SUBSTRATE TREATING APPARATUS AND METHOD

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This U.S. non-provisional patent application claims priority under 35 U.S.C. § 119 of Korean Patent Application No. 10-2009-0027371, filed on March 31, 2009, the entire contents of which are hereby incorporated by reference.

BACKGROUND OF THE INVENTION

[0002] The present invention disclosed herein relates to a substrate treating apparatus and method, and more particularly, to a substrate treating apparatus and method, which vacuum-absorb a substrate.

[0003] A lithography process using a photoresist is essential in a process of fabricating a semiconductor device. The photoresist includes an organic photosensitive polymer or a mixture of a photosensitive material and a polymer. Exposure and etch processes are performed to form photoresist patterns on a substrate, and then, patterns corresponding to the photoresist patterns are transferred onto the substrate while the substrate or layers formed on the substrate are etched. Such a photosensitive polymer is referred to as a photoresist, and a process in which fine patterns are formed on a substrate using light is referred to as a lithography process.

[0004] In a semiconductor manufacturing process, a photoresist used as a mask in a process of forming fine circuit patterns such as a line or space pattern or an ion implantation process is mainly removed from a substrate by using an ashing process.

[0005] An electrostatic chuck in which a substrate is fixed using a simple clamp or an electrostatic force is used in a conventional ashing process.

[0006] However, as linewidth of a substrate becomes narrow, and a process becomes delicate, it is difficult to improve uniformity of the substrate using a conventional substrate chucking apparatus. As a result, productivity may be reduced due to poor quality. Alternatively, the substrate may be chucked using a vacuum chuck. However, it is difficult to maintain a vacuum state during processing.

SUMMARY OF THE INVENTION

[0007] The present invention provides a substrate treating apparatus and method that chuck a substrate using a pressure difference.

[0008] The present invention also provides a substrate treating apparatus and method that may increase absorption between a substrate and a vacuum chuck.

[0009] The present invention also provides a substrate treating apparatus and method that may control absorption between a substrate and a vacuum chuck according to regions of the substrate.

[0010] The present invention also provides a substrate treating apparatus and method that may easily control a pressure difference.

[0011] The present invention also provides a substrate treating apparatus and method that may improve production yield and quality of a substrate.

[0012] Embodiments of the present invention provide substrate treating apparatuses including: a housing including an inner space; a vacuum chuck in which a vacuum hole is defined in a top surface thereof, the vacuum chuck being disposed in the inner space to vacuum-absorb a substrate; a pipe through which a gas within the inner space is exhausted to the outside, the pipe being coupled to the housing; a

vacuum pump disposed at a first position of the pipe to control a pressure within the inner space; a pipe valve disposed at a second position of the pipe between the first position and the housing to open and close the pipe or to control a flow amount of a gas flowing into the pipe; and a vacuum line including a first line having one end connected to the vacuum hole and the other end connected to the pipe between the first position and the second position and a first valve opening and closing the first line.

[0013] In some embodiments, the vacuum line may further include: a second line having one end connected to the first line between the vacuum hole and the first valve and the other end connected to the pipe between the housing and the second position; and a second valve disposed in the second line to open and close the second line.

[0014] In other embodiments, the vacuum line may further include: a third line having one end connected to the first line between the vacuum hole and the first valve and the other end connected to a gas supply part supplying a gas to supply the gas into the first line; and a third valve disposed in the third line to open and close the third line.

[0015] In other embodiments of the present invention, substrate treating apparatuses include: a housing including an inner space; first and second vacuum chucks in which vacuum holes vacuum-absorbing a substrate are defined in top surfaces thereof, respectively, the first and second vacuum chucks being spaced apart from each other in the inner space; a pipe through which a gas within the inner space is exhausted to the outside, the pipe being coupled to the housing; a vacuum pump disposed at a first position of the pipe to control a pressure within the inner space; a pipe valve disposed at a second position of the pipe between the first position and the

housing to open and close the pipe or to control a flow amount of a gas flowing into the pipe; a first line having one end connected to the vacuum holes of the first vacuum chuck and the other end connected to the pipe between the first position and the second position; and a division line divided from the first line, the division line being connected to the vacuum holes of the second vacuum chuck; a first valve disposed in the first line between a divided position, at which the division line is divided from the first line, and the pipe, the first valve opening and closing the first line; an auxiliary valve disposed in the first line between the divided position and the vacuum holes of the first vacuum chuck, the auxiliary valve opening and closing the first line; and a division valve disposed in the division line, the division valve opening and closing the division line.

[0016] In some embodiments, the substrate treating apparatuses may further include: a second line having one end connected to the first line between the divided position and the first valve and the other end connected to the pipe between the housing and the second position; and a second valve disposed in the second line, the second valve opening and closing the second line.

[0017] In other embodiments, the substrate treating apparatuses may further include: a third line having one end connected to the first line between the divided position and the first valve and the other end connected to a gas supply part supplying a gas to supply the gas into the first line; and a third valve disposed in the third line, the third valve opening and closing the third line.

[0018] In still other embodiments of the present invention, substrate treating methods include using a substrate treating apparatus including: a housing including an inner space; a vacuum chuck in which a vacuum hole is defined in a top surface thereof, the vacuum chuck being disposed in the inner space to vacuum-absorb a

substrate; a pipe through which a gas within the inner space is exhausted to the outside, the pipe being coupled to the housing; a vacuum pump disposed at a first position of the pipe to control a pressure within the inner space; a pipe valve disposed at a second position of the pipe between the first position and the housing to open and close the pipe according to the pressure of the inner space or to control a flow amount of a gas flowing into the pipe; and a vacuum line including a first line having one end connected to the vacuum hole and the other end connected to the pipe between the first position and the second position and a first valve opening and closing the first line, the substrate treating method including: maintaining a first pressure between the first position and the second position when the substrate is carried into the inner space and partially opening the pipe valve to maintain the pressure within the inner space at a second pressure greater than the first pressure; and opening the first valve to maintain a pressure within the vacuum hole at a third pressure less than the second pressure, thereby to vacuum-absorb the substrate on the vacuum chuck.

[0019] In some embodiments, the substrate treating methods may further include supplying a processing gas into the inner space to process the substrate when the substrate is vacuum-absorbed on the vacuum chuck.

[0020] In other embodiments, the vacuum line may further include: a second line having one end connected to the first line between the vacuum hole and the first valve and the other end connected to the pipe between the housing and the second position; and a second valve disposed in the second line to open and close the second line, wherein, after the substrate processing is completed, further comprising opening the second valve to maintain a difference between the third pressure and the second

pressure within a previously set range, thereby to unload the substrate from the vacuum chuck.

[0021] In still other embodiments, the vacuum line may further include: a third line having one end connected to the first line between the vacuum hole and the first valve and the other end connected to a gas supply part supplying a gas to supply the gas into the first line; and a third valve disposed in the third line to open and close the third line, wherein the unloading of the substrate further including opening the third valve to supply a gas into the first line, thereby to maintain the difference between the third pressure and the second pressure within the previously set range.

[0022] In even other embodiments, the unloading of the substrate may include closing the pipe valve.

[0023] In yet other embodiments, the third pressure may be greater than or equal to the first pressure.

[0024] In even other embodiments of the present invention, substrate treating apparatuses include: a housing comprising an inner space; a vacuum chuck in which first vacuum holes are defined in a first region of a top surface thereof, and second vacuum holes are defined in a second region, which is different from the first region, of the top surface, the vacuum chuck being disposed in the inner space to vacuum-absorb a substrate; a pipe through which a gas within the inner space is exhausted to the outside, the pipe being coupled to the housing; a vacuum pump disposed at a first position of the pipe to control a pressure within the inner space; a pipe valve disposed at a second position of the pipe between the first position and the housing to open and close the pipe or to control a flow amount of a gas flowing into the pipe; and a vacuum line comprising a first line having one end connected to the first vacuum holes and the other end connected to the pipe between the first position and

the second position and a first valve opening and closing the first line. The first region may include a central region, and the second region may include an edge region.

[0025] In some embodiments, the vacuum line may further include: a second line having one end connected to the first line between the first vacuum holes and the first valve and the other end connected to the pipe between the housing and the second position; a third line having one end connected to the first line between the first vacuum holes and the first valve and the other end connected to a first gas supply part supplying a gas to supply the gas into the first line; a second valve disposed in the second line to open and close the second line; and a third valve disposed in the third line to open and close the third line.

[0026] In other embodiments, the vacuum line may further include a fourth line having one end connected to the second vacuum holes and the other end connected to a pressure control pump controlling a pressure within the second vacuum holes. The vacuum line may further include: a fourth line having connected to the second vacuum holes and the other end connected to the first line between the first vacuum holes and the first valve; and a second pressure controller disposed in the fourth line to control a pressure within the fourth line.

[0027] In still other embodiments, the vacuum line may further include: a fourth line having one end connected to the second vacuum holes and the other end connected to the pipe between the first position and the second position; and a fourth valve opening and closing the fourth line. The vacuum line may further include: a fifth line having one end connected to the fourth line between the second vacuum holes and the fourth valve and the other end connected to the pipe between the housing and the second position; a sixth line having one end connected to the fourth

line between the second vacuum holes and the fourth valve and the other end connected to a second gas supply part supplying a gas to supply the gas into the fourth line; a fifth valve disposed in the fifth line to open and close the fifth line; and a sixth valve disposed in the sixth line to open and close the sixth line.

BRIEF DESCRIPTION OF THE FIGURES

[0028] The accompanying figures are included to provide a further understanding of the present invention, and are incorporated in and constitute a part of this specification. The drawings illustrate exemplary embodiments of the present invention and, together with the description, serve to explain principles of the present invention. In the figures:

[0029] FIG. 1 is a schematic view of a substrate treating apparatus according to an embodiment of the present invention;

[0030] FIG. 2 is a view of a vacuum chuck according to an embodiment of the present invention;

[0031] FIG. 3 is a schematic view of a substrate treating apparatus according to another embodiment of the present invention;

[0032] FIGS. 4A through 4C are views illustrating a substrate treating method according to the present invention;

[0033] FIG. 5A is a cross-sectional view of a vacuum chuck according to another embodiment of the present invention;

[0034] FIG. 5B is a plan view of a vacuum chuck according to another embodiment of the present invention;

[0035] FIG. 6 is a schematic view illustrating a portion of a substrate treating apparatus according to another embodiment of the present invention;

[0036] FIG. 7 is a schematic view illustrating a portion of a substrate treating apparatus according to another embodiment of the present invention; and

[0037] FIG. 8 is a schematic view illustrating a portion of a substrate treating apparatus according to another embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0038] Preferred embodiments of the present invention will be described below in more detail with reference to the accompanying drawings. The present invention may, however, be embodied in 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 present invention to those skilled in the art. Thus, in the figures, the dimensions of layers and regions are exaggerated for clarity of illustration.

[0039] FIG. 1 is a schematic view of a substrate treating apparatus according to an embodiment of the present invention, and FIG. 2 is a view of a vacuum chuck according to an embodiment of the present invention.

[0040] Referring to FIGS. 1 and 2, a substrate treating apparatus 1 includes a processing part 100, a plasma generating part 200, an exhausting part 300, and a vacuum line 400. A substrate treating process such as an ashing process is performed by the processing part 100. The plasma generating part 200 generates plasma required for the substrate treating process to supply the generated plasma into the processing part 100. The exhausting part 300 exhausts residual process gases and reaction by-products within the processing part 100 to the outside.

[0041] Specifically, the processing part 100 includes a housing 110, a vacuum chuck 120, a closing cover 140, and a shower head 150.

[0042] The housing 100 includes an inner space 111 in which the ashing process is performed. An opening 112 through which a substrate W comes in and goes out is defined in a sidewall of the housing 110. The opening 112 is opened or closed by an opening/closing member such as a slit door (not shown). An exhaust hole (not shown) is defined in a bottom surface of the housing 110 to exhaust gases within the inner space 111 through a pipe 310 that will be described later.

[0043] The vacuum chuck 120 is disposed in the inner space 111 of the housing 110 to vacuum-absorb the substrate W. The vacuum chuck 120 has a circular plate shape. Vacuum holes 122 for vacuum-absorbing the substrate W are defined in a top surface of the vacuum chuck 120. The vacuum holes 122 are connected to each other through a hole defined inside the vacuum chuck 120. The vacuum holes 122 are connected to a first line 410 that will be described later to suck air existing in a space between the top surface of the vacuum chuck 120 and a bottom surface of the substrate W. The vacuum chuck 120 may include at least one heater for heating the substrate W seated during processing at a previously set processing temperature. A lift pin may be disposed to ascend and descend along a hole that is vertically formed through the vacuum chuck 120, thereby loading and unloading the substrate W on/from the vacuum chuck 120. A support shaft 123 for supporting the vacuum chuck 120 is disposed on a lower end of the vacuum chuck 120.

[0044] The closing cover 140 and the shower head 150 are disposed above the vacuum chuck 120. The closing cover 140 is disposed on an upper portion of the housing 110 and is coupled to the housing 110 to cover the inner space 111. The closing cover 140 is coupled to the plasma generating part 200. Intake holes, through which the plasma generated in the plasma generating part 200 is introduced, are defined in the closing cover 140. An inducement space GS for providing the

plasma flowing through the intake holes to the shower head 150 is defined inside the closing cover 140. According to the present embodiment, the inducement space GS has an inverted funnel shape.

[0045] The shower head 150 is disposed between the closing cover 140 and the vacuum chuck 120 to spray the plasma flowing into the inducement space GS of the closing cover 140 onto the substrate W seated on the vacuum chuck 120. Specifically, the shower head 150 is disposed on an inner upper surface of the housing 110 adjacent to the inducement space GS of the closing cover 140. A plurality of holes for spraying the plasma is defined in the shower head 150.

[0046] The plasma generating part 200 is disposed on an upper portion of the closing cover 140 and generates the plasma to supply the generated plasma into the inducement space GS within the closing cover 140. The plasma generating part 200 includes a magnetron 211, a waveguide 212, a plasma source part 213, and a gas supply tube 214.

[0047] The magnetron 211 generates a microwave for generating the plasma, and the waveguide 212 connected to the magnetron 211 induces the microwave generated by the magnetron 211 to the plasma source part 213. The gas supply tube 214 is connected to the plasma source part 213 to supply a reaction gas necessary for generating the plasma to the plasma source part 213.

[0048] The plasma is generated within the plasma source part 213 by the reaction gas supplied from the gas supply tube 214 and the microwave generated from the magnetron 211.

[0049] The plasma source part 213 is coupled to the closing cover 140, and the plasma generated by the plasma source part 213 is supplied into the inducement

space GS of the closing cover 140 and is sprayed onto the substrate W seated on the vacuum chuck 120 through the shower head 150.

[0050] The exhausting part 300 is disposed below the processing part 100. The exhausting part 300 controls a pressure within the inner space 111 of the housing 110 and exhausts an internal gas. The exhausting part 300 includes the pipe 310 for exhausting the gases within the inner space 111 of the housing 110 to the outside and a vacuum pump 320 for controlling the pressure within the inner space 111 of the housing 110.

[0051] The pipe 310 is disposed on a lower portion of the housing 110 to form a passage through which the gases and the reaction by-products within the inner space 111 of the housing 110 are exhausted. The passage of the pipe 310 is connected to the exhaust hole to communicate with the inner space 111 of the housing 110.

[0052] The vacuum pump 320 is disposed at a first position L1 of the pipe 310. The vacuum pump 320 forcedly sucks the gases within the inner space 111 of the housing 110 to control the pressure within the inner space 111 of the housing 110. Also, the vacuum pump 320 sucks the reaction by-products within the inner space 111 of the housing 110 to exhaust the sucked reaction by-products to the outside. When the vacuum pump 320 is operated, the interior of the pipe 310 is maintained at a first pressure P1. The first position L1 is sufficiently spaced apart from the housing 110.

[0053] A pipe valve 330 is disposed at a second position L2 between the first position L1, at which the vacuum pump 320 is disposed, and the housing 110. The pipe valve 330 opens and closes the pipe 310 or controls a flow amount of a gas flowing into the pipe 310. When the plasma is supplied into the inner space 111 of

the housing 110 to perform the substrate treating process, the pipe valve 330 partially opens the pipe 310. When the gases and reaction by-products within the inner space 111 are exhausted through the opened passage of the pipe 310, the inner space 111 of the housing 110 is maintained at a second pressure P2. The second pressure P2 is greater than the first pressure P1. According to the present embodiment, a bellows seal valve, which is shrunk and extended in a longitudinal direction according to a pressure of injected air, may be used as the pipe valve 330.

[0054] A vacuum line 400 is connected to the vacuum holes 122 to control a pressure within the vacuum holes 122. Specifically, the vacuum line 400 includes a first line 410 connecting the vacuum holes 122 to the pipe 310, a second line 420 connecting the first line 410 to the pipe 310, a third line 430 supplying a gas into the first line 410, and first through third valves 411, 421, and 431, which are disposed in the first through third lines 410, 420, and 430 to open and close the first through third lines 410, 420, and 430, respectively.

[0055] Specifically, the first line 410 has one end connected to the vacuum holes 122 of the vacuum chuck 120 and the other end connected to the pipe 310 between the first position L1 and the second position L2. A first valve 411 for opening and closing the first line 410 is disposed in the first line 410. The first valve 411 is opened or closed to control the pressure within the vacuum holes 122. When the second and third valves 421 and 431 are closed, and the first valve 411 is opened, the interiors of the vacuum holes 122 are maintained at a third pressure P3. The third pressure P3 is less than the second pressure P2 and is greater than or equal to the first pressure P1.

[0056] The second line 320 has one end connected to the first line 410 between the vacuum holes 122 and the first valve 411 and the other end connected to

the pipe 310 between the housing 110 and the second position L2. A second valve 421 for opening and closing the second line 420 is disposed in the second line 420. The second valve 421 is opened or closed to control pressures within the first line 410 and the vacuum holes 122. When the first and third valves 411 and 431 are closed, and the second valve 421 is opened, the inner space 111 of the housing 110 communicates with the first line 410 to gradually decrease a difference between the third pressure P3 and the second pressure P2.

[0057] The third line 430 has one end connected to the first line 410 between the vacuum holes 122 and the first valve 411 and the other end connected to a gas supply part 435. The third line 430 receives a gas from the gas supply part 435 to supply the received gas into the first line 410. A third valve 431 for opening and closing the third line 430 is disposed in the third line 430. The gas supply part 435 stores a gas to supply the stored gas into the third line 430. The supplied gas may include an inert gas. A flow control valve 434, a filter 433, and a pressure regulator 432 may be disposed between the gas supply part 435 and the third valve 430. The flow control valve 434 controls a flow amount of the gas supplied from the gas supply part 435. The filter 433 filters the supplied gas, and the pressure regulator 432 controls a pressure of the supplied gas. When the first and second valves 411 and 421 are closed, and the third valve 431 is opened, the gas is supplied into the first line 410 to increase the third pressure P3. Thus, the difference between the third pressure P3 and the second pressure P2 is gradually reduced.

[0058] FIG. 3 is a schematic view of a substrate treating apparatus according to another embodiment of the present invention.

[0059] Referring to FIG. 3, an inner space 111 of a housing 110 is divided into a first space FS and a second space SS. The first and second spaces FS and SS

provide spaces in which an ashing process is performed, respectively. Openings 112a and 112b through which a substrate W comes in and goes out are defined in sidewalls of the first and second spaces FS and SS, respectively. Each of the openings 112a and 112b is opened or closed by an opening/closing member such as a slit door. A first vacuum chuck 120a is disposed in the first space FS, and a second vacuum chuck 120b is disposed in the second space SS. The first and second vacuum chucks 120a and 120b vacuum-absorb the substrate W, respectively. The first and second vacuum chucks 120a and 120b have the same structure as the vacuum chuck 120 of FIG. 1.

[0060] A closing cover 140 and first and second shower heads 150a and 150b are disposed above the first and second vacuum chucks 120a and 120b. The closing cover 140 is in one-to-one correspondence to the first and second spaces FS and SS and is disposed above the housing 110. In addition, the closing cover 140 is coupled to the housing 110 to cover the first and second spaces FS and SS. The closing cover 140 includes a first cover part 141 disposed on an upper portion of the first space FS and a second cover part 142 disposed on an upper portion of the second space SS. The first and second cover parts 141 and 142 have the same structure as the closing cover 140 of FIG. 1.

[0061] A first shower head 150a is disposed between the first cover part 141 and the first vacuum chuck 120a, and a second shower head 150b is disposed between the second cover part 142 and the second vacuum chuck 120b. A plurality of holes for spraying plasma onto substrates W, which are seated on the first and second vacuum chucks 120a and 120b, is defined in the first and second shower heads 150a and 150b, respectively.

[0062] A first plasma generating unit 210 is disposed on an upper portion of the first cover part 141, and a second plasma generating unit 220 is disposed on an upper portion of the second cover part 142. The first and second plasma generating units 210 and 220 generate plasma to supply the generated plasma into an inducement space GS1 of the first cover part 141 or an inducement space GS2 of the second cover part 142. The first and second plasma generating units 210 and 220 have the same structure as the plasma generating part 200 of FIG. 1.

[0063] An exhausting part 300 is disposed below a processing part 100. The exhausting part 300 controls a pressure within the inner space 111 of the housing 110 and exhausts an internal gas. The exhausting part 300 includes a pipe 310 for exhausting a gas within the inner space 111 of the housing 110 to the outside and a vacuum pump 320 for controlling the pressure within the inner space 111 of the housing 110.

[0064] Since the pipe 310, the vacuum pump 320, and a pipe valve 330 have the same structures as those shown in FIG. 1, their detailed descriptions will be omitted here.

[0065] A vacuum line 400 is connected to vacuum holes 122 to control a pressure within the vacuum holes 122. Specifically, the vacuum line 400 includes a first line 410 connecting a vacuum hole 122a of a first vacuum chuck 120a to the pipe 310, a division line 413 divided from the first line 410 and connected to a vacuum hole 122b of a second vacuum chuck 120b, a second line 420 connecting the first line 410 to the pipe 310, a third line 430 supplying the gas into the first line 410, and valves, which are disposed in the lines 410, 420, and 430, respectively.

[0066] Specifically, the first line has one end connected to the vacuum hole 122a of the first vacuum chuck 120a and the other end connected to the pipe 310

between a first position L1 and a second position L2. A first valve 411 and an auxiliary valve 412 for opening and closing the first line 410 are disposed in the first line 410. The auxiliary valve 412 is disposed between a divided position DP, at which the division line 413 is divided from the first line 410, and the vacuum hole 122a of the first vacuum chuck 120a. The first valve 411 is disposed between the divided position DP and the pipe 310. The first valve 411 and the auxiliary valve 412 are opened or closed to control a pressure within the vacuum hole 122a of the first vacuum chuck 120a. When the first vacuum chuck 120a is not used for a substrate treating process, the auxiliary valve 412 prevents the gas from being supplied into the first vacuum hole 122a of the first vacuum chuck 120a. When second and third valves 421 and 431 are closed, and the first valve 411 and the auxiliary valve 412 are opened, the interior of the vacuum hole 122a of the first vacuum chuck 120a is maintained at a third pressure P3. The third pressure P3 is less than a second pressure P2 and is greater than or equal to a first pressure P1.

[0067] The division line 413 is divided from the first line 410 and is connected to the vacuum hole 122b of the second vacuum chuck 120b. A division valve 414 for opening and closing the division line 413 is disposed in the division line 413. When the second vacuum chuck 120b is not used for the substrate treating process, the division valve 414 prevents the gas from being supplied into the vacuum hole 122b of the second vacuum chuck 120b. The auxiliary valve 412 or the division valve 414 is closed to selectively close any one of the vacuum holes 122a and 122b when any one of the first and second vacuum chucks 120a and 120b is not used for the substrate treating process, thereby performing an efficient substrate treating process. The first valve 411 and the division valve 414 are opened or closed to control a pressure within the vacuum hole 122b of the second vacuum chuck 120b.

When the second and third valves 421 and 431 are closed, and the first valve 411 and the division valve 414 are opened, the interior of the vacuum hole 122b of the second vacuum chuck 120b is maintained at the third pressure P3. The pressure is less than the second pressure P2 and is greater than or equal to the first pressure P1.

[0068] The second line 420 has one end connected to the first line 410 between the divided position DP and the first valve 411 and the other end connected to the pipe 310 between the housing 110 and the second position L2. The second valve 421 for opening and closing the second line 420 is disposed in the second line 420. The second valve 421 is opened or closed to control a pressure within the vacuum holes 122a and 122b. When the first and third valves 411 and 431 are closed, and the second valve 421, the auxiliary valve 412, and the division valve 414 are opened, the inner space 111 of the housing 110 communicates with the first line 410 to gradually reduce a difference between the third pressure P3 and the second pressure P2.

[0069] The third line 430 has one end connected to the first line 410 between the divided position DP and the first valve 411 and the other end connected to a gas supply part 435. The third line 430 receives gas from the gas supply part 435 to supply the gas into the first line 410. The third valve 431 for opening and closing the third line 430 is disposed in the third line 430. The gas supply part 435 stores the gas to supply the stored gas into the third line 430. A flow control valve 434, a filter 433, and a pressure regulator 432 may be disposed between the gas supply part 435 and the third valve 431. The flow control valve 434 controls a flow amount of the gas supplied from the gas supply part 435. The filter 433 filters the supplied gas, and the pressure regulator 432 controls a pressure of the supplied gas. When the first and second valves 411 and 421 are closed, and the third valve 431, the auxiliary valve

412, and the division valve 414 are opened, the gas is supplied into the first line 410 to increase the third pressure P3. Thus, a difference between the third pressure P3 and the second pressure P2 is gradually reduced.

[0070] A substrate treating method using a substrate treating apparatus including the above-described parts will be described below.

[0071] The substrate treating method includes maintaining a pressure within an inner space of a housing 110 at a second pressure P2, vacuum-absorbing a substrate W on a vacuum chuck 120, processing the substrate W, and unloading the substrate W in which the processing is completed. A process of treating the substrate will be described below in detail.

[0072] FIGS. 4A through 4C are views illustrating a substrate treating method according to the present invention.

[0073] Referring to FIG. 4A, a substrate W is carried into an inner space 111 of a housing 110 by a transfer unit (not shown) to move the substrate W above a vacuum chuck 120. Then, the substrate W is seated on a top surface of the vacuum chuck 120 by ascent/descent of a lift pin (not shown). A vacuum pump 320 is operated to maintain a first pressure P1 between a first position L1 of a pipe and a second position L2. At this time, a pipe valve 330 is in a partially opened state. Thus, since the pipe valve 330 is partially opened, a pressure within the inner space 111 of the housing 110 is maintained at a second pressure P2 greater than a first pressure P1.

[0074] When a first valve 411 is opened to connect a pipe 310 between the first position L1 and the second position L2 to a first line 410, the first pressure P1 between the first position L1 and the second position L2 is transmitted into the first line 410 to maintain the interior of a vacuum hole 122 of the vacuum chuck 120 is

maintained at a third pressure P3. The third pressure P3 is greater than or equal to the first pressure P1 and is less than the second pressure P2. Thus, since the second pressure P2 applied to a top surface of the substrate W is greater than the third pressure P3 applied to a bottom surface of the substrate W, the substrate W is continuously absorbed on the vacuum chuck 120.

[0075] Referring to FIG. 4B, when the substrate W is continuously absorbed on the vacuum chuck 120, a plasma generating part 200 generates plasma to supply the generated plasma into an inducement space GS of a closing cover 140. The supplied plasma is sprayed onto the substrate W through holes defined in a shower head 150 to process the substrate W. Gases and reaction by-products generated during the processing are forcedly sucked to discharge the sucked gases and reaction by-products to the outside through the pipe 310. The pipe valve 330 is maintained in a partially opened state during the processing. Thus, the gases and reaction by-products are discharged to the outside through the partially opened pipe valve 330.

[0076] Referring to FIG. 4C, when the processing of the substrate w is completed, the substrate W is unloaded from the vacuum chuck 120. The substrate W is unloaded by maintaining a difference between the third pressure P3 and the second pressure P2 within a previously set range. The previously set range denotes a difference between the third pressure P3 and the second pressure P2, which may prevent the substrate W from being damaged when the lift pin ascends to lift the substrate W seated on the vacuum chuck 120. In addition, the previously set range includes a state in which the third pressure P3 and the second pressure P2 are maintained at equilibrium. Also, the previously set range includes a case in which the third pressure P3 is less than the second pressure P2 within a range in which the substrate W is not damaged by the lift pin. Also, the previously set range includes a

case in which the third pressure P3 is greater than the second pressure P2 within a range in which a popping phenomenon, in which the substrate W bounces from the vacuum chuck 120, does not occur.

[0077] According to an embodiment, the second valve 421 is opened to connect the inner space 111 of the housing 110 to the first line 410, thereby to maintain the difference between the third pressure P3 and the second pressure P2 within the previously set range. When the second pressure P2 greater than the third pressure P3 is transmitted into the first line 410 through the second line 420, the difference between the third pressure P3 and the second pressure P2 is reduced, and thus, is maintained within the previously set range.

[0078] According to another embodiment, the third valve 431 is opened to supply a gas into the first line 410, thereby to maintain the difference between the third pressure P3 and the second pressure P2 within the previously set range. The supplied gas may include an inert gas. When the gas stored in the gas supply part 435 is supplied into the first line 410 through the third line 430, the third pressure P3 is increased to maintain the difference between the third pressure P3 and the second pressure P2 within the previously set range. Since a flow amount of the supplied gas may be controlled by the pressure regulator 432, the difference between the third pressure P3 and the second pressure P2 may be efficiently maintained within the previously set range in relatively short time.

[0079] According to further another embodiment, the second valve 421 and the third valve 431 are opened at the same time to maintain the difference between the third pressure P3 and the second pressure P2 within the previously set range. The second valve 421 is opened to connect the inner space 111 of the housing 110 to the first line 410, thereby to reduce the difference between the third pressure P3 and the

second pressure P2. Also, the third valve 431 is opened to increase the third pressure P3 by the gas supplied into the first line 410, thereby to reduce the difference between the third pressure P3 and the second pressure P2.

[0080] When the difference between the third pressure P3 and the second pressure P2 is maintained within the previously set range, the lift pin ascends to lift the substrate W above the vacuum chuck 120. The substrate W supported by the lift pin is transferred into another processing part (not shown) by the transfer unit.

[0081] Hereinafter, a substrate treating apparatus according to another embodiment will be described.

[0082] FIG. 5A is a cross-sectional view of a vacuum chuck according to another embodiment of the present invention, and FIG. 5B is a plan view of a vacuum chuck according to another embodiment of the present invention.

[0083] Referring to FIGS. 5A and 5B, a vacuum chuck 120 is disposed in an inner space 111 of a housing 110 to vacuum-absorb a substrate W. The vacuum chuck 120 has a circular plate shape. Vacuum holes 122 for vacuum-absorbing the substrate W are defined in a top surface of the vacuum chuck 120. The vacuum holes 122 include first vacuum holes 122a defined in a first region of the top surface of the vacuum chuck 120 and second vacuum holes 122b defined in a second region of the top surface of the vacuum chuck 120. According to the present embodiment, the first region corresponds to a central region of the top surface of the vacuum chuck 122, and the second region corresponds to an edge region of the top surface of the vacuum chuck 122. The first vacuum holes 122a are connected to each other through a hole defined inside the vacuum chuck 122. The second vacuum holes 122b are connected to each other through a hole defined inside the vacuum chuck 122. The first vacuum holes 122a do not communicate with the second vacuum

holes 122b. The first vacuum holes 122a are connected to a first line 410 to vacuum-absorb the substrate W at a region corresponding to the first region. The second vacuum holes 122b are connected to a fourth line 440, which will be described later, to vacuum-absorb the substrate W at a region corresponding to the second region. According to the present embodiment, the first vacuum holes 122a vacuum-absorb the substrate W at a the central region of the substrate W, and the second vacuum holes 122b vacuum-absorb the substrate W at the edge region of the substrate W.

[0084] FIG. 6 is a schematic view illustrating a portion of the substrate treating apparatus shown in FIGS. 5A and 5B.

[0085] Referring to FIGS. 5A, 5B and 6, an exhausting part 300 is disposed below a processing part 100. The exhausting part 300 controls a pressure within the inner space 111 of the housing 110 and exhausts an internal gas. The exhausting part 300 includes a pipe 310 for exhausting a gas within the inner space 111 of the housing 110 to the outside, a vacuum pump 320 for controlling the pressure within the inner space 111 of the housing 110, and a pipe valve for opening and closing the pipe 310 or for controlling a flow amount of the gas flowing into the pipe 310. Since the pipe 310, the vacuum pump 320, and the pipe valve 330 have the same structure as those of FIG. 1, their detailed descriptions will be omitted.

[0086] A vacuum line 400 is connected to the vacuum holes 122 to control a pressure within the vacuum holes 122. Specifically, the vacuum line 400 includes a first line 410 connecting the first vacuum holes 122a to the pipe 310, a second line 420 connecting the first line 410 to the pipe 310, a third line 430 supplying the gas into the first line 410, a fourth line 440 connecting the second vacuum holes 122b to the first line 410, first through third valves 411, 421, 431 disposed in the first through third lines 410, 420, and 430, respectively, to open and close the first through third

lines 410, 420, and 430, a first pressure controller 417 disposed in the first line 410 to control a pressure within the first line 410, and a second pressure controller 448 disposed in the fourth line 440 to control a pressure within the fourth line 440. Since the first through third lines and the first through third valves have the same structure as those of FIG. 1, their detailed descriptions will be omitted.

[0087] The first pressure controller 417 is disposed in the first line 410 between the first vacuum holes 122a and the first valve 411 to control the pressure within the first line 410. A vacuum pressure within the first vacuum holes 122a are controlled by the first pressure controller 417. Thus, the pressure within the first vacuum holes 122a may be controlled by following four steps. First, the first valve 411 is opened to maintain the interiors of the first vacuum holes 122a at the third pressure P3. The inner space 111 of the housing 110 communicates with the first line 410 by opening the second valve 421 to gradually reduce a difference between the third pressure P3 and the second pressure P2. The third valve 431 is opened to supply the gas into the first line 410, thereby to gradually reduce the difference between the third pressure P3 and the second pressure P2. Finally, the pressure within the first vacuum holes 122a is controlled by the first pressure controller 417.

[0088] The fourth line 440 has one end connected to the second vacuum holes 122b and the other end connected to the first line 410 between the first vacuum holes 122a and the first valve 411. The second pressure controller 448 for controlling the fourth line 440 is disposed in the fourth line 440. The pressure within the second vacuum holes 122b may be controlled independently from the first vacuum holes 122a by the second pressure controller 448. Thus, since a vacuum absorption force between the substrate W and the vacuum chuck 120 may be different according to the regions of the substrate W, the absorption between the

substrate W and the vacuum chuck 120 may be increased. The pressure within the second vacuum holes 122b may be controlled by four steps, similar to the first vacuum holes 122a.

[0089] FIG. 7 is a schematic view illustrating a portion of a substrate treating apparatus according to another embodiment of the present invention.

[0090] Referring to FIGS. 5A, 5B, and 7, a fourth line 440 has one end connected to second vacuum holes 122b and the other end connected to a pressure control pump 442. A pressure control pump 442 controls pressure within second vacuum holes 122b. The pressure within the second vacuum holes 122b may be controlled independently from first vacuum holes 122a by the pressure control pump 442. Thus, since a vacuum absorption force between a substrate W and a vacuum chuck 120 may be different according to regions of the substrate W, the absorption between the substrate W and the vacuum chuck 120 may be increased.

[0091] FIG. 8 is a schematic view illustrating a portion of a substrate treating apparatus according to another embodiment of the present invention.

[0092] Referring to FIGS. 5A, 5B, and 8, a vacuum line 400 is connected to vacuum holes 122 to control pressure within vacuum holes 122. The vacuum line 400 includes a first line 410 connecting first vacuum holes 122a to a pipe 310, a second line 420 connecting the first line 410 to the pipe 310, a third line 430 supplying a gas into the first line 410, a fourth line 440 connecting second vacuum holes 122b to the pipe 310, a fifth line 450 connecting the fourth line 440 to the pipe 310, and a sixth line 460 supplying the gas into the fourth line 440.

[0093] The first line 410 has one end connected to the first vacuum holes 122a of a vacuum chuck 120 and the other end connected to the pipe 310 between a first position L1 and a second position L2. A first valve 411 for opening and closing

the first line 410 is disposed in the first line 410. The first valve 411 is opened or closed to control a pressure within the first vacuum holes 122a.

[0094] The second line 420 has one end connected to the first line 410 between the first vacuum holes 122a and the first valve 411 and the other end connected to the pipe 310 between a housing 110 and the second position L2. A second valve 421 for opening and closing the second line 420 is disposed in the second line 420. The second valve 421 is opened or closed to control pressures within the first line 410 and the first vacuum holes 122a.

[0095] The third line 430 has one end connected to the first line 410 between the first vacuum holes 122a and the first valve 411 and the other end connected to a first gas supply part 435. The third line 430 receives a gas from the first gas supply part 435 to supply the received gas into the first line 410. A third valve 431 for opening and closing the third line 430 is disposed in the third line 430. The first gas supply part 435 stores the gas to supply the stored gas into the third line 430. The supplied gas may include an inert gas. A flow control valve 434 for controlling a flow amount of the gas supplied from the first gas supply part 435, a filter 433 for filtering the supplied gas, and a first pressure regulator 432 for controlling a pressure of the supplied gas may be disposed between the first gas supply part 435 and the third valve 430.

[0096] A fourth line 440 has one end connected to second vacuum holes 122b of a vacuum chuck 120 and the other end connected to the pipe 310 between the first position L1 and the second position L2. A fourth valve 441 for opening and closing the fourth line 440 is disposed in the fourth line 440. The fourth valve 441 is opened or closed to control a pressure within the second vacuum holes 122b.

[0097] A fifth line 450 has one end connected to the fourth line 440 between the second vacuum holes 122b and the fourth valve 441 and the other end connected to the pipe 310 between the housing 110 and the second position L2. A fifth valve 451 for opening and closing the fifth line 450 is disposed in the fifth line 450. The fifth valve 451 is opened or closed to control pressures within the fifth line 450 and the second vacuum holes 122b.

[0098] A sixth line 460 has one end connected to the fourth line 440 between the second vacuum holes 122b and the fourth valve 441 and the other end connected to a second gas supply part 465. The sixth line 460 receives a gas from the second gas supply part 465 to supply the received gas into the fourth line 440, thereby to control the pressure within the second vacuum holes 122b. A sixth valve 461 for opening and closing the sixth line 460 is disposed in the sixth line 460. The second gas supply part 465 stores the gas to supply the stored gas into the sixth line 460. The supplied gas may include an inert gas. A flow control valve 464 for controlling a flow amount of the gas supplied from the second gas supply part 465, a filter 463 for filtering the supplied gas, and a second pressure regulator 462 for controlling a pressure of the supplied gas may be disposed between the second gas supply part 465 and the sixth valve 460.

[0099] According to the present invention, the substrate can be fixed to the vacuum chuck using a difference between the pressure within the inner space of the housing and the pressure within the vacuum holes of the vacuum chuck.

[00100] Also, the difference between the pressure within the inner space of the housing and the pressure within the vacuum holes of the vacuum chuck can be easily controlled.

[00101] Also, the absorption between the substrate and the vacuum chuck can be increased.

[00102] Also, the absorption between the substrate and the vacuum chuck can be controlled according to the regions of the substrate.

[00103] Also, production yield and surface roughness of the substrate can be improved.

[00104] As described above, according to the embodiments, the process is uniformly performed over the entire region of the wafer W to improve a processing efficiency. The above-disclosed subject matter is to be considered illustrative, and not restrictive, and the appended claims are intended to cover all such modifications, enhancements, and other embodiments, which fall within the true spirit and scope of the present invention. Thus, to the maximum extent allowed by law, the scope of the present invention is to be determined by the broadest permissible interpretation of the following claims and their equivalents, and shall not be restricted or limited by the foregoing detailed description.

WHAT IS CLAIMED IS:

1. A substrate treating apparatus, comprising:

a housing comprising an inner space;

a vacuum chuck in which a vacuum hole is defined in a top surface thereof, the vacuum chuck being disposed in the inner space to vacuum-absorb a substrate;

a pipe through which a gas within the inner space is exhausted to the outside, the pipe being coupled to the housing;

a vacuum pump disposed at a first position of the pipe to control a pressure within the inner space;

a pipe valve disposed at a second position of the pipe between the first position and the housing to open and close the pipe or to control a flow amount of a gas flowing into the pipe; and

a vacuum line comprising a first line having one end connected to the vacuum hole and the other end connected to the pipe between the first position and the second position and a first valve opening and closing the first line, wherein the vacuum line further comprises:

a third line having one end connected to the first line between the vacuum hole and the first valve and the other end connected to a gas supply part supplying a gas to supply the gas into the first line; and

a third valve disposed in the third line to open and close the third line.

2. The substrate treating apparatus of claim 1, wherein the vacuum line further comprises:

a second line having one end connected to the first line between the vacuum hole and the first valve and the other end connected to the pipe between the housing and the second position; and

a second valve disposed in the second line to open and close the second line.

3. A substrate treating apparatus, comprising:

a housing comprising an inner space;

first and second vacuum chucks in which vacuum holes vacuum-absorbing a substrate are defined in top surfaces thereof, respectively, the first and second vacuum chucks being spaced apart from each other in the inner space;

a pipe through which a gas within the inner space is exhausted to the outside, the pipe being coupled to the housing;

a vacuum pump disposed at a first position of the pipe to control a pressure within the inner space;

a pipe valve disposed at a second position of the pipe between the first position and the housing to open and close the pipe or to control a flow amount of a gas flowing into the pipe;

a first line having one end connected to the vacuum holes of the first vacuum chuck and the other end connected to the pipe between the first position and the second position;

a division line divided from the first line, the division line being connected to the vacuum holes of the second vacuum chuck;

a first valve disposed in the first line between a divided position, at which the division line is divided from the first line, and the pipe, the first valve opening and closing the first line;

an auxiliary valve disposed in the first line between the divided position and the vacuum holes of the first vacuum chuck, the auxiliary valve opening and closing the first line; and

a division valve disposed in the division line, the division valve opening and closing the division line

further comprising:

a third line having one end connected to the first line between the divided position and the first valve and the other end connected to a gas supply part supplying a gas to supply the gas into the first line; and

a third valve disposed in the third line, the third valve opening and closing the third line.

4. The substrate treating apparatus of claim 3, further comprising:

a second line having one end connected to the first line between the divided position and the first valve and the other end connected to the pipe between the housing and the second position; and

a second valve disposed in the second line, the second valve opening and closing the second line.

5. A substrate treating method using a substrate treating apparatus including: a housing comprising an inner space; a vacuum chuck in which a vacuum hole is defined in a top surface thereof, the vacuum chuck being disposed in the inner space to vacuum-absorb a substrate; a pipe through which a gas within the inner space is exhausted to the outside, the pipe being coupled to the housing; a vacuum pump disposed at a first position of the pipe to control a pressure within the inner space; a pipe valve disposed at a second position of the pipe between the first position and the housing to open and close the pipe according to the pressure of the inner space or to control a flow amount of a gas flowing into the pipe; and a vacuum line comprising a first line having one end connected to the vacuum hole and the other end connected to the pipe between the first position and the second position and a first valve opening and closing the first line, the substrate treating method comprising:

maintaining a first pressure between the first position and the second position when the substrate is carried into the inner space and partially opening the pipe valve to maintain the pressure within the inner space at a second pressure greater than the first pressure; and

opening the first valve to maintain a pressure within the vacuum hole at a third pressure less than the second pressure, thereby to vacuum-absorb the substrate on the vacuum chuck.

6. The substrate treating method of claim 5, further comprising supplying a processing gas into the inner space to process the substrate when the substrate is vacuum-absorbed on the vacuum chuck.

7. The substrate treating method of claim 6, wherein the apparatus further comprises: a second line having one end connected to the first line between the vacuum hole and the first valve and the other end connected to the pipe between the housing and the second position; and a second valve disposed in the second line to open and close the second line,

wherein, after the substrate processing is completed, further comprising opening the second valve to maintain a difference between the third pressure and the second pressure within a previously set range, thereby to unload the substrate from the vacuum chuck.

8. The substrate treating method of claim 7, wherein the apparatus further comprises: a third line having one end connected to the first line between the vacuum hole and the first valve and the other end connected to a gas supply part supplying a gas to supply the gas into the first line; and a third valve disposed in the third line to open and close the third line,

wherein the unloading of the substrate further comprises opening the third valve to supply a gas into the first line, thereby to maintain the difference between the third pressure and the second pressure within the previously set range.

9. The substrate treating method of claim 7 or 8, wherein the unloading of the substrate comprises closing the pipe valve.

10. The substrate treating method of any one of claims 5 to 8, wherein the third pressure is greater than or equal to the first pressure.

11. A substrate treating apparatus, comprising:

a housing comprising an inner space;

a vacuum chuck in which first vacuum holes are defined in a first region of a top surface thereof, and second vacuum holes are defined in a second region, which is different from the first region, of the top surface, the vacuum chuck being disposed in the inner space to vacuum-absorb a substrate;

a pipe through which a gas within the inner space is exhausted to the outside, the pipe being coupled to the housing;

a vacuum pump disposed at a first position of the pipe to control a pressure within the inner space;

a pipe valve disposed at a second position of the pipe between the first position and the housing to open and close the pipe or to control a flow amount of a gas flowing into the pipe; and

a vacuum line comprising a first line having one end connected to the first vacuum holes and the other end connected to the pipe between the first position and the second position and a first valve opening and closing the first line.

12. The substrate treating apparatus of claim 11, wherein the first region comprises a central region, and the second region comprises an edge region.

13. The substrate treating apparatus of claim 11, wherein the vacuum line further comprises:

a second line having one end connected to the first line between the first vacuum holes and the first valve and the other end connected to the pipe between the housing and the second position;

a third line having one end connected to the first line between the first vacuum holes and the first valve and the other end connected to a first gas supply part supplying a gas to supply the gas into the first line;

a second valve disposed in the second line to open and close the second line; and

a third valve disposed in the third line to open and close the third line.

14. The substrate treating apparatus of any one of claims 11 to 13, wherein the vacuum line further comprises a fourth line having one end connected to the second vacuum holes and the other end connected to a pressure control pump controlling a pressure within the second vacuum holes.

15. The substrate treating apparatus of any one of claims 11 to 13, wherein the vacuum line further comprises:

a fourth line having connected to the second vacuum holes and the other end connected to the first line between the first vacuum holes and the first valve; and

a second pressure controller disposed in the fourth line to control a pressure within the fourth line.

16. The substrate treating apparatus of any one of claims 11 to 13, wherein the vacuum line further comprises:

a fourth line having one end connected to the second vacuum holes and the other end connected to the pipe between the first position and the second position; and

a fourth valve opening and closing the fourth line.

17. The substrate treating apparatus of claim 16, wherein the vacuum line further comprises:

a fifth line having one end connected to the fourth line between the second vacuum holes and the fourth valve and the other end connected to the pipe between the housing and the second position;

a sixth line having one end connected to the fourth line between the second vacuum holes and the fourth valve and the other end connected to a second gas supply part supplying a gas to supply the gas into the fourth line;

a fifth valve disposed in the fifth line to open and close the fifth line; and

a sixth valve disposed in the sixth line to open and close the sixth line.