

GRINDING HEAD AND WAFER GRINDING APPARATUS HAVING THE SAME

TECHNICAL FIELD

5 The present disclosure relates to the technical field of wafer grinding, in particular to a grinding head and a wafer grinding apparatus having the same.

BACKGROUND

10 In the chip manufacturing process, chemical mechanical polishing (CMP) process is used as an important planarization technology in the wafer grinding process. However, with the increase in the diameter of the wafer and the gradual reduction in the size of the key features of chips, the processing for high planarization of the chips, uniformity of the wafer surfaces, and consistency becomes more and more difficult. At the same time, in the wafer manufacturing process, the wafer is
15 continuously thickened, especially in the metal and through-hole manufacturing process in the latter stage, and the chemical mechanical polishing (CMP) process is used multiple times to grind the wafer to ensure high flatness of the wafer surface. During the grinding process, if the grinding rate at the wafer edge is too slow, or the material removal rate is too low, the result is that there is a large height difference
20 between the periphery and the center, and the adjacent complete chips will be affected in the subsequent grinding process.

 Existing wafer grinding technologies all fill pressure in a flexible membrane chamber in the grinding head, where the dimension of the flexible membrane chamber is similar to that of the wafer. Through pressure filling, a downward pressure is
25 generated inside the flexible membrane chamber, to grind and polish the wafer on the polishing pad. However, there is only one flexible membrane chamber in the grinding head that is in direct contact with the wafer. There may be partition design of the flexible membrane chamber in the prior art, such that the pressure is filled in the flexible membrane chamber to form different pressure zones; however, with respect to
30 the circular interface, during the pressure filling process, the downward pressure generated by the pressure filling is more uniform in the central area of the flexible membrane mechanism; the closer to the periphery of the flexible membrane chamber, limited by the soft material properties of the flexible membrane chamber, the

peripheral portion of the flexible membrane chamber cannot directly contact the peripheral region of the wafer, resulting in uneven pressure in the peripheral region of the wafer.

5 SUMMARY

Therefore, the technical problem to be solved by the present disclosure is to overcome the defect of uneven pressure in the peripheral region of the wafer in the prior art due to the fact that the peripheral portion of the flexible membrane chamber cannot directly contact the peripheral region of the wafer, thereby providing a grinding head and a wafer grinding apparatus having the same, so that the wafer is more planarized, uniform and consistent after grinding.

To solve the above technical problems, the present disclosure provides a grinding head, including:

a main body, wherein a first flexible membrane chamber and a second flexible membrane chamber are sequentially arranged in the main body along a direction of force application;

a force application structure, at a junction of the first flexible membrane chamber and the second flexible membrane chamber, and extending to be adjacent to an outer periphery of a working surface of the second flexible membrane chamber; the force application structure having: a first state, in which the force application structure exerts a force on the outer periphery of the working surface of the second flexible membrane chamber under air pressure in the first flexible membrane chamber, so that it presses a periphery of a workpiece; and a second state, in which a gap is provided between the force application structure and the outer periphery of the working surface of the second flexible membrane chamber where the first flexible membrane chamber is not pressurized.

Optionally, the force application structure includes a first support member in the first flexible membrane chamber, a pressing member in the second flexible membrane chamber, and a connection assembly for connecting the first support member and the pressing member; wherein the pressing member is movable in the second flexible membrane chamber to press the outer periphery of the working surface of the second flexible membrane chamber.

Optionally, the connection assembly includes a fastener connected to both the first support member and the pressing member, and a limiter sleeved around the fastener; wherein the limiter covers an outer peripheral wall of the first flexible membrane chamber, so as to restrict radial deformation of the first flexible membrane chamber under air pressure.

Optionally, a second support member is sleeved on an outer peripheral wall of the second flexible membrane chamber, so as to restrict radial deformation of the second flexible membrane chamber under air pressure.

Optionally, an end of the pressing member adjacent to the working surface of the second flexible membrane chamber is formed into a flat surface.

Optionally, a first elastic sealing member is arranged between the first support member and the connection assembly, and a second elastic sealing member is arranged between the connection assembly and the pressing member.

Optionally, the first elastic sealing member has an annular boss structure.

Optionally, a difference in filled pressure between the first flexible membrane chamber and the second flexible membrane chamber is less than or equal to 2psi.

Optionally, the filled pressure in the first flexible membrane chamber is 3.5-6.5 psi, and the filled pressure in the second flexible membrane chamber is 1.5-4.5psi.

There is also provided a wafer grinding apparatus, including a grinding head as described in the present disclosure.

The technical solutions of the present disclosure have the following benefits:

1. In the grinding head provided by the present disclosure, the force application structure is arranged at a junction of the first flexible membrane chamber and the second flexible membrane chamber, and extending to be adjacent to an outer periphery of a working surface of the second flexible membrane chamber; the force application structure having: a first state, in which the force application structure exerts a force on the outer periphery of the working surface of the second flexible membrane chamber under air pressure in the first flexible membrane chamber, so that it presses a periphery of a workpiece; and a second state, in which a gap is provided between the force application structure and the outer periphery of the working surface of the second flexible membrane chamber where the first flexible membrane chamber is not pressurized. During grinding of the workpiece, the periphery of the workpiece is pressed by the force application structure with the second flexible membrane

chamber, so that the bottom surface of the second flexible membrane chamber is in complete contact with the workpiece, and the grinding is more uniform. Compared with downward pressure generated by vacuum pressure contact, the downward pressure generated by the rigid force application structure is transmitted faster, with
5 no lag, and high timeliness, so that the workpiece may be more flatly ground.

2. In the grinding head provided by the present disclosure, the force application structure includes a first support member in the first flexible membrane chamber, a pressing member in the second flexible membrane chamber, and a connection assembly for connecting the first support member and the pressing member; wherein
10 the pressing member is movable in the second flexible membrane chamber to press the outer periphery of the working surface of the second flexible membrane chamber. The first flexible membrane chamber and the second flexible membrane chamber are connected through the connection assembly, which ensures the uniformity of downward pressure by the pressing member.

3. In the grinding head provided by the present disclosure, the connection assembly includes a fastener connected to both the first support member and the pressing member, and a limiter sleeved around the fastener; wherein the limiter covers an outer peripheral wall of the first flexible membrane chamber, so as to restrict radial deformation of the first flexible membrane chamber under air pressure. The limiter
20 effectively restricts the radial deformation of the first flexible membrane chamber, so that the first flexible membrane chamber generates constant longitudinal deformation under pressure, and the longitudinal deformation generates a uniform downward pressure, which is effectively transmitted through the limiter to the pressing member. The timeliness of force transmission is further improved, the periphery of the
25 workpiece is effectively pressed, and the pressing uniformity is ensured.

4. In the grinding head provided by the present disclosure, a second support member is sleeved on an outer peripheral wall of the second flexible membrane chamber, so as to restrict radial deformation of the second flexible membrane chamber under air pressure. The second support member effectively restricts the
30 radial deformation of the second flexible membrane chamber, forcing the second flexible membrane chamber to form longitudinal deformation, further improving the timeliness of force transmission, so that the bottom surface of the second flexible

membrane chamber is in contact with the back of the workpiece, improving the flatness of the periphery of the workpiece.

5. In the grinding head provided by the present disclosure, an end of the pressing member adjacent to the working surface of the second flexible membrane chamber is formed into a flat surface. With the flat surface, the contact area between the pressing member and the second flexible membrane chamber is increased, so that the downward pressure generated by the longitudinal deformation of the first flexible membrane chamber is transmitted to the pressing member, and evenly distributed on the workpiece, avoiding damage to the workpiece due to concentration of the downward pressure on one point.

6. In the grinding head provided by the present disclosure, a first elastic sealing member is arranged between the first support member and the connection assembly, and a second elastic sealing member is arranged between the connection assembly and the pressing member. The first elastic sealing member has an annular boss structure. The annular boss structure squeezes the connection assembly, improving the sealing effect; and by embracing the first flexible membrane chamber, it solved the problem that the flexible membrane structure of the grinding head may be deviated from the center during use of the grinding head. The first flexible membrane chamber, under air pressure, exerts a downward force in the vertical direction, and the movement is smooth. At the same time, the amount of tensile deformation of the first flexible membrane chamber is reduced, and the service life and operation stability are improved.

7. In the grinding head provided by the present disclosure, a difference in filled pressure between the first flexible membrane chamber and the second flexible membrane chamber is less than or equal to 2psi. The smaller pressure difference improves the consistency of the process, and prevents the pressing member from overly pressing the workpiece, improving the controllability of the peripheral pressure of the workpiece, and reducing the risk of air leakage during use of the flexible membrane chamber.

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BRIEF DESCRIPTION OF DRAWINGS

In order to more clearly illustrate the embodiments of the present disclosure or the technical solutions in the prior art, the following will briefly describe the drawings

used in the description of the embodiments or the prior art. Clearly, the drawings of the following descriptions are some embodiments of the present disclosure. Those of ordinary skill in the art may obtain other drawings based on these drawings without creative efforts.

5 Fig. 1 is a schematic structural diagram of part of the grinding head.

 Fig. 2 is a schematic structural diagram of the sealing member.

 Reference numerals:

 1-first flexible membrane chamber; 2-first support member; 3-fastener; 4-second flexible membrane chamber;

10 5-pressing member; 6-second support member; 7-third flexible membrane chamber; 8-third support member;

 9-limiter; 10-retaining ring; 11-housing; 12-first elastic sealing member;

 13-second elastic sealing member.

15 **DETAILED DESCRIPTION**

 The technical solutions of the present disclosure will be more clearly and completely described below with reference to the drawings. Clearly, the described embodiments are only some of the embodiments of the present disclosure, not all of the embodiments. Based on the embodiments in the present disclosure, all other
20 embodiments obtainable by those of ordinary skill in the art without creative efforts shall fall within the scope of protection of the present disclosure.

 In the description of the present disclosure, it should be noted that orientation or positional relationship indicated by the terms "center", "upper", "lower", "left", "right", "vertical", "horizontal", "inner", "outer", etc. is based on the orientation or
25 positional relationship as shown in the drawings, only for the convenience of describing and simplifying the description, and does not indicate or imply that the referred apparatus or component must have a specific orientation, or constructed or operated in a specific orientation. Thus, it should not be construed as a limitation of the present disclosure. Further, the terms "first", "second", "third" are used for
30 descriptive purposes only and cannot be construed as indicating or implying relative importance.

 In the description of the present disclosure, it should be noted that, unless otherwise explicitly specified and limited, the terms "mount", "connect" and

"connection" should be construed in a broad sense. For example, it may be a fixed connection or a detachable connection, or integral connection. It may be mechanical connection or electrical connection. It may be direct connection, or indirect connection through an intermediate medium, or internal communication between two components. For those of ordinary skill in the art, the specific meanings of the above terms in the present disclosure can be understood in specific situations.

In addition, the technical features involved in the different embodiments of the present disclosure described below can be combined with each other as long as they do not conflict with each other.

As shown in Fig. 1, a grinding head for grinding wafers, includes a main body and a force application structure.

A first flexible membrane chamber 1, a second flexible membrane chamber 4, and a third flexible membrane chamber 7 are sequentially arranged in the main body along a direction of force application.

The force application structure is arranged at a junction of the first flexible membrane chamber 1 and the second flexible membrane chamber 4, and extending to be adjacent to an outer periphery of a working surface of the second flexible membrane chamber 4. Specifically, the force application structure includes a first support member 2 in the first flexible membrane chamber 1, a pressing member 5 in the second flexible membrane chamber 4, and a fastener 3 for connecting the first support member 2 and the pressing member 5. The fastener 3 is a screw. The fastener 3 is also sleeved with a limiter 9. The limiter 9 has a T-shaped structure, connected to the first support member 2 and the pressing member 5 through screw. The T-shaped structure is placed horizontally, so that the angled part covers the lower end of the side wall of the first flexible membrane chamber 1. The pressing member 5 includes a support part with a groove and a force application part below the support part. The lower end of the screw is fastened in the groove of the support part. The inner ring portion of the support part is in contact with the top of the third flexible membrane chamber 7.

The force application structure has a first state, in which the force application structure exerts a force on the outer periphery of the working surface of the second flexible membrane chamber 4 under air pressure in the first flexible membrane chamber 1, so that it presses a periphery of the workpiece; and a second state, in

which a gap is provided between the force application structure and the outer periphery of the working surface of the second flexible membrane chamber 4 where the first flexible membrane chamber 1 is not pressurized. Specifically, the first state is that when the first flexible membrane chamber 1 is inflated, the first flexible

5 membrane chamber 1 is deformed and drives the first support member 2 to move downward. Because the upper part of the limiter 9 restricts radial deformation of the first flexible membrane chamber 1, and the first support member 2 is connected to the first flexible membrane chamber 1, the first flexible membrane chamber 1 generates a constant longitudinal deformation, and the longitudinal deformation of the first

10 flexible membrane chamber 1 generates a downward pressure which is transmitted to the pressing member 5 located in the second flexible membrane chamber 4 through the limiter 9. The pressing member 5 is forced to move in the second flexible membrane chamber 4 to press the outer periphery of the working surface second flexible membrane chamber 4. In order to ensure that the periphery of the workpiece

15 is not over-pressed, an end of the pressing member 5 adjacent to the working surface of the second flexible membrane chamber 4 is formed into a flat surface. In order to ensure that the working surface of the second flexible membrane chamber 4 is in full contact with the workpiece, a second support member 6 and a third support member 8 are sleeved on the outer circumference of the second flexible membrane chamber 4.

20 The second support member 6 and the third support member 8 restrict the radial deformation of the second flexible membrane chamber 4, and the second support member 6 also restricts the radial deformation of the third flexible membrane chamber 7, forcing the second flexible membrane chamber 4 and the third flexible membrane chambers 7 to form longitudinal deformation, so that the working surface of the

25 second flexible membrane chamber 4 is in contact with the back of the periphery of the workpiece. The downward pressure generated by the longitudinal deformation of the second flexible membrane chamber 4 is transmitted to the third flexible membrane chamber 7, and the third flexible membrane chamber 7 is pressed against the back of the center of the workpiece. The workpiece is an object to be ground or polished, and

30 for example, the workpiece is a wafer. The second state is that when the first flexible membrane chamber 1 is not filled with air, a gap of 0.7-1mm is maintained between the pressing member 5 and the second flexible membrane chamber 4.

To ensure the overall air tightness of the grinding head, as shown in Fig. 2, a first elastic sealing member 12 is provided between the first supporting member 2 and the limiter 9, and the first elastic sealing member 12 has an annular boss structure. The annular boss can further enhance the sealing by squeezing the limiter 9. The boss has a semi-circular structure, and the number of rings of the annular boss is ≥ 2 . A second elastic sealing member 13 is provided between the limiter 9 and the pressing member 5. The second elastic sealing member 13 is an O-shaped sealing ring. An O-shaped sealing ring is also provided between the fastener 3 and the first support member 2, and the area where the fastener 3 contacts the O-shaped sealing ring is a curved surface, to restrict movement of the O-shaped sealing ring, further improving the sealing.

In order to prevent the workpiece from slipping off the grinding head, a retaining ring 10 is provided at the edge of the grinding head housing 11.

During use of the grinding head, it first fills the flexible membrane chambers contacting the wafer with air of different pressures, wherein the filled pressure in the first flexible membrane chamber 1 is 3.5-6.5 psi, and the filled pressure in the second flexible membrane chamber 4 is 1.5-4.5psi; a difference in the filled pressure between the first flexible membrane chamber 1 and the second flexible membrane chamber 4 is controlled to be ≤ 2 psi. When the first flexible membrane chamber 1 is filled with air, the first flexible membrane chamber 1 is deformed. Since the upper part of the limiter 9 restricts the radial deformation of the first flexible membrane chamber 1, the first flexible membrane chamber 1 generates a constant longitudinal deformation, and the downward pressure generated by the longitudinal deformation of the first flexible membrane chamber 1 drives the first support member 2 to move downward. Since the first support member 2 and the pressing member 5 are connected by the fastener 3, the downward pressure generated by the longitudinal deformation of the first flexible membrane chamber 1 is transmitted to the pressing member 5, so that the pressing member 5 moves in the second flexible membrane chamber 4. The bottom end of the pressing member 5 presses the outer periphery of the working surface of the second flexible membrane chamber 4. The working surface of the second flexible membrane chamber 4 is in contact with the wafer edge. Air is injected into the second flexible membrane chamber 4, and the second flexible membrane chamber 4 is deformed. Since the outer peripheral wall of the second flexible membrane chamber 4 is sleeved

with the second support member 6, the second support member 6 restricts the radial deformation of the second flexible membrane chamber 4 under air pressure, causing longitudinal deformation of the second flexible membrane chamber 4. Because the bottom end of the pressing member 5 exerts a force on the working surface of the second flexible membrane chamber 4, it helps the working surface of the second flexible membrane chamber 4 to be in full contact with the back of the wafer. At the same time, the downward force generated by the second flexible membrane chamber 4 due to the action of the air is transmitted to the third flexible membrane chamber 7. Since the second support member 6 restricts the radial deformation of the third flexible membrane chamber 7, the third flexible membrane chamber 7 is deformed longitudinally, so that the working surface of the third flexible membrane chamber 7 contacts the center of the wafer.

There is also provided a wafer grinding apparatus, including a grinding head as described.

As an alternative embodiment, the force application structure is an integrally formed press strip penetrating the first flexible membrane chamber 1 and the second flexible membrane chamber 4 at the same time, and the lower end of the press strip is formed with an inclined surface.

As an alternative embodiment, the limiter 9 and the second supporting member 6 are both annular, and are sleeved around the first flexible membrane chamber 1 and the second flexible membrane chamber 4, respectively.

As an alternative embodiment, the annular boss may also be of an oval, or other shaped, structure.

Clearly, the above embodiments are only examples for clear description, and are not intended to limit the manner of implementation. For those of ordinary skill in the art, there are other variations or changes that can be made in different forms based on the above description. It is not necessary or possible to exhaust all embodiments here. The obvious variations or changes derived therefrom are still within the scope of protection of the present disclosure.

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CLAIMS

1. A grinding head, comprising:

a main body, wherein a first flexible membrane chamber (1) and a second flexible membrane chamber (4) are sequentially arranged in the main body along a direction of force application; and

a force application structure, at a junction of the first flexible membrane chamber (1) and the second flexible membrane chamber (4), and extending to be adjacent to an outer periphery of a working surface of the second flexible membrane chamber (4); the force application structure having: a first state, in which the force application structure exerts a force on the outer periphery of the working surface of the second flexible membrane chamber (4) under air pressure in the first flexible membrane chamber (1), so that it presses a periphery of a workpiece; and a second state, in which a gap is provided between the force application structure and the outer periphery of the working surface of the second flexible membrane chamber (4) where the first flexible membrane chamber (1) is not pressurized;

wherein the force application structure comprises a first support member (2) in the first flexible membrane chamber (1), a pressing member (5) in the second flexible membrane chamber (4), and a connection assembly for connecting the first support member (2) and the pressing member (5); wherein the pressing member (5) is movable in the second flexible membrane chamber (4) to press the outer periphery of the working surface of the second flexible membrane chamber (4);

wherein the connection assembly comprises a fastener (3) connected to both the first support member (2) and the pressing member (5), and a limiter (9) sleeved around the fastener (3); wherein the limiter (9) covers an outer peripheral wall of the first flexible membrane chamber (1), so as to restrict radial deformation of the first flexible membrane chamber (1) under air pressure.

2. The grinding head according to claim 1, wherein a second support member (6) is sleeved on an outer peripheral wall of the second flexible membrane chamber (4), so as to restrict radial deformation of the second flexible membrane chamber (4) under air pressure.

3. The grinding head according to claim 1 or 2, wherein an end of the pressing member (5) adjacent to the working surface of the second flexible membrane chamber (4) is formed into a flat surface.

4. The grinding head according to any one of claims 1 to 3, wherein a first elastic sealing member (12) is arranged between the first support member (2) and the connection assembly, and a second elastic sealing member (13) is arranged between the connection assembly and the pressing member (5).

5 5. The grinding head according to claim 4, wherein the first elastic sealing member (12) has an annular boss structure.

6. The grinding head according to any one of claims 1 to 5, wherein a difference in filled pressure between the first flexible membrane chamber (1) and the second flexible membrane chamber (4) is less than or equal to 2psi.

10 7. The grinding head according to claim 6, wherein the filled pressure in the first flexible membrane chamber (1) is 3.5-6.5 psi, and the filled pressure in the second flexible membrane chamber (4) is 1.5-4.5psi.

8. A wafer grinding apparatus, comprising a grinding head according to any one of claims 1 to 7.

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