

VIBRATION ATTENUATION CONTROL METHOD AND APPARATUS FOR ELECTROPLATING EQUIPMENT, AND ELECTRONIC EQUIPMENT

FIELD OF THE INVENTION

The present application relates to the technical field of integrated circuit production and manufacturing, and particularly relates to a vibration attenuation control method, an apparatus for an electroplating equipment and an electronic equipment.

BACKGROUND

With the rapid development of the technical field of integrated circuit production and manufacturing, the chip area continues to be increased, and the number of transistors in the chip has been increased dramatically. There are even more than tens of thousands or even tens of billions of transistors in a chip. The electroplating process has higher and higher requirements for electroplating rate and output, and in the field of advanced packaging, the requirements for uniformity in chips are also higher. In order to ensure the stability of quality transmission in the electroplating process and meet the requirements of production capacity and quality, the high-speed oscillating paddle assembly is introduced into the electroplating equipment. The paddle assembly comprises a plurality of paddles parallel to the surface of the substrate. The paddles perform the reciprocating movement to stir the electroplating solution, so as to sufficiently supply the metal ions and electroplating solution additives to the surface of the substrate.

For details, please refer to FIG. 1, FIG. 1 shows a schematic structural view of an electroplating equipment disclosed in the patent application number 202110154928.5. As shown in FIG. 1, the electroplating equipment comprises an electroplating bath 101, a substrate clamp 102 and a plurality of strip-shaped paddles 103 arranged in parallel. Wherein, the substrate clamp 102 is used to clamp a substrate 104. The paddles 103 are positioned between the substrate 104 and the electrode (not shown in the figure), and the paddles 103 are parallel to the substrate 104. When electroplating, the substrate 104 and the paddles 103 are immersed in the electroplating solution in the

electroplating bath 101. The paddles 103 perform the reciprocating movement in the direction parallel to the substrate 104 under the drive of a driving mechanism 105, so as to stir the electroplating solution. The direction of movement of the paddles 103 may be further limited by a guiding rail 109 connected thereto. A controller 106 is connected to the driving mechanism 105, and the controller 106 controls the movement of the paddles 103 by controlling the action of the driving mechanism 105 via the program. a is defined as the width of paddles and b is the narrowest width of the gap between the adjacent paddles. Please refer to FIG. 2 for a mode of movement of the paddles 103. FIG. 2 shows a schematic view of the position change of the paddles in one cycle when the paddles in the prior art are vibrated in manner of the stepwise reciprocating stepping. As can be seen from FIG. 2, in one working cycle, the action of the paddles 103 is divided into the following four steps: Step 501, move from the coordinate origin (black triangle) to the right to the coordinate Δ ; Step 502, move to the left to the coordinate a ; Step 503, move to the right to the coordinate $\Delta + a$; Step 504, move to the left back to the coordinate origin. In one working cycle, the paddles 103 move left and right alternately. Since each corresponding point on the substrate 104 is blocked by the paddles 103 for the same time, when the electric field is evenly distributed, the amount of electricity received by each corresponding point on the substrate 104 is equal, and thus the electroplating height of each point is the same. In one working cycle, in order to ensure that the coordinate ranges covered by the paddles 103 at each turn-back position do not overlap with each other, it is required that $\Delta \geq a + b$, that is, $\Delta \geq 2a$, so that the stirring degree of all places in the electroplating is more balanced. In the electroplating process, the paddles 103 immediately enter the next working cycle of movement after completing one working cycle of movement.

With the increasing demand for high-speed electroplating, after the high-speed copper electroplating equipment, the high-speed tin-silver electroplating equipment has become the standard configuration. More and more electroplating chambers with high-speed oscillating paddles are configured on the same electroplating equipment. Taking a certain electroplating equipment as an example, there used to be 8 copper electroplating chambers with paddles, but now 4 tin-silver electroplating chambers with paddles have been added. A total of 12 electroplating chambers are equipped with paddles. However, the main machine frames of the electroplating equipment are bound to each other. When multiple electroplating chambers work simultaneously, each

electroplating chamber will produce vibration, causing each module of the electroplating equipment to interact with each other. At a certain frequency, the whole electroplating equipment produces the resonance. At this time, the substrate in the electroplating chambers is easy to move, and the movement data is measured to be 0.5 mm. The movement often causes the alarm of dislocation of the substrate position, which affects the normal processing of the substrate. After measurement, in this case, the resonance frequency when the electroplating equipment and the paddles reach resonance is 1 Hz. A schematic view of the period when the electroplating equipment and the paddles reach resonance is shown in FIG. 3.

As the requirements for electroplating uniformity become higher and higher, the paddles 103 adopt the above-described vibration mode in manner of the stepwise reciprocating stepping. The vibration of the paddles 103 and the vibration of the electroplating equipment generate two vibration frequencies similar to the harmonic waves and carrier waves in the electromagnetic waves. When the two frequencies are close, the resonance is easy to occur. Once the resonance occurs, the overall amplitude of the electroplating equipment will increase, and the vibration of the electroplating equipment will be transmitted to each module of the machine via the main frame of the machine, causing the relevant components to passively start vibrating. For example, the substrate loading box and substrate alignment apparatus in the front-end module are both affected by the shake, causing the position of the substrate to shift. Even the manipulator itself will be affected, and there is a risk that the substrate will fall or the position will shift during the high-speed movement.

SUMMARY

In view of the above, the embodiments of the present application provide a vibration attenuation control method, an apparatus for an electroplating equipment and an electronic equipment, which at least partially solve problems existing in the prior art, can reduce the vibration of the electroplating equipment during working, and achieve the purpose of stabilizing the substrate process and equipment.

According to a first aspect, an embodiment of the present application provides a vibration attenuation control method of an electroplating equipment, the method comprising:

acquiring the resonance frequency of an electroplating equipment;

selecting the working frequency of the paddles based on the resonance frequency, the working frequency being equal to m times of the resonance frequency, m being a real number within the numerical range $(0, 0.5]$, and the working cycle corresponding to the working frequency of the paddles being less than the process time of the electroplating;

wherein, the working frequency is the frequency at which the paddles perform the periodic movement in manner of the stepwise reciprocating stepping in an electroplating chamber of the electroplating equipment.

According to a specific implementation of the embodiment of the present application, the electroplating equipment comprises a pre-wetting chamber, an electroplating chamber, a cleaning chamber, a frame of the electroplating equipment and a manipulator.

According to a specific implementation of the embodiment of the present application, the method further comprises: after selecting the working frequency of the paddles, calculating the generated displacement Δ required for the paddles to move forward once and then move backward once every time based on the working frequency by using formula 1;

wherein, the formula 1 is:

$$\Delta = L * mf * t1 * R$$

wherein,

L represents the distance between the starting point and the ending point in the vibration process of the paddles in manner of the stepwise reciprocating stepping;

f represents the resonance frequency of the electroplating equipment;

$t1$ represents the length of time spent for the paddles to move forward once and then move backward once every time;

R represents the number of times that the paddles have moved and reached the distance L in one working cycle of vibration.

According to a specific implementation of the embodiment of the present application, when the number of electroplating chambers of the electroplating equipment is an even number, the paddles in the two adjacent electroplating chambers move in opposite directions.

According to a specific implementation of the embodiment of the present application, when the number of electroplating chambers of the electroplating equipment is an even number, define two adjacent electroplating chambers of the same horizontal height as a group, and the paddles in the electroplating chambers of the same group move in opposite directions.

According to a second aspect, a vibration attenuation control method of an electroplating equipment is provided. When the number of electroplating chambers of the electroplating equipment is an even number, the paddles in the two adjacent electroplating chambers move in opposite directions.

According to a specific implementation of the embodiment of the present application, when the number of electroplating chambers of the electroplating equipment is an even number, define two adjacent electroplating chambers of the same horizontal height as a group, the paddles in the electroplating chambers of the same group move in opposite directions.

According to a third aspect, a vibration attenuation control apparatus of an electroplating equipment is provided, the apparatus comprising:

an information acquisition unit, used for acquiring the resonance frequency of an electroplating equipment, and sending the resonance frequency of the electroplating equipment to a processing unit;

a processing unit, used for receiving the resonance frequency of the electroplating equipment sent by the information acquisition unit, selecting the working frequency of the paddles based on the resonance frequency of the electroplating equipment,

including determining that the working frequency of the paddles is equal to m times of the resonance frequency, m being a real number within the numerical range $(0, 0.5]$, and the working cycle corresponding to the working frequency of the paddles being less than the process time of the electroplating, wherein, the working frequency of the paddles is the frequency at which the paddles perform the periodic movement in manner of the stepwise reciprocating stepping in the electroplating chamber of the electroplating equipment;

a controlling unit, used for controlling the work of the paddles according to the working frequency of the paddles selected by the processing unit.

According to a specific implementation of the embodiment of the present application, the processing unit is further configured to calculate the generated displacement required for the paddles to move forward once and then move backward once according to the working frequency of the paddles. According to the generated displacement required for the paddles to move forward once and then move backward once, the stepping instruction data of the paddles is generated, and the instruction data is sent to the controlling unit.

According to a specific implementation of the embodiment of the present application, the controlling unit is further configured to receive the stepping instruction data of the generated displacement required for the paddles to move forward once and then move backward once every time sent by the processing unit. The paddles are controlled to act according to the instruction data.

According to a specific implementation of the embodiment of the present application, the electroplating equipment comprises a pre-wetting chamber, an electroplating chamber, a cleaning chamber, a frame of the electroplating equipment and a manipulator.

According to a specific implementation of the embodiment of the present application, the processing unit calculates the generated displacement required for the paddles to move forward once and then move backward once according to the working frequency of the paddles, comprising:

calculating the generated displacement Δ required for the paddles to move forward once and then move backward once every time by using formula 1;

wherein, the formula 1 is:

$$\Delta = L * mf * t1 * R$$

wherein,

L represents the distance between the starting point and the ending point in the vibration process of the paddles in manner of the stepwise reciprocating stepping;

f represents the resonance frequency of the electroplating equipment;

$t1$ represents the length of time spent for the paddles to move forward once and then move backward once every time;

R represents the number of times that the paddles have moved and reached the distance L in one cycle of vibration.

According to a fourth aspect, an electroplating equipment, comprising the vibration attenuation control apparatus of any one of the third aspect.

According to a specific implementation of the embodiment of the present application, when the number of electroplating chambers of the electroplating equipment is an even number, the paddles in two adjacent electroplating chambers move in opposite directions.

According to a specific implementation of the embodiment of the present application, when the number of electroplating chambers of the electroplating equipment is an even number, define two adjacent electroplating chambers of the same horizontal height as a group, the paddles in the electroplating chambers of the same group move in opposite directions.

According to a fifth aspect, an electronic equipment is provided, comprising:

at least one processor; and,

a memorizer, communicatively connected to at least one processor;

wherein, the memorizer stores an instruction executed by at least one processor, the instruction is executed by at least one processor, so that at least one processor can perform the vibration attenuation control method of the electroplating equipment in any of the embodiments of the foregoing first or second aspect.

According to a sixth aspect, a non-transitory computer-readable storage medium is provided. The non-transitory computer-readable storage medium stores a computer instruction. The computer instruction is used for causing the computer to perform the vibration attenuation control method of the electroplating equipment in any of the embodiments of the foregoing first or second aspect.

In terms of the vibration attenuation control method and apparatus for the electroplating equipment and the electronic equipment of the present application, according to different resonance frequencies possessed by different electroplating equipment, the working frequency of the paddles in the electroplating chambers of the electroplating equipment and the vibration modes of the paddles in the different electroplating chambers are controlled in a targeted manner. The influence brought by the vibration of the paddles can be mitigated to a great extent, the stability of the substrate in the actual process environment can be ensured, and the processing quality of the substrate can be guaranteed, thereby improving the yield of the substrate.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to more clearly explain the technical solutions of the embodiments of the present application, the drawings that need to be used in the embodiments will be briefly introduced below. It is obvious that the drawings in the following description are only some embodiments of the present application, and for those of ordinary skill in the art, other drawings can be obtained according to these drawings under the premise without making creative efforts.

FIG. 1 shows a schematic structural view of an electroplating equipment in the prior art;

FIG. 2 shows a schematic view of the position change of the paddles in one cycle when the paddles in the prior art are vibrated in manner of the stepwise reciprocating stepping;

FIG. 3 shows a schematic view of the period during which an electroplating equipment reaches resonance with the paddles in the prior art;

FIG. 4a shows a flow diagram of a vibration attenuation control method of an electroplating equipment according to an embodiment of the present invention;

FIG. 4b shows a flow diagram of a vibration attenuation control method of an electroplating equipment according to another embodiment of the present invention;

FIGS. 5a and 5b show schematic views of the movement situation of the paddles according to embodiments of the present invention;

FIG. 6 shows a schematic view of the vibration period when the working frequency of the paddles is $1/10$ of the resonance frequency of the electroplating equipment according to an embodiment of the present invention;

FIG. 7 shows a schematic view of the movement situation of the paddles in the two electroplating chambers when the electroplating equipment has two electroplating chambers according to an embodiment of the present invention;

FIG. 8 shows a schematic structural view of a vibration attenuation control apparatus for an electroplating equipment according to an embodiment of the present invention;

FIG. 9 shows a timing view of the vibration control of the paddles in the adjacent electroplating chambers according to an embodiment of the present invention; and

FIG. 10 shows a schematic view of the vibration period of the paddles in the adjacent electroplating chambers according to an embodiment of the present invention.

PREFERRED EMBODIMENTS OF THE INVENTION

Hereinafter, the embodiments of the present application are described in detail with reference to the accompanying drawings.

Hereinafter, the embodiments of the present application will be described with specific and concrete embodiments, and those skilled in the art will readily understand other advantages and effects of the present application from the disclosure of the present specification. Obviously, the described embodiments are only a part of the embodiments of the present application, but not all of the embodiments. The present application can also be implemented or applied by other different and specific embodiments, and various details in the present specification can also be modified or changed based on different viewpoints and applications without departing from the spirit of the present application. It should be noted that the following embodiments and features in the embodiments may be combined with each other without conflicting. Based on the embodiments in the present application, all other embodiments obtained by those of ordinary skill in the art under the premise without making creative efforts all belong to the scope of protection of the present application.

It is to be noted that various aspects of embodiments that are within the scope of the appended claims are described below. It should be apparent that the aspects described herein may be embodied in a wide variety of forms, and that any particular structure and/or function described herein is illustrative only. Based on the present application, those skilled in the art will appreciate that one aspect described herein can be implemented independently of any other aspect, and that two or more of these aspects may be combined in various ways. For example, the apparatus may be implemented and/or the method may be practiced using any number of aspects set forth herein. Additionally, the apparatus may be implemented and/or the method may be practiced using other structures and/or functionalities in addition to one or more of all aspects set forth herein.

It should also be noted that the drawings provided in the following embodiments only illustrate the basic concept of the present application in a schematic manner. And only components related to the present application are shown in the drawings instead of drawings according to the number, shape and size of the components in actual implementation. The type, number and proportion of each component in actual implementation may be arbitrarily changed, and the layout of the components may also

be more complicated.

In addition, in the following description, specific details are provided to facilitate a thorough understanding of the embodiments. However, those skilled in the art will appreciate that the described aspects may be practiced without these specific details.

The embodiments of the present application provide a vibration attenuation control method of an electroplating equipment, comprising: acquiring the resonance frequency of the electroplating equipment; based on the resonance frequency of the electroplating equipment, selecting the working frequency of the paddles. When selecting, the working frequency of the paddles is required to be equal to m times of the resonance frequency of the electroplating equipment, m is a real number within the numerical range $(0, 0.5]$, and the working cycle corresponding to the working frequency of the paddles is less than the process time of the electroplating; Wherein, the working frequency of the paddles is the frequency at which the paddles perform the periodic movement in manner of the stepwise reciprocating stepping in the electroplating chambers of the electroplating equipment. The present invention controls the working frequency of the paddles according to the vibration frequency of the whole system in the working process of the electroplating equipment, so as to achieve the purpose of vibration attenuation and stabilizing the substrate in the process of the electroplating equipment, thereby ensuring the processing yield of the substrate.

Hereinafter, the vibration attenuation control method of the electroplating equipment provided by the present invention will be introduced and described in detail through specific embodiments.

Please refer to FIG. 4a, FIG. 4a shows a flow diagram of a vibration attenuation control method of an electroplating equipment according to an embodiment of the present invention. As shown in FIG. 4a, the embodiment of the present application provides the vibration attenuation control method of the electroplating equipment, comprising:

Step S100: acquire the resonance frequency of the electroplating equipment;

Step S200: select the working frequency of the paddles based on the resonance

frequency of the electroplating equipment, and when selecting, it is required that the working frequency is equal to m times of the resonance frequency, m is a real number within the numerical range $(0, 0.5]$, and the working cycle corresponding to the working frequency of the paddles is less than the process time of the electroplating; wherein, the working frequency of the paddles is the frequency at which the paddles perform the periodic movement in manner of the stepwise reciprocating steeping in the electroplating chambers of the electroplating equipment.

The value of m is a value less than or equal to 0.5, and when $m = 0.5$, it means that the working frequency of the paddles is 0.5 times the resonance frequency of the electroplating equipment; when $m = 0.1$, it means that the working frequency of the paddles is 0.1 times the resonance frequency of the electroplating equipment; when $m = 0.01$, it means that the working frequency of the paddles is 0.01 times the resonance frequency of the electroplating equipment. It should be understood that when the value of m is less, the farther the difference between the working frequency of the paddles and the resonance frequency of the electroplating equipment is. The less likely the paddles and electroplating equipment are to achieve resonance, the better the vibration attenuation effect can be achieved. The specific value selected by m will be selected within the range of more than 0 and less than or equal to 0.5 according to the actual process requirements, and is not limited for the time being in the embodiments of the present invention.

It should be understood that the electroplating equipment comprises, but is not limited to, a pre-wetting chamber, an electroplating chamber, a cleaning chamber, a frame of the electroplating equipment, a manipulator and the like, and all components provided in the electroplating equipment are included in the system.

The embodiments of the present invention are described in detail by taking the electroplating equipment to perform the high-speed copper electroplating process as an example.

It is determined that the electroplating equipment is about to perform the high-speed copper electroplating process, and before performing the process, the resonance frequency of the electroplating equipment is measured in advance. The data value of the resonance frequency of the electroplating equipment at the time of performing the

process is measured, and in the embodiments of the present invention, the measured resonance frequency is 1 Hz. The resonance period view of the electroplating equipment is shown in FIG. 3. The vibration period of the electroplating equipment is 1s and the resonance frequency is 1Hz.

From the resonance frequency $f = 1$ Hz of the electroplating equipment acquired in step S100, the working frequency F of the paddles can be selected based on the resonance frequency f . Specifically, in order to ensure the stability of the substrate during the process, it is required that the working frequency of the paddles is staggered from the resonance frequency of the electroplating equipment. The optional treatment method is: reducing the working frequency of the paddles or increasing the working frequency of the paddles. The method adopted by the present invention is: the working frequency F of the paddles is less than the resonance frequency f of the electroplating equipment, and the working frequency F of the paddles is required to be as small as possible. However, in order to realize uniform electroplating in the electroplating process, it is also necessary to consider the factor that the paddles need to complete at least one cycle in the electroplating chambers within one electroplating process time, so as to ensure that each corresponding point on the substrate is blocked cumulatively by the paddles for the equal time in one working cycle. Therefore, on the basis of ensuring that the paddles are infinitely approaching to performing the reciprocating movement, the paddles also need to be able to complete a cycle within the preset electroplating process time. Therefore, when selecting, the working frequency is required to be equal to m times of the resonance frequency, and m is a real number within the numerical range $(0, 0.5]$, that is, $F = mf$. The working frequency of the paddles is $F = mf$.

FIG. 4b shows a flow diagram of a vibration attenuation control method of an electroplating equipment according to an embodiment of the present invention. As shown in FIG. 4b, a vibration attenuation control method of an electroplating equipment according to another embodiment of the present application further includes the step S300: According to the above working frequency F of the paddles, calculate the paddles to move forward once and then move backward once every time, that is, the generated displacement required for one reciprocating stepping. According to the generated displacement required for one reciprocating stepping, the stepping

instruction data of the paddles can be generated. The paddles are controlled to perform the action in manner of the stepwise reciprocating stepping according to the instruction data.

For example, according to the determination of m times of the resonance frequency f of the electroplating equipment as the value of the working frequency F of the paddles in step S100, the generated displacement Δ required for the paddles to move forward once and then move backward once can be calculated by using formula 1, wherein, the formula 1 is expressed as:

$$\Delta = L * mf * t1 * R \quad \text{Formula (1)}$$

Wherein, Δ is the generated displacement caused by the paddles moving forward once and then moving backward once; L represents the distance between the starting point and the ending point in the vibration process of the paddles in manner of the stepwise reciprocating stepping, L is a specific value determined according to the actual size of the machine; m is the value that the working frequency of the paddles is a multiple of the resonance frequency and is a constant value preset according to the actual process needs; f represents the resonance frequency of the electroplating equipment, which is a determined known value before the process is performed; $t1$ represents the length of time that the paddles move forward once and then move backward once every time, that is, the time required for the position of the paddles to generate each Δ . $t1$ is determined by the driving mechanism selected in the actual process, and is a known value in the calculation process. This value can be adjusted by screening the driving mechanism according to the actual process conditions; R is the number of times the paddles have moved and reached the distance L in one working cycle of vibration.

It is worth noting that in the embodiments of the present invention, the ending point in the vibration process of the paddles in manner of the stepwise reciprocating stepping refers to the position that the paddles can move farthest from the starting point during the movement process.

Specifically, since the frequency is the number of times a periodic change is completed in per unit time, the frequency is a quantity that describes the frequency of

periodic movement. Then:

$$F = \frac{1}{T} = mf \quad \text{Formula (2)}$$

Wherein, T is the time required for the paddles to complete a working cycle in the electroplating chambers. The time required for one working cycle in this embodiment refers to the paddles begin to move until each corresponding point on the substrate is cumulatively blocked by the paddles for the first equal time. Please refer to FIG. 5a, FIG. 5b and FIG. 6, divide one working cycle of the paddles in the vibration process into R parts equally, R is 2 or 4, the starting point is point A, the ending point is point B. The ending point B is the ending point in the process of the paddles in manner of the reciprocating stepping, which refers to the position where the paddles can move farthest from the starting point during the movement process. The distance from point A to point B is L, and all the displacement generated by the paddles is one L for each R part of the time.

As mentioned above, in order to avoid resonance between the paddles and the electroplating equipment, it is necessary to stagger the working frequency of the paddles from the resonance frequency of the electroplating equipment. The optional treatment method is: reducing the working frequency of the paddles or increasing the working frequency of the paddles. It can be understood that when the vibration frequency of the paddles is more than or less than the resonance frequency of the electroplating equipment, neither cause resonance of the paddles nor the electroplating equipment, and the problem that the resonance of the existing machine causes the instability of the substrate can be solved. It can be speculated that in order to make the solution more effective, the working frequency of the paddles can be selected to be much more or much less than the resonance frequency in the embodiments of the present invention. In the embodiments of the present invention, “much more than” means that the working frequency of the paddles is at least 1.5 times the resonance frequency of the electroplating equipment; “much less than” means that the working frequency of the paddles is at most 0.5 times the resonance frequency of the electroplating equipment. For example, in the embodiments of the present invention, the control is performed in a manner that limits the working frequency of the paddles to be much less than the resonance frequency. Then it is stipulated that for each L, the

paddles need to go N times in manner of the stepwise reciprocating steeping. When N is a non-integer in the calculation process, a positive integer more than N is automatically taken. It can be concluded that the paddles need to walk $R * L$ to complete a working cycle, that is, $R * N$ times. Define the time spent by the paddles to walk each N as t_1 . It should be understood that the meaning of each N walk in this embodiment is that the paddles move forward one step and move backward one step in the electroplating chambers. Then:

$$T = R * N * t_1 \quad \text{Formula (3)}$$

Combining formula (3) with formula (2) can obtain:

$$F = \frac{1}{T} = \frac{1}{R * N * t_1} = mf$$

The above formula can be deformed to obtain:

$$N = \frac{1}{R * t_1 * mf} \quad \text{Formula (4)}$$

Then in the process from the starting point A to the ending point B or from the ending point B to the starting point A, the generated displacement Δ by the paddles to move forward one step and move backward one step every time is:

$$\Delta = \frac{L}{N} = L * F * t_1 * R = L * mf * t_1 * R \quad \text{Formula (1)}$$

The calculated value Δ is the generated displacement required for the paddles to move forward once and then move backward once every time. Generate the stepping instruction data of the paddles according to the calculated value Δ , and control the paddles to perform the action in manner of the stepwise reciprocating steeping according to the instruction data.

Because the size of the machine is determined, the time t_1 required for the driving mechanism to drive the paddles to move forward one step and move backward one step every time is determined. The L that the paddles need to walk in each working cycle can be preset, that is, after determining the working frequency of the paddles, the control mode of the paddles can be determined through directly calculating the

generated displacement Δ by the paddles to move forward one step and move backward one step every time. Therefore, it can be concluded that in order to solve the problem that the resonance between the paddles and the electroplating equipment causes passive vibration of the related components, which affects the stability of the substrate, thereby affecting the processing yield of the substrate. The present invention calculates the generated displacement required by the paddles to move forward once and then move backward once every time in manner of the stepwise reciprocating stepping by utilizing the resonance frequency of the electroplating equipment, and controls the vibration of the paddles according to the calculated displacement value combined with the size of the actual machine, so as to avoid resonance in the electroplating process and achieve the effect of stabilizing the substrate.

Please refer to FIGS. 5a and 5b, which show schematic views of the movement situation of the paddles in the embodiments of the present invention. Wherein, FIG. 5a shows a schematic view of the movement situation of the paddles when R is 2; FIG. 5b shows a schematic view of the movement situation of the paddles when R is 4.

For example, please refer to FIG. 5a, in the embodiment of the present invention, $L = 10\text{ mm}$, $f = 1\text{ Hz}$, t_1 is set to 0.1 s . The multiple relationship m between the working frequency of the paddles and the resonance frequency takes a value of 0.5 , and in one cycle, L needs to be walked twice, and R is 2 . It can be calculated from formula (1) that the generated displacement Δ required for the paddles to move forward once and then move backward once is that $\Delta = 1\text{ mm}$.

After determining that the generated displacement Δ required for the paddles to move forward once and then move backward once is that $\Delta = 1\text{ mm}$, the generated displacement $\Delta = 1\text{ mm}$ for the paddles to move forward once and then move backward once is used to generate the instruction data of the paddles in manner of the reciprocating stepping. The paddles are controlled to act according to the instruction data. Specifically, when the instruction data of the paddles in manner of the reciprocating stepping is that $\Delta = 1\text{ mm}$, the action mode of controlling the paddles can be: Move 10 mm from point A to point B, then move 9 mm from point B to point A, at this time take the distance of 1 mm from point A as a new starting point, record the new starting point as point A'. Move 10 mm from point A' to point B, and then move 9 mm in the opposite direction to point A' until completes the distance L (10 mm) and reaches

the ending point B. Then, take point B as the starting point, move 10mm from point B to point A, and then move 9mm to point B in the opposite direction. Step $\Delta = 1\text{mm}$ after each reciprocating, so back and forth, it is divided into 10 times to complete 10mm.

For example, please refer to FIG. 5b, in the embodiment of the present invention, $L = 10\text{ mm}$, $f = 1\text{ Hz}$, t_1 is set to 0.1 s . The multiple relationship m between the working frequency of the paddles and the resonance frequency takes a value of 0.5 , and in one cycle, L needs to be walked 4 times, and R is 4. It can be calculated from formula (1) that the generated displacement Δ required for the paddles to move forward once and then move backward once is that $\Delta = 2\text{mm}$.

After determining that the generated displacement Δ required for the paddles to move forward once and then move backward once is that $\Delta = 2\text{ mm}$, the generated displacement $\Delta = 2\text{ mm}$ required for the paddles to move forward once and then move backward once is used to generate the instruction data of the paddles in manner of the reciprocating steeping. The paddles are controlled to act according to the instruction data. Specifically, when the instruction data of the paddles in manner of the reciprocating steeping is that $\Delta = 2\text{mm}$, the movement process of the paddles is divided into four processes, and the process ① is to move from point A to point B; the process ② is to move from point B to point A; the process ③ is to move from point A to point C; the process ④ is to move from point C to point A. The action mode of controlling the paddles in each process is controlled with reference to the control mode in FIG. 5a, and will not be described here.

In the actual process, in order to facilitate the display of the movement trend of the paddles, please refer to FIG. 6, which shows a schematic view of the oscillation period of the paddles that the working frequency of the paddles is $1/10$ of the resonance frequency of the electroplating equipment in the embodiment of the present invention. $1/10$ of the resonance frequency f of the electroplating equipment is determined as the endpoint value of the maximum value of the working frequency F of the paddles. It can be seen from the figure that in the embodiment of the present invention, L is 10 mm , t_1 is 0.1 s , and in one cycle, the paddles need to walk 2 distances of L , and R is 2, which can be calculated from the formula (1) that $\Delta = 0.2\text{ mm}$.

After determining that the generated displacement Δ required for the paddles to

move forward once and then move backward once is that $\Delta = 0.2$ mm, the generated displacement $\Delta = 0.2$ mm required for the paddles to move forward once and then move backward once is used to generate the instruction data of the paddles in manner of the reciprocating stepping. The paddles are controlled to act according to the instruction data. Specifically, please refer to FIG. 6, which shows a schematic view of the movement situation of the paddles in the embodiment of the present invention. As shown in FIG. 5a and FIG. 6, when the instruction data of the paddles in manner of the reciprocating stepping is that $\Delta = 0.2$ mm, the action mode of controlling the paddles can be as follows: Move 10mm from point A to point B, and then move 9.8 mm from point B to point A. At this time, take a distance of 0.2 mm from point A as a new starting point, record the new starting point as point A', move 10mm from point A' to point B, and then move 9.8 mm to point A' in the opposite direction. Step $\Delta = 0.2$ mm each time until completes the distance L (10mm) and reaches the ending point B. Then, take point B as the starting point, move 10mm from point B to point A, and then move 9.8 mm to point B in the opposite direction. Step $\Delta = 0.2$ mm after each reciprocating, so back and forth, and it is divided into 50 times to complete 10mm.

Furthermore, when the number of electroplating chambers of the electroplating equipment is an even number, the paddles in the two adjacent electroplating chambers move in opposite directions, as shown in FIG. 7, which shows a schematic view of the movement situation of the paddles in the two electroplating chambers when there are two electroplating chambers in the embodiment of the present invention. In the present embodiment, when the number of electroplating chambers is an even number, the paddles provided in the electroplating chambers may be vibrated in manner of the stepwise reciprocating stepping as described in the above embodiment, or other vibration manners may be selected. And only the paddles in two adjacent electroplating chambers need to move in opposite directions, so that vibration waves generated when the paddles in the adjacent electroplating chambers vibrate can cancel each other.

Furthermore, when the number of electroplating chambers of the electroplating equipment is an even number, define two adjacent electroplating chambers of the same horizontal height as a group, and the paddles in the electroplating chambers of the same group move in opposite directions. Opposite movement directions can mutually cancel the vibration waves generated by vibration, which can better achieve the effect of

vibration attenuation.

Corresponding to the above method embodiment, please refer to FIG. 8, which shows a schematic structural view of the vibration attenuation control apparatus of the electroplating equipment according to the embodiment of the present invention. As shown in FIG. 8, the embodiment of the present application further provides a vibration attenuation control apparatus of an electroplating equipment, comprising: an information acquisition unit 310, a processing unit 320 and a controlling unit 330.

the information acquisition unit 310, used for acquiring the resonance frequency of the electroplating equipment, and sending the resonance frequency of the electroplating equipment to a processing unit 320;

the processing unit 320, used for receiving the resonance frequency of the electroplating equipment sent by the information acquisition unit 310, selecting the working frequency of the paddles based on the resonance frequency of the electroplating equipment, including determining that the working frequency of the paddles being equal to m times of the resonance frequency, m being a real number within the numerical range $(0, 0.5]$, and the working cycle corresponding to the working frequency of the paddles being less than the process time of the electroplating; wherein, the working frequency of the paddles is the frequency at which the paddles perform the periodic movement in manner of the stepwise reciprocating stepping in the electroplating chamber of the electroplating equipment. Similarly, the data of m value selection is selected within a range of more than 0 and less than or equal to 0.5 according to the actual process requirements, and the specific value is not limited in the embodiment of the present invention.

Furthermore, the processing unit 320 is further configured to calculate the generated displacement required for the paddles to move forward once and then move backward once according to the working frequency of the paddles. According to the generated displacement required for the paddles to move forward once and then move backward once, the stepping instruction data of the paddles is generated, and the instruction data is sent to the controlling unit 330.

the controlling unit 330, used for controlling the work of the paddles according to

the working frequency of the paddles selected by the processing unit 320.

Specifically, the controlling unit 330 receives the stepping instruction data of the generated displacement required for the paddles to move forward once and then move backward once every time sent by the processing unit, and the paddles is controlled to work according to the instruction data.

wherein, the processing unit 320 is further used to calculate the generated displacement Δ required for the paddles to move forward once and then move backward once every time based on the working frequency of the paddles by using formula 1;

wherein, the formula 1 is:

$$\Delta = L * mf * t1 * R \quad \text{Formula (1)}$$

wherein,

Δ is the displacement generated by the paddles moving forward once and then moving backward once; L represents the distance between the starting point and the ending point in the process of the paddles in manner of the stepwise reciprocating stepping; L is a specific value determined according to the actual size of the machine; m is the value that the working frequency of the paddles is a multiple of the resonance frequency and is a constant value preset according to the actual process needs; f represents the resonance frequency of the electroplating equipment, which is a determined known value when the process is determined to be performed; $t1$ represents the length of time spent for the paddles to move forward once and then move backward once every time, that is, the time required for the position of the paddles to generate each Δ . $t1$ is determined by the driving mechanism selected in the actual process, and is a known value in the calculation process. This value can be adjusted by screening the driving mechanism according to the actual process conditions; R is the number of times the paddles have moved and reached the distance L in one cycle of vibration.

Furthermore, the electroplating equipment comprises a pre-wetting chamber, an electroplating chamber, a cleaning chamber, a frame of the electroplating equipment, a manipulator and the like.

With the increase of high-speed electroplating demand, after the high-speed copper electroplating equipment, the high-speed tin-silver electroplating equipment has become the standard configuration. More and more electroplating chambers with high-speed oscillating paddles are configured on the same electroplating equipment. Taking a certain electroplating equipment as an example, there were 8 copper electroplating chambers before, and now 4 tin-silver electroplating chambers have been added, and there are 12 electroplating chambers with paddles in total. However, as the requirements for electroplating uniformity become higher and higher, the form of the movement of the paddles needs to adopt the oscillation mode in manner of the stepwise reciprocating steeping, which further intensifies the vibration intensity. Therefore, the embodiment of the present application further provides an electroplating equipment, comprising the above-described vibration attenuation control apparatus.

Furthermore, when the number of electroplating chambers of the electroplating equipment is an even number, the paddles in two adjacent electroplating chambers move in opposite directions. Two adjacent electroplating chambers include not only adjacent in the same horizontal height direction, but also adjacent in the vertical height direction. Furthermore, in this embodiment, when the number of electroplating chambers of the electroplating equipment is an even number, define two adjacent electroplating chambers of the same horizontal height as a group, and the paddles in the electroplating chambers of the same group move in opposite directions. The paddles in two adjacent electroplating chambers oscillate in opposite directions, thereby avoiding resonance between the paddles and the electroplating equipment, so as to achieve the purpose of reducing the vibration of each module of the electroplating equipment and thereby stabilizing the electroplating equipment.

Specifically, the vibration of the paddles is affected by the process state within the electroplating chambers as well as the control instruction.

Next, a method of controlling the opposite direction of the oscillation of the paddles in two adjacent electroplating chambers will be described in detail with reference to FIGS. 7, 8 and 9. Two adjacent electroplating chambers in FIG. 7 are defined as the chamber A and chamber B respectively. The controlling steps of the opposite direction of the vibration of the paddles in the two adjacent electroplating chambers comprise:

①.The controlling unit 330 detects the process state of the chamber A and chamber B;

when the process state of the chamber A or chamber B is in progress, the controlling unit 330 directly controls the paddles provided in the chamber A and the chamber B to move in opposite directions with the same moving speed and the same acceleration;

when the process state of the chamber A is in progress, and the process state of the chamber B is idle, the controlling unit 330 similarly controls the paddles provided in the chamber A and the chamber B to move in opposite directions with the same moving speed and the same acceleration;

similarly, when the process state of the chamber B is in progress, and the process state of the chamber A is idle, the controlling unit 330 still controls the paddles provided in the chamber A and the chamber B to move in opposite directions with the same moving speed and the same acceleration;

②.The controlling unit 330 detects the control instruction of the driving mechanism connected to the paddles in the chamber A and the chamber B, and the driving mechanism in the present embodiment may be a motor;

when the controlling unit 330 detects that the control instruction of the driving mechanism connected to the paddles in the chamber A or the chamber B is to start the driving mechanism to drive the paddles to vibrate, the controlling unit 330 directly controls the paddles provided in the chamber A and the chamber B to move in opposite directions with the same moving speed and the same acceleration.

when the controlling unit 330 detects two adjacent electroplating chambers, the process state of any one of the electroplating chambers in the exemplary chamber A and chamber B is a process-in-progress state; or,

when the controlling unit 330 detects two adjacent electroplating chambers, the control instruction of the driving mechanism connected to the paddles in any one of

the electroplating chambers in the exemplary chamber A and chamber B is to start the driving mechanism to drive the paddles to vibrate, the controlling unit 330 both controls the paddles provided in two adjacent electroplating chambers to move in opposite directions with the same moving speed and the same acceleration. Hence, the vibration waves generated by the paddles in the adjacent electroplating chambers cancel each other, and the paddles and the electroplating equipment are avoided from reaching resonance, so as to achieve the purpose of reducing the vibration of each module of the electroplating equipment and thereby stabilizing the electroplating equipment. When and only when the controlling unit 330 detects that the process states of the two adjacent electroplating chambers are both in the idle state and the controlling unit 330 detects that the control instruction of the driving mechanism connected to the paddles in the two adjacent electroplating chambers is closed, the controlling unit 330 controls the paddles in the electroplating chambers to stop vibrating.

Specifically, as shown in FIGS. 7 and 9, wherein, FIG. 9 shows a timing view of the vibration control in adjacent electroplating chambers in the embodiment of the present invention. At time t_1 , the process states of chamber A and chamber B are both idle, at this time, both the control instruction of the driving mechanism connected to the paddles in the chamber A and chamber B are closed, the paddles in each chamber are both in a state of stopping working, and the position instruction of the paddles in the chamber A and chamber B are the same as the position instruction in the initial state; In the period t_1 - t_2 , the process state of the chamber A changes to the process-in-progress state, and the process state of the chamber B is still idle. In the period t_1 - t_2 , the controlling unit 330 receives the control instruction of the driving mechanism connected to the paddles in the chamber A is to start the driving mechanism to drive the paddles to vibrate. When the control instruction of the driving mechanism connected to the paddles in the chamber B is closed, at this time, the controlling unit 330 controls the paddles in the chamber A and in the chamber B to move in opposite directions with the same moving speed and the same acceleration.

In the period t_2 - t_3 , the controlling unit 330 detects that the process states of the chamber A and the chamber B are both in progress. And the controlling unit 330 detects that the control instruction of the driving mechanism connected to the paddles in the two adjacent electroplating chambers is to start the driving mechanism to drive the

paddles to vibrate, at this time, the controlling unit 330 controls the paddles in the chamber A and the chamber B to move in opposite directions with the same moving speed and the same acceleration.

In the period t3-t4, the controlling unit 330 detects that the process state of the chamber A is an idle state and the process state of the chamber B is a process in progress. The controlling unit 330 detects that the control instruction of the driving mechanism connected to the paddles in the chamber A is closed, and the control instruction of the driving mechanism connected to the paddles in the chamber B is to start the driving mechanism to drive the paddles to vibrate, at this time, the controlling unit 330 controls the paddles in the chamber A and in the chamber B to move in opposite directions with the same moving speed and the same acceleration.

In the period t4-t5, the controlling unit 330 detects that the process states of the chamber A and the chamber B are both in progress, and the controlling unit 330 detects that the control instruction of the driving mechanism connected to the paddles in the chamber A and the chamber B is both to start the driving mechanisms to drive the paddles to vibrate, at this time, the controlling unit 330 controls the paddles in the chamber A and the chamber B to move in opposite directions with the same moving speed and the same acceleration.

In the period t5-t6, the controlling unit 330 detects that the process state of the chamber A is idle, and the process state of the chamber B is in progress. The controlling unit 330 detects that the control instruction of the driving mechanism connected to the paddles in the chamber A is closed, and the control instruction of the driving mechanism connected to the paddles in the chamber B is to start the driving mechanism to drive the paddles to vibrate, at this time, the controlling unit 330 controls the paddles in the chamber A and in the chamber B to move in opposite directions with the same moving speed and the same acceleration.

In the period t6-t7, the controlling unit 330 detects that the process states of the two adjacent electroplating chambers A and B are both idle, and when the controlling unit 330 detects that the control instruction of the driving mechanism connected to the paddles in the two adjacent electroplating chambers A and B are both closed, the controlling unit 330 controls the paddles in the electroplating chambers to stop

vibrating.

In the above process, the vibration period of the paddles in the chamber A and the chamber B is shown in FIG. 10, and FIG. 10 shows a schematic view of the vibration period of the paddles in the adjacent electroplating chambers according to the embodiment of the present invention.

The embodiment of the present application further provides an electronic equipment, comprising:

at least one processor; and

a memorizer communicatively connected to at least one processor;

wherein, the memorizer stores an instruction executed by at least one processor, the instruction is executed by at least one processor, so that at least one processor can perform the vibration attenuation control method of the electroplating equipment in the aforementioned method embodiment.

The embodiment of the present application also provides a non-transitory computer-readable storage medium. The non-transitory computer-readable storage medium stores a computer instruction, and the computer instruction is used for causing the computer to execute the vibration attenuation control method of the electroplating equipment in the aforementioned method embodiment.

The embodiment of the present application also provides a computer program product. The computer program product includes the computer program stored on the non-transitory computer-readable storage medium. The computer program includes program instruction, when the program instruction is executed by the computer, can cause the computer to execute the vibration attenuation control method of the electroplating equipment in the aforementioned method embodiment.

When the vibration attenuation control method of the electroplating equipment is implemented as the computer program, the computer program may also be stored in the computer-readable storage medium as a product. For example, the computer-readable storage medium may include, but are not limited to, magnetic storage devices

(e.g., hard disks, floppy disks, magnetic strips), optical disks (e.g., compact disks (CD), digital versatile disks (DVD)), smart cards and flash memory devices (e.g., electrically erasable programmable read-only memory (EPROM), cards, sticks, key drives). Besides, the various storage medium described herein can represent one or more devices and/or other machine-readable medium for storing information. The term “machine-readable medium” may include, but are not limited to, wireless channels and various other medium (and/or storage medium) capable of storing, including, and/or carrying code and/or instruction, and/or data.

It should be understood that the embodiments described above are merely illustrative. The embodiments described herein may be implemented in hardware, software, firmware, middleware, microcode or any combination thereof. For hardware implementations, the processor may be implemented within one or more application-specific integrated circuits (ASIC), digital signal processors (DSP), digital signal processing devices (DSPD), programmable logic devices (PLD), field programmable gate arrays (FPGA), processors, controllers, microcontrollers, microprocessors, and/or other electronic units designed to perform the functions described herein, or combinations thereof.

Some aspects of the present application may be executed entirely by hardware, may be executed entirely by software (including firmware, resident software, microcode, etc.), or may be executed by a combination of hardware and software. Each of the above hardware or software may be referred to as a “data block”, “module”, “engine”, “unit”, “component” or “system”. The processor may be one or more application specific integrated circuits (ASIC), digital signal processors (DSP), digital signal processing devices (DAPD), programmable logic devices (PLD), field programmable gate arrays (FPGA), processors, controllers, microcontrollers, microprocessors, or combinations thereof. Besides, aspects of the present application may be embodied as a computer product located in one or more computer-readable medium, and the product includes computer-readable program encoding. For example, the computer-readable medium may include, but are not limited to, magnetic storage devices (e.g., hard disks, floppy disks, magnetic tapes...), optical disks (e.g., compact disks CD, digital versatile disks DVD...), smart cards, and flash memory devices (e.g., cards, sticks, key drives...).

The computer-readable medium may include a propagated data signal comprising the computer program encoding therein, for example, on a baseband or as a part of the carrier wave. The propagated signal may take a variety of manifestations, including electromagnetic forms, optical forms, and the like, or suitable combinations. The computer-readable medium may be any computer-readable medium other than the computer-readable storage medium that may be connected to an instruction execution system, apparatus, or equipment to enable communication, propagation, or transmission of the program for use. The program encoding located on the computer-readable medium may be propagated through any suitable medium, including radio, cable, fiber optic cable, radio frequency signal, or similar medium, or a combination of any of the foregoing.

The flow diagrams and block diagrams in the drawings illustrate the architecture, functionality and operation of possible implementations of the system, method, and computer program product in accordance with various embodiments of the present disclosure. In this regard, each block in the flow diagrams or block diagrams may represent a module, program segment, or portion of code that contains one or more executable instruction for implementing the specified logical function. It should also be noted that, in some alternative implementations, the functions noted in the block may also occur in the different order than noted in the figures. For example, two blocks represented in succession may actually be executed substantially in parallel, and the two blocks may sometimes be executed in reverse order, depending on the function involved. It is also noted that each block in the block diagrams and/or flow diagrams, and combinations of blocks in the block diagrams and/or flow diagrams, may be implemented with a dedicated hardware-based system that performs the specified functions or operations, or may be implemented with a combination of dedicated hardware and computer instruction.

The related units described in the embodiments of the present application may be implemented by software or hardware. Wherein, the name of the unit does not constitute a limitation of the unit itself in some cases.

The above is merely the specific embodiments of the present disclosure, but the scope of protection of the present disclosure is not limited thereto, and any changes or substitutions that can be easily conceived by those skilled in the art within the technical

scope of the present disclosure should be covered within the scope of protection of the present disclosure. Therefore, the scope of protection of the present disclosure should be subject to the scope of protection of the claims.

What is claimed is:

1. A vibration attenuation control method of an electroplating equipment, comprising:

acquiring the resonance frequency of the electroplating equipment;

selecting the working frequency of paddles of the electroplating equipment based on the resonance frequency, the working frequency being equal to m times of the resonance frequency, m being a real number within the numerical range (0, 0.5], and the working cycle corresponding to the working frequency of the paddles being less than the process time of the electroplating;

wherein, the working frequency is the frequency at which the paddles perform the periodic movement in manner of the stepwise reciprocating stepping in an electroplating chamber of the electroplating equipment.

2. The vibration attenuation control method of the electroplating equipment according to claim 1, wherein,

the electroplating equipment comprises a pre-wetting chamber, an electroplating chamber, a cleaning chamber, a frame of the electroplating equipment and a manipulator.

3. The vibration attenuation control method of the electroplating equipment according to claim 1, further comprising: after selecting the working frequency of the paddles, calculating the generated displacement Δ required for the paddles to move forward once and then move backward once based on the working frequency by using formula 1;

wherein, the formula 1 is:

$$\Delta = L * mf * t1 * R$$

wherein,

L represents the distance between the starting point and the ending point in the vibration process of the paddles in manner of the stepwise reciprocating stepping;

f represents the resonance frequency of the electroplating equipment;

t_1 represents the length of time spent for the paddles to move forward once and then move backward once every time;

R represents the number of times that the paddles have moved and reached the distance L in one working cycle of vibration.

4. The vibration attenuation control method of the electroplating equipment according to claim 1, wherein,

when the number of electroplating chambers of the electroplating equipment is an even number, the paddles in two adjacent electroplating chambers move in opposite directions.

5. The vibration attenuation control method of the electroplating equipment according to claim 4, wherein,

when the number of electroplating chambers of the electroplating equipment is an even number, define two adjacent electroplating chambers of the same horizontal height as a group, and the paddles in the electroplating chambers of the same group move in opposite directions.

6. A vibration attenuation control method of an electroplating equipment, comprising:

when the number of electroplating chambers of the electroplating equipment is an even number, paddles in two adjacent electroplating chambers move in opposite directions.

7. The vibration attenuation control method of the electroplating equipment

according to claim 6, wherein,

when the number of electroplating chambers of the electroplating equipment is an even number, define two adjacent electroplating chambers of the same horizontal height as a group, and the paddles in the electroplating chambers of the same group move in opposite directions.

8. A vibration attenuation control apparatus of an electroplating equipment, comprising:

an information acquisition unit, used for acquiring the resonance frequency of the electroplating equipment, and sending the resonance frequency of the electroplating equipment to a processing unit;

a processing unit, used for receiving the resonance frequency of the electroplating equipment sent by the information acquisition unit, selecting the working frequency of paddles based on the resonance frequency of the electroplating equipment, including determining that the working frequency of the paddles being equal to m times of the resonance frequency, m being a real number within the numerical range $(0, 0.5]$, and the working cycle corresponding to the working frequency of the paddles being less than the process time of the electroplating; wherein, the working frequency of the paddles is the frequency at which the paddles perform the periodic movement in manner of the stepwise reciprocating stepping in an electroplating chamber of the electroplating equipment;

a controlling unit, used for controlling the work of the paddles according to the working frequency of the paddles selected by the processing unit.

9. The vibration attenuation control apparatus of the electroplating equipment according to claim 8, wherein,

the processing unit is further configured to calculate the generated displacement required for the paddles to move forward once and then move backward once according to the working frequency of the paddles, according to the generated displacement required for the paddles to move forward once and then move backward

once, the stepping instruction data of the paddles is generated, and the instruction data is sent to the controlling unit.

10. The vibration attenuation control apparatus of the electroplating equipment according to claim 9, wherein,

the controlling unit is further configured to receive the stepping instruction data of the generated displacement required for the paddles to move forward once and then move backward once every time sent by the processing unit, the paddles are controlled to act according to the instruction data.

11. The vibration attenuation control apparatus of the electroplating equipment according to claim 8, wherein,

the electroplating equipment comprises a pre-wetting chamber, an electroplating chamber, a cleaning chamber, a frame of the electroplating equipment and a manipulator.

12. The vibration attenuation control apparatus of the electroplating equipment according to claim 9, wherein,

the processing unit calculates the generated displacement required for the paddles to move forward once and then move backward once every time according to the working frequency of the paddles, comprising:

calculating the generated displacement Δ required for the paddles to move forward once and then move backward once every time by using formula 1;

wherein, the formula 1 is:

$$\Delta = L * mf * t1 * R$$

wherein,

L represents the distance between the starting point and the ending point in the vibration process of the paddles in manner of the stepwise reciprocating stepping;

f represents the resonance frequency of the electroplating equipment;

t_1 represents the length of time spent for the paddles to move forward once and then move backward once every time;

R represents the number of times that the paddles have moved and reached the distance L in one cycle of vibration.

13. An electroplating equipment, comprising a vibration attenuation control apparatus according to any one of claims 8 to 12.

14. The electroplating equipment according to claim 13, wherein,

when the number of electroplating chambers of the electroplating equipment is an even number, the paddles in two adjacent electroplating chambers move in opposite directions.

15. The electroplating equipment according to claim 14, wherein,

when the number of electroplating chambers of the electroplating equipment is an even number, define two adjacent electroplating chambers of the same horizontal height as a group, and the paddles in the electroplating chambers of the same group move in opposite directions.

16. An electronic equipment, comprising:

at least one processor; and,

a memorizer, communicatively connected to at least one processor;

wherein, the memorizer stores an instruction executed by at least one processor, the instruction is executed by at least one processor, so that at least one processor can perform the vibration attenuation control method of the electroplating equipment of any one of preceding claims 1-5 and 6-7.

17. A non-transitory computer-readable storage medium, storing a computer instruction, and the computer instruction is used to cause the computer to perform the

vibration attenuation control method of the electroplating equipment of any of the preceding claims 1-5 and 6-7.