US 20030190873A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2003/0190873 A1**

(43) **Pub. Date: Oct. 9, 2003**

Wang et al.

(54) **CHEMICAL-MECHANICAL POLISHING PLATFORM**

(76) Inventors: **Jiun-Fang Wang**, Hsinchu City (TW); **Ming-Cheng Yang**, Taipei (TW); **Hao-Ming Lien**, Hsinchu (TW); **Sam Chou**, Hsinchu Hsien (TW)

Correspondence Address:
J.C. Patents, Inc.
4 Venture
Suite 250
Irvine, CA 92618 (US)

(21) Appl. No.: **09/829,221**

(22) Filed: **Apr. 9, 2001**

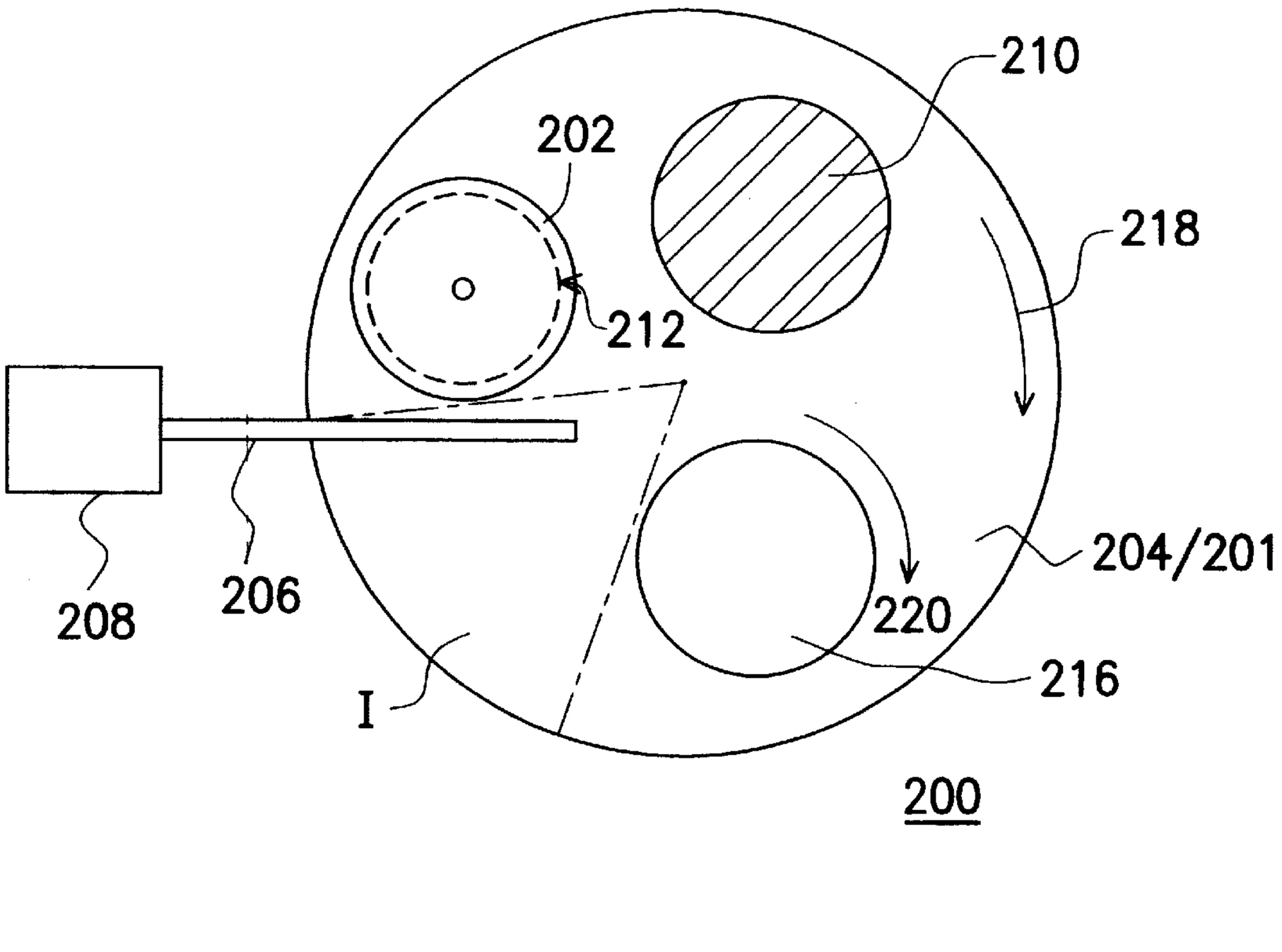
Publication Classification

(51) **Int. Cl.**[7] **B24B 53/00**

(52) **U.S. Cl.** **451/56**

(57) **ABSTRACT**

A chemical-mechanical polishing platform that comprises a polishing table, a wafer carrier, a polishing pad, a slurry supplier, a conditioner, and a means for cleaning the polishing pad. With respect to in-situ or ex-situ chemical-mechanical polishing, the wafer carrier, conditioner, and means for cleaning the polishing pad are adequately disposed above the polishing pad. The chemical-mechanical polishing is performed by rotation of the polishing pad; the region of the polishing pad that has polished the wafer then passes sequentially through the conditioner, the means for cleaning that removes diamond particles that may drop on the polishing pad, and through the slurry supplier that provides adequate slurry such that the polishing process can be repeated without scraping damage of the wafer. The means for cleaning of the present invention can have any shapes adapted to remove diamond particles on the polishing pad, such as circular or cylindrical brush sweeper.



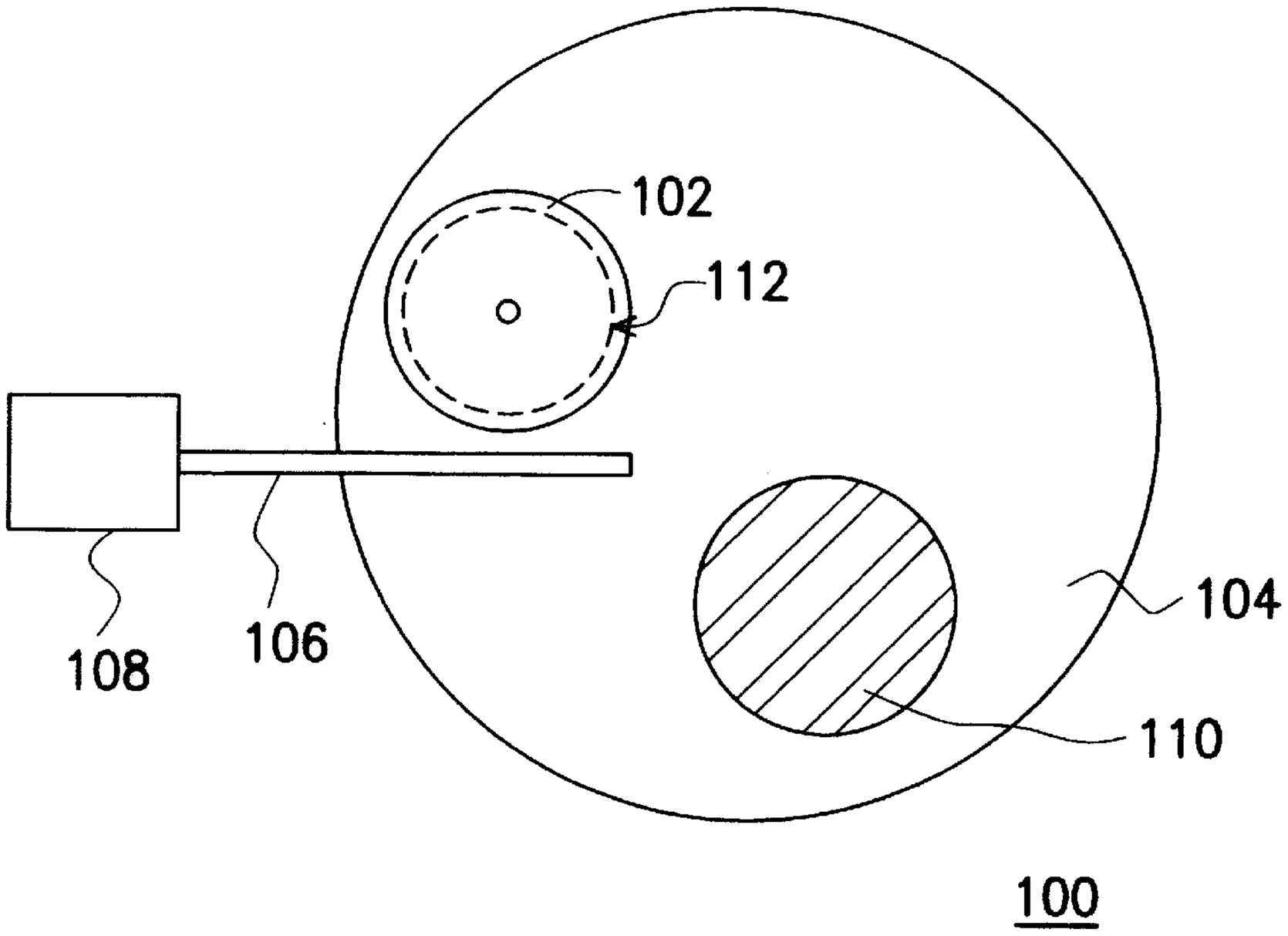


FIG. 1A (PRIOR ART)

FIG. 1B (PRIOR ART)

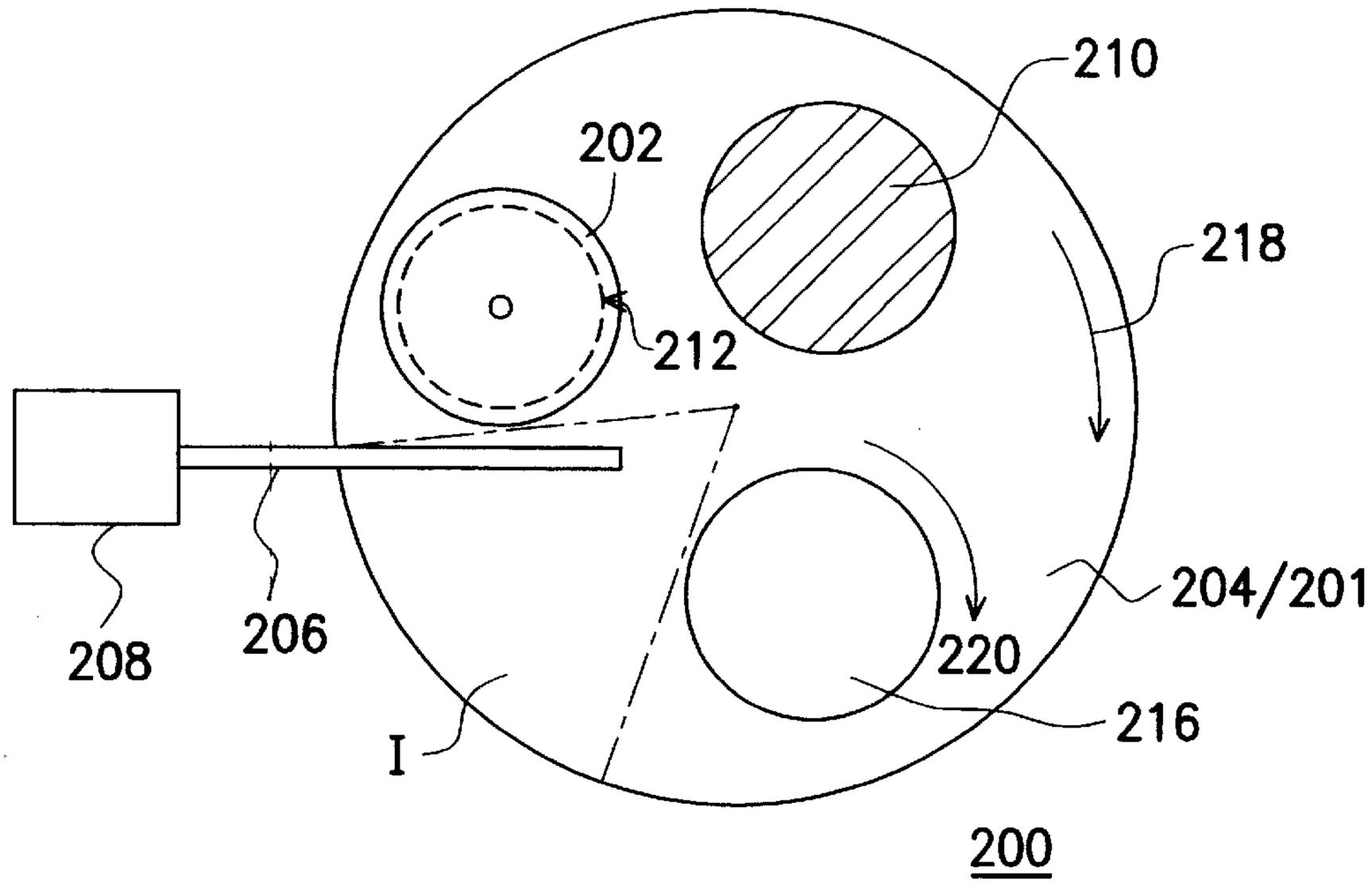

210
202
218
212
208
206
204/201
220
216
I
200

FIG. 2

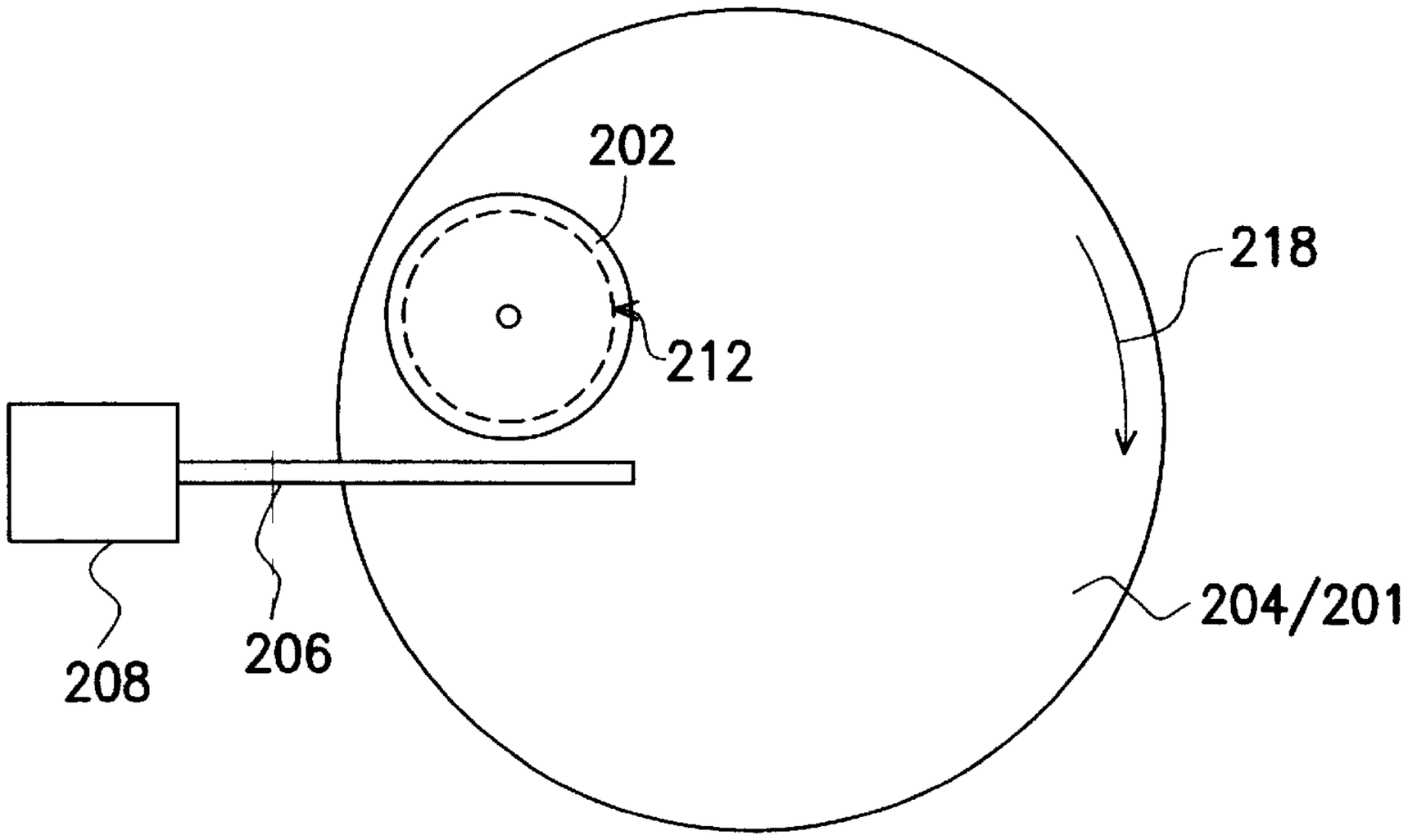

202
218
212
208
206
204/201
200

FIG. 3A

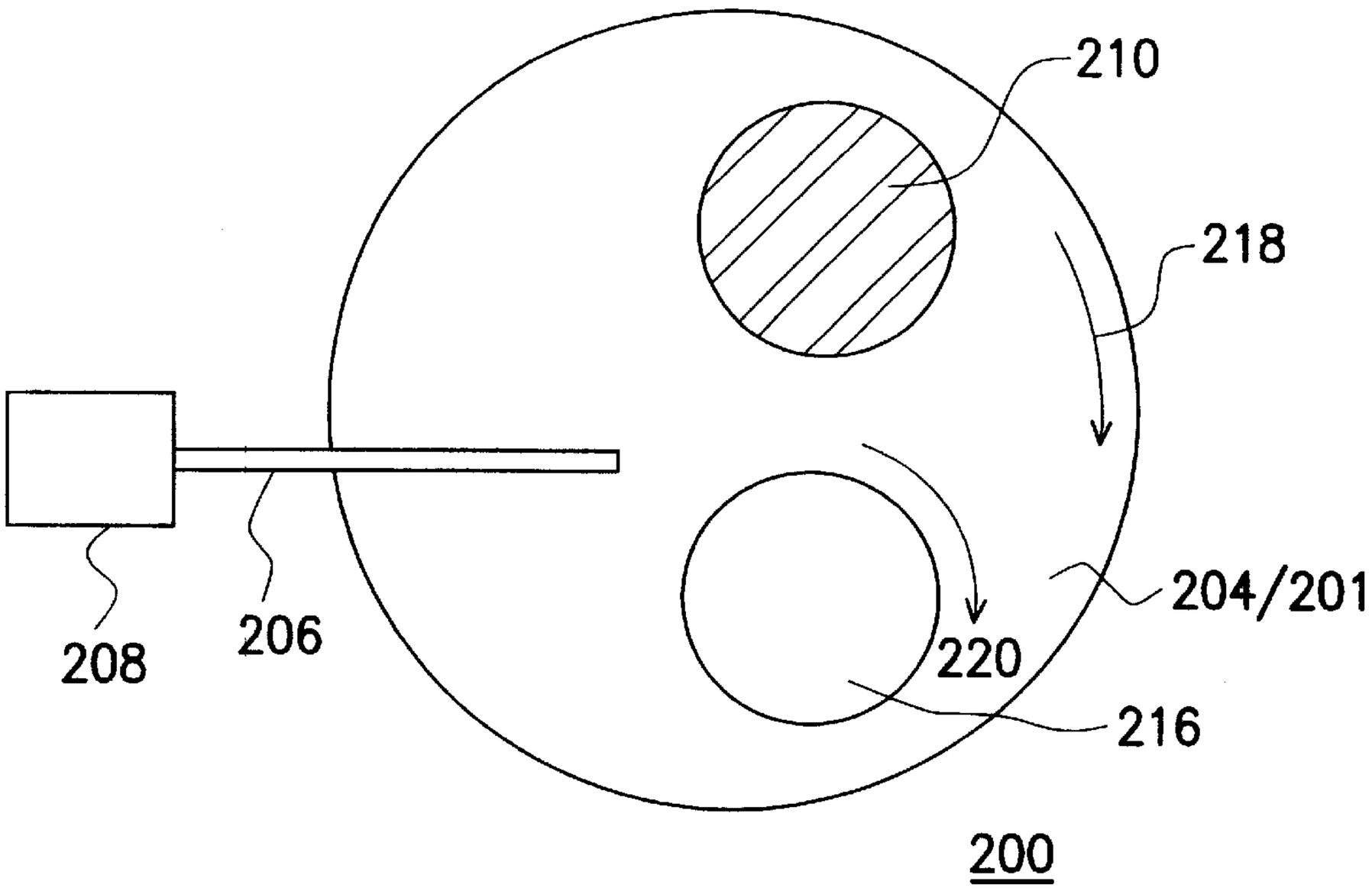

210
218
208
206
220
204/201
216
200

FIG. 3B

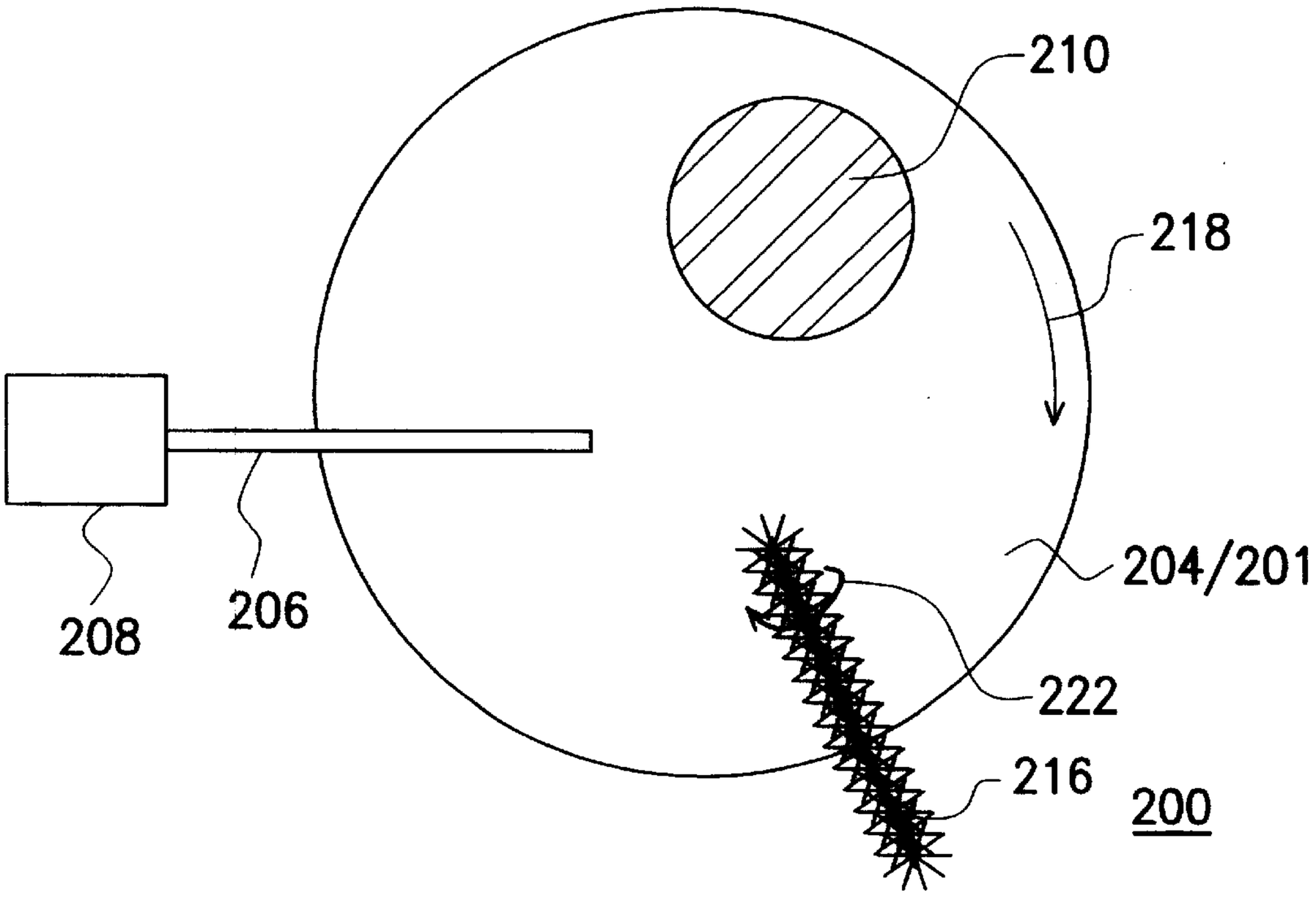

210
218
208
206
204/201
222
216
200

FIG. 4

CHEMICAL-MECHANICAL POLISHING PLATFORM

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The invention relates to chemical-mechanical polishing. More particularly, the present invention relates to a chemical-mechanical polishing platform.

[0003] 2. Description of the Related Art

[0004] In semiconductor processes, the quality of the surface of the substrate is critical to prepare the substrate for a subsequent photolithography process. High accuracy of the pattern transfer onto the substrate during the photolithography process is ensured only if the surface of the substrate does not present irregularity that can scatter the light during exposure. Presently, planarization techniques principally comprise spin-on glass (SOG) and chemical-mechanical polishing. However, since the semiconductor processes has been in the era of a sub-half-micron technology, spin-on glass (SOG) can no longer satisfy the requirement of accuracy for the planarization. Hence, the chemical-mechanical polishing technique is chosen because it provides a global planarization and satisfies the criteria for very large scale integration (VLSI), and even for ultra large scale integration (ULSI). Chemical-mechanical polishing produces a chemical reaction by using a slurry which comprises specific reagents introduced to the surface of a wafer to form an abrasive layer, and then the un-planarized parts on the abrasive layer are mechanically polished by the abrasive particles in the slurry. Thus, the wafer can be planarized by repeat chemical-mechanical polishing.

[0005] Referring to **FIG. 1**A and **FIG. 1B, a** top view and a cross-sectional view respectively show a conventional in-situ chemical-mechanical polishing platform. The chemical-mechanical polishing platform **100** can be used according to an in-situ or ex-situ fashion. The in-situ chemical-mechanical polishing platform comprises a polishing table **101**, a wafer carrier **102**, a polishing pad **104**, a slurry supplier tube **106**, a pump **108**, and a conditioner **110**. The wafer carrier **102** maintains the surface of the wafer to be planarized against the polishing pad **104**. The slurry supplier tube **106** and pump **108** supply the polishing pad **104** with necessary slurry comprising adequate reagents to perform the polishing, while the conditioner **110**, provided with diamond particles in contact with the polishing pad **104**, maintains an adequate roughness of the polishing pad **104** and cleans away undesirable particles. Thus, a sufficient adsorption of the slurry and a stable polishing rate are maintained.

[0006] The principal difference between in-situ and ex-situ chemical-mechanical polishing is that in in-situ chemical-mechanical polishing, the polishing of the wafer, maintenance of the roughness of the polishing pad, and cleaning away of undesirable particles are simultaneously performed on the polishing pad, while, in ex-situ chemical-mechanical polishing, the conditioner is applied onto the polishing pad only after the polishing of the wafer has been completed.

[0007] An important problem of the above conventional chemical-mechanical polishing platform is that diamond particles of the conditioner may drop on the polishing pad, which scratches and irreversibly damages the wafer. This problem is caused by the corrosive characteristic of the slurry and mechanical forces that are regularly exerted on the diamond particles of the conditioner during polishing.

[0008] A chemical-mechanical polishing that does not damage the wafer to be polished would reduce the amount of damaged wafers and improve the general manufacturing yield.

SUMMARY OF THE INVENTION

[0009] One major aspect of the present invention is to provide a chemical-mechanical polishing platform comprising a means for cleaning away particle residue dropped on the polishing pad.

[0010] To attain the foregoing and other objects, a chemical-mechanical polishing platform, according to an embodiment of the present invention, comprises: a polishing table, a wafer carrier, a polishing pad fixed onto the polishing table, a slurry supplier, a conditioner, and a cleaning device. With respect to an in-situ chemical-mechanical polishing, the wafer carrier, conditioner, cleaning device, and slurry supplier are adequately disposed above the polishing table such that when the polishing table rotates to perform polishing, the polishing pad passes sequentially under the conditioner, the cleaning device, and the slurry supplier after passing under the wafer carrier. The conditioner continuously maintains an adequate roughness of the polishing pad during polishing of the wafer. The cleaning device cleans away residue dropped on the polishing pad, such as diamond particles dropped from the conditioner, thereby preventing the wafer from being damaged. After the cleaning device cleans away residue, the slurry supplier supplies the polishing pad with sufficient slurry to maintain a stable polishing rate. With respect to ex-situ chemical-mechanical polishing, the arrangement of the wafer carrier, conditioner, cleaning device, and slurry supplier are not as restrictive as in in-situ chemical-mechanical polishing. In the embodiments and examples of the present invention, the cleaning device can be for example a brush sweeper of any shape adapted for cleaning away residue dropped on the polishing pad.

[0011] It is to be understood that both the foregoing general description and the following detailed description are exemplary, and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] 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,

[0013] **FIG. 1**A and **FIG. 1B** are respectively a top view and a side-view schematically illustrating a conventional in-situ chemical-mechanical polishing platform;

[0014] **FIG. 2** is a top view schematically illustrating an in-situ chemical-mechanical polishing platform, according to an embodiment of the present invention;

[0015] **FIG. 3**A and **FIG. 3B** are top views schematically illustrating an ex-situ chemical-mechanical polishing platform according to an embodiment of the present invention; and

[0016] **FIG. 4** is a top view schematically illustrating another example of a chemical-mechanical polishing platform according to an embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0017] The following detailed description of the embodiments and examples of the present invention with reference to the accompanying drawings is only illustrative and not limiting. Wherever possible, like reference numerals are used to refer to like elements.

[0018] Referring now to **FIG. 2, a** top view schematically illustrates an in-situ chemical-mechanical polishing platform, according to an embodiment of the present invention. The in-situ chemical-mechanical polishing platform principally comprises: a polishing table **201**, a wafer carrier **202**, a polishing pad **204**, a slurry supplier, a conditioner **210**, and a cleaning device **216**. For example of illustration, the cleaning device **216** can be for example a brush sweeper. The wafer carrier **202** maintains a wafer **212** to be polished in contact with the polishing pad **204**. The polishing pad **204** is, for example, a polyimide IC 1000 material arranged on the polishing table **201**. The conditioner **210**, typically a diamond dresser, is in contact with the polishing pad **204**. The conditioner **210** is provided, by its contact surface with the polishing pad **204**, with a plurality of diamond particles, such that when the polishing table **201** rotates to perform the polishing, the diamond particles scrape the polishing pad **204**. As a result, a substantial roughness of the polishing pad **204** can be maintained. The slurry supplier, that comprises typically a pump **208** and an outlet tube **206**, provides the polishing pad **204** with necessary slurry **214**. The cleaning device **216** cleans out the diamond particles that may drop from the conditioner **210** onto the polishing pad **204**, thereby preventing the wafer **212** from being scratched during the in-situ polishing process.

[0019] When a chemical-mechanical polishing is performed on a wafer **212**, the wafer carrier **202** presses on a back surface of the wafer **212**, thereby maintaining a front surface of the wafer **212** to be polished against the polishing pad **204**. The wafer carrier **202**, conditioner **210**, and cleaning device **216** are disposed sequentially on the polishing pad **204**. Hence, when the polishing table **201** rotates, for instance according to a first direction **218**, the region of the polishing pad **204** that has passed under the wafer **212** is scraped by the conditioner **210**. Thus, an adequate roughness of the polishing pad **204** can be continuously maintained during polishing, resulting in the maintenance of a stable polishing rate of the wafer. The cleaning device **216** can be, for example, a rounded-shape device capable to rotate according to a second direction **220**, such that it cleans away undesirable residue that may drop on the polishing pad **204**, such as diamond particles from the conditioner **210**. Thus, the wafer **212** can be prevented from being scratched during polishing. The slurry **214** is regularly supplied to the polishing pad **204** by the slurry supplier at the region I between the wafer carrier **202** and the cleaning device **216**. With the regular maintenance of the roughness of the surface of the polishing pad **204** combined with the cleaning action of the cleaning device, the slurry **214** can thus adequately adsorb on the polishing pad **204**, and a stable polishing rate can be favorably maintained.

[0020] Referring to **FIG. 3**A and **FIG. 3**B, top views schematically illustrate an ex-situ chemical-mechanical polishing platform, according to another embodiment of the present invention. Similar to the above, the ex-situ chemical-mechanical polishing platform principally comprises: the polishing table **201**, the wafer carrier **202**, the polishing pad **204**, the slurry supplier, the conditioner **210**, and the cleaning device **216**. However, since the conditioning of the polishing pad **204** is performed only after the wafer polishing is completed and removed, the disposition of the conditioner **210**, cleaning device **216**, and slurry supplier is thus not restrictive, and any arrangements thereof are possible on the polishing pad **204**. The wafer carrier **202** presses on the wafer to maintain its front surface to be polished against the polishing pad **204**. After the wafer **212** is polished and removed from the polishing pad **204**, the conditioner **210** maintains an adequate roughness of the polishing pad **204**, while the cleaning device **216** cleans away undesirable residue on the polishing pad **204**, such as diamond particles that might have dropped from the conditioner **210**. As a result, the slurry **214** provided by the slurry supplier adequately adsorbs on the polishing pad **204**, and a stable and efficient polishing rate can be maintained for the following wafer to be polished.

[0021] Referring to **FIG. 4, a** top view schematically illustrates another example of the chemical-mechanical polishing platform, according to an embodiment of the present invention. As shown in **FIG. 4**, the cleaning device **216** can be, for example, a cylindrical brush that rotates according to the third direction **222** to remove undesirable residue out of the polishing pad **204**.

[0022] The foregoing description of embodiments and examples of the present invention reveals at least that the chemical-mechanical polishing platform of the present invention, comprising the cleaning device, can prevent the wafer that is polished from being damaged by undesirable residue/abrasive particles dropped on the polishing pad, such as diamond particles from the conditioner. Such an advantage is obtained by simple modification of the conventional chemical-mechanical polishing platform, that substantially reduces the rate of defect wafers which are caused by dropped diamond particles.

[0023] It will be apparent to those skilled in the art that various modifications and variations can be made to the structure of the present invention without departing from the scope or spirit of the invention.

What is claimed is:

1. A chemical-mechanical polishing platform that is suitable to be used for in-situ chemical-mechanical polishing of a wafer, the chemical-mechanical polishing platform comprising:

a polishing table that has a polishing pad located thereon, wherein the polishing table rotates in a first direction to polish the wafer;

a wafer carrier that is directed to maintain the wafer to be polished against the polishing pad;

a conditioner having a plurality of diamond particles, wherein the diamond particles are in contact with the polishing pad, such that an adequate roughness of the polishing pad is maintained when the polishing table rotates; and

a means for cleaning mounted above the polishing pad, wherein the means for cleaning rotates such that diamond particle residues dropping on the polishing pad can be removed.

2. The chemical-mechanical polishing platform of claim 1, further comprising a slurry supplier arranged above the polishing pad and between the wafer carrier and means for cleaning.

3. The chemical-mechanical polishing platform of claim 2, wherein the slurry supplier further comprises:

a supply tube that supplies the polishing pad with slurry; and

a pump that conducts the slurry to the supply tube.

4. The chemical-mechanical polishing platform of claim 1, wherein the means for cleaning is round-shaped, and performs a rotation movement according to a direction identical to the rotation of the polishing table.

5. The chemical-mechanical polishing platform of claim 1, wherein the means for cleaning is cylindrical-shaped and performs a rotation movement.

6. A chemical-mechanical polishing platform that is suitable to be used for ex-situ chemical-mechanical polishing of a wafer, the chemical-mechanical polishing platform comprising:

a polishing table that has a polishing pad located thereon, wherein the polishing table rotates in a first direction to polish the wafer;

a wafer carrier that is directed to maintain the wafer to be polished against the polishing pad;

a conditioner having a plurality of diamond particles, wherein the diamond particles are in contact with the polishing pad, such that an adequate roughness of the polishing pad is maintained when the polishing table rotates; and

a means for cleaning mounted above the polishing pad, wherein the means for cleaning rotates such that diamond particle residue dropping on the polishing pad can be removed.

7. The chemical-mechanical polishing platform of claim 6, further comprising a slurry supplier arranged along the first direction of rotation of the polishing pad between the means for cleaning and wafer carrier.

8. The chemical-mechanical polishing platform of claim 6, wherein the slurry supplier further comprises:

a supply tube that supplies the polishing pad with slurry; and

a pump that conducts the slurry to the supply tube.

9. The chemical-mechanical polishing platform of claim 6, wherein the means for cleaning is round-shaped, and performs a rotation movement according to a direction identical to the rotation of the polishing table.

10. The chemical-mechanical polishing platform of claim 6, wherein the means for cleaning is cylindrical-shaped and performs a rotation movement.

11. A method for performing a chemical-mechanical polishing on a wafer using a polishing pad that can prevent damages of the wafer by diamond particles dropped on the polishing pad, the method comprising:

providing the polishing pad with a slurry;

rotating the polishing pad to polish the wafer;

scraping the polishing pad to maintain an adequate roughness thereof; and

cleaning away diamond particles that may drop on the polishing pad.

12. The method of claim 11, wherein in an in-situ chemical-mechanical polishing, the step of cleaning away diamond particles is performed simultaneously with the polishing of the wafer by rotating the polishing pad.

13. The method of claim 11, wherein in an ex-situ chemical-mechanical polishing, the step of cleaning away diamond particles is alternately performed with the polishing of the wafer.

14. The method of claim 11, wherein the cleaning of the polishing pad is performed via a substantially rounded brush sweeper.

15. The method of claim 11, wherein the cleaning of the polishing pad is performed via a substantially cylindrical brush sweeper.

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