

WAFER CLEANING APPARATUS AND WAFER CLEANING METHOD

TECHNICAL FIELD

[0001]

The present invention relates to a wafer cleaning apparatus and a wafer cleaning method.

BACKGROUND ART

[0002]

A wafer cleaning apparatus as shown in FIG. 2 is known. In FIG. 2, a cleaning apparatus 20 is constituted of: a chamber 23 including an inlet section 21 through which a gas is supplied, and an outlet section 22 through which the gas is exhausted; a table 25 for supporting and rotating a wafer 24; and a cup unit 26 for collecting or discharging a spread chemical solution.

[0003]

The cup unit 26 for collecting or discharging a spread chemical solution needs to be lowered to a position lower than the wafer 24 in order to convey the wafer, and is provided with an elevator mechanism.

[0004]

In the gas flow path from the inlet section 21 to the outlet section 22 in the cleaning apparatus 20 of FIG. 2, the gas flows only in a one-way direction via the inside of the cup unit 26.

[0005]

In this case, to convey the wafer, the cup unit 26 needs to be lowered to a position lower than the wafer 24. In such a conventional wafer cleaning apparatus, when the cup unit 26 is lowered, the distance between the table unit 25 and the cup unit 26 is shortened, and

the gas flow path is restricted. By this influence, the pressure above the table unit 25 in the chamber 23 is increased, and the gas flow from the inlet section 21 is disturbed, so that the gas is whirled up.

[0006]

As a result of the change in the gas flow, a mist generated during cleaning diffuses inside the chamber 23, bringing about a problem of wafer contamination.

[0007]

To solve these problems, adjusting the gas supply amount by electronic control (see Patent Document 1) has been proposed. However, when the supply amount is adjusted by electronic control, it is impossible to make a quick response, and consequently the pressure variation occurs.

CITATION LIST

PATENT LITERATURE

[0008]

Patent Document 1: Japanese Unexamined Patent Application Publication No. 2008-060107

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0009]

The present invention has been made in view of the above-described problems. An object of the present invention is to provide a wafer cleaning apparatus and a wafer cleaning method which do not allow gas flow path to greatly change between when a cup unit is raised and when the cup unit is lowered, thereby keeping the pressure in a chamber constant.

SOLUTION TO PROBLEM

[0010]

To achieve the object, the present invention provides a wafer cleaning apparatus in which a wafer held on a rotatable table disposed in a chamber is rotated and cleaned with a chemical solution, wherein

the chamber includes an inlet section where a gas is supplied into the chamber and an outlet section where the gas is exhausted, and

the wafer cleaning apparatus comprises:

a cup unit disposed to surround the table holding the wafer, and configured to move vertically and to catch the chemical solution scattered away from the rotating wafer after cleaning; and

a shield plate disposed outside the cup unit, extending inwardly from an inner wall of the chamber, and shaped to have a central hole.

[0011]

Such a wafer cleaning apparatus makes it possible to keep the pressure in the chamber constant without greatly changing the gas flow path between the events of raising and lowering the cup unit. This enables superior quality cleaning of wafer in comparison with conventional cleaning apparatuses. Moreover, with the inventive wafer cleaning apparatus, a wafer can be cleaned without requiring flow amount control on the inlet side.

[0012]

In this case, the shield plate is preferably installed at a position lower than a height position of the wafer held by the table.

[0013]

Such a wafer cleaning apparatus allows wafer

conveyance without problems.

[0014]

Moreover, in this case, the hole of the shield plate preferably has an inner diameter equal to or larger than an inner diameter of the cup unit and equal to or smaller than an outer diameter thereof.

[0015]

Such a wafer cleaning apparatus increases the gas discharge efficiency when the cup unit is raised, and can enhance the wafer quality.

[0016]

More preferably, in this case, the shield plate completely blocks a space provided between the shield plate and the cup unit when the cup unit is raised.

[0017]

Such a wafer cleaning apparatus can further enhance the wafer quality by increasing the discharge efficiency when the cup unit is raised.

[0018]

Further, in this case, the shield plate preferably satisfies a condition that a sum of an exhaust sectional area 2 and an exhaust sectional area 3 is equal to or larger than an exhaust sectional area 1, where

the exhaust sectional area 1 is an area of a space which is formed between the table and the cup unit when the cup unit is raised,

the exhaust sectional area 2 is an area of a space which is formed between the table and the cup unit when the cup unit is lowered, and

the exhaust sectional area 3 is an area of a space which is formed between the shield plate and the cup unit when the cup unit is lowered.

[0019]

With such a wafer cleaning apparatus, when the cup unit is raised, the gas velocity at the table perimeter is maintained by forming a small clearance therearound. In contrast, when the cup unit is lowered, a large clearance is formed so that the gas velocity at the table perimeter can be slowed. This makes it possible to prevent attachment of residual mist to a wafer, which is otherwise caused by eddy flow.

[0020]

Furthermore, in this case, the cup unit preferably has a space between the table and an upper end of the cup unit when the cup unit is lowered.

[0021]

Such a wafer cleaning apparatus makes it possible to prevent whirling up of residual mist when the cup unit is lowered.

[0022]

Furthermore, in this case, an upper portion of the cup unit is preferably inwardly inclined or R-shaped.

[0023]

Such a wafer cleaning apparatus is capable of favorably catching the chemical solution after cleaning, and does not allow the exhaust flow path, through which the gas from the inlet in the upper portion of the chamber flows to an area below the table, to change between the events of raising and lowering the cup unit.

[0024]

In addition, the present invention provides a wafer cleaning method with the above-described wafer cleaning apparatus, the method comprising

cleaning a wafer with a gas flow inside the chamber being regulated by the shield plate.

[0025]

Such a wafer cleaning method makes it possible to keep the pressure in the chamber constant without greatly changing the gas flow path between the events of raising and lowering the cup unit. This enables superior quality cleaning of wafer in comparison with conventional cleaning methods. Moreover, according to such a wafer cleaning method, a wafer can be cleaned without necessarily requiring flow amount control on the inlet side.

ADVANTAGEOUS EFFECTS OF INVENTION

[0026]

The inventive wafer cleaning apparatus and wafer cleaning method hardly change the gas flow path from the inlet section to the outlet section between the events of the upward and downward movements of the cup unit, and suppress the pressure variation in the chamber, thereby successfully eliminating the possibility of whirling up of residual mist after cleaning. Accordingly, wafers with higher quality can be obtained than those cleaned with conventional wafer cleaning apparatuses. Moreover, the inventive wafer cleaning apparatus and wafer cleaning method make it possible to provide a wafer cleaning apparatus and a wafer cleaning method that do not require flow amount control on the inlet side.

BRIEF DESCRIPTION OF DRAWINGS

[0027]

FIG. 1 shows drawings for illustrating an example of a wafer cleaning apparatus according to the present invention. (a) illustrates when a cup unit is raised, and (b) illustrates when the cup is lowered.

FIG. 2 shows drawings for illustrating an example of a conventional wafer cleaning apparatus. (a) illustrates when a cup unit is raised, and (b) illustrates when the cup is lowered.

FIG. 3 shows drawings for illustrating: exhaust flow paths in the inventive wafer cleaning apparatus, (a) when the cup unit is raised, and (b) when the cup is lowered (Example); and exhaust flow paths in the conventional wafer cleaning apparatus, (c) when the cup unit is raised, and (d) when the cup is lowered (Comparative Example).

FIG. 4 is a graph showing the number of defects increased after cleaning in Example and Comparative Example.

FIG. 5 is a graph showing the pressure variations inside chambers in Example and Comparative Example.

DESCRIPTION OF EMBODIMENTS

[0028]

As stated above, there have been problems that electronic control of the intake amount of gas through an inlet section cannot sufficiently suppress pressure variation, so that generated mist contaminates a wafer.

[0029]

Accordingly, in order to solve the above problems, the present inventors have keenly studied and consequently found that a wafer cleaning apparatus in which a shield plate formed to have a central hole is disposed outside a cup unit configured to catch a chemical solution enables superior quality wafer cleaning in comparison with conventional wafer cleaning apparatuses. This finding has led to the present invention.

[0030]

Specifically, the inventive apparatus is a wafer cleaning apparatus in which a wafer held on a rotatable table disposed in a chamber is rotated and cleaned with a chemical solution, wherein

the chamber includes an inlet section where a gas is supplied into the chamber and an outlet section where the gas is exhausted, and

the wafer cleaning apparatus comprises:

a cup unit disposed to surround the table holding the wafer, and configured to move vertically and to catch the chemical solution scattered away from the rotating wafer after cleaning; and

a shield plate disposed outside the cup unit, extending inwardly from an inner wall of the chamber, and shaped to have a central hole.

[0031]

Hereinafter, the present invention will be specifically described, but the present invention is not limited thereto.

[0032]

First, the wafer cleaning apparatus of the present invention will be described. FIG. 1 shows schematic drawings for illustrating an example of the inventive wafer cleaning apparatus.

[0033]

In a wafer cleaning apparatus 10, a wafer 14 is held on a table 15 that is driven to rotate. While the wafer 14 is rotated, the wafer 14 is cleaned with a chemical solution. During cleaning, a gas is introduced into a chamber 13 through an inlet section 11, and exhausted through an outlet section 12.

[0034]

Moreover, a cup unit 16 configured to move vertically is disposed to surround the table 15. The cup unit 16 is configured to catch a chemical solution scattered away from the rotating wafer 14 after cleaning.
[0035]

In this situation, outside the cup unit 16, a shield plate 17 is disposed which extends inwardly from an inner wall of the chamber 13 and is shaped to have a central hole. Installing such a shield plate 17 makes it possible to eliminate the pressure variation inside the chamber quite easily, and thus clean a wafer to a higher quality state.
[0036]

To put it differently, in the conventional wafer cleaning apparatus 20, when the cup unit 26 is raised, a spread chemical solution is collected or discharged, while a gas is exhausted through an exhaust flow path D in FIG. 2(a) and FIG. 3(c). Meanwhile, when the cup unit 26 is lowered, an exhaust flow path E formed between the table 25 and the cup unit 26 in FIG. 2(b) and FIG. 3(d) is so narrow that the gas flow path is restricted. Hence, when the cup unit 26 is raised and lowered, the pressure in the chamber 23 varies, and residual mist generated during cleaning is whirled up, causing wafer contamination.
[0037]

According to the inventive wafer cleaning apparatus 10, a narrow exhaust flow path A is formed so as to maintain the gas velocity at the perimeter of the table 15 when the cup unit 16 is raised. Meanwhile, when the cup unit 16 is lowered, a large clearance is formed from an exhaust flow path B and an exhaust flow path C along an outer circumference of the cup unit 16

so as to decrease the gas velocity at the perimeter of the table 15. Thus, the pressure in the chamber can be kept constant with little change in the gas flow path between when the cup unit 16 is raised and when the cup unit 16 is lowered. This makes it possible to suppress the wafer contamination with generated mist.

[0038]

Furthermore, in the inventive wafer cleaning apparatus, since the pressure inside the chamber hardly varies, the supply amount does not necessarily have to be adjusted, so that a wafer can be cleaned more easily.

[0039]

The height position where the shield plate 17 is installed is not particularly limited, but is preferably installed at a position lower than a height position of the wafer 14 held by the table 15. With such height position, the shield plate does not interfere when a wafer is carried in and out. Accordingly, the wafer can be conveyed without problems.

[0040]

The shape of the shield plate 17 is not particularly limited, but the hole thereof preferably has an inner diameter equal to or larger than an inner diameter of the cup unit 16 and equal to or smaller than an outer diameter thereof. The shield plate shaped in this manner increases the gas discharge efficiency when the cup is raised, and can enhance the wafer quality.

[0041]

Moreover, the shield plate 17 preferably completely blocks a space provided between the shield plate 17 and the cup unit 16 when the cup unit 16 is raised. The shield plate shaped in this manner increases the discharge efficiency when the cup is

raised, and can enhance the wafer quality.

[0042]

The shield plate 17 preferably satisfies a condition that a sum of an exhaust sectional area 2 and an exhaust sectional area 3 is equal to or larger than an exhaust sectional area 1. Here, the exhaust sectional area 1 is an area of the exhaust flow path A which is shown in FIG. 1(a) and FIG. 3(a), and formed between the table 15 and the cup unit 16 when the cup unit 16 is raised. The exhaust sectional area 2 is an area of the exhaust flow path B which is shown in FIG. 1(b) and FIG. 3(b), and formed between the table 15 and the cup unit 16 when the cup unit 16 is lowered. The exhaust sectional area 3 is an area of the exhaust flow path C which is shown in FIG. 1(b) and FIG. 3(b), and formed between the shield plate 17 and the cup unit 16 when the cup unit 16 is lowered. The inventive wafer cleaning apparatus including such a shield plate 17 maintains the gas velocity at the table perimeter by forming a small clearance therearound when the cup unit is raised. Meanwhile, when the cup unit is lowered, a large clearance is formed so that the gas velocity at the table perimeter can be slowed. This makes it possible to prevent attachment of residual mist to a wafer, which is otherwise caused by eddy flow. In this case, as the sum of the exhaust sectional area 2 and the exhaust sectional area 3, the value at most 3.0 times as large as the exhaust sectional area 1 is sufficient.

[0043]

The cup unit 16 preferably has a space between the table 15 and an upper end of the cup unit 16 when the cup unit 16 is lowered. Such a cup unit makes it possible to prevent whirling up of residual mist when

the cup unit 16 is lowered.

[0044]

In this case, an upper portion of the cup unit 16 is preferably inwardly inclined or R-shaped. With such a cup unit, the exhaust flow path through which a gas from the inlet section 11 in the upper portion of the chamber 13 flows downwardly to the table 15 does not change when the cup unit 16 is raised and lowered. Specifically, when the cup unit 16 is lowered, a gas flows not only through the exhaust flow path B along the inner circumferential portion of the cup unit 16 but also through the exhaust flow path C along the outer circumferential portion of the cup unit. Nevertheless, this exhaust flow path is not greatly different from the exhaust flow path A for the event of raising the cup.

[0045]

Next, a wafer cleaning method according to the present invention will be described. The inventive wafer cleaning method employs the wafer cleaning apparatus 10 to clean the wafer 14 with a gas flow inside the chamber 13 being regulated by the shield plate 17.

[0046]

In a conventional wafer cleaning method, the pressure in the chamber varies when the cup unit 26 is raised and lowered, so that residual mist generated during cleaning is whirled up and contaminates a wafer. In contrast, according to the inventive wafer cleaning method, the pressure variation can be eliminated quite easily, and a wafer can be cleaned to a higher quality state.

[0047]

Moreover, in the conventional wafer cleaning

method, the gas supply amount needs to be adjusted. In contrast, according to the inventive wafer cleaning method, since the pressure inside the chamber 13 hardly varies, the supply amount adjustment is not necessarily required, and wafer can be cleaned more easily.

[0048]

Further, according to the inventive wafer cleaning method, the pressure inside the chamber 13 can also be kept constant because the exhaust flow path through which a gas from the inlet section in the upper portion of the chamber 13 flows downwardly to the table 15 does not change between when the cup unit 16 is raised and when the cup unit 16 is lowered.

EXAMPLE

[0049]

Hereinafter, description will be given more specifically with reference to Example of the present invention. However, the present invention is not limited thereto.

[0050]

(Example)

Using the inventive wafer cleaning apparatus as shown in FIG. 1, wafers were cleaned.

[0051]

After final polishing and cleaning, five wafers were used to measure defects on the surface in advance. Further, the wafers were cleaned, and then the surface defects were measured again. Evaluation was performed only from incremental defects relative to the pre-measured defects. The measurements were performed using Surfscan SP5 manufactured by KLA-Tencor to measure defects with particle sizes of 19 nm or more.

[0052]

(Comparative Example)

The measurements were performed using five wafers as in Example, except that the conventional wafer cleaning apparatus as shown in FIG. 2 was used to clean the wafers.

[0053]

FIG. 4 shows the results of the number of defects increased after cleaning in Example and Comparative Example.

[0054]

As shown in FIG. 4, in Example, the number of defects increased after cleaning was smaller than that in Comparative Example, and particles did not increase during the drying.

[0055]

Moreover, FIG. 5 shows the result of the pressure variations in the chambers when the cup units were raised and lowered in the cleaning treatments of Example and Comparative Example.

[0056]

As shown in FIG. 5, in Comparative Example, when the cup unit was lowered, the pressure in the chamber was increased and then stayed. In contrast, in Example, the pressure in the chamber hardly varied. Similarly, when the cup unit was raised, the pressure varied greatly in Comparative Example because the pressure in the chamber was decreased. Meanwhile, in Example, such pressure variation hardly occurred.

[0057]

It should be noted that the present invention is not limited to the above-described embodiments. The embodiments are just examples, and any examples that

have substantially the same feature and demonstrate the same functions and effects as those in the technical concept disclosed in claims of the present invention are included in the technical scope of the present invention.

CLAIMS

1. A wafer cleaning apparatus in which a wafer held on a rotatable table disposed in a chamber is rotated and cleaned with a chemical solution, wherein

the chamber includes an inlet section where a gas is supplied into the chamber and an outlet section where the gas is exhausted, and

the wafer cleaning apparatus comprises:

a cup unit disposed to surround the table holding the wafer, and configured to move vertically and to catch the chemical solution scattered away from the rotating wafer after cleaning; and

a shield plate disposed outside the cup unit, extending inwardly from an inner wall of the chamber, and shaped to have a central hole.

2. The wafer cleaning apparatus according to claim 1, wherein the shield plate is installed at a position lower than a height position of the wafer held by the table.

3. The wafer cleaning apparatus according to claim 1 or 2, wherein the hole of the shield plate has an inner diameter equal to or larger than an inner diameter of the cup unit and equal to or smaller than an outer diameter thereof.

4. The wafer cleaning apparatus according to any one of claims 1 to 3, wherein the shield plate completely blocks a space provided between the shield plate and the cup unit when the cup unit is raised.

5. The wafer cleaning apparatus according to any one of claims 1 to 4, wherein

the shield plate satisfies a condition that a sum of an exhaust sectional area 2 and an exhaust sectional area 3 is equal to or larger than an exhaust sectional area 1, where

the exhaust sectional area 1 is an area of a space which is formed between the table and the cup unit when the cup unit is raised,

the exhaust sectional area 2 is an area of a space which is formed between the table and the cup unit when the cup unit is lowered, and

the exhaust sectional area 3 is an area of a space which is formed between the shield plate and the cup unit when the cup unit is lowered.

6. The wafer cleaning apparatus according to any one of claims 1 to 5, wherein the cup unit has a space between the table and an upper end of the cup unit when the cup unit is lowered.

7. The wafer cleaning apparatus according to any one of claims 1 to 6, wherein an upper portion of the cup unit is inwardly inclined or R-shaped.

8. A wafer cleaning method with the wafer cleaning apparatus according to any one of claims 1 to 7, the method comprising

cleaning a wafer with a gas flow inside the chamber being regulated by the shield plate.