PROCESS TREATING MEMBER, SUBSTRATE TREATING APPARATUS INCLUDING THE MEMBER, AND SUBSTRATE TREATING METHOD USING THE APPARATUS

BACKGROUND OF THE INVENTION

The present general inventive concept relates to substrate treating apparatuses and, more particularly, to a substrate treating apparatus including a process chamber.

A method for manufacturing a semiconductor device, a flat display panel, a solar cell or the like includes an ashing process for removing remove a photoresist. The ashing process is performed to remove a photoresist coated on a substrate.

An apparatus for performing an ashing process is disclosed in Korean Patent Registration No. 10-0750828. A process gas is supplied into a process chamber after being excited into a plasma state. An ashing process is performed while the inside of the process chamber is maintained at a higher temperature than the outside thereof and a substrate is heated to a temperature of about 250 degrees centigrade.

The inside of the process chamber is affected by an external environment during the ashing process. The inside of the process chamber decreases in temperature due to an external temperature. Especially, the edge region adjacent to the outside of the process chamber undergoes significant temperature decrease. Due to the temperature decrease, reactive byproducts remaining inside the process chamber are cured to form a reactive byproduct layer on an inner wall of the process chamber. The reactive byproduct layer acts as a particle in a subsequent substrate treating process.

SUMMARY OF THE INVENTION

An aspect of the inventive concept provides a substrate treating apparatus which may include an inner chamber in which a first space is formed; a first outer chamber surrounding the inner chamber and forming a second space separated from the first space; a susceptor disposed in the first space and adapted to support a substrate; a first exhaust line connected to the inner chamber and exhausting a gas in the first space to the outside; a process gas supply member adapted to supply a process gas for treating the substrate to the first space; and a monitor module disposed in the second space and adapted to monitor a state of the first space.

In an exemplary embodiment, the first outer chamber may be provided in plurality. The plurality of first outer chambers may be disposed to be spaced apart from each other along the circumference of the inner chamber. Each of the first outer chambers may form a second space. The monitor module may be provided to the respective second spaces.

In an exemplar embodiment, the first outer chamber may be provided along the circumference of the inner chamber. The second space may exhibit a shape of ring surrounding the first space.

In an exemplar embodiment, the first outer chamber may include an upper plate having one end connected to a sidewall of the inner chamber; a lower plate disposed below the upper plate and having one end of the sidewall of the inner chamber; and a sidewall facing the sidewall of the inner chamber and connecting the other end of the upper plate to the other end of the lower plate. The second space may be formed by combination of the upper plate, the lower plate, the sidewall of the inner chamber, and the sidewall of the first outer chamber.

In an exemplar embodiment, the substrate treating apparatus may further include a second exhaust line connected to the first outer chamber and exhausting a gas in the second space to the outside.

In an exemplar embodiment, the substrate treating apparatus may further include a process kit disposed in the second space and adapted to control a substrate treating process.

In an exemplar embodiment, the monitor module may include a first monitor sensor fixedly mounted on the sidewall of the inner chamber, having a portion exposed to the first space, and adapted to measure a state variation of the first space; and a second monitor sensor disposed in the second space and adapted to measure a pressure variation of the second space.

In an exemplar embodiment, the first monitor sensor may measure at least one of a temperature variation, a pressure variation, a magnitude variation of an electric field, and a density variation of a process gas in the first space.

In an exemplar embodiment, the process gas supply member may include a process gas supply line disposed in the second space, connected to the sidewall of the inner chamber, and supplying a process gas to the first space.

In an exemplar embodiment, the process gas supply member may further include a generator mounted on the process gas supply line and adapted to excite a process gas into a plasma sate.

In an exemplar embodiment, the substrate treating apparatus may further include a second outer chamber surrounding the first outer chamber outside the first outer chamber and forming a third space separated from the second space; and a third exhaust line connected to the second outer chamber and exhausting a gas in the second space to the outside.

In an exemplar embodiment, the substrate treating apparatus may further include an exhaust pump mounted on the first exhaust line; and a first control valve mounted on the first exhaust line between the inner chamber and the exhaust pump. The third exhaust line may be connected to the first exhaust line in a section between the control valve and the exhaust pump, and a second control valve may be mounted on the second exhaust line.

In an exemplar embodiment, the substrate treating apparatus may further include a first exhaust pump mounted on the first exhaust line; and a second exhaust pump mounted on the third exhaust line.

Another aspect of the inventive concept provides a process treating member which may include an inner chamber in which a first space is formed; a first outer chamber surrounding the inner chamber and forming a second space separated from the first space; a susceptor disposed in the first space and adapted to support a substrate; an exhaust line connected to the inner chamber and exhausting a gas in the first space to the outside; and a monitor module disposed in the second space and adapted to monitor a state of the first space.

In an exemplar embodiment, the process treating member may further include a second outer chamber surrounding the first outer chamber outside the first outer chamber and forming a third space separated from the second space; and an exhaust line connected to the second outer chamber and exhausting a gas in the second space to the outside.

In an exemplar embodiment, the monitor module may include a first monitor sensor fixedly mounted on the sidewall of the inner chamber, having a portion exposed to the first space, and adapted to measure a state variation of the first space; and a

second monitor sensor disposed in the second space and adapted to measure a pressure variation of the second space.

In an exemplar embodiment, the process treating member may further include a process kit disposed in the second space and adapted to control a substrate treating process.

In an exemplar embodiment, the second space may exhibit a shape of ring surrounding the first space. The monitor module may be provided in plurality, and the plurality of monitor modules may be disposed to be spaced apart from each other along the second space.

In an exemplar embodiment, the first outer chamber may be disposed to be spaced apart from each other along the circumference of the inner chamber and forms the second space. The monitor module may be provided to the respective second spaces.

In an exemplar embodiment, the process treating member may further include an exhaust line connected to the first outer chamber and exhausting a gas in the second space to the outside.

Further another aspect of the inventive concept provides a substrate treating method which may include providing a process gas is supplied to a first space in an inner chamber to treat a substrate; and monitoring a state of the first space by a monitor module surrounding the inner chamber and disposed inside a first outer chamber forming a second space separated from the first space.

In an exemplar embodiment, a gas in the first space may be exhausted to the outside through an exhaust line connected to the inner chamber. The second space may be maintained at a higher pressure than the first space.

In an exemplar embodiment, the first space and the second space may be maintained at a pressure lower than an atmospheric pressure.

In an exemplar embodiment, the monitor module may measure at least one of a temperature variation, a pressure variation, a magnitude variation of an electric field, and a density variation of a process gas in the first space.

In an exemplar embodiment, a second outer chamber may be provided outside the first outer chamber to surround the first outer chamber and form a third space separated from the second space. The third space may be maintained in a vacuum state while a substrate treatment is performed.

BRIEF DESCRIPTION OF THE DRAWINGS

The inventive concept will become more apparent in view of the attached drawings and accompanying detailed description. The embodiments depicted therein are provided by way of example, not by way of limitation, wherein like reference numerals refer to the same or similar elements. The drawings are not necessarily to scale, emphasis instead being placed upon illustrating aspects of the inventive concept.

FIG. 1 illustrates a substrate treating apparatus according to an embodiment of the inventive concept.

FIG. 2 is a cross-sectional view of a process treating member, which taken along the line A-A' in FIG. 1.

FIG. 3 is a cross-sectional view of a process treating member, which is taken along the line A-A' in FIG. 1 according to another embodiment of the inventive concept.

FIG. 4 illustrates an example of a monitor module shown in FIG. 1.

FIG. 5 illustrates a second plasma supply unit.

FIG. 6 is a cross-sectional view taken along the line A-A' in FIG. 1 according to another embodiment of the inventive concept.

FIG. 7 is a cross-sectional view of a substrate treating apparatus according to another embodiment of the inventive concept.

FIG. 8 is a cross-sectional view of a process treating member, which is taken along a line A-A' in FIG. 7.

FIG. 9 illustrates an example of a monitor module shown in FIG. 7.

FIG. 10 is a cross-sectional view of a substrate treating apparatus according to another embodiment of the inventive concept.

FIG. 11 illustrates a substrate treating apparatus according to another embodiment of the inventive concept.

DETAILED DESCRIPTION

The inventive concept will now be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the inventive concept are shown. However, the inventive concept may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the inventive concept to those skilled in the art. In the drawings, the thicknesses of layers and regions are exaggerated for clarity. It will also be understood that when a layer is referred to as being "on" another layer or substrate, it can be directly on the other layer or substrate, or intervening layers may also be present. Like numbers refer to like elements throughout.

FIG. 1 is illustrates a substrate treating apparatus 1000 according to an embodiment of the inventive concept.

Referring to FIG. 1, the substrate treating apparatus 1000 treats a substrate W using a process gas. The substrate treating apparatus 1000 may a substrate W using a process gas of plasma state. For example, the substrate treating apparatus 1000 may perform an etching process, an ashing process, a deposition process or the like. Hereinafter, it will be described that the substrate treating apparatus 1000 performs an ashing process using a process gas of plasma state. The substrate treating apparatus 1000 includes a process treating member 100 and a process gas supply member 200.

The process treating member 100 performs an ashing process on a substrate W using a process gas. The process treating member 100 includes a process chamber 110, a susceptor 120, a baffle 130, an exhaust unit 140, and a monitor module 150.

FIG. 2 is a cross-sectional view of the process treating member 100, which taken along the line A-A' in FIG. 1.

Referring to FIGS. 1 and 2, the process chamber 110 provides a space in which a process of treating a substrate W is performed. The process chamber 110 includes an inner chamber 111 and an outer chamber 112.

A space having an open top surface is formed inside the inner chamber 111. A process gas is supplied through the open top surface of the inner chamber 111. The internal space of the inner chamber 111 is provided as a first space S1 in which the substrate W is treated. An exhaust hole 111a is formed at a bottom surface of the inner chamber 111. The exhaust hole 111a provides a passageway along which reactive byproducts remaining in the first space S1 are exhausted to the outside.

The outer chamber 112 is provided outside the inner chamber 111. The external chamber 112 is provided in plurality. The plurality of external chambers 112

are disposed to be spaced apart from each other along the circumference of the inner chamber 111. Each of the outer chambers 112 forms a second space S2 in a space between the outer chamber 112 and the inner chamber 111. The second space S2 is separated from the first space S1 by a sidewall of the inner chamber 111 and provided along the circumference of the first space S1. The outer chamber 112 includes an upper plate 112a, a lower plate 112b, and a sidewall 112c. The upper plate 112a has one end that is fixedly coupled to the sidewall of the inner chamber 111. The lower plate 112b is disposed below the upper plate 112a and has one end that is fixedly coupled to the sidewall of the inner chamber 111. The sidewall 112c faces the sidewall of the inner chamber 111 and connects the other end of the upper plate 112a to the other end of the lower plate 112b. The upper plate 112a, the lower plate 112b, and the sidewall 112c of the outer chamber 11 are combined with the sidewall of the inner chamber 1111 to form the second space S2.

The susceptor 120 is disposed in the first space S1 to support the substrate W. The susceptor 120 is provided in form of disk and has a top surface on which the substrate W is placed. An electrode (not shown) may be provided inside the susceptor 120. The electrode is connected to an external power supply and generates static electricity by an applied power. The static electricity fixes the substrate W on a top surface of the susceptor 120. Heating coils 121a and 121b and a cooling coil (not shown) may be provided inside the susceptor 120. The heating coils 121a and 121b heat the substrate W at a predetermined temperature. In case of an ashing process, the substrate W may be heated at a temperature of about 200 degrees centigrade. The heating coils 121a and 121b include a first heating coil 121a provided in a center region of the susceptor 120 and a second heating coil 121b provided in an edge region of the susceptor 120. The first heating coil 121a and the second heating coil 121b heat the

substrate W while dividing the region of the substrate W. The first heating coil 121a and the second heating coil 121b may generate heat of different temperatures. The first heating coil 121a and the second heating coil 121b heat the substrate W in consideration of a temperature influence caused by an external environment. The susceptor 120 may be formed of aluminum or a ceramic material to effectively transfer a temperature to the substrate W. The cooling coil (not shown) forcibly cools a heated substrate W. The completely treated substrate W is cooled in a room-temperature state or at a temperature required to perform the next process. The susceptor 120 may be supported by a support shaft 122. The support shaft 122 is cylindrically provided to support the susceptor 120 beneath the susceptor 120.

The baffle 130 is disposed over the susceptor 120. The baffle 130 is disposed to face a top surface of the susceptor 120. Holes 131 are formed at the baffle 130. The holes 131 are provided as through-holes connecting the top surface to a bottom surface of the baffle 130 and uniformly formed at respective regions of the baffle 130. The holes 131 provide a passageway through which a process gas passes. The baffle 130 may be grounded. The baffle 130 passes migration of free radicals among constituents of the process gas of plasma state but blocks migration of ions. The free radical has an incomplete bonding and exhibits an electrically neutral state. The free radical has very high reactivity and mainly performs a process through a chemical reaction to a material on the substrate W. On the other hand, since the ions exhibit charges, they are accelerated in a constant direction according to a potential difference. The accelerated ions collide against the material on the substrate W to perform a substrate process. For this reason, the ions may collide against not only a photoresist layer but also substrate patterns. The collision of the ions may result in damage of the patterns and variation in charge amount of the patterns. The variation in charge

amount of the patterns has an influence on a subsequent process. Due to the grounded baffle 130, the migration of the ions is blocked to prevent the disadvantages resulting from the collision of the ions.

The exhaust unit 140 allows the first space S1 and the second space S2 to be maintained in a vacuum state. The exhaust unit 140 includes a first exhaust line 141, a second exhaust line 142, and an exhaust pump 143.

The first exhaust line 141 is connected to an exhaust hole 111a of the inner chamber 111. The first exhaust line 141 provides a passageway along which a gas in the first space S1 is exhausted to the outside. The exhaust pump 143 is mounted on the first exhaust line 141. The exhaust pump 143 establishes a vacuum pressure. The vacuum pressure is transferred to the first space S1 through the first exhaust line 141. While the substrate treatment is performed, the first space S1 is decompressed to a vacuum state. In the region of the first exhaust line 141, a first control valve 144 is mounted in a section between the inner chamber 111 and the exhaust pump 143. The first control valve 144 may open and close the first exhaust line 141 and adjust an open ratio of an inner passageway of the first exhaust line 141. The magnitude of pressure of the first space S1 may be adjusted depending on the open ratio of the inner passageway of the first exhaust line 141.

One end of the second exhaust line 142 may be connected to the outer chamber 112, and the other end thereof may be connected to the first exhaust line 141. The second exhaust line 142 may be connected to the first exhaust line in the section between the first control valve 144 and the exhaust pump 143. A second control valve 142 is mounted on the second exhaust line 142. The second control valve 145 may open and close the second exhaust line 142 and adjust an open ratio of an inner passageway of the second exhaust line 142. The magnitude of pressure of the second

space S2 may be adjusted depending on the open ratio of the inner passageway of the second exhaust line 142.

In this embodiment, it has been described that the pressures of the first and second spaces S1 and S2 are adjusted by the single exhaust pump 143. However, as shown in FIG. 3, the pressures of the first and second spaces S1 and S2 may be adjusted by separate exhaust pumps 143 and 146, respectively.

FIG. 4 illustrates an example of the monitor module 150 shown in FIG. 1.

Referring to FIGS. 1 and 4, the monitor module 150 includes a first monitor sensor 151, a second monitor sensor 152, and a controller 153.

The first monitor sensor 151 measures a state variation of the first space S1 during a substrate treating process. The first monitor sensor 151 is inserted and fixed into the sidewall of the inner chamber 111. A portion of the first monitor sensor 151 is exposed to the first space S1. The first monitor sensor 151 includes a plurality sensing units (not shown) which may measure different elements, respectively. Each of the sensing units may measure one of a temperature variation, a pressure variation, an intensity variation of an electric field, and a density variation of plasma in the first space S1. The data measured in the first monitor sensor 151 is transmitted to the controller 153.

The second monitor sensor 152 is disposed in the second space S2. The second monitor sensor 152 monitors a pressure variation of the second space S2. Various devices may be disposed in the second space S2. For example, not only the foregoing monitor module 150 but also other devices such as a process kit 160 controlling the substrate treating process may be disposed in the second space S2. These devices 160 may be directly connected to the first space S1 of the inner chamber 111. In this case, leak or a difference in environment between the first and second

spaces S1 and S2 occurs at a contact point where these devices 160 are connected to the inner chamber 111. For example, when the first space S1 is maintained in the vacuum state and the second space S2 is maintained in a higher pressure state than the first space S1, a gas remaining in the second space S2 flows into the first space S1 due to the leak occurring at the contact point. The influence caused by the leak changes the environment of the first space S1 and affects uniform treatment of the substrate W. The second monitor sensor 152 measures the pressure variation of the second space S2 to monitor whether leak occurs at the contact point. The data measured in the second monitor sensor 152 is transmitted to the controller 153.

The controller 153 collects data received at the first monitor sensor 151 and the second monitor sensor 152 and provides the collected data to a worker. Based on the provided data, the worker may confirm a state of the first space S1.

The process gas supply member 200 supplies a process gas to the first space S1. The process gas supply member 200 includes a first plasma supply unit 210 and a second plasma supply unit (230 in FIG. 5).

The first plasma supply unit 210 is disposed over the process chamber 110. The first plasma supply unit 210 establishes an electric field to excite the process gas into a plasma state and supplies the process gas of plasma state to the first space S1. The first plasma supply unit 210 includes a plasma chamber 211, a process gas supply line 212, a power applying unit 213, and an inflow duct 216.

The plasma chamber 211 is disposed over the process chamber 110. A discharge space IS having an open top surface and an open bottom surface is disposed inside the plasma chamber 211. The upper end of the plasma chamber 211 is hermetically sealed by a gas supply port 217. The gas supply port 217 is connected to the process gas supply line 212. The process gas supplied from the process gas supply

line 212 flows into the discharge space IS. The process gas may be a mixed gas including at least one of helium (He), nitrogen (H_2), and neon (Ne).

The power applying unit 213 applies radio-frequency power to the discharge space IS. The power applying unit 213 includes an antenna 214 and a power supply 215.

The antenna 214 is an inductively coupled plasma (ICP) antenna and is provided in the form of coil. The antenna 214 is wound, two or more times, on the plasma chamber 211 outside the plasma chamber 211. The antenna 214 is wound on the plasma chamber 211 in a region corresponding to the discharge space IS. One end of the discharge space IS is connected to the power supply 215, and the other end thereof is grounded.

The power supply 215 supplies radio-frequency current to the antenna 214. The radio-frequency current supplied to the antenna 214 is applied to the discharge space IS. An electric field is established in the discharge space IS by the radio-frequency current, and the process gas obtains energy required for ionization from the electric field to be excited into a plasma state. In the discharge space IS, plasma may be vertically established with a distribution in the form of a vertically symmetrical bell.

The inflow duct 216 is disposed between the plasma chamber 211 and the process chamber 110. The inflow duct 2160 hermetically seals the open top surface of the process chamber 110 and has the lower end to which the baffle 130 is coupled. An inflow space FS is formed inside the inflow duct 216. The inflow space FS connects the discharge space IS to the first space S1 and provides a passageway along which the plasma generated in the discharge space IS is supplied to the first space S1.

FIG. 5 illustrates a second plasma supply unit 230.

Referring to FIG. 5, the second plasma supply unit 230 includes a process gas supply line 231 and a generator 232. The process gas supply line 231 has some regions disposed in the second region S2 and is inserted into the sidewall of the inner chamber 111 to make the end of the process gas supply line 231 disposed in the first space S1. The process gas supply line 231 may be provided in the respective second spaces S2. The process gas supply line 231 supplies a process gas to the edge region of the first space S1. The generator 232 is mounted on the process gas supply line 231. The generator 232 establishes an electric filed in an inner passageway of the process gas supply line 231. The process gas obtains energy required for ionization from the electric field to be excited into a plasma state. The process gas of plasma state may be supplied to the edge region of the first space S1 according to driving of the generator 232. As semiconductor integration increases and feature size decreases, there is a requirement for high process uniformity with respect to a center region and an edge region of a substrate W. The second plasma supply unit 230 additionally supplies the process gas to the edge region of the first region S1 to enhance throughput for the edge region of the substrate W.

Hereinafter, the procedure of treating a substrate using the foregoing substrate treating apparatus will now be described below.

When a substrate W is placed on the susceptor 120, the heating coils 121a and 121b provided inside the susceptor 120 generate heat to heat the substrate W at a predetermined temperature. The exhaust unit 140 applies a vacuum voltage to the first space S1 and the second space S2, allowing the first space S1 and the second space S2 to be maintained in a vacuum state. The process gas is supplied to the discharge space IS through the process gas supply line 212 and excited into the plasma state by the electric field established at the antenna 214. The process gas is supplied to the firs

space S1 through the inflow space FS and the holes 131 of the baffle 130. At the same time, the process gas of plasma state is supplied to the edge region of the first space S1 through the process gas supply line 231 of the second plasma supply unit 230. The process gas removes a photoresist layer coated on the substrate W. Byproducts formed during the substrate treatment are exhausted to the outside through the first exhaust line 141.

The first space S1 is maintained at a high temperature above an external temperature and in a vacuum state during the process. An electric field is established by the process gas of plasma state.

The internal environment of the process chamber is affected by the external environment. For example, an external temperature maintained less than the inside of the process chamber 110 drops an internal temperature of the process chamber 110. Especially, a temperature of the edge region adjacent to the outside drops significantly. The temperature drop cures byproducts remaining inside the process chamber 110 and forms a byproduct layer on an inner side surface of the process chamber 110. The byproducts are provided as particles in a subsequent process of treating the substrate W. For this reason, there is a requirement for an apparatus which is capable of minimizing an influence on the external environment and monitoring the internal environment of the process chamber 110 in real time.

The process chamber 110 according to the inventive concept forms a second space S2 maintained vacuum between the outside of the process chamber 110 and a first space S1 in which a process treatment is performed. A vacuum space has a low heat transfer rate and thus reduces a temperature influence caused by the external environment. Since the influence caused by the external temperature is reduced by the

second space S2, the temperature of the center region and the edge region in the first space S1 may be uniformly maintained.

In the second space S2, the monitor module 150 is provided to monitor a state variation of the first space S1 in real time. The first monitor sensor 151 monitors a temperature variation, a pressure variation, a magnitude variation of an electric field, and a density variation of plasma in the first space S1 in real time. A result measured at the first monitor sensor 151 serves as data to determine substrate treating uniformity. The second monitor sensor 152 monitors occurrence of leak caused by devices that are directly connected to the inside of the inner chamber 111. Since a result measured at the second monitor sensor 152 is provided to a worker, the worker may monitor an influence of the second space S2 on the first space S1 in real time.

Since conditions of respective regions of the first space S1 are uniformly maintained by means of the foregoing substrate treating apparatus 1000, substrate treating uniformity may be enhanced.

FIG. 6 is a cross-sectional view taken along the line A-A' in FIG. 1 according to another embodiment of the inventive concept.

Referring to FIGS. 1 and 6, an outer chamber 112' is cylindrically provided to surround an inner chamber 111. The outer chamber 112' forms a second space S2 along the circumference of the inner chamber 111. The second space S2 exhibits a shape of ring surrounding the first space S1. A plurality of monitor modules 150 are provided in the second space S2. The monitor modules 150 are arranged to be spaced apart from each other along the circumference of the second space S2.

FIG. 7 is a cross-sectional view of a substrate treating apparatus according to another embodiment of the inventive concept. FIG. 8 is a cross-sectional view of a

process treating member, which is taken along a line A-A' in FIG. 7, and FIG. 9 illustrates an example of a monitor module shown in FIG. 7.

Referring to FIGS. 7 to 9, a process chamber 110 includes an inner chamber 111, a first outer chamber 112, and a second outer chamber 113.

The inner chamber 111 forms a first space S1. The first outer chamber 112 is disposed outside the inner chamber 111. The first outer chamber 112 forms a second space S2 in a space with the inner chamber 111. The second space S2 is separated from the first space S1. The first outer chamber 112 is provided in plurality. The first chambers 112 are spaced apart from each other along the circumference of the inner chamber 111. The second outer chamber 113 exhibits a cylindrical shape and is disposed to surround the inner chamber 111 and the first outer chambers 112. The second outer chamber 113 forms a third space S3 in a space with the first outer chamber 112. The third space S3 exhibits a ring shape.

A first exhaust line 141 of an exhaust unit 140 is connected to the inner chamber 111 and a second exhaust line 142 thereof is connected to the first outer chamber 112. A third exhaust line 143 of the exhaust unit 140 is connected to the second outer chamber 113. The first exhaust line 141 may exhaust a gas in the first space S1 to the outside and allow the first space S1 to be maintained in a vacuum state. The second exhaust line 142 may exhaust a gas in the second space S2 to the outside and allow the second space S2 to be maintained in a vacuum state. The third exhaust line 143 may exhaust a gas in the third space S3 and allow the third space S3 to be maintained in a vacuum state. The second and third exhaust lines 142 and 143 may be connected to the first exhaust line 141 between a first control valve 145 and an exhaust pump 144. Control valves 146 and 147 may be mounted on the second and third exhaust lines 142 and 143, respectively. The magnitude of a vacuum voltage applied

to the second and third spaces S2 and S3 may be adjusted depending on open ratios of the control valves 146 and 147.

Alternatively, a vacuum pump may be mounted on each of the first to third exhaust lines 141 to 143, and a vacuum voltage may be individually applied to the first to third spaces S1 to S3.

The first space S1 and the third space S3 are maintained in a vacuum state during a substrate treating process. As the third space S3 is maintained in the vacuum state, the first space S1 may be minimally affected by an external environment. The second space S2 may be maintained in a higher pressure state than the first space S1 and the third space S3. The second monitor sensor 152 may measure a pressure variation of the second space S2 to monitor whether leak caused by devices 151 and 160 directly connected to the inside of the inner chamber 111 occurs. Alternatively, the second space S2 may be maintained at the same pressure as the first and third spaces S1 and S3. Since the pressure of the second space S2 is equal to that of the first space S1, an influence caused by occurrence of leak at a contact point may be minimized.

A process gas supply member 200 has the same configuration as described in the embodiment of FIG. 1 and will not be described in further detail.

FIG. 10 is a cross-sectional view of a substrate treating apparatus according to another embodiment of the inventive concept.

Referring to FIG. 10, it has been described in the foregoing embodiments that the substrate treating apparatuses 1000 and 1000' are inductively coupled plasma (ICP) type substrate treating apparatuses. However, a substrate treating apparatus 1000" may be a capacitively coupled plasma (CCP) type substrate treating apparatus. A shower head 170 is disposed in a first space S1 of an inner chamber 111. The shower

head 170 is disposed over a susceptor 120. Injection holes 171 are formed on a bottom surface of the shower head 170. An upper electrode 180 is disposed inside the shower head 170. The upper electrode 180 is disposed to face a top surface of the susceptor 210. The susceptor 210 is provided as a lower electrode. A process gas supplied into the shower head 170 through a process gas supply line 212 may be uniformly supplied to the first space S1 through the injection holes 171. When power is applied to the upper electrode 180 from an external power supply 190, an electric field is established between the upper electrode 180 and the susceptor 210 and the process gas is excited into a plasma state.

An outer chamber 112 is provided outside the inner chamber 111. The outer chamber 112 forms a second space S2 in a space with the inner chamber 111. The second space S2 is a space separated from the first space S1 by a sidewall of the inner chamber 111. A process kit 160 and a monitor module 150 are provided in the second space S2.

Gases in the first space S1 and the second space S2 are exhausted to the outside through exhaust lines 141 and 142, and the first space S1 and the second space S2 are maintained at a pressure lower than an atmospheric pressure. The first space S1 and the second space S2 may be maintained in a vacuum state.

FIG. 11 illustrates a substrate treating apparatus according to another embodiment of the inventive concept.

Referring to FIG. 10, unlike the substrate treating apparatus 1000" in FIG. 9, a process chamber 110 further includes a second outer chamber 113. The second outer chamber 113 forms a third space S3 in a space with the first outer chamber 112. The third space S2 exhibits a ring shape.

The inner chamber 111, the first outer chamber 112, and the second outer chamber 113 are connected to exhaust lines 141, 142, and 143, respectively. Gases in the first to third spaces S1, S2, and S3 are exhausted to the outside through the exhaust lines 141, 142, and 143. The first to third spaces S1, S2, and S3 may be maintained in a vacuum state through the exhaust lines 141, 142, and 143, respectively. The second space S2 and the third space S3 may be maintained in a vacuum state during a process. For this reason, the first space S2 may be minimally affected by an external environment. Alternatively, the second space S2 may be maintained at a higher pressure than the first space S1 and the third space S3. A second monitor sensor 152 measures a pressure variation of the second space S2 to monitor whether leak occurs at a contact point between a process kit 160 or the like and the inner chamber 111.

According to embodiments of the inventive concept, since the condition of a space in which a substrate treatment is performed is uniformly maintained, a substrate is uniformly treated. In addition, an influence of external temperature on the space in a substrate treatment is performed is minimized. In addition, the condition of the space in which a substrate treatment is performed is monitored in real time.

While the inventive concept has been particularly shown and described with reference to exemplary embodiments thereof, it will be apparent to those of ordinary skill in the art that various changes in form and detail may be made therein without departing from the spirit and scope of the inventive concept as defined by the following claims.

What is claimed is:

1. A substrate treating apparatus comprising:

an inner chamber in which a first space is formed;

a first outer chamber surrounding the inner chamber and forming a second space separated from the first space;

a susceptor disposed in the first space and adapted to support a substrate;

a first exhaust line connected to the inner chamber and exhausting a gas in the first space to the outside;

a process gas supply member adapted to supply a process gas for treating the substrate to the first space; and

a monitor module disposed in the second space and adapted to monitor a state of the first space.

2. The substrate treating apparatus of claim 1, wherein the first outer chamber is provided in plurality, the plurality of first outer chambers are disposed to be spaced apart from each other along the circumference of the inner chamber, and each of the first outer chambers forms the second space; and

wherein the monitor module is provided to the respective second spaces.

3. The substrate treating apparatus of claim 1, wherein the first outer chamber is provided along the circumference of the inner chamber; and

wherein the second space exhibits a shape of ring surrounding the first space.

4. The substrate treating apparatus of claim 1, wherein the first outer chamber comprises:

an upper plate having one end connected to a sidewall of the inner chamber;

a lower plate disposed below the upper plate and having one end connected to the sidewall of the inner chamber; and

a sidewall facing the sidewall of the inner chamber and connecting the other end of the upper plate to the other end of the lower plate,

wherein the second space is formed by combination of the upper plate, the lower plate, the sidewall of the inner chamber, and the sidewall of the first outer chamber.

5. The substrate treating apparatus of claim 1, further comprising:

a second exhaust line connected to the first outer chamber and exhausting a gas in the second space to the outside.

6. The substrate treating apparatus of claim 1, further comprising:

a process kit disposed in the second space and adapted to control a substrate treating process.

7. The substrate treating apparatus of claim 1, wherein the monitor module comprises:

a first monitor sensor fixedly mounted on the sidewall of the inner chamber, having a portion exposed to the first space, and adapted to measure a state variation of the first space; and

a second monitor sensor disposed in the second space and adapted to measure a pressure variation of the second space.

8. The substrate treating apparatus of claim 7, wherein the first monitor sensor measures at least one of a temperature variation, a pressure variation, a magnitude variation of an electric field, and a density variation of a process gas in the first space.

9. The substrate treating apparatus of claim 7, wherein the process gas supply member comprises:

a process gas supply line disposed in the second space, connected to the sidewall of the inner chamber, and supplying a process gas to the first space.

10. The substrate treating apparatus of claim 9, wherein the process gas supply member further comprises:

a generator mounted on the process gas supply line and adapted to excite a process gas into a plasma sate.

11. The substrate treating apparatus of claim 1, further comprising:

a second outer chamber surrounding the first outer chamber outside the first outer chamber and forming a third space separated from the second space; and

a third exhaust line connected to the second outer chamber and exhausting a gas in the third space to the outside.

12. The substrate treating apparatus of claim 11, further comprising:

an exhaust pump mounted on the first exhaust line; and

a first control valve mounted on the first exhaust line between the inner chamber and the exhaust pump,

wherein the third exhaust line is connected to the first exhaust line in a section between the first control valve and the exhaust pump, and a control valve is mounted on the third exhaust line.

13. The substrate treating apparatus of claim 5, further comprising:

a first exhaust pump mounted on the first exhaust line; and

a second exhaust pump mounted on the second exhaust line.

14. A process treating member comprising:

an inner chamber in which a first space is formed;

a first outer chamber surrounding the inner chamber and forming a second space separated from the first space;

a susceptor disposed in the first space and adapted to support a substrate;

a first exhaust line connected to the inner chamber and exhausting a gas in the first space to the outside; and

a monitor module disposed in the second space and adapted to monitor a state of the first space.

15. The process treating member of claim 14, further comprising:

a second outer chamber surrounding the first outer chamber outside the first outer chamber and forming a third space separated from the second space; and

a third exhaust line connected to the second outer chamber and exhausting a gas in the third space to the outside.

16. The process treating member of claim 14, wherein the monitor module comprises:

a first monitor sensor fixedly mounted on the sidewall of the inner chamber, having a portion exposed to the first space, and adapted to measure a state variation of the first space; and

a second monitor sensor disposed in the second space and adapted to measure a pressure variation of the second space.

17. The process treating member of claim 16, further comprising:

a process kit disposed in the second space and adapted to control a substrate treating process.

18. The process treating member of claim 16, wherein the second space exhibits a shape of ring surrounding the first space; and

wherein the monitor module is provided in plurality, and the plurality of monitor modules are disposed to be spaced apart from each other along the second space.

19. The process treating member of claim 16, wherein the first outer chamber is disposed to be spaced apart from each other along the circumference of the inner chamber and forms the second space; and

wherein the monitor module is provided to the respective second spaces.

20. The process treating member of claim 16, further comprising:

a second exhaust line connected to the first outer chamber and exhausting a gas in the second space to the outside.

21. A substrate treating method comprising:

providing a process gas supplied to a first space in an inner chamber to treat a substrate; and

monitoring a state of the first space by a monitor module surrounding the inner chamber and disposed inside a first outer chamber forming a second space separated from the first space.

22. The substrate treating method of claim 21, wherein a gas in the first space is exhausted to the outside through an exhaust line connected to the inner chamber; and

wherein the second space is maintained at a higher pressure than the first space.

23. The substrate treating method of claim 21, wherein the first space and the second space are maintained at a pressure lower than an atmospheric pressure.

24. The substrate treating method of claim 21, wherein the monitor module measures at least one of a temperature variation, a pressure variation, a magnitude variation of an electric field, and a density variation of a process gas in the first space.

25. The substrate treating method of claim 24, wherein a second outer chamber is provided outside the first outer chamber to surround the first outer chamber and forms a third space separated from the second space; and

wherein the third space is maintained in a vacuum state while a substrate treatment is performed.