

CLEANING METHOD

[0001] The present application claims the priority to the Chinese Patent Application No. 202211640937.6, titled "CLEANING METHOD", filed on December 20, 2022 with the
5 China National Intellectual Property Administration, which is incorporated herein by reference in its entirety.

FIELD

[0002] The present application relates to the technical field of workpiece cleaning, and in
10 particular to a cleaning device and a cleaning method.

BACKGROUND

[0003] During the production process of a wafer, the manufacturing equipment processes the wafer. After that, the surface of the wafer is often contaminated with swarf and other
15 impurities. Therefore, it is necessary to clean the wafer to remove these adherent impurities.

[0004] Current cleaning devices clean the wafer by spraying cleaning water. On the one hand, the cleaning effect is unsatisfactory, and on the other hand, the cleaning water adheres to the wafer surface after cleaning, which is difficult to remove.

SUMMARY

[0005] In order to solve the above technical problems, a cleaning device and a cleaning method are provided according to the present application, which can improve the cleaning effect and reduce or eliminate cleaning water adhering to the surface of a component to be cleaned.

25 **[0006]** A cleaning method is provided according to the present application, which is carried out by a swinging water pipe and an atomizing nozzle and a gas nozzle that are provided on the swinging water pipe. The cleaning method includes the following steps:

[0007] controlling a cleaning platform to rotate to drive a workpiece to be cleaned to rotate, where the workpiece to be cleaned is fixed on the cleaning platform;

[0008] supplying water and gas to the atomizing nozzle to spray water mist through the atomizing nozzle onto an upper surface of the workpiece to be cleaned, where the swinging water pipe swings such that the upper surface of the workpiece to be cleaned is within a cleaning range of the atomizing nozzle; and

- 5 **[0009]** stopping the supply of water and gas to the atomizing nozzle, and supplying gas to the gas nozzle to inject the gas through the gas nozzle onto the upper surface of the workpiece to be cleaned, where the swinging water pipe keeps swinging.

[0010] In a specific embodiment, the step of supplying water and gas to the atomizing nozzle includes:

- 10 **[0011]** supplying gas to the atomizing nozzle, and then supplying water to the atomizing nozzle.

[0012] In a specific embodiment, the step of stopping the supply of water and gas to the atomizing nozzle includes:

- 15 **[0013]** stopping the supply of water to the atomizing nozzle, and then stopping the supply of gas to the atomizing nozzle.

[0014] In a specific embodiment, the cleaning method further includes:

[0015] adjusting an angle of the gas nozzle before the gas is supplied to the gas nozzle.

[0016] In a specific embodiment, the angle of the gas nozzle is adjusted during the supply of gas to the gas nozzle.

- 20 **[0017]** In a specific embodiment, a gas pressure in the atomizing nozzle ranges from 0.6 MPa to 0.8 MPa, and a water pressure in the atomizing nozzle ranges from 0.2 MPa to 0.4 MPa.

- 25 **[0018]** In a specific embodiment, the swinging water pipe is controlled to swing back and forth when the atomizing nozzle sprays the water mist and when the gas nozzle injects the gas.

[0019] In the present application, when cleaning the workpiece to be cleaned, water mist is firstly sprayed onto the upper surface of the workpiece through the atomizing nozzle to remove swarf and other impurities on the upper surface. While the atomizing nozzle sprays the water mist onto the workpiece to be cleaned, the swinging water pipe swings to ensure

that the atomizing nozzle can clean any area of the upper surface of the workpiece. To enhance the cleaning effect, the atomizing nozzle swings back and forth above the workpiece. After cleaning, the atomizing nozzle is turned off, and gas is supplied to the gas nozzle to be injected through the gas nozzle onto the upper surface of the workpiece to be cleaned while
5 keeping the swinging water pipe swinging, thereby removing water droplets from the upper surface of the workpiece. This reduces or prevents the cleaning water from adhering to the upper surface of the workpiece to be cleaned. The water mist sprayed by the atomizing nozzle can easily rinse off debris particles, and the water adhering to the upper surface of the workpiece to be cleaned is more likely to form into water droplets. Compared with water
10 stains left by flushing water, water droplets are easier to be blown away and dried by the gas nozzle.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] FIG. 1 is a flowchart of a cleaning method according to an embodiment of the
15 present application;

[0021] FIG. 2 is a schematic view of a cleaning device according to an embodiment of the present application;

[0022] FIG. 3 is an enlarged view of a part A in FIG. 2; and

[0023] FIG. 4 is a schematic view of an adjusting plate in FIG. 3.

20 **[0024]** Reference numerals in FIGS. 1 to 4 are listed as follows:

1	cleaning platform,	2	swinging water pipe,
21	first pipe body,	22	second pipe body,
3	gas nozzle,	4	atomizing nozzle,
5	first connector,	6	mounting assembly,
25	61 fixing block,	611	clamp,
	612 blocking plate,	62	adjusting plate,
	62a arc-shaped groove,	62b	third mounting hole,
	62c fixing hole,	63	third bolt,

64	first bolt,	65	second bolt,
7	second connector,	8	third connector.

DETAILED DESCRIPTION OF THE EMBODIMENTS

5 [0025] In order to enable those skilled in the art to better understand the solutions of the present application, the present application is described in further detail below in conjunction with the accompanying drawings and specific embodiments.

[0026] Reference is made to FIGS. 1 and 2. FIG. 1 is a flowchart of a cleaning method according to an embodiment of the present application, and FIG. 2 is a schematic view of a
10 cleaning device according to an embodiment of the present application.

[0027] The cleaning device in this embodiment includes a cleaning platform 1 for supporting a workpiece to be cleaned, such as a wafer. Accordingly, the cleaning platform 1 may include a circular surface as shown in FIG. 2. Certainly, the workpiece to be cleaned may be other components that require cleaning, and the workpiece to be cleaned can be fixed onto
15 the cleaning platform 1. The cleaning device further includes a swinging water pipe 2, and an atomizing nozzle 4 and a gas nozzle 3 that are arranged on the swinging water pipe 2. The atomizing nozzle 4 is communicated with both the swinging water pipe 2 and a gas line. The swinging water pipe 2 supplies water to the atomizing nozzle 4, while the gas line supplies gas to the atomizing nozzle 4. The high-speed gas flow and water are mixed to cause
20 atomization. For example, the high-speed gas drives the water to collide, producing fog-like particles, i.e., the desired water mist. Additionally, the gas nozzle 3 is communicated with the gas line, that is, the gas nozzle 3 is used solely for injecting gas flow. The swinging water pipe 2 can swing horizontally above the cleaning platform 1, correspondingly driving the atomizing nozzle 4 and the gas nozzle 3 to swing above the cleaning platform 1, which may
25 be a reciprocating swing during the cleaning process.

[0028] When cleaning the workpiece to be cleaned, the water mist may firstly be sprayed onto an upper surface of the workpiece supported by the cleaning platform 1 through the atomizing nozzle 4 to remove swarf and other impurities from the upper surface of the workpiece. While the atomizing nozzle 4 is spraying water mist onto the workpiece, the
30 swinging water pipe 2 may swing synchronously, causing the atomizing nozzle 4 to swing above the workpiece, thereby ensuring that the atomizing nozzle 4 can clean any area of the

upper surface of the workpiece to be cleaned. The swinging water pipe 2 may swing back and forth to enhance the cleaning effect. After cleaning, the atomizing nozzle 4 is turned off, and the gas is supplied to the gas nozzle 3 to be injected onto the upper surface of the workpiece to be cleaned through the gas nozzle 3 while the swinging water pipe 2 keeps swinging. Since the swinging water pipe 2 keeps swinging, the gas nozzle 3 also swings above the workpiece to be cleaned, blowing away water droplets on the upper surface of the workpiece to be cleaned, thereby reducing or preventing the cleaning water from adhering to the upper surface of the workpiece. Similarly, the swinging water pipe 2 can swing reciprocally to make it easier to blow away the water droplets on the upper surface of the workpiece to be cleaned, thereby improving the drying effect and efficiency.

[0029] The specific steps of the cleaning method may be understood with reference to FIG. 1, and the cleaning method includes the following steps.

[0030] The cleaning platform 1 is controlled to rotate, thereby driving the workpiece to be cleaned, which is fixed on the cleaning platform 1, to rotate.

[0031] Water and gas are supplied to the atomizing nozzle 4 to spray water mist onto the upper surface of the workpiece to be cleaned through the atomizing nozzle 4. The swinging water pipe 2 swings such that the upper surface of the workpiece to be cleaned is within a cleaning range of the atomizing nozzle 4.

[0032] The supply of water and gas to the atomizing nozzle 4 is stopped, and a gas is supplied to the gas nozzle 3 to be injected onto the upper surface of the workpiece to be cleaned through the gas nozzle 3 while the swinging water pipe 2 keeps swinging.

[0033] As a further solution, during the step of supplying water and gas to the atomizing nozzle 4, the gas is supplied to the atomizing nozzle 4 before the water. By supplying the gas first and then the water to the atomizing nozzle 4, the cleaning water can be prevented from splashing.

[0034] The step of stopping the supply of water and gas to the atomizing nozzle 4 includes stopping the supply of water to the atomizing nozzle 4 first, and then stopping the supply of gas. Similarly, stopping the supply of water and gas in this order may also prevent the cleaning water from splashing.

[0035] Reference is further made to FIG. 3. FIG. 3 is an enlarged view of a part A in FIG. 2.

[0036] The cleaning device in this embodiment further includes a mounting assembly 6. The gas nozzle 3 is fixed to the swinging water pipe 2 through the mounting assembly 6, and an angle of the gas nozzle 3 relative to the mounting assembly 6 is adjustable, so as to change the angle and position of the gas nozzle 3 pointing towards the workpiece to be cleaned. Since the angle of the gas nozzle 3 is adjustable, the gas nozzle 3 can be adjusted to the demanded angle for blowing based on process requirements after the water mist cleaning. This ensures that the range of gas injection of the gas nozzle 3 covers the entire upper surface of the workpiece to be cleaned during the swinging of the swinging water pipe 2, and the water droplets can be effectively blown away and dried in this blowing angle, thus more efficiently meeting the drying requirements.

[0037] As shown in FIG. 3, the mounting assembly 6 specifically includes a fixing block 61, which is fixed to the swinging water pipe 2. The fixing block 61 may be a sleeve structure with a through-hole, which is arranged around and fixed to the swinging water pipe 2. Alternatively, as shown in FIG. 3, the fixing block 61 includes a clamp 611 with an opening on one side and a blocking plate 612. The swinging water pipe 2 can be engaged into the clamp 611 from the opening, and the opening of the clamp 611 is blocked by the blocking plate 612. The blocking plate 612 and the clamp 611 may be fixed by one or more third bolts 63. In FIG. 3, two third bolts 63 are provided, so as to reliably secure the fixing block 61 to the swinging water pipe 2, and the fixing operation is relatively convenient. Certainly, the fixing block 61 fixed to the swinging water pipe 2 may be of other structural forms, such as a closed clamp, which will not be listed herein.

[0038] Based on the above cleaning method, before supplying gas to the gas nozzle 3, the angle of the gas nozzle 3 is adjusted properly according to process requirements. The specific structure for adjusting the angle of the gas nozzle 3 can be further understood with reference to FIGS. 3 and 4. FIG. 4 is a schematic view of an adjusting plate 62 in FIG. 3.

[0039] In this embodiment, the mounting assembly 6 further includes an adjusting plate 62. The fixing block 61 is provided with a first mounting hole and a second mounting hole, and the adjusting plate 62 includes an arc-shaped groove 62a and a third mounting hole. The mounting assembly 6 further includes a first bolt 64 and a second bolt 65. The gas nozzle 3 is mounted on the adjusting plate 62. The first bolt 64 is inserted into the arc-shaped groove 62a and the first mounting hole, and the second bolt 65 is inserted into the third mounting hole

and the second mounting hole. By adjusting the relative position of the first bolt 64 and the arc-shaped groove 62a, the angle of the gas nozzle 3 can be adjusted. After the angle is adjusted to the proper position, the first bolt 64 and the second bolt 65 are tightened. This method for adjusting the angle of the gas nozzle 3 is simple and low in cost.

5 **[0040]** As shown in FIG. 4, the adjusting plate 3 includes a first plate body 621, a second plate body 622, and a third plate body 623. The first plate body 621 is bent relative to the second plate body 622, and the third plate body 623 is bent relative to the second plate body 622. The third mounting hole 62b and the arc-shaped groove 62a are provided on the first plate body 62a. The third plate body 623 is provided with a fixing hole 62c, and the gas
10 nozzle 3 is inserted in the fixing hole 62c and fixed to the third plate body 623. Specifically, the gas nozzle 3 is provided with a screw that passes through the fixing hole 62c and is secured by a nut. With this arrangement, as shown in FIG. 3, the first plate body 621 may be fixed to a side portion of the fixing block 61, and the third plate body 623 may be substantially horizontal, allowing for angle adjustment as the relative position of the first bolt
15 64 and the arc-shaped groove 62a changes.

[0041] In addition to adjusting the angle of the gas nozzle 3 through a mechanical structure, a driving mechanism may be provided to drive the gas nozzle 3 to adjust its angle. For example, the driving mechanism includes a motor, which may be equipped with a corresponding speed-reduction mechanism to drive the gas nozzle 3 to rotate, thereby
20 adjusting its angle. The angle may be adjusted before the drying process and remain unchanged during the drying process, or the driving mechanism may drive the gas nozzle 3 to change its angle while the swinging water pipe 2 swings reciprocally, allowing the angle of the gas nozzle 3 to be more flexibly adjusted as needed during the drying process. As such, it is possible to blow away and dry the water droplets on the upper surface of the workpiece to
25 be cleaned more efficiently and completely. It is understandable that there are various ways to adjust the angle of the gas nozzle 3, which will not be specifically limited in this embodiment.

[0042] Specifically, with reference to FIG. 3, the cleaning device further includes a first connector 5, which connects the atomizing nozzle 4 to an end portion of the swinging water pipe 2, thereby facilitating the supply of water from the swinging water pipe 2 to the
30 atomizing nozzle 4. The cleaning device further includes a second connector 7, which connects the atomizing nozzle 4 to the gas line. The gas line may include a first pipeline (not

shown in the figures), which is connected to a compressed gas source to supply a compressed gas to the atomizing nozzle 4. The first connector 5 and the second connector 7 may be located on opposite sides of the atomizing nozzle 4 respectively, and an outlet of the atomizing nozzle 4 is located on a lower side of the atomizing nozzle 4 as shown in FIG. 3.

5 This arrangement is more conducive to the connections of the gas line and the water line, and is also more compact in structure.

[0043] With reference to FIG. 3 again, the cleaning device in this embodiment further includes a third connector 8, which is located at a top of the gas nozzle 3, and an outlet of the gas nozzle 3 is located on a lower side of the gas nozzle 3. The third connector 8 is connected
10 to the gas line, which may include a second pipeline (not shown in the figures). The second pipeline may also be connected to the compressed gas source, that is, the gas source can provide gas to the atomizing nozzle 4 through the first pipeline and to the gas nozzle 3 through the second pipeline.

[0044] Specifically, the gas nozzle 3 is located approximately in the middle of the swinging water pipe 2. One end of the swinging water pipe 2 is connected to the atomizing nozzle 4,
15 and the other end of the swinging water pipe 2 may be connected to a driving device, which drives the swinging water pipe 2 to swing back and forth. The gas nozzle 3 is fixed between two ends of the swinging water pipe 2 through the mounting assembly 6, making it less likely to interfere with the atomizing nozzle 4. There may be a certain spacing between the gas
20 nozzle 3 and the atomizing nozzle 4, and the specific mounting position of the gas nozzle 3 is not limited.

[0045] A cleaning device is further provided according to an embodiment of the present application, which includes the aforementioned cleaning device. The cleaning device further includes a cleaning tank (not shown in the figures). The cleaning device in the above
25 embodiment is located in the cleaning tank. In this case, the swinging water pipe 2 includes a first pipe body 21 and a second pipe body 22, and an angle between an axis of the first pipe body 21 and an axis of the second pipe body 22 ranges from 130 degrees to 135 degrees. Since the swinging water pipe 2 is bent in a certain angle, it can roughly fit the shape of the wall of the cleaning tank, allowing the cleaning device to be mounted on the inner side of the
30 cleaning tank with less space occupancy.

[0046] As shown in FIG. 3, the gas nozzle 3 is located at one end of the first pipe body 21

that is in connection with the second pipe body 22, and the atomizing nozzle 4 is located at the other end of the first pipe body 21. By arranging the gas nozzle 3 at this position, it is possible to ensure that the gas nozzle 3 can adequately cover the upper surface of the workpiece to be cleaned, so that the gas is injected at an appropriate angle.

5 **[0047]** In this embodiment, when the atomizing nozzle 4 swings relative to the swinging water pipe 2, the atomizing nozzle 4 can pass through the middle of the cleaning platform 1. This helps to ensure that the water mist can cover the entire surface of the cleaning platform 1, allowing for more comprehensive cleaning of the workpiece to be cleaned on the cleaning platform 1, resulting in thorough and uniform cleaning effects. The gas nozzle 3 blows to dry,
10 and its angle is adjustable, so that it does not need to pass through the middle of the cleaning platform 1.

[0048] Additionally, in this embodiment, a gas pressure in the atomizing nozzle 4 ranges from 0.6 MPa to 0.8 MPa, and a water pressure in the atomizing nozzle 4 ranges from 0.2 MPa to 0.4 MPa. Under these gas and water pressures, the diameter of the water mist particles
15 sprayed by the atomizing nozzle 4 can reach about 5 μ m to 10 μ m, leading to excellent cleaning results.

[0049] Furthermore, in this embodiment, when the atomizing nozzle 4 sprays water mist and the gas nozzle 3 injects gas, the swinging water pipe 2 is controlled to swing back and forth. This reciprocal swing allows the water mist and gas to be sprayed back and forth above the
20 workpiece to be cleaned, thereby improving the cleaning and drying effects.

[0050] Specific embodiments are used herein to describe the principle and implementation of the present application, and the description of the above embodiments is only used to help understand the method and the core idea of the present application. It should be noted that, several improvements and modifications may be made to the present application by those
25 skilled in the art without departing from the principle of the present application, and these improvements and modifications also fall within the protection scope of the claims of the present application.

CLAIMS

1. A cleaning method, which is carried out by a swinging water pipe and an atomizing nozzle and a gas nozzle that are provided on the swinging water pipe, wherein the cleaning
5 method comprises the following steps:

controlling a cleaning platform to rotate to drive a workpiece to be cleaned to rotate, wherein the workpiece to be cleaned is fixed on the cleaning platform;

supplying water and gas to the atomizing nozzle to spray water mist through the atomizing nozzle onto an upper surface of the workpiece to be cleaned, wherein the swinging
10 water pipe swings such that the upper surface of the workpiece to be cleaned is within a cleaning range of the atomizing nozzle; and

stopping the supply of water and gas to the atomizing nozzle, and supplying gas to the gas nozzle to inject the gas through the gas nozzle onto the upper surface of the workpiece to be cleaned, wherein the swinging water pipe keeps swinging.

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2. The cleaning method according to claim 1, wherein the step of supplying water and gas to the atomizing nozzle comprises:

supplying gas to the atomizing nozzle, and then supplying water to the atomizing nozzle.

20 3. The cleaning method according to claim 1, wherein the step of stopping the supply of water and gas to the atomizing nozzle comprises:

stopping the supply of water to the atomizing nozzle, and then stopping the supply of gas to the atomizing nozzle.

25 4. The cleaning method according to any one of claims 1 to 3, further comprising adjusting an angle of the gas nozzle before the gas is supplied to the gas nozzle.

5. The cleaning method according to any one of claims 1 to 3, wherein an angle of the

gas nozzle is adjusted during the supply of gas to the gas nozzle.

6. The cleaning method according to any one of claims 1 to 3, wherein a gas pressure in the atomizing nozzle ranges from 0.6 MPa to 0.8 MPa, and a water pressure in the atomizing
5 nozzle ranges from 0.2 MPa to 0.4 MPa.

7. The cleaning method according to any one of claims 1 to 3, wherein the swinging water pipe is controlled to swing back and forth when the atomizing nozzle sprays the water mist and when the gas nozzle injects the gas.