

OSCILLATION METHOD OF WAFER OSCILLATION APPARATUS, AND WAFER OSCILLATION APPARATUS AND CHEMICAL PLATING DEVICE

CROSS-REFERENCE TO THE RELATED APPLICATIONS

[0001] The present disclosure claims priority to Chinese Patent Application No. 202311761973.2, filed with the China National Intellectual Property Administration on December 20, 2023, and entitled “OSCILLATION METHOD OF WAFER OSCILLATION APPARATUS, AND WAFER OSCILLATION APPARATUS AND CHEMICAL PLATING DEVICE”, the contents of which are incorporated herein by reference in entirety.

TECHNICAL FIELD

[0002] The present invention relates to the technical field of surface treatment, and in particular, to an oscillation method of a wafer oscillation apparatus, a wafer oscillation apparatus and a chemical plating device.

BACKGROUND

[0003] In the process of manufacturing semiconductor chips, a nickel layer is usually plated on the surface of semiconductor chips to improve the solderability of the semiconductor chips. During soldering, a gold layer is further plated on the nickel layer to prevent oxidation of nickel. Common methods for nickel-gold plating include electroless nickel-gold plating and electroplating nickel-gold plating, and the electroless nickel-gold plating method is widely used due to its simple operation and low cost.

[0004] However, with the development of semiconductor technology, the requirements for the uniformity of plated layers are increasingly high, and existing chemical plating devices gradually fail to meet the requirements.

SUMMARY

[0005] In view of this, embodiments of the present invention provide an oscillation method of a wafer oscillation apparatus, a wafer oscillation apparatus and a chemical plating device to solve the technical problems existing in the background art.

[0006] To achieve the above purpose, the technical solution of the present invention is embodied as follows:

[0007] In a first aspect, an embodiment of the present invention provides an oscillation method of a wafer oscillation apparatus, applied to a plating device, including:

[0008] controlling an oscillation frame to move from a first position to a second position, wherein the first position is located above the second position, and both the first position and the second position are lower than a liquid level in a process tank of the plating device; and

[0009] controlling a first speed of the oscillation frame to be within a first preset speed range when it reaches the second position and before it stops moving, thereby enabling the oscillation frame to generate vibration with a first preset amplitude when it stops moving.

[0010] Optionally, the controlling a first speed of the oscillation frame to be within a first preset speed range when it reaches the second position and before it stops moving includes:

[0011] controlling a movement stroke of the oscillation frame to include at least an acceleration phase and a deceleration phase, such that the first speed of the oscillation frame is within the first preset speed range when it reaches the second position and before it stops moving, and a time required for the oscillation frame to reach the second position is less than a first preset time, wherein the first preset time is a preset process time for descending of the oscillation frame.

[0012] Optionally, the controlling a movement stroke of the oscillation frame to include at least an acceleration phase and a deceleration phase includes:

[0013] controlling accelerations of the acceleration phase and the deceleration phase in the movement stroke of the oscillation frame to be constant values.

[0014] Optionally, the deceleration phase includes:

[0015] controlling the oscillation frame to move deceleratingly at a preset first acceleration for a second preset time, wherein the second preset time is less than a time taken by the oscillation frame in the deceleration phase;

[0016] controlling the oscillation frame to move deceleratingly at a preset second acceleration until reaching the second position, wherein an absolute value of the second acceleration is less than an absolute value of the first acceleration.

[0017] Optionally, the method further including:

[0018] controlling the oscillation frame to move from the second position to the first position;

[0019] controlling a second speed of the oscillation frame to be within a second preset speed range when it reaches the first position and before it stops moving, thereby enabling the oscillation frame to generate vibration with a second preset amplitude when it stops moving.

[0020] Optionally, the controlling a second speed of the oscillation frame to be within a second preset speed range when it reaches the first position and before it stops moving includes:

[0021] controlling a movement stroke of the oscillation frame to include at least an acceleration phase and a deceleration phase, such that the second speed of the oscillation frame is within the second preset speed range when it reaches the first position and before it stops moving, and a time

required for the oscillation frame to reach the first position is less than a third preset time, wherein the third preset time is a preset process time for ascending of the oscillation frame.

[0022] In a second aspect, an embodiment of the present invention provides a wafer oscillation apparatus, which implements any of the oscillation methods of a wafer oscillation apparatus as described above, the oscillation apparatus including:

[0023] a driving member, having a driving output shaft and an abutting member connected to the output shaft;

[0024] an oscillation arm, connected to the driving member and is moved up and down under an action of the driving member;

[0025] an oscillation frame, connected to the oscillation arm and movable therewith, where the oscillation frame has a hollow accommodating cavity for placing a cassette loaded with wafers;

[0026] a position limiting assembly, including a first position limiting member and a second position limiting member, where the abutting member follows the output shaft to move between the first position limiting member and the second position limiting member.

[0027] Optionally, the first position limiting member has a bottom surface, and the oscillation frame is located at the first position when the abutting member abuts against the bottom surface of the first position limiting member; and

[0028] the second position limiting member has a top surface, and the oscillation frame is located at the second position when the abutting member abuts against the top surface of the second position limiting member.

[0029] Optionally, the oscillation arm includes a positioning groove;

[0030] the oscillation frame has a positioning block matched with the positioning groove, and the oscillation frame is connected to the oscillation arm through the positioning groove and the positioning block.

[0031] In a third aspect, an embodiment of the present invention provides a chemical plating device, including: a feeding device, a wafer oscillation apparatus, a number of process tanks and a number of discharging devices;

[0032] wherein the wafer oscillation apparatus is any of the wafer oscillation apparatuses as described above.

[0033] Embodiments of the present invention provide an oscillation method of a wafer oscillation apparatus, a wafer oscillation apparatus and a chemical plating device. The method includes: controlling an oscillation frame to move from a first position to a second position, wherein the first position is located above the second position, and both the first position and the second position are lower than a liquid level in a process tank of a plating device; and controlling

a first speed of the oscillation frame to be within a first preset speed range when the oscillation frame reaches the second position and before the oscillation frame stops moving, such that the oscillation frame can generate vibration with a first preset amplitude when stopping moving. It can be seen that, with the oscillation method of a wafer oscillation apparatus, the wafer oscillation apparatus and the chemical plating device according to embodiments of the present invention, the first speed of the oscillation frame is controlled to be within the first preset speed range when the oscillation frame stops moving, so that the oscillation frame can generate vibration with the first preset amplitude when stopping moving. Wafers autocatalytically generate hydrogen bubbles of different sizes in a plating solution, and these bubbles adhere to the surfaces of the wafers. With such arrangement, friction between the wafers and the plating solution can remove large-diameter bubbles on the surfaces of the wafers during descending of the wafers. On this basis, the vibration with the first preset amplitude in the present invention can more effectively remove small-diameter hydrogen bubbles adhering to the surfaces of the wafers, thereby achieving an effect of no bubbles on the surfaces of the wafers, enabling the plating solution to fully contact a product to be plated, improving the uniformity of a plated layer, and avoiding damage to the product to be plated caused by excessive vibration. Therefore, the uniformity of a plated layer can be improved by the oscillation method of a wafer oscillation apparatus, the wafer oscillation apparatus and the chemical plating device according to embodiments of the present invention.

[0034] Additional aspects and advantages of the present invention will be partially set forth in the following description, and partially will become apparent from the following description, or may be learned through practice of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0035] The drawings described herein are used to provide a further understanding of the present invention and constitute a part of the present invention. The exemplary embodiments of the present invention and descriptions thereof are used to explain the present invention and do not constitute an improper limitation of the present invention. In the drawings:

[0036] FIG. 1 is a first schematic diagram of a chemical plating device provided by an embodiment of the present invention;

[0037] FIG. 2 is a second schematic diagram of a chemical plating device provided by an embodiment of the present invention;

[0038] FIG. 3 is a schematic flowchart of an oscillation method of a wafer oscillation apparatus provided by an embodiment of the present invention;

[0039] FIG. 4 is a first schematic diagram of a movement speed change of an oscillation frame in an oscillation method of a wafer oscillation apparatus provided by an embodiment of the present invention;

[0040] FIG. 5 is a second schematic diagram of a movement speed change of an oscillation frame in an oscillation method of a wafer oscillation apparatus provided by an embodiment of the present invention.

[0041] Description of reference numerals:

[0042] 20, wafer oscillation apparatus; 21, driving member; 211, abutting member; 22, oscillation arm; 221, clamping frame; 222, positioning groove; 23, oscillation frame; 231, positioning block; 241, first position limiting member; 242, second position limiting member; 30, process tank; 40, cassette.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0043] To make the technical solution and beneficial effects of the present invention more obvious and understandable, detailed description will be given below by listing specific embodiments. The drawings are not necessarily drawn to scale, and some features may be enlarged or reduced to more clearly show details of local features; unless otherwise defined, technical and scientific terms used herein have the same meanings as those commonly understood in the technical field to which the present invention belongs.

[0044] In the description of the present invention, the orientations or positional relationships indicated by the terms “center”, “longitudinal”, “lateral”, “length”, “width”, “thickness”, “height”, “upper”, “lower”, “front”, “rear”, “left”, “right”, “vertical”, “horizontal”, “top”, “bottom”, “inner”, “outer”, “clockwise”, “counterclockwise” and the like are based on the orientations or positional relationships shown in the drawings, which are only for the convenience of simplified description of the present invention, and do not indicate or imply that the referred device or element must have a specific orientation, be constructed and operated in a specific orientation, and thus cannot be construed as a limitation to the present invention.

[0045] In the present invention, the terms “first” and “second” are only used for descriptive purposes and cannot be construed as indicating or implying relative importance of the indicated features or implying the quantity of the indicated technical features. Therefore, a feature defined with “first” and “second” may explicitly include at least one such feature. In the description of the present invention, “a plurality of” means at least two, such as two, three and the like; “a number of” means at least one, such as one, two, three and the like; unless otherwise explicitly and specifically defined.

[0046] In the present invention, unless otherwise explicitly defined and limited, the terms “mounted”, “connected”, “linked”, “fixed”, “arranged” and the like should be understood broadly. For example, “connected” may be a fixed connection, a detachable connection, or an integral connection; it may be a mechanical connection or an electrical connection; it may be a direct connection or an indirect connection through an intermediate medium, or it may be internal communication between two elements or an interaction relationship between two elements. For those of ordinary skill in the art, the specific meanings of the above terms in the present invention can be understood according to specific situations.

[0047] In the present invention, unless otherwise explicitly defined and limited, a first feature “on”, “above” and “over” a second feature or “under”, “below” and “beneath” a second feature may mean that the first feature is in direct contact with the second feature or the first feature and the second feature are not in direct contact but are in contact through an intermediate medium. Moreover, a first feature “on”, “above” and “over” a second feature may mean that the first feature is directly above or obliquely above the second feature, or merely means that the horizontal level of the first feature is higher than that of the second feature. A first feature “under”, “below” and “beneath” a second feature may mean that the first feature is directly below or obliquely below the second feature, or merely means that the horizontal level of the first feature is lower than that of the second feature.

[0048] For a thorough understanding of the present invention, detailed steps and detailed structures will be set forth in the following description to explain the technical solution of the present invention. Preferred embodiments of the present invention are described in detail below; however, the present invention may have other embodiments in addition to these detailed descriptions.

[0049] In related art, plating technology is widely used in semiconductor manufacturing fields such as wire bonding, flip chip packaging, 3D integration, and Micro-Electro-Mechanical System (MEMS).

[0050] However, after extensive research, the inventor of the present invention has found that, during plating of semiconductor wafers, a large number of bubbles are generated during autocatalytic reaction of the plating solution in the process of precipitation of a plated layer, wherein the bubbles include relatively large-diameter bubbles and relatively small-diameter bubbles. These bubbles adhere to the surfaces of the wafers along with deposition, resulting in failure of the plating solution to fully contact the surfaces of the wafers, thereby affecting precipitation of the plated layer, and even bubbles may enter the precipitation layer of the plated layer and generate stress, reducing the quality of the plated layer.

[0051] Therefore, after further extensive research, the inventor of the present invention proposes the following technical solution.

[0052] An embodiment of the present invention provides an oscillation method of a wafer oscillation apparatus, applied to a plating device. In this embodiment, the plating device is exemplified by a chemical plating device. The plating solution mentioned above generates a large number of bubbles, i.e., hydrogen bubbles (hereinafter referred to as bubbles), during autocatalytic reaction. Therefore, an embodiment of the present invention provides a chemical plating device, a wafer oscillation apparatus 20 in the chemical plating device, and an oscillation method of the wafer oscillation apparatus 20. Referring to FIG. 1 and FIG. 2, the chemical plating device includes: a feeding device, a wafer oscillation apparatus 20, a number of process tanks 30 and a number of discharging devices, wherein the wafer oscillation apparatus 20 includes: a driving member 21 having a driving output shaft and an abutting member 211 connected to the output shaft, an oscillation arm 22 connected to the driving member 21, and an oscillation frame 23 connected to the oscillation arm 22. The oscillation frame 23 has a hollow accommodating cavity, and a cassette 40 loaded with wafers is fixed in the hollow accommodating cavity by a fixing member, wherein the fixing member can restrict relative movement between the cassette and the oscillation frame. When the wafer oscillation apparatus operates, the driving member can drive the oscillation arm 22 to drive the oscillation frame 23 to move up and down, thereby driving the cassette 40 and the wafers in the oscillation frame 23 to move in the plating solution in the process tank.

[0053] In other embodiments, the plating device may further include other plating devices such as an electroplating device, and the wafer oscillation apparatus and the oscillation method of the wafer oscillation apparatus are also applicable to other plating devices, which will not be repeated herein.

[0054] It should be noted that, in this embodiment, the oscillation frame 23 has a hollow accommodating cavity for placing the cassette 40, and the cassette 40 is an open hollow structure. When the oscillation frame 23 and the cassette 40 are located in the plating solution, the plating solution can contact the wafers through the hollow accommodating cavity and the hollow cassette, so as to achieve a plating effect on the wafers. In this embodiment, the oscillation frame with the hollow accommodating cavity is of a rectangular structure, and two cassettes can be accommodated in each hollow accommodating cavity. In other embodiments, the structure, shape and specification of the oscillation frame are not specifically limited, as long as the above effects can be achieved.

[0055] Specifically, in this embodiment, the driving member 21 is an air cylinder. The air cylinder may include a cylinder barrel and a piston rod. The output shaft of the driving member 21 may be the piston rod of the air cylinder.

[0056] In other embodiments, the driving member 21 may be a motor. Further, since the oscillation movement is linear movement, a power output end of the motor may further be provided with: a conversion mechanism for converting rotation into movement, for example, a screw nut and screw rod, a worm gear and worm, a gear and rack, and the like. The output shaft may be a motion output component after conversion.

[0057] In this embodiment, the wafer oscillation apparatus further includes a position limiting assembly for limiting a movement stroke of the abutting member 211, and the movement stroke of the abutting member 211 is a linear trajectory. Specifically, the position limiting assembly includes a first position limiting member 241 and a second position limiting member 242, wherein the abutting member 211 moves between the first position limiting member 241 and the second position limiting member 242 following the output shaft. More specifically, the first position limiting member 241 limits an extreme position of the abutting member 211 in one direction, and the second position limiting member 242 limits an extreme position of the abutting member 211 in the other direction. Since the abutting member 211 is connected to the output shaft, i.e., the abutting member 211 and the output shaft are linked, the position limiting assembly also limits the movement stroke of the output shaft, thereby limiting the movement stroke of the oscillation arm 22 and the oscillation frame 23, so that the oscillation frame 23 moves linearly between two preset positions.

[0058] Specifically, the movement of the oscillation frame 23 in this embodiment is up-and-down linear movement.

[0059] In some embodiments, the first position limiting member 241 has a bottom surface, and the oscillation frame 23 is located at a first position when the abutting member 211 abuts against the bottom surface of the first position limiting member 241;

[0060] the second position limiting member 242 has a top surface, and the oscillation frame 23 is located at a second position when the abutting member 211 abuts against the top surface of the second position limiting member 242.

[0061] The bottom surface and the top surface make the position limiting of the abutting member 211 more stable, so that the oscillation frame 23 can be stably located at the first position or the second position.

[0062] Moreover, due to the arrangement of the first position limiting member 241, the oscillation frame 23 with a certain movement speed can be limited by contacting the first position

limiting member 241 during upward movement, so that the speed of the oscillation frame is reduced to 0. Since the cassette and the oscillation frame are fixed by the fixing member, the speed of the cassette is also reduced to 0 at the same time.

[0063] Due to the arrangement of the second position limiting member 242, the oscillation frame 23 with a certain movement speed can be limited by contacting the second position limiting member 242 during downward movement, so that the speed of the oscillation frame is reduced to 0. Since the cassette and the oscillation frame are fixed by the fixing member, the speed of the cassette is also reduced to 0 at the same time. At this time, the wafers loaded in the cassette still have a certain movement speed, so as to contact the cassette and generate vibration, thereby making large-diameter bubbles and small-diameter bubbles adhering to the wafers detach from the wafers and rise under the influence of vibration, so that the surfaces of the wafers can fully contact the plating solution and a relatively uniform plated layer is generated.

[0064] In some embodiments, the wafer oscillation apparatus further includes a damper, and the damper can adjust a movement speed of the oscillation frame 23.

[0065] Further, two dampers are provided, and the two dampers may be disposed near the first position limiting member 241 and the second position limiting member 242 or integrated in the air cylinder, as long as the movement speed of the oscillation frame 23 can be adjusted. For example, in this embodiment, the dampers can realize switching from an acceleration phase to a deceleration phase. On the other hand, the provision of the dampers can reduce vibration generated by the oscillation frame 23 when the oscillation frame 23 moves to the first position limiting member 241 or the second position limiting member 242, reduce the force of relative collision between the wafers and the oscillation frame 23, and prevent the wafers from being broken. In other embodiments, other buffering and decelerating structures may also be provided, and the structures and positions thereof are not specifically limited herein, as long as the above effects can be achieved.

[0066] In some embodiments, the oscillation arm 22 includes a positioning groove 222;

[0067] the oscillation frame 23 has a positioning block 231 matched with the positioning groove 222, and the oscillation frame 23 is connected to the oscillation arm 22 through the positioning groove 222 and the positioning block 231.

[0068] Through the positioning groove 222 and the positioning block 231, the connection between the oscillation frame 23 and the oscillation arm 22 can be a more flexible detachable connection, and the connection positioning is more convenient and accurate.

[0069] Specifically, the oscillation arm 22 includes a clamping frame 221 surrounding the oscillation frame 23, and the positioning groove 222 is formed in the clamping frame 221. The

positioning block 231 is disposed at the top of the oscillation frame 23, and there is a certain distance from the top of the cassette 40 in the oscillation frame 23, so that the clamping frame 221 is above the liquid level of the chemical solution during plating.

[0070] The principle of removing bubbles on the surfaces of the wafers by the wafer oscillation apparatus is as follows: the driving member 21 drives the oscillation frame 23 to move between the first position limiting member 241 and the second position limiting member 242, thereby driving the cassette 40 to move up and down in the plating solution. In this embodiment, during descending of the cassette 40 and the wafers, the wafers in the cassette 40 do not detach from the cassette 40, but move downward together with the cassette 40 until moving to the second position. The oscillation frame 23 and the cassette 40 suddenly stop moving to the second position at a first speed. At this time, the wafers in the cassette 40 still have a tendency to move downward, and generate vibration with a first preset amplitude after receiving a reaction force from contact with the bottom of the cassette 40, so that friction between the wafers and the plating solution can remove large-diameter bubbles on the surfaces of the wafers during descending of the wafers, and the vibration with the first preset amplitude can remove small-diameter bubbles on the surfaces of the wafers. During ascending of the oscillation frame 23, when moving to the first position, the oscillation frame 23 and the cassette 40 stop moving. The wafers in the cassette 40 have a tendency to continue moving upward due to inertia. Since the cassette 40 is an open structure, the wafers do not contact any structure above, and at this time, the wafers shake relative to the cassette 40, but the shaking is small and can be ignored; in the next process, the oscillation frame 23 stays at the first position for a short time, and conversely, when the cassette 40 continues to descend following the oscillation frame 23, the wafers fall into the cassette 40 under the action of gravity and then descend following the cassette 40 again, so that the wafers do not detach from the cassette 40 during descending. Therefore, during upward movement of the wafers, friction between the wafers and the plating solution also removes large-diameter bubbles on the surfaces of the wafers, achieving a certain bubble removal effect.

[0071] Specifically, in this embodiment, an acceleration of movement of the oscillation frame 23 is 0.4g to 0.6g.

[0072] Referring to FIG. 3, the oscillation method of a wafer oscillation apparatus provided by an embodiment of the present invention includes:

[0073] Step 601: controlling an oscillation frame 23 to move from a first position to a second position, wherein the first position is located above the second position, and both the first position and the second position are lower than a liquid level in a process tank 30 of a plating device;

[0074] Step 602: controlling a first speed to be within a first preset speed range when the oscillation frame 23 reaches the second position and before the oscillation frame 23 stops moving, such that wafers can generate vibration with a first preset amplitude when the oscillation frame 23 stops moving.

[0075] The method may be implemented by a computer, and the computer may be a computing device configured with a processor. The processor may be a general-purpose processor, a digital signal processor (DSP), a field programmable gate array (FPGA), or other programmable logic devices, discrete gate or transistor logic devices, discrete hardware components, and the like.

[0076] In Step 601, the purpose of controlling the oscillation frame 23 may be achieved by controlling the driving member 21 to drive the oscillation frame 23 to move. Moving from the upper first position to the lower second position means that the abutting member 211 performs a descending movement, thereby driving the cassette 40 and the wafers in the oscillation frame 23 to move from an opening of the process tank 30 to the bottom of the process tank 30.

[0077] In this embodiment, since the wafer oscillation apparatus is applied to a chemical plating device, the process tank 30 is also referred to as a plating tank, which is filled with a plating solution, also referred to as a chemical solution. The wafers are immersed therein for a certain period of time to complete the plating process. Of course, it is also necessary to control components, temperature, immersion time and the like of the plating solution, which will not be described in detail herein.

[0078] In other embodiments, the wafer oscillation apparatus may also be applied to other devices. At this time, the process tank is another corresponding functional tank, and the liquid in the process tank is also a liquid that can realize the function corresponding to the functional tank. The application of the wafer oscillation apparatus, the type of the chemical solution and the function of the process tank are not specifically limited herein, and may be determined according to actual situations.

[0079] In Step 602, the vibration with the first preset amplitude is generated to remove hydrogen bubbles adhering to the surfaces of the wafers, thereby further improving the quality of the plated layer. The first preset amplitude can neither be too large nor too small. Too large amplitude is easy to damage the wafers, and too small amplitude cannot achieve the purpose of removing bubbles.

[0080] In some embodiments, the amplitude of the vibration is controlled by controlling the first speed of the oscillation frame 23 before stopping moving.

[0081] Specifically, the oscillation frame 23 and the cassette 40 suddenly stop moving to the second position at the first speed. At this time, the wafers in the cassette 40 contact the bottom of

the cassette 40 at the first speed to generate vibration, thereby achieving an effect of removing bubbles on the surfaces of the wafers.

[0082] In other embodiments, under the condition that the wafers are not damaged, the bubbles adhering to the surfaces of the wafers can be better removed by adjusting the vibration frequency and waveform. The vibration form of the wafers is not specifically limited herein, as long as the effect of removing the bubbles adhering to the surfaces of the wafers can be achieved.

[0083] In some embodiments, the controlling a first speed to be within a first preset speed range when the oscillation frame 23 reaches the second position and before the oscillation frame 23 stops moving includes: controlling a movement stroke of the oscillation frame 23 to include at least an acceleration phase and a deceleration phase, such that the first speed is within the first preset speed range when the oscillation frame 23 reaches the second position and before the oscillation frame 23 stops moving, and a time required for the oscillation frame 23 to reach the second position is less than a first preset time; the first preset time is a preset process time for descending of the oscillation frame 23.

[0084] It can be understood that, in order to reduce the process time for descending of the oscillation frame 23 and improve production efficiency, the oscillation frame 23 needs to move quickly, but in order to reduce damage to the wafers, the first speed before stopping moving cannot be too high. Therefore, both an acceleration phase and a deceleration phase are required in the movement stroke of the oscillation frame 23, referring to FIG. 4 and FIG. 5.

[0085] In some embodiments, the controlling a movement stroke of the oscillation frame 23 to include at least an acceleration phase and a deceleration phase includes:

[0086] controlling accelerations of the acceleration phase and the deceleration phase in the movement stroke of the oscillation frame 23 to be constant values. That is, the acceleration phase is uniform acceleration, and the deceleration phase is uniform deceleration, referring to FIG. 4. In this way, the wafers are less damaged during the movement stroke of the oscillation frame 23.

[0087] It can be understood that, in other embodiments, referring to FIG. 5, both acceleration and deceleration of the oscillation frame 23 may be variable acceleration movements, as long as the first speed is within the first preset speed range, so that vibration with the first preset amplitude can be generated when the oscillation frame moves at the first speed to stop moving. The speed change range is controlled within a certain range.

[0088] In some embodiments, the deceleration phase may include at least two deceleration sub-phases, which is the same as the above, as long as the first speed is within the first preset speed range, so that vibration with the first preset amplitude can be generated when the oscillation frame

moves at the first speed to stop moving, and the speed change range is controlled within a certain range.

[0089] The deceleration phase includes:

[0090] controlling the oscillation frame 23 to decelerate and move at a preset first acceleration for a second preset time; the second preset time is less than a time spent by the oscillation frame 23 in the deceleration phase;

[0091] controlling the oscillation frame 23 to decelerate and move at a preset second acceleration until reaching the second position; an absolute value of the second acceleration is less than an absolute value of the first acceleration.

[0092] That is, the deceleration phase may be two-stage deceleration, which can not only reduce the time of the deceleration phase and improve processing efficiency, but also make the process of the first speed of the oscillation frame 23 entering the first preset speed range before stopping moving more stable.

[0093] Specifically, the second preset time may be half of the time spent by the oscillation frame 23 in the deceleration phase. In this way, the control is more convenient and the operation is more stable. It can be understood that the deceleration phase may be multi-stage deceleration with more than two deceleration sub-phases. In this way, it is more conducive to reducing the time of the oscillation frame 23 in the deceleration phase and improving processing efficiency.

[0094] In some embodiments, the method further includes:

[0095] controlling the oscillation frame 23 to move from the second position to the first position;

[0096] controlling a second speed to be within a second preset speed range when the oscillation frame 23 reaches the first position and before the oscillation frame 23 stops moving, such that the wafers shake in the cassette 40 when the oscillation frame 23 stops moving, and the shaking cannot detach bubbles on the surfaces of the wafers from the wafers.

[0097] Specifically, during ascending of the oscillation frame 23, when abutting and limiting against the first position limiting member 241, both the oscillation frame 23 and the cassette 40 stop moving. At this time, the wafers in the cassette 40 still have a tendency to move upward, so that inertia is generated to make the wafers shake slightly up and down (since the cassette 40 is an open structure, no structure contacts the wafers shaking slightly up and down, so the ascending wafers do not receive any other acting force, for example, do not receive an upward reaction force from the cassette 40 caused by contact between the wafers and the cassette 40 when the wafers descend, and the bubble removal effect cannot be achieved). However, during movement of the wafers in the cassette 40 from the bottom of the process tank to a position close to the top following the oscillation frame 23, the bubbles on the surfaces of the wafers also have a tendency to move

upward, and friction between the wafers and the plating solution is intensified during the movement, so that hydrogen bubbles are accelerated to be removed under the action of friction.

[0098] In some embodiments, the controlling a second speed to be within a second preset speed range when the oscillation frame 23 reaches the first position and before the oscillation frame 23 stops moving includes:

[0099] controlling a movement stroke of the oscillation frame 23 to include at least an acceleration phase and a deceleration phase, such that the second speed is within the second preset speed range when the oscillation frame 23 reaches the first position and before the oscillation frame 23 stops moving, and a time required for the oscillation frame 23 to reach the first position is less than a third preset time; the third preset time is a preset process time for ascending of the oscillation frame 23.

[0100] It can be understood that, in order to reduce the process time for descending of the oscillation frame 23 and improve production efficiency, the oscillation frame 23 needs to move quickly, but in order to reduce damage to the wafers, the second speed before stopping moving cannot be too high. Therefore, both an acceleration phase and a deceleration phase are required in the movement stroke of the oscillation frame 23. It can be understood that there may be a plurality of acceleration phases and deceleration phases.

[0101] It should be noted that the movement stroke of the oscillation frame 23 includes both a descending stroke and an ascending stroke, and there is no inevitable requirement for an execution order of the two, that is, the descending stroke may be executed first, or the ascending stroke may be executed first. However, the descending stroke has a better effect in removing hydrogen bubbles, so the descending stroke is introduced first. The execution of the ascending stroke is the same as that of the descending stroke except that the movement direction is different and the generated effect is slightly different. For content not introduced in the ascending stroke, reference may be made to the descending stroke.

[0102] It should be understood that the above embodiments are exemplary and are not intended to include all possible embodiments covered by the claims. Various modifications and changes may be made on the basis of the above embodiments without departing from the scope of the present disclosure. Similarly, any combination of the technical features of the above embodiments may be made to form other embodiments of the present invention that may not be explicitly described. Therefore, the above embodiments only represent several implementations of the present invention and do not limit the protection scope of the present patent.

CLAIMS

1. An oscillation method of a wafer oscillation apparatus, applied to a plating device, characterized in that it comprises steps of:

controlling an oscillation frame to move from a first position to a second position, wherein the first position is located above the second position, and both the first position and the second position are lower than a liquid level in a process tank of the plating device; and

controlling a first speed of the oscillation frame to be within a first preset speed range when it reaches the second position and before it stops moving, thereby enabling the oscillation frame to generate vibration with a first preset amplitude when it stops moving.

2. The oscillation method of a wafer oscillation apparatus according to claim 1, wherein the step of controlling a first speed of the oscillation frame to be within a first preset speed range when it reaches the second position and before it stops moving comprises a step of:

controlling a movement stroke of the oscillation frame to include at least an acceleration phase and a deceleration phase, such that the first speed of the oscillation frame is within the first preset speed range when it reaches the second position and before it stops moving, and a time required for the oscillation frame to reach the second position is less than a first preset time, wherein the first preset time is a preset process time for descending of the oscillation frame.

3. The oscillation method of a wafer oscillation apparatus according to claim 2, wherein the step of controlling a movement stroke of the oscillation frame to include at least an acceleration phase and a deceleration phase comprises:

controlling accelerations of the acceleration phase and the deceleration phase in the movement stroke of the oscillation frame to be constant values.

4. The oscillation method of a wafer oscillation apparatus according to claim 3, wherein the deceleration phase comprises:

controlling the oscillation frame to move deceleratingly at a preset first acceleration for a second preset time, wherein the second preset time is less than a time taken by the oscillation frame in the deceleration phase;

controlling the oscillation frame to move deceleratingly at a preset second acceleration until reaching the second position, wherein an absolute value of the second acceleration is less than an absolute value of the first acceleration.

5. The oscillation method of a wafer oscillation apparatus according to claim 1, further comprising steps of:

controlling the oscillation frame to move from the second position to the first position;

controlling a second speed of the oscillation frame to be within a second preset speed range when it reaches the first position and before it stops moving, thereby enabling the oscillation frame to generate vibration with a second preset amplitude when it stops moving.

6. The oscillation method of a wafer oscillation apparatus according to claim 5, wherein the step of controlling a second speed of the oscillation frame to be within a second preset speed range when it reaches the first position and before it stops moving comprises:

controlling a movement stroke of the oscillation frame to include at least an acceleration phase and a deceleration phase, such that the second speed of the oscillation frame is within the second preset speed range when it reaches the first position and before it stops moving, and a time required for the oscillation frame to reach the first position is less than a third preset time, wherein the third preset time is a preset process time for ascending of the oscillation frame.

7. A wafer oscillation apparatus, characterized in that it implements the oscillation method of a wafer oscillation apparatus according to any one of claims 1 to 6, wherein the wafer oscillation apparatus comprises:

a driving member, having a driving output shaft and an abutting member connected to the output shaft;

an oscillation arm, connected to the driving member and moved up and down under an action of the driving member;

an oscillation frame, connected to the oscillation arm and movable therewith, wherein the oscillation frame has a hollow accommodating cavity for placing a cassette loaded with wafers;

a position limiting assembly, comprising a first position limiting member and a second position limiting member, wherein the abutting member follows the output shaft to move between the first position limiting member and the second position limiting member.

8. The wafer oscillation apparatus according to claim 7, wherein the first position limiting member has a bottom surface, and the oscillation frame is located at the first position when the abutting member abuts against the bottom surface of the first position limiting member; and

the second position limiting member has a top surface, and the oscillation frame is located at the second position when the abutting member abuts against the top surface of the second position limiting member.

9. The wafer oscillation apparatus according to claim 7, wherein the oscillation arm comprises a positioning groove; and

the oscillation frame is provided with a positioning block matched with the positioning groove, and the oscillation frame is connected to the oscillation arm through the positioning groove and the positioning block.

10. A chemical plating device, characterized by comprising: a feeding device, a wafer oscillation apparatus, a number of process tanks and a number of discharging devices;

wherein the wafer oscillation apparatus is the wafer oscillation apparatus according to any one of claims 7 to 9.