SEMICONDUCTOR PROCESS APPARATUS AND EXHAUST GAS TREATMENT DEVICE THEREOF

TECHNICAL FIELD

[0001] The present disclosure relates to the field of semiconductor manufacturing, and in particular, to a semiconductor process apparatus and an exhaust gas treatment device thereof.

BACKGROUND

[0002] In the chemical vapor deposition process, low pressure chemical vapor deposition (LPCVD) can reduce vapor nucleation at the low pressure, and has obvious advantages in uniformity and step coverage, as well as less pollution and higher product quality. The LPCVD process has become the mainstream film deposition process at present. LPCVD equipment is also favored by semiconductor manufacturers.

[0003] In cases involving the LPCVD process, some processes produce by-products. The by-products affect the process quality, and further block tubes and valves or affect the normal operation of vacuum pumps. To ensure the product quality of the LPCVD equipment and prolong the maintenance and replacement cycle of a reaction chamber, it is necessary to collect or treat the by-products in time.

[0004] In view of that, how to more thoroughly absorb the by-products is an urgent technical problem for those of ordinary skill in the art.

SUMMARY

[0005] To solve at least one of the technical problems in the prior art, the present disclosure provides a semiconductor process apparatus and an exhaust gas treatment device thereof, which can prolong residence time of process gas in the exhaust gas treatment device, and further more fully absorb a by-product.

[0006] To achieve the objective of the present disclosure, an exhaust gas treatment device is provided. The exhaust gas treatment device is applied to a semiconductor process apparatus and includes a housing, a flow guide member, and an adsorption member, where

[0007] the housing includes an inlet and an outlet, and the inlet is configured to introduce, into the housing, process gas exhausted from a reaction chamber;

[0008] the flow guide member is arranged in the housing, and partitions an interior of the housing into fluid channels, the fluid channels include an inflow channel and an outflow channel that communicate with the inlet and the outlet respectively, and the inflow channel communicates with the outflow channel; and

[0009] a portion of the adsorption member is arranged in the inflow channel, the remaining portion of the adsorption member is arranged in the outflow channel, and the adsorption member is configured to adsorb a by-product in the process gas.

[0010] In some embodiments, an included angle is formed between an orientation of the outlet and an orientation of the inlet; and

[0011] the flow guide member includes a first flow guide plate and a second flow guide plate between which an included angle is formed, the one end of the first flow guide plate is connected to a position, between the inlet and the outlet, of the housing, the other end of the first flow guide plate extends in a direction away from the inlet and is connected to the one end of the second flow guide plate, and the other end of the second flow guide plate extends in a direction away from the outlet.

[0012] In some embodiments, the housing includes a first housing and a second housing, and each of the first housing and the second housing has a side wall extending in a circumferential direction; and an end, in an axial direction of the side wall, of the first housing and an end, in an axial direction of the side wall, of the second housing are hermetically connected to each other, the outlet is located in an end, farthest from the second housing in the axial direction of the side wall, of the first housing, and the inlet is located in the side wall of the second housing.

[0013] In some embodiments, the second flow guide plate partitions a space defined by the side wall of the second housing into a first subspace and a second subspace, and an end, farthest from the outlet, of the second flow guide plate is spaced apart from the second housing, to make an end, farthest from the outlet, of the first subspace communicate with an end, farthest from the outlet, of the second subspace; and

[0014] the first flow guide plate is connected to an end, closest to the outlet, of the second flow guide plate and the side wall of the second housing, to close an end, closest to the outlet, of one of the first subspace and the second subspace; one of the first subspace and the second subspace forms the inflow channel; and an end, closest to the outlet, of the other of the first subspace and the second subspace and a space defined by the side wall of the first housing communicate with each other, and jointly form the outflow channel.

[0015] In some embodiments, the adsorption member includes a plurality of condensation sheets, the plurality of condensation sheets are arranged at the second flow guide plate, and arrayed in a direction away from the outlet, and an included angle is formed between each of the condensation sheets and the second flow guide plate.

[0016] In some embodiments, the condensation sheets include first condensation sheets, at least two first condensation sheets are arranged, and lengths by which the at least two first condensation sheets extend relative to the second flow guide plate are gradually reduced in the direction away from the outlet.

[0017] In some embodiments, the condensation sheets further include second condensation sheets, a plurality of second condensation sheets are arranged, the second condensation sheets are arranged at a side, farthest from the outlet, of all the first condensation sheets, and lengths by which the second condensation sheets extend relative to the second flow guide plate are equal; and

[0018] the length by which each of the second condensation sheets extends relative to the second flow guide plate is less than or equal to a minimum of the lengths by which the at least two first condensation sheets extend relative to the second flow guide plate.

[0019] In some embodiments, each of the first condensation sheets is perpendicular to the second flow guide plate, and on a plane perpendicular to the second flow guide plate, a center of an orthographic projection of each of the first condensation sheets passes through a center of an orthographic projection of the second flow guide plate; or

[0020] each of the second condensation sheets is perpendicular to the second flow guide plate, and on a plane perpendicular to the second flow guide plate, a center of an orthographic projection of each of the second condensation sheets passes through a center of an orthographic projection of the second flow guide plate.

[0021] In some embodiments, a maintenance port is provided in an end, farthest from the first housing in the axial direction of the side wall, of the second housing, the exhaust gas treatment device further includes a sealing cover detachably connected to the maintenance port, and a second sealing ring is arranged between the maintenance port and the sealing cover.

[0022] In some embodiments, an absorption liquid is provided in a location where the inflow channel communicates with the outflow channel, and is configured to absorb incompletely reacted process gas.

[0023] The present disclosure further provides a semiconductor process apparatus. The semiconductor process apparatus includes a reaction chamber, a flow control valve, and any one of the above exhaust gas treatment devices, where an inlet of the exhaust gas treatment device is connected to an exhaust port of the reaction chamber, and an outlet of the exhaust gas treatment device is connected to an inlet of the flow control valve.

[0024] The present disclosure has the following beneficial effects:

[0025] In the exhaust gas treatment device according to the present disclosure, the flow guide member is arranged in the housing, and the flow guide member partitions the interior of the housing into the fluid channels. The fluid channels include the inflow channel and the outflow channel that communicate with the inlet and the outlet respectively, and the inflow channel communicates with the outflow channel. In this way, the process gas entering the housing from the inlet can flow through the inflow channel and the outflow channel sequentially and be exhausted from the outlet. On this basis, the portion of the adsorption member is arranged in the inflow channel, and the remaining portion of the adsorption member is arranged in the outflow channel. The adsorption member is configured to absorb the by-product in the process gas during flow of the process gas. The fluid channel formed by partitioning the interior of the housing through the flow guide member increases flow resistance and a flow path of the process gas, prolongs residence time of the process gas in the housing, and makes the adsorption member fully absorb the by-product in the process gas. Thus, an absorption rate of the by-product is improved.

[0026] The present disclosure further provides the semiconductor process apparatus. The semiconductor process apparatus includes the exhaust gas treatment device, and has the advantages described above.

BRIEF DESCRIPTION OF DRAWINGS

[0027] FIG. 1 is a schematic structural diagram of an interior of an exhaust gas treatment device according to a particular implementation of the present disclosure;

[0028] FIG. 2 is a schematic structural diagram of the other side of the interior of the exhaust gas treatment device in FIG. 1;

[0029] FIG. 3 is a schematic structural diagram of cooperation between a flow guide member and an adsorption member in FIG. 1;

[0030] FIG. 4 is a sectional view along A-A in FIG. 1;

[0031] FIG. 5 is a sectional view along B-B in FIG. 1; and

[0032] FIG. 6 is a schematic structural diagram of a semiconductor process apparatus according to a particular implementation of the present disclosure.

[0033] Reference numerals in FIG. 1 to FIG. 6 are as follows:

[0034] 100. reaction chamber; 200. vacuum tube; 300. exhaust gas treatment device; 310. housing; 311. inlet; 312. outlet; 313. maintenance port; 314. connection flange; 315. blind plate; 316. first housing; 317. second housing; 318. first clamp; 319. second clamp; 320. flow guide member; 321. first flow guide plate; 322. second flow guide plate; 330. adsorption member; 331. condensation sheet; 340. absorption liquid; and 400. flow control valve.

DETAILED DESCRIPTION

[0035] To make those of ordinary skill in the art better understand the technical solution of the present disclosure, the semiconductor process apparatus and an exhaust gas treatment device thereof according to the present disclosure will be described below in detail in conjunction with the accompanying drawings.

[0036] As shown in FIG. 1, an exhaust gas treatment device 300 according to the present disclosure is applied to a semiconductor process apparatus. The exhaust gas treatment device 300 includes a housing 310, a flow guide member 320, and an adsorption member 330. The housing 310 includes an inlet 311 and an outlet 312. The inlet 311 is configured to introduce, into the housing 310, process gas exhausted from a reaction chamber. That is, the process gas exhausted from the reaction chamber of the semiconductor process apparatus enters the housing 310 through the inlet 311, and the process gas generally includes a by-product generated during the reaction process. After the exhaust gas treatment device 300 absorbs the by-product in the process gas, the process gas is exhausted from the outlet 312.

[0037] The flow guide member 320 is arranged in the housing 310, and partitions an interior of the housing 310 into fluid channels. In some embodiments, the flow guide member 320 and an inner wall of the housing 310 are connected to each other, and sealed at a joint therebetween, such that the interior of the housing 310 is partitioned into the fluid channels. The fluid channel includes an inflow channel and an outflow channel that communicate with the inlet 311 and the outlet 312 respectively, and the inflow channel communicates with the outflow channel. The flow guide member 320 may guide the process gas to flow through the inflow channel and the outflow channel sequentially. A portion of the adsorption member 330 is arranged in the inflow

channel, the remaining portion of the adsorption member 330 is arranged in the outflow channel, and the adsorption member is configured to adsorb a by-product in the process gas.

[0038] A structure of the fluid channel may be set according to needs of a user, such as a U-shape, an S-shape, and a spiral shape. The adsorption member 330 is arranged in the inflow channel and the outflow channel, leaving a space for the process gas to flow. During flow of the process gas, the adsorption member 330 may absorb the by-products in the process gas. Specifically, the process gas generally includes a liquid by-product and a solid by-product. The solid by-product may be attached to the adsorption member 330, and the liquid by-product may flow down along the adsorption member 330 and the flow guide member 320, thus causing the liquid by-product and the solid by-product to reside in the exhaust gas treatment device 300.

[0039] In this embodiment, the flow guide member 320 is arranged in the exhaust gas treatment device 300. The flow guide member 320 partitions the interior of the housing 310 into the fluid channels. Thus, a flow path of the process gas in the housing 310 is increased, flow resistance of the process gas is increased, residence time of the process gas in the housing 310 is further prolonged, and the adsorption member 330 can more fully adsorb the by-products in the process gas.

[0040] In some embodiments, an included angle is formed between an orientation of the outlet 312 and an orientation of the inlet 311. The flow guide member 320 includes a first flow guide plate 321 and a second flow guide plate 322 between which an included angle is formed, the one end of the first flow guide plate 321 is connected to a position, between the inlet 311 and the outlet 312, of the housing 310, the other end of the first flow guide plate 321 extends in a direction away from the inlet 311 and is connected to the one end of the second flow guide plate 322, and the other end of the second flow guide plate 322 extends in a direction away from the outlet 312. The inflow channel is defined by a surface, farthest from the outlet 312, of the first flow guide plate 321, a surface, oriented towards the inlet 311, of the second flow guide plate 322 and the inner wall where the inlet 311 is located of the housing 310. The outflow channel is defined by a surface, oriented away from the inlet 311, of the second flow guide plate 322 and an inner wall, opposite the inlet 311, of the housing 310. The outflow channel communicates with the inflow channel and the outlet 312.

[0041] By connecting the one end of the first flow guide plate 321 to the position, between the inlet 311 and the outlet 312, of the housing 310, and extending the other end of the first flow guide plate 321 in the direction away from the inlet 311 (for example, in a direction from left to right

in FIG. 1), the first flow guide plate 321 can be located for blocking between the inlet 311 and the outlet 312, and the process gas can be prevented from flowing directly to the outlet 312 after entering the housing 310 from the inlet 311. On this basis, in combination with extending the other end of the second flow guide plate 322 in the direction away from the outlet 312 (for example, a direction from top to bottom in FIG. 1), the process gas entering the housing 310 from the inlet 311 can be blocked from flowing in the direction away from the inlet 311 (for example, the direction from left to right in FIG. 1), the process gas can change a direction after entering the inlet 311, to flow in the direction away from the outlet 312, and the process gas can be further prevented from flowing directly to the outlet 312 after entering the housing 310 from the inlet 311. Further, the flow path of the process gas in the housing 310 can be increased as much as possible.

[0042] Further, in some embodiments, in the exhaust gas treatment device 300 shown in FIG. 1, the included angle between the orientation of the outlet 312 and the orientation of the inlet 311 is 90°, and an included angle between the first flow guide plate 321 and the second flow guide plate 322 is 90°. However, the embodiment of the present disclosure is not limited to such arrangements above. In practical application, the included angle between the orientation of the outlet 312 and the orientation of the inlet 311, and the included angle between the first flow guide plate 321 and the second flow guide plate 322 may be set according to specific needs as long as the process gas can be prevented from flowing directly to the outlet 312 after entering the housing 310 from the inlet 311 and the flow path of the process gas in the housing 310 can be further increased.

[0043] In addition, the orientation of the outlet 312 and the orientation of the inlet 311 may be set according to a specific structure of the housing 310. In some embodiments, the housing 310 may be a vertical or horizontal container, for example, the housing 310 shown in FIG. 1 is the vertical container. In this case, the outlet 312 may be located in an upper end of the housing 310, while the inlet 311 may be provided in the side wall of the housing 310. If the housing is the horizontal container, the outlet 312 may be located in an upper side wall of the housing 310 while the inlet 311 may be located in a left end or a right end of the housing 310 clearly. It should be noted that the so-called vertical container means that the housing 310 has the side wall extending in the circumferential direction, and an axis of the side wall is perpendicular to a horizontal plane, and the so-called horizontal container means that the housing 310 has the side wall extending in the circumferential direction, and an axis of the side wall is parallel to the horizontal plane.

[0044] In some embodiments, as shown in FIG. 1, the housing 310 includes a first housing 316 and a second housing 317, and each of the first housing 316 and the second housing 317 has a side wall extending in a circumferential direction. An end, in an axial direction of the side wall, of the first housing 316 and an end, in an axial direction of the side wall, of the second housing 317 are hermetically connected to each other, the outlet 312 is located in an end in the axial direction of the side wall, farthest from the second housing 317, of the first housing 316, and the inlet 311 is located in the side wall of the second housing 317. In a particular embodiment, the first housing 316 is located above the second housing 317, and an end (that is, an upper end), in the axial direction of the side wall, of the second housing 317 is an open end, and correspondingly, an end (that is, a lower end), in the axial direction of the side wall, of the first housing 316 is an open end. The open end of the first housing 316 is hermetically connected to the open end of the second housing 317, to form a closed space in the housing 310. The outlet 312 is located in an end (that is, an upper end), farthest from the second housing 317, of the first housing 316 in the axial direction of the sidewall, and the inlet 311 is located in the side wall of the second housing 317.

[0045] The housing 310 adopts a split structure (that is, the housing 310 includes the first housing 316 and the second housing 317). The flow guide member 320 and the adsorption member 330 may be first mounted in the second housing 317 and/or the first housing 316, and then the first housing 316 and the second housing 317 are hermetically connected to each other, to reduce assembly difficulty of the exhaust gas treatment device 300.

[0046] In some embodiments, the second flow guide plate 322 partitions a space defined by the side wall of the second housing 317 into a first subspace and a second subspace, and an end, farthest from the outlet 312, of the second flow guide plate 322 is spaced apart from the second housing 317, to make an end, farthest from the outlet 312, of the first subspace communicate with an end, farthest from the outlet 312, of the second subspace. Specifically, in some embodiments, the second flow guide plate 322 is arranged in the axial direction of the side wall of the second housing 317, and extends from a top end of the second housing 317 to a position having a preset distance from a bottom of the second housing 317. The inlet 311 is located in the side wall of the second flow guide plate 322, and the first flow guide plate 321 closes an opening of a side, closest to the inlet 311, of the second flow guide plate 322.

[0047] The first flow guide plate 321 is connected to an end, closest to the outlet 312, of the second flow guide plate 322 and the side wall of the second housing 317, to close an end, closest to the

outlet 312, of one of the first subspace and the second subspace. One of the first subspace and the second subspace forms the inflow channel. An end, closest to the outlet 312, of the other of the first subspace and the second subspace and a space defined by the side wall of the first housing 316 communicate with each other, and jointly form the outflow channel.

[0048] In particular implementations shown in FIG. 1 and FIG. 2, the flow guide member 320 and the adsorption member 330 are mounted in the second housing 317. Specifically, the second flow guide plate 322 extends downwards in the axial direction of the side wall of the second housing 317 to a position having a preset distance from a bottom of the second housing 317. Two sides of the second flow guide plate 322 are the inflow channel and the outflow channel respectively. The inflow channel communicates with the inlet 311, and a communication port is formed between the second flow guide plate 322 and the bottom of the second housing 317. The communication port makes the inflow channel communicate with the outflow channel. The first flow guide plate 321 is hermetically connected to the second flow guide plate 322 and the inner wall of the second housing 317, to close a top end of the inflow channel. In particular implementations shown in FIG. 3 and FIG. 4, a cross section of the inflow channel is semicircular, and the first flow guide plate 321 is also semicircular. A cambered side edge of the first flow guide plate 321 is hermetically connected to the inner wall of the second housing 317, and a straight edge of the first flow guide plate 321 is hermetically connected to the top end of the second flow guide plate 322. After entering the inflow channel, the process gas may only flow downwards along the inflow channel, flow upwards along the outflow channel after flowing through the communication port, and finally be exhausted from the outlet 312. The flow guide member 320 may alternatively be set in other structures according to the needs of the user, which is not limited herein.

[0049] In some embodiments, the adsorption member 330 includes a plurality of condensation sheets 331, the plurality of condensation sheets 331 are arranged at the second flow guide plate 322, and arrayed in a direction away from outlet 312, and an included angle is formed between each of the condensation sheets 331 and the second flow guide plate 322. For example, an included angle of 90° is formed between each condensation sheet 331 and the second flow guide plate 322, and the condensation sheets are arrayed in the direction away from outlet 312.

[0050] As shown in FIG. 1 and FIG. 2, the process gas flows along the fluid channel, and the condensation sheet 331 can play a particular role of damping, increase the flow resistance of the process gas, reduce a flow rate of the process gas, and further prolong the residence time of the

process gas in the exhaust gas treatment device 300. The adsorption member 330 may alternatively adopt other structures clearly, such as a mesh structure and a porous block structure, and the condensation sheet 331 may be arranged on the inner wall of the housing 310 as required, which is not limited herein. The lengths by which the plurality of condensation sheets 331 extend relative to the second flow guide plate 322 may be equal or not equal, which is not limited herein. In a case that the condensation sheet 331 is a circular sheet, the condensation sheet 331 penetrates the second flow guide plate 322, such that the first condensation sheet protrudes from two sides of the second flow guide plate 322. Diameters of the condensation sheets 331 may be the same or different.

[0051] The condensation sheet 331 may be a stainless steel sheet, and the solid by-product in the process gas is attached to a surface of the condensation sheet 331 after coming into contact with the condensation sheet 331, such that the solid by-product can be fully condensed and collected. The stainless steel material has low cost, corrosion resistance, etc. The condensation sheet 331 may alternatively be made of other materials clearly, which is not limited herein.

[0052] In some embodiments, as shown in FIG. 3, the condensation sheets include first condensation sheets 331a, at least two first condensation sheets 331a are arranged, and lengths by which the at least two first condensation sheets 331a extend relative to the second flow guide plate 322 are gradually reduced in the direction away from outlet 312. In a case that the condensation sheets 331 are circular sheets, the first condensation sheets 331a penetrate the second flow guide plate 322, such that the first condensation sheets protrude from two sides of the second flow guide plate 322. Diameters of the first condensation sheets 331a gradually decrease in the direction away from the outlet 312.

[0053] As shown in FIG. 1 to FIG. 3, first three condensation sheets 331 arrayed from top to bottom in the housing 310 are the first condensation sheets 331a. The three first condensation sheets 331a are circular, and penetrate the second flow guide plate 322 in a direction perpendicular to the second flow guide plate 322, such that the first condensation sheets 331a protrude from the two sides of the second flow guide plate 322. In addition, the diameters of the three first condensation sheets 331a gradually decrease, such that lengths of portions, protruding from the two sides of the second flow guide plate 322, of the three first condensation sheets 331a can gradually decrease. That is, gaps between outer edges of the first condensation sheets 331a and an inner wall of the housing 310 gradually increase from top to bottom. Thus, the process gas flowing to the top end of the inflow channel can be reduced and more process gas can flow

downwards. Specifically, to further reduce the process gas flowing to the top end of the inflow channel, as shown in FIG. 1, a height of the uppermost first condensation sheet 331a is generally not lower than a height of an axis of the inlet 311.

[0054] In some other embodiments, the lengths by which the plurality of condensation sheets 331 extend relative to the second flow guide plate 322 may alternatively be equal. The number of the first condensation sheets 331a and the lengths by which the first condensation sheets extend relative to the second flow guide plate 322 may be set according to the needs of the user, which are not limited herein. In addition, the first condensation sheet 331a may alternatively be a condensation sheet of other shapes than the circular sheet, such as an elliptical sheet. Moreover, the first condensation sheet 331a may be an integral condensation sheet. In this case, the condensation sheet may penetrate the second flow guide plate 322 such that the first condensation sheet 331a protrudes from the two sides of the second flow guide plate 322. Alternatively, the first condensation sheet 331a may be a split condensation sheet. In this case, the condensation sheet may include two condensation sub-sheets arranged at the two sides of the second flow guide plate 322 respectively. The two condensation sub-sheets are, for example, semicircular sheets or semielliptical sheets.

[0055] In some embodiments, the condensation sheets 331 further include second condensation sheets 331b, a plurality of second condensation sheets 331b are arranged, the second condensation sheets 331b are arranged at a side, farthest from the outlet 312 of all the first condensation sheets 331a, and lengths by which the second condensation sheet 331b extend relative to the second flow guide plate 322 are equal. In addition, the length by which each of the second condensation sheets 331b extends relative to the second flow guide plate 322 is less than or equal to a minimum of the lengths by which the at least two first condensation sheets 331a extend relative to the second flow guide plate 322. For example, the second condensation sheet 331b and the first condensation sheet 331a are circular sheets. The diameters of all the second condensation sheets 331b are equal and less than a minimum diameter of the first condensation sheets 331a.

[0056] In particular implementations shown in FIG. 1 and FIG. 3, the second condensation sheet 331b is located below the first condensation sheet 331a, and the second condensation sheet 331b and the first condensation sheet 331a are circular sheets. The diameters of the first condensation sheets 331a gradually decrease in the direction away from the outlet 312, and the diameters of the second condensation sheets 331b are equal and less than the minimum diameter of the first

condensation sheets 331a. The process gas may flow through the gap between the second condensation sheet 331b and the inner wall of the housing 310. The process gas may flow downwards in a direction indicated by an arrow in FIG. 1 in the inflow channel, enter the outflow channel after passing through the gap between the second flow guide plate 322 and the bottom of the housing 310, flow upwards in the direction indicated by the arrow in FIG. 1, and finally flow out of the outlet 312.

[0057] The lengths by which the second condensation sheets 331b extend relative to the second flow guide plate 322 may alternatively be set according to the needs of the user clearly. For example, in the particular implementation where the lengths by which the first condensation sheets 331a extend relative to the second flow guide plate 322 gradually decrease in the direction away from the outlet 312, the lengths by which the second condensation sheets 331b extend relative to the second flow guide plate 322 may alternatively decrease gradually in the direction away from the outlet 312, and a maximum of the lengths by which the second condensation sheets 331b extend relative to the second flow guide plate 322 is less than a minimum of the lengths by which the first condensation sheets 331a extend relative to the second flow guide plate 322. In the embodiment where the lengths by which the first condensation sheets 331a extend relative to the second flow guide plate 322 are equal, the lengths by which the second condensation sheets 331b extend relative to the second flow guide plate 322 are less than the lengths of the first condensation sheets 331a extend relative to the second flow guide plate 322. Through the above arrangement, a distance between the second condensation sheet 331b and the inner wall of the housing 310 can be increased by reducing the lengths by which the second condensation sheet 331b extend relative to the second flow guide plate 322, and resistance of the process gas flowing downwards in the inflow channel can be further reduced.

[0058] The lengths by which the plurality of condensation sheets 331 extend relative to the second flow guide plate 322 are increased gradually from bottom to top. When the process gas flows out of the outflow channel, the gas flow resistance can be further increased, and a contact area between the adsorption member 330 and the process gas can be increased, such that the solid by-products in the process gas can be fully absorbed. Illustratively, the distance between an outer edge of an uppermost condensation sheet 331 and the inner wall of the housing 310 is 10 mm. The distance increases by 20 mm sequentially from top to bottom until the distance reaches 70 mm. The user may alternatively set the distance between the outer edge of the

condensation sheet 331 and the inner wall of the housing 310 as required, which is not limited herein.

[0059] In some embodiments, a cross section, perpendicular to the second flow guide plate 322, of the housing 310 is circular, and the condensation sheet 331 is also the circular sheet. As shown in FIG. 3, the condensation sheet 331 penetrates the second flow guide plate 322 and is welded to the second flow guide plate 322 as a whole.

[0060] In some embodiments, each of the first condensation sheets 331a is perpendicular to the second flow guide plate 322, and on a plane perpendicular to the second flow guide plate 322, a center of an orthographic projection of each of the first condensation sheets 331a passes through a center of an orthographic projection of the second flow guide plate 322. In some embodiments, each of the second condensation sheets 331b is perpendicular to the second flow guide plate 322, and on a plane perpendicular to the second flow guide plate 322, a center of an orthographic projection of each of the second condensation sheets 331b passes through a center of an orthographic projection of the second flow guide plate 322. In this way, the lengths by which each condensation sheet 331 extends from the two sides of the second flow guide plate 322 may be equal. For example, in the embodiment where the condensation sheet 331 is the circular sheet, a circle center of the condensation sheet 331 may be located at a center line of the second flow guide plate 322. As shown in FIG. 5, the gap exists between the outer edge of the condensation sheet 331 and the inner wall of the second housing 317, through which the process gas may flow upwards and downwards.

[0061] In some embodiments, during assembly, the second flow guide plate 322 may be welded to the condensation sheet 331 into a whole, and then welded to the first flow guide plate 321. Then, the flow guide member 320 and the adsorption member 330 are mounted into the second housing 317. The first flow guide plate 321 and the second flow guide plate 322 may be hermetically connected to the second housing 317 through a sealant. When necessary, the first flow guide plate 321 and the second flow guide plate 322 may be detached from the housing 310.

[0062] In some embodiments, as shown in FIG. 1 and FIG. 2, the housing 310 further includes a first clamp 318. Each of the first housing 316 and the second housing 317 has a first connection edge and a second connection edge that extend radially outwards. The first clamp 318 is configured to clamp and fix the first connection edge and the second connection edge.

[0063] As shown in FIG. 1 and FIG. 2, the first housing 316 and the second housing 317 connect the first connection edge to the second connection edge through the first clamp 318, implementing a hermetical connection. The clamp connection can reduce connection difficulty between the first housing 316 and the second housing 317, and reduce assembly and disassembly cost of the two housings.

[0064] In some embodiments, the first clamp 318 may be a nominal width (NW) chain clamp. The NW chain clamp has the advantages of convenient assembly and disassembly and repeated reuse, and can quickly separate the first housing 316 from the second housing 317 during disassembly.

[0065] In some embodiments, the housing 310 further includes a first sealing ring located between the first housing 316 and the second housing 317. When the first clamp 318 connects the first housing 316 to the second housing 317, the first housing and the second housing press the sealing ring tightly from two sides, thus implementing sealing between the first housing 316 and the second housing 317.

[0066] In the particular implementations shown in FIG. 1 and FIG. 2, the liquid by-product in the process gas is attached to the second flow guide plate 322, and flows to the bottom of the housing 310 along the second flow guide plate 322. With the long-term use of the exhaust gas treatment device 300, more and more liquid by-products accumulate at the bottom of the housing 310, such that the exhaust gas treatment device 300 needs to clear the liquid by-products regularly. In this particular implementation, a maintenance port 313 is provided in an end, farthest from the first housing 316 in the axial direction of the side wall, of the second housing 317, the exhaust gas treatment device 300 further includes a sealing cover detachably connected to the maintenance port 313, and a second sealing ring is arranged between the maintenance port 313 and the sealing cover.

[0067] As shown in FIG. 2, a connection flange 314 is arranged at an end, farthest from the first housing 316 in the axial direction of the side wall, of the second housing 317, and is arranged around the maintenance port 313, and the sealing cover is detachably connected to the connection flange 314. When the liquid by-products are cleared, the sealing cover may be removed from the housing 310, to exhaust the liquid by-products from the maintenance port 313. After clearing of the liquid by-products is completed, the sealing cover is fixedly connected to the connection flange 314, and the second sealing ring is located between a flange surface of the connection flange 314 and the sealing cover. When the sealing cover and the connection flange are connected, the second sealing ring is pressed tightly, thus sealing the maintenance port 313.

[0068] In some embodiments, the housing 310 further includes a second clamp 319, and the connection flange 314 and the sealing cover are connected to each other through the second clamp 319. As shown in FIG. 2, the sealing cover may be specifically a blind plate 315, and the blind plate 315 is connected to the connection flange 314 through the second clamp 319. The connection method can improve disassembly and assembly efficiency between the connection flange 314 and the blind plate 315. The second clamp 319 may alternatively be an NW chain clamp for the convenience of assembly and disassembly of the blind plate 315. The user may alternatively connect the blind plate 315 to the connection flange 314 by other methods clearly, such as bolt connection, which is not limited herein.

[0069] In some embodiments, the process gas further includes incompletely reacted process gas, and the exhaust gas treatment device 300 is further configured to absorb the incompletely reacted process gas. An absorption liquid 340 is provided in the bottom (that is, the location where the inflow channel communicates with the outflow channel) of the housing 310, and is configured to absorb the incompletely reacted process gas. As shown in FIG. 1, a lower end of the second flow guide plate 322 is located above a liquid level of the absorption liquid 340. The process gas passes through a gap between the lower end of the second flow guide plate 322 and the liquid level of the absorption liquid 340. The process gas may come into contact with the absorption liquid 340 during flow, and the absorption liquid 340 can absorb the incompletely reacted process gas in the process gas. A distance between the lower end of the second flow guide plate 322 and the bottom of the housing 310 is generally 10 mm to 30 mm. Distances within the range can guarantee that the gas flow smoothly passes through a position between the second flow guide plate 322 and the bottom of the housing 310, and can further make the incompletely reacted process gas and the by-products be more fully absorbed.

[0070] In a particular implementation of the present disclosure, the chemical vapor deposition adopts a tetraethoxysilane process. There is potentially unpolymerized process gas in this process, and the process gas is continuously polymerized and deposited in a vacuum tube 200, to form the by-products. To prevent the by-products from being exhausted to the vacuum tube or a vacuum pump downstream of the exhaust gas treatment device 300, the exhaust gas treatment device 300 uses ultrapure water as the absorption liquid 340. In the presence of water, tetraethoxysilane may undergo accelerated polymerization to form solid or liquid substances, and the potentially unreacted process gas may fully react at the bottom of the exhaust gas treatment device 300, and then be intercepted by the exhaust gas treatment device 300 and

collected at the bottom of the exhaust gas treatment device 300. The exhaust gas treatment device 300 may alternatively be applied to other processes clearly, and the bottom of the exhaust gas treatment device 300 may store a medium capable of collecting the by-products in combination with particular processes, to intercept potential incompletely reacted process gas that has not yet generated by-products.

[0071] The present disclosure further provides a semiconductor process apparatus. The semiconductor process apparatus includes a reaction chamber 100, a flow control valve 400, and the exhaust gas treatment device 300 in any embodiment. As shown in FIG. 6, an inlet 311 of the exhaust gas treatment device 300 is connected to an exhaust port of the reaction chamber 100 through a vacuum tube 200, and an inlet of the flow control valve 400 is connected to an outlet of the exhaust gas treatment device 300 for controlling a flow rate of process gas. In this embodiment, the exhaust gas treatment device 300 is located upstream of the flow control valve 400, and the process gas does not need to pass through the flow control valve 400 before entering the exhaust gas treatment device 300. Thus, a length of the gas path is shortened, and impact of blockage of the flow control valve 400 on treatment of the process gas is reduced.

[0072] In some embodiments, the semiconductor process apparatus may further include a vacuum pump (not shown in the figure), and an outlet of the flow control valve 400 is connected to the vacuum pump. The vacuum pump operates to generate a negative pressure. The negative pressure is transmitted to the exhaust port of the reaction chamber 100 by the exhaust gas treatment device 300 and the vacuum tube 200, and the process gas in the reaction chamber 100 enters the exhaust gas treatment device 300 for recovery treatment. A mechanism of the other portions of the semiconductor process apparatus may refer to the prior art and will not be described herein.

[0073] It can be understood that the above implementations are merely illustrative implementations adopted for explaining the principles of the present disclosure, but the present disclosure is not limited to such implementations. For those of ordinary skill in the art, various variations and improvements can be made without departing from the spirit and essence of the present disclosure, and these variations and improvements are also regarded to fall within the protection scope of the present disclosure.

Claims

1. An exhaust gas treatment device, applied to a semiconductor process apparatus, comprising a housing, a flow guide member, and an adsorption member, wherein

the housing comprises an inlet and an outlet, and the inlet is configured to introduce, into the housing, process gas exhausted from a reaction chamber;

the flow guide member is arranged in the housing, and partitions an interior of the housing into fluid channels, the fluid channels comprise an inflow channel and an outflow channel that communicate with the inlet and the outlet respectively, and the inflow channel communicates with the outflow channel; and

a portion of the adsorption member is arranged in the inflow channel, the remaining portion of the adsorption member is arranged in the outflow channel, and the adsorption member is configured to adsorb a by-product in the process gas.

2. The exhaust gas treatment device according to claim 1, wherein an included angle is formed between an orientation of the outlet and an orientation of the inlet; and

the flow guide member comprises a first flow guide plate and a second flow guide plate between which an included angle is formed, the one end of the first flow guide plate is connected to a position, between the inlet and the outlet, of the housing, the other end of the first flow guide plate extends in a direction away from the inlet and is connected to the one end of the second flow guide plate, and the other end of the second flow guide plate extends in a direction away from the outlet.

3. The exhaust gas treatment device according to claim 2, wherein the housing comprises a first housing and a second housing, and each of the first housing and the second housing has a side wall extending in a circumferential direction; and an end, in an axial direction of the side wall, of the first housing and an end, in an axial direction of the side wall, of the second housing are hermetically connected to each other, the outlet is located in an end, farthest from the second housing in the axial direction of the side wall, of the first housing, and the inlet is located in the side wall of the second housing.

4. The exhaust gas treatment device according to claim 3, wherein the second flow guide plate partitions a space defined by the side wall of the second housing into a first subspace and a second subspace, and an end, farthest from the outlet, of the second flow guide plate is spaced apart from the second housing, to make an end, farthest from the outlet, of the first subspace communicate with an end, farthest from the outlet, of the second subspace; and

the first flow guide plate is connected to an end, closest to the outlet, of the second flow guide plate and the side wall of the second housing, to close an end, closest to the outlet, of one of the first subspace and the second subspace; one of the first subspace and the second subspace forms the inflow channel; and an end, closest to the outlet, of the other of the first subspace and the second subspace and a space defined by the side wall of the first housing communicate with each other, and jointly form the outflow channel.

5. The exhaust gas treatment device according to claim 2, wherein the adsorption member comprises a plurality of condensation sheets, the plurality of condensation sheets are arranged at the second flow guide plate, and arrayed in a direction away from the outlet, and an included angle is formed between each of the condensation sheets and the second flow guide plate.

6. The exhaust gas treatment device according to claim 5, wherein the condensation sheets comprise first condensation sheets, at least two first condensation sheets are arranged, and lengths by which the at least two first condensation sheets extend relative to the second flow guide plate are gradually reduced in the direction away from the outlet.

7. The exhaust gas treatment device according to claim 6, wherein the condensation sheets further comprise second condensation sheets, a plurality of second condensation sheets are arranged, the second condensation sheets are arranged at a side, farthest from the outlet, of all the first condensation sheets, and lengths by which the second condensation sheets extend relative to the second flow guide plate are equal; and

the length by which each of the second condensation sheets extends relative to the second flow guide plate is less than or equal to a minimum of the lengths by which the at least two first condensation sheets extend relative to the second flow guide plate.

8. The exhaust gas treatment device according to claim 7, wherein each of the first condensation sheets is perpendicular to the second flow guide plate, and on a plane perpendicular to the second flow guide plate, a center of an orthographic projection of each of the first condensation sheets passes through a center of an orthographic projection of the second flow guide plate; or

each of the second condensation sheets is perpendicular to the second flow guide plate, and on a plane perpendicular to the second flow guide plate, a center of an orthographic projection of each of the second condensation sheets passes through a center of an orthographic projection of the second flow guide plate.

9. The exhaust gas treatment device according to claim 3, wherein a maintenance port is provided in an end, farthest from the first housing in the axial direction of the side wall, of the second housing, the exhaust gas treatment device further comprises a sealing cover detachably connected to the maintenance port, and a second sealing ring is arranged between the maintenance port and the sealing cover.

10. The exhaust gas treatment device according to any one of claims 1 to 9, wherein an absorption liquid is provided in a location where the inflow channel communicates with the outflow channel, and is configured to absorb incompletely reacted process gas.

11. A semiconductor process apparatus, comprising a reaction chamber, a flow control valve, and the exhaust gas treatment device according to any one of claims 1 to 10, wherein an inlet of the exhaust gas treatment device is connected to an exhaust port of the reaction chamber, and an outlet of the exhaust gas treatment device is connected to an inlet of the flow control valve.