

EDGE GAS INLET APPARATUS, SEMICONDUCTOR PROCESS CHAMBER, AND SEMICONDUCTOR PROCESS EQUIPMENT

TECHNICAL FIELD

[0001] The present disclosure relates to the field of semiconductor manufacturing, and in particular, to an edge gas inlet apparatus, a semiconductor process chamber, and semiconductor process equipment.

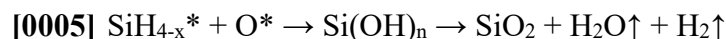
BACKGROUND

[0002] An important process in the manufacturing of integrated circuit chips is the deposition of silicon oxide. Since integrated circuit manufacturing needs to consider the thermal budget, a Plasma Enhanced Chemical Vapor Deposition (PECVD) method suitable for low-temperature deposition is generally used to deposit silicon oxide. Under normal circumstances, PECVD based on the principle of Capacitively Coupled Plasma (CCP) can satisfy the requirements of the above deposition process. However, when the deposition of silicon oxide needs to be performed in a structure having a certain aspect ratio, PECVD based on the CCP principle cannot satisfy the requirements, because the deposition easily produces a pinch-off effect at an opening of the structure having the aspect ratio, thereby forming a void inside the structure.

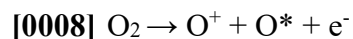
[0003] Many solutions have been proposed for the deposition of silicon oxide in structures having an aspect ratio, for example, High Density Plasma Chemical Vapor Deposition (HDP CVD) based on the principle of Inductively Coupled Plasma (ICP), Selected Area Chemical Vapor Deposition (SACVD), Flame Chemical Vapor Deposition (FCVD), or the like. Although

SACVD and FCVD have stronger gap-filling capability than HDP CVD, the film quality thereof is poorer than that of HDP CVD. Therefore, HDP CVD still receives attention from industry.

[0004] In the plasma deposition of silicon oxide, film formation thereof depends on surface reactions:



[0006] This is a two-step reaction. An intermediate product $\text{Si}(\text{OH})_n$ is generated first, and then silicon oxide is generated under the thermal effect assisted by the lower electrode power and ion physical bombardment. The generation of SiH_{4-x}^* and O^* radicals is based on the following gas-phase reactions:



[0009] If SiH_4 and O_2 are mixed too early when being introduced into the process chamber, a chemical reaction is likely to occur, thereby causing particle issues. Therefore, SiH_4 and O_2 need to be introduced into the process chamber from the top and the side of the process chamber, respectively. However, when the above gases are introduced into the process chamber from the side of the process chamber through the existing edge gas inlet apparatus, there is a problem of non-uniform distribution of the gases introduced into the process chamber, thereby resulting in non-uniform process results, and particularly failing to satisfy the requirement of the HDP CVD process for gas distribution uniformity.

SUMMARY

[0010] The present disclosure aims to solve at least one of the technical problems existing in the related art, and provides an edge gas inlet apparatus, a semiconductor process chamber, and

semiconductor process equipment, which can improve the uniformity of the distribution of gases introduced into the semiconductor process chamber, thereby improving process uniformity.

[0011] To achieve the purpose of the present disclosure, an edge gas inlet apparatus is provided for a semiconductor process chamber, the edge gas inlet apparatus including:

[0012] A rotary gas inlet assembly, being annular and is rotatable about an axis of the rotary gas inlet assembly;

[0013] A fixed gas inlet assembly, being annular and arranged outside the rotary gas inlet assembly. A first mating surface located at an outer periphery of the rotary gas inlet assembly and a second mating surface located at an inner periphery of the fixed gas inlet assembly are rotatably mated with each other, a first gas inlet passage is provided in the rotary gas inlet assembly, the first gas inlet passage is provided with a first gas inlet port at the first mating surface and is provided with a plurality of first gas outlet ports along the inner periphery of the rotary gas inlet assembly; and a second gas inlet passage is provided in the fixed gas inlet assembly, the second gas inlet passage is provided with a second gas outlet port at the second mating surface, and the first gas inlet port is in communication with the second gas outlet port.

[0014] In some embodiments, the first gas inlet port is annular and extends along the outer periphery of the rotary gas inlet assembly.

[0015] In some embodiments, the second gas outlet port is annular and extends along the inner periphery of the fixed gas inlet assembly; or, the second gas outlet port includes a plurality of sub-gas outlet ports uniformly distributed along the inner periphery of the fixed gas inlet assembly, and the plurality of sub-gas outlet ports are each in communication with the first gas inlet port.

[0016] In some embodiments, the edge gas inlet apparatus further includes:

[0017] A dynamic sealing assembly, arranged at a mating position between the first mating surface and the second mating surface, and configured to seal a gap at the mating position while allowing the rotary gas inlet assembly to rotate.

[0018] In some embodiments, the dynamic sealing assembly includes a first annular dynamic sealing part and a second annular dynamic sealing part, the first annular dynamic sealing part and the second annular dynamic sealing part being respectively located at an upper side and a lower side of the mating position, and configured to respectively seal an upper-side gap and a lower-side gap of the mating position while allowing the rotary gas inlet assembly to rotate.

[0019] In some embodiments, the rotary gas inlet assembly and the fixed gas inlet assembly are both made of magnetically permeable materials;

[0020] Annular gaps are respectively formed between two ends of the first annular dynamic sealing part and the fixed gas inlet assembly and the rotary gas inlet assembly, and between two ends of the second annular dynamic sealing part and the fixed gas inlet assembly and the rotary gas inlet assembly, the magnetic pole directions at two ends of the first annular dynamic sealing part being opposite to the magnetic pole directions at two ends of the second annular dynamic sealing part, and the annular gaps being filled with ferrofluid.

[0021] In some embodiments, the fixed gas inlet assembly includes a fixed gas inlet ring, the fixed gas inlet ring being configured to pass through a sidewall of the semiconductor process chamber, and a part of the fixed gas inlet ring being configured to be located outside the semiconductor process chamber; and the second gas inlet passage is provided with a second gas inlet port in a part of the fixed gas inlet ring configured to be located outside the semiconductor process chamber, for connection to a gas source of process gas.

[0022] In some embodiments, the fixed gas inlet assembly includes a fixed gas inlet ring and at least one gas inlet pipeline, the fixed gas inlet ring being configured to be located between the sidewall of the semiconductor process chamber and the rotary gas inlet assembly;

[0023] The second gas inlet passage includes at least one second gas inlet port, each second gas inlet port being connected to a gas outlet end of a corresponding gas inlet pipeline in a one-to-one manner, and a gas inlet end of each gas inlet pipeline being configured to pass through the sidewall of the semiconductor process chamber and extend outside of the semiconductor process chamber for connection to a gas source.

[0024] In some embodiments, the rotary gas inlet assembly includes a rotating gas inlet ring, a rotation drive source configured to drive the rotating gas inlet ring to rotate, and a plurality of gas inlet nozzles. The plurality of gas inlet nozzles are connected to the rotating gas inlet ring and are uniformly distributed along a circumferential direction of the rotating gas inlet ring;

[0025] A first sub-passage is provided in the rotating gas inlet ring, a second sub-passage is provided in each gas inlet nozzle, the first sub-passage is in communication with each second sub-passage and together therewith constitutes the first gas inlet passage, and a gas outlet port of each second sub-passage serves as the first gas outlet port.

[0026] In some embodiments, each gas inlet nozzle is connected to the rotating gas inlet ring through an angle adjustment structure, and the angle adjustment structure is configured to adjust a gas outlet direction of the gas inlet nozzle.

[0027] As another technical solution, the present disclosure further provides a semiconductor process chamber including:

[0028] A chamber body, having a carrier apparatus for carrying a wafer;

[0029] The above edge gas inlet apparatus provided in the present disclosure, where the rotary gas inlet assembly is arranged around a periphery of the carrier apparatus in the chamber body and is located above the carrier apparatus;

[0030] A rotation drive source configured to drive the rotary gas inlet assembly to rotate.

[0031] In some embodiments, the rotation drive source includes a rotation driving member, a transmission structure, and a dynamic sealing member, where the rotation driving member is located outside the chamber body and is configured to provide rotational power; and the transmission structure rotatably passes through the chamber body and is respectively connected to the rotation driving member and the rotary gas inlet assembly, and is configured to drive the rotary gas inlet assembly to rotate under the driving of the rotation driving member;

[0032] The dynamic sealing member is configured to seal a gap between the transmission structure and the chamber body while allowing the transmission structure to rotate.

[0033] In some embodiments, the rotation driving member is arranged above the chamber body, the transmission structure includes a first connection rod and a plurality of second connection rods, the first connection rod is vertically arranged, and one end of the first connection rod passes through the top of the chamber body and extends outside of the chamber body to be connected to a drive shaft of the rotation driving member, another end of the first connection rod is connected to one end of each of the plurality of second connection rods; and other ends of the plurality of second connection rods are bent and extend to an edge inside the chamber body, and are connected to different positions of the rotary gas inlet assembly in a circumferential direction thereof.

[0034] In some embodiments, the semiconductor process chamber further includes a center gas inlet apparatus, and the center gas inlet apparatus is configured to deliver process gas from the top of the chamber body into the chamber body.

[0035] In some embodiments, the semiconductor process chamber is a chemical vapor deposition chamber; the center gas inlet apparatus and the edge gas inlet apparatus are configured to respectively deliver a first process gas and a second process gas into the semiconductor process chamber, and plasmas formed from the first process gas and the second process gas are capable of reacting with each other to form a film.

[0036] As another technical solution, the present disclosure further provides semiconductor process equipment, including the above semiconductor process chamber provided in the present disclosure.

[0037] The present disclosure has the following beneficial effects:

[0038] In the technical solutions of the edge gas inlet apparatus, the semiconductor process chamber, and the semiconductor process equipment provided in the present disclosure, the rotary gas inlet assembly is annular and is capable of rotating about an axis of the rotary gas inlet assembly, and outputs process gas into the semiconductor process chamber during rotation. In the related art, the edge gas inlet apparatus is fixed. Since there is a certain distance between two adjacent gas outlet ports in a circumferential direction of the edge gas inlet apparatus, the process gas flowing out from the two adjacent gas outlet ports needs to reach a position between the two adjacent gas outlet ports through diffusion, while the process gas flowing out from each gas outlet port can flow more quickly to a position directly facing the respective gas outlet port. That is, under the condition of the same distance, there is a difference between a speed at which the process gas flowing out from the plurality of gas outlet ports reaches the positions directly facing

the gas outlet ports and a speed at which the process gas reaches positions between two adjacent gas outlet ports, thereby causing non-uniform distribution of the process gas flowing into the semiconductor process chamber in a circumferential direction. In view of this, through rotation, the rotary gas inlet assembly in the present disclosure can enable the gas flowing out from each first gas outlet port to uniformly reach any position on the circumference without diffusion, thereby solving the problem in the related art that there is a difference between the speed at which the process gas flowing out from the plurality of gas outlet ports reaches the positions directly facing the gas outlet ports and the speed at which the process gas reaches positions between two adjacent gas outlet ports. Therefore, the uniformity of the distribution of gas introduced into the semiconductor process chamber can be improved, thereby improving process uniformity, and particularly satisfying the requirement of the HDP CVD process for gas distribution uniformity.

BRIEF DESCRIPTION OF THE DRAWINGS

[0039] FIG. 1 is a cross-sectional view of semiconductor process equipment provided in the embodiments of the present disclosure;

[0040] FIG. 2 is a top view of an edge gas inlet apparatus in the embodiments of the present disclosure;

[0041] FIG. 3 is a schematic cross-sectional view of an edge gas inlet apparatus in the embodiments of the present disclosure;

[0042] FIG. 4 is a comparison diagram of gas flow from a first gas outlet port of an edge gas inlet apparatus in a fixed state and a rotating state;

[0043] FIG. 5 is a cross-sectional view of a dynamic sealing assembly in the embodiments of the present disclosure;

[0044] FIG. 6 is a cross-sectional view of another dynamic sealing assembly in the embodiments of the present disclosure.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0045] To enable those skilled in the art to better understand the technical solutions of the present disclosure, the edge gas inlet apparatus, the semiconductor process chamber, and the semiconductor process equipment provided in the present disclosure are described in detail below with reference to the accompanying drawings.

[0046] Referring to FIG. 1, semiconductor process equipment 100 is provided in the embodiments of the present disclosure. The semiconductor process equipment 100 is, for example, an Inductively Coupled Plasma (ICP) equipment, and includes, for example, a semiconductor process chamber 1, an upper radio-frequency coil 2, an upper radio-frequency source, a lower radio-frequency source, and an edge gas inlet apparatus 5. The semiconductor process chamber 1 includes a chamber body 13, and a carrier apparatus 3 for carrying a wafer is provided in the chamber body 13, where the carrier apparatus 3 is, for example, an electrostatic chuck. The carrier apparatus 3 is electrically connected to the lower radio-frequency source (not shown in the figure), and the lower radio-frequency source includes a lower matcher and a lower radio-frequency power supply. The lower radio-frequency power supply loads radio-frequency power onto the carrier apparatus 3 through the lower matcher, so as to attract plasma to move toward the carrier apparatus 3. The upper radio-frequency coil 2 is electrically connected to the upper radio-frequency source (not shown in the figure), and the upper radio-frequency source includes an upper matcher and an upper radio-frequency power supply. The upper radio-frequency power supply loads radio-frequency power onto the upper radio-frequency coil 2 through the upper matcher, so as to excite process gas in the chamber body 13 to form plasma.

[0047] The semiconductor process chamber 1 further includes an edge gas inlet apparatus 5, and the edge gas inlet apparatus 5 delivers process gas from an edge within the chamber body 13 into the chamber body 13. In some embodiments, the semiconductor process chamber 1 further includes a center gas inlet apparatus 4, and the center gas inlet apparatus 4 is configured to deliver process gas from a top within the chamber body 13 into the chamber body 13. The center gas inlet apparatus 4 includes, for example, one or more nozzles arranged at the top of the chamber body 13. A vacuum pump 6 is further provided at a bottom of the semiconductor process chamber 1 and is configured to extract gas from the semiconductor process chamber 1.

[0048] For a chemical vapor deposition process, such as a High Density Plasma Chemical Vapor Deposition (HDP CVD) process, the center gas inlet apparatus 4 and the edge gas inlet apparatus 5 are configured to respectively deliver a first process gas and a second process gas into the chamber body 13, and plasmas formed from the first process gas and the second process gas are capable of reacting with each other to form a film. For example, for silicon oxide deposition in a structure having an aspect ratio, the first process gas and the second process gas are, for example, SiH_4 and O_2 , respectively, and silicon oxide is generated from the two gases under the thermal effect and ion physical bombardment assisted by the lower electrode power.

[0049] If SiH_4 and O_2 are mixed too early when being introduced into the chamber body 13, a chemical reaction is likely to occur, thereby causing particle issues. Therefore, SiH_4 and O_2 need to be introduced into the chamber body 13 from the top and the side of the chamber body 13, respectively. However, the inventors have found through research that, when the above gases are introduced into the chamber body 13 from the side of the chamber body 13 through the existing edge gas inlet apparatus 5, there is a problem of non-uniform distribution of the gases introduced

into the chamber body 13, thereby resulting in non-uniform process results, and particularly failing to satisfy the requirement of the HDP CVD process for gas distribution uniformity.

[0050] To solve the above problem, the embodiments of the present disclosure further provide an edge gas inlet apparatus 5, which is applied to the semiconductor process chamber 1 provided in the embodiments of the present disclosure and is configured to introduce process gas into the chamber body 13. In practical applications, the edge gas inlet apparatus provided in the embodiments of the present disclosure may also be applied to semiconductor process chambers having other structures, and the embodiments of the present disclosure impose no particular limitation thereon.

[0051] Referring to FIG. 2, the edge gas inlet apparatus 5 provided in the embodiments of the present disclosure includes a rotary gas inlet assembly 51, and the rotary gas inlet assembly 51 is annular. Taking an example in which the rotary gas inlet assembly 51 is applied to the semiconductor process chamber 1 provided in the embodiments of the present disclosure, the rotary gas inlet assembly 51 surrounds a periphery of the carrier apparatus 3 and is located above the carrier apparatus 3. For a chemical vapor deposition process, such as a High Density Plasma Chemical Vapor Deposition (HDP CVD) process, compared with an etching process, a higher requirement is imposed on the uniformity of gas distribution in the chamber body 13. In this case, by arranging the rotary gas inlet assembly 51 around the periphery of the carrier apparatus 3 and above the carrier apparatus 3, compared with arranging gas outlet ports on a sidewall of the semiconductor process chamber, a distance between the rotary gas inlet assembly 51 and the carrier apparatus 3 can be reduced, and the reduction in the distance helps improve the uniformity of process gas distribution.

[0052] Moreover, referring to FIG. 3, the rotary gas inlet assembly 51 is capable of rotating about an axis of the rotary gas inlet assembly (i.e., the axis of the annular structure formed by the rotary gas inlet assembly 51). A first gas inlet passage 511 is provided in the rotary gas inlet assembly 51, and the first gas inlet passage 511 is provided with a plurality of first gas outlet ports 511a along an inner periphery of the rotary gas inlet assembly 51 for outputting process gas into the semiconductor process chamber 1. In some embodiments, the plurality of first gas outlet ports 511a are uniformly distributed along the inner periphery of the rotary gas inlet assembly 51. FIG. 3 shows a radial cross-sectional view of the edge gas inlet apparatus 5. In FIG. 3, a right side of the rotary gas inlet assembly 51 is the inner-periphery side of the rotary gas inlet assembly 51, and a left side thereof is the outer-periphery side of the rotary gas inlet assembly 51.

[0053] In the related art, the plurality of first gas outlet ports 511a of the edge gas inlet apparatus are fixed. As shown in FIG. 4(a), there is a certain distance between two adjacent first gas outlet ports 511a, which causes the process gas flowing out from the two adjacent first gas outlet ports 511a to reach any position between the two adjacent first gas outlet ports 511a only through diffusion (i.e., the position of the five-pointed star shown in FIG. 4(a)), while the process gas flowing out from each first gas outlet port 511a can flow more quickly to a position directly facing the respective first gas outlet port 511a. That is, there is a difference between a speed at which the process gas flowing out from the plurality of first gas outlet ports 511a reaches positions directly facing the first gas outlet ports 511a and a speed at which the process gas reaches positions between two adjacent first gas outlet ports 511a, thereby causing non-uniform distribution of the process gas flowing into the semiconductor process chamber 1 in a circumferential direction. In view of this, as shown in FIG. 4(b), through rotation of the rotary

gas inlet assembly 51 in the embodiments of the present disclosure, a position of each first gas outlet port 511a continuously changes in a circumferential direction of the carrier apparatus 3. For example, as shown in FIG. 4(b), one of the first gas outlet ports 511a rotates clockwise to a position indicated by the dashed line, i.e., moves to a position directly facing the five-pointed star. In this manner, the gas flowing out from each first gas outlet port 511a can uniformly reach any position on the circumference without diffusion, thereby solving the problem in the related art that there is a difference between the speed at which the process gas flowing out from the plurality of first gas outlet ports 511a reaches positions directly facing the first gas outlet ports 511a and the speed at which the process gas reaches positions between two adjacent first gas outlet ports 511a. Therefore, the uniformity of the distribution of gas introduced into the semiconductor process chamber 1 can be improved, thereby improving process uniformity, and particularly satisfying the requirement of the HDP CVD process for gas distribution uniformity.

[0054] During processing, the rotary gas inlet assembly 51 may continuously rotate in a clockwise direction or a counterclockwise direction, and a linear velocity of the rotation should be comparable to a flow velocity of the gas flow flowing out from the first gas outlet ports 511a, so as to ensure that the above rotation motion can affect the gas flow and improve the uniformity of gas distribution. In some embodiments, the linear velocity of rotation of the rotary gas inlet assembly 51 is, for example, greater than or equal to 1 m/s and less than or equal to 3 m/s. In practical applications, the rotary gas inlet assembly 51 may also be controlled to switch between clockwise rotation and counterclockwise rotation according to specific requirements. Under this mode, a rotation angle in a single rotation in the same direction should be increased as much as possible, so as to ensure that the uniformity of gas distribution can be improved.

[0055] In some embodiments, in order to introduce process gas into the semiconductor process chamber 1 and deliver the process gas to the rotary gas inlet assembly 51 during rotation, while ensuring the sealing of the first gas inlet passage 511, as shown in FIG. 2 and FIG. 3, the edge gas inlet apparatus 5 further includes a fixed gas inlet assembly 52. A first mating surface 512 located at the outer periphery of the rotary gas inlet assembly 51 and a second mating surface 522 located at the inner periphery of the fixed gas inlet assembly 52 are rotatably mated with each other. The first gas inlet passage 511 in the rotary gas inlet assembly 51 is provided with a first gas inlet port 511b on the first mating surface 512. A second gas inlet passage 521 is provided in the fixed gas inlet assembly 52, and the second gas inlet passage 521 is provided with a second gas outlet port 521b at the second mating surface 522. The first gas inlet port 511b is in communication with the second gas outlet port 521b. During rotation of the rotary gas inlet assembly 51, the first mating surface 512 is capable of rotating relative to the second mating surface 522, while the first gas inlet port 511b and the second gas outlet port 521b remain in communication at all times, thereby supplying gas to the rotary gas inlet assembly 51 during rotation.

[0056] In some embodiments, the edge gas inlet apparatus 5 further includes a dynamic sealing assembly. The dynamic sealing assembly is arranged at a mating position between the first mating surface 512 and the second mating surface 522, and is configured to seal a gap at the mating position while ensuring that the rotary gas inlet assembly 51 is capable of rotating, thereby ensuring, by means of the dynamic sealing assembly, the sealing at a position where the first gas inlet port 511b and the second gas outlet port 521b are in communication while gas is supplied to the rotary gas inlet assembly 51 during rotation.

[0057] In some embodiments, without affecting rotation and gas discharge of the rotary gas inlet assembly 51, the fixed gas inlet assembly 52 may surround the outer periphery of the rotary gas inlet assembly 51, or may be located above or below the rotary gas inlet assembly 51 (directly above or directly below, or obliquely above or obliquely below). Different relative positions between the fixed gas inlet assembly 52 and the rotary gas inlet assembly 51 correspond to different positions of the first mating surface 512 on the rotary gas inlet assembly 51 and different positions of the second mating surface 522 on the fixed gas inlet assembly 52. Taking an example in which the fixed gas inlet assembly 52 surrounds the outer periphery of the rotary gas inlet assembly 51, as shown in FIG. 2 and FIG. 3, the first mating surface 512 is located at the outer periphery of the rotary gas inlet assembly 51, and correspondingly, the second mating surface 522 is located at the inner periphery of the fixed gas inlet assembly 52. The first gas inlet port 511b is annular and extends along the outer periphery of the rotary gas inlet assembly 51. Since the first gas inlet port 511b is annular, it can remain in communication with the second gas outlet port 521b at all times during rotation of the rotary gas inlet assembly 51. On this basis, the second gas outlet port 521b may also be annular and extend along the inner periphery of the fixed gas inlet assembly 52; alternatively, the second gas outlet port 521b may include a plurality of sub-gas outlet ports uniformly distributed along the inner periphery of the fixed gas inlet assembly 52, and the plurality of sub-gas outlet ports are each in communication with the first gas inlet port 511b.

[0058] In some embodiments, to facilitate mating, as shown in FIG. 3, an extension portion 523 extending from the first gas inlet port 511b into the first gas inlet passage 511 is further provided at the first mating surface 512, and the above second gas outlet port 521b is located at an end of the extension portion 523 away from the first mating surface 512. In practical applications, an

extension portion extending from the second gas outlet port 521b into the second gas inlet passage 521 may also be provided at the second mating surface 522, and the above first gas inlet port 511b is located at an end of the extension portion away from the second mating surface 522.

[0059] In order to seal a gap at a mating position between the first mating surface 512 and the second mating surface 522 while ensuring that the rotary gas inlet assembly 51 is capable of rotating, the dynamic sealing assembly may have various structures. For example, as shown in FIG. 5, the dynamic sealing assembly includes a first annular dynamic sealing part 6a and a second annular dynamic sealing part 6b. The first annular dynamic sealing part 6a and the second annular dynamic sealing part 6b are respectively located at an upper side and a lower side of a mating position A (i.e., the mating position between the first mating surface 512 and the second mating surface 522), and are configured to respectively seal an upper-side gap and a lower-side gap at the mating position A while ensuring that the rotary gas inlet assembly 51 is capable of rotating. In some embodiments, the first annular dynamic sealing part 6a and the second annular dynamic sealing part 6b are oppositely arranged in an axial direction of the carrier apparatus 3.

[0060] The first annular dynamic sealing part 6a and the second annular dynamic sealing part 6b are both sealed, for example, by using a ferrofluid sealing manner. Specifically, the rotary gas inlet assembly 51 and the fixed gas inlet assembly 52 are both made of magnetically permeable materials (i.e., ferromagnetic materials); annular gaps are respectively formed between two ends of the first annular dynamic sealing part 6a and the fixed gas inlet assembly 52 and the rotary gas inlet assembly 51, and between two ends of the second annular dynamic sealing part 6b and the fixed gas inlet assembly 52 and the rotary gas inlet assembly 51. The magnetic pole directions at two ends (the inner-periphery end and the outer-periphery end) of the first annular dynamic sealing part 6a are opposite to the magnetic pole directions at two ends (the inner-periphery end

and the outer-periphery end) of the second annular dynamic sealing part 6b, and the above annular gaps are filled with ferrofluid. The specific structures of the first annular dynamic sealing part 6a and the second annular dynamic sealing part 6b are, for example, that the first annular dynamic sealing part 6a and the second annular dynamic sealing part 6b each include an annular permanent magnet 61 (for example, a permanent magnet) and a first annular magnetic pole 62 and a second annular magnetic pole 63. The annular permanent magnets 61 of the first annular dynamic sealing part 6a and the second annular dynamic sealing part 6b are respectively arranged at the upper side and the lower side of the mating position A, and an outer-periphery end of each annular permanent magnet 61 is a first magnetic pole and an inner-periphery end thereof is a second magnetic pole, the polarity of the first magnetic pole being opposite to the polarity of the second magnetic pole, for generating a magnetic field. In addition, the magnetic pole directions at two ends (the inner-periphery end and the outer-periphery end) of the annular permanent magnet 61 in the first annular dynamic sealing part 6a are opposite to the magnetic pole directions at two ends (the inner-periphery end and the outer-periphery end) of the annular permanent magnet 61 in the second annular dynamic sealing part 6b. For example, as shown in FIG. 5, the magnetic pole at the inner-periphery end of the annular permanent magnet 61 in the first annular dynamic sealing part 6a is an S pole, and the magnetic pole at the outer-periphery end thereof is an N pole; and the magnetic pole at the inner-periphery end of the annular permanent magnet 61 in the second annular dynamic sealing part 6b is an N pole, and the magnetic pole at the outer-periphery end thereof is an S pole.

[0061] For the first annular dynamic sealing part 6a located at the upper side of the mating position A, upper ends of the first annular magnetic pole 62 and the second annular magnetic pole 63 are respectively in contact with the outer-periphery end and the inner-periphery end of

the annular permanent magnet 61, and lower ends of the first annular magnetic pole 62 and the second annular magnetic pole 63 are respectively located at an outer-periphery side and an inner-periphery side of the upper-side gap, i.e., the upper-side gap is located between the lower end of the first annular magnetic pole 62 and the lower end of the second annular magnetic pole 63. In addition, annular gaps are respectively formed between the lower end of the first annular magnetic pole 62 and an upper end surface of the fixed gas inlet assembly 52 and between the lower end of the second annular magnetic pole 63 and an upper end surface of the rotary gas inlet assembly 51, and the annular gaps are filled with ferrofluid 64.

[0062] For the second annular dynamic sealing part 6b located at the lower side of the mating position A, lower ends of the first annular magnetic pole 62 and the second annular magnetic pole 63 are respectively in contact with the outer-periphery end and the inner-periphery end of the annular permanent magnet 61, and upper ends of the first annular magnetic pole 62 and the second annular magnetic pole 63 are respectively located at an outer-periphery side and an inner-periphery side of the lower-side gap, i.e., the lower-side gap is located between the upper end of the first annular magnetic pole 62 and the upper end of the second annular magnetic pole 63. In addition, annular gaps are respectively formed between the upper end of the first annular magnetic pole 62 and a lower end surface of the fixed gas inlet assembly 52 and between the upper end of the second annular magnetic pole 63 and a lower end surface of the rotary gas inlet assembly 51, and the annular gaps are filled with ferrofluid 64.

[0063] The above annular permanent magnet 61, the first annular magnetic pole 62, the second annular magnetic pole 63, the rotary gas inlet assembly 51 made of a magnetically permeable material, and the fixed gas inlet assembly 52 made of a magnetically permeable material can constitute a closed magnetic circuit. A magnetic field generated by the annular permanent

magnet 61 can "confine" the ferrofluid within the above annular gaps to form a liquid "O"-shaped ring, thereby achieving sealing of the upper-side gap and the lower-side gap. It is readily understood that, in order to ensure that the rotary gas inlet assembly 51 is capable of rotating, a gap is present between the above first mating surface 512 and the second mating surface 522, and air in the gap is magnetically permeable, thereby ensuring formation of the above closed magnetic circuit. In addition, the first annular dynamic sealing part 6a and the second annular dynamic sealing part 6b each further include a fixing member, for example, the black outline shown in FIG. 5 and covering the outside of the annular permanent magnet 61, the first annular magnetic pole 62, and the second annular magnetic pole 63. The fixing member is configured to fix the above annular permanent magnet 61, the first annular magnetic pole 62, and the second annular magnetic pole 63, and forms a space accommodating the upper-side gap or the lower-side gap therein, and the space is formed into a sealed space B through the sealing effect of the ferrofluid 64.

[0064] In some embodiments, taking an example in which the rotary gas inlet assembly 51 is applied to the semiconductor process chamber 1 provided in the embodiments of the present disclosure, the above fixing member is fixedly connected to the sidewall 11 of the chamber body 13 through a connection member 12, so as to integrally fix the first annular dynamic sealing part 6a and the second annular dynamic sealing part 6b.

[0065] In other embodiments, in order to avoid the influence of the gap between the above first mating surface 512 and the second mating surface 522 on the ferrofluid sealing capability, the first annular dynamic sealing part 6a' and the second annular dynamic sealing part 6b' may both adopt the following structure. Specifically, as shown in FIG. 6, the rotary gas inlet assembly 51 and the fixed gas inlet assembly 52 are both made of magnetically permeable materials; the first

annular dynamic sealing part 6a' and the second annular dynamic sealing part 6b' each include a first dynamic sealing group 65a and a second dynamic sealing group 65b. For the first annular dynamic sealing part 6a' located at the upper side of the mating position A, the first dynamic sealing group 65a is located at the outer-periphery side of the upper-side gap, and the second dynamic sealing group 65b is located at the inner-periphery side of the upper-side gap, and is configured to seal the upper-side gap located between the first dynamic sealing group 65a and the second dynamic sealing group 65b. The first dynamic sealing group 65a and the second dynamic sealing group 65b each include an annular permanent magnet, a first annular magnetic pole, and a second annular magnetic pole. The annular permanent magnet of the first dynamic sealing group 65a is arranged at the upper side of the fixed gas inlet assembly 52, and the annular permanent magnet of the second dynamic sealing group 65b is arranged at the upper side of the rotary gas inlet assembly 51. An outer-periphery end of each annular permanent magnet is a first magnetic pole, and an inner-periphery end thereof is a second magnetic pole, the polarity of the first magnetic pole being opposite to the polarity of the second magnetic pole, for generating a magnetic field. In addition, upper ends of the first annular magnetic pole and the second annular magnetic pole of the first dynamic sealing group 65a are respectively in contact with the outer-periphery end and the inner-periphery end of the annular permanent magnet, and a first annular gap is formed between lower ends thereof and the upper end surface of the fixed gas inlet assembly 52; upper ends of the first annular magnetic pole and the second annular magnetic pole of the second dynamic sealing group 65b are respectively in contact with the outer-periphery end and the inner-periphery end of the annular permanent magnet, and a second annular gap is formed between lower ends thereof and the upper end surface of the rotary gas inlet assembly 51, and both the first annular gap and the second annular gap are filled with ferrofluid. The

structures and functions of the annular permanent magnet, the first annular magnetic pole, and the second annular magnetic pole in FIG. 6 are similar to the structures and functions of the annular permanent magnet 61, the first annular magnetic pole 62, and the second annular magnetic pole 63 in FIG. 5.

[0066] For the first annular dynamic sealing part 6b' located at the lower side of the mating position A, the first dynamic sealing group 65a is located at the outer-periphery side of the lower-side gap, and the second dynamic sealing group 65b is located at the inner-periphery side of the lower-side gap, and is configured to seal the lower-side gap located between the first dynamic sealing group 65a and the second dynamic sealing group 65b. The first dynamic sealing group 65a and the second dynamic sealing group 65b each include an annular permanent magnet, a first annular magnetic pole, and a second annular magnetic pole. The annular permanent magnet of the first dynamic sealing group 65a is arranged at the lower side of the fixed gas inlet assembly 52, and the annular permanent magnet of the second dynamic sealing group 65b is arranged at the lower side of the rotary gas inlet assembly 51. An outer-periphery end of each annular permanent magnet is a first magnetic pole, and an inner-periphery end thereof is a second magnetic pole, the polarity of the first magnetic pole being opposite to the polarity of the second magnetic pole, for generating a magnetic field. In addition, the magnetic pole directions at two ends of each annular permanent magnet in the first annular dynamic sealing part 6a' are opposite to the magnetic pole directions at two ends of each annular permanent magnet in the second annular dynamic sealing part 6b'. Further, lower ends of the first annular magnetic pole and the second annular magnetic pole of the first dynamic sealing group 65a are respectively in contact with the outer-periphery end and the inner-periphery end of the annular permanent magnet, and a first annular gap is formed between upper ends thereof and the lower end surface

of the fixed gas inlet assembly 52; lower ends of the first annular magnetic pole and the second annular magnetic pole of the second dynamic sealing group 65b are respectively in contact with the outer-periphery end and the inner-periphery end of the annular permanent magnet, and a second annular gap is formed between upper ends thereof and the lower end surface of the rotary gas inlet assembly 51, and both the first annular gap and the second annular gap are filled with ferrofluid.

[0067] For the first dynamic sealing group 65a or the second dynamic sealing group 65b located at the outer-periphery side of the upper-side gap or the lower-side gap, the above annular permanent magnet, the first annular magnetic pole, the second annular magnetic pole, and the fixed gas inlet assembly 52 made of a magnetically permeable material can constitute a closed magnetic circuit, and the magnetic field generated by the annular permanent magnet can "confine" the ferrofluid within the above first annular gap to form a liquid "O"-shaped ring. For the dynamic sealing group (65a or 65b) located at the inner-periphery side of the upper-side gap or the lower-side gap, the above annular permanent magnet, the first annular magnetic pole, the second annular magnetic pole, and the rotary gas inlet assembly 51 made of a magnetically permeable material can constitute a closed magnetic circuit, and the magnetic field generated by the annular permanent magnet can "confine" the ferrofluid within the above second annular gap to form a liquid "O"-shaped ring. Since the upper-side gap and the lower-side gap are both located between the first annular gap and the second annular gap, the ferrofluid in the first annular gap and the second annular gap can seal the upper-side gap or the lower-side gap. It is readily understood that the above closed magnetic circuit is constituted by the annular permanent magnet, the first annular magnetic pole, the second annular magnetic pole, and the rotary gas inlet assembly 51 (or the fixed gas inlet assembly 52), and does not need the presence of a gap

between the first mating surface 512 and the second mating surface 522, thereby avoiding the influence of the gap on the ferrofluid sealing capability and improving the ferrofluid sealing capability.

[0068] In some embodiments, the first annular dynamic sealing part 6a' and the second annular dynamic sealing part 6b' each further include a fixing member, for example, the black outline shown in FIG. 6 and covering the outside of the first dynamic sealing group 65a and the second dynamic sealing group 65b. The first dynamic sealing group 65a and the second dynamic sealing group 65b are fixed to the fixing member, and the fixing member is configured to form, between the first dynamic sealing group 65a and the second dynamic sealing group 65b, a sealed space C accommodating the upper-side gap or the lower-side gap therein. Specifically, the annular permanent magnets, the first annular magnetic poles, and the second annular magnetic poles of the first dynamic sealing group 65a and the second dynamic sealing group 65b are all fixed to the fixing member. Moreover, the above fixing member constitutes a space accommodating the upper-side gap or the lower-side gap, and the space forms the above sealed space C under the sealing effect of the ferrofluid.

[0069] The fixed gas inlet assembly 52 for introducing process gas into the semiconductor process chamber 1 may have various structures. For example, in some embodiments, as shown in FIG. 5, the fixed gas inlet assembly 52 includes a fixed gas inlet ring, and the fixed gas inlet ring is configured to pass through a sidewall of the semiconductor process chamber 1 (i.e., the chamber body 13), and a part of the fixed gas inlet ring is configured to be located outside the sidewall of the semiconductor process chamber 1; as shown in FIG. 3, the second gas inlet passage 521 is provided with a second gas inlet port 521a in a part of the fixed gas inlet ring configured to be located outside the semiconductor process chamber 1, for connection to a gas

source. Process gas provided by the gas source flows into the second gas inlet passage 521 through the second gas inlet port 521a. In order to ensure the sealing of the semiconductor process chamber 1, a sealing member (not shown in the figure) may be provided between the fixed gas inlet ring and the sidewall of the semiconductor process chamber 1 to seal a gap therebetween.

[0070] As another example, in other embodiments, the fixed gas inlet assembly 52 may further include a fixed gas inlet ring and at least one gas inlet pipeline, and the fixed gas inlet ring is configured to be located between the sidewall of the semiconductor process chamber 1 and the rotary gas inlet assembly 51; the second gas inlet passage 521 has at least one second gas inlet port 521a, each second gas inlet port 521a being connected to a gas outlet end of a corresponding gas inlet pipeline in a one-to-one manner, and a gas inlet end of each gas inlet pipeline being configured to pass through the sidewall of the semiconductor process chamber 1 and extend to the outside of the semiconductor process chamber 1 for connection to a gas source of process gas. In one specific embodiment, the second gas inlet passage 521 may include an annular passage, the annular passage having the above at least one second gas inlet port 521a at an outer periphery thereof and having an annular second gas outlet port 521b on an inner periphery thereof, or a second gas outlet port 521b formed by a plurality of sub-gas outlet ports uniformly distributed along the inner periphery of the annular passage. Alternatively, the second gas inlet passage 521 may include a plurality of straight passages extending along a radial direction of the fixed gas inlet ring, and the plurality of straight passages are uniformly distributed along the inner periphery of the fixed gas inlet ring. A gas inlet end of each straight passage serves as the second gas inlet port 521a and is located at the outer periphery of the fixed gas inlet ring, and a

gas outlet end thereof serves as the above sub-gas outlet port and is located at the inner periphery of the fixed gas inlet ring.

[0071] In some embodiments, as shown in FIG. 2, the rotary gas inlet assembly 51 includes a rotating gas inlet ring 51a, a rotation drive source configured to drive the rotating gas inlet ring 51a to rotate, and a plurality of gas inlet nozzles 51b; where the plurality of gas inlet nozzles 51b are connected to the rotating gas inlet ring 51a and are uniformly distributed along a circumferential direction of the rotating gas inlet ring 51a; a first sub-passage is provided in the rotating gas inlet ring 51a, a second sub-passage is provided in each gas inlet nozzle 51b, the first sub-passage is in communication with each second sub-passage and together therewith constitutes the first gas inlet passage 511, and a gas outlet port of each second sub-passage serves as the first gas outlet port 511a. The above first sub-passage is, for example, an annular passage. In some embodiments, the number of gas inlet nozzles 51b is, for example, 4, 8, 16, 32, 64, or the like, and is preferably 32, and this quantity provides a relatively good effect in improving the uniformity of gas distribution.

[0072] In some embodiments, each gas inlet nozzle 51b is connected to the rotating gas inlet ring 51a through an angle adjustment structure, and the angle adjustment structure is configured to adjust a gas outlet direction of the gas inlet nozzle 51b. The angle adjustment structure may, for example, be an adjustment structure that manually adjusts an angle of the gas inlet nozzle 51b.

[0073] As another technical solution, as shown in FIG. 1, the embodiments of the present disclosure further provide a semiconductor process chamber 1. The semiconductor process chamber 1 includes a chamber body 13 and an edge gas inlet apparatus 5, and a carrier apparatus 3 for carrying a wafer is provided in the chamber body 13. The structures and functions of the

chamber body 13, the edge gas inlet apparatus 5, and the carrier apparatus 3 have already been described in detail in the above embodiments and will not be repeated herein.

[0074] The semiconductor process chamber 1 provided in the embodiments of the present disclosure, by employing the above edge gas inlet apparatus provided in the embodiments of the present disclosure, can improve the uniformity of the distribution of gas introduced into the semiconductor process chamber, thereby improving process uniformity, and particularly satisfying the requirement of the HDP CVD process for gas distribution uniformity.

[0075] In some embodiments, the semiconductor process chamber 1 further includes a rotation drive source, and the rotation drive source includes a rotation driving member 53, a transmission structure, and a dynamic sealing member, where the rotation driving member 53 is located outside the chamber body 13 and is configured to provide rotational power; the rotation driving member 53 is, for example, a rotary motor. The transmission structure rotatably passes through the chamber body 13 and is respectively connected to the rotation driving member 53 and the rotary gas inlet assembly 51 (i.e., the rotating gas inlet ring 51a), and is configured to drive the rotary gas inlet assembly 51 to rotate under the driving of the rotation driving member 53; and the dynamic sealing member (not shown in the figure) is configured to seal a gap between the transmission structure and the chamber body 13 while allowing the transmission structure to rotate. The dynamic sealing member is, for example, sealed by using a ferrofluid sealing manner.

[0076] Without affecting the process and operation of the rotary gas inlet assembly 51, the above rotation driving member 53 may be arranged at any position outside the chamber body 13. For example, in order to simplify the structure while ensuring that the structure inside the chamber body 13 is symmetrical with respect to an axis of the chamber body 13, as shown in FIG. 1, the rotation driving member 53 is arranged above the chamber body 13. Moreover, the transmission

structure includes a first connection rod 54 and a plurality of second connection rods 55. The first connection rod 54 is vertically arranged, and one end of the first connection rod 54 passes through the top of the chamber body 13 and extends to the outside of the chamber body 13 to be connected to a drive shaft of the rotation driving member 53, and the other end of the first connection rod 54 is connected to one end of each of the plurality of second connection rods 55; and the other ends of the plurality of second connection rods 55 are bent and extend to an edge inside the chamber body 13, and are connected to different positions of the rotary gas inlet assembly 51 in a circumferential direction thereof. Under the driving of the drive shaft of the rotation driving member 53, the first connection rod 54 drives the second connection rods 55 to synchronously rotate, thereby driving the rotary gas inlet assembly 51 to rotate.

[0077] In a specific embodiment, the above second connection rod 55 includes a horizontal portion extending along a radial direction of the rotary gas inlet assembly 51 and a vertical portion extending in a vertical direction. One end of the horizontal portion is connected to one end of the first connection rod 54, and the other end of the horizontal portion extends to a position close to a sidewall of the rotary gas inlet assembly 51; one end of the vertical portion is integrally connected to the horizontal portion, and the other end thereof extends downward and is connected to the rotary gas inlet assembly 51. The above second connection rods 55 are, for example, two in number and are symmetrically arranged with respect to the axis of the rotary gas inlet assembly 51, so as to ensure that forces acting on the rotary gas inlet assembly 51 during rotation are uniform, while rotation of the two second connection rods 55 has a relatively small influence on gas flow entering the chamber body 13 from the center gas inlet apparatus 4.

[0078] As another technical solution, as shown in FIG. 1, the semiconductor process equipment 100 provided in the embodiments of the present disclosure, by employing the above

semiconductor process chamber 1 provided in the embodiments of the present disclosure, can improve the uniformity of the distribution of gas introduced into the semiconductor process chamber, thereby improving process uniformity, and particularly satisfying the requirement of the HDP CVD process for gas distribution uniformity.

[0079] It can be understood that the above embodiments are merely exemplary embodiments adopted to illustrate the principles of the present disclosure, and the present disclosure is not limited thereto. Those of ordinary skill in the art can make various modifications and improvements without departing from the spirit and essence of the present disclosure, and these modifications and improvements are also regarded as falling within the scope of the present disclosure.

CLAIMS

WHAT IS CLAIMED IS:

1. An edge gas inlet apparatus for a semiconductor process chamber, comprising:
a rotary gas inlet assembly, being annular and rotatable about an axis of the rotary gas inlet assembly;
a fixed gas inlet assembly, being annular and arranged outside the rotary gas inlet assembly, wherein a first mating surface located at an outer periphery of the rotary gas inlet assembly and a second mating surface located at an inner periphery of the fixed gas inlet assembly are rotatably mated with each other, a first gas inlet passage is provided in the rotary gas inlet assembly, the first gas inlet passage is provided with a first gas inlet port at the first mating surface and is provided with a plurality of first gas outlet ports along an inner periphery of the rotary gas inlet assembly; and a second gas inlet passage is provided in the fixed gas inlet assembly, the second gas inlet passage is provided with a second gas outlet port at the second mating surface, and the first gas inlet port is in communication with the second gas outlet port.
2. The edge gas inlet apparatus according to claim 1, wherein the first gas inlet port is annular and extends along the outer periphery of the rotary gas inlet assembly.
3. The edge gas inlet apparatus according to claim 2, wherein the second gas outlet port is annular and extends along the inner periphery of the fixed gas inlet assembly; or, the second gas outlet port includes a plurality of sub-gas outlet ports uniformly distributed along the inner periphery of the fixed gas inlet assembly, and the plurality of sub-gas outlet ports are each in communication with the first gas inlet port.

4. The edge gas inlet apparatus according to claim 1, further comprising:
a dynamic sealing assembly, arranged at a mating position between the first mating surface and the second mating surface, and configured to seal a gap at the mating position while allowing the rotary gas inlet assembly to rotate.

5. The edge gas inlet apparatus according to claim 4, wherein the dynamic sealing assembly includes a first annular dynamic sealing part and a second annular dynamic sealing part, the first annular dynamic sealing part and the second annular dynamic sealing part being respectively located at an upper side and a lower side of the mating position, and configured to respectively seal an upper-side gap and a lower-side gap of the mating position while allowing the rotary gas inlet assembly to rotate.

6. The edge gas inlet apparatus according to claim 5, wherein the rotary gas inlet assembly and the fixed gas inlet assembly are both made of magnetically permeable materials;
annular gaps are respectively formed between two ends of the first annular dynamic sealing part and the fixed gas inlet assembly and the rotary gas inlet assembly, and between two ends of the second annular dynamic sealing part and the fixed gas inlet assembly and the rotary gas inlet assembly, magnetic pole directions at the two ends of the first annular dynamic sealing part being opposite to the magnetic pole directions at the two ends of the second annular dynamic sealing part, and the annular gaps being filled with ferrofluid.

7. The edge gas inlet apparatus according to any one of claims 1-6, wherein the fixed gas inlet assembly includes a fixed gas inlet ring, the fixed gas inlet ring being configured

to pass through a sidewall of the semiconductor process chamber, and a part of the fixed gas inlet ring being configured to be located outside the semiconductor process chamber; and the second gas inlet passage is provided with a second gas inlet port in the part of the fixed gas inlet ring configured to be located outside the semiconductor process chamber, for connection to a gas source of process gas.

8. The edge gas inlet apparatus according to any one of claims 1-6, wherein the fixed gas inlet assembly includes a fixed gas inlet ring and at least one gas inlet pipeline, the fixed gas inlet ring being configured to be located between the sidewall of the semiconductor process chamber and the rotary gas inlet assembly;

the second gas inlet passage includes at least one second gas inlet port, each second gas inlet port being connected to a gas outlet end of a corresponding gas inlet pipeline in a one-to-one manner, and a gas inlet end of each gas inlet pipeline being configured to pass through the sidewall of the semiconductor process chamber and extend outside of the semiconductor process chamber for connection to a gas source.

9. The edge gas inlet apparatus according to any one of claims 1-6, wherein the rotary gas inlet assembly includes a rotating gas inlet ring, a rotation drive source configured to drive the rotating gas inlet ring to rotate, and a plurality of gas inlet nozzles, the plurality of gas inlet nozzles being connected to the rotating gas inlet ring and being uniformly distributed along a circumferential direction of the rotating gas inlet ring;

a first sub-passage is provided in the rotating gas inlet ring, a second sub-passage is provided in each gas inlet nozzle, the first sub-passage is in communication with each second

sub-passage and together therewith constitutes the first gas inlet passage, and a gas outlet port of each second sub-passage serves as the first gas outlet port.

10. The edge gas inlet apparatus according to claim 9, wherein each gas inlet nozzle is connected to the rotating gas inlet ring through an angle adjustment structure, and the angle adjustment structure is configured to adjust a gas outlet direction of the gas inlet nozzle.

11. A semiconductor process chamber, comprising:
a chamber body, having a carrier apparatus for carrying a wafer;
the edge gas inlet apparatus according to any one of claims 1-10, the rotary gas inlet assembly being arranged around a periphery of the carrier apparatus in the chamber body and being located above the carrier apparatus;
a rotation drive source configured to drive the rotary gas inlet assembly to rotate.

12. The semiconductor process chamber according to claim 11, wherein the rotation drive source includes a rotation driving member, a transmission structure, and a dynamic sealing member, the rotation driving member being located outside the chamber body and being configured to provide rotational power, the transmission structure rotatably passing through the chamber body and being respectively connected to the rotation driving member and the rotary gas inlet assembly, and being configured to drive the rotary gas inlet assembly to rotate under driving of the rotation driving member;

the dynamic sealing member is configured to seal a gap between the transmission structure and the chamber body while allowing the transmission structure to rotate.

13. The semiconductor process chamber according to claim 12, wherein the rotation driving member is arranged above the chamber body, the transmission structure includes a first connection rod and a plurality of second connection rods, the first connection rod is vertically arranged, and one end of the first connection rod passes through the top of the chamber body and extends outside of the chamber body to be connected to a drive shaft of the rotation driving member, another end of the first connection rod is connected to one end of each of the plurality of second connection rods, and other ends of the plurality of second connection rods are bent and extend to an edge inside the chamber body, and are connected to different positions of the rotary gas inlet assembly in a circumferential direction thereof.

14. The semiconductor process chamber according to claim 12 or 13, further comprising a center gas inlet apparatus, the center gas inlet apparatus being configured to deliver process gas from the top of the chamber body into the chamber body.

15. The semiconductor process chamber according to claim 14, wherein the semiconductor process chamber is a chemical vapor deposition chamber; and the center gas inlet apparatus and the edge gas inlet apparatus are configured to respectively deliver a first process gas and a second process gas into the semiconductor process chamber.

16. Semiconductor process equipment, comprising the semiconductor process chamber according to any one of claims 11-15.