US 20060128288A1

(19) United States
(12) Patent Application Publication (10) Pub. No.: US 2006/0128288 A1
An et al. (43) Pub. Date: Jun. 15, 2006

(54) CONDITIONER FOR CHEMICAL MECHANICAL PLANARIZATION PAD

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(21) Appl. No.: **11/296,733**

(22) Filed: **Dec. 7, 2005**

(30) **Foreign Application Priority Data**

Dec. 13, 2004 (KR) ............................. 10-2004-105068

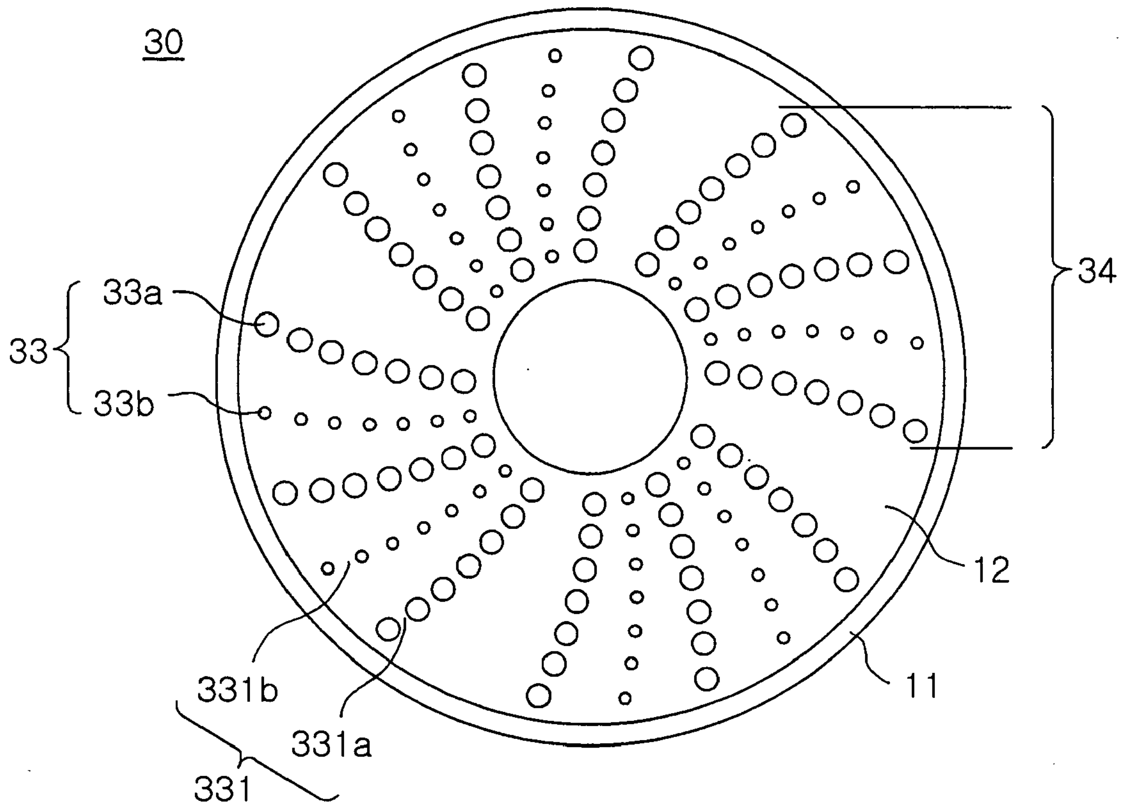
**Publication Classification**

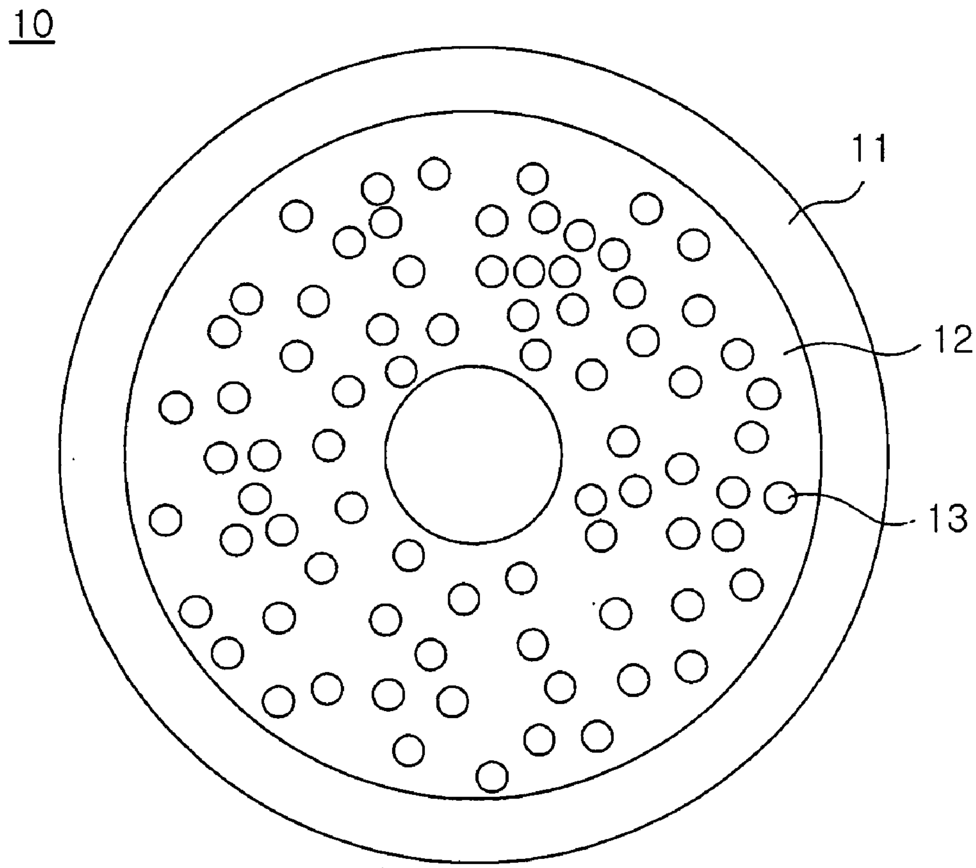
(51) **Int. Cl.**
*B24B 21/18* (2006.01)

(52) **U.S. Cl.** ............................................................ **451/444**

(57) **ABSTRACT**

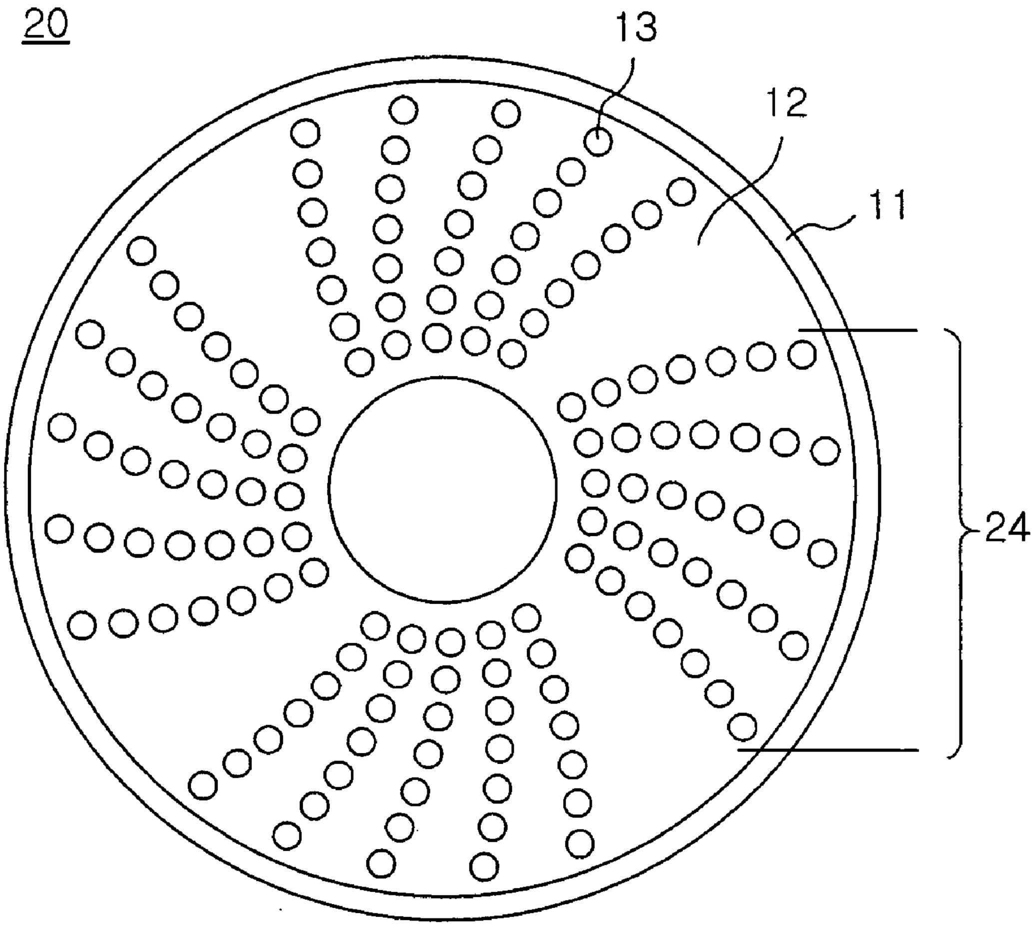
The present invention provides a conditioner for CMP pad required for global planarization of wafer to achieve high integration of a semiconductor element. The conditioner for CMP pad includes a metal substrate having abrasive particles fixed thereto, a plurality of abrasive particles fixed to the metal substrate, and a layer of metal binder fixing the abrasive particles to the metal substrate. The abrasive particles include at least one pattern. The pattern includes at least one row of abrasive particles and the abrasive particles include bigger abrasive particles and smaller abrasive particles. In addition, a diameter difference between smaller and bigger abrasive particles is 10 to 40%. The present invention ensures uniform dressing of conditioner, superior dressing efficiency and superior performance reproducibility.






PRIOR ART

FIG. 1




PRIOR ART

FIG. 2

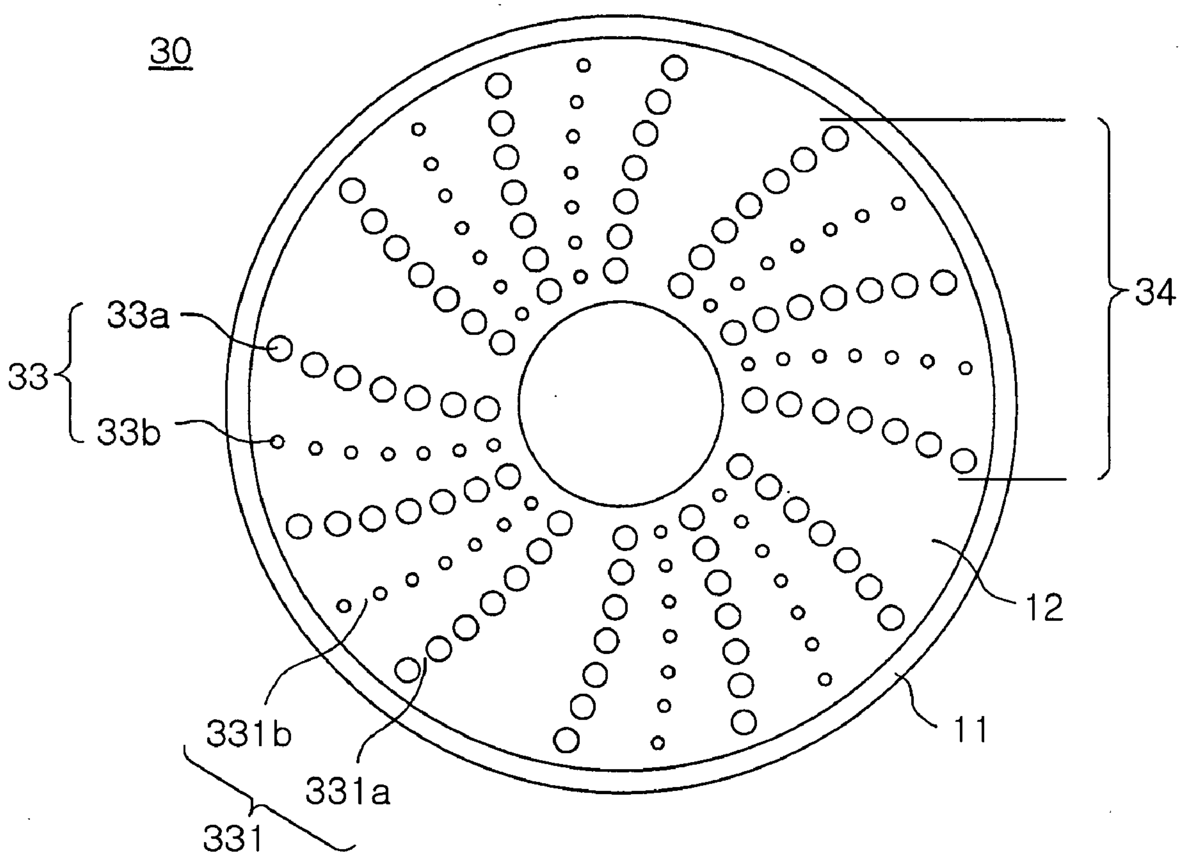



FIG. 3

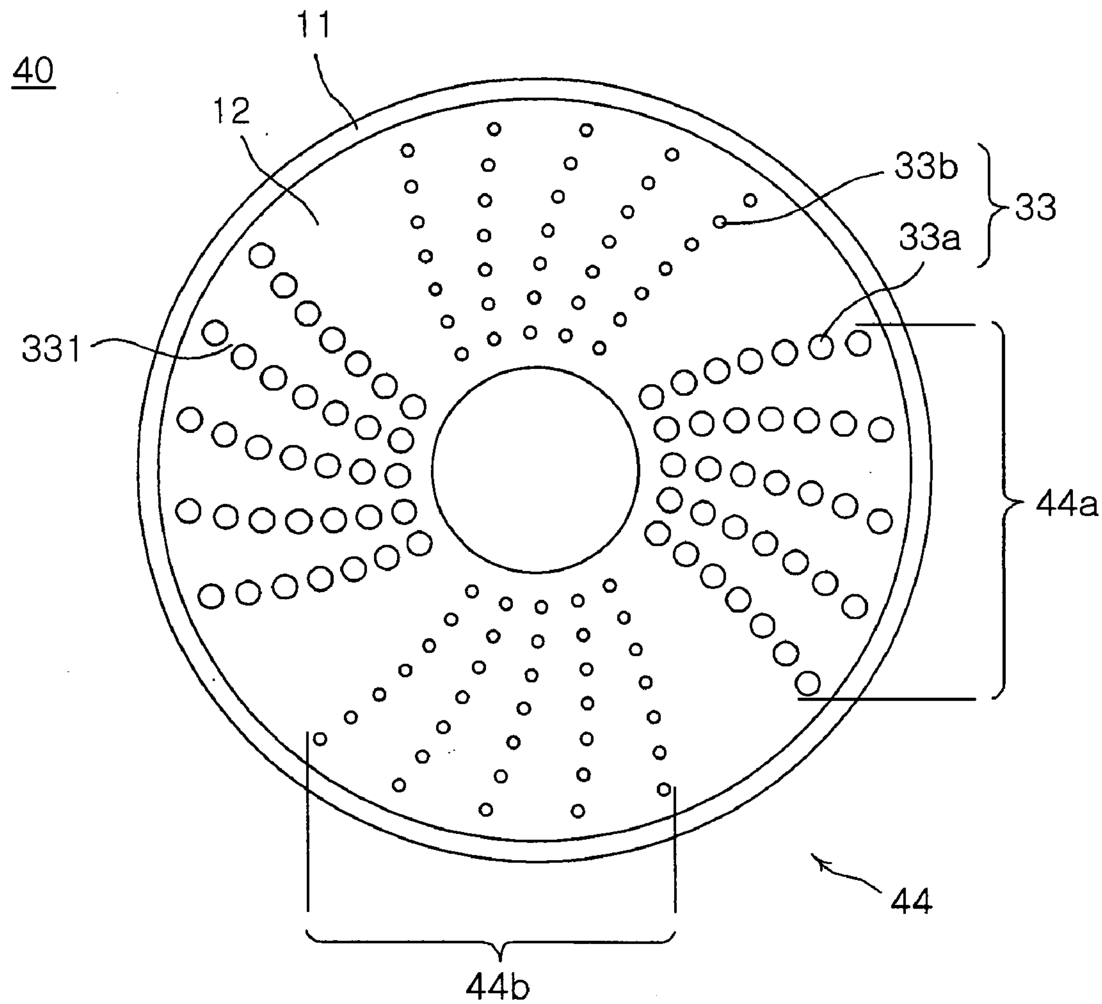



FIG. 4

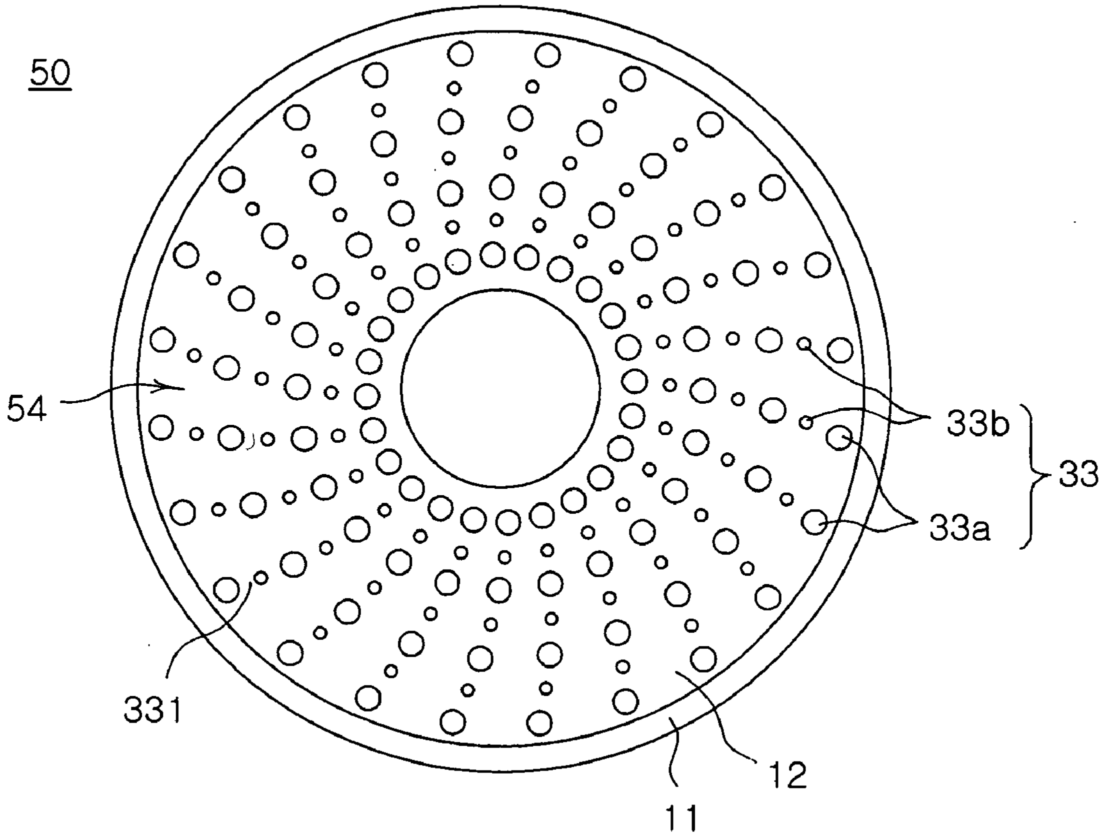



FIG. 5

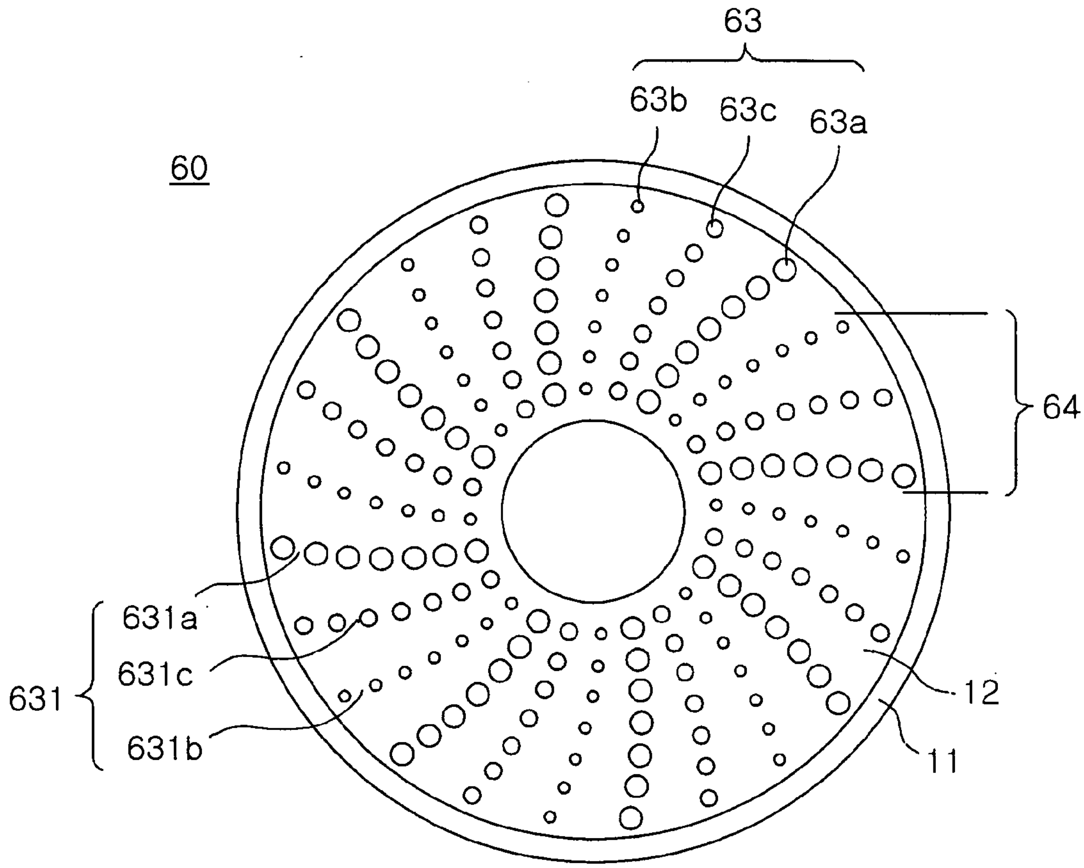



FIG. 6

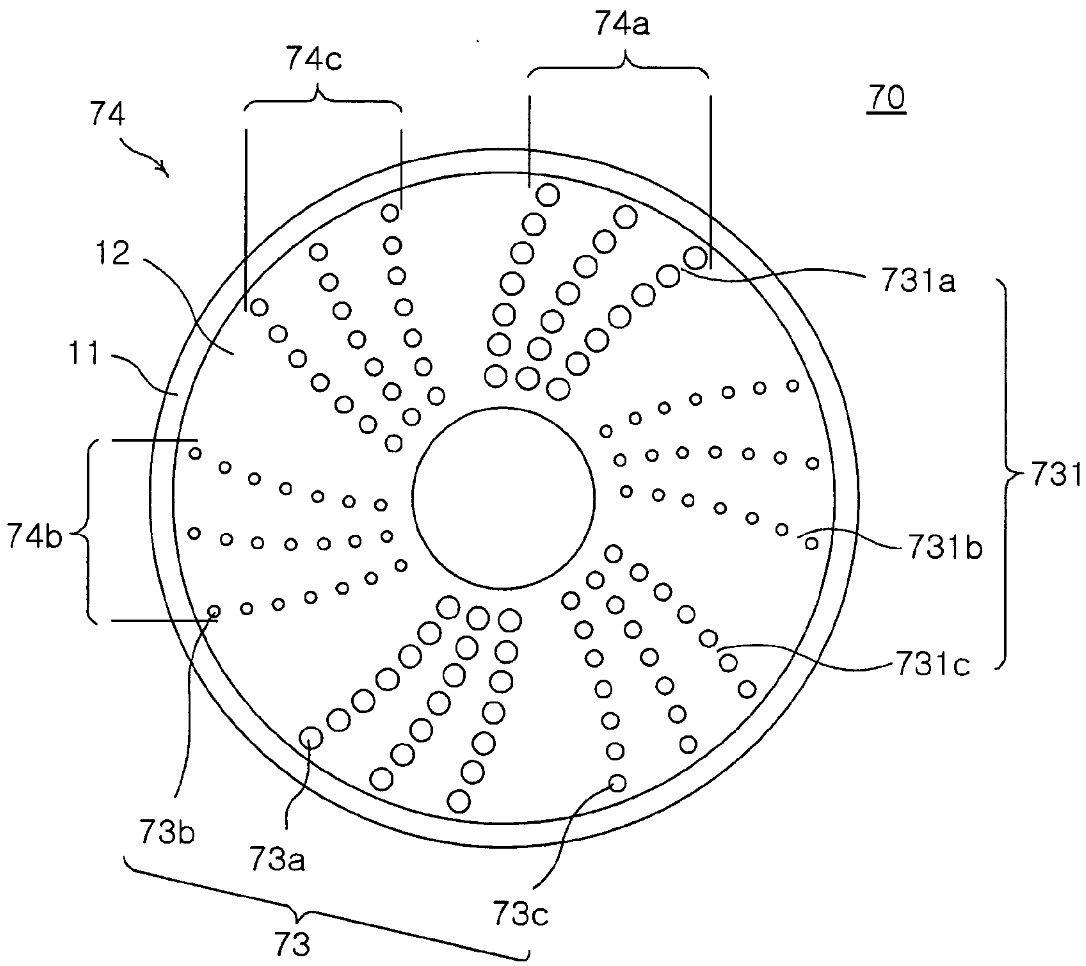



FIG. 7

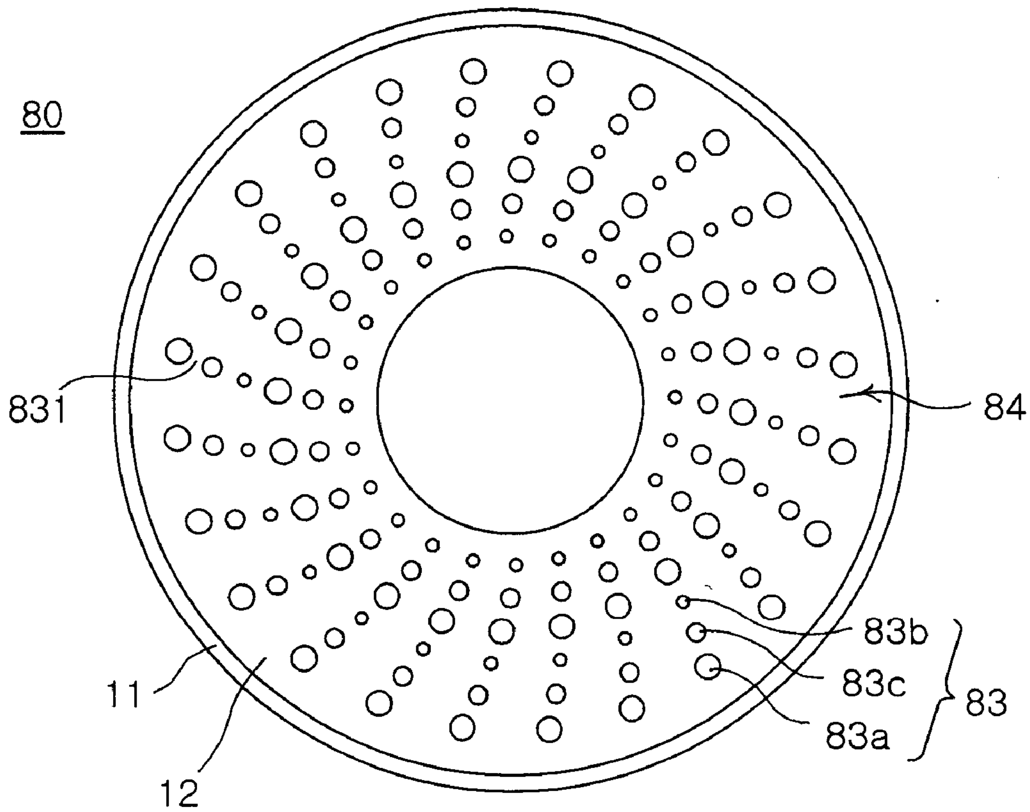
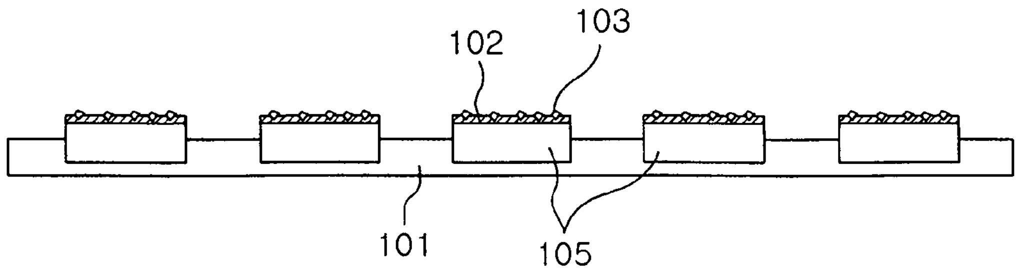
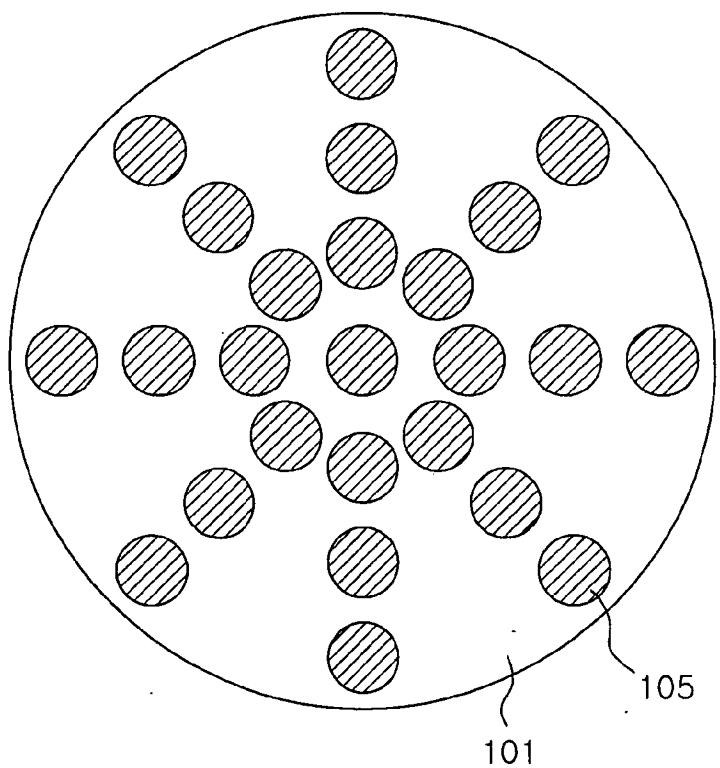



FIG. 8




(a)




(b)

FIG. 9

# CONDITIONER FOR CHEMICAL MECHANICAL PLANARIZATION PAD

## CLAIM OF PRIORITY

[0001] This application claims the benefit of Korean Patent Application No. 2004-105068 filed on Dec. 13, 2004, in the Korean Intellectual Property Office, the disclosure of which is incorporated herein by reference.

## BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to a conditioner for Chemical Mechanical Planarization (CMP) pad required for global planarization of wafer to achieve high integration of a semiconductor element. More particularly, the present invention relates to a conditioner for CMP pad in which the arrangement of abrasive particles is properly controlled.

[0004] 2. Description of the Related Art

[0005] These days, the semiconductor industry experiences high-speed and high-integration in circuits, and with integration capacity enlarged increasingly, chip size becomes bigger. To overcome the resultant limitations, the industry has undergone structural changes such as minimized width of wiring, larger diameter of wafer and multi-layered wiring.

[0006] However with higher integration of elements and reduced minimum width of wiring, the semiconductor industry has encountered limitations the conventional local planarization technology cannot overcome. To achieve processing efficiency and high quality, planarization across wafer or global planarization by Chemical Mechanical Polishing (CMP) has served as the only solution. Global planarization by CMP is necessary for the current wafer process.

[0007] CMP is a polishing process in which semiconductor wafer is planarized via polishing elimination process and dissolution of chemical solution at the same time by chemical and mechanical polishing process.

[0008] For the process, polishing pad and wafer are pressurized, and placed under relative motion. Slurry mixed with abrasive particles and chemical solution is provided to the pad. Then, numerous bubbling pores on a polyurethane polishing pad serve to contain a new polishing solution. Thereby a certain polishing efficiency and polishing uniformity across wafer surface can be attained.

[0009] However, during polishing, pressure and relative speed are added, and thus with process time passing, the surface of pad becomes uneven and fine pores on the polishing pad are glazed by abrasive remnants, no longer capable of playing their role.

[0010] Subsequently, global planarization across wafer surface and uniform polishing on wafers during the whole process can not be accomplished.

[0011] To prevent pad from becoming uneven and fine pores from being glazed, a conditioner is used to finely polish the surface so as to induce new micro pores to come out.

[0012] A conditioner for CMP pad, as shown in **FIG. 1**, comprises a metal substrate **11** including stainless or nickel plate, a number of abrasive particles **13** fixed to the metal substrate **11**, and a layer of metal binder **12** fixing the abrasive particles **13** to the metal substrate **11**.

[0013] There are many methods for manufacturing a conditioner capable of finely polishing the pad surface as described above. For example, electroplating, brazing or sintering is used according to a method for fixing abrasive particles. Abrasive particles and super abrasive particles (CBN) are used as abrasive particles.

[0014] A method for arranging abrasive particles on the conditioner includes a random arrangement in which abrasive particles are randomly arranged as shown in **FIG. 1** and a patterning in which abrasive particles are arranged in a predetermined position as shown in **FIG. 2**.

[0015] Out of the methods of arranging abrasive particles, the random arrangement, as shown in **FIG. 1**, does not allow precise control of the number of abrasive particles **11** which are contained in a conditioner **10**, thus unlikely to achieve reproducibility of design and performance.

[0016] Furthermore, for the random arrangement, a uniform gap of abrasive particles cannot be maintained, possibly causing abrasive particles to be locally biased in the conditioner. In this case, a pad goes through uneven wear, resultantly deteriorating profile or uniformity of wafer to be polished.

[0017] Meanwhile out of the methods of arranging abrasive particles regularly in a predetermined position, as shown in **FIG. 2**, there is a known method of arranging abrasive particles **23** in a predetermined pattern **24** by maintaining a uniform gap of abrasive particles **23** in consideration of only position of abrasive particles **23** regardless of size thereof.

[0018] Unlike random arrangement, the regular arrangement as just described can prevent abrasive particles **23** from being biased. Also the regular arrangement is more advantageous in terms of reproducibility of product performance since an equal number of abrasive particles are arranged for each conditioner **20** and the abrasive particles can be arranged in the same position.

[0019] In general, bigger abrasive particles and smaller abrasive particles are mixed in a predetermined ratio in manufacturing the conditioner.

[0020] Bigger abrasive particles and smaller abrasive particles are mixed in a predetermined ratio due to the following reason. In case of using only abrasive particles of a predetermined size, protrusion height of abrasive particles in the conditioner becomes uniform, and thus with lessened stress on each abrasive particle, the abrasive particles can be prevented from falling off. However, with a significant increase in the number of abrasive particles being involved in a dressing, the abrasive particles cannot deeply penetrate the pad, resultantly deteriorating dressing effects.

[0021] But in case of manufacturing the conditioner according to the conventional patterning method, a predetermined ratio of bigger and smaller abrasive particles is hardly maintainable. As a result, the conventional patterning method has limitations in realizing superior reproducibility.

[0022] Moreover, according to the conventional patterning method, in case where bigger abrasive particles or relatively smaller abrasive particles are biased in a certain region, abrasive particles of a certain region are involved in the dressing, while those of another region are not, leading to uneven wear of the pad. As a result, superior profile of wafer may not be obtainable.

## SUMMARY OF THE INVENTION

[0023] The present invention has been made to solve the foregoing problems of the prior art and it is therefore an object of the present invention to provide a conditioner for CMP pad capable of achieving uniform dressing and superior dressing efficiency and performance reproducibility by arranging abrasive particles by proper size, by proper form and in a proper position, maintaining a uniform gap without abrasive particles being biased and at the same time ensuring a desired particle size distribution of abrasive particles in a predetermined ratio in the conditioner.

[0024] The present invention will be explained hereunder.

[0025] According to an aspect of the invention for realizing the object, there is provided a conditioner for CMP pad, the conditioner comprising a metal substrate having abrasive particles fixed thereto, a number of abrasive particles fixed to the metal substrate and a layer of metal binder fixing the abrasive particles to the metal substrate, wherein the abrasive particles have at least one pattern, the pattern including at least one row of abrasive particles, the abrasive particles including bigger abrasive particles and smaller abrasive particles, and wherein a diameter difference between smaller and bigger abrasive particles is 10 to 40%.

[0026] According to another aspect of the invention for realizing the object, there is provided a conditioner for CMP pad, the conditioner comprising a metal substrate having abrasive particles fixed thereto, a number of abrasive particles fixed to the metal substrate, and a layer of metal binder fixing the abrasive particles to the metal substrate, wherein the abrasive particles include at least three groups of abrasive particles with different sizes, respectively, the abrasive particles have at least one pattern, each pattern including at least one row of abrasive particles and abrasive particles including at least three groups of abrasive particles, and wherein a diameter difference of abrasive particles between a group of biggest abrasive particles and a group of smallest abrasive particles is 10 to 40%.

[0027] The invention will be explained in greater detail hereunder.

[0028] According to the invention, there is provided a conditioner for CMP pad, the conditioner comprising a metal substrate having abrasive particles fixed thereto, a number of abrasive particles fixed to the metal substrate, and a layer of metal binder fixing the abrasive particles to the metal substrate, wherein size of the abrasive particles is adequately controlled and the abrasive particles are adequately arranged.

[0029] The conditioner for CMP pad of the invention includes at least one pattern made of a number of abrasive particles.

[0030] Each pattern includes at least one row of abrasive particles and the abrasive particles comprise 2 groups of bigger abrasive particles and smaller abrasive particles.

[0031] A diameter difference between smaller and bigger abrasive particles is 10 to 40%.

[0032] Bigger abrasive particles are directly involved in pad dressing, while smaller abrasive particles help slurry and abrasive remnants move.

[0033] To more clarify the role of bigger abrasive particles and smaller abrasive particles as described above, a diameter difference between smaller and bigger abrasive particles should be 10 to 40%.

[0034] Also, according to the invention, the abrasive particles can be broken down into at least 3 groups of abrasive particles by size.

[0035] For example, the group of abrasive particles may comprise a group of bigger abrasive particles, a group of mid-sized abrasive particles and a group of smaller abrasive particles. Or the group of abrasive particles may comprise a group of bigger abrasive particles, a group of mid-sized abrasive particles, a group of smaller abrasive particles and a group of smallest abrasive particles.

[0036] Out of the groups of abrasive particles, a diameter difference of abrasive particle between the group of biggest abrasive particles and the group of smallest abrasive particles should be 10 to 40%.

[0037] Relatively bigger abrasive particles are directly involved in pad dressing while relatively smaller abrasive particles help slurry and polishing remnants move.

[0038] As described above, to more clarify the role of abrasive particles by size, a diameter difference of abrasive particles between the group of biggest abrasive particles and the group of smallest abrasive particles should be 10 to 40%.

[0039] The present invention is applicable to not only a patterned conditioner but also an unpatterned conditioner.

[0040] Also, the present invention is not limited to a method for manufacturing a conditioner but applicable to any of the manufacturing methods of brazing, electroplating and sintering.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0041] The above and other objects, features and other advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

[0042] **FIG. 1** illustrates a conventional conditioner for Chemical Mechanical Polishing (CMP) pad having abrasive particles randomly arranged;

[0043] **FIG. 2** illustrates another conventional conditioner for CMP pad having abrasive particles patterned;

[0044] **FIG. 3** is an embodiment of a conditioner for CMP pad of the invention;

[0045] **FIG. 4** is another embodiment of the conditioner for CMP pad of the invention;

[0046] **FIG. 5** is further another embodiment of the conditioner for CMP pad of the invention;

[0047] **FIG. 6** is other embodiment of the conditioner for CMP pad of the invention;

[0048] **FIG. 7** is another embodiment of the conditioner for CMP pad of the invention;

[0049] **FIG. 8** is further another embodiment of the conditioner for CMP pad of the invention; and

[0050] **FIG. 9** is yet another embodiment of the conditioner for CMP pad of the invention, in which (a) shows a sectional view of the conditioner, and (b) shows a schematic view of the conditioner.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0051] Preferred embodiments of the present invention will now be described in detail with reference to the accompanying drawings.

[0052] **FIG. 3** to **5** show preferred embodiments of a conditioner for CMP pad according to the invention.

[0053] As shown in **FIG. 3**, a conditioner for Chemical Mechanical Polishing (CMP) pad **30** includes at least one pattern **34** comprising a number of abrasive particles **33**.

[0054] The pattern **34** includes at least one row of abrasive particles **331**.

[0055] The row of abrasive particles **331** includes a row of bigger abrasive particles **331***a* having bigger abrasives **33***a* and a row of smaller abrasive particles **331***b* having smaller abrasive particles **33***b*.

[0056] The pattern **34** has the row of big abrasive particles **331***a* and the row of small abrasive particles **331***b* alternatively arranged.

[0057] A diameter difference between the abrasive particles is 10 to 40%, and bigger abrasive particles **33***a* and smaller abrasive particles **33***b* are alternately attached to the conditioner.

[0058] Bigger abrasive particles directly engage in pad dressing, while smaller abrasive particles help slurry and abrasive remnants move.

[0059] Meanwhile, in case where bigger abrasive particles or smaller abrasive particles are biased, each abrasive particle biased receives fewer loads so that abrasive particles cannot deeply penetrate the pad.

[0060] Like a conditioner **30** of the invention as shown in **FIG. 3**, in case where smaller abrasive particles are arranged around bigger abrasive particles, bigger abrasive particles, which play a considerable role in pad dressing, sustain increasing load. Subsequently, bigger abrasive particles can penetrate the pad more deeply, enhancing dressing effects and restraining glazing of pad more effectively.

[0061] Likewise, the conditioner of the invention enables abrasive particles to maintain a predetermined position in terms of arrangement of abrasive particles. Further, smaller abrasive particles which have 10 to 40% of diameter difference from bigger abrasive particles can be fixed to a certain position. Therefore, the uneven wear caused by biased bigger or smaller abrasive particles can be inhibited. In addition, each conditioner product has abrasive particles attached thereto in a predetermined number and in a predetermined size, thus efficient to achieve reproducibility thereof.

[0062] **FIG. 4** shows another embodiment of the conditioner of the invention.

[0063] As shown in **FIG. 4**, according to the invention, a pattern **44** of the conditioner **40** includes a pattern with bigger abrasive particles **44***a* and a pattern with smaller abrasive particles **44***b*, both of which are alternately arranged. Thereby abrasive particles of different sizes are alternately attached to the conditioner, increasing effects of pad dressing.

[0064] **FIG. 5** illustrates yet another embodiment of the conditioner of the invention.

[0065] As shown in **FIG. 5**, according to the invention, abrasive particles of different sizes are alternately arranged circlewise.

[0066] For arrangement of abrasive particles according to the invention, a gap of abrasive particle rows including at least one relatively bigger abrasive particle, which plays a substantial role in dressing, is preferably 2.5 to 150 times the average diameter of the bigger abrasive particles, and more preferably 2.5 to 100 times the average diameter of the bigger abrasive particles. As a result, superior effects of dressing are attainable.

[0067] If a gap of abrasive particle rows including at least one of bigger abrasive particles is at least 150 times the average diameter of the bigger abrasive particles, fewer bigger abrasive particles engage in dressing, lowering dressing efficiency.

[0068] Abrasive particle rows of **FIG. 3** and **4** are made of only smaller particles or only bigger particles. But the conditioner of the invention is not limited as just described. For example, abrasive particle rows can have bigger abrasive particles and smaller abrasive particles alternately arranged.

[0069] Also, according to the invention, abrasive particle rows can be formed in such a manner that bigger abrasive particles are successively arranged and then smaller abrasive particles are arranged, or bigger abrasive particles are arranged and then small abrasive particles are successively arranged.

[0070] Although as in **FIG. 3** to **5**, two types of abrasive particles of bigger abrasive particles and smaller abrasive particles can be used, the conditioner of the invention is not limited thereto. Also, as shown in **FIG. 6** to **8**, the conditioner can be manufactured in such a manner that mid-sized abrasive particles are added to the bigger and smaller abrasive particles. Alternatively, much smaller particles, sized smaller than the smaller abrasive particles may be added to the arrangement. This results in improved conditioning effects.

[0071] As shown in **FIG. 6**, the invention uses bigger abrasive particles **63***a*, smaller abrasive particles **63***b* and mid-sized abrasive particles **63***c* as abrasive particles **63**, and a row of abrasive particles **631** is formed by each abrasive particle. A conditioner **60** can be manufactured by alternately arranging the rows of abrasive particles **631***a*, **631***b* and **631***c* to form a pattern **64**.

[0072] As shown in **FIG. 7**, the invention uses bigger abrasive particles **73***a*, smaller abrasive particles **73***b* and mid-sized abrasive particles **73***c* as abrasive particles **73**, and a row of abrasive particles **731** is formed by each abrasive particle. The rows of abrasive particles **731***a*, **731***b* and, **731***c* form patterns **74***a*, **74***b* and **74***c* and a conditioner **70** is manufactured by alternately arranging the patterns.

**[0073]** Further, as shown in **FIG. 8**, the invention uses bigger abrasive particles **83***a*, smaller abrasive particles **83***b* and mid-sized abrasive particles **83***c* as abrasive particles **83**, and a row of abrasive particles is formed by alternately arranging each abrasive particle. A conditioner **80** is manufactured in such a manner that the rows of abrasive particles are arranged to form a pattern **84**.

**[0074]** Also, according to the invention, a row of abrasive particles can be formed by arranging at least two particles of any size, and then arranging other abrasive particles in succession by one or two. Alternatively, at least two abrasive particles of one size may be arranged in succession, and alternate with other sized abrasive particles, which are also arranged in succession by two.

**[0075]** In this case, a gap between abrasive particle rows having at least one of biggest abrasive particle is preferably 2.5 to 150 times the average diameter of the biggest abrasive particles, and more preferably, 2.5 to 100 times the average diameter of the bigger abrasive particles. Thereby superior dressing effects can be attained.

**[0076]** **FIG. 9** illustrates an example of the conditioner in which a number of pellets having abrasive particles attached thereto by a layer of metal binder are bonded to a metal substrate according to the invention. **FIG. 9**(*a*) shows a sectional view of the conditioner and **FIG. 9**(*b*) shows a schematic view of the conditioner.

**[0077]** Unlike a conditioner having abrasive particles attached to a metal substrate by a layer of metal binder, the present invention, as shown in **FIG. 9**, allows a conditioner **100** including a number of pellets **105** having abrasive particles **102** attached to a metal substrate **101** by a layer of metal binder **103** to control arrangement of the pellets. This leads to better dressing effects.

**[0078]** In this case, abrasive particles can be arranged in the pellet in any of the aforesaid arrangement.

**[0079]** For example, as in **FIG. 3**, two types of abrasive particles with size difference are alternately attached in the pellet. Also, as in **FIG. 4**, abrasive particles with the same size are attached in the pellet so that each pellet has different sizes.

**[0080]** In addition, abrasive particles with different size can be arranged circlewise in the pellets which are arranged as shown in **FIG. 5**, or numerous other abrasive particles with different sizes are applicable to pellets according to the method for arranging abrasive particles of the invention.

**[0081]** The pellets can be equally sized or differently sized, or a shape of the pellets can be modified.

**[0082]** A technical object of the invention is not only applied to a conditioner for CMP pad but to a cutting tool.

**[0083]** The invention will be explained in greater detail in the examples which follow.

## EXAMPLE 1

**[0084]** The products prepared include a conditioner of random arrangement having abrasive particles without size difference randomly arranged (conventional product 1), a conditioner of conventional patterning having abrasive particles without size difference regularly arranged (conventional product 2), a conditioner of the invention having at least 2 abrasive particles with size difference alternately attached in a row to a segment (inventive product **1**), a conditioner of the invention having at least 2 abrasive particles with size difference alternately attached to each segment (inventive product 2), and a conditioner of the invention having abrasive particles attached in a row forming a circle (inventive product 3).

**[0085]** With respect to the conventional conditioner and the conditioner of the invention, an evaluation was conducted on cut rate of pad and fracture of abrasive particles. The results are shown in Table 1.

TABLE 1

| | Evaluation results | | | | |
|---|---|---|---|---|---|
| | Pad cut rate(μm/hr) | | | | Fracture or pulling out of abrasive |
| | 1st | 2nd | 3rd | Variation | particles |
| Conventional product 1 | 322 | 357 | 298 | 59 | None |
| Conventional product 2 | 403 | 378 | 417 | 39 | None |
| Inventive product 1 | 466 | 460 | 472 | 12 | None |
| Inventive product 2 | 455 | 442 | 439 | 16 | None |
| Inventive product 3 | 433 | 421 | 420 | 13 | None |

**[0086]** As shown in Table 1, conventional product 1 has low cut rate of pad, with big variations in pad cut rate for each conditioner. Conventional product 2 indicates improvement in cut rate of pad amount from conventional product 1 but varies to some extent in terms of reproducibility of products.

**[0087]** Meanwhile, inventive products 1, 2 and 3 show a great excellence in wear amount and reproducibility of products compared with the conventional conditioner.

**[0088]** Generally, a high abrasion effect increases stress of abrasion particles involved in dressing, possibly causing fracture or pulling out thereof. Invention products 1, 2 and 3 did not suffer fracture or pulling out of abrasive particles.

## EXAMPLE 2

**[0089]** The products prepared include a conditioner (comparative product 1) representing less than 10% size difference between bigger and smaller abrasive particles, a conditioner (inventive product 4) having abrasive particles with 10 to 40% of size difference and a conditioner (comparative product 2) having abrasive particles with 45 to 70% of size difference. The products have bigger and smaller abrasive particles in a row at a predetermined rate.

**[0090]** For the conditioners manufactured as just described, wafer removal rate was measured on a time basis and the results are shown in table 2 below.

TABLE 2

| | Wafer removal rate (Å/min) | | | | |
|---|---|---|---|---|---|
| | 1 hour | 20 hours | 40 hours | Average | variation |
| Comparative product 1 | 3642 | 3287 | 2769 | 3233 | 873 |
| Inventive product 4 | 3685 | 3514 | 3397 | 3532 | 288 |
| Comparative product 2 | 3991 | 3102 | 2554 | 3215 | 1437 |

[0091] As shown in Table 2, for comparative product 1 having abrasive particles with less than 10% size difference, wafer removal rate after 40-hour use drops significantly from the initial removal rate.

[0092] That is because abrasive particles are gradually worn away during dressing but due to little height variation in abrasive particles, abrasive particles with new sharp edges are not created, consequently unable to perform effective pad dressing so that wafer removal rate diminishes.

[0093] Since comparative product 1 has a greater number of abrasives particles playing a substantial role in abrasion process than comparative product 2, comparative product 1 shows higher removal rate and less reduction in removal rate.

[0094] For inventive product 4 having abrasive particles with 10 to 40% size difference, overall removal rate is high and variation of wafer removal rate on a time basis is not considerable. This means good conditioning effects and uniform removal rate.

[0095] For comparative product 2 having abrasive particles with 45 to 70% of size difference, bigger abrasive particles used for abrasion process sustain more load than those of comparative product 1 and inventive product 4 and thus deeply penetrate the pad so that removal rate is high in the early stage.

[0096] With abrasive particles worn away, new abrasive particles or smaller abrasive particles should engage in dressing, but cannot due to wide size difference, leading to sharp decrease in removal rate.

## EXAMPLE 3

[0097] Manufactured were conditioners having bigger abrasive particles, mid-sized abrasive particles and smaller abrasive particles with 10-40% of overall size difference arranged in a row. With respect to the conditioners, an evaluation was conducted on cut rate of pad and the results are shown in Table 3 below.

[0098] In Table 3 below, inventive product 5 is a conditioner having bigger abrasive particles A, mid-sized abrasive particles B and smaller abrasive particles C arranged successively in a row. Inventive product 6 is a conditioner having bigger abrasive particles A, smaller abrasive particles C and mid-sized abrasive particles B arranged successively in a row. Conventional product 1 is a conditioner having abrasive particles without size difference arranged randomly.

TABLE 3

| | Pad cut rate (μm/hr) | | | | |
|---|---|---|---|---|---|
| | 1st | 2nd | 3rd | Average | variation |
| Inventive product 5 | 457 | 449 | 461 | 456 | 12 |
| Inventive product 6 | 455 | 457 | 440 | 451 | 17 |
| Conventional product 1 | 322 | 357 | 298 | 325 | 59 |

[0099] As shown in table 3, if abrasive particles have 10 to 40% of size difference and are arranged in a row, inventive product 5 and 6 indicate little difference in cut rate of pad although bigger abrasive particles, mid-sized particles and smaller particles are arranged in a different order. Also they indicate higher cut rate and more uniform cut rate than conventional conditioner 1.

## EXAMPLE 4

[0100] An evaluation was conducted on variations in cut rate of pad when a gap of bigger abrasive particles arranged in a row was large or small. The results are shown in Table 4.

[0101] With respect to conditioners of inventive product used in this example, abrasive particles with size difference of 10 to 40% were used and arranged in a row.

[0102] Inventive product 7 in Table 4 shows a conditioner in which a gap between bigger abrasive particles arranged in a row and bigger abrasive particles arranged in the next row is 2.5 times the diameter of the bigger abrasive particles; in invention product 8, the gap is 25 times, in inventive product 9, the gap is 50 times, in inventive product 10, the gap is 100 times, in inventive product 11, the gap is 150 times, and in inventive product 12, the gap is 200 times.

TABLE 4

| | Pad cut rate [μm/hr] | | | |
|---|---|---|---|---|
| | 1st | 2nd | 3rd | Average |
| Conventional product 1 | 322 | 357 | 298 | 326 |
| Inventive product 7 | 400 | 424 | 407 | 410 |
| Inventive product 8 | 459 | 470 | 474 | 468 |
| Inventive product 9 | 467 | 459 | 446 | 457 |
| Inventive product 10 | 448 | 434 | 461 | 448 |
| Inventive product 11 | 383 | 400 | 395 | 393 |
| Inventive product 12 | 352 | 329 | 342 | 341 |

[0103] As shown in Table 4, conditioners of invention product having 10-40% size difference and arranged in a row indicate excellent pad cut rate and narrow variance thereof.

[0104] When a gap of rows of bigger abrasives playing a significant role in dressing is 2.5 to 100 times the diameter of the bigger abrasive particles, cut rate of pad is greatly increased. When the gap is 150 times, cut rate of pad is higher than that of conventional product 1.

[0105] However, when the gap of rows of bigger abrasive particles is more than 150 times the diameter of the bigger abrasive particles, cut rate of pad is less increased than that of conventional product 1.

[0106] Consequently, if the gap of rows of bigger abrasives is less than 2.5 times the diameter of the bigger abrasive particles, the bigger abrasive particles cannot deeply penetrate a pad, reducing dressing efficiency. If the gap is greater than 150 times, due to a small number of bigger abrasive particles, cut rate of pad increases in the early stage but with time passing, abrasive particles are quickly worn away, leading to less improvement in cut rate of pad.

[0107] As stated above, the present invention provides a conditioner having at least 2 abrasive particles with size difference arranged uniformly and abrasive particles with size difference attached in a desired ratio and position. Thereby, the cutting tool will experience improvement in useful life and dressing effects, and realize superior reproducibility of performance.

[0108] While the present invention has been shown and described in connection with the preferred embodiments, it will be apparent to those skilled in the art that modifications and variations can be made without departing from the spirit and scope of the invention as defined by the appended claims.

What is claimed is:

1. A conditioner for Chemical Mechanical Planarization (CMP) pad comprising:

a metal substrate having abrasive particles fixed thereto;

a number of abrasive particles fixed to the metal substrate; and

a layer of metal binder fixing the abrasive particles to the metal substrate,

wherein the abrasive particles have at least one pattern, the pattern including at least one row of abrasive particles, the abrasive particles including bigger abrasive particles and smaller abrasive particles, and

wherein a diameter difference between smaller and big abrasive particles is 10 to 40%.

2. The conditioner for CMP pad according to claim 1, wherein the pattern comprises a row of bigger abrasive particles and a row of smaller abrasive particles alternately arranged.

3. The conditioner for CMP pad according to claim 1, wherein the pattern comprises a pattern of bigger abrasive particles and a pattern of smaller abrasive particles alternately arranged.

4. The conditioner for CMP pad according to claim 1, wherein the row of abrasive particles comprises bigger abrasive particles and smaller abrasive particles alternately arranged.

5. The conditioner for CMP pad according to claim 1, wherein the pattern has two rows of bigger abrasive particles and a row of smaller abrasive particles alternately arranged.

6. The conditioner for CMP pad according to claim 1 wherein a gap of abrasive particle rows including at lest one bigger abrasive particle is 2.5 to 150 times the average diameter of the bigger abrasive particles.

7. The conditioner for CMP pad according to claim 6, wherein a gap of the abrasive particle rows is 2.5 to 100 times the average diameter of the bigger abrasive particles.

8. The conditioner for CMP pad according to claim 1, wherein the abrasive particles comprise one selected from a group consisting of super-abrasive particle, cubic boron nitride (CBN) particle and diamond particle.

9. The conditioner for CMP pad according to claim 6, wherein the abrasive particles comprise one selected from a group consisting of super-abrasive particle, cubic boron nitride (CBN) and diamond particle.

10. A conditioner for Chemical Mechanical Planarization (CMP) pad comprising:

a metal substrate having abrasive particles fixed thereto;

a number of abrasive particles fixed to the metal substrate; and

a layer of metal binder fixing the abrasive particles to the metal substrate,

wherein the abrasive particles include at least three groups of abrasive particles of different sizes, respectively, the abrasive particles having at least one pattern, each pattern including at least one row of abrasive particles and abrasive particles having at least 3 groups of abrasive particles, and

wherein a diameter difference of abrasive particles between a group of biggest abrasive particles and a group of smallest abrasive particles is 10 to 40%.

11. The conditioner for CMP pad according to claim 10, wherein each of the rows of abrasive particles comprises abrasive particles of equal size, and the rows are repetitively arranged in the order of the size of abrasive particles.

12. The conditioner for CMP pad according to claim 10, wherein the row of abrasive particles comprises abrasive particles including at least 3 groups of abrasive particles; and is repetitively arranged by size of the abrasive particles.

13. The conditioner for CMP pad according to claim 10, wherein a gap of abrasive particle rows including at least one biggest abrasive particle is 2.5 to 150 times the average diameter of the biggest abrasive particle.

14. The conditioner for CMP pad according to claim 13, wherein a gap of abrasive particle rows including at least one biggest abrasive particle is 2.5 to 100 times the average diameter of the biggest abrasive particle.

15. The conditioner for CMP pad according to claim 10 wherein the abrasive particles comprise one selected from a group consisting of super abrasive particle, cubic boron nitride (CBN) particle and diamond particle.

16. The conditioner for CMP pad according to claim 13, wherein the abrasive particles comprise one selected from a group consisting of super abrasive particle, cubic boron nitride (CBN) and diamond particle.

17. A conditioner for Chemical Mechanical Planarization (CMP) pad comprising a plurality of pellets having abrasive particles arranged thereon, wherein the abrasive particles are patterned as described in claim 1.

18. The conditioner for CMP pad according to claim 17, wherein the abrasive particles comprise one selected from a group consisting of super abrasive particle, cubic boron nitride (CBN) particle and diamond particle.

19. A conditioner for CMP pad comprising a plurality of pellets having abrasive particles arranged thereon, wherein the abrasive particles are patterned as described in claim 10.

20. The conditioner for CMP pad according to claim 19, wherein the abrasive particles comprise one selected from a group consisting of super abrasive particle, CBN particle and diamond particle.

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