

DESCRIPTION

POLISHING HEAD AND POLISHING APPARATUS

TECHNICAL FIELD

[0001]

The present invention relates to a polishing head for holding a workpiece when a surface of the workpiece is polished and a polishing apparatus having it, and more particularly to a polishing head for holding the workpiece on a rubber film and a polishing apparatus having it.

BACKGROUND ART

[0002]

As an apparatus for polishing a surface of a workpiece such as a silicon wafer, there are a single-side polishing apparatus in which the workpiece is polished by each side and a double-side polishing apparatus in which the both sides of the workpiece are polished at the same time.

For example as shown in FIG. 9, a common single-side polishing apparatus comprises a turn table 93 onto which a polishing pad 94 is attached, a polishing agent supply mechanism 96, a polishing head 92 and the like. The polishing apparatus 91 polishes a workpiece W by holding the workpiece W with the polishing head 92, supplying the polishing agent 95 to the polishing pad 94 through the polishing agent supply mechanism 96, rotating the turn table 93 and the polishing head 92 respectively, and bringing the surface of the workpiece W into sliding contact with the polishing pad 94.

[0003]

As a method for holding the workpiece in the polishing head, for example, there is a method of attaching the workpiece onto a flat disk-shaped plate through an adhesive such as a wax. Other than that, as a method for improving flatness over the workpiece, there is a so-called rubber chuck method in which a workpiece holding portion is made of a rubber film, a pressurized fluid such as air is poured into a back surface of the rubber film, and the rubber film is inflated by a uniform pressure so as to press the workpiece to the polishing pad (See Japanese Patent Application Laid-open (kokai) No.H05-69310, Japanese Patent Application Laid-open (kokai) No.2005-313313, etc.).

[0004]

An example of structure of a conventional polishing head by a rubber chuck method is schematically shown in FIG. 8 (a) and an enlarged diagram of a peripheral portion of the polishing head is shown in FIG. 8 (b). An essential part of the polishing head 71 consists of an approximately discoid mid plate 72 and a rubber film 73 fixed by fitting it with the mid plate 72. The rubber film 73 is supported by a peripheral portion 72c of an upper face, a side face portion 72b and a peripheral portion of a lower face portion 72a of the mid plate. A projecting portion 72d is formed in the peripheral portion of the lower face portion 72a of the mid plate in order to form a space portion 74 between the rubber film 73 and the mid plate. A through hole 76 for pressure adjustment communicating with a pressure adjustment mechanism 75 is provided at the center of the mid plate 72 and pressure of the space portion 74 is adjusted, for example, by supplying a pressurized fluid

with the pressure adjustment mechanism 75. In addition, the polishing head comprises a pressing means, not shown, for pressing the mid plate 72 toward the polishing pad 94.

[0005]

Besides, there is the case where a polishing head having the structure as described in Japanese Patent Application Laid-open (kokai) No.2005-313313 is used and it is provided with a mechanism for uniformly applying pressure to the mid plate, a mechanism for applying pressure to a retainer ring placed in a periphery of a workpiece holding portion and the like, in addition to a mechanism for applying pressure to the rubber film.

The workpiece W is held on the lower face portion of the rubber film 73 through a backing pad 77 and is brought into sliding contact with the polishing pad 94 attached onto an upper face of the turn table 93 by pressing the mid plate for performing polishing using the polishing head configured as described above.

[0006]

It is described that polishing the workpiece using the polishing head by a rubber chuck method as described above enables obtaining the workpiece having a relatively good polishing stock removal uniformity. However, there is a problem that a polishing sag or the like occurs particularly on an outer peripheral portion. Thus, the polishing stock removal uniformity is required to further improve.

DISCLOSURE OF INVENTION

[0007]

In view of the above-explained problems, it is a main object of the present invention to provide a

polishing head by a rubber chuck method in which a uniform polishing load can be applied over the workpiece without influence of stiffness or flatness of the mid plate.

[0008]

In order to accomplish the above object, the present invention provides a polishing head having at least: an approximately discoid mid plate; a rubber film covering at least a lower face portion and a side face portion of the mid plate; and a space portion surrounded by the mid plate and the rubber film; in which pressure of the space portion can be changed by a pressure adjustment mechanism, a back surface of a workpiece is held on a lower face portion of the rubber film and a front surface of the workpiece is brought into sliding contact with a polishing pad attached onto a turn table for performing polishing; wherein the mid plate and the rubber film do not contact one another to have a gap at least throughout a whole of the lower face portion of the mid plate.

[0009]

When the workpiece is polished using the polishing head in which the mid plate and the rubber film do not contact one another to have a gap at least throughout a whole of the lower face portion of the mid plate as described above, since there is the gap between the lower face portion of the mid plate and the rubber film, the workpiece can be polished while a uniform polishing load is applied over the workpiece without the influence of stiffness or flatness of the mid plate. As a result, the workpiece can be polished with maintaining a high flatness throughout a whole of the workpiece, particularly in the outer peripheral portion.

[0010]

In this case, it is preferable that the gap between the mid plate and the rubber film is less than 1 mm.

In this manner, when the gap between the mid plate and the rubber film is less than 1 mm, the workpiece can be polished with the pressure of the space portion more stabilized.

[0011]

In addition, it is preferable that the mid plate and the rubber film also do not contact one another to have a gap throughout a whole of the side face portion of the mid plate.

In this manner, when the mid plate and the rubber film also do not contact one another to have a gap throughout a whole of the side face portion of the mid plate, since the side face of the mid plate also does not contact with the rubber film, the influence of the stiffness or the shape of the side face portion of the mid plate on the rubber film can be further reduced and thus the workpiece can be polished while the back surface of the workpiece is more effectively pressed with a uniform polishing load. As a result, the workpiece can be polished with more effectively maintaining a high flatness of the front surface of the workpiece.

[0012]

In addition, it is preferable that an inner diameter of the portion covering the side face portion of the mid plate in the rubber film is larger than a flatness quality area of the workpiece.

In this manner, when an inner diameter of the portion covering the side face portion of the mid plate

in the rubber film is larger than a flatness quality area of the workpiece, the influence of the stiffness of the portion covering the side face portion of the mid plate in the rubber film on a workpiece holding face of the rubber film can be reduced and the polishing stock removal uniformity can be more effectively improved while the workpiece is polished.

[0013]

In addition, the polishing head can have a backing pad on the face of the rubber film, the face holding the workpiece. In this case, it is preferable that a diameter of the backing pad is larger than that of the workpiece.

In this manner, even if the polishing head has a backing pad in order to surely hold the workpiece in the polishing head and to prevent an occurrence of a scratch and the like on the back surface, when a diameter of the backing pad is larger than that of the workpiece, the influence of a limit to inflation of the rubber film due to the backing pad on the workpiece can be reduced. As a result, the workpiece can be pressed with a more uniform polishing load.

[0014]

Furthermore, the present invention provides a polishing apparatus used for polishing a surface of a workpiece at least comprising: a polishing pad attached onto a turn table; a polishing agent supply mechanism for providing a polishing agent to the polishing pad; and a polishing head for holding the workpiece, which is the polishing head according to the present invention.

[0015]

In this manner, when the workpiece is polished using the polishing apparatus including the polishing

head according to the present invention, the workpiece can be polished while a uniform polishing load is applied over the workpiece. As a result, the workpiece can be polished with maintaining a high flatness throughout a whole surface of the workpiece, particularly in the outer peripheral portion.

[0016]

When the workpiece is polished using the polishing head according to the present invention, the workpiece can be polished while a uniform pressing force is applied throughout the whole of the front surface of the workpiece. As a result, the polishing stock removal uniformity can be improved throughout the whole surface of the workpiece and the surface flatness of the polished workpiece can be made to be good.

BRIEF DESCRIPTION OF DRAWINGS

[0017]

FIGS. 1 are schematic sectional views showing a first embodiment of the polishing head according to the present invention, wherein (a) is a schematic sectional view showing the whole of the polishing head and (b) is an enlarged view showing the peripheral portion thereof.

FIGS. 2 are schematic sectional views showing a second embodiment of the polishing head according to the present invention, wherein (a) is a schematic sectional view showing the whole of the polishing head and (b) is an enlarged view showing the peripheral portion thereof.

FIG. 3 is a schematic constitutional view showing an example of the polishing apparatus comprising the polishing head according to the present invention.

FIGS. 4 are explanatory views showing a positional relationship between the portion covering the side face

portion of the mid plate in the rubber film (a rubber film side portion) and the outermost peripheral portion of the workpiece.

FIG. 5 is a graph showing the polishing stock removal uniformities of the workpiece polished in Example 1, Example 2, and Comparative Example.

FIG. 6 is a graph showing the polishing stock removal uniformities of the workpiece in the case that an inner diameter of the portion covering the side face portion of the mid plate in the rubber film (a rubber film side portion) is changed.

FIG. 7 is a graph showing the polishing stock removal uniformities of the workpiece in the case that an outer diameter of the backing pad is changed.

FIGS. 8 are schematic sectional views showing an example of structure of a conventional polishing head by a rubber chuck method, wherein (a) is a schematic sectional view showing the whole of the polishing head and (b) is an enlarged view showing the peripheral portion thereof.

FIG. 9 is a schematic constitutional view showing an example of a single-side polishing apparatus.

FIG. 10 is a schematic sectional view showing an example of the case where the polishing head according to the present invention comprises a retainer ring.

FIGS. 11 are explanatory views showing a positional relationship among the workpiece, the backing pad and the rubber film in the polishing head according to the present invention.

BEST MODES FOR CARRYING OUT THE INVENTION

[0018]

Hereinafter, the present invention will be

explained more specifically.

As described above, in the case of holding a workpiece with the polishing head by a rubber chuck method and polishing the surface of the workpiece, the surface flatness of the polished workpiece is required to be a still higher level. However, conventionally there is a problem that a polishing sag and the like occurs particularly in the peripheral portion.

In order to solve the problem, the present inventors have conducted experiments and studies.

[0019]

The present inventors found as follows through them. As shown in FIGS. 8, conventionally there is the case that a part (a projecting portion) 72d where a lower face portion 72a of a mid plate 72 and a rubber film 73 contact one another is provided. In this case, even if the projecting portion 72d does not adhere to the rubber film 73 and they are in free condition due to a pressurized fluid during polishing the workpiece, the mid plate is pressed toward a polishing pad 94 at the time of pressing the whole of the polishing head 71 and then a workpiece holding portion of the rubber film 73 is affected by stiffness of the mid plate 72, flatness of the lower face portion 72a (a lower face of the projecting portion 72d) or the like, at the time of polishing. As a result, its shape or pressing force becomes nonuniform and thereby a shape of the workpiece W that is held on the workpiece holding face of the rubber film 73 and polished deteriorates.

[0020]

In particular, in the case of the polishing head configured such that a retainer ring is placed outside the workpiece holding face of the rubber film 73 and an

edge portion of the workpiece W is held by the retainer ring, the workpiece W is held up to the almost outermost peripheral portion of the lower face portion of the rubber film 73. There is consequently a great influence of a contact portion between the rubber film 73 and the projecting portion 72d formed in the peripheral portion of the lower face portion 72a of the mid plate. In addition, in the case that the workpiece W is not held just below the contact portion between the rubber film 73 and the projecting portion 72d of the mid plate unlike described above but is held more inside, the workpiece holding face of the rubber film 73 is not a little affected by existence of the contact portion between the rubber film 73 and the projecting portion 72d of the mid plate such as an occurrence of pressure distribution.

[0021]

The present inventors studied measures to solve the above-mentioned problems. As a result, the present inventors found as follows. It was conventionally considered that structure was essential in which the projecting portion 72d was provided so as to support the rubber film 73 in the peripheral portion of the mid plate 72. However, the present inventors found that the structure was not essential. That is, the present inventors found that the problems can be solved by configuring in such a manner that the mid plate and the rubber film do not contact one another to provide a gap between them throughout the whole surface of the lower face portion of the mid plate and that the shape of the rubber film can be stably maintained, and thereby bringing the present invention to completion.

[0022]

Hereinafter, a polishing head and a polishing apparatus according to the present invention will be explained specifically referring to the attached figures. However, the present invention is not limited thereto.

FIGS. 1 show an example of the polishing head according to the present invention (a first embodiment). The polishing head 11 comprises an approximately discoid mid plate 12 and a rubber film (an elastic film) 13 covering at least a lower face portion 12a and a side face portion 12b of the mid plate 12. The rubber film 13 is fixed to the mid plate 12 on the peripheral portion 12c of the upper face of the mid plate. The rubber film can be fixed on a peripheral portion 12c of an upper face of the mid plate, for example, in such a manner that the rubber film is adhered using an adhesive, is pinched with a back plate 18 and is fixed using a screw and the like. In this case, the mid plate 12 and the rubber film 13 do not contact one another to have a gap 14a at least throughout the whole of the lower face portion 12a. The rubber film can be formed by a conventionally known method to prepare the rubber film 13 having the shape as described above. A thickness of the rubber film is not particularly restricted and a suitable thickness can be appropriately selected. For example, it can be a thickness of about 1 mm.

[0023]

A space portion 14 is thus defined between the mid plate 12 and the rubber film 13, at least between the lower face portion 12a of the mid plate and the rubber film 13. A pressure adjustment mechanism 15 is further provided to adjust the pressure of the space portion 14. The pressure of the space portion 14 is adjusted, for example, by supplying a pressurized fluid through a

through-hole 16 provided in the mid plate 12.

[0024]

It is preferable to configure the polishing head 31 in such a manner that the mid plate and the rubber film 13 also do not contact one another to have a gap 14b throughout the whole surface of the side face portion 12b of the mid plate, like a second embodiment of the polishing head according to the present invention in which a schematic sectional view of the whole of the polishing head is shown in FIG. 2 (a) and an enlarged view is shown in FIG. 2 (b). In this case, the rubber film 13 contacts with only the peripheral portion 12c of the upper face of the mid plate and is fixed. In this case, the rubber film can also be formed by a conventionally known method.

It is to be noted that it is desirable that both of them are not fixed by adhering and the like, as the case where there is not the gap between the side face portion 12b of the mid plate and the rubber film 13 and they contact one another unlike the polishing head in which the mid plate and the rubber film 13 do not contact one another to have the gap 14b throughout the whole surface of the side face portion 12b of the mid plate as shown in FIGS. 2.

[0025]

Besides, a backing pad 17 can be attached to be provided on the workpiece holding face of the rubber film 13 so as to more surely hold the workpiece W. The backing pad 17 is made to contain water so as to attach and to hold the workpiece W on the workpiece holding face of the rubber film 13. The backing pad 17 can be made of, for example, foamed polyurethane. By providing such backing pad 17 and having it contain water, the

workpiece W can be surely held by surface tension of the water contained in the backing pad 17.

In addition, the polishing head 11, 31 comprises a means for pressing the mid plate 12 (or the whole of the polishing head 11, 31) (not shown).

[0026]

With the polishing head 11, 31 configured as described above, the mid plate 12 is pressed toward the polishing pad 22 attached onto the turn table 21 by the means for pressing the mid plate, which not shown, and the workpiece W is brought into sliding contact with the polishing pad 22 for polishing the workpiece surface. The means for pressing the mid plate is preferably able to press the mid plate throughout the whole face with a uniform pressure.

[0027]

As an example is shown in FIG. 10 regarding the case of the first embodiment (the polishing head 11), the polishing head 11, 31 can comprise a retainer ring 19 that is placed along the peripheral portion of the lower face portion of the rubber film 13 and that is capable of pressing the polishing pad 22 working with or being independent from the workpiece holding face of the rubber film 13. The retainer ring 19 can be configured, for example, such that a guide ring 19a, which holds the edge portion of the workpiece W, and a dress ring 19b, which is placed outside the guide ring 19a and that performs dressing of the polishing pad 22.

[0028]

It is desirable that the distance of the gap 14a between the lower face portion 12a of the mid plate and the rubber film 13 is sufficient so that the lower face portion 12a of the mid plate and the rubber film 13 do

not contact one another during polishing. Its limit is desirably less than 1 mm. When the distance is less than 1 mm, the pressure of the space portion 14 can be easily controlled to be stably uniform throughout the whole surface. Also, in the case of the second embodiment shown in FIGS. 2, the same settings are applied to the distance of the gap 14a between the lower face portion 12a of the mid plate and the rubber film 13, but the distance of the gap 14b between the side face portion 12b of the mid plate and the rubber film 13 is not particularly restricted. However, it is desirable that the distance that makes the shape of the rubber film 13 unstable is avoided. For example, it is desirably about 2 mm or less.

[0029]

The structure of the polishing head 11, 31 as described above enables adjusting the shape and the pressure distribution of the rubber film 13 by the pressure of the space portion 14. In addition to this, since the lower face portion 12a of the mid plate and the rubber film 13 do not contact one another, the stiffness of the mid plate, the shape of the mid plate or the like has no affect on the rubber film 13 and consequently the workpiece W can be polished with a uniform polishing pressure.

The structure of the polishing head 31 in which the side face portion 12b of the mid plate and the rubber film 13 do not contact one another as the second embodiment described above enables preventing not only the influence of the lower face portion 12a of the mid plate on the rubber film 13 but also the influence of the side face portion 12c on the rubber film 13.

[0030]

In the present invention, in the case of holding the workpiece W on the approximately whole of the lower face portion of the rubber film 13, for example the retainer ring 19, which holds the edge portion of the workpiece W, is placed outside the workpiece holding face of the rubber film 13 and the workpiece W is held on the approximately whole of the lower face portion of the rubber film 13, a particularly high effect of improving the polishing stock removal uniformity is achieved by the structure such that there is not a contact portion between the lower face portion 12a of the mid plate and the rubber film 13 as well as a conventional polishing head. However, the present invention is not restricted thereto. When the workpiece is held in state where an outer diameter of the workpiece is located inside the peripheral portion of the rubber film 13, the present invention can also completely dissolve the influence of the pressure distribution conventionally occurring on the workpiece holding face of the rubber film 13 due to existence of the contact portion between the lower face portion 12a of the mid plate and rubber film 13, and can consequently improve the polishing stock removal uniformity in comparison with a conventional polishing head.

[0031]

The present invention can completely dissolve the influence of the stiffness and the shape of the lower face portion 12a of the mid plate on the workpiece holding portion of the rubber film 13. In contrast, when the workpiece is held on the whole of the lower face portion of the rubber film 13, for example in the case that the retainer ring 19, which holds the edge

portion of the workpiece W, is placed outside the workpiece holding portion of the rubber film 13 and the workpiece W is held on the approximately whole of the lower face portion of the rubber film 13, the influence of the stiffness of the portion (hereinafter also referred to as a rubber film side portion) covering the side face portion 12b of the mid plate in the rubber film 13 remains on the rubber film 13. The influence of the stiffness of the rubber film side portion is minor than the influence of the mid plate 12. However, the influence is preferably suppressed as much as possible to further improve the polishing stock removal uniformity of the workpiece W.

[0032]

FIGS. 4 show enlarged views the peripheral portion of the polishing head for reducing the influence of the rubber film side portion. FIG. 4 (a) shows the case of the first embodiment and FIG. 4 (b) shows the case of the second embodiment. As shown in FIGS. 4 (a) and (b), it is preferable that an outer diameter of the portion (the rubber film side portion) 13b covering the side face portion 12b of the mid plate in the rubber film 13 is larger than that of the workpiece W. However, for example, in the case that the retainer ring, which holds the edge portion of the workpiece W, is placed outside the workpiece holding face of the rubber film 13 and the workpiece W is held on the approximately whole of the lower face portion of the rubber film 13, by reason that a size of the retainer ring is set beforehand etc., it can be difficult to configure such that an inner diameter of the rubber film side portion 13b is larger than an outer diameter of the workpiece W. In this case, the inner diameter of the rubber film side portion 13b

can be larger than at least a flatness quality area of the workpiece W.

The flatness quality area of the workpiece is an area where a prescribed flatness is guaranteed in the whole surface of the workpiece. It is determined by specifications. For example in the case of a silicon single crystal wafer having a diameter of 300 mm, it is normally the area except about 1 to 2 mm of the outermost periphery.

[0033]

The structure and the placement of the mid plate 12 and rubber film 13 for the workpiece W enable reducing the influence of the stiffness of the rubber film side portion 13b on the workpiece holding face of the rubber film 13 and further improving the polishing stock removal uniformity while the polishing is performed.

[0034]

As described above, the backing pad 17 can be attached to be provided on the lower face of the rubber film 13 to hold the workpiece W on the workpiece holding face of the rubber film 13. In this case, as shown FIGS. 11, it is preferable that a diameter of the backing pad 17 is larger than a diameter of the workpiece W. It is noted to be that FIG. 11 (a) shows the case of the first embodiment and FIG. 11 (b) shows the case of the second embodiment. These structures bring about reducing the influence on the polishing pressure or the polishing shape that occurs by reason that the inflation of the rubber film 13 itself is restricted by the backing pad 17 in the adhering boundary between the baking pad 17 and rubber film 13.

[0035]

However, of course, the diameter of the backing pad 17 needs to be equal to that of the lower face portion of the rubber film 13 on which the backing pad 17 is attached to be provided or to be less than that. In particular, in the case that the retainer ring, which holds the edge portion of the workpiece W, is placed outside the workpiece holding face of the rubber film 13 and the workpiece W is held on the approximately whole of the lower face portion of the rubber film 13, a size of the backing pad cannot be made to be so large. For example, when a silicon wafer having a diameter of 300 mm as the workpiece is polished, the inner diameter of the retainer ring is about 302 mm. In this case, when the diameter of the lower face portion of the rubber film 13 is 301.5 mm or less, the diameter of the baking pad is also 301.5 mm or less.

However, as described above, when the diameter of the baking pad 17 is even slightly larger than that of the workpiece W, the polishing stock removal uniformity of the workpiece W can be more effectively improved.

[0036]

FIG. 3 shows an outline of a polishing apparatus 61 provided with the polishing head 11 described above. The polishing apparatus 61 comprises a polishing pad 22 attached onto a turn table 21 and a polishing agent supply mechanism 66 for providing a polishing agent 65 onto the polishing pad 22 in addition to the polishing head 11.

When the workpiece W is polished using the polishing apparatus 61, first the workpiece W is held on the rubber film 13. In the case that the backing pad 17 is attached to be provided on the rubber film 13, the back surface of the workpiece W can be held on the

rubber film 13 by attaching the workpiece W onto the backing pad 17 containing water. In the case that the retainer ring is placed in the periphery of the rubber film 13, the edge of the workpiece W is held by the retainer ring.

[0037]

Then, the polishing agent 65 is supplied onto the polishing pad 22 through the polishing agent supply mechanism 66, and while the polishing head 11 and the turn table 21 are rotated in predetermined directions respectively, the workpiece W is brought into sliding contact with the polishing pad 22. The front surface of the workpiece W can be polished by pressing the workpiece W held by the rubber film 13 toward the polishing pad 22 on the turn table 21 with a predetermined pressing force while rotating it.

[0038]

When the workpiece W is polished using the polishing apparatus 61 provided with the polishing head 11 as described above, the shape and the pressure distribution of the rubber film 13 can be adjusted by the pressure of the space portion 14. In addition to that, since the lower face portion 12a of the mid plate and the rubber film 13 do not contact one another, the stiffness, the shape of the mid plate or the like has no affect on the rubber film 13 and consequently the workpiece W can be polished with a uniform polishing pressure.

The polishing apparatus in which the polishing head 11 shown in FIG. 3 is replaced with the polishing head 31 shown in FIGS. 2 can achieve the same effects.

[0039]

Hereinafter, Examples and Comparative Example of the present invention are explained.

(Example 1)

The polishing head 11 configured as shown in FIGS. 1 was manufactured as follows.

The rubber film 13 having a thickness of 1 mm of which a diameter of the lower face portion is 300 mm was fit with the mid plate 12 having a outer diameter of 298 mm, and was pinched with the back plate 18 to fix using a screw so that the gap 14a between the lower face portion 12a of the mid plate and rubber film 13 was 0.5 mm. The backing pad 17 having a diameter of 298 mm was attached to be provided on the lower face portion of the rubber film 13. The retainer ring having an inner diameter of 302 mm was placed in the periphery of the rubber film 13.

[0040]

A silicon single crystal wafer having a diameter of 300 mm and a thickness of 775 μm as the workpiece W was polished using the polishing apparatus provided with the polishing head 11 described above as follows. The used silicon single crystal wafer was subjected to first polishing on its both surfaces in advance and its edge portion was also polished. The turn table 21 having a diameter of 800 mm and a usual polishing pad 22 were used.

[0041]

At the polishing, an alkaline solution containing colloidal silica was used as the polishing agent, and the polishing head 11 and the turn table 21 were rotated at 42 rpm and 44 rpm respectively. A polishing load (pressing force) of the workpiece W was set as the pressure of the space portion 14 were 28, 29 and 30 kPa

and the two workpieces were polished with each polishing load respectively. The polishing time was 80 seconds.

[0042]

The polishing stock removal uniformity of the workpiece W polished as described above was evaluated. It is to be noted that the polishing stock removal uniformity is obtained by measuring the thickness of the workpiece before and after the polishing in a region excluding an outermost circumference portion 2-mm width as a flatness quality area in a plane by a flatness measurement instrument and by taking a difference in the polishing stock removal and represented by a formula of polishing stock removal uniformity (%)=(maximum polishing stock removal in the plane-minimum polishing stock removal in the plane)/average polishing stock removal in the plane.

[0043]

The polishing stock removal uniformity of the workpiece obtained from the result is shown in FIG. 5. The obtained polishing stock removal uniformity was about 25 to 30 % and was good.

[0044]

(Example 2)

The polishing head 31 as shown in FIGS. 2 was manufactured as with Example 1 except that the mid plate 12 having an outer diameter of 296 mm was used and the gap 14b between the lower face portion 12b of the mid plate and rubber film 13 was 1 mm.

Silicon single crystal wafers were polished using the polishing head 31 as with Example 1.

The polishing stock removal uniformity of the workpiece obtained from the result is shown in FIG. 5.

The obtained polishing stock removal uniformity was about 15 to 25 % and was further improved in comparison with Example 1.

[0045]

(Comparative Example)

As with Example 1, silicon single crystal wafers were polished using the conventional polishing head 71 as shown in FIGS. 8.

[0046]

The polishing stock removal uniformity of the workpiece obtained from the result is shown in FIG. 5. The obtained polishing stock removal uniformity, which had variation though, was about 50 to 80 % and became worse than Examples 1 and 2.

[0047]

From the results described above, in Example 1 and 2 having the structure of the polishing head according to the present invention, the polishing stock removal uniformity of the workpiece is improved in comparison with the conventional polishing head and the effect of the present invention is clearly achieved.

[0048]

(Example 3)

As with Example 2 described above, except of using the polishing head 31 manufactured in such a manner that the inner diameter of the rubber film side portion 13b was varied in the range of 296.9 to 299.5 mm, a silicon single crystal wafer having a diameter of 300 mm was used as the workpiece W and the one workpiece was polished respectively with the polishing load of 30 kPa. The outer diameter of the rubber film side portion and

the lower portion of the rubber film were 298.9 to 301.5 mm since the thickness of the rubber film was 1 mm. The flatness quality area of the workpiece W was 298 mm in the case of excepting a width of the workpiece outermost peripheral portion of 1 mm and it was 296 mm in the case of excepting a width of the workpiece outermost peripheral portion of 2 mm.

The polishing stock removal uniformity of the workpiece obtained from the result is shown in FIG. 6. There is a tendency that the larger the inner diameter of the rubber film side portion 13b is, the more the polishing stock removal uniformity improve.

[0049]

(Example 4)

As with Example 2 described above, except that the inner diameter of the rubber film side portion 13b was 299.5 mm, the polishing load was 30 kPa and the diameter of the backing pad 17 was varied in the range of 298 to 300.4 mm, a silicon single crystal wafer having a diameter of 300 mm was used as the workpiece W and the one workpiece was polished respectively.

The polishing stock removal uniformity of the workpiece obtained from the result is shown in FIG. 7. The polishing stock removal uniformity was further improved in the case that the diameter of the backing pad 17 is larger than 300 mm, which is the same as the diameter of the workpiece W in this case.

[0050]

The present invention is not restricted to the foregoing embodiment. The embodiment is just an exemplification, and any examples that have

substantially the same feature and demonstrate the same functions and influences as those in the technical concept described in claims of the present invention are included in the technical scope of the present invention.
[0051]

For example, the polishing head according to the present invention is not restricted to the embodiments shown in FIGS. 1 and 2. The shape and the like of the polishing head can be designed as far as the whole of the lower face portion of the mid plate and the rubber film do not contact one another.

The feature of the polishing apparatus is not also restricted to one shown in FIG. 3. The polishing apparatus can comprise a plurality of the polishing heads according to the present invention.

CLAIMS

1. A polishing head having at least: an approximately discoid mid plate; a rubber film covering at least a lower face portion and a side face portion of the mid plate; and a space portion surrounded by the mid plate and the rubber film; in which pressure of the space portion can be changed by a pressure adjustment mechanism, a back surface of a workpiece is held on a lower face portion of the rubber film and a front surface of the workpiece is brought into sliding contact with a polishing pad attached onto a turn table for performing polishing; wherein

the mid plate and the rubber film do not contact one another to have a gap at least throughout a whole of the lower face portion of the mid plate.

2. The polishing head according to claim 1, wherein the gap between the mid plate and the rubber film is less than 1 mm.

3. The polishing head according to claim 1 or claim 2, wherein the mid plate and the rubber film also do not contact one another to have a gap throughout a whole of the side face portion of the mid plate.

4. The polishing head according to any one of claims 1 to 3, wherein an inner diameter of the portion covering the side face portion of the mid plate in the rubber film is larger than a flatness quality area of the workpiece.

5. The polishing head according to any one of claims

1 to 4, wherein the polishing head has a backing pad on the face of the rubber film, the face holding the workpiece.

6. The polishing head according to claim 5, wherein a diameter of the backing pad is larger than that of the workpiece.

7. A polishing apparatus used for polishing a surface of a workpiece at least comprising: a polishing pad attached onto a turn table; a polishing agent supply mechanism for providing a polishing agent to the polishing pad; and a polishing head for holding the workpiece, which is the polishing head according to any one of claims 1 to 6.