

SEMICONDUCTOR PROCESS CHAMBER AND SEMICODUCTOR PROCESS APPARATUS

FIELD OF THE TECHNOLOGY

[0001] The present disclosure relates to a field of semiconductor technology, and in particular to a semiconductor process chamber and a semiconductor process apparatus.

BACKGROUND

[0002] The deposition rate of the Plasma Enhanced Atomic Layer Deposition (PEALD) process is relatively slow. Developing a process chamber with multiple reaction chambers has become a better solution to increase the production capacity of PEALD process.

[0003] An existing process chamber with multiple reaction chambers has a transfer chamber and multiple reaction areas. Each reaction area is provided with a reaction chamber, a carrying device and an elastic sealing bellows. The multiple reaction chambers are arranged at intervals and are respectively connected to the transfer chambers. The carrying device includes a carrier and a liftable support shaft. The carrier is configured to carry the wafer. The support shaft is arranged at the bottom of the carrier. The support shaft is configured to support the carrier to descend to the transferring position in the transfer chamber or to ascend to the processing position in the reaction chamber. When the carrier descends to the transferring position, the wafer may be transferred. When the carrier ascends to the processing position, the semiconductor process of the wafer may be realized. The elastic sealing bellows is located below the carrier and surrounds the support shaft, and the bottom of the elastic sealing bellows is connected to the bottom of the transfer chamber. When the carrier descends to the transferring position, the top of the elastic sealing bellows contacts the bottom of the carrier, and the elastic sealing bellows is at a compressed state. In the process of the carrier ascending from the transferring position to the

processing position, the elastic sealing bellows gradually stretches under the action of its own elasticity. When the carrier ascends to the processing position, the top of the elastic sealing bellows contacts the bottom of the reaction chamber to seal the reaction chamber, thereby preventing multiple reaction chambers from being interconnected through the transfer chamber, causing the gas flow fields of multiple reaction chambers to interfere with each other.

[0004] However, in practice, since the top of the elastic sealing bellows contacts the bottom of the reaction chamber during the semiconductor fabrication process, the elastic sealing bellows will be affected by the high temperature of the reaction chamber for a long time, causing the elastic force of the elastic sealing bellows to gradually decrease. In addition, the elastic force of the elastic sealing bellows may gradually decrease during the frequent compression and extension process. In addition, due to the elasticity of the elastic sealing bellows, at the moment when the top of the elastic sealing bellows is separated from the bottom of the reaction chamber, the elastic sealing bellows may jump irregularly. It may affect the contaminated particles in the process chamber and may even cause wafer slippage. In addition, the elastic sealing bellows may not be used for high-temperature processes of 550°C and above. These situations may lead to a decrease in the sealing effect of the elastic sealing bellows, poor sealing stability, and poor stability in the use of semiconductor process chambers and semiconductor process apparatus.

SUMMARY

[0005] The present disclosure aims to solve at least one of the technical problems existing in the technical field, and proposes a semiconductor process chamber and semiconductor process apparatus, which may improve the sealing stability of the sealing component and improve the stability of the semiconductor process chamber and semiconductor process apparatus.

[0006] To achieve the objectives of the present disclosure, a semiconductor processing chamber is provided, including an outer chamber having multiple reaction areas within the outer chamber, each reaction area is provided with a reaction chamber, a carrying device, and a sealing assembly; where:

[0007] a bottom end of the reaction chamber has an opening;

[0008] the carrying device includes a carrier and a liftable support shaft, the carrier is configured to carry wafers, the support shaft is arranged at the bottom of the carrier and supports the carrier, allowing it to ascend and descend through the opening between a processing position within the reaction chamber and a transferring position below the reaction chamber;

[0009] the sealing assembly is arranged below the carrier and connected to the carrier, the support shaft passes through the sealing assembly and is configured to ascend and descend with the support shaft, when the support shaft supports the carrier and raises it to the processing position, the sealing assembly contacts the bottom end of the reaction chamber to seal the opening.

[0010] In certain embodiments, the sealing assembly is connected to the support shaft.

[0011] In certain embodiments, the support shaft is provided with an engagement portion, the engagement portion surrounding the support shaft;

[0012] the sealing assembly includes a connecting member and ring-shaped sealing body.

[0013] the sealing body surrounds the support shaft and is configured to seal the opening, the sealing body has an engagement space that surrounds the support shaft and is configured to accommodate the engagement portion;

[0014] the connecting member is configured to connect the sealing body and the engagement portion to connect the sealing assembly to the support shaft.

[0015] In certain embodiments, a preset gap is defined between the sealing body and the carrier.

[0016] In certain embodiments, the sealing body includes: a ring-shaped first sealing plate; a ring-shaped second sealing plate located on a side of the first sealing plate facing away from the carrier and spaced apart from the first sealing plate; and a side wall located between the first and second sealing plates;

[0017] the first sealing plate is configured to seal the opening;

[0018] the side wall connects the first sealing plate and the second sealing plate to form the engagement space between the first sealing plate, the second sealing plate, and the side wall, with an engagement port of the engagement space facing the outer circumferential surface of the support shaft.

[0019] In certain embodiments, the first sealing plate has a gas channel therein. The first sealing plate has a plurality of first gas outlets extending through the gas channel on a side facing the carrier. The inner ring surface of the first sealing plate has a first gas inlet connected to the gas channel;

[0020] the support shaft is provided with a gas inlet channel and a second gas outlet located opposite the inner ring surface of the first sealing plate. Gas in the gas inlet channel is sequentially delivered through the second gas outlet, the first gas inlet, the gas channel, and the first gas outlet to a preset gap between the sealing body and the carrier.

[0021] In certain embodiments, the gas channel includes a plurality of branch gas channels distributed circumferentially along the first sealing plate and a main gas channel connected to each of the branch gas channels;

[0022] the main gas channel is ring-shaped, with multiple branch gas channels arranged

around it, each extending radially along the first sealing plate;

[0023] the first gas inlet is connected to the main gas channel.

[0024] In certain embodiments, the carrying device further includes multiple liftable support columns extending through the carrier;

[0025] the first sealing plate further includes a through hole for each support column to pass through, with an orthographic projection of each through hole on the carrier coinciding with an orthographic projection of the first gas outlet on the carrier.

[0026] In certain embodiments, a radial dimension of the first gas inlet gradually decreases from an end of the first gas inlet close to the support shaft to an end of the first gas inlet away from the support shaft.

[0027] In certain embodiments, the sealing assembly further includes a first sealing member, the sealing body is provided with an engagement groove, the engagement groove is arranged on one side of the sealing body facing the bottom end of the reaction chamber, and is arranged along the circumference of the sealing body, the first sealing member is ring-shaped, and engages with the engagement groove, the first sealing member is configured to contact the bottom end of the reaction chamber when the support shaft supports the carrier to ascend to the processing position, and seal the opening by sealing between the sealing body and the bottom end of the reaction chamber.

[0028] In certain embodiments, the radial dimension of the opening of the engagement groove is smaller than the radial dimension of the bottom of the engagement groove.

[0029] In certain embodiments, the surface of the sealing body facing the support portion is arc-shaped, and the distance between the surface of the sealing body facing the carrier and the carrier gradually increases from the center to the edge of the surface of the sealing body facing

the carrier.

[0030] In certain embodiments, the connecting member is further configured to adjust the distance between the sealing body and the engagement portion in the axial direction of the support shaft.

[0031] In certain embodiments, the connecting member includes an outer screw member, a middle screw member, and inner screw member, the outer screw member has a first outer thread and a first inner thread, and the thread direction of the first outer thread is opposite to the thread direction of the first inner thread, the outer screw member passes through the sealing body to the engagement space, and is threadedly engaged with the sealing body through the first outer thread, the middle screw member has a second outer thread, the middle screw member passes through the interior of the outer screw member, and is threadedly engaged with the first inner thread through the second outer thread, the inner screw member has a third outer thread, the inner screw member passes through the interior of the middle screw member, and is threadedly engaged with the assembly portion through the third outer thread.

[0032] In certain embodiments, the screw pitch of the first outer thread is greater than the pitch of the first inner thread.

[0033] In certain embodiments, the connecting member further includes a support reinforcement member, which is ring-shaped and arranged along the inner circumference of the middle screw member and is fixedly connected to the middle screw member. One end of the support reinforcement member abuts the engagement portion, and the other end abuts the head of the inner screw member.

[0034] In certain embodiments, there are multiple connecting members, each of which is spaced apart along the circumference of the sealing body.

[0035] The present disclosure also provides semiconductor processing apparatus, including a wafer transfer device and the semiconductor process chamber provided herein. The wafer transfer device is located within the outer chamber and is configured to transfer wafers to and from each carrier when the carrier is at the transferring position.

[0036] The present disclosure has the following beneficial effects:

[0037] The semiconductor process chamber provided by the present disclosure connects the sealing assembly provided in each reaction area with the carrying device provided in each reaction area, so that the sealing assembly may ascend and descend along with the support shaft. In this way, when the carrier supported by the support shaft ascends to the processing position, the sealing assembly may contact the bottom end of the reaction chamber to seal the opening at the bottom end of the reaction chamber, thereby avoiding interference between multiple reaction chambers during the semiconductor fabrication process, making multiple reaction chambers independent of each other, and thus improving the consistency and stability of the semiconductor process of wafers in multiple reaction chambers. Since the sealing assembly is connected to the carrying device and may ascend and descend along with the support shaft, compared with the certain existing technology, the sealing assembly does not need to have an elastic expansion and contraction function itself, that is, there is no need to adopt the elastic sealing bellows of the existing technology, thereby avoiding the problems caused by the reduced elastic force, irregular jumping and inability to be applied to high-temperature processes (for example, 550°C and above) of the elastic bellows, thereby improving the sealing stability of the sealing assembly and improving the stability of use of the semiconductor process chamber and semiconductor process apparatus.

[0038] The semiconductor process apparatus provided by the present disclosure, with the

help of the semiconductor process chamber provided by the present disclosure, may avoid mutual interference between multiple reaction chambers when performing semiconductor processes, so that multiple reaction chambers may be independent of each other, thereby improving the consistency and stability of semiconductor processes performed on wafers in multiple reaction chambers, and may avoid problems caused by the reduction of elastic force, irregular jumping and inability to be applicable to high-temperature processes (for example, 550°C and above) of the elastic bellows, thereby improving the sealing stability of the sealing component and improving the stability of use of the semiconductor process chamber and the semiconductor process apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

[0039] FIG. 1 is a schematic diagram of a structure of a process chamber according to certain embodiments of the present disclosure, with the carrier at the processing position;

[0040] FIG. 2 is a schematic diagram of a structure of a process chamber according to certain embodiments of the present disclosure, with the carrier at the transferring position;

[0041] FIG. 3 is a schematic diagram of a top view of an outer chamber according to certain embodiments of the present disclosure;

[0042] FIG. 4 is an enlarged schematic diagram of a structure of a reaction chamber according to certain embodiments of the present disclosure, with the carrier at the processing position;

[0043] FIG. 5 is an enlarged schematic diagram of a seal between a sealing assembly and a reaction chamber according to certain embodiments of the present disclosure;

[0044] FIG. 6 is a schematic diagram of a three-dimensional structure of a support shaft according to certain embodiments of the present disclosure;

- [0045]** FIG. 7 is a schematic diagram of a front cross-sectional structure of a support shaft according to certain embodiments of the present disclosure;
- [0046]** FIG. 8 is a schematic diagram of a three-dimensional structure of a sealing assembly according to certain embodiments of the present disclosure;
- [0047]** FIG. 9 is a schematic diagram of a three-dimensional structure of a connecting member according to certain embodiments of the present disclosure;
- [0048]** FIG. 10 is a schematic diagram of look-up view of a three-dimensional structure of a sealing assembly and a support shaft according to certain embodiments of the present disclosure;
- [0049]** FIG. 11 is a schematic diagram of a three-dimensional cross-sectional structure of the connecting member according to certain embodiments of the present disclosure;
- [0050]** FIG. 12 is a schematic diagram of a cross-sectional top view of the connecting member according to certain embodiments of the present disclosure;
- [0051]** FIG. 13 is a schematic diagram of a partial front cross-sectional view of a sealing body according to certain embodiments of the present disclosure;
- [0052]** FIG. 14 is a schematic diagram of a three-dimensional cross-sectional view of a uniform flow ring according to certain embodiments of the present disclosure;
- [0053]** FIG. 15 is a schematic diagram of a three-dimensional cross-sectional view of the lower exhaust ring according to certain embodiments of the present disclosure;
- [0054]** FIG. 16 is a schematic diagram of the front and cross-sectional structure of a connecting member respectively connected to a sealing body and an engagement portion, according to certain embodiments of the present disclosure;
- [0055]** FIG. 17 is a schematic diagram of a three-dimensional structure of a connecting

member according to certain embodiments of the present disclosure; and

[0056] FIG. 18 is a schematic diagram of a front and cross-sectional structure of a connecting member according to certain embodiments of the present disclosure.

[0057] Reference numerals -- outer chamber 1; wafer transfer device 11; transfer portion 111; wafer transfer port 12; reaction chamber 2; carrying device 3; carrier 31; through hole 311; support shaft 32; gas inlet channel 321; gas inlet 322; second gas outlet 323; engagement portion 324; sealing assembly 4; engagement groove 41; connector 42; connect through hole 421; connector part 43; screw connect hole 431; main gas channel 432; branch gas channel 433; first gas outlet 434; first gas inlet 435; engagement space 436; through hole 437; second sealing member 44; first sealing plate 451; ring-shaped protrusion 451a; second sealing plate 452; side wall 453; uniform flow ring 51; uniform flow port 511; upper exhaust ring 52; lower exhaust ring 53; outer ring body 531; inner ring body 532; connect ring body 533; exhaust port 534; extraction port 535; exhaust space 54; connecting member 6; outer screw member 61; middle screw member 62; inner screw member 63; support reinforcement member 64; support column 71; support member 72; lift drive source 81; drive source 82; outer gas pipe 83; and upper electrode structure 9.

DETAILED DESCRIPTION

[0058] In order to enable those skilled in the technical field to better understand the technical solution of the present disclosure, the semiconductor process chamber and semiconductor process apparatus provided by certain embodiments of the present disclosure are described in detail below with reference to the accompanying drawings.

[0059] As shown in FIG. 1 and FIG. 2, certain embodiments of the present disclosure provide a semiconductor process chamber, including an outer chamber 1, wherein the outer

chamber 1 has therein multiple reaction areas (two reaction areas are used as an example in FIG. 1 and FIG. 2), each reaction area is provided with a reaction chamber 2, a carrying device 3 and a sealing assembly 4; where: the bottom end of the reaction chamber 2 has an opening; the carrying device 3 includes a carrier 31 and a liftable support shaft 32. The carrier 31 is configured to carry the wafer. The support shaft 32 is arranged at the bottom of the carrier 31 to support the carrier 31 and to ascend and descend between the processing position of the reaction chamber 2 and the transferring position located below the reaction chamber 2 via the opening; the sealing assembly 4 is arranged below the carrier 31 and is connected to the carrying device 3. The support shaft 32 passes through the sealing assembly 4, and the sealing assembly 4 is configured to ascend and descend with the support shaft 32. When the support shaft 32 supports the carrier 31 to ascend to the processing position, it contacts the bottom end of the reaction chamber 2 to seal the opening, so that a sealed space is formed between the sealing assembly 4 and the reaction chamber 2.

[0060] The semiconductor process chamber provided in certain embodiments of the present disclosure connects the sealing assembly 4 provided in each reaction area with the carrying device 3 provided in each reaction area, so that the sealing assembly 4 may be raised and lowered along with the support shaft 32. In this way, when the support shaft 32 supports the carrier 31 to ascend to the processing position, the sealing assembly 4 may contact the bottom end of the reaction chamber 2 to seal the opening at the bottom end of the reaction chamber 2, thereby avoiding interference between the multiple reaction chambers 2 during the semiconductor fabrication process and making the multiple reaction chambers 2 independent of each other. This may improve the consistency and stability of semiconductor processes performed on wafers in multiple reaction chambers 2. Since the sealing assembly 4 is connected

to the carrying device 3 and may ascend and descend with the support shaft 32, compared with certain existing technology, the sealing assembly 4 does not need to have an elastic expansion and contraction function itself, that is, there is no need to adopt the elastic sealing bellows of the certain existing technology, thereby avoiding the problems caused by the reduced elastic force of the elastic bellows, irregular jumping, and inability to be applied to high-temperature processes (for example, 550°C and above), thereby improving the sealing stability of the sealing assembly 4 and improving the use stability of the semiconductor process chamber and semiconductor process apparatus.

[0061] In certain embodiments, the sealing assembly 4 is arranged below the carrier 31 and is fixed relative to the support shaft 32 so as to be able to ascend and descend with the support shaft 32. The sealing assembly 4 is configured to contact the bottom end of the reaction chamber 2 when the support shaft 32 supports the carrier 31 to ascend to the processing position, so as to seal the opening and form a sealed space between the sealing assembly 4 and the reaction chamber 2.

[0062] For example, as shown in FIGs. 1 to 3, there may be four reaction areas in the outer chamber 1, the number of reaction chambers 2, the number of carrying devices 3 and the number of sealing assemblies 4 may all be four, and each reaction area may be provided with a reaction chamber 2, a carrying device 3 and a sealing assembly 4. In certain embodiments, as shown in FIG. 3, a wafer transfer port 12 may be provided on one side wall of the outer chamber 1, and a rotatable wafer transfer device 11 may be provided in the outer chamber 1. The wafer transfer device 11 may have four transfer portions 111. In certain embodiments, the support shaft 32 may be connected to a lift drive source 81, which is configured to provide a lift drive force to drive the support shaft 32 to ascend and descend.

[0063] During the semiconductor fabrication process, the robot outside the outer chamber 1 may transfer the wafer into the outer chamber 1 through the wafer transfer port 12. At this time, the four carriers 31 may all be located at the transfer position. At this time, each support column 71 is located higher than the carrier 31. The wafer transfer device 11 may be rotated so that each transfer portion 111 is sequentially located at the position corresponding to the wafer transfer port 12 to receive the wafer transferred by the robot from outside the outer chamber 1 to the outer chamber 1 through the wafer transfer port 12. The transfer portion 111 carrying the wafer is then rotated to the top of the corresponding carrier 31. Each transfer portion 111 is then lowered, transferring the wafer to each support column 71 and having the wafer supported on the support column 71. The lift drive source 81 then provides a lift force to drive the support shaft 32 upward. The support shaft 32 supports the carrier 31 as it ascends through the opening to the processing position within the reaction chamber 2 (as shown in FIG. 1). As the carrier 31 ascends from the transferring position to the processing position, the carrier 31 lifts the wafer on each support column 71 and supports the wafers as they ascend to the processing position. The sealing assembly 4 may ascend with the support shaft 32, and when the carrier 31 ascends to the processing position, it contacts the bottom end of the reaction chamber 2 to seal the opening, thereby sealing the reaction chamber 2, so that the semiconductor process may be performed on the wafer in a sealed environment, and then the interference between the multiple reaction chambers 2 may be avoided during the semiconductor fabrication process, so that the multiple reaction chambers 2 may be independent of each other, thereby improving the consistency and stability of the semiconductor process (for example, deposition of film layers) performed on the wafers in the multiple reaction chambers 2.

[0064] After the semiconductor fabrication process is completed, the lift drive source 81

may provide a descend drive force to drive the support shaft 32 to descend. The support shaft 32 supports the carrier 31 to descend through the opening to the transferring position below the reaction chamber 2 (as shown in FIG. 2). During the process of the carrier 31 descending from the processing position to the transferring position, the sealing assembly 4 may descend along with the support shaft 32, thereby separating from the bottom end of the reaction chamber 2 and removing the seal of the reaction chamber 2. When the carrier 31 descends to the transferring position, each support column 71 is higher than the carrier 31 to support the processed wafer on the carrier 31. Then, the wafer transfer device 11 may rotate the four transfer portions 111 to move between the four carriers 31 and the wafers supported by the support columns 71. Then, by raising the transfer portions 111, the four wafers are transferred from the support columns 71 to the four transfer portions 111. Then, the wafer transfer device 11 may be rotated so that each transfer portion 111 is located in the position corresponding to the wafer transfer port 12 in sequence, so that the robot in the outer chamber 1 may take out the wafer from the transfer portion 111 corresponding to the transfer port 12. After that, the robot may transfer four wafers from the outer chamber 1 through the transfer port 12 to the outside of the process chamber in sequence.

[0065] The number of reaction areas, the number of reaction chambers 2, the number of carrying devices 3, the number of sealing assemblies 4 and the number of transfer portions 111 are not limited to four. For example, the number of reaction areas, the number of reaction chambers 2, the number of carrying devices 3, the number of sealing assemblies 4 and the number of transfer portions 111 may be two, three, five or more.

[0066] In certain embodiments, the number of lift drive sources 81 may be the same as the number of support shafts 32, and the lift drive sources 81 may be provided in a one-to-one

correspondence with the support shafts 32. In this way, each lift drive source 81 may independently drive the corresponding carrier 31 to ascend and descend, thereby improving the flexibility of controlling the ascend and descend of each carrier 31.

[0067] In certain embodiments, the lift drive source 81 may be arranged outside of the outer chamber 1 and located below the outer chamber 1. The support shaft 32 may pass through the bottom of the outer chamber 1 and connect with the lift drive source 81, and the support shaft 32 may ascend or descend relative to the outer chamber 1.

[0068] In certain embodiments, a drive source 82 may be further provided outside of the outer chamber 1, and the wafer transfer device 11 may pass through the bottom of the outer chamber 1 and be connected to the drive source 82, and the wafer transfer device 11 may rotate and ascend and descend relative to the outer chamber 1. The drive source 82 is configured to provide rotational drive force and lift drive force to the wafer transfer device 11, so as to drive the wafer transfer device 11 to rotate and ascend and descend in the outer chamber 1.

[0069] As shown in FIGs. 1, 2, and 4, in certain embodiments of the present disclosure, the sealing assembly 4 may be connected to the support shaft 32.

[0070] In other words, by connecting the sealing assembly 4 to the support shaft 32, the sealing assembly 4 may be located below the carrier 31 and fixed relative to the support shaft 32, allowing the sealing assembly 4 to ascend and descend with the support shaft 32.

[0071] As shown in FIGs. 1, 2, 4, and 6-7, in certain embodiments of the present disclosure, the support shaft 32 passes through the sealing assembly 4. The support shaft 32 may be provided with an engagement portion 324, which surrounds the support shaft 32; the sealing assembly 4 may include a connecting member 6 and a ring-shaped sealing body. The sealing body surrounds the support shaft 32, the sealing body is configured to seal the opening, and the

sealing body has a ring-shaped engagement space 436 surrounding the support shaft 32 and for accommodating the engagement portion 324; the connecting member 6 is configured to connect the sealing assembly 4 and the support shaft 32 by connecting the sealing body and the engagement portion 324.

[0072] That is, the sealing body surrounds the support shaft 32, and the engagement portion 324 surrounding the support shaft 32 is accommodated in the engagement space 436 of the sealing body. The connecting member 6 may connect the sealing body and the engagement portion 324. The connection between the sealing body and the engagement portion 324 may realize the connection between the sealing assembly 4 and the support shaft 32. Sealing the opening by the sealing assembly 4 may be achieved by sealing the opening by the sealing body.

[0073] In certain embodiments, when the sealing body seals the opening, there is a preset gap between the sealing body and the carrier 31. This design is arranged because after the sealing body seals the opening and the carrier 31 ascends to the processing position, the carrier 31 may heat the wafer. For example, the carrier 31 may heat the wafer to 550°C. By arranging a preset gap between the sealing body and the carrier 31 when the opening is sealed, the heat transferred from the carrier 31 to the sealing body may be reduced, thereby reducing the probability of the sealing body being damaged due to high temperature, thereby increasing the service life of the sealing assembly 4 and improving the stability of the sealing assembly 4 in sealing the reaction chamber 2, thereby improving the use stability of the semiconductor process chamber and the stability of the semiconductor process.

[0074] As shown in FIGs. 9-12, in certain embodiments, the sealing body may include a connector 42 and multiple connector parts 43, each connector part 43 is arc-shaped, and the multiple connector parts 43 are combined to form a ring. The connector 42 is ring-shaped, and

the multiple connector parts 43 are connected through the connector 42.

[0075] As shown in FIGs. 8 and 10, for example, the number of connector parts 43 may be two, each connector part 43 is semicircular, the two connector parts 43 are located on both sides of the support shaft 32 respectively, and the two connector parts 43 are combined into a circular ring shape. The connector 42 is circular and is respectively connected to the two connector parts 43, thereby connecting the two connector parts 43 together.

[0076] However, the number of the connector parts 43 is not limited thereto, for example, the number of the connector parts 43 may be three or more. The shape of the combination of the connector parts 43 and the shape of the connector 42 are not limited thereto.

[0077] As shown in FIGs. 4-5, 8-9, 11-13, and 16, in certain embodiments of the present disclosure, the sealing body may include: a ring-shaped first sealing plate 451, a ring-shaped second sealing plate 452 located on a side of the first sealing plate 451 facing away from the carrier 31 and spaced apart from the first sealing plate 451, and a side wall 453 located between the first sealing plate 451 and the second sealing plate 452. The first sealing plate 451 is configured to seal the opening, and the side wall 453 connects the first sealing plate 451 and the second sealing plate 452 to form an engagement space 436 between the first sealing plate 451, the second sealing plate 452 and the side wall 453, and the engagement port of the engagement space 436 faces the outer circumference surface of the support shaft 32.

[0078] That is, the first sealing plate 451 and the second sealing plate 452 are opposite each other and spaced apart, and the side wall 453 is provided between the first sealing plate 451 and the second sealing plate 452. The first sealing plate 451 and the second sealing plate 452 are both ring-shaped so as to surround the support shaft 32. The side wall 453 is ring-shaped and provided along the circumference of the first sealing plate 451 and the second sealing plate 452.

The ring-shaped engagement space 436 may be formed by the space between the first sealing plate 451, the second sealing plate 452, and the side wall 453. The support shaft 32 may pass through the engagement port of the engagement space 436 such that the support shaft 32 passes through the sealing assembly 4. Sealing the opening by the sealing body may be achieved via sealing the opening by the first sealing plate 451.

[0079] As shown in FIGs. 4-9 and FIGs. 11-13, in certain embodiments of the present disclosure, a gas channel may be defined inside the first sealing plate 451. The first sealing plate 451 has a plurality of first gas outlets 434 extending through the gas channel on a side facing the carrier 31. The first sealing plate 451 has a first gas inlet 435 on an inner ring surface thereof that communicates with the gas channel. A gas inlet channel 321 is provided in the support shaft 32, and the support shaft 32 may have second gas outlets 323 at a location opposite to the inner ring surface of the first sealing plate 451, so that the gas in the gas inlet channel 321 is transported to the preset gap between the sealing body and the carrier part 31 through the second gas outlet 323, the first gas inlet 435, the gas channel and the first gas outlet 434 in sequence.

[0080] That is to say, the first sealing plate 451 is provided with a gas channel, a first gas inlet 435 and a plurality of first gas outlets 434, where the gas channel is arranged inside the first sealing plate 451, one end of the first gas inlet 435 is located on the inner ring surface of the first sealing plate 451, and the other end is connected to the gas channel, and one end of the first gas outlet 434 is located on the side of the first sealing plate 451 facing the carrier 31, and the other end is connected to the gas channel. The support shaft 32 is provided with an gas inlet channel 321 and a second gas outlet 323, where the gas inlet channel 321 is arranged inside the support shaft 32, one end of the second gas outlet 323 is connected to the gas inlet channel 321, and the other end is opposite to one end of the first gas inlet 435 located on the inner ring surface of the

first sealing plate 451. In some implementations, the gas in the gas inlet channel 321 may first enter the second gas outlet 323, then enter the first gas inlet 435 through the second gas outlet 323, then enter the gas channel through the first gas inlet 435, then enter the plurality of first gas outlets 434 through the gas channel, and then enter the preset gap through the plurality of first gas outlets 434.

[0081] This design is arranged as such because during the semiconductor fabrication process, the reaction gas used for the semiconductor process in the reaction chamber 2 may flow to the bottom of the carrier 31 and accumulate and deposit on the lower surface of the carrier 31, resulting in the generation of particles in the reaction chamber 2 during the semiconductor fabrication process, which may affect the semiconductor process. By delivering gas to the above-mentioned preset gap, the preset gap may have a certain pressure to form a stable environment, thereby reducing the possibility of the reaction gas flowing below the carrier 31, and then reducing the particles generated by the aggregation and deposition of the reaction gas in the reaction chamber 2, thereby improving the semiconductor process.

[0082] In certain embodiments, the gas may include nitrogen or an inert gas.

[0083] As shown in FIG. 7, in certain embodiments, the support shaft 32 may further include a gas inlet 322, one end of which is connected to the gas inlet channel 321 and the other end of which is connected to the gas source.

[0084] In various implementations, a gas source may provide gas. The gas source may be located outside of and below the outer chamber 1 to avoid affecting the environment within the semiconductor process chamber. The gas provided by the gas source may first enter the gas inlet 322 and then enter the gas inlet channel 321 through the gas inlet 322.

[0085] As shown in FIGs. 1 and 2, in certain embodiments, the gas inlet 322 may be

connected to the gas source via an outer gas pipe 83.

[0086] As shown in FIGs. 4-5, 8-9, and 11-13, in certain embodiments of the present disclosure, the gas channel may include a plurality of branch gas channels 433 distributed along the ring direction of the first sealing plate 451 and a main gas channel 432 connected to the plurality of branch gas channels 433. The main gas channel 432 is ring-shaped, and a plurality of branch gas channels 433 are arranged around the main gas channel 432. Each branch gas channel 433 extends radially along the first sealing plate 451. The first gas inlet 435 is in communication with the main gas channel 432.

[0087] In various implementations, multiple first gas outlets 434 may be distributed in the extension direction of each branch gas channel 433, and one end of each first gas outlet 434 connected to the gas channel may be connected to the branch gas channel 433, that is, the connection between the first gas outlet 434 and the gas channel may be achieved by connecting to the branch gas channel 433. In this way, the gas passing through the first gas inlet 435 may first enter the main gas channel 432, then enter the multiple branch gas channels 433 through the main gas channel 432, then enter the multiple first gas outlets 434 through the multiple branch gas channels 433, and then enter the preset gap through the multiple first gas outlets 434. That is to say, the gas in the first gas inlet 435 may be transported to the preset gap through the main gas channel 432, the multiple branch gas channels 433 and the multiple first gas outlets 434 in sequence.

[0088] In certain embodiments, the multiple branch gas channels 433 may be evenly spaced along the arc of the connector parts 43. This may improve the uniformity of gas delivery to the preset gap.

[0089] In certain embodiments, the multiple first gas outlets 434 may be evenly spaced

along the extension direction of the branch gas channels 433. This may improve the uniformity of gas delivery to the preset gap.

[0090] As shown in Figures 1, 2, 4 and 8, in certain embodiments of the present disclosure, the carrying device 3 may also include a plurality of support columns 71 that pass through the carrier 31 and may ascend and descend; the first sealing plate 451 also has a through hole 437 for each support column 71 to pass through, and the orthographic projection of the through hole 437 on the carrier 31 coincides with the orthographic projection of the first gas outlet 434 on the carrier 31.

[0091] In some implementations, when the carrier 31 descends to the transferring position, the tops of the multiple support columns 71 may protrude relative to the top surface of the carrier 31. In this way, when the wafer is transferred above the carrier 31, the wafer may be placed on the multiple support columns 71. After that, the carrier 31 ascends to lift the wafer on the multiple support columns 71, and then continues to ascend to the processing position. Multiple support columns 71 may ascend together. When the semiconductor process is completed, the carrier 31 descends, may descend along with the multiple support columns 71. As the carrier 31 descends to the transferring position, the support columns 71 may gradually ascend relative to the carrier 31 until the tops of the support columns 71 protrude relative to the top surface of the carrier 31, thereby lifting the wafer on the carrier 31. The wafer may then be removed from the support columns 71.

[0092] In certain embodiments, the support columns 71 may be a pin.

[0093] As shown in FIG. 7, in certain embodiments, the carrier 31 may be provided with a plurality of through holes 311. These through holes 311 correspond to the plurality of through holes 437, allowing the support columns 71 to pass through the corresponding through holes 311

and through holes 437.

[0094] In certain embodiments, through holes 437 may extend through the branch gas channels 433.

[0095] As shown in FIGs. 1-2, in certain embodiments, a plurality of support members 72 are arranged at the bottom of outer chamber 1. The support members 72 are spaced circumferentially and correspond one-to-one with the plurality of support columns 71.

[0096] In some implementations, when the carrier 31 is at the transferring position, the plurality of support columns 71 may be supported one by one by the plurality of support members 72, so that the tops of the plurality of support columns 71 may protrude relative to the top surface of the carrier 31. When the carrier 31 descends from the processing position until the plurality of support columns 71 and the support members 72 abut against each other, as the carrier 31 continues to descend, the multiple support columns 71 are supported by the support members 72 and no longer continue to descend with the carrier 31, the multiple support columns 71 gradually ascend relative to the carrier 31 until the tops of the multiple support columns 71 protrude relative to the top surface of the carrier 31.

[0097] In certain embodiments of the present disclosure, both the support columns 71 and the support member 72 may be made of ceramic.

[0098] This prevents the materials of the support column 71 and the support member 72 from contaminating the environment within the semiconductor process chamber. Furthermore, it prevents dents in the support member 72 caused by repeated impacts of the support column 71, thereby increasing the service life of the support member 72.

[0099] In certain embodiments of the present disclosure, the radial dimension of the first gas inlet 435 may gradually decrease from an end of the first gas inlet 435 close to the support

shaft 32 to an end of the first gas inlet 435 away from the support shaft 32.

[00100] That is, the radial dimension of the end of the first gas inlet 435 close to the support shaft 32 is larger than the radial dimension of the end of the first gas inlet 435 away from the support shaft 32, and the radial dimension of the first gas inlet 435 may gradually decrease from the end of the first gas inlet 435 close to the support shaft 32 to the end of the first gas inlet 435 away from the support shaft 32. It is shaped like a trumpet mouth, so that the first gas inlet 435 may have a larger range for the gas flowing out through the second gas outlet 323 to enter, so that the gas flowing out through the second gas outlet 323 may enter the first gas inlet 435 more easily.

[00101] In certain embodiments of the present disclosure, as shown in FIG. 4 and FIG. 5, the sealing assembly 4 may further include a first sealing member (not shown in the figure), and the sealing body is provided with an engagement groove 41. The engagement groove 41 is provided on a surface of the sealing body facing the bottom end of the reaction chamber 2 and is provided along the circumference of the sealing body. The first sealing member is ring-shaped and is engaged in the engagement groove 41. The first sealing member is configured to contact the bottom end of the reaction chamber 2 when the support shaft 32 supports the carrier 31 to ascend to the processing position, and seal the opening by sealing between the sealing body and the bottom end of the reaction chamber 2.

[00102] That is, when the support shaft 32 supports the carrier 31 to ascend to the processing position, the first sealing member may contact the bottom end of the reaction chamber 2 to seal the sealing body and the bottom end of the reaction chamber 2. The first sealing member may seal the sealing body and the bottom end of the reaction chamber 2, thereby sealing the opening. The sealing assembly 4 may thereby seal the opening. The first sealing

member may be engaged in the engagement groove 41, through the engagement groove 41, thereby preventing the first sealing member from moving freely on the side of the sealing body facing the bottom end of the reaction chamber 2. This may further improve the stability of the first sealing member in sealing between the sealing body and the bottom end of the reaction chamber 2, and improve the stability of the sealing assembly 4 in sealing the opening.

[00103] In certain embodiments, as shown in FIGs. 4-5, a ring-shaped protrusion 451a may be provided on the sealing body. The ring-shaped protrusion 451a is ring-shaped and arranged along the circumference of the sealing body. The ring-shaped protrusion 451a and the connector 42 may serve as the two ring-shaped side walls of the engagement groove 41.

[00104] In certain embodiments, as shown in FIGs. 5 and 9, the outer diameter of the connector 42 may be smaller than the outer diameter of the connector parts 43, a connect through hole 421 may be provided on the connector 42, and a screw connect hole 431 may be provided on the connector parts 43. A screw connector (not shown in the figure) passes through the connect through hole 421 and is threadedly connected to the screw connect hole 431, so that the connector 42 and the connector parts 43 may be connected through the screw connector.

[00105] In certain embodiments, the connect through hole 421 may be a countersunk hole. This prevents the screw connector from protruding relative to the connect through hole 421 and interfering with the bottom of the reaction chamber 2, thereby affecting the contact between the first sealing member and the bottom end of the reaction chamber 2. This improves the stability of the first sealing member in sealing the sealing body and the bottom end of the reaction chamber 2, and further improves the stability of the sealing assembly 4 in sealing the opening.

[00106] In certain embodiments, the first sealing member may be a flexible sealing ring.

[00107] As shown in FIGs. 4-5, in certain embodiments, the branch gas channel 433 may

extend to a location proximate to the inside of the screw connect hole 431.

[00108] As shown in FIGs. 11-13, in certain embodiments, the branch gas channel 433 may extend to below the engagement groove 41 where the first sealing member is located. Furthermore, the branch gas channel 433 may extend to the outer circumference edge of the connector part 43.

[00109] As shown in FIG. 13, in certain embodiments, the branch gas channel 433 may extend to be below the engagement groove 41, so that the branch gas channel 433 may extend to be below the first sealing member, so that the gas may flow to be below the first sealing member, thereby enabling the first sealing member to be cooled with the help of gas during the semiconductor fabrication process, thereby reducing the possibility of sealing failure of the first sealing member due to high temperature, and increasing the service life of the first sealing member, thereby increasing the stability of the first sealing member in sealing between the sealing body and the bottom end of the reaction chamber 2, and further increasing the stability of the sealing assembly 4 in sealing the opening. In certain embodiments, the portion of the branch gas channel 433 located below the first sealing member may not be provided with the first gas outlet 434. Alternatively, the screw connect hole 431 may extend from the bottom of the branch gas channel 433 to the lower surface of the connector parts 43. In this scenario, a screw connector (not shown) passes through the connect through hole 421 and the branch gas channel 433, threadedly engaging with the screw connect hole 431, thereby connecting the connector 42 and the connector parts 43 via the screw connector.

[00110] As shown in FIG. 5, in certain embodiments of the present disclosure, the radial dimension of the groove port of the engagement groove 41 may be smaller than the radial dimension of the groove bottom of the engagement groove 41.

[00111] This design is arranged as such because in some implementations, the first sealing member may adhere to the bottom of the reaction chamber 2 due to the high temperature of the reaction chamber 2. By making the radial dimension of the groove port of the engagement groove 41 smaller than the radial dimension of the groove bottom of the engagement groove 41, the first sealing member may be restrained in the engagement groove 41, through the relatively smaller in size groove port of the engagement groove 41. The possibility of the first sealing member being pulled out of the engagement groove 41 due to adhesion to the bottom end of the reaction chamber 2 is reduced, thereby improving the stability of the first sealing member in sealing between the sealing body and the bottom end of the reaction chamber 2, and improving the stability of the sealing assembly 4 in sealing the opening.

[00112] In certain embodiments, the radial dimension of the engagement groove 41 may gradually increase from the groove port of the engagement groove 41 to the groove port of the engagement groove 41.

[00113] As shown in FIGs. 4-5 and 13, in certain embodiments of the present disclosure, the surface of the sealing body facing the carrier 31 may be arc-shaped, and the distance between the surface of the sealing body facing the carrier 31 and the carrier 31 gradually increases from the center of the surface of the sealing body facing the carrier 31 to the edge.

[00114] This facilitates the flow of gas entering the preset gap from the center to the edge of the preset gap, preventing gas from accumulating in the center of the preset gap. This allows the gas entering the preset gap to be quickly discharged from the edge of the reaction chamber 2.

[00115] In certain embodiments of the present disclosure, the connecting member 6 may be configured to adjust the axial distance between the sealing body and the engagement portion 324 on the support shaft 32.

[00116] This design is arranged as such because in some implementations, according to the requirements of the semiconductor process, the carrier 31 may need to be located at different heights in the reaction chamber 2, that is, the carrier 31 may need to be located at processing positions at different heights. By adjusting the distance between the sealing body and the engagement portion 324 in the axial direction of the support shaft 32 with the help of the connecting member 6, the distance between the sealing body and the carrier 31 may be adjusted. When the height of the processing position where the carrier 31 is required to be located changes, the sealing body may still be in contact with the bottom end of the reaction chamber 2 to seal the opening. For example, when the height of the processing position where the carrier 31 is required to be located is increased, the distance between the sealing body and the carrier 31 may be increased so that the sealing body may still contact the bottom end of the reaction chamber 2 to seal the opening. When the height of the processing position where the carrier 31 is required to be located is lowered, the distance between the sealing body and the carrier 31 may be reduced so that the sealing body may still contact the bottom end of the reaction chamber 2 to seal the opening.

[00117] Moreover, in certain embodiments of the present disclosure, the radial dimension of the first gas inlet 435 may be gradually reduced from one end of the first gas inlet 435 close to the support shaft 32 to the end of the first gas inlet 435 away from the support shaft 32, forming a shape similar to a trumpet mouth. In this way, when the sealing body moves axially along the support shaft 32, the first gas inlet 435 may still be opposite to the second gas outlet 323.

[00118] As shown in FIGs. 16-18, in certain embodiments of the present disclosure, the connecting member 6 may include an outer screw member 61, a middle screw member 62, and an inner screw member 63. The outer screw member 61 has a first outer thread and a first inner

thread, and the thread direction of the first outer thread is opposite to the thread direction of the first inner thread. The outer screw member 61 passes through the sealing body to the engagement space 436, and is threadedly engaged with the sealing body through a first outer thread. The middle screw member 62 has a second outer thread. The middle screw member 62 passes through the interior of the outer screw member 61, and is threadedly engaged with the first inner thread through the second outer thread. The inner screw member 63 has a third outer thread. The inner screw member 63 passes through the interior of the middle screw member 62, and is threadedly engaged with the engagement portion 324 through the third outer thread.

[00119] In some implementations, the outer screw member 61 is tightened when being rotated clockwise and loosened when being rotated counterclockwise. When the height of the sealing body needs to be raised, the outer screw member 61 may be loosened by being rotated counterclockwise. Under the cooperation of the second outer thread and the first inner thread, the middle screw member 62 has an upward trend. Since the upper end of the middle screw member 62 abuts against the engagement portion 324, the inner screw member 63 remains stationary due to the descend reaction force exerted by the engagement portion 324, thereby causing the outer screw member 61 to descend. At the same time, under the action of the first outer thread and the sealing body thread, the height of the engagement portion 324 in the engagement space 436 is relatively lowered, that is, the height of the sealing body is raised. When the height of the sealing body needs to be lowered, the outer screw member 61 may be rotated clockwise. When the outer screw member 61 is tightened, the middle screw member 62 tends to descend under the cooperation of the second outer thread and the first inner thread. Since the lower end of the middle screw member 62 abuts against the screw head of the inner screw member 63 (as shown in FIG. 16) or the step portion on the inner circumference wall of the outer screw member 61 (as

shown in FIG. 18), the inner screw member 63 remains stationary due to the upward reaction force exerted by it, thereby causing the outer screw member 61 to ascend. At the same time, under the cooperation of the first outer thread and the sealing body thread, the height of the engagement portion 324 in the engagement space 436 is relatively increased, that is, the height of the sealing body is lowered. In certain embodiments, the outer screw member 61 in FIG. 16 is at a tightened state and may not ascend further. In addition, in some implementations, the inner screw member 63 may not be tightened into the screw hole of the engagement portion 324. In this scenario, there is a certain distance between the lower end of the middle screw member 62 and the screw head of the inner screw member 63 (as shown in FIG. 16) or the step portion on the inner circumference wall of the outer screw member 61 (as shown in FIG. 18). In this scenario, the outer screw member 61 may be rotated clockwise first to make it ascend, and at the same time, under the cooperation of the second outer thread and the first inner thread, the middle screw member 62 descends until the lower end of the middle screw member 62 abuts against the screw head of the inner screw member 63 (as shown in FIG. 16) or abuts against the step portion on the inner circumference wall of the outer screw member 61 (as shown in FIG. 18). This creates a certain distance between the upper end of the middle screw member 62 and the engagement portion 324, leaving a certain amount of adjustment for the subsequent clockwise rotation of the inner screw member 63 to make it ascend and drive the middle screw member 62 to ascend synchronously. Afterwards, the inner screw member 63 may be rotated clockwise to tighten the inner screw member 63 so that it is screwed into place in the screw hole of the engagement portion 324.

[00120] As shown in FIGs. 16 and 18, in certain embodiments of the present disclosure, the screw pitch of the first outer thread may be greater than the screw pitch of the first inner

thread. This allows for fine-tuning of the inner screw member 63. Because the screw pitch of the first inner thread is relatively small, the height of the outer screw member 61 remains substantially unchanged when the inner screw member 63 is rotated. This allows for fine-tuning of the inner screw member 63 without substantially affecting the height of the sealing body.

[00121] As shown in FIGs. 16 and 18, in certain embodiments of the present disclosure, the connecting member 6 may further include a support reinforcement member 64. The support reinforcement member 64 is ring-shaped and is arranged along the inner circumference of the middle screw member 62. It is fixedly connected to the middle screw member 62, and one end of the support reinforcement member 64 abuts against the engagement portion 324, and the other end abuts against the head of the inner screw member 63. The support reinforcement member 64 may enhance the support for the inner screw member 63.

[00122] As shown in FIGs. 10 and 16, in certain embodiments of the present disclosure, there may be multiple connecting members 6, and the multiple connecting members 6 are spaced apart in the ring direction of the sealing body.

[00123] The sealing body and the engagement portion 324 may be connected at multiple locations on the circumference of the sealing body by means of multiple connecting members 6, thereby improving the stability of the connection between the sealing body and the engagement portion 324, and further improving the stability of the connection between the sealing assembly 4 and the support shaft 32. With the help of multiple connecting members 6, the distance between the sealing body and the engagement portion 324 in the axial direction of the support shaft 32 may be adjusted from multiple locations on the circumference of the sealing body, so that the sealing body may be adjusted to be parallel to the engagement portion 324, and then the sealing body may be adjusted to be parallel to the carrier 31, thereby improving the sealing effect of the

sealing assembly 4 in sealing the reaction chamber 2.

[00124] In certain embodiments, an exhaust assembly may be provided within reaction chamber 2 to exhaust gases within reaction chamber 2.

[00125] In other words, both the reaction gases entering reaction chamber 2 and the gases entering the preset gap may be exhausted from reaction chamber 2 to the outside of reaction chamber 2 through the exhaust assembly.

[00126] As shown in FIGs. 1-2, 4, and 14-15, in certain embodiments, the exhaust assembly may include a uniform flow ring 51, an upper exhaust ring 52 and a lower exhaust ring 53. The lower exhaust ring 53 is ring-shaped and is arranged along the inner circumference of the reaction chamber 2. The upper exhaust ring 52 is arranged on the lower exhaust ring 53. The uniform flow ring 51 is arranged in a ring shape along the inner circumference of the reaction chamber 2. The uniform flow ring 51 is arranged on the lower exhaust ring 53 and is arranged in a ring shape inside the upper exhaust ring 52. An exhaust space 54 is formed between the uniform flow ring 51, the upper exhaust ring 52 and the lower exhaust ring 53. A plurality of uniform flow ports 511 are arranged at intervals on the circumference of the uniform flow ring 51. The uniform flow port 511 communicates with the exhaust space 54 for discharging the reaction gas in the reaction chamber 2 to the exhaust space 54. The exhaust space 54 communicates with the outside of the reaction chamber 2 for discharging the reaction gas to outside of the reaction chamber 2.

[00127] In some implementations, the exhaust space 54 may be connected to the extraction device outside of the process chamber. Under the extraction action of the extraction device, the reaction gas located above the carrier 31 in the reaction chamber 2 may be discharged into the exhaust space 54 through multiple uniform flow ports 511, and then be exhausted to the

outside of the process chamber through the exhaust space 54, so that the reaction gas in the reaction chamber 2 may be discharged to outside of the reaction chamber 2. Furthermore, by arranging a plurality of uniform flow ports 511 at intervals in the ring direction of the uniform flow ring 51, the reaction gas may be discharged into the exhaust space 54 through the uniform flow ports 511 from a plurality of locations in the ring direction of the uniform flow ring 51, thereby increasing the speed at which the reaction gas is discharged into the exhaust space 54, increasing the speed at which the reaction gas is discharged out of the process chamber, reducing the possibility of the reaction gas gathering and depositing at the edge of the reaction chamber 2, and subsequently reducing the particles generated in the reaction chamber 2 due to the gathering and deposition of the reaction gas, thereby improving the semiconductor process.

[00128] In certain embodiments, multiple uniform flow ports 511 may be uniformly spaced around the circumference of the uniform flow ring 51.

[00129] In certain embodiments, the uniform flow ports 511 may be U-shaped.

[00130] As shown in FIG. 15, in certain embodiments, the lower exhaust ring 53 may include an outer ring body 531, an inner ring body 532, and a connect ring body 533. The outer ring body 531 is ring-shaped and is arranged around the inner ring body 532. The outer ring body 531 and the inner ring body 532 are connected by the ring-shaped connect ring body 533. The inner diameter of the inner ring body 532 is larger than the outer diameter of the carrier 31, and a plurality of exhaust ports 534 are arranged at intervals in the ring direction of the inner ring body 532. The exhaust ports 534 are connected to the exhaust space 54 and are configured to discharge the gas into the exhaust space 54. The outer ring body 531 is provided with an extraction port 535 for connecting to the extraction device outside the reaction chamber 2 and is configured to discharge the gas outside of the reaction chamber 2.

[00131] By making the inner diameter of the inner ring body 532 larger than the outer diameter of the carrier 31, a gap may be created between the inner ring body 532 and the carrier 31 when the carrier 31 is at the processing position, so that the gas in the preset gap below the carrier 31 may flow into the gap between the inner ring body 532 and the carrier 31. Then, under the extraction effect of the extraction device, the gas may be discharged into the exhaust space 54 through the multiple exhaust ports 534 of the inner ring body 532, and then be extracted out of the process chamber through the exhaust space 54 and the extraction port 535, so that the gas in the reaction chamber 2 may be discharged out of the reaction chamber 2. In addition, by providing multiple exhaust ports 534 at intervals in the ring direction of the inner ring body 532, the gas may be discharged from multiple locations around the inner ring body 532 through the exhaust ports 534 to the exhaust space 54, thereby increasing the speed at which the gas is discharged into the exhaust space 54, increasing the speed at which the gas is discharged out of the process chamber, and reducing the possibility of the gas escaping to above the carrier 31, thereby reducing the possibility of the gas interfering with the semiconductor process, and thus improving the semiconductor process.

[00132] In certain embodiments, multiple exhaust ports 534 may be uniformly spaced around the circumference of the inner ring body 532.

[00133] As shown in FIG. 15, in certain embodiments, the radial dimensions of the exhaust ports 534 may gradually increase from closer to the extraction port 535 to farther away from the extraction port 535 along the circumference of the inner ring body 532.

[00134] This design is arranged as such because the extraction force of the extraction device gradually decreases from close to the extraction port 535 to far away from the extraction port 535 on the circumference of the inner ring body 532. By gradually increasing the radial size

of the exhaust port 534 from close to the extraction port 535 to far away from the extraction port 535 on the circumference of the inner ring body 532, the gas may be quickly extracted from multiple locations on the circumference of the inner ring body 532 to the exhaust space 54.

[00135] As shown in FIG. 4, in certain embodiments, the sealing assembly 4 may further include a second sealing member 44, which is telescopically arranged in the engagement space 436 for sealing between the support shaft 32 and the sealing body.

[00136] This design is arranged because the sealing body is arranged on the support shaft 32 so that it may move along the axial direction of the support shaft 32. Therefore, there may be a gap between the support shaft 32 and the sealing body, resulting in the reaction chamber 2 and the outer chamber 1 being connected through the gap. By arranging the second sealing member 44 in the engagement space 436, the second sealing member 44 may be configured to seal the support shaft 32 and the sealing body, thereby isolating the reaction chamber 2 from the outer chamber 1. Furthermore, by making the second sealing member 44 telescopic, when the sealing body moves along the axial direction of the support shaft 32, the second sealing member 44 may be retracted and extended accordingly to maintain the seal between the support shaft 32 and the sealing body.

[00137] As shown in FIG. 4, in certain embodiments, the second sealing member 44 may be ring-shaped and arranged around the support shaft 32, with one end of the second sealing member 44 connected by sealing to the engagement portion 324 and the other end connected by sealing to the sealing body. This design allows the second sealing member 44 to seal between the support shaft 32 and the sealing body.

[00138] In certain embodiments, the second sealing member 44 may include a bellows, one end of which may be welded to the engagement portion 324 for sealing, and the other end of

which may be welded to the sealing body for sealing, thereby sealing between the support shaft 32 and the sealing body.

[00139] As shown in FIG. 1 and FIG. 2, in certain embodiments, the semiconductor process chamber may further include an upper electrode structure 9, which is arranged on top of the plurality of reaction chambers 2 and is configured to provide radio frequency energy for the semiconductor process and excite the reaction gas to form plasma.

[00140] In certain embodiments, the semiconductor process chamber may be suitable for a plasma enhanced atomic layer deposition process.

[00141] As shown in FIGs. 1-3, certain embodiments of the present disclosure provide a semiconductor process apparatus, including a wafer transfer device 11 and a semiconductor process chamber as provided in certain embodiments of the present disclosure. The wafer transfer device 11 is located in the outer chamber 1 and is configured to take and place wafers to and from the carrier 31 when each carrier 31 is at the transferring position.

[00142] The semiconductor process apparatus provided in certain embodiments of the present disclosure, with the help of the semiconductor process chamber provided in certain embodiments of the present disclosure, may avoid the interference between the multiple reaction chambers 2 when performing the semiconductor process, so that the multiple reaction chambers 2 may be independent of each other, thereby improving the consistency and stability of the semiconductor process of the wafers in the multiple reaction chambers 2. Moreover, it may avoid problems caused by reduced elastic force, irregular jumping and inability to apply high-temperature processes (such as 550°C and above) of the elastic bellows, thereby improving the sealing stability of the sealing assembly 4 and improving the use stability of the semiconductor process chamber and semiconductor process apparatus.

[00143] In summary, the semiconductor process chamber and semiconductor process apparatus provided by certain embodiments of the present disclosure may improve the sealing stability of the sealing assembly 4 and may improve the operating stability of the semiconductor process chamber and the semiconductor process apparatus.

[00144] The described embodiments are exemplary embodiments for illustrating the principles of the present disclosure, and the present disclosure is not limited thereto. Those skilled in the technical field may make various modifications and improvements without departing from the spirit and substance of the present disclosure, and such modifications and improvements are within the scope of protection of the present disclosure.

CLAIMS

What is claimed is:

1. A semiconductor processing chamber, comprising an outer chamber having multiple reaction areas, each of the multiple reaction areas is provided with a reaction chamber, a carrying device, and a sealing assembly, wherein:

a bottom end of the reaction chamber has an opening;

the carrying device includes a carrier and a liftable support shaft, wherein the carrier is configured to carry a wafer, and the support shaft arranged at a bottom of the carrier, is configured to support the carrier, and ascends and descends between a processing position in the reaction chamber and a transferring position below the reaction chamber through the opening; and

the sealing assembly is arranged below the carrier and connected to the carrying device, and the support shaft passes through the sealing assembly, the sealing assembly is configured to ascend and descend with the support shaft, and when the support shaft supports the carrier to ascend to the processing position, the sealing assembly contacts the bottom end of the reaction chamber to seal the opening.

2. The semiconductor process chamber of claim 1, wherein the sealing assembly is connected to the support shaft.

3. The semiconductor processing chamber of claim 2, wherein the support shaft is provided with an engagement portion that surrounds the support shaft;

the sealing assembly includes a connecting member and a ring-shaped sealing body;

the sealing body surrounds the support shaft, is configured to seal the opening, and has a ring-shaped engagement space surrounding the support shaft and configured to accommodate the engagement portion; and

the connecting member is configured to connect the sealing assembly to the support shaft by connecting the sealing body and the engagement portion.

4 . The semiconductor process chamber of claim 3, wherein when the sealing body seals the opening, a preset gap is provided between the sealing body and the carrier.

5. The semiconductor processing chamber of claim 4, wherein the sealing body includes: a ring-shaped first sealing plate, a ring-shaped second sealing plate located on a side of the first sealing plate facing away from the carrier and spaced apart from the first sealing plate, and a side wall located between the first and second sealing plates;

the first sealing plate is configured to seal the opening;

the side wall connects the first and second sealing plates to form an engagement space between the first and second sealing plates, with an engagement port of the engagement space facing the outer circumference surface of the support shaft.

6. The semiconductor processing chamber of claim 5, wherein a gas channel is defined within the first sealing plate, a side of the first sealing plate facing the carrier has a plurality of first gas outlets extending through the gas channel, and an inner ring-shaped surface of the first sealing plate has a first gas inlet communicating with the gas channel; and

an gas inlet channel is arranged in the support shaft, and the support shaft has a second gas outlet at a location opposite to the inner ring-shaped surface of the first sealing plate, so that the gas in the gas inlet channel is transported to the preset gap through the second gas outlet, the first gas inlet, the gas channel, and the first gas outlet in sequence.

7. The semiconductor processing chamber of claim 6, wherein the gas channel includes a plurality of branch gas channels distributed circumferentially along the first sealing plate and a main gas channel connected to each of the plurality of branch gas channels;

the main gas channel is ring-shaped, and the plurality of branch gas channels are arranged around the main gas channel, each extending radially along the first sealing plate; and the first gas inlet is connected to the main gas channel.

8. The semiconductor processing chamber of claim 6, wherein the carrying device further includes a plurality of support columns extending through the carrier and capable of ascending and descending; and

the first sealing plate further includes a through hole for each of the support columns to pass through, wherein an orthographic projection of each of the through holes on the carrier coincides with an orthographic projection of the first gas outlet on the carrier.

9. The semiconductor processing chamber of claim 6, wherein a radial dimension of the first gas inlet gradually decreases from an end of the first gas inlet close to the support shaft to an end of the first gas inlet away from the support shaft.

10. The semiconductor process chamber of claim 3, wherein the sealing assembly further includes a first sealing member, the sealing body is arranged with an engagement groove, the engagement groove is arranged on a surface of the sealing body facing the bottom end of the reaction chamber and is arranged along the circumference of the sealing body, the first sealing member is ring-shaped and engaged in the engagement groove, the first sealing member is arranged to contact the bottom end of the reaction chamber when the support shaft supports the carrier to ascend to the processing position, and seal the opening by sealing between the sealing body and the bottom end of the reaction chamber.

11. The semiconductor process chamber of claim 10, wherein a radial dimension of the groove port of the engagement groove is smaller than a radial dimension of a groove bottom of the engagement groove.

12. The semiconductor processing chamber of claim 4, wherein a surface of the sealing body facing the carrier is arc-shaped, and a distance between the surface of the sealing body facing the carrier and the carrier gradually increases from a center to an edge of the surface of the sealing body facing the carrier.

13. The semiconductor process chamber of claim 3, wherein the connecting member is further configured to adjust a distance between the sealing body and the engagement portion in an axial direction of the support shaft.

14. The semiconductor process chamber of claim 13, wherein the connecting member

includes an outer screw member, a middle screw member, and an inner screw member, the outer screw member has a first outer thread and a first inner thread, and the thread direction of the first outer thread is opposite to the thread direction of the first inner thread, the outer screw member passes through the sealing body to the engagement space, and is threadedly engaged with the sealing body through the first outer thread, the middle screw member has a second outer thread, the middle screw member passes through the interior of the outer screw member, and is threadedly engaged with the first inner thread through the second outer thread, the inner screw member has a third outer thread, the inner screw member passes through the interior of the middle screw member, and is threadedly engaged with the assembly part through the third outer thread.

15. The semiconductor processing chamber of claim 14, wherein a screw pitch of the first outer thread is greater than a screw pitch of the first inner thread.

16. The semiconductor process chamber of claim 14, wherein the connecting member further includes a support reinforcement member, the support reinforcement member is ring-shaped and arranged along an inner circumference of the middle screw member and fixedly connected to the middle screw member, and one end of the support reinforcement member abuts against the assembly portion, and another end of the support reinforcement member abuts against a head of the inner screw member.

17. The semiconductor process chamber of claim 3, wherein a number of the connecting members is plural, and the connecting members are spaced apart in a ring direction of the sealing

body.

18. A semiconductor process apparatus, comprising: a wafer transfer device and the semiconductor process chamber of any one of claims 1-17, wherein the wafer transfer device is located in the outer chamber and is configured to take and place wafers on the carrier when each carrier is located at the transferring position.