

DOOR OPENER, TRANSPORT CHAMBER AND SEMICONDUCTOR PROCESSING DEVICE

TECHNICAL FIELD

The present disclosure relates to the field of semiconductor manufacturing technologies, and particularly relates to a door opener, a transport chamber and a semiconductor processing device.

BACKGROUND

In the semiconductor processing technology, very high requirements are placed on core process parameters such as film forming uniformity, film forming quality, control of metal ion contamination, control of particle contamination and the like. Particulate contamination is one of the main causes affecting product yield and performance of process devices in the manufacturing process of semiconductor chips, and thus, the contamination of wafers by particles needs to be strictly controlled.

There are many factors that affect wafer cleanliness, including selections on the base material and the heater, configurations of the movable parts, equipment interfaces, wafer transfer paths, gas lines, device cleanliness and the like. The wafer transport process is one of the most susceptible processes to contamination. For example, in a vertical thermal process device, a sealing door of a wafer cassette needs to be opened by a door opener to perform wafer transfer through a wafer transfer port of the wafer cassette, while movable parts inside the door opener form one of the main links that generate particles.

An existing door opener includes a mounting structure provided at a bottom of a wafer cassette and connected to a sealing door of the wafer cassette, and a drive mechanism configured to drive the mounting structure to move vertically. Under the drive of the drive mechanism, after the wafer cassette door is opened by the mounting structure and since an interior of the wafer cassette, the space where the mounting structure on the bottom of the chamber is located, and an interior of the drive mechanism are all in communication, movable parts within the mounting structure

and the drive mechanism will generate particles during movement due to friction, while lubricating oil for the movable parts also volatilizes to generate particles. These particles may enter the wafer cassette and cause contamination to the wafer in the wafer cassette, thereby affecting the product yield.

SUMMARY

To solve at least part of the problems in the existing art, the present disclosure provides a door opener, a transport chamber and a semiconductor processing device that are configured to prevent particles generated by friction of movable parts in the door opener and particles generated by volatilization of lubricating oil from contaminating wafers inside a wafer cassette during opening of the wafer cassette.

According to an aspect of the present disclosure, there is provided a door opener for opening or closing a sealing door of a wafer cassette, the door opener including:

- a housing part configured to be movably butted with a chamber wall of a transport chamber and located at a peripheral position of a transfer interface at which the chamber wall is butted with a wafer transfer port of the wafer cassette so that the transfer interface and the wafer transfer port of the wafer cassette is openable or closeable, wherein a first opening is provided on a side of the housing part facing the wafer cassette; and

- a butting assembly provided at the first opening and configured to be butted with the sealing door and separate the sealing door from the wafer cassette when the housing part is in a position for closing the transfer interface and the wafer transfer port, wherein the sealing door or the butting assembly is in a seal fit with the first opening to form a sealed space within the housing part.

In some embodiments of the present disclosure, the butting assembly includes:

- a butting plate; and

- a drive mechanism provided in the housing part, and configured to drive the butting plate to move to a first position where the butting plate is capable of butting with the sealing door, and drive the butting plate to move to a second position where the sealing door or the butting plate is in a seal fit with the first opening after the

butting plate is butted with the sealing door.

In some embodiments of the present disclosure, a suction structure is provided on the butting plate and configured to fix the sealing door by suction when the butting plate is in the first position.

In some embodiments of the present disclosure, a first sealing member is provided at a position of the sealing door or the butting plate corresponding to a periphery of the first opening and/or at a position on the housing part at a periphery of the first opening, and configured to seal the first opening when the butting plate is in the second position.

In some embodiments of the present disclosure, the housing part includes an annulus and a cover, wherein,

an end face of an opening of the cover is butted with a first end face of the annulus and a second sealing member is provided therebetween; and

a hole of the annulus is used as the first opening, a second end face of the annulus, which is away from the first end face, is configured to be butted with a surface of the sealing door or a surface of the butting plate away from the wafer cassette and the first sealing member is provided therebetween.

In some embodiments of the present disclosure, the door opener further includes:

a housing drive mechanism connected to the housing part and configured to drive the housing part and the butting assembly therein to move as a whole.

In some embodiments of the present disclosure, a third sealing member is provided at a position of the housing part corresponding to a periphery of the transfer interface and/or at a position on the chamber wall of the transport chamber at the periphery of the transfer interface, and configured to seal the transfer interface and the wafer transfer port when the housing part is in a position for closing the transfer interface and the wafer transfer port.

In some embodiments of the present disclosure, the door opener further includes:

a purging mechanism configured to introduce purging gas into the wafer cassette and discharge gas from the wafer cassette at the same time when the housing part is in a position for closing the wafer transfer port and the sealing door is separated from the

wafer cassette.

In some embodiments of the present disclosure, the purging mechanism includes:
a purging nozzle provided on a side of the housing part facing the wafer cassette and configured to blow the purging gas into the wafer cassette;

a gas inlet path respectively connected to the purging nozzle and a gas source and configured to convey the purging gas provided by the gas source to the purging nozzle; and

a gas outlet path configured to discharge the gas in the wafer cassette to an outside of the housing part.

In some embodiments of the present disclosure, the housing part is provided with a vent structure for venting gas in the housing part to an outside of the housing part.

According to another aspect of the present disclosure, there is provided a transport chamber, including:

a chamber body provided with a transfer interface for butting with a wafer transfer port of a wafer cassette;

the door opener according to any one of claims 1 to 10, by which the wafer transfer port and the transfer interface are opened or closed simultaneously so that an interior of the chamber body is in communication with or separated from an interior of the wafer cassette.

In some embodiments of the present disclosure, the door opener as describe above is provided;

the gas inlet path is a gas inlet channel provided in the chamber body, which has an inlet opened outside of the chamber body and configured to be connected to the gas source, and has an outlet opened inside of the chamber body and configured to be butted and in communication with an inlet of the purging nozzle when the housing part is in a position for closing the wafer transfer port; and

the gas outlet path is a gas outlet channel opened inside a body of the wafer cassette, which has an inlet in communication with an interior of the wafer cassette, and has an outlet opened outside of the body of the wafer cassette.

In some embodiments of the present disclosure, a bracket is provided outside of a

sidewall of the chamber body at the transfer interface, and configured to support the wafer cassette when the wafer transfer port of the wafer cassette is butted with the transfer interface.

According to another aspect of the present disclosure, there is provided a semiconductor processing device, including:

a reaction chamber;

the transport chamber according to any one of claims 11 to 13;

a wafer carrier configured to carry a wafer and being movable between the reaction chamber and the transport chamber; and

a manipulator provided in the transport chamber and configured to transfer the wafer between the wafer cassette and the wafer carrier when the housing part is in a position for opening the wafer transfer port and the wafer carrier is in the transport chamber.

In some embodiments of the present disclosure, the semiconductor processing device is a vertical thermal process device.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and advantages of the present disclosure will become more apparent from the following description of the embodiments of the present disclosure with reference to the accompanying drawings, in which:

FIG. 1 is a schematic view illustrating a state where a sealing door of a wafer cassette has not been opened by the door opener yet according to an embodiment of the present disclosure;

FIG. 2 is a schematic view illustrating a state where a sealing door of a wafer cassette has been opened by a door opener according to an embodiment of the present disclosure;

FIG. 3 is a schematic view illustrating a state where a sealing door of a wafer cassette has been opened by a door opener according to another embodiment of the present disclosure;

FIG. 4 is a schematic structural view of a semiconductor processing device

according to an embodiment of the present disclosure; and

FIG. 5 is a schematic view illustrating the positional relationship of the wafer cassette and the door opener according to an embodiment of the present disclosure.

Reference signs

1 - heater; 2 - process tube; 3 - sealing door of a process tube; 4 - wafer carrier; 5 - transport space; 6 - heat preservation barrel; 7 - process gate; 8 - manipulator; 9 - wafer cassette; 9A - sealing door; 10 - wafer; 11 - purging nozzle; 12 - door opener; 12A - seal ring; 12B - second sealing member; 12D - first sealing member; 12C - pneumatic seal ring; 12E - driver; 12F - unlocking mechanism; 12G - guide mechanism; 12H - vent structure; 12K1 - inner annulus; 12M - butting plate; 12N - support frame; 12K2 - outer annulus; 12J - top plate; 12L - side plate; 13 - suction structure; P1 - inlet; P2 - outlet; 14 - chamber body; 15 - bracket; 101 - housing part; 102 - annulus; 103 - first opening; 104 - cover; 105 - drive mechanism; 106 - butting assembly; and 107 - transfer interface.

DETAILED DESCRIPTION

To make the objects, technical solutions and advantages of the present disclosure more apparent, the present disclosure will be described in further detail below with reference to specific embodiments and the accompanying drawings. It should be understood that these descriptions are illustrative only and are not intended to limit the scope of the present disclosure. Moreover, in the following description, descriptions of well-known structures and techniques are omitted so as to not unnecessarily obscure the concepts of the present disclosure.

In an embodiment of the present disclosure, there is provided a door opener for opening a sealing door of a wafer transfer port of a wafer cassette. FIG. 1 shows a state where the sealing door of the wafer cassette has not been opened by the door opener yet; and FIG. 2 shows a state where the sealing door of the wafer cassette has been opened by the door opener. Referring to FIGS. 1 and 2 together, a door opener 12 provided in the embodiment includes a housing part 101 and a butting assembly 106.

The housing part 101 is configured to be movably butted with a chamber body 14 (i.e., a chamber wall) of the transport chamber and is located at a peripheral position of a transfer interface at which the chamber body 14 is butted with a wafer transfer port of a wafer cassette 9, so as to open or close the transfer interface and the wafer transfer port. A first opening 103 is further provided on a side of the housing part 101 facing the wafer cassette 9. A butting assembly 106 is provided at the first opening 103 and configured to be butted with the sealing door 9A and separate the sealing door 9A from the wafer cassette 9 when the housing part 101 is in a position for closing the transfer interface and the wafer transfer port, while the sealing door 9A is in a seal fit with the first opening 103 to form a sealed space within the housing part 101.

As can be seen from the above, when the housing part 101 is in the position for closing the transfer interface and the wafer transfer port, the butting assembly 106 may remove the sealing door 9A from the wafer cassette 9, i.e., separate the sealing door 9A from the wafer cassette 9, but at this time, the housing part 101 still closes the transfer interface and the wafer transfer port so that an interior of the wafer cassette 9 and an interior of the butted chamber are kept isolated. The butting assembly 106 can hold the sealing door 9A after it is removed, while the sealing door 9A is in a seal fit with the first opening 103 to form a sealed space within the housing part 101. In this way, movable parts of the butting assembly 106 are sealed in the sealed space, thus ensuring that contaminants produced by the described movable parts and lubricating oil thereon do not cause any contamination to the wafer 10 in the wafer cassette 9, facilitating improvement in the product yield and performance.

When the housing part 101 is moved as a whole to a position for opening the transfer interface and the wafer transfer port, the sealing door 9A may be moved together with the housing part 101. At this time, the interior of the wafer cassette 9 and the interior of the butted chamber are in communication, and during this process, the sealing door 9A and the first opening 103 are always in a seal fit, so as to ensure that the movable parts of the butting assembly 106 are always sealed in the sealed space.

In this embodiment, a third sealing member 12C is provided at a position of the housing part 101 corresponding to a periphery of the transfer interface and/or at a position on the chamber body 14 at the periphery of the transfer interface, and configured to seal the transfer interface and the wafer transfer port when the housing part 101 is in a position for closing the transfer interface and the wafer transfer port. Specifically, a side of the housing part 101 facing the chamber body 14 is in seal butting with an inside of the sidewall of the chamber body 14 at a position on the periphery of the transfer interface so that the interior of the door opener 12 is separated from the interior of the chamber body 14 and the interior of the door opener 12 is prevented from contaminating the interior of the chamber body 14. Optionally, the third sealing member 12C is a pneumatic seal ring.

Optionally, the door opener 12 further includes a housing drive mechanism (not shown) connected to the housing part 101 and configured to drive the housing part 101 and the butting assembly 106 therein to move as a whole. The type and structure of the housing drive mechanism is not limited in the embodiment as long as the door opener 12 can be driven to move. The moving direction of the door opener 12 is not limited, and may be the vertical direction in FIG. 1 or the direction perpendicular to the paper surface as long as the wafer transfer port of the wafer cassette 9 can be fully opened.

Apparently, in practical applications, the housing drive mechanism may be omitted, and the housing part 101 may be manually moved or removed. In this case, the movable butting between the housing part 101 and the wafer cassette 9 is realized in a relatively movable manner or a detachable connection.

In this embodiment, the butting assembly 106 includes a butting plate 12M and a drive mechanism 105, wherein the drive mechanism 105 is provided in the housing part 101 and configured to drive the butting plate 12M to move to a first position where the butting plate 12M is capable of butting with the sealing door 9A and drive the butting plate 12M to move to a second position (the position of the butting plate 12M in FIG. 2) where the sealing door 9A can come into a seal fit with the first opening 103 after the butting plate 12M is butted with the sealing door 9A.

Specifically, the drive mechanism 105 drives the butting plate 12M to move horizontally in a direction toward the wafer transfer port of the wafer cassette 9 until the butting plate 12M reaches the first position for butting with the sealing door 9A, and the drive mechanism 105 drives the butting plate 12M to move horizontally in a direction away from the wafer transfer port of the wafer cassette 9 until the butting plate 12M reaches the second position for a seal fit of the sealing door 9A and the first opening 103.

Optionally, the drive mechanism 105 includes a support frame 12N, a driver 12E, and a guide mechanism 12G. The support frame 12N is fixed in the housing part 101 and configured to support the driver 12E and the guide mechanism 12G. The driver 12E is configured to drive the butting plate 12M to move between the first position and the second position, and may be, for example but not limited to, a cylinder. The guide mechanism 12G is configured to define a moving direction of the butting plate 12M, such as moving in a direction perpendicular to the sealing door 9A of the wafer cassette 9, i.e., moving toward left and right in the horizontal direction in FIG. 2. By means of the guide mechanism 12G, the butting plate 12M can be moved smoothly to achieve smooth opening of the sealing door 9A. The guide mechanism 12G is, for example but not limited to, a linear bearing.

Optionally, a suction structure 13 is provided on the butting plate 12M and configured to fix the sealing door 9A by suction when the butting plate 12M is in the first position. Optionally, the suction structure 13 includes at least one suction member, and is provided on a side of the butting plate 12M facing the sealing door 9A to suck the sealing door 9A. In an example, the suction member employs a suction cup. The suction structure 13 further includes a vacuumizing device provided outside the door opener 12 and communicated with the suction cup 13 for controlling suction actions of the suction cup 13. In other examples, the suction structure 13 may use other types of suction devices as long as the sealing door 9A can be sucked to the butting plate 12M.

Optionally, the butting assembly 106 further includes an unlocking mechanism 12F provided on a side of the butting plate 12M facing away from the sealing door 9A

and configured to lock or unlock a locking structure (not shown) mounted on the sealing door 9A. Specifically, the unlocking mechanism 12F has a retractable rotary pin that can open the locking structure through the butting plate 12M and thus unlock the sealing door 9A.

In this embodiment, a first sealing member 12D is provided on the housing part 101 at a position on a periphery of the first opening 103 and configured to seal the first opening 103 when the butting plate 12M is in the second position. Specifically, while the butting plate 12M is moved to the second position, a surface of the sealing door 9A opposite to the first opening 103 comes into contact with the first sealing member 12D and makes it compressed and deformed, and at this time, the first sealing member 12D can seal a gap between the two butting surfaces of the sealing door 9A and the housing part 101.

In practical applications, the first sealing member 12D may be provided at a position of the sealing door 9A corresponding to the periphery of the first opening 103, or two first sealing members 12D may be provided at a position on the housing part 101 at the periphery of the first opening 103 and a position of the sealing door 9A corresponding to the periphery of the first opening 103, respectively.

It should be noted that the sealing door 9A should have a larger size than the first opening 103 so that the surface of the sealing door 9A opposite to the first opening 103 can be butted with the surface of the housing part 101 on the periphery of the first opening 103. In addition, the butting plate 12M should have a size slightly smaller than the first opening 103 so that the butting plate 12M can be extended into or out of the first opening 103.

It should be further noted that, as for the butting assembly 106, the included suction structure 13 is also only an exemplary illustration, and the disclosure is not limited thereto. In fact, the suction structure 13 may be replaced by any one of the parts that can be fixedly connected to the sealing door 9A, such as a clamping part, a screwing part and the like.

In this embodiment, the housing part 101 includes an annulus 102 and a cover 104. The cover 104 is composed of a closed annulus side plate 12L and a top plate 12J

closing an opening at one end of the side plate 12L, wherein a radial section of the side plate 12L may have a circular or quadrangular shape, and the top plate 12J may have a shape similar to the opening of the side plate 12L. A seal ring 12A is provided between a surface of the top plate 12J facing the side plate 12L and one of the end faces of the side plate 12L, so as to seal a gap therebetween.

An axis of the annulus 102 is perpendicular to the butting plate 12M, and a hole of the annulus 102 serves as the first opening 103. Further, a first end face of the annulus 102 (the rightward end face of the annulus 102 in FIG. 1) is butted with an end face of the side plate 12L away from the top plate 12J, and a second sealing member 12B is provided therebetween for sealing a gap between the annulus 102 and the side plate 12L. In practical applications, obviously, the housing part 101 may be formed of an integral structure, i.e., the annulus 102 and the cover 104 may be connected together or integrally formed, so as to avoid gaps at joints between the parts constituting the housing part 101.

A second end face of the annulus 102 (the leftward end face of the annulus 102 in FIG. 1) facing away from the first end face thereof is configured to be butted with a surface of the sealing door 9A facing away from the wafer cassette 9, and the first sealing member 12D is provided therebetween.

In this embodiment, the annulus 102 includes an outer annulus 12K2 and an inner annulus 12K1 located inside the outer annulus 12K2, and an axial thickness of the inner annulus 12K1 is smaller than that of the outer annulus 12K2 so that a height difference is formed between a surface of the inner annulus 12K1 facing the sealing door 9A and a surface of the outer annulus 12K2 facing the seal door 9A, thereby forming a stepped structure. The axial thickness refers to a length of the inner annulus 12K1 or the outer annulus 12K2 in the direction perpendicular to the sealing door 9A, i.e., a length of the inner annulus 12K1 or the outer annulus 12K2 in the horizontal direction in FIG. 2.

An end face of the inner annulus 12K1 facing the sealing door 9A is configured to be butted with the sealing door 9A, and a first sealing member 12D is provided on this end face and/or the butted surface of the sealing door 9A. Two end faces of the

outer annulus 12K2 are configured to be in seal butting with peripheral sidewalls of the cover 104 and the transfer interface of the chamber that is butted with the wafer transfer port of the wafer cassette 9, respectively.

As can be seen from the above, the drive mechanism 105 includes movable parts such as the driver 12E and the guide mechanism 12G. During the above-described opening process of the sealing door 9A of the wafer cassette, these movable parts inevitably generate particulate contaminants due to the moving friction. In addition, these movable parts are lubricated by lubricating oil, which also volatilizes to produce contaminants. Compared with the existing art, the drive mechanism 105 in the embodiment is always sealed in the sealed space formed inside the housing part 101 by means of the seal fit between the sealing door 9A and the first opening 103 when the sealing door 9A of the wafer cassette is in an open state, thereby realizing complete isolation of the above movable parts of the drive mechanism 105 from the wafer cassette 9 and thus ensuring that contaminants produced by the described movable parts and lubricating oil thereon do not cause any contamination to the wafer 10 in the wafer cassette 9, facilitating improvement in the product yield and performance.

A door opener according to another embodiment of the present disclosure, as shown in FIG. 3, also includes a housing part 101 and a butting assembly 106, compared to the previous embodiment. However, this embodiment is different from the previous embodiment in that when the butting assembly 106 is butted with the sealing door 9A and separates it from the wafer cassette 9, the butting plate 12M of the butting assembly 106 is in a seal fit with the first opening 103 so that a sealed space is formed inside the housing part 101.

Specifically, in this embodiment, the height difference between the surface of the inner annulus 12K1 of the annulus 102 facing the sealing door 9A and the surface of the outer annulus 12K2 of the annulus 102 facing the seal gate 9A is larger than that of the previous embodiment so that the inner annulus 12K1 is farther from the wafer cassette 9 than the inner annulus 12K1 of the previous embodiment; meanwhile, the inner annulus 12K1 has a smaller inner diameter than the inner annulus 12K1 of the

previous embodiment, so as to be butted with the butting plate 12M. In this way, when the butting plate 12M and the sealing door 9A of this embodiment are moved to the same second position (the position of the butting plate 12M shown in FIG. 2) as the previous embodiment, the butting plate 12M can be in a seal fit with the first opening 103, i.e., the end face of the inner annulus 12K1 facing the butting plate 12M is configured to be butted with the butting plate 12M, while the sealing door 9A does not contact the inner annulus 12K1. Also, a first sealing member 12D is provided on this end face and/or the butted surface of the butting plate 12M.

In this embodiment, with the seal fit between the butting assembly 106 and the first opening 103, an increased pressing force may be applied to the first sealing member 12D, thereby achieving a better sealing effect.

In this embodiment, it is preferable that the door opener further includes a purging mechanism configured to introduce purging gas into the wafer cassette 9 and discharge gas from the wafer cassette 9 at the same time when the housing part 101 is in a position for closing the transfer interface and the wafer transfer port and the sealing door 9A is separated from the wafer cassette 9. The purging gas is an inert gas such as nitrogen.

By introducing the purging gas into the wafer cassette 9 with the purging mechanism, impurities such as particles in the wafer cassette 9 can be discharged from the wafer cassette 9 along with the purging gas, thereby improving the interior cleanliness of the wafer cassette 9; also, during the purging process, the housing part 101 is in the position for closing the transfer interface and the wafer transfer port and an interior of the wafer cassette 9 and an interior of the butted chamber are kept isolated, thereby preventing the gas from the wafer cassette 9 from leaking into the chamber. Meanwhile, since the sealing door 9A or the butting assembly 106 is in a seal fit with the first opening 103, the purging gas cannot enter the door opener 12, thereby ensuring good gas partial pressure and laminar flow and thus achieving a better purification purging effect. After the door opener 12 finishes the opening and the purification purging of the sealing door 9A, the door opener 12 sucking the sealing door 9A may be moved to the position for opening the transfer interface and the wafer

transfer port, so as to communicate the interior of the wafer cassette 9 and the interior of the chamber.

In this embodiment, the purging mechanism includes a purging nozzle 11, a gas inlet path and a gas outlet path. The purging nozzle 11 is provided on a side of the housing part 101 facing the wafer cassette 9 and configured to blow purging gas into the wafer cassette 9. Specifically, the purging nozzle 11 is provided on a side of the annulus 102 facing the wafer cassette 9, for example, on the outer annulus 12K2 of a plate-like member 102, and configured to blow the inert gas into the wafer cassette 9. The gas inlet path is respectively connected to the purging nozzle 11 and a gas source (not shown in the figure), and configured to convey the purging gas provided by the gas source to the purging nozzle 11. The gas outlet path is configured to discharge the gas in the wafer cassette 9 to an outside of the housing part 101.

Optionally, the housing part 101 is provided with a vent structure 12H for venting gas in the housing part 101 to an outside of the housing part 101. The vent structure 12H is, for example, a vent pipe. By means of the vent structure 12H, contaminants generated by various movable parts and lubricating devices inside the housing part 101 can be vented to ensure interior cleanliness of the housing part 101.

In yet another embodiment of the present disclosure, there is provided a transport chamber for transporting a wafer between a wafer cassette and a reaction chamber. Referring to FIGS. 2 and 4 together, the transport chamber includes a chamber body 14 and the door opener 12 according to the above embodiments. The chamber body 14 is provided with a transfer interface 107 for butting with a wafer transfer port of a wafer cassette 9. The door opener 12 can open or close the wafer transfer port of the wafer cassette 9 and the transfer interface 107 at the same time, and can open or close the wafer transfer port and the transfer interface 107 at the same time to communicate or isolate the interior of the chamber body 14 and the interior of the wafer cassette 9.

Specifically, a closed transport space 5 is formed inside the chamber body 14, and a transfer interface 107 for butting with the wafer transfer port of the wafer cassette 9 is provided on a sidewall of the chamber body 14. The door opener 12 is movably provided inside the sidewall of the chamber body 14 where the transfer

interface 107 is located. For example, the door opener 12 may be moved along the sidewall of the chamber body 14 where the transfer interface 107 is located under driving of the housing drive mechanism, so as to be moved to a position for opening or closing the transfer interface 107. It is easy to understand that, since the wafer transfer port of the wafer cassette 9 is butted with the transfer interface 107, after the sealing door 9A is removed from the wafer cassette 9 by the door opener 12, the wafer transfer port of the wafer cassette 9 is also opened or closed while the transfer interface 107 is opened or closed by the door opener 12, that is, the wafer transfer port of the wafer cassette 9 is communicated with or isolated from the transport space 5.

In this embodiment, a seal ring is provided on a surface of the wafer cassette 9 butted with an outside of the sidewall of the chamber body 14, and configured to seal a gap therebetween.

In this embodiment, a side of the housing part 101 facing the chamber body 14 is in seal butting with an inside of the sidewall of the chamber body 14 at a position on the periphery of the transfer interface 107. Specifically, the outer annulus 12K2 of the annulus 102 of the housing part 101 is sealed with the inner side of the sidewall of the chamber body 14 by a third sealing member 12C, so as to isolate an interior of the door opener 12 from the transport space 5, and prevent the interior of the door opener 12 from contaminating the transport space 5.

As shown in FIG. 5, a bracket 15 is provided outside of a sidewall of the chamber body 14 at the transfer interface 107, and configured to support the wafer cassette 9 when the wafer transfer port of the wafer cassette 9 is butted with the transfer interface 107.

Referring to FIGS. 2, 3 and 5 together, the transport chamber of this embodiment is further provided with a purging mechanism including a purging nozzle 11, a gas inlet path and a gas outlet path. The purging nozzle 11 is configured to blow purging gas into the wafer cassette 9.

The gas inlet path is a gas inlet channel provided in the chamber body 14, which has an inlet P1 opened outside of the sidewall of the chamber body 14 and configured to be connected to the gas source; and has an outlet provided inside of the sidewall of

the chamber body 14 and configured to be butted and in communication with an inlet of the purging nozzle 11 when the housing part 101 is in a position for closing the wafer transfer port.

The gas outlet path is a gas outlet channel opened inside a body of the wafer cassette 9, which has an inlet in communication with an interior of the wafer cassette 9, and has an outlet P2 opened outside of the body of the wafer cassette 9 as well as outside of the sidewall of the chamber body 14.

After the door opener 12 opens the sealing door 9A, an external gas source introduces purging gas such as nitrogen into the inlet P1 of the gas inlet channel, and then the purging gas is blown into the wafer cassette 9 through the gas inlet channel and the purging nozzle 11. The purging gas inside the wafer cassette 9 goes through the gas outlet channel and is discharged via an outlet P2 thereof. During the purging process, since the sealing door 9A or the butting assembly 106 is in a seal fit with the first opening 103, the purging gas cannot enter the door opener 12, thereby ensuring good gas partial pressure and laminar flow and thus achieving a better purification purging effect. After the door opener 12 finishes the opening and the purification purging of the sealing door 9A of the wafer cassette, the door opener 12 sucking the sealing door 9A is moved along the sidewall of the chamber body 14 so that the transfer interface 107 and the wafer transfer port are fully opened and communication between the wafer cassette 9 and the transport space 5 is achieved.

In another embodiment of the present disclosure, there is further provided a semiconductor processing device, which may be, for example, a vertical semiconductor processing device. As shown in FIG. 4, the device includes a wafer cassette 9, a reaction chamber, the transport chamber according to the above embodiments, a support assembly and a manipulator 8, the transport chamber being used for transporting a wafer 10 between the wafer cassette 9 and the reaction chamber.

In this embodiment, a top transfer interface in communication with the reaction chamber is opened on a top wall of the chamber body 14. The reaction chamber includes: a process tube 2, a heater 1 surrounding the process tube 2, and a support

assembly. A sealing door 3 is provided on a bottom end of the process tube 2 which, when closed, causes the process tube 2 to be isolated from the chamber body 14, and when opened, causes the process tube 2 to be communicated with the chamber body 14 via the top transfer interface.

The support assembly includes: a wafer carrier 4 for carrying the wafer 10, a heat preservation barrel 6 for supporting the wafer carrier 4, a process gate 7 and a lifting device. The lifting device may drive the wafer carrier 4, the heat preservation barrel 6 and the process gate 7 to move as a whole. After the sealing door 3 of the process tube is opened, the support assembly may enter the process tube 2 from the chamber body 14, or enter the chamber body 14 from the process tube 2.

Before the process starts, the door opener 12 keeps the transfer interface 107 closed and the wafer 10 is placed inside the wafer cassette 9. When the transport chamber of this embodiment is operated, the wafer cassette 9 is transferred onto the bracket 15 and is in sealed butt with the outside of the sidewall of the chamber body 14, while the wafer transfer port of the wafer cassette 9 is butted with the transfer interface 107. After the door opener 12 opens the sealing door 9A of the wafer cassette, the door opener 12 is moved away from the transfer interface 107 together with the sealing door 9A of the wafer cassette so that the transfer interface 107 and the wafer transfer port are completely opened at the same time. At this time, the interior of the wafer cassette 9 is in communication with the interior of the chamber body 14.

The manipulator 8 is provided in the transport chamber and configured to transfer the wafer 10 between the wafer cassette 9 and the wafer carrier 4 when the door opener 12 is in a position for opening the wafer transfer port and the wafer carrier 4 is in the transport chamber. Specifically, when the interior of the wafer cassette 9 is in communication with the interior of the chamber body 14, the manipulator 8 takes out the wafer 10 from the wafer cassette 9 and transfers it onto the wafer carrier 4. Then, the sealing door 3 of the process tube is opened, the lifting device drives the wafer carrier 4, the heat preservation barrel 6 and the process gate 7 to move upwards to enter the process tube 2. The sealing door 3 of the process tube is closed, and the wafer 10 is subjected to processes in the process tube 2. When the

process is finished, the sealing door 3 of the process tube is opened, the lifting device drives the wafer carrier 4, the heat preservation barrel 6 and the process gate 7 to move downwards to return to their initial positions in the chamber body 14, and the manipulator 8 takes the wafer 10 from the wafer carrier 4 and transfers the wafer 10 into the wafer cassette 9 through the transfer interface 107 and the wafer transfer port. Then, the door opener 12 is moved to the transfer interface 107 to close the transfer interface 107 and the sealing door 9A of the wafer cassette. The wafer cassette 9 is removed from the chamber body 14 and thus the whole process is completed.

In summary, in the technical solutions of the door opener, the transport chamber and the semiconductor processing device provided in the embodiments, it is ensured that contaminants produced by the described movable parts and lubricating oil thereon do not cause any contamination to the wafer 10 in the wafer cassette 9, thereby facilitating improvement in the product yield and performance.

The objects, technical solutions and advantages of the present disclosure are further described in detail through the above specific embodiments, but it is to be understood that the above are merely specific embodiments of the present disclosure and are not intended to limit the present disclosure. Any amendments, equivalent substitutions, improvements, etc. within the principle of the disclosure are all included in the scope of the protection defined by the appended claims of the disclosure.

It should also be noted that the directional terms mentioned in the embodiments, such as "upper", "lower", "front", "back", "left", "right", etc., are only directions referring to the drawings, and are not intended to limit the protection scope of the present disclosure. Throughout the drawings, like elements are represented by like or similar reference numerals. Conventional structures or constructions will be omitted when they may obscure the understanding of the present disclosure.

Unless otherwise indicated, the numerical parameters set forth in the specification and attached claims are approximations that can vary depending upon the desired properties sought to be obtained by the present disclosure. In particular, all numbers expressing quantities of ingredients, reaction conditions, and so forth used in the specification and claims are to be understood as being modified in all instances by

the term "about". In general, the meaning of the expression is meant to encompass variations of a specified number by $\pm 10\%$ in some embodiments, by $\pm 5\%$ in some embodiments, by $\pm 1\%$ in some embodiments, by $\pm 0.5\%$ in some embodiments.

Furthermore, the word "comprising" does not exclude the presence of elements or steps not listed in a claim. The word "a" or "an" preceding an element does not exclude the presence of a plurality of such elements.

The use of ordinal numbers such as "first," "second," "third," etc., in the specification and claims to modify a corresponding element is not by itself intended to imply any ordinal numbers for the element, nor the order in which an element is sequenced or in which it is sequenced or which order is associated with a manufacturing method, but are used merely to distinguish one element having a certain name from another element having a same name.

Similarly, it should be appreciated that in the foregoing description of exemplary embodiments of the disclosure, various features of the disclosure are sometimes grouped together in a single embodiment, figure, or description thereof for the purpose of streamlining the disclosure and aiding in the understanding of one or more of the various disclosed aspects. However, the disclosed method should not be construed to reflect the intent: rather, the present disclosure is directed to more features than are expressly recited in each claim. Rather, as the following claims reflect, disclosed aspects lie in less than all features of a single foregoing disclosed embodiment. Thus, the claims following the detailed description are hereby expressly incorporated into this detailed description, with each claim standing on its own as a separate embodiment of this disclosure.

What is claimed is:

1. A door opener for opening or closing a sealing door of a wafer cassette, characterized in that the door opener comprises:

a housing part configured to be movably butted with a chamber wall of a transport chamber and located at a peripheral position of a transfer interface at which the chamber wall is butted with a wafer transfer port of the wafer cassette so that the transfer interface and the wafer transfer port of the wafer cassette is openable or closeable, wherein a first opening is provided on a side of the housing part facing the wafer cassette; and

a butting assembly provided at the first opening and configured to be butted with the sealing door and separate the sealing door from the wafer cassette when the housing part is in a position for closing the transfer interface and the wafer transfer port, wherein the sealing door or the butting assembly is in a seal fit with the first opening to form a sealed space within the housing part.

2. The door opener according to claim 1, characterized in that the butting assembly comprises:

a butting plate; and

a drive mechanism provided in the housing part, and configured to drive the butting plate to move to a first position where the butting plate is capable of butting with the sealing door, and drive the butting plate to move to a second position where the sealing door or the butting plate is in a seal fit with the first opening after the butting plate is butted with the sealing door.

3. The door opener according to claim 2, characterized in that a suction structure is provided on the butting plate and configured to fix the sealing door by suction when the butting plate is in the first position.

4. The door opener according to claim 2, characterized in that a first sealing

member is provided at a position of the sealing door or the butting plate corresponding to a periphery of the first opening and/or at a position on the housing part at a periphery of the first opening, and configured to seal the first opening when the butting plate is in the second position.

5. The door opener according to claim 4, characterized in that the housing part comprises an annulus and a cover, wherein,

an end face of an opening of the cover is butted with a first end face of the annulus, and a second sealing member is provided therebetween; and

a hole of the annulus is used as the first opening, a second end face of the annulus, which is away from the first end face, is configured to be butted with a surface of the sealing door or a surface of the butting plate away from the wafer cassette, and the first sealing member is provided therebetween.

6. The door opener according to any one of claims 1 to 5, characterized in that the door opener further comprises:

a housing drive mechanism connected to the housing part and configured to drive the housing part and the butting assembly therein to move as a whole.

7. The door opener according to any one of claims 1 to 5, characterized in that a third sealing member is provided at a position of the housing part corresponding to a periphery of the transfer interface and/or at a position on the chamber wall of the transport chamber at the periphery of the transfer interface, and configured to seal the transfer interface and the wafer transfer port when the housing part is in a position for closing the transfer interface and the wafer transfer port.

8. The door opener according to any one of claims 1 to 5, characterized in that the door opener further comprises:

a purging mechanism configured to introduce purging gas into the wafer cassette and discharge gas from the wafer cassette at the same time when the housing part is in

a position for closing the wafer transfer port and the sealing door is separated from the wafer cassette.

9. The door opener according to claim 8, characterized in that the purging mechanism comprises:

a purging nozzle provided on a side of the housing part facing the wafer cassette and configured to blow the purging gas into the wafer cassette;

a gas inlet path respectively connected to the purging nozzle and a gas source and configured to convey the purging gas provided by the gas source to the purging nozzle; and

a gas outlet path configured to discharge the gas in the wafer cassette to an outside of the housing part.

10. The door opener according to claim 1, characterized in that the housing part is provided with a vent structure for venting gas in the housing part to an outside of the housing part.

11. A transport chamber, characterized in comprising:

a chamber body provided with a transfer interface for butting with a wafer transfer port of a wafer cassette;

the door opener according to any one of claims 1 to 10, by which the wafer transfer port and the transfer interface are opened or closed simultaneously so that an interior of the chamber body is in communication with or separated from an interior of the wafer cassette.

12. The transport chamber according to claim 11, characterized in comprising the door opener according to claim 9, wherein

the gas inlet path is a gas inlet channel provided in the chamber body, the gas inlet channel has an inlet opened outside of the chamber body and configured to be connected to the gas source, and has an outlet opened inside of the chamber body and

configured to be butted and in communication with an inlet of the purging nozzle when the housing part is in a position for closing the wafer transfer port; and

the gas outlet path is a gas outlet channel opened inside a body of the wafer cassette, the gas outlet channel has an inlet in communication with an interior of the wafer cassette, and has an outlet opened outside of the body of the wafer cassette.

13. The transport chamber according to claim 11, characterized in that a bracket is provided outside of a sidewall of the chamber body at the transfer interface, and configured to support the wafer cassette when the wafer transfer port of the wafer cassette is butted with the transfer interface.

14. A semiconductor processing device, characterized in comprising:

a reaction chamber;

the transport chamber according to any one of claims 11 to 13;

a wafer carrier configured to carry a wafer and being movable between the reaction chamber and the transport chamber; and

a manipulator provided in the transport chamber and configured to transfer the wafer between the wafer cassette and the wafer carrier when the housing part is in a position for opening the wafer transfer port and the wafer carrier is in the transport chamber.

15. The semiconductor processing device according to claim 14, characterized in that the semiconductor processing device is a vertical thermal process device.