WAFER PROCESSING METHOD AND WAFER PROCESSING APPARATUS

FIELD OF THE INVENTION

The present application relates to the technical field of semiconductors, and specifically relates to a wafer processing method and a wafer processing apparatus.

BACKGROUND

In integrated circuit manufacturing, wafer processing equipment is required for performing processes such as etching and cleaning on wafers. Existing wafer processing equipment mainly places a wafer on a chuck, rotates the wafer while spraying a processing liquid onto the surface of the wafer to implement process treatment. Specifically, as shown in FIG. 1, the wafer processing equipment comprises a chuck 2 for carrying a wafer 1, a driving member 3 for driving the chuck 2 to rotate, and a nozzle 4 for supplying the processing liquid. During the processing of wafer 1, the nozzle 4 sprays the processing liquid onto the wafer 1, and the driving member 3 drives the chuck 2 to rotate.

Due to the height difference existing between the nozzle 4 and the wafer 1 when the nozzle 4 supplies the processing liquid to the wafer 1, the processing liquid usually impacts the wafer 1 at a certain velocity under the action of gravity. This not only easily causes splashing of the processing liquid, which exerts a certain impact on the processing of the wafer 1 and the chamber environment, but in severe cases, the impact of the processing liquid on the wafer 1 may also induce defects on the wafer 1.

SUMMARY

Embodiments of the present application provide a wafer processing method and a wafer processing apparatus, which can alleviate the problem of processing liquid splashing.

In one aspect, the present application provides a wafer processing method, comprising: rotating a wafer; supplying a processing liquid to the rotation center of the wafer through a nozzle, so as to form a localized liquid film on the surface of the wafer; before the localized liquid film diffuses to the edge of the wafer, moving the nozzle and continuously supplying the processing liquid, so that the liquid landing point of the processing liquid moves from the rotation center of the wafer to a first position.

Specifically, the nozzle is moved before the localized liquid film diffuses to the first position.

Specifically, the nozzle is moved when the localized liquid film diffuses to a second position, such that when the liquid landing point reaches the first position, the distance between the localized liquid film and the rotation center of the wafer is greater than or equal to the distance between the first position and the rotation center of the wafer, and the second position is located between the rotation center of the wafer and the first position.

Specifically, the nozzle continuously supplies the processing liquid.

Specifically, the nozzle supplies the processing liquid for a preset duration to the rotation center of the wafer, such that the localized liquid film diffuses to the second position when the nozzle starts to move.

Specifically, the method further comprises: acquiring a time t1 for the liquid landing point to move from the rotation center of the wafer to the first position, and a time t2 for the localized liquid film to diffuse from the rotation center of the wafer to the first position, wherein the preset duration t satisfies $t = t2 - t1$.

Specifically, the method further comprises: acquiring a volume of the processing liquid required for the localized liquid film to cover the second position, when the volume of the processing liquid required for the localized liquid film to cover the second position is supplied at the rotation center of the wafer, the nozzle stopping supplying the processing liquid.

Specifically, the wafer processing method further comprises: after the liquid landing point reaches the first position, making the nozzle reciprocate between the rotation center of the wafer and the first position.

Specifically, the velocity at which the liquid landing point moves from the rotation center to the first position is less than the velocity at which the liquid landing point moves from the first position to the rotation center.

Specifically, the velocity of the liquid landing point gradually decreases when the liquid landing point moves from the rotation center to the first position; the velocity of the liquid landing point gradually increases when the liquid landing point moves from the first position to the rotation center.

Specifically, the wafer processing method further comprises: after the liquid landing point reaches the first position, moving the nozzle to shift the liquid landing point from the first position to a third position, and making the nozzle reciprocate between the first position and the third position, wherein the third position and the first position are symmetric about the rotation center of the wafer.

In the wafer processing method of the present application, a localized liquid film is formed on the surface of the wafer before the nozzle moves, and the nozzle is moved before the localized liquid film diffuses to the edge of the wafer. This enables at least part of the processing liquid sprayed by the nozzle to fall onto the localized liquid film, which reduces splashing of the processing liquid, and also shortens the superposition duration of the processing liquid at the rotation center of the wafer at the same time, thereby achieving uniform processing of the wafer.

In another aspect, the present application provides a wafer processing apparatus, comprising: a controller; a rotating unit, electrically connected to the controller, and configured to rotate a wafer; a supply unit, electrically connected to the controller, and including a nozzle, wherein the supply unit is configured to supply a processing liquid to the rotation center of the wafer through the nozzle under the control of the controller, so as to form a localized liquid film on the surface of the wafer; a moving unit, electrically connected to the controller, and connected to the nozzle, wherein the

moving unit is configured to move the nozzle and continuously supply the processing liquid before the localized liquid film diffuses to the edge of the wafer under the control of the controller, so that the liquid landing point of the processing liquid moves from the rotation center of the wafer to a first position.

Other characteristics and advantages of the present application will become apparent through the following detailed description, or may be partially learned through practice of the present application.

It should be understood that the foregoing general description and the following detailed description are merely exemplary and explanatory, and shall not be construed as limiting the present application.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated into and constitute a part of this specification, illustrate embodiments consistent with the present application, and together with the specification, serve to explain the principles of the present application. Obviously, the accompanying drawings described below merely illustrate some embodiments of the present application, and those of ordinary skill in the art may obtain other accompanying drawings from these accompanying drawings without making creative efforts. In the accompanying drawings:

FIG. 1 is a schematic structural diagram of a wafer processing equipment according to an implementation mode of an embodiment of the present application;

FIG. 2 schematically illustrates a flowchart of a wafer processing method according to an implementation mode of an embodiment of the present application;

FIG. 3 schematically illustrates a schematic diagram of nozzle movement according to an implementation mode of an embodiment of the present application;

FIG. 4 schematically illustrates a flowchart of a wafer processing method according to an implementation mode of an embodiment of the present application;

FIG. 5 schematically illustrates a schematic diagram of nozzle movement according to an implementation mode of an embodiment of the present application;

FIG. 6 schematically illustrates a block diagram of a wafer processing apparatus according to an implementation mode of an embodiment of the present application.

PREFERRED EMBODIMENTS OF THE INVENTION

Exemplary embodiments will now be described more comprehensively with reference to the accompanying drawings. However, the exemplary embodiments can be implemented in various forms and shall not be construed as limited to the examples set forth herein; instead, these embodiments are provided to render the present application more comprehensive and complete, and to fully convey the concept of the exemplary embodiments to those skilled in the art.

In addition, the features, structures, or characteristics described may be combined in any suitable manner in one or more embodiments. In the following description, numerous specific details are provided to give a thorough understanding of the embodiments of the present application. However, those skilled in the art will recognize that the technical solutions of the present application may be practiced without one or more of these specific details, or using other methods, assemblies, apparatuses, steps, etc. In other cases, well-known methods, apparatuses, implementations, or operations are not shown or described in detail to avoid obscuring various aspects of the present application.

With reference to FIGS. 2 to 5, the present application provides a wafer processing method executable by a wafer processing equipment shown in FIG. 1. In this application, the processing liquid may be a cleaning liquid, an etching liquid, or other liquids used in wet processing. By way of example, the processing liquid may include hydrofluoric acid (HF), sulfuric acid-hydrogen peroxide mixture (SPM), diluted sulfuric acid-hydrogen peroxide mixture (DSP), ammonia-hydrogen peroxide-water mixture (SC1), high-purity phosphoric acid (H_3PO_4), and the like. The wafer processing method of the present application can alleviate the problem of splashing of the processing liquid during wet processing of a wafer 1.

As shown in FIG. 2, the wafer processing method provided by an embodiment of the present application comprises the following steps:

Step S110: Rotate the wafer 1, and supply the processing liquid to the rotation center of the wafer through a nozzle 4, so as to form a localized liquid film on the surface of the wafer 1.

The wafer 1 is placed on a chuck 2 of the wafer processing equipment, and the wafer 1 horizontally rotates around the vertical axis on the chuck 2, with the center of the wafer serving as the rotation center of the wafer. The nozzle 4 is aligned with the rotation center of the wafer while supplying the processing liquid, such that the liquid landing point of the processing liquid from the nozzle 4 falls on the rotation center of the wafer. Under the centrifugal force generated by the rotation of the wafer 1, the processing liquid diffuses from the rotation center of the wafer 1 toward the edge of the wafer 1, so that the processing liquid reaches a position closer to the edge of the wafer than the rotation center of the wafer, thereby forming the localized liquid film. The area of the localized liquid film is larger than the area of liquid droplets formed on the wafer 1 by the liquid landing point of the nozzle 4 during movement of the nozzle 4, such that the liquid landing point is located inside the localized liquid film during movement of the nozzle 4. Compared to the scenario where the liquid landing point directly contacts the solid wafer 1, this arrangement can reduce splashing of the processing liquid generated by the impact of the processing liquid on the wafer 1. The liquid landing point of the nozzle 4 refers to the position where the processing liquid from the nozzle 4 lands on the wafer 1. Reference may be made to FIG. 3 or FIG. 5 for the movement of the nozzle 4. The nozzle 4 moves from the rotation center of the wafer toward a direction away from the rotation center of the wafer, and then reciprocates within a certain range from the rotation center of the wafer.

Step S120: Before the localized liquid film diffuses to the edge of the wafer, move the nozzle 4 and continuously supply the processing liquid, so that the liquid landing point of the processing liquid moves from the rotation center of the wafer to a first position 5.

After the nozzle 4 supplies the processing liquid for a preset duration at the rotation center of the wafer, the nozzle 4 is moved. That is, the nozzle 4 stays at the rotation center of the wafer and supplies the processing liquid for a preset duration. The preset duration is longer than the time required for nozzle 4 to pass through each position on the wafer 1 during movement, so that a localized liquid film is formed at the rotation center of the wafer; meanwhile, the preset duration is shorter than the time required for the localized liquid film to diffuse to the edge of the wafer. The movement condition of the nozzle 4 is determined by controlling the supply duration, so that the nozzle 4 is moved before the localized liquid film diffuses to the edge of the wafer. The processing liquid is continuously supplied by the nozzle 4 during formation of the localized liquid film, after formation of the localized liquid film and before movement of the nozzle 4, and during movement of the nozzle 4. The time required for the localized liquid film to diffuse to the edge of the wafer is obtained through pre-testing, wherein pre-test conditions are identical to actual processing conditions of the wafer 1, and an average value may be taken after multiple tests under identical conditions. The time required for nozzle 4 to pass through each position on the wafer 1 during movement is set according to processing requirements. The flow rate of the processing liquid supplied when the nozzle 4 is stationary or when the nozzle 4 is moving, the type of the processing liquid, the height of the nozzle 4, and other conditions may be set as required; all conditions except the movement velocity of the nozzle 4 may remain identical. During the movement of the nozzle 4, the movement velocity of the liquid landing point is higher than the diffusion velocity of the localized liquid film.

In one implementation mode of the embodiment of the present application, the nozzle 4 is moved after supplying a preset volume of the processing liquid at the rotation center of the wafer. The preset volume is larger than the volume of liquid droplets at the liquid landing point of the processing liquid when the nozzle 4 passes through each position on the wafer 1 during movement, so that a localized liquid film is formed at the rotation center of the wafer; meanwhile, the preset volume is smaller than the volume of the processing liquid required for the localized liquid film to diffuse to the edge of the wafer. The movement condition of the nozzle 4 is determined by controlling the supply volume, so that the nozzle 4 is moved before the localized liquid film diffuses to the edge of the wafer. The processing liquid is continuously supplied

by the nozzle 4 during formation of the localized liquid film and movement of the nozzle 4, while the nozzle 4 stops supplying the processing liquid after formation of the localized liquid film and before movement of the nozzle 4. The volume of the processing liquid required for the localized liquid film to diffuse to the edge of the wafer is obtained through pre-testing, wherein pre-test conditions are identical to actual processing conditions of the wafer 1, and an average value may be taken after multiple tests under identical conditions.

The wafer processing equipment further comprises an outer housing, and the chuck 2 and the nozzle 4 are arranged inside the outer housing. The first position 5 is located between the rotation center of the wafer and the edge of the wafer, and is determined with reference to the outer housing. Therefore, the positional relationship between the first position 5 and the nozzle 4 does not change with the rotation of the wafer 1. The first position 5 is determined according to the processing requirements and splashing conditions of the processing liquid. The distance from the first position 5 to the rotation center of the wafer may range from 10 mm to 70 mm, preferably 20 mm to 40 mm, such as 25 mm, 30 mm, or 35 mm.

In one implementation mode of the embodiment of the present application, the movement velocity of the nozzle 4 may be constant. In another implementation mode of the embodiment of the present application, the movement velocity of the nozzle 4 may be variable. By way of example, the velocity may gradually decrease when the nozzle 4 moves from the rotation center of the wafer to the first position 5. The processing liquid closer to the edge of the wafer is more prone to splashing under centrifugal force, and the inventors have found that the splashing of processing liquid becomes more severe as the movement velocity of the nozzle 4 increases. Therefore, appropriately reducing the movement velocity of the nozzle 4 at a position closer to the edge of the wafer can reduce splashing of the processing liquid.

Moving the nozzle 4 before the localized liquid film diffuses to the edge of the wafer, compared with moving the nozzle 4 after the localized liquid film fully covers the wafer 1, can, while forming the localized liquid film to reduce splashing of the processing liquid, also reduce the supply duration or volume of the processing liquid

at the rotation center of the wafer during the formation of the localized liquid film, thereby making the duration or volume of the processing liquid at the rotation center position of the wafer closer to the duration or volume at other positions on the wafer 1, thus increasing the uniformity of processing of the wafer 1.

Further, moving the nozzle 4 before the localized liquid film diffuses to the first position 5 further reduces the duration or volume of the processing liquid at the rotation center of the wafer and improves processing uniformity of the wafer 1.

Still further, the nozzle 4 is moved when the localized liquid film diffuses to a second position 6, such that when the liquid landing point reaches the first position 5, the distance between the localized liquid film and the rotation center of the wafer is equal to the distance between the first position 5 and the rotation center of the wafer. This enables the localized liquid film and the liquid landing point to reach the first position 5 simultaneously. Since the movement velocity of the liquid landing point is higher than the diffusion velocity of the localized liquid film, the localized liquid film is always positioned ahead of the liquid landing point during movement of the liquid landing point from the rotation center of the wafer to the first position 5, that is, the liquid landing point moves entirely within the localized liquid film, which can further reduce splashing of the processing liquid. The second position 6 is located between the rotation center of the wafer and the first position 5, and lies on the movement trajectory of the nozzle 4 when the nozzle 4 moves from the first position 5 to the second position 6. The second position 6 is determined with reference to the outer housing, and the positional relationship between the first position 5 and the nozzle 4 does not change with the rotation of the wafer 1. In another implementation mode of the embodiment of the present application, the nozzle 4 is moved when the localized liquid film diffuses to the second position 6, such that when the liquid landing point reaches the first position 5, the distance between the localized liquid film and the rotation center of the wafer is greater than the distance between the first position 5 and the rotation center of the wafer. This enables the localized liquid film to reach the first position 5 prior to the liquid landing point, and also allows the liquid landing point to move entirely within the localized liquid film, which can further reduce splashing of the processing liquid.

Specifically, the nozzle 4 supplies the processing liquid for a preset duration to the rotation center of the wafer, such that the localized liquid film diffuses to the second position 6 when the nozzle 4 starts to move. Specifically, a time t1 for the liquid landing point to move from the rotation center of the wafer to the first position 5 and a time t2 for the localized liquid film to diffuse from the rotation center of the wafer to the first position 5 are acquired, and the preset duration t satisfies $t = t2 - t1$. The time t1 for the liquid landing point to move from the rotation center of the wafer to the first position 5 is obtained through calculation or pre-testing, and the time t2 for the localized liquid film to diffuse to the first position 5 is obtained through pre-testing, wherein pre-test conditions are identical to actual processing conditions of the wafer 1, and an average value may be taken after multiple tests under identical conditions. By way of example, when calculating the time for the liquid landing point to move from the rotation center of the wafer to the first position 5 with constant velocity movement of the nozzle 4, the time of the liquid landing point to move from the rotation center of the wafer to the first position 5 is equal to the quotient of the distance between the rotation center of the wafer and the first position 5 divided by the movement velocity of the nozzle 4.

Table 1 records splashing conditions of the processing liquid after processing the wafer 1 for 3 hours with DSP as the processing liquid, constant movement velocity of the nozzle 4 of 100 mm/s, the first position 5 located 70 mm from the rotation center of the wafer, and preset durations of 1 s, 3 s, 5 s, and 7 s, respectively, wherein the time required for the localized liquid film to diffuse from the rotation center of the wafer to the first position 5 is 2.3 s. It can be seen that a favorable splashing condition is achieved with a preset duration of 3 s.

Table 1

Serial Number	**Nozzle Velocity**	**Scanning Range**	**Duration**	**Processing Liquid**	**Splashing Condition**

1	100 mm/s	70 mm	1 s	DSP	Liquid splashing
2	100 mm/s	70 mm	3 s	DSP	No liquid splashing
3	100 mm/s	70 mm	5 s	DSP	No liquid splashing
4	100 mm/s	70 mm	7 s	DSP	No liquid splashing

In one implementation mode of the embodiment of the present application, a volume of the processing liquid required for the localized liquid film to cover the second position 6 is acquired. When the volume of the processing liquid required for the localized liquid film to cover the second position 6 is supplied at the rotation center of the wafer, the nozzle 4 stops supplying the processing liquid. The volume of the processing liquid required for the localized liquid film to diffuse to the second position 6 is obtained through pre-testing, wherein pre-test conditions are identical to actual processing conditions of the wafer 1, and an average value may be taken after multiple tests under identical conditions.

With continued reference to FIG. 2, Step S130: After the liquid landing point reaches the first position 5, make the nozzle 4 reciprocate between the rotation center of the wafer and the first position 5.

FIG. 3 schematically illustrates a schematic diagram of the reciprocating movement of the nozzle 4 between the rotation center of the wafer and the first position 5. The nozzle 4 may reciprocate at a constant velocity between the rotation center of the wafer and the first position 5. Reciprocating movement of the nozzle 4 between the rotation center of the wafer and the first position 5 continues until the thickness of the processing liquid on the wafer 1 meets requirements, until the processing of the wafer 1 is completed, or until other termination conditions are satisfied.

Table 2 records splashing conditions of the processing liquid after processing the wafer 1 for 3 hours with DSP as the processing liquid, movement velocity of the nozzle 4 of 100 mm/s, fixed duration of 1 s for the processing liquid sprayed by the nozzle 4 to the rotation center of the wafer 1, and the first position 5 located 40 mm, 30 mm, and 20 mm from the rotation center of the wafer, respectively. It can be seen that a favorable splashing condition of the processing liquid is achieved when the nozzle 4 reciprocates between the rotation center of the wafer and the first position 5.

Table 2

Serial Number	**Nozzle Velocity**	**Scanning Range**	**Duration**	**Processing Liquid**	**Splashing Condition**
1	100 mm/s	Single-side 40 mm	1 s	DSP	No liquid splashing
2	100 mm/s	Single-side 30 mm	1 s	DSP	No liquid splashing
3	100 mm/s	Single-side 20 mm	1 s	DSP	No liquid splashing

In one implementation mode of the embodiment of the present application, the nozzle 4 may move at a variable velocity during reciprocation between the rotation center of the wafer and the first position 5. The velocity may gradually decrease when the nozzle 4 moves from the rotation center of the wafer to the first position 5, and gradually increase when the nozzle 4 moves from the first position 5 to the rotation center of the wafer. The processing liquid closer to the edge of the wafer is more prone to splashing under centrifugal force, and the inventors have found that the splashing of the processing liquid becomes more severe as the movement velocity of the nozzle 4 increases. Therefore, appropriately reducing the movement velocity of the nozzle 4 at a position closer to the edge of the wafer can reduce splashing of the processing liquid.

In one implementation mode of the embodiment of the present application, the nozzle 4 may move at a variable velocity during reciprocation between the rotation center of the wafer and the first position 5. The velocity of the nozzle 4 at which the nozzle 4 moves from the rotation center of the wafer to the first position 5 is less than the velocity at which the nozzle 4 moves from the first position 5 to the rotation center of the wafer. That is, the velocity of the nozzle 4 at which the nozzle 4 moves from the rotation center of the wafer to a position away from the rotation center is less than the velocity at which the nozzle 4 moves from a position away from the rotation center toward the rotation center of the wafer. Due to centrifugal force, the processing liquid on the wafer 1 always diffuses outward, and the liquid splashing is more severe during movement from the rotation center of the wafer toward the edge of the wafer than during movement from the edge of the wafer toward the rotation center of the wafer. The inventors have found that the higher movement velocity of nozzle 4, the more severe the liquid splashing becomes, so setting the movement velocity from the rotation center of the wafer to the first position 5 to be lower than the movement velocity from the first position to the rotation center of the wafer can reduce the liquid splashing.

In one implementation mode of the embodiment of the present application, as shown in FIG. 4, after Step S120, the method may further comprise Step S140: After the liquid landing point reaches the first position 5, move the nozzle 4 to shift the liquid landing point from the first position 5 to a third position 7, and make the nozzle 4 reciprocate between the first position 5 and the third position 7, wherein the third position 7 and the first position 5 are symmetric about the rotation center of the wafer within the outer housing.

The wafer processing method shown in FIG. 4 can further reduce overlapping duration of landing positions of the processing liquid. FIG. 5 schematically illustrates a schematic diagram of the reciprocating movement of the nozzle 4 between the first position 5 and the third position 7. The nozzle 4 may reciprocate at a constant velocity between the first position 5 and the third position 7. Reciprocating movement of the nozzle 4 between the first position 5 and the third position 7 continues until the thickness of the processing liquid on the wafer 1 meets requirements, until the

processing of the wafer 1 is completed, or until other termination conditions are satisfied.

In one implementation mode of the embodiment of the present application, the nozzle 4 may move at a variable velocity during reciprocation between the first position 5 and the third position 7. By way of example, in Step S140, the velocity of the nozzle 4 at which the nozzle 4 moves from the rotation center of the wafer to the first position 5 is less than the velocity at which the nozzle 4 moves from the first position 5 to the rotation center of the wafer, and the velocity of the nozzle 4 at which the nozzle 4 moves from the rotation center of the wafer to the third position 7 is less than the velocity at which the nozzle 4 moves from the third position 7 to the rotation center of the wafer. That is, the velocity of the nozzle 4 at which the nozzle 4 moves from the rotation center of the wafer to a position away from the rotation center of the wafer is less than the velocity at which the nozzle 4 moves from the position away from the rotation center of the wafer toward the rotation center of the wafer, so as to reduce the liquid splashing.

In one implementation mode of the embodiment of the present application, the movement velocity of the nozzle 4 may be variable. By way of example, the velocity may gradually decrease when the nozzle 4 moves from the rotation center of the wafer to the first position 5 and gradually increase when the nozzle 4 moves from the first position 5 to the rotation center of the wafer; the velocity may gradually decrease when the nozzle 4 moves from the rotation center of the wafer to the third position 7 and gradually decrease when the nozzle 4 moves from the third position 7 to the rotation center of the wafer, thereby reducing splashing of the processing liquid.

FIG. 6 shows a block diagram of a wafer processing apparatus according to an embodiment of the present application, which may be arranged inside the wafer processing equipment.

With reference to FIG. 6, a wafer processing apparatus 600 according to an embodiment of the present application includes a controller 601, a rotating unit 602, a

supply unit 603, and a moving unit 604, wherein the rotating unit 602, the supply unit 603, and the moving unit 604 are all electrically connected to the controller 601.

The rotating unit 602 is configured to rotate the wafer 1 under the control of the controller 601. The supply unit 603 includes the aforementioned nozzle 4 and is configured to supply the processing liquid to the rotation center of the wafer 1 through the nozzle 4 under the control of the controller 601, so as to form a localized liquid film on the surface of the wafer 1. The moving unit 604 is connected to the nozzle 4, and is configured to move the nozzle 4 and continuously supply the processing liquid before the localized liquid film diffuses to the edge of the wafer under the control of the controller 601, so that the liquid landing point of the processing liquid moves from the rotation center of the wafer 1 to the first position 5.

Specifically, based on the foregoing solution, the moving unit 604 is further configured to move the nozzle 4 before the localized liquid film diffuses to the first position 5.

Specifically, based on the foregoing solution, the moving unit 604 is further configured to move the nozzle 4 when the localized liquid film diffuses to the second position 6, such that when the liquid landing point reaches the first position 5, the distance between the localized liquid film and the rotation center of the wafer 1 is greater than or equal to the distance between the first position 5 and the rotation center of the wafer 1, and the second position 6 is located between the rotation center of the wafer 1 and the first position 5.

Specifically, based on the foregoing solution, the supply unit 603 is further configured to continuously supply the processing liquid through the nozzle 4.

Specifically, based on the foregoing solution, the supply unit 603 is further configured to supply the processing liquid for a preset duration to the rotation center of the wafer 1 through the nozzle 4, such that the localized liquid film diffuses to the second position 6 when the nozzle 4 starts to move.

Specifically, the controller 601 is further configured to acquire the time t1 for the liquid landing point to move from the rotation center of the wafer 1 to the first position 5 and the time t2 for the localized liquid film to diffuse from the rotation center of the wafer 1 to the first position 5, wherein the preset duration t satisfies $t = t2 - t1$.

Specifically, the controller 601 is further configured to acquire the volume of the processing liquid required for the localized liquid film to cover the second position 6 and transmit the volume to the supply unit 603. The supply unit 603 is further configured to stop supplying the processing liquid through the nozzle 4 when the volume of the processing liquid required for the localized liquid film to cover the second position 6 is supplied at the rotation center of the wafer 1.

Specifically, the moving unit 604 is further configured to make the nozzle 4 reciprocate between the rotation center of the wafer 1 and the first position 5 after the liquid landing point reaches the first position 5. The moment when the liquid landing point reaches the first position 5 may be notified to the moving unit 604 by the controller 601.

Specifically, the moving unit 604 is further configured such that the velocity of the liquid landing point when the liquid landing point moves from the rotation center to the first position 5 is less than the velocity of the liquid landing point when the liquid landing point moves from the first position 5 to the rotation center.

Specifically, the moving unit 604 is further configured such that the velocity of the liquid landing point gradually decreases when the liquid landing point moves from the rotation center to the first position 5; the velocity of the liquid landing point gradually increases when the liquid landing point moves from the first position 5 to the rotation center.

Specifically, the moving unit 604 is further configured such that after the liquid landing point reaches the first position 5, the nozzle 4 is moved to shift the liquid landing point from the first position 5 to the third position 7, and the nozzle 4 reciprocates between the first position 5 and the third position 7, wherein the third

position 7 and the first position 5 are symmetric about the rotation center of the wafer 1.

Those skilled in the art will readily conceive other embodiments of the present application upon reviewing the specification and practicing the embodiments disclosed herein. The present application intends to cover any modifications, applications, or adaptive changes of the present application that comply with the general principles of the present application, including well-known common knowledge or conventional technical means in the field not disclosed in the present application.

It should be understood that the present application is not limited to the precise structures described above and illustrated in the accompanying drawings, and various modifications and changes may be made without departing from the scope of the present application. The scope of the present application shall be defined solely by the appended claims.

What is claimed is:

1. A wafer processing method, comprising:

rotating a wafer;

supplying a processing liquid to the rotation center of the wafer through a nozzle, so as to form a localized liquid film on the surface of the wafer;

before the localized liquid film diffuses to the edge of the wafer, moving the nozzle and continuously supplying the processing liquid, so that the liquid landing point of the processing liquid moves from the rotation center of the wafer to a first position.

2. The wafer processing method according to claim 1, wherein the nozzle is moved before the localized liquid film diffuses to the first position.

3. The wafer processing method according to claim 2, wherein the nozzle is moved when the localized liquid film diffuses to a second position, such that when the liquid landing point reaches the first position, the distance between the localized liquid film and the rotation center of the wafer is greater than or equal to the distance between the first position and the rotation center of the wafer, and the second position is located between the rotation center of the wafer and the first position.

4. The wafer processing method according to claim 3, wherein the nozzle continuously supplies the processing liquid.

5. The wafer processing method according to claim 4, wherein the nozzle supplies the processing liquid for a preset duration to the rotation center of the wafer, such that the localized liquid film diffuses to the second position when the nozzle starts to move.

6. The wafer processing method according to claim 5, wherein the wafer processing method further comprises acquiring a time t1 for the liquid landing point to move from the rotation center of the wafer to the first position and a time t2 for the

localized liquid film to diffuse from the rotation center of the wafer to the first position, and the preset duration t satisfies $t = t2 - t1$.

7. The wafer processing method according to claim 3, wherein the wafer processing method further comprises acquiring the volume of the processing liquid required for the localized liquid film to cover the second position, and when the volume of the processing liquid required for the localized liquid film to cover the second position is supplied at the rotation center of the wafer, the nozzle stops supplying the processing liquid.

8. The wafer processing method according to claim 1, wherein the wafer processing method further comprises: after the liquid landing point reaches the first position, making the nozzle reciprocate between the rotation center of the wafer and the first position.

9. The wafer processing method according to claim 8, wherein the velocity at which the liquid landing point moves from the rotation center to the first position is less than the velocity at which the liquid landing point moves from the first position to the rotation center.

10. The wafer processing method according to claim 8, wherein the velocity of the liquid landing point gradually decreases when the liquid landing point moves from the rotation center to the first position; the velocity of the liquid landing point gradually increases when the liquid landing point moves from the first position to the rotation center.

11. The wafer processing method according to claim 1, wherein the wafer processing method further comprises: after the liquid landing point reaches the first position, moving the nozzle to shift the liquid landing point from the first position to a third position, and making the nozzle reciprocate between the first position and the third position, wherein the first position and the third position are symmetric about the rotation center of the wafer.

12. A wafer processing apparatus, comprising:

a controller;

a rotating unit, electrically connected to the controller, and configured to rotate a wafer;

a supply unit, electrically connected to the controller, and including a nozzle, wherein the supply unit is configured to supply a processing liquid to the rotation center of the wafer through the nozzle under the control of the controller, so as to form a localized liquid film on the surface of the wafer;

a moving unit, electrically connected to the controller, and connected to the nozzle, wherein the moving unit is configured to move the nozzle and continuously supply the processing liquid before the localized liquid film diffuses to the edge of the wafer under the control of the controller, so that the liquid landing point of the processing liquid moves from the rotation center of the wafer to a first position.