

MOISTURE REMOVAL DEVICE AND ELECTROPLATING APPARATUS

FIELD OF THE INVENTION

The present application relates to the field of electroplating, and in particular, to a moisture removal device and an electroplating apparatus.

BACKGROUND

After a wafer is electroplated in an electroplating tank of an electroplating chamber, the wafer needs to be cleaned to remove the electroplating solution on the wafer. During the wafer cleaning process, a portion of the deionized water (DIW) used for cleaning the wafer is discharged out of the electroplating chamber, and another portion falls into the electroplating tank and flows back to a liquid storage tank along with the circulation of the electroplating solution, thereby causing the concentration of the electroplating solution in the liquid storage tank to decrease and fail to meet the specified concentration range. When the electroplating solution is circulated from the liquid storage tank to the electroplating tank again for the electroplating process, the electroplating solution that does not meet the concentration requirement will have an adverse effect on the electroplating quality. Therefore, when the concentration of the electroplating solution in the liquid storage tank is lower than the standard concentration range, the excess moisture in the liquid storage tank needs to be removed to make the concentration of the electroplating solution meet the standard range.

SUMMARY

In a first aspect, an embodiment of the present application provides a moisture removal device, comprising:

a housing, a cover plate being disposed on the top of the housing;

a first liquid inlet pipeline, disposed on the cover plate and configured to receive a liquid to be subjected to moisture removal;

a first flow distribution plate, disposed below the cover plate and inside the housing, and configured to distribute the liquid entering the housing through the first

liquid inlet pipeline;

a plurality of flow guide plates, mounted on the first flow distribution plate, the distributed liquid flowing along the flow guide plates;

an intake port, configured to supply gas to a gap between adjacent flow guide plates;

a discharge port, configured to discharge the gas flowing through the gap between the adjacent flow guide plates.

In a second aspect, an embodiment of the present application further provides an electroplating apparatus, comprising an electroplating chamber, a liquid storage tank, and the moisture removal device according to the first aspect, wherein the moisture removal device is configured to receive the electroplating solution from the electroplating chamber and perform moisture removal treatment on the electroplating solution, and the electroplating solution after the moisture removal treatment flows into the liquid storage tank.

The details of one or more embodiments of the present application are set forth in the accompanying drawings and the descriptions below to make other features, purposes, and advantages of the present application more concise and understandable.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings described herein are used to provide a further understanding of the present application and form a part of the present application. The illustrative embodiments of the present application and the descriptions of the embodiments are used to explain the present application and do not constitute an improper limitation of the present application. In the accompanying drawings:

FIG. 1 is a cross-sectional front view of a moisture removal device according to the first embodiment of the present application;

FIG. 2 is a cross-sectional left view of the moisture removal device according to the first embodiment of the present application;

FIG. 3 is a schematic structural view of a second flow distribution plate according to an embodiment of the present application;

FIG. 4 is a schematic structural view of a first flow distribution plate according to an embodiment of the present application;

FIG. 5 is a cross-sectional view of a first flow distribution plate according to an embodiment of the present application;

FIG. 6 is a schematic structural view of a first flow distribution plate according to an embodiment of the present application;

FIG. 7 is a schematic structural view of flow guide plates according to an embodiment of the present application;

FIG. 8 is a top view of flow guide plates according to an embodiment of the present application;

FIG. 9 is a top view of flow guide plates according to another embodiment of the present application;

FIG. 10 is a schematic three-dimensional structural view of a moisture removal device according to the second embodiment of the present application;

FIG. 11 is a structural block diagram of an electroplating apparatus according to an embodiment of the present application; and

FIG. 12 is a structural block diagram of an electroplating apparatus according to another embodiment of the present application.

PREFERRED EMBODIMENTS OF THE INVENTION

To further clarify the objectives, technical solutions, and advantages of the present application, the present application is described and illustrated below with reference to the accompanying drawings and embodiments. It should be understood that the specific embodiments described herein are only used to explain the present application

and are not intended to limit the present application. All other embodiments obtained by those of ordinary skill in the art based on the embodiments provided in the present application without making creative efforts, shall fall within the protection scope of the present application. In addition, it can be understood that although the efforts made in such a development process may be complex and time-consuming, for those of ordinary skill in the art related to the content disclosed in the present application, any variations in design, manufacturing, or production based on the technical content disclosed in the present application are only conventional technical means and shall not be construed as insufficient disclosure of the present application.

In the embodiments of the present application, the liquid to be subjected to moisture removal is taken as an electroplating solution by way of example.

According to FIG. 1, an embodiment of the present application provides a moisture removal device 100, the moisture removal device 100 can be applied to an electroplating apparatus, and the structure of the moisture removal device 100 will be described later. FIG. 11 shows an electroplating apparatus comprising the moisture removal device 100. As shown in FIG. 11, the electroplating apparatus comprises the moisture removal device 100, a liquid storage tank 300, an electroplating chamber 200, a negative pressure device 500, and a filtering device 600. The moisture removal device 100 includes flow guide plates 13, discharge ports 15, and a first liquid inlet pipeline 11. The bottom of the flow guide plates 13 is immersed in the electroplating solution of the liquid storage tank 300. The moisture removal device 100 is configured to receive the electroplating solution from the electroplating chamber 200 and perform moisture removal treatment on the electroplating solution, and the electroplating solution after the moisture removal treatment flows into the liquid storage tank 300 through the flow guide plates 13, so that the concentration of the electroplating solution of the liquid storage tank 300 can reach a preset standard concentration, thereby enabling the electroplating solution in the liquid storage tank 300 to be supplied to the electroplating chamber 200 again for reuse. In one embodiment, the moisture removal device 100 may be disposed in the liquid storage tank 300. The filtering device 600 is connected between the first liquid inlet pipeline 11 and the electroplating chamber 200, and is configured to filter the electroplating solution from the electroplating chamber 200 to filter out impurities in the electroplating solution. The negative pressure device

500 is connected to the discharge ports 15 of the moisture removal device 100, and is configured to adjust the gas pressure in the moisture removal device 100 to a negative pressure.

In this embodiment, by using the negative pressure device 500 to adjust the gas pressure in the moisture removal device 100 to a negative pressure, it is advantageous for gas to enter the moisture removal device 100 and carry away moisture from the electroplating solution. It should be noted that the magnitude of the negative pressure in the moisture removal device 100 can be adjusted by controlling the negative pressure device 500, thereby adjusting the gas flow rate and achieving the adjustment of the moisture removal efficiency. In this embodiment, the negative pressure device 500 may be an exhaust pump.

In this embodiment, the filtering device 600 is used to filter the electroplating solution flowing from the electroplating chamber 200 to the moisture removal device 100, which can reduce impurities in the electroplating solution and improve the purity of the electroplating solution.

FIG. 1 is a cross-sectional view of a moisture removal device 100 according to an embodiment of the present application. As shown in FIG. 1, the moisture removal device 100 includes a housing 10, a first liquid inlet pipeline 11, a first flow distribution plate 12, flow guide plates 13, an intake port 14, and discharge ports 15.

The housing 10 is a cuboid, the top of the housing 10 is provided with an opening, and a cover plate 22 is disposed at the opening on the top of the housing 10 to seal the opening on the top of the housing 10. The interior of the housing 10 is divided into a first space 21 and a second space 30 by a partition plate 40, and the partition plate 40 is provided with openings.

The first liquid inlet pipeline 11 is disposed on the cover plate 22, and is configured to receive the electroplating solution from the electroplating chamber 200 in FIG. 11 into the second space 30 of the housing 10.

The first flow distribution plate 12 is disposed below the cover plate 22 and in the second space 30 of the housing 10, and is configured to distribute the electroplating

solution entering the housing 10 through the first liquid inlet pipeline 11. Since the electroplating solution entering the housing 10 through the first liquid inlet pipeline 11 is relatively concentrated, the first flow distribution plate 12 is disposed, so that the electroplating solution entering through the first liquid inlet pipeline 11 flows onto the first flow distribution plate 12 and then disperses along the surface of the first flow distribution plate 12, so as to achieve the effect of dispersing the electroplating solution, thereby facilitating the evaporation of moisture in the electroplating solution.

The intake port 14 is disposed on the cover plate 22. One end of the intake port 14 is in communication with ambient air, and the other end of the intake port 14 is in communication with the first space 21. The ambient air enters the first space 21 through the intake port 14, and then enters the second space 30 through the openings on the partition plate 40.

According to FIGS. 1 and 2, the top of the flow guide plates 13 is disposed on the first flow distribution plate 12 and in the second space 30, and the flow guide plates 13 are arranged parallel to the flow direction of the air entering the second space 30 from the first space 21, so that the air can pass through the gap between the adjacent flow guide plates 13 and carry away water vapor. The bottom of the flow guide plates 13 penetrates through the bottom of the housing 10 and is immersed in the electroplating solution of the liquid storage tank 300 (as shown in FIG. 11), and is configured to make the electroplating solution after moisture removal flow into the liquid storage tank 300 storing the electroplating solution along the bottom of the flow guide plates 13. A plurality of flow guide plates 13 are disposed to increase the contact area between water in the electroplating solution and the air entering the second space 30 from the first space 21, thereby improving the efficiency of moisture evaporation in the electroplating solution.

With continued reference to FIGS. 1 and 2, the discharge ports 15 are disposed on the side wall of the housing 10, the discharge ports 15 are disposed opposite to the openings on the partition plate 40, and are connected to the negative pressure device 500 in FIG. 11 and in communication with the second space 30. The negative pressure device 500 adjusts the interior of the moisture removal device 100 to a negative pressure through the discharge ports 15, so that air can enter the first space 21 through the intake port 14 and enter the second space 30 through the openings on the partition

plate 40, so as to discharge the water vapor in the electroplating solution on the flow guide plates 13 in the second space 30. In this way, the air carries away the water vapor, so as to achieve the effect of discharging the water vapor.

In this embodiment, after the electroplating solution enters the moisture removal device 100 through the first liquid inlet pipeline 11, the electroplating solution is distributed by the first flow distribution plate 12. After distribution, the electroplating solution flows onto the flow guide plates 13 and flows down along the side walls of the flow guide plates 13. During this process, ambient air is sucked into the moisture removal device 100 through the intake port 14 on the cover plate 22. When the air is discharged from the discharge ports 15 through the intake port 14, the first space 21, and the gap between the adjacent flow guide plates 13 in the second space 30, the air can carry away the excess moisture in the electroplating solution, thereby realizing the evaporation of water in the electroplating solution to increase the concentration of the electroplating solution, so that the concentration of the electroplating solution can reach a preset standard concentration.

In the above embodiment, the efficiency of water vapor removal can be improved by adjusting the interior of the moisture removal device 100 to a negative pressure to suck in air for carrying away the water vapor attached to the flow guide plates 13 in the electroplating solution. Secondly, by setting the surface of the flow guide plate 13 to the styles shown in FIGS. 8 and 9, the area where water vapor attaches to the flow guide plate 13 can be increased, thereby further improving the efficiency of air carrying away water vapor.

As shown in FIG. 1, in this embodiment, the moisture removal device 100 further includes sealing rings 16, and the sealing rings 16 are disposed between the first liquid inlet pipeline 11 and the cover plate 22 to avoid the problem of electroplating solution leakage caused by the gap between the first liquid inlet pipeline 11 and the cover plate 22.

With continued reference to FIG. 1, the moisture removal device 100 further includes a second flow distribution plate 18, the specific structure of the second flow distribution plate 18 is shown in FIG. 3. The dashed circle in FIG. 3 is the projection of the first liquid inlet pipeline 11 on the second flow distribution plate 18. The second

flow distribution plate 18 is provided with a plurality of through holes. Preferably, the aperture sizes of the plurality of through holes on the second flow distribution plate 18 may gradually increase according to the arrangement direction of the flow guide plates 13. Since the electroplating solution tends to concentrate at the position corresponding to the first liquid inlet pipeline 11, the diameter of the through hole on the second flow distribution plate 18 at the position corresponding to the first liquid inlet pipeline 11 is smaller than the diameter of the through hole at the position far away from the first liquid inlet pipeline 11, so that the electroplating solution is dispersed on the second flow distribution plate 18 relatively uniformly, so as to realize the preliminary distribution of the electroplating solution.

Preferably, the through holes on the second flow distribution plate 18 may be arranged such that the closer to the first liquid inlet pipeline 11, the smaller the aperture of the through holes.

In some embodiments, the through holes on the second flow distribution plate 18 may be designed in shapes such as triangles, squares, trapezoids, etc., which can implement the solution of the embodiments of the present application, in addition to the circular design shown in FIG. 3.

FIG. 4 is a front structural schematic view of the first flow distribution plate 12, and FIG. 5 is a cross-sectional view of the first flow distribution plate 12. As shown in FIGS. 4 and 5, the first flow distribution plate 12 is provided with a plurality of strip-shaped openings 24 for redistributing the electroplating solution flowing down from the second flow distribution plate 18. The strip-shaped openings 24 may be arranged in multiple rows and/or multiple columns.

In this embodiment, the electroplating solution flows onto the first flow distribution plate 12 through the through holes on the second flow distribution plate 18 for secondary distribution, which can avoid the problem of poor moisture removal effect in the electroplating solution caused by excessive concentration of the electroplating solution. In addition, the distribution efficiency of the electroplating solution can be improved by arranging the strip-shaped openings 24 on the first flow distribution plate 12, so as to improve the moisture removal efficiency.

FIG. 6 is a back structural schematic view of the first flow distribution plate 12. As shown in FIG. 6, the back of the first flow distribution plate 12 is provided with a plurality of strip-shaped grooves 23, and each strip-shaped groove 23 is located on the same straight line with each strip-shaped opening 24. The flow guide plates 13 (as shown in FIGS. 1 and 7) are embedded and fixed on the first flow distribution plate 12 through the strip-shaped grooves 23.

In this embodiment, by embedding and fixing the flow guide plates 13 on the first flow distribution plate 12 through the strip-shaped grooves 23, the electroplating solution can flow directly onto the flow guide plates 13 along the strip-shaped openings 24, avoiding the problem of dripping and splashing of the electroplating solution caused by the gap between the first flow distribution plate 12 and the flow guide plates 13.

In this embodiment, the width of the strip-shaped openings 24 is generally larger than the width of the flow guide plates 13, and preferably, the range of the difference between the width of the strip-shaped openings 24 and the width of the flow guide plates 13 is 2 mm to 5 mm. In this way, the electroplating solution can flow onto the flow guide plates 13 from the strip-shaped openings 24 conveniently.

To further increase the moisture evaporation area, in some embodiments, as shown in FIG. 7, vertical strip-shaped grooves 25 may also be disposed on the flow guide plates 13.

In this embodiment, the strip-shaped grooves 25 may be arranged as arc-shaped grooves, the cross-sectional shape of the strip-shaped grooves 25 is shown in the top view of the flow guide plates in FIG. 8. In another embodiment, the strip-shaped grooves 25 may also be arranged as triangular grooves, the cross-sectional shape of the strip-shaped grooves 25 is shown in the top view of the flow guide plates in another embodiment in FIG. 9.

It should be noted that in some embodiments, the cross-sectional shape of the strip-shaped grooves 25 may also be trapezoidal, square, etc., to further increase the moisture evaporation area.

In this embodiment, at least the surface of the flow guide plates 13 is preferably made of a hydrophilic material. In this way, water in the electroplating solution can be effectively adsorbed, so that more moisture can be carried away when air passes through the gap between the adjacent flow guide plates 13, so as to improve the efficiency of water evaporation in the electroplating solution.

With continued reference to FIG. 1, in this embodiment, the housing 10 is further provided with overflow holes 19, and the overflow holes 19 are disposed between the second flow distribution plate 18 and the cover plate 22. By providing the overflow holes 19, when the flow rate of the electroplating solution in the moisture removal device 100 is excessively high, the electroplating solution can flow into the electroplating tank 300 through the overflow holes 19, and at the same time, the risk of the electroplating solution overflowing from the first liquid inlet pipeline 11 can be avoided.

It should be noted that a plurality of overflow holes 19 may be disposed between the second flow distribution plate 18 and the cover plate 22.

In some embodiments, the partition plate 40 does not need to be disposed in the housing 10, but the intake port 14 is disposed on the other side surface of the housing 10 and opposite to the discharge ports 15, gas is directly supplied to the gap between the adjacent flow guide plates by the intake port 14 and discharged through the discharge ports 15, so as to realize the evaporation of water vapor in the electroplating solution on the flow guide plates 13.

FIG. 12 discloses a schematic structural view of an electroplating apparatus according to another embodiment of the present application. The difference from the electroplating apparatus disclosed in FIG. 11 is that the electroplating apparatus disclosed in FIG. 12 further comprises a circulation loop 400. The circulation loop 400 is a self-circulation pipeline in the liquid storage tank 300, that is, the circulation loop 400 can be understood as a pipeline for keeping the electroplating solution in the liquid storage tank 300 in a flowing state. Specifically, the liquid outlet of the circulation loop 400 is connected to the liquid storage tank 300, the liquid inlet of the circulation loop 400 is also connected to the liquid storage tank 300, and the electroplating solution in the liquid storage tank 300 enters the circulation loop 400 through the liquid outlet of

the circulation loop 400 and enters the liquid storage tank 300 through the liquid inlet of the circulation loop 400, so as to form a self-circulation pipeline of the liquid storage tank 300.

In this embodiment, disposing the circulation loop 400 in the electroplating apparatus has the following advantages:

Advantage 1: The self-circulation of the circulation loop 400 can make the electroplating solution in the liquid storage tank 300 flow, facilitating the sufficient mixing of the electroplating solution in the liquid storage tank 300. For example, when the electroplating solution is added to the liquid storage tank 300, the concentration of the electroplating solution at the inlet where the electroplating solution is added will change greatly, and then the electroplating solution at the inlet can be mixed uniformly through the self-circulation;

Advantage 2: Since the electroplating chamber 200 is open, the electroplating solution flowing back to the liquid storage tank 300 from the electroplating chamber 200 may contain impurities, and then the impurities in the electroplating solution can be filtered out through the filtering equipment of the circulation loop 400 itself.

FIG. 10 is a schematic three-dimensional structural view of the moisture removal device according to the second embodiment of the present application. In this embodiment, the moisture removal device further includes a second liquid inlet pipeline 20. The second liquid inlet pipeline 20 is disposed on the cover plate 22 and connected to the liquid inlet of the circulation loop 400, and is configured to receive the electroplating solution from the circulation loop 400. The electroplating solution in the circulation loop 400 flows into the second space 30 of the housing 10 through the second liquid inlet pipeline 20. In this embodiment, the efficiency of moisture evaporation of the electroplating solution can be improved by receiving the electroplating solution from the circulation loop 400 through the second liquid inlet pipeline 20.

Those skilled in the art should understand that the various technical features of the above embodiments can be combined arbitrarily. For the sake of concise description, not all possible combinations of the various technical features in the above

embodiments have been described. However, any combination of these technical features shall be considered to be within the scope of the present specification, provided that no contradiction arises.

The above embodiments only express several embodiments of the present application, and the descriptions of the embodiments are relatively specific and detailed. However, the descriptions should not be construed as limiting the scope of the invention patent. It should be pointed out that for those of ordinary skill in the art, without departing from the concept of the present application, several modifications and improvements can be made, and these modifications and improvements all fall within the protection scope of the present application. Therefore, the scope of protection of the patent of the present application shall be defined by the appended claims.

What is claimed is:

1. A moisture removal device, comprising:

a housing, a cover plate being disposed on the top of the housing;

a first liquid inlet pipeline, disposed on the cover plate and configured to receive a liquid to be subjected to moisture removal;

a first flow distribution plate, disposed below the cover plate and inside the housing, and configured to distribute the liquid entering the housing through the first liquid inlet pipeline;

a plurality of flow guide plates, mounted on the first flow distribution plate, the distributed liquid flowing along the flow guide plates;

an intake port, configured to supply gas to a gap between adjacent flow guide plates;

a discharge port, configured to discharge the gas flowing through the gap between the adjacent flow guide plates.

2. The moisture removal device according to claim 1, wherein the first flow distribution plate is provided with strip-shaped openings.

3. The moisture removal device according to claim 2, wherein one side of the first flow distribution plate is provided with strip-shaped grooves, each strip-shaped groove is located on the same straight line with each strip-shaped opening, and the flow guide plates are embedded and fixed on the first flow distribution plate through the strip-shaped grooves.

4. The moisture removal device according to claim 3, wherein the width of the strip-shaped openings is larger than the width of the flow guide plates.

5. The moisture removal device according to claim 4, wherein the range of the difference between the width of the strip-shaped openings and the width of the flow

guide plates is 2 mm to 5 mm.

6. The moisture removal device according to claim 1, wherein the flow guide plates are provided with vertical strip-shaped grooves.

7. The moisture removal device according to claim 1, wherein the surface of the flow guide plates is provided with a hydrophilic material.

8. The moisture removal device according to claim 1, wherein the moisture removal device further comprises a second flow distribution plate, the second flow distribution plate is disposed between the first flow distribution plate and the cover plate, and the second flow distribution plate is provided with through holes and configured to perform preliminary distribution on the liquid to be subjected to moisture removal.

9. The moisture removal device according to claim 8, wherein the housing is further provided with an overflow hole, and the overflow hole is disposed between the second flow distribution plate and the cover plate.

10. The moisture removal device according to claim 1, wherein a partition plate is disposed in the housing, the partition plate divides the interior of the housing into a first space and a second space, the partition plate is provided with openings, the intake port is in communication with the first space, the flow guide plates are disposed in the second space, and the intake port supplies gas to the gap between the adjacent flow guide plates through the openings.

11. The moisture removal device according to claim 1, wherein the moisture removal device further comprises a sealing ring, the sealing ring is disposed between the first liquid inlet pipeline and the cover plate.

12. The moisture removal device according to claim 1, wherein a part of the lower end of the flow guide plates is immersed in the liquid to be subjected to moisture removal.

13. An electroplating apparatus, comprising an electroplating chamber, a liquid storage tank, and the moisture removal device according to any one of claims 1 to 12,

the moisture removal device being configured to receive the electroplating solution from the electroplating chamber and perform moisture removal treatment on the electroplating solution, and the electroplating solution after the moisture removal treatment flowing into the liquid storage tank.

14. The electroplating apparatus according to claim 13, wherein the moisture removal device is disposed in the liquid storage tank, and the bottom of the flow guide plates of the moisture removal device is immersed in the electroplating solution in the liquid storage tank.

15. The electroplating apparatus according to claim 13, wherein the electroplating apparatus further comprises a filtering device, the first liquid inlet pipeline of the moisture removal device is connected to the electroplating chamber and configured to receive the electroplating solution from the electroplating chamber and perform moisture removal treatment on the electroplating solution, and the filtering device is disposed between the first liquid inlet pipeline and the electroplating chamber.

16. The electroplating apparatus according to claim 13, wherein the electroplating apparatus further comprises a negative pressure device, and the negative pressure device is connected to the discharge port of the moisture removal device.

17. The electroplating apparatus according to claim 13, wherein the electroplating apparatus further comprises a circulation loop, the circulation loop is a self-circulation pipeline in the liquid storage tank, and the moisture removal device further includes a second liquid inlet pipeline configured to receive the electroplating solution from the circulation loop to perform moisture removal treatment on the electroplating solution in the circulation loop.