

CONNECTING DEVICE, SUBSTRATE HEAT TREATMENT UNIT, AND COATING AND DEVELOPING APPARATUS

TECHNICAL FIELD

The present invention relates to the field of semiconductor processing equipment, and further relates to a connecting device, a substrate heat treatment unit, and a coating and developing apparatus.

BACKGROUND

The lithography process mainly includes a photoresist coating process, an exposure process, a developing process, and a baking process performed among the processes described above.

Amid the development and technological iteration of the semiconductor industry, higher requirements are put forward for the overall size and production capacity of a coating and developing apparatus. Restricted by the design requirements of the overall size of the apparatus, increasing the production capacity means a more compact internal structure of the apparatus, which in turn leads to smaller operating space inside the apparatus and more difficult maintenance.

A heat treatment unit is provided in the coating and developing apparatus for the baking process described above. As shown in FIG. 14, a heat treatment unit 500 includes a plurality of columns of heat treatment modules 510 stacked vertically, each heat treatment module 510 is independent of each other, each column of heat treatment modules 510 is generally configured with a vertical exhaust pipe 520, and each heat treatment module 510 is respectively conductively connected to the corresponding vertical exhaust pipe 520, facilitating timely discharge of hot gas generated in the chamber of the heat treatment module 510 and maintaining the thermal balance within the apparatus. In one aspect, each column of heat treatment modules 510 is connected by the vertical exhaust pipe 520, respectively, which occupies a large space and makes it impossible to add more other processing modules to increase the production capacity of the apparatus; in another aspect, during the maintenance of the heat treatment module 510, the heat treatment module 510 needs to be individually extracted from the

heat treatment unit 500, but the connection between the heat treatment module 510 and the vertical exhaust pipe 520 needs to be disconnected before extracting the heat treatment module 510, complicating disassembly and increasing maintenance costs.

SUMMARY

In view of the technical problems described above, the present invention discloses a connecting device, a substrate heat treatment unit, and a coating and developing apparatus, aiming to reduce the overall size of the heat treatment unit and facilitate maintenance.

In some embodiments, the connecting device is used for connecting adjacent chambers, vent holes are provided on the opposing sides of the adjacent chambers, a preset spacing is provided between the adjacent chambers, and the connecting device is of a tubular structure and is configured to be capable of extending and retracting in the length direction of the connecting device; wherein, in an extended state, the connecting device has a first preset length longer than the preset spacing; in a retracted state, the connecting device has a second preset length shorter than or equal to the preset spacing, so that the connecting device can be installed between the adjacent chambers, and the two ends of the connecting device are respectively connected to the corresponding vent holes for forming an exhaust channel between the adjacent chambers.

In some embodiments, the substrate heat treatment unit includes a plurality of heat treatment modules, each of the heat treatment modules includes a chamber, and the connecting device described above is arranged between at least two of the adjacent heat treatment modules for forming an exhaust channel between the adjacent heat treatment modules.

In some embodiments, the coating and developing apparatus comprises an equipment front end module, a process station, and an interface station connected in sequence, the process station includes: a coating unit, for performing coating treatment on a substrate; a developing unit, for performing developing treatment on the substrate; the substrate heat treatment unit described above; a transfer unit, for transferring the substrate located in the equipment front end module to the coating unit, transferring

the post-coating substrate to the interface station, and transferring the post-developing substrate in the developing unit back to the equipment front end module.

Compared with the prior art, the present invention has the following beneficial effects:

in the present application, adjacent chambers are conductively connected via the connecting device, thereby forming an exhaust channel between adjacent chambers; in addition, the connecting device is applied to the substrate heat treatment unit, and adjacent heat treatment modules are conductively connected via the connecting device, so that adjacent heat treatment modules are mutually conductive, and only one vertical exhaust pipe needs to be installed in the same row of heat treatment modules to extract gas from each heat treatment module in the row, thereby reducing the required number and footprint of the vertical exhaust pipes, and reducing the influence of the number of vertical exhaust pipes on the overall size of the heat treatment unit at the same time; further, the connecting device has different lengths in the extended state and the retracted state, which facilitates the installation or disassembly between the heat treatment modules, and further facilitates the extraction of the heat treatment modules during equipment maintenance.

BRIEF DESCRIPTION OF THE DRAWINGS

The features and performance of the present application will be further described with reference to the following embodiments and accompanying drawings of the embodiments.

The characteristics, technical features, advantages, and implementation modes of the present invention described above will be further described in a clear and understandable manner with reference to the accompanying drawings and preferred embodiments.

FIG. 1 is a schematic view of a connecting device according to an embodiment of the present application;

FIG. 2 is a front view of the connecting device shown in FIG. 1 in an extended state;

FIG. 3 is a front view of the connecting device shown in FIG. 1 in a retracted state;

FIG. 4a is a schematic view of the connecting device shown in FIG. 1 during installation;

FIG. 4b is a view taken in the viewing direction V1 of FIG. 4a;

FIG. 5a is a schematic view of the connecting device shown in FIG. 1 at a preset position;

FIG. 5b is a view taken in the viewing direction V2 of FIG. 5a;

FIG. 6 is an exploded view of the connecting device shown in FIG. 1;

FIG. 7 is a sectional view taken at section C of the connecting device shown in FIG. 1;

FIG. 8 is a schematic view of a heat treatment module according to an embodiment of the present application;

FIG. 9 is a schematic view of a substrate heat treatment unit according to an embodiment of the present application;

FIG. 10 is a left side view of FIG. 9;

FIG. 11 is an exploded view of FIG. 9;

FIG. 12 is a schematic view of a coating and developing apparatus according to an embodiment of the present application;

FIG. 13 is a sectional view taken in direction a-a of FIG. 12;

FIG. 14 is a schematic view of a substrate heat treatment unit.

PREFERRED EMBODIMENTS OF THE PRESENT APPLICATION

To further clarify the embodiments of the present invention or the technical

solutions in the prior art, the specific implementation modes of the present invention will be described below with reference to the accompanying drawings. Obviously, the accompanying drawings in the following description are only some embodiments of the present invention, and for those of ordinary skill in the art, other accompanying drawings and other implementation modes can be obtained according to these accompanying drawings without making creative efforts.

To simplify the drawings, only the parts related to the invention are schematically shown in each drawing, and the parts do not represent the actual structure of the product. In addition, to simplify the drawings and for ease of understanding the drawings, in some drawings, only one of the components with the same structure or function is schematically drawn or only one of the components is marked. In this document, "one" not only means "only one," but also can mean the case of "more than one."

In this document, it should be noted that unless otherwise clearly specified and defined, the terms "install," "interconnect," and "connect" should be understood in a broad sense, for example, the connection can be a fixed connection, a detachable connection, or an integral connection; the connection can be a mechanical connection or an electrical connection; the connection can be a direct connection or an indirect connection through an intermediate medium, and the connection can be an internal communication between two elements. For those of ordinary skill in the art, the specific meanings of the terms described above in the present invention can be understood according to specific situations.

In addition, in the description of the present application, the terms "first," "second," and the like are only used for distinguishing description, and cannot be understood as indicating or implying relative importance.

As shown in FIGS. 1 to 3, a connecting device 130 according to an embodiment of the present application is disclosed, which is used for connecting adjacent chambers 600, vent holes 1121 are formed on the opposing sides of adjacent chambers 600, and a preset spacing $d1$ is provided between adjacent chambers 600. According to FIG. 9, the connecting device 130 can be applied to a substrate heat treatment unit 100, the substrate heat treatment unit 100 includes a plurality of heat treatment modules 110 arranged in horizontal rows, each heat treatment module 110 includes the chamber 600,

the plurality of rows of heat treatment modules 110 are stacked in the vertical direction, and a preset spacing $d1$ is provided between adjacent heat treatment modules 110 in the same row or the same column.

Specifically, the connecting device 130 is of a tubular structure and is configured to be capable of extending and retracting in the length direction s of the connecting device 130. Wherein, as shown in FIG. 2, in an extended state, the connecting device 130 has a first preset length $d2$ longer than the preset spacing $d1$; as shown in FIG. 3, in a retracted state, the connecting device 130 has a second preset length $d3$ shorter than or equal to the preset spacing $d1$, so that the connecting device 130 can be installed between adjacent chambers 600, and the two ends of the connecting device 130 are respectively connected to the corresponding vent holes 1121 for forming an exhaust channel between adjacent chambers 600.

In practical application, the connecting device 130 can be installed between adjacent heat treatment modules 110 in the same row or the same column, so that adjacent heat treatment modules 110 are directly conductive. By analogy, if the connecting device 130 is installed between adjacent heat treatment modules 110 in the same row, assuming that the number of the heat treatment modules 110 in the same row is n , the heat treatment modules 110 in the same row can be conductive via $(n - 1)$ connecting devices 130. At this time, the row of heat treatment modules 110 only needs to be connected to one vertical exhaust pipe 120 to extract gas from all heat treatment modules 110 in the row, the vertical exhaust pipe 120 can be installed at the end of the heat treatment modules 110 in the same row and conductively connected via the connecting device 130, and a plurality of rows of heat treatment modules 110 can be conductively connected to the same vertical exhaust pipe 120, thereby reducing the required number and footprint of the vertical exhaust pipes 120, and reducing the overall size of the heat treatment unit at the same time. In addition, the connecting device 130 has different lengths in the extended state and the retracted state, and the connecting device 130 can be quickly installed or disassembled without changing the preset spacing $d1$ between adjacent heat treatment modules 110. After the connecting device 130 is disassembled, the corresponding heat treatment module 110 can be extracted for maintenance, which facilitates equipment maintenance.

Preferably, the connecting device 130 includes a sliding guide member 137

mounted at least at one end of the connecting device 130, for reducing the frictional force between the connecting device 130 and the surfaces of the chambers 600 when the connecting device 130 is installed between adjacent chambers 600, so as to move the connecting device 130 between adjacent chambers 600, for example, sliding the connecting device 130 from the position shown in FIG. 4a to the preset position shown in FIGS. 5a and 5b in the direction t shown in FIG. 4b. It should be noted that, with reference to the embodiment shown in FIG. 1, the connecting device 130 is of a tubular structure, one end of the connecting device 130 includes both the two end faces of the connecting device 130 in the length direction s of the connecting device 130 and the outer tube walls near the end faces described above, and in the embodiment shown in FIG. 1, the sliding guide member 137 is mounted on the outer tube walls near the end faces of the connecting device 130.

In addition, the connecting device 130 includes a sealing member 138 mounted at least at one end face of the connecting device 130, for forming a seal between the connecting device 130 and the surfaces of the chambers 600 to prevent gas flow leakage at the joint between the connecting device 130 and the chambers 600 when adjacent chambers 600 transfer gas flow via the connecting device 130.

Preferably, the connecting device 130 includes a fixed pipe fitting 131, a first pipe fitting 132, and an elastic member 134. Wherein, the first pipe fitting 132 is slidably sleeved on one end of the fixed pipe fitting 131, and the elastic member 134 is arranged on the fixed pipe fitting 131 and elastically connected to the first pipe fitting 132, for providing an elastic force in the length direction s for the first pipe fitting 132 to allow the connecting device 130 to switch between the extended state and the retracted state.

Preferably, the connecting device 130 further includes a second pipe fitting 133 slidably sleeved on the end of the fixed pipe fitting 131 away from the first pipe fitting 132, and the elastic member 134 is elastically connected to the second pipe fitting 133 to provide an elastic force in the length direction s for the second pipe fitting 133. Wherein, annular contact surfaces 135 corresponding to adjacent chambers 600 are respectively provided on the end faces of the first pipe fitting 132 and the second pipe fitting 133 that are away from each other.

Preferably, the connecting device 130 further includes a first guide wheel 1321

and a second guide wheel 1331, and the first guide wheel 1321 and the second guide wheel 1331 correspond to the sliding guide member 137 described above. Specifically, the first guide wheel 1321 is mounted at the end of the first pipe fitting 132 away from the fixed pipe fitting 131, and the second guide wheel 1331 is mounted at the end of the second pipe fitting 133 away from the fixed pipe fitting 131. The axial direction of the first guide wheel 1321 is parallel to the axial direction of the second guide wheel 1331, the two axial directions are respectively perpendicular to the length direction s described above, and the first guide wheel 1321 and the second guide wheel 1331 respectively protrude from the annular contact surfaces 135, so that the connecting device 130 can slide to a preset position between adjacent chambers 600 in the retracted state, for example, sliding the connecting device 130 from the position shown in FIGS. 4a and 4b to the preset position shown in FIGS. 5a and 5b in the direction t.

Specifically, grooves 1122 are formed on the opposing sides of adjacent chambers 600, the grooves 1122 are adapted to the first guide wheel 1321 or the second guide wheel 1331, and when the connecting device 130 slides to a preset position, the first guide wheel 1321 and the second guide wheel 1331 respectively snap into the corresponding grooves 1122. At this time, the annular contact surfaces 135 are in sealed contact with the edges of the vent holes 1121. In addition, with reference to the embodiment shown in FIGS. 4a and 4b, to prevent the first guide wheel 1321 and the second guide wheel 1331 from snapping into the vent holes 1121 before reaching the grooves 1122, sliding guide bars 1126 are provided on the vent holes 1121 in the travel direction of the first guide wheel 1321 and the second guide wheel 1331 to facilitate the passage of the first guide wheel 1321 and the second guide wheel 1331, and the sliding guide bar 1126 divides the vent hole 1121 into two parts.

Preferably, sealing gaskets 136 are respectively arranged at the ends of the first pipe fitting 132 and the second pipe fitting 133 that are away from each other, and the sealing gaskets 136 correspond to the sealing member 138 described above. Specifically, the annular contact surfaces 135 described above are located on the end faces of the sealing gaskets 136 away from the fixed pipe fitting 131, and when the connecting device 130 slides to a preset position, the first pipe fitting 132 and the second pipe fitting 133 respectively compress the corresponding sealing gaskets 136 under the elastic force of the elastic member 134, so that the annular contact surfaces

135 are in sealed contact with the edges of the vent holes 1121. The sealing gaskets 136 described above are preferably made of an elastic material, such as a rubber material.

Specifically, as shown in FIGS. 6 and 7, the connection structure of the first pipe fitting 132 and the second pipe fitting 133 with the fixed pipe fitting 131 is as follows: a first flange 1311 is provided at one end of the fixed pipe fitting 131, and a second flange 1312 is provided at the other end of the fixed pipe fitting 131. A first inner retaining ring 1322 corresponding to the first flange 1311 is provided on the inner wall of the first pipe fitting 132, and a second inner retaining ring 1332 corresponding to the second flange 1312 is provided on the inner wall of the second pipe fitting 133. Wherein, when the connecting device 130 switches between the extended state and the retracted state, the first inner retaining ring 1322 and the second inner retaining ring 1332 are respectively limited to sliding between the first flange 1311 and the second flange 1312 in the length direction s under the elastic force of the elastic member 134, thereby limiting the extension distance and retraction distance of the first pipe fitting 132 and the second pipe fitting 133. In addition, sealing washers 1313 can be respectively mounted on the opposing sides of the first flange 1311 and the first inner retaining ring 1322, and the opposing sides of the second flange 1312 and the second inner retaining ring 1332, for forming a seal between the first flange 1311 and the first inner retaining ring 1322, and between the second flange 1312 and the second inner retaining ring 1332 when the connecting device 130 is in the retracted state.

Preferably, the elastic member 134 described above is preferably a torsion spring 1341, at least two fixing posts 1342 for fixing the torsion spring 1341 are arranged on the tube wall of the fixed pipe fitting 131, the main body of the torsion spring 1341 is sleeved on the fixing posts 1342, and the two elastic contacts of the torsion spring 1341 respectively abut against the opposing sides of the first inner retaining ring 1322 and the second inner retaining ring 1332. Specifically, with reference to the embodiment shown in FIG. 6, the fixed pipe fitting 131 is of a square tubular structure and includes four tube walls arranged in two opposite pairs, at least two tube walls are provided with fixing posts 1342 on the surface of the tube walls, and the two tube walls are opposing each other.

Wherein, in the extended state, the spacing between the first pipe fitting 132 and

the second pipe fitting 133 increases under the elastic force of the torsion spring 1341 until the first inner retaining ring 1322 abuts against the first flange 1311 and the second inner retaining ring 1332 abuts against the second flange 1312; in the retracted state, the spacing between the first pipe fitting 132 and the second pipe fitting 133 decreases when an external force is applied to overcome the elastic force of the torsion spring 1341 until the overall length of the connecting device 130 is shortened to the second preset length d_3 shorter than or equal to the preset distance d_1 , so as to be installed between adjacent chambers 600. After the connecting device 130 is placed between adjacent chambers 600, the first guide wheel 1321 and the second guide wheel 1331 respectively abut against the opposing sides of adjacent chambers 600, which facilitates the pushing of the connecting device 130 to reach a preset position. When the connecting device 130 reaches the preset position, the first guide wheel 1321 and the second guide wheel 1331 respectively snap into the corresponding grooves 1122, and the spacing between the first pipe fitting 132 and the second pipe fitting 133 slightly increases under the elastic force of the torsion spring until the annular contact surfaces 135 are in sealed contact with the edges of the vent holes 1121, completing the conductive connection of the adjacent chambers 600 described above.

In practical application, before extracting the heat treatment module 110 for equipment maintenance, the connecting device 130 between two adjacent heat treatment modules 110 needs to be disassembled first. When the connecting device 130 between two adjacent heat treatment modules 110 is disassembled, push the connecting device 130 to first make the first guide wheel 1321 and the second guide wheel 1331 of the connecting device 130 slide out of the corresponding grooves 1122, or compress the connecting device 130 to make the connecting device 130 in the retracted state before pushing the connecting device 130, and then push the connecting device 130 out from between the two adjacent heat treatment modules 110 described above. In addition, according to FIGS. 4a and 4b, to facilitate the sliding of the first guide wheel 1321 or the second guide wheel 1331 out of the groove 1122, a sliding guide surface 1123 can be arranged at the inlet edge of the groove 1122, and the sliding guide surface 1123 can be configured as a plane chamfer or a curved chamfer.

As shown in FIGS. 9 to 11, a substrate heat treatment unit 100 according to an embodiment of the invention is disclosed, the substrate heat treatment unit 100 includes

a plurality of heat treatment modules 110, each heat treatment module 110 includes the chamber 600, and the connecting device 130 described above is arranged between at least two adjacent heat treatment modules 110 for forming an exhaust channel between adjacent heat treatment modules 110. In combination with the connecting device 130 described above, the chamber 600 is specifically implemented as a transfer gas chamber 112 of the heat treatment module 110 in the substrate heat treatment unit 100, and the connecting device 130 is installed between the transfer gas chambers 112 of adjacent heat treatment modules 110.

Specifically, the heat treatment modules 110 are arranged in a plurality of horizontal rows, the plurality of rows of heat treatment modules 110 are stacked, and the connecting device 130 is arranged between adjacent heat treatment modules 110 in the same row, so that the heat treatment modules 110 in the same row are conductively connected in sequence.

Preferably, the substrate heat treatment unit 100 includes a vertical exhaust pipe 120 located at the same end of the plurality of rows of heat treatment modules 110, and the vertical exhaust pipe 120 is connected to the heat treatment module 110 adjacent to the vertical exhaust pipe 120 via the connecting device 130, so that each row of heat treatment modules 110 is conductively connected to the vertical exhaust pipe 120 in sequence for exhausting gas within each heat treatment module 110.

In addition, in other embodiments of the application, the connecting device 130 can be installed between two adjacent heat treatment modules 110 in the same column, so that the heat treatment modules 110 in the same column are conductively connected in sequence. Specifically, the substrate heat treatment unit 100 includes a horizontal exhaust pipe, and the horizontal exhaust pipe passes through each column of heat treatment modules 110 in sequence, and the horizontal exhaust pipe is connected to the heat treatment module 110 adjacent to the horizontal exhaust pipe via the connecting device 130, so that each column of heat treatment modules 110 is conductively connected to the horizontal exhaust pipe in sequence for exhausting gas within each heat treatment module 110.

Preferably, as shown in FIG. 8, the heat treatment module 110 includes a heat treatment module body 111 and the transfer gas chamber 112. Wherein, the heat

treatment module body 111 is used for substrate heat treatment. The transfer gas chamber 112 is arranged on the front side or the rear side of the heat treatment module body 111 and is conductively connected to the interior of the heat treatment module body 111, and the chamber 600 described above includes the transfer gas chamber 112, that is, vent holes 1121 are provided on the opposing sides of adjacent transfer gas chambers 112 in the same row, the vent holes 1121 are conductively connected to the interior of the transfer gas chambers 112, the two ends of the connecting device 130 are provided with annular contact surfaces 135 corresponding to adjacent transfer gas chambers 112, and when the connecting device 130 slides to a preset position, the annular contact surfaces 135 are in sealed contact with the edges of the vent holes 1121. Specifically, the heat treatment module body 111 is conductively connected to the transfer gas chamber 112 via a conduit 1125.

Preferably, the heat treatment module 110 further includes a control unit 113 mounted on the side of the transfer gas chamber 112 away from the heat treatment module body 111, for controlling substrate processing parameters such as substrate processing temperature, gas flow rate, and gas type of the heat treatment module 110.

Preferably, with continued reference to FIG. 3, the heat treatment module 110 includes a blocking mechanism 1124 matched with the vent hole 1121 of the chamber 600, for opening the vent hole 1121 when the connecting device 130 is at a preset position and blocking the vent hole 1121 when the connecting device 130 is not at the preset position. Specifically, the blocking mechanism 1124 includes a sealing plate and a drive member, when the vent hole 1121 needs to be blocked, the drive member drives the sealing plate to cover and block the vent hole 1121; when the vent hole 1121 needs to be opened, the drive member drives the sealing plate to leave the vent hole 1121.

In practical application, if only one heat treatment module 110 is extracted for maintenance or inspection, the connecting device 130 connected to the heat treatment module 110 is first extracted, and after the connecting device 130 is extracted, the heat treatment module 110 adjacent to the heat treatment module 110 to be maintained or inspected can automatically block the corresponding vent hole 1121 via the blocking mechanism 1124, so as to prevent gas leakage from the vent hole 1121 of the transfer gas chamber 112, which can otherwise affect the exhaust of other heat treatment modules 110.

In addition, in some preferred embodiments, grooves 1122 are further formed on the opposing sides of adjacent transfer gas chambers 112 in the same row, the grooves 1122 are located near the vent holes 1121 and are adapted to the sliding guide member 137 of the connecting device 130, such as the first guide wheel 1321 and the second guide wheel 1331. When the connecting device 130 slides to a preset position, the first guide wheel 1321 and the second guide wheel 1331 respectively snap into the corresponding grooves 1122, and the annular contact surfaces 135 are in sealed contact with the edges of the vent holes 1121.

Preferably, the substrate heat treatment unit 100 is configured with a plurality of vertical exhaust pipes 120, and each vertical exhaust pipe 120 is respectively connected to the heat treatment modules 110 in different rows. As an example, in FIG. 9, three columns and twelve rows of heat treatment modules 110 are present, three vertical exhaust pipes 121, 122, and 123 are provided, the vertical exhaust pipes 121, 122, and 123 are installed on the same side (the right side) of each row of heat treatment modules 110, and the vertical exhaust pipe 121, 122, and 123 are conductively connected to four rows of heat treatment modules 110 at the same time. It should be noted that in practical application, the number and arrangement mode of the heat treatment modules 110, and the number of the vertical exhaust pipes 120 and number of rows of heat treatment modules 110 connected to each vertical exhaust pipe 120 can be adaptively adjusted according to actual conditions.

The way of connecting each vertical exhaust pipe 120 to the heat treatment modules 110 in different rows described above can, in one aspect, prevent a significant error in the exhaust volumes of the heat treatment modules 110 connected at different positions of the vertical exhaust pipe 120, and ensure that the exhaust efficiency of the vertical exhaust pipe 120 for each row of heat treatment modules 110 is basically the same; in another aspect, the exhaust states of the heat treatment modules 110 connected to different vertical exhaust pipes 121 do not affect each other, and when a certain row of heat treatment modules 110 is extracted for maintenance or inspection, only the vertical exhaust pipe 120 connected to the row of heat treatment modules 110 needs to be closed, and the other vertical exhaust pipes 120 can still perform exhaust operation for the heat treatment modules 110 connected to the vertical exhaust pipes.

As shown in FIGS. 12 and 13, the present application further discloses a coating

and developing apparatus 10, which comprises an equipment front end module 11, a process station 12, and an interface station 13 connected in sequence.

Specifically, the process station 12 includes: a coating unit 200, a developing unit 300, a transfer unit 400, and the substrate heat treatment unit 100 in the embodiments described above. Wherein, the coating unit 200 is used for performing coating treatment on a substrate; the developing unit 300 is used for performing developing treatment on the substrate; the transfer unit 400 is used for transferring the substrate among the equipment front end module 11, the process station 12, and the interface station 13, and transferring the substrate inside the process station 12.

It should be noted that the embodiments described above can be freely combined as required. The above embodiments are only preferred embodiments of the present invention, and for those of ordinary skill in the art, a plurality of improvements and modifications can be made without departing from the principle of the invention, and these improvements and modifications shall also be regarded as falling within the protection scope of the present invention.

What is claimed is:

1. A connecting device, for connecting adjacent chambers, vent holes being provided on the opposing sides of the adjacent chambers, a preset spacing being provided between the adjacent chambers, wherein the connecting device is of a tubular structure and is configured to be capable of extending and retracting in the length direction of the connecting device; in an extended state, the connecting device has a first preset length longer than the preset spacing; in a retracted state, the connecting device has a second preset length shorter than or equal to the preset spacing, so that the connecting device can be installed between the adjacent chambers, and the two ends of the connecting device are respectively connected to the corresponding vent holes for forming an exhaust channel between the adjacent chambers.

2. The connecting device according to claim 1, wherein the connecting device includes a sliding guide member mounted at least at one end of the connecting device, for reducing the frictional force between the connecting device and the surfaces of the chambers when the connecting device is installed between the adjacent chambers.

3. The connecting device according to claim 1, wherein the connecting device includes a sealing member mounted at least at one end face of the connecting device, for forming a seal between the connecting device and the surfaces of the chambers.

4. The connecting device according to claim 1, wherein the connecting device includes a fixed pipe fitting; a first pipe fitting, slidably sleeved on one end of the fixed pipe fitting; and an elastic member, arranged on the fixed pipe fitting and elastically connected to the first pipe fitting, for providing an elastic force in the length direction for the first pipe fitting to allow the connecting device to switch between the extended state and the retracted state.

5. The connecting device according to claim 4, wherein the connecting device further includes a second pipe fitting slidably sleeved on the end of the fixed pipe fitting away from the first pipe fitting, the elastic member is elastically connected to the second pipe fitting to provide an elastic force in the length direction for the second pipe fitting, and annular contact surfaces corresponding to the adjacent chambers are respectively provided on the sides of the first pipe fitting and the second pipe fitting

that are away from each other.

6. The connecting device according to claim 5, wherein the connecting device further includes a first guide wheel mounted at the end of the first pipe fitting away from the fixed pipe fitting, and a second guide wheel mounted at the end of the second pipe fitting away from the fixed pipe fitting; the axial direction of the first guide wheel is parallel to the axial direction of the second guide wheel, the two axial directions are respectively perpendicular to the length direction, and the first guide wheel and the second guide wheel respectively protrude from the annular contact surfaces, so that the connecting device can slide to a preset position between the adjacent chambers in the retracted state.

7. The connecting device according to claim 6, wherein grooves are formed on the opposing sides of the adjacent chambers, the grooves are adapted to the first guide wheel or the second guide wheel, and when the connecting device slides to the preset position, the first guide wheel and the second guide wheel respectively snap into the corresponding grooves, and the annular contact surfaces are in sealed contact with the edges of the vent holes.

8. The connecting device according to claim 5, wherein sealing gaskets are respectively arranged at the ends of the first pipe fitting and the second pipe fitting that are away from each other.

9. The connecting device according to claim 5, wherein a first flange is provided at one end of the fixed pipe fitting, and a second flange is provided at the other end of the fixed pipe fitting; a first inner retaining ring corresponding to the first flange is provided on the inner wall of the first pipe fitting, a second inner retaining ring corresponding to the second flange is provided on the inner wall of the second pipe fitting, the inner diameter of the first inner retaining ring is smaller than the outer diameter of the first flange, the inner diameter of the second inner retaining ring is smaller than the outer diameter of the second flange, when the connecting device switches between the extended state and the retracted state, and the first inner retaining ring and the second inner retaining ring are respectively limited to sliding between the first flange and the second flange in the length direction under the elastic force of the elastic member.

10. A substrate heat treatment unit, comprising:

a plurality of heat treatment modules, each heat treatment module including a chamber, and the connecting device according to any of claims 1 to 9 being arranged between at least two of the adjacent heat treatment modules, for forming an exhaust channel between the adjacent heat treatment modules.

11. The substrate heat treatment unit according to claim 10, wherein the heat treatment modules are arranged in a plurality of horizontal rows, the plurality of rows of heat treatment modules are stacked, and the connecting device is arranged between the adjacent heat treatment modules in the same row, so that the heat treatment modules in the same row are conductively connected in sequence.

12. The substrate heat treatment unit according to claim 11, wherein the substrate heat treatment unit includes a vertical exhaust pipe located at the same end of the plurality of rows of heat treatment modules, and the vertical exhaust pipe is connected to the heat treatment module adjacent to the vertical exhaust pipe via the connecting device, so that each row of heat treatment modules is conductively connected to the vertical exhaust pipe in sequence, for exhausting gas within each heat treatment module.

13. The substrate heat treatment unit according to claim 12, wherein the heat treatment module further includes a heat treatment module body for substrate heat treatment, the chamber includes a transfer gas chamber conductively connected to the interior of the heat treatment module body, the vent holes are provided on the opposing sides of the adjacent transfer gas chambers, the two ends of the connecting device are provided with annular contact surfaces corresponding to the adjacent transfer gas chambers, and when the connecting device slides to a preset position, the annular contact surfaces are in sealed contact with the edges of the vent holes.

14. The substrate heat treatment unit according to claim 10, wherein the substrate heat treatment unit includes a blocking mechanism matched with the vent hole, for opening the vent hole when the connecting device is at the preset position, and blocking the vent hole when the connecting device is not at the preset position.

15. The substrate heat treatment unit according to claim 13, wherein the connecting device includes a sliding guide member mounted at least at one end of the connecting device, for reducing the frictional force between the connecting device and the surfaces of the chambers when the connecting device is installed between the adjacent transfer gas chambers; grooves are formed on the opposing sides of the adjacent transfer gas chambers in the same row, the grooves are adapted to the sliding guide member, and when the connecting device slides to the preset position, the sliding guide member snaps into the corresponding grooves, and the annular contact surfaces are in sealed contact with the edges of the vent holes.

16. The substrate heat treatment unit according to claim 12, wherein the substrate heat treatment unit is configured with a plurality of vertical exhaust pipes, and each vertical exhaust pipe is respectively connected to the heat treatment modules in different rows.

17. A coating and developing apparatus, comprising an equipment front end module, a process station, and an interface station connected in sequence, the process station including:

the substrate heat treatment unit according to any of claims 10 to 16;

a coating unit, for performing coating treatment on a substrate;

a developing unit, for performing developing treatment on the substrate;

a transfer unit, for transferring the substrate among the equipment front end module, the process station, and the interface station, and transferring the substrate inside the process station.