A polishing device includes a polishing surface plate which is driven rotatively, a polishing cloth attached on a surface of the polishing surface plate, an abrasive feeding mechanism feeding abrasive on the polishing cloth, a wafer holding mechanism holding a semiconductor wafer, and a guide member arranged on the polishing cloth and having a groove to allow the abrasive to pass therethrough and guide the abrasive to an inward side of the polishing surface plate.
POLISHING DEVICE AND POLISHING METHOD FOR SEMICONDUCTOR WAFER

BACKGROUND OF THE INVENTION

0001) 1. Field of the Invention

0002) The present invention relates to a polishing device and a polishing method for a semiconductor wafer (which is referred to as a “wafer” hereinafter) and, more specifically, to a polishing device and a polishing method for polishing a wafer by holding the wafer with a wafer holding mechanism and pressing the wafer against a polishing member attached on a surface of a rotating polishing surface plate while supplying abrasive on the polishing member.

0003) 2. Description of the Background Art

0004) As the recent design rule of semiconductors becomes finer, efforts have been made to enhance a resolution of lithography. By enhancing the resolution, however, so-called DOF (Depth of Focus) decreases. Though the property of resist must be improved to solve this problem, demands for finer structures actually precede the improvement of resist. Therefore, a method of accurately resolving a fine pattern without defocusing, which compensates for the lack of the DOF by reducing level difference of the device structure, has been considered.

0005) A CMP (Chemical Mechanical Polishing) method, which is an applied method of mirror processing of a silicon wafer, is recently adopted as a method of planarizing a device structure. This method is widely applied in semiconductor manufacture not only for the planarization of the device structure, but also for a metal micromachining in a wiring process of the device.

0006) FIGS. 9 and 10 are schematic diagrams showing an example of a conventional polishing device for performing the CMP.

0007) As shown in FIGS. 9 and 10, the polishing device is generally formed with a polishing surface plate 1 made of a rigid body having a flat surface, a rotation axis 8 and a polishing cloth 2 adhered on a surface thereof, a wafer holding mechanism 4 having a rotation axis 5 and holding a wafer 3, and an abrasive supplying mechanism 6 supplying abrasive 7 to a portion near the center of polishing surface plate 1.

0008) Thus, the surface of wafer 3 is polished by rotating each of polishing surface plate 1 and wafer holding mechanism 4 holding wafer 3, supplying abrasive 7 from abrasive supplying mechanism 6 to the portion near the center of polishing cloth 2, and pressing wafer 3 against polishing cloth 2.

0009) In the conventional polishing device, however, because of a centrifugal force of polishing surface plate 1, most of abrasive 7 supplied to polishing cloth 2 is diffused to periphery of polishing surface plate 1 according to a flow 10 of abrasive shown by an arrow in FIG. 10, and drained from the peripheral portion of polishing cloth 2.

0010) Therefore, only a little amount of abrasive 7 actually contributes for the polishing of wafer 3, and most of expensive abrasive 7 is not used at all or used only once before drained as liquid waste. Thus, the use of abrasive 7 is inefficient, which results in a high cost.

0011) In addition, even when the volume of abrasive 7 is controlled to be minimum, at least the supply volume sufficient to uniformly disperse the abrasive over polishing cloth 2 is necessary to uniformly polish the polishing surface of wafer 3. Therefore, there has been a limitation to reduce a processing cost for a polishing process.

0012) To solve this problem, in Japanese Patent Laying-Open No. 7-156063, a refluxing member is fixedly arranged directly above a polishing cloth to reflux a flow of abrasive on a surface of the polishing cloth, which abrasive expands while flowing because of a centrifugal force, to a central portion of the polishing cloth.

0013) With this method, however, the dispersion of the abrasive on polishing cloth 2 will become non-uniform because all of the abrasive refluxes to the central portion of the polishing cloth due to the refluxing member. Thus, good and uniform polishing of the polishing surface of the wafer is not possible.

SUMMARY OF THE INVENTION

0014) The present invention was made to solve the above-described problem. An object of the present invention is to provide a polishing device and a polishing method which can enhance an efficiency of abrasive use and allow uniform and good polishing of a semiconductor wafer.

0015) A polishing device for a semiconductor wafer according to the present invention includes a polishing surface plate which is driven rotatively, a polishing member attached on a surface of the polishing surface plate, an abrasive supplying mechanism supplying abrasive on the polishing member, a wafer holding mechanism holding a semiconductor wafer on the polishing member, and a guide member arranged on the polishing member and having a groove which allows the abrasive to pass therethrough and guides the abrasive to an inward side of the polishing surface plate.

0016) By setting the guide member as mentioned above on the polishing member, the abrasive can be guided to the inward side of the polishing surface plate after passing through the groove provided on the guide member. Therefore, the amount of the abrasive drained from the periphery of the polishing surface plate after passing through the guide member can be reduced, and much of the abrasive can remain on the polishing member after passing through the guide member.

0017) At least one of wall surfaces of the guide member, which is opposed to the other to define the above-mentioned groove, preferably extends in a direction inclined from a tangential direction of the periphery of the polishing surface plate which is located directly below the guide member to an inward side of the polishing surface plate. As used herein, “a direction inclined to an inward side of the polishing surface plate” refers, for example, to an oblique direction 11 which is inclined from a tangential direction 12 of the polishing surface plate, which is also a rotative direction of the polishing surface plate, to the inward side of the polishing surface plate, as shown in FIG. 4.

0018) The above-mentioned groove has a first aperture located on a side facing the semiconductor wafer, and a second aperture located on a side distant from the semiconductor wafer. In this example, the first aperture preferably
has a larger width than the second aperture. In addition, in the guide member, the above-mentioned groove may be provided on a portion located near the peripheral portion of the polishing surface plate, and may not be provided on a portion located on the central portion of the polishing surface plate. Furthermore, when a plurality of such grooves are provided, it is preferable that the aperture widths of the grooves are made larger in the grooves nearer to the periphery of the polishing surface plate.

[0019] A polishing method for a semiconductor wafer according to the present invention is for polishing a semiconductor wafer by pressing the semiconductor wafer against a polishing member attached on a surface of a rotating polishing surface plate while supplying abrasive on the polishing member. In the method, a guide member is arranged on the polishing member, the guide member guides the abrasive towards a side of the semiconductor wafer while allowing the abrasive to pass through the guide member, and the semiconductor wafer is polished while the abrasive which passed through the guide member is guided to an inward side of the polishing surface plate.

[0020] Therefore, the abrasive can efficiently be supplied to the semiconductor wafer and, in addition, much of the abrasive can remain on the polishing member after passing through the guide member because, the abrasive which has passed through the guide member is guided to the inward side of the polishing surface plate while the abrasive is also guided towards the side of the semiconductor wafer by the guide member, as described above.

[0021] The foregoing and other objects, features, aspects and advantages of the present invention will become more apparent from the following detailed description of the present invention when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] Figs. 1 to 3 are plan views showing polishing devices in first to third embodiments of the present invention, respectively.

[0023] Fig. 4 is a conceptual diagram showing a design concept of a groove in a guide member of the present invention.

[0024] Figs. 5 to 8 are plan views showing different examples of the guide member of the present invention.

[0025] Fig. 9 is a perspective view of a conventional polishing device.

[0026] Fig. 10 is a plan view of a conventional polishing device.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0027] Embodiments of the present invention will now be described with reference to Figs. 1-8.

[0028] First Embodiment

[0029] A polishing device and a polishing method in a first embodiment of the present invention will be described with reference to Figs. 1, 4 and 5.

[0030] As shown in Fig. 1, the polishing device in the first embodiment of the present invention includes a polishing surface plate having a polishing cloth 2, which is a polishing member, adhered on a surface thereof, a wafer holding mechanism 4 holding a wafer and having a rotation axis 5, an abrasive feeding mechanism 6 feeding abrasive 7 on a portion near the center of the polishing surface plate, and a guide member (a collection and dispersion member) 9. It is to be noted that, though a polishing surface plate, a rotation axis rotatively driving the polishing surface plate, and a wafer are not shown in Fig. 1, the shapes thereof are the same as those shown in Fig. 9.

[0031] Guide member 9 is provided on polishing cloth 2, and has a plurality of grooves 9a allowing the abrasive to pass therethrough and guiding the abrasive to the inward side of the polishing surface plate. In addition, in the example shown in Fig. 1, guide member 9 is constructed with board-like members of which two-dimensional shape is rectangular. Groove 9a may be a slit-like recess portion, for example, which extends from one side surface to the other side surface of guide member 9. This groove 9a is provided such as to extend in an oblique direction.

[0032] It is to be noted that, a through hole or a recess portion having an arbitrary shape, for example, can be adopted in place of groove 9a so far as it allows the abrasive to pass through guide member 9. Such through hole or the like should be interpreted as equivalent to groove 9a so far as it has the function equal to that of groove 9a.

[0033] Fig. 5 is a plan view of guide member 9 in the first embodiment seen from the side of groove 9a. As shown in Fig. 5, a plurality of grooves 9a are provided parallel to each other with a space L2. Groove 9a has an aperture 9a1 located on a side facing the wafer and an aperture 9a2 located on a side distant from the wafer. In the example shown in Fig. 5, the widths L1 of apertures 9a1 and 9a2 are the same.

[0034] As shown in Fig. 4, groove 9a extends in oblique direction 11 which is inclined from tangential direction 12 of the periphery of the polishing surface plate to the inward side of the polishing surface plate by a prescribed angle. Herein, tangential direction 12 indicates a direction parallel to the tangent of the periphery of the polishing surface plate which is located directly under guide member 9 as shown in Fig. 4, that is, a direction perpendicular to a center line (shown by a chain line in Fig. 4) in a longitudinal direction of guide member 9.

[0035] With groove 9a extending in oblique direction 11 as described above, abrasive 7 which has passed through guide member 9 within groove 9a can be led to the inward side of the polishing surface plate, and much of abrasive 7 which has passed through guide member 9 can remain on the polishing surface plate.

[0036] With this, contribution of abrasive 7 to the polishing of the wafer is increased, and the same effect as when abrasive 7 is supplied in a larger amount can be obtained. As a result, efficiency in using abrasive 7 can be enhanced, and therefore the consumption of abrasive 7 can be decreased.

[0037] In addition, by providing groove 9a, abrasive 7 can be supplied to the backward side of guide member 9 (forward side in the rotative direction of the polishing surface plate), and also, abrasive 7 which has passed through
guide member 9 can be dispersed uniformly on polishing cloth 2. Therefore, uniform and good polishing of the wafer is possible.

[0038] Furthermore, by arranging a number of grooves 9a with regular intervals, abrasive 7 can be dispersed on polishing cloth 2 more effectively and uniformly, and uniform and good polishing of the wafer is possible.

[0039] If at least one of the side walls of guide member 9, which walls are opposing to define groove 9a, is extended in oblique direction 11 as shown in FIG. 4, abrasive 7 can be guided towards the inside of the periphery of the polishing surface plate. It is especially preferable that the wall surface located on the peripheral side of the polishing surface plate is extended in oblique direction 11 shown in FIG. 4. The angle between oblique direction 11 and tangential direction 12 can be set to any acute angle.

[0040] A polishing method of the present invention will now be described. First, the polishing surface plate is rotationally driven clockwise as shown by an arrow by rotating a rotation axis which is not shown, and wafer holding mechanism 4 holding the wafer is rotated in the same direction by rotating rotation axis 5. Then, abrasive 7 is supplied from abrasive feeding mechanism 6 to the portion near the center of polishing cloth 2 while the above-mentioned guide member 9 is fixed on a predetermined position on polishing cloth 2 with a fixing member which is not shown, and the wafer is pressed against polishing cloth 2 for polishing.

[0041] At this time, abrasive 7, either contributed or not contributed to the polishing, is dispersed to the peripheral side of polishing cloth 2 by the centrifugal force of the polishing surface plate. Then, part of the dispersed abrasive 7 is blocked by one surface of guide member 9 (a side surface facing the wafer) and guided to the side of the wafer (the side of wafer holding mechanism 4 in FIG. 1). Much of the remaining abrasive 7 passes through guide member 9 along groove 9a of guide member 9, and is guided onto polishing cloth 2 on the inward portion of the polishing surface plate. Thus, abrasive 7 which has passed through guide member 9 is uniformly dispersed on the backward side of guide member 9 (opposite to the side where the wafer is set). Therefore, the amount of abrasive 7 which is drained from the periphery of the polishing surface plate can be reduced, and besides, abrasive 7 can be dispersed on polishing cloth 2 again. As a result, efficiency in use of abrasive 7 supplied on polishing cloth 2 is enhanced, and the uniform and good polishing of the wafer is possible.

[0042] The wafer may be polished without rotation in FIG. 1, if desired. In addition, the wafer may be polished while rocking wafer holding mechanism 4.

[0043] Second Embodiment

[0044] A second embodiment of the present invention will be described with reference to FIGS. 2 and 6. As shown in FIGS. 2 and 6, the shape of groove 9a in guide member 9 in the second embodiment is different from that in the first embodiment. The other structures are the same as the first embodiment.

[0045] As shown in FIG. 6, groove 9a has first aperture 9a1 located on a side facing the wafer, and second aperture 9a2 located on a side distant from the wafer. In the second embodiment, the width L12 of first aperture 9a1 is made larger than the width L11 of second aperture 9a2. Therefore, more abrasive 7 can be accepted in groove 9a of guide member 9, and can be made to pass through guide member 9.

[0046] In addition, an outside wall surface of groove 9a which is located on an end portion side of guide member 9 in a longitudinal direction, that is, the peripheral side of the polishing surface plate, is extended in oblique direction 11 as shown in FIG. 4, while an inside wall surface of groove 9a opposing to the outside wall surface is extended in tangential direction 12 as shown in FIG. 4. By extending the outside wall surface of groove 9a in the direction oblique to tangential direction 12 as such, abrasive 7 can be guided inwardly from the peripheral side of the polishing surface plate.

[0047] Third Embodiment

[0048] A third embodiment of the present invention will be described with reference to FIGS. 3 and 7. As shown in FIGS. 3 and 7, the shape and position of groove 9a in guide member 9 in the third embodiment are different from those in the first embodiment. The other structures are the same as the first embodiment.

[0049] As shown in FIG. 3, in the third embodiment, groove 9a is not provided on that portion of guide member 9 which is located on the central portion of the polishing surface plate (a portion shown by lengths L34 and L40 in FIG. 7). With this central portion of guide member 9, abrasive 7 fed on the central portion of the polishing surface plate can be led to the side of the wafer.

[0050] On the other hand, groove 9a is provided on that portion of guide member 9 which is located on the portion near the peripheral portion of the polishing surface plate. As shown in FIG. 7, in the third embodiment, widths L31 and L32 of first aperture 9a1 located on the side of groove 9a facing the wafer are made larger than widths L35 and L37 of second aperture 9a2 located on the side distant from the wafer. With this, more abrasive 7 can be accepted in groove 9a of guide member 9, and can be made to pass through guide member 9.

[0051] In addition, widths L31, L32 and L33 of first aperture 9a1 located on the side facing the wafer are made larger in a portion nearer to the periphery of the polishing surface plate, and widths L35, L37 and L39 of second aperture 9a2 located on the side distant from the wafer are also made larger in a portion nearer to the periphery of the polishing surface plate. With this, abrasive 7 near the periphery of the polishing surface plate can be guided to the inner side of the polishing surface plate.

[0052] In the example shown in FIG. 7, spaces L36 and L38 between adjacent second apertures 9a2 are also made larger in a portion nearer to the periphery of the polishing surface plate. In addition, grooves 9a having the same shapes are formed in symmetrical positions with regard to the center of guide member 9. In FIG. 7, each of L34 and L40 indicates a length from the central portion in a longitudinal direction of guide member 9 to groove 9a located nearest to the center of guide member 9.

[0053] A variation of guide member 9 in the third embodiment will now be described with reference to FIG. 8. As
shown in FIG. 8, groove 9a having the same shape as that in the third embodiment may be formed in that portion of guide member 9 which will be placed near the wafer, and groove 9b having the same shape as that in the second embodiment may be formed in that portion of guide member 9 which will be placed distant from the wafer. That is, features of the embodiments described above may be combined appropriately.

[0054] According to the polishing device and the polishing method of the present invention, because much of the abrasive can remain on the polishing member after passing through the guide member, contribution of the abrasive to the polishing of the wafer is increased, and the same effect as when the abrasive is supplied in a larger amount can be obtained. Therefore, efficiency in use of the abrasive can be enhanced, and the consumption of the abrasive can be decreased. In addition, uniform and good polishing of the wafer is possible because the abrasive which has passed through the guide member can be dispersed again uniformly on the polishing member.

[0055] When at least one of the wall surfaces of the guide member, which surfaces are opposing to define the groove of the guide member, is extended in the direction inclined from a tangential direction of the periphery of the polishing surface plate which is located directly below the guide member to an inward side of the polishing surface plate (for example, oblique direction 11 in FIG. 4), the abrasive which has passed through the groove can be guided to the inside of the polishing surface plate.

[0056] In addition, when the width of the first aperture located on the side of the above-mentioned groove facing the semiconductor wafer is made larger than the width of the second aperture located on the side distant from the semiconductor wafer, more abrasive can be accepted in the groove of the guide member. Therefore, more abrasive can be guided to the inside of the polishing surface plate.

[0057] When the groove is not provided on that portion of the above-mentioned guide member which is located on the central portion of the polishing surface plate, while the above-mentioned groove is provided on that portion which is located on the portion near the periphery of the polishing surface plate, the abrasive can be guided to the side of the semiconductor wafer by the portion without the groove of the guide member, while the abrasive existing near the peripheral portion of the polishing surface plate can be guided to the inside of the polishing surface plate.

[0058] When a plurality of aforementioned grooves are provided on the guide member, and when the widths of the grooves located on the side facing the semiconductor wafer are made larger in a portion nearer to the periphery of the polishing surface plate, the abrasive existing near the periphery of the polishing surface plate can efficiently be guided to the inside of the polishing surface plate.

[0059] Although the present invention has been described and illustrated in detail, it is clearly understood that the same is by way of illustration and example only and is not to be taken by way of limitation, the spirit and scope of the present invention being limited only by the terms of the appended claims.

What is claimed is:

1. A polishing device for a semiconductor wafer, comprising:
   a polishing surface plate driven rotatively;
   a polishing member attached on a surface of said polishing surface plate;
   an abrasive feeding mechanism feeding abrasive on said polishing member;
   a wafer holding mechanism holding a semiconductor wafer on said polishing member; and
   a guide member arranged on said polishing member and having a groove to allow said abrasive to pass therethrough and guide said abrasive to an inward side of said polishing surface plate.

2. The polishing device for a semiconductor wafer according to claim 1, wherein
   at least one of wall surfaces of said guide member, which are opposing to define said groove, is extended in a direction inclined from a tangential direction of a periphery of said polishing surface plate which is located directly below said guide member to an inward side of said polishing surface plate.

3. The polishing device for a semiconductor wafer according to claim 1, wherein
   said groove has a first aperture located on a side facing said semiconductor wafer and a second aperture located on a side distant from said semiconductor wafer, and
   width of said first aperture is made larger than that of said second aperture.

4. The polishing device for a semiconductor wafer according to claim 1, wherein
   said groove is not provided on a portion of said guide member which is located on the central portion of said polishing surface plate, and said groove is provided on a portion which is located on the portion near the periphery of said polishing surface plate.

5. The polishing device for a semiconductor wafer according to claim 1, wherein
   a plurality of said grooves are provided, and widths of said grooves are made larger in a portion nearer to the periphery of said polishing surface plate.

6. A polishing method of polishing a semiconductor wafer, including the step of pressing said semiconductor wafer against a polishing member attached on a surface of a rotating polishing surface plate while supplying abrasive on said polishing member, wherein
   said polishing member has a guide member arranged thereon, the guide member guides said abrasive towards the side of said semiconductor wafer while allowing said abrasive to pass through said guide member, and said semiconductor wafer is polished while guiding said abrasive which has passed through said guide member to an inward side of said polishing surface place.

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