafer **222** is in direct contact with the second polishing pad **112***b*. Preferably, the surface area of the annular edge region E is about one-third of the total surface area of the wafer **222**.

[0021] Those skilled in the art will readily observe that numerous modifications and alterations of the device and method may be made while retaining the teachings of the invention.

What is claimed is:

1. A CMP apparatus, comprising:
- an enclosure;
- a platen disposed within the enclosure, wherein the platen consists of a central, circular-shaped segment and a peripheral, annular-shaped segment encircling the central, circular-shaped segment with a gap therebetween;
- a carrier for holding and rotating a wafer;
- a first polishing pad mounted on the central, circular-shaped segment; and
- a second polishing pad mounted on the peripheral, annular-shaped segment.

2. The CMP apparatus according to claim **1** further comprising:
- a first nozzle for supplying a first slurry onto the first polishing pad; and
- a second nozzle for supplying a second slurry onto the second polishing pad.

3. The CMP apparatus according to claim **2** wherein the first slurry and the second slurry are supplied at different flow rates.

4. The CMP apparatus according to claim **2** wherein the first slurry and the second slurry have different concentration settings.

5. The CMP apparatus according to claim **1** wherein the gap has a width d of about 0.5-5 mm.

6. The CMP apparatus according to claim **1** wherein the central, circular-shaped segment and the peripheral, annular-shaped segment rotate in the same direction.

7. The CMP apparatus according to claim **1** wherein the central, circular-shaped segment and the peripheral, annular-shaped segment rotate at different rotation speeds.

8. The CMP apparatus according to claim **7** wherein the rotation speed of the peripheral, annular-shaped segment is slower than that of the central, circular-shaped segment.

9. The CMP apparatus according to claim **1** wherein in polishing the carrier rotates between the first and second polishing pads, such that an annular edge region of the wafer is in direct contact with the second polishing pad.

10. The CMP apparatus according to claim **9** wherein a surface area of the annular edge region is about one-third of a total surface area of the wafer.

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