

SYSTEM AND APPARATUS FOR CLEANING OR DRYING MEDIA HANDLING DEVICES

Field of the Invention

[0001] The present invention generally relates to the field of processing media handling devices, and more particularly to a processing system and apparatus for cleaning or drying wafer cassettes that are used incident to the manufacture of semiconductor devices.

Background of the Invention

[0002] In semiconductor manufacturing, electronic devices are fabricated on wafers by a sequence of processes. Typically, media handling devices are used to handle and store the wafers in these fabrication processes. In order to achieve good yield and quality in the fabrication of electronic devices, the wafer surface must be free from contamination, for example dust particles. As contamination on the media handling devices can be easily transferred to the wafers through contact, the media handling devices that handle and store the wafers should also be free of contamination.

[0003] One type of media handling devices for handling and storing wafer is the cassette. Typically, such wafer cassettes have a longitudinal boat shaped body comprising several slots for storing wafers. The wafer cassettes are often used to transport the wafers between different fabrication processes. During transportation, contaminants are transferred by the contact between wafers and wafer cassettes. Therefore, the wafer cassette must undergo a prior cleaning process to remove and minimize contaminants. The wafer cassette also undergoes a subsequent drying process to evaporate any cleaning fluid on the wafer cassettes.

[0004] There are several known wafer cassette cleaning methods available in the semiconductor industry. For example, US 5,839,455 discloses an enhanced high pressure cleaning system for wafer handling devices. The system comprises a chamber adapted to receive a wafer handling device, wherein the chamber has a lid configured with an array of nozzles. The nozzles on the lid direct a pressurized cleansing medium, for example inert gas, against the wafer handling device to dislodge contaminants from the wafer handling

device. US 5,991,965 discloses an apparatus for dry-cleaning dust-contaminated auxiliary objects for handling and storing semiconductor wafers. The apparatus comprises a housing that receives an auxiliary object. Similarly, the housing has a lid configured with nozzles that directs cleaning gas onto the auxiliary object. Although the above system and apparatus address the issue of removing contaminants and dust particles from wafer handling device, it has drawbacks. For example, the nozzles are mounted on the top lid of the chamber for delivering the cleansing medium to the wafer handling device. Thus, the cleansing medium may not reach certain parts of the wafer handling device. As a result, the wafer handling device may not be cleansed effectively.

[0005] Therefore, there is an imperative need to have a system that overcomes the aforementioned problem and can provide an effective means of cleaning or drying media handling devices. This invention satisfies this need by disclosing a system for cleaning or drying media handling devices. Furthermore, the system provides a more efficient means for cleaning media handling devices by reducing the cleaning cycle time. Other advantages of this invention will be apparent with reference to the detailed description.

Summary of the Invention

[0006] The present invention provides a processing system and apparatus for cleaning or drying wafer cassettes that are used incident to the manufacture of semiconductor devices.

[0007] Accordingly, in one aspect, the present invention provides an apparatus for cleaning or drying a media handling device, the apparatus comprising: a top cover; a plurality of bottom panels; an enclosure disposed between the top cover and the plurality of bottom panels, wherein the enclosure is configured to circumferentially enclose the media handling device, the enclosure having a top surface and a bottom surface; wherein the top surface having a plurality of depressions, and wherein the top surface is coupled to the top cover to enclose the plurality of depressions, thereby creating a plurality of channels; and the bottom surface having a plurality of chambers, wherein the plurality of chambers are coupled to the plurality of channels by a plurality of conduits; and wherein the plurality of bottom panels are coupled to the bottom surface to enclose the plurality of chambers, thereby creating a plurality of reservoirs, the plurality of reservoirs having a

plurality of outlets configured to circumferentially surround the media handling device; and wherein the plurality of channels receive and distribute a fluid to the plurality of reservoirs via the plurality of conduits, wherein the plurality of reservoirs regulate the fluid and evenly distribute the fluid to the plurality of outlets, and wherein the plurality of outlets are configured to release streams of fluid around the media handling device, thereby effectively cleaning or drying the media handling device.

[0008] In another aspect, the present invention provides a system for cleaning or drying a media handling device, the system comprising: an apparatus comprising, a top cover; a plurality of bottom panels; an enclosure disposed between the top cover and the plurality of bottom panels, wherein the enclosure is configured to circumferentially enclose the media handling device, the enclosure having a top surface and a bottom surface; wherein the top surface having a plurality of depressions, and wherein the top surface is coupled to the top cover to enclose the plurality of depressions, thereby creating a plurality of channels; and the bottom surface having a plurality of chambers, wherein the plurality of chambers are coupled to the plurality of channels by a plurality of conduits; and wherein the plurality of bottom panels are coupled to the bottom surface to enclose the plurality of chambers, thereby creating a plurality of reservoirs, the plurality of reservoirs having a plurality of outlets configured to circumferentially surround the media handling device; and wherein the plurality of channels receive and distribute a fluid to the plurality of reservoirs via the plurality of conduits, wherein the plurality of reservoirs regulate the fluid and evenly distribute the fluid to the plurality of outlets, and wherein the plurality of outlets are configured to release streams of fluid around the media handling device, thereby effectively cleaning or drying the media handling device; an actuator coupled to the upper portion of the apparatus; a servo motor coupled to the actuator; and wherein the servo motor is operable to move the actuator, thereby moving the apparatus, wherein the apparatus is movable to enclose the media handling device for cleaning or drying.

Brief Description of the Drawings

[0009] Preferred embodiments according to the present invention will now be described with reference to the Figures, in which like reference numerals denote like elements.

[0010] Figure 1 is a top perspective view of a processing system in accordance with one embodiment of the present invention.

[0011] Figure 2 is an exploded view of the processing apparatus in accordance with one embodiment of the present invention.

[0012] Figure 3 is a bottom perspective view of the enclosure and the end cover in accordance with one embodiment of the present invention.

[0013] Figure 4 is a top plan view of the enclosure in Figure 3.

[0014] Figure 5 is a bottom plan view of the enclosure in Figure 3.

[0015] Figure 6 is a cross-sectional view of the enclosure from the line X-X in Figure 3 illustrating the flow of fluid from the plurality of channels to the plurality of outlets.

[0016] Figure 7 is an alternative cross-sectional view of the enclosure from the line X-X in Figure 3 illustrating the flow of fluid from the plurality of channels to the plurality of outlets.

[0017] Figure 8 is an enlarged cross-sectional view of an outlet shown in Figure 6.

[0018] Figure 9 is an alternative enlarged cross-sectional view of the outlet shown in Figure 6.

Detailed Description of the Invention

[0019] The present invention may be understood more readily by reference to the following detailed description of certain embodiments of the invention. The present invention provides a processing system for media handling devices, and the like. In particular, the following description discloses a processing system for drying a type of media handling devices known as wafer cassettes. The wafer cassettes are typically used for handling or storing wafers during the various semiconductor manufacturing processes.

[0020] Figure 1 illustrates a wafer cassette processing system **1** in accordance with one embodiment of the present invention. The processing system comprises a servo motor **2**, an actuator **3** and a processing apparatus **4**. The servo motor **2** is securely mounted on a base **5** and is coupled to the actuator **3** via a gear system (not shown). The actuator **3** has a central axis A-A perpendicular to the base **5**. The processing apparatus **4** is coupled to the actuator **3** via a mounting bracket **6**, wherein the mounting bracket **6** is movable with respect to the base **5** in a direction parallel to the axis A-A. The servo motor **2** can be

controlled or programmed to drive the actuator 3, thereby moving the mounting bracket 6 in the direction parallel to the axis A-A. Accordingly, the movements of the mounting bracket 6 cause the processing apparatus 4 to move in directions parallel to the axis A-A. Thus, by controllably driving the servo motor 2, the processing apparatus 4 can be moved relative to a wafer cassette 10 to clean or dry the wafer cassette 10. Typically, the wafer cassette 10 is a longitudinal boat shaped device comprising a plurality of slots for storing semiconductor wafers.

[0021] Referring to Figure 2, the processing apparatus 4 comprises a top cover 20, a seal 30, an enclosure 40, and an end cover 50. In a preferred embodiment, the top cover 20 is rectangular in shape with two apertures 22 for receiving the wafer cassette 10, which will be discussed hereinafter. The top cover 20 can be coupled to the enclosure 40 by conventional bolts and nuts, or any other similar forms of connection. The seal 30 preferably has the same rectangular shape as the top cover 20, wherein the seal 30 has two holes 33 that corresponds to the shape of the two apertures 22 in the top cover 20. Furthermore, the seal 30 is disposed between the top cover 20 and the enclosure 40 to prevent the leakage of air injected into the enclosure 40. The enclosure 40 is configured to accommodate the wafer cassette 10. Furthermore, the enclosure 40 is coupled to the end cover 50, wherein the end cover 50 comprises a plurality of panels. Preferably, the top cover 20, the enclosure 40, and the end cover 50 are made from aluminum or any other types of metals or metal alloys. The seal 30 is made from TEFLON materials, or the like.

[0022] Referring to Figures 2 and 3, the enclosure 40 is configured to accommodate the wafer cassette 10, wherein the enclosure 40 comprises an upper portion 60 and a lower portion 70. In one embodiment, the upper portion 60 has a cuboid shape and comprises two openings 62 to receive the wafer cassette 10, wherein the two openings 62 corresponds to the shape of the two apertures 22 in the top cover 20. The openings 62 are so configured to circumferentially enclose the wafer cassette 10. Furthermore, the upper portion 60 has a plurality of depressions 64, wherein the plurality of depressions 64 are disposed on the top surface of the upper portion 60. Figure 5 provides a better illustration of the configuration of the plurality of depressions 64, wherein the plurality of depressions 64 extend circumferentially around the openings 62.

[0023] In Figure 2, the upper portion 60 comprises a side panel 61 having a plurality of inlets 66 coupled to the plurality of depressions 64, wherein the plurality of

inlets **66** provide means for allowing the injection of air from a supply source (not shown) into the plurality of depressions **64**. For the present invention, the air is supplied from the semiconductor plant facility, and is known as compressed dry air (CDA). As discussed above, the processing apparatus **4** is coupled to the actuator **3** via a mounting bracket **6**. Specifically, the side panel **61** of the processing apparatus **4** is coupled to the mounting bracket **6**.

[0024] The lower portion **70** is an integral extension of the upper portion **60**, wherein the lower portion is configured with a plurality of sections or walls **72** to accommodate the wafer cassette **10**. In a preferred embodiment, the lower portion **70** comprises four sidewalls (**72a**, **72b**, **72c**, **72d**) and one center wall **72e** (see Figure 3). The four sidewalls (**72a**, **72b**, **72c**, **72d**) and center wall **72e** are integral extensions of the upper portion **60** which circumferentially enclose the wafer cassette **10**. Briefly referring to Figure 7 which is a cross-sectional view from the line X-X in Figure 2, it shows a better illustration of the upper portion **60** and lower portion **70** configured to enclose the wafer cassette **10**. In Figure 3, the side edges of the plurality of walls (**72a**, **72b**, **72c**, **72d**, **72e**) are unconnected. However, it would be contemplated that the side edges of the plurality of walls (**72a**, **72b**, **72c**, **72d**, **72e**) can be connected. Furthermore, it can be appreciated that the arrangement of the plurality of walls (**72a**, **72b**, **72c**, **72d**, **72e**) can be re-configured to suit other shapes and sizes of the wafer cassette or the media handling device.

[0025] Referring to Figure 5, the lower portion **70** of the enclosure **40** comprises a plurality of chambers **74**, wherein the plurality of chambers **74** are disposed at the bottom of the plurality of walls (**72a**, **72b**, **72c**, **72d**, **72e**). The plurality of chambers **74** are coupled to the plurality of depressions **64** via a plurality of conduits **76**, wherein the plurality of conduits **76** are narrow passages that transfers air from the plurality of depressions **64** to the plurality of chambers **74**.

[0026] Figures 6 and 7 illustrates the cross-sectional view of the processing apparatus **4** from the line X-X in Figure 3, showing the air flow from the plurality of depression **64** to the plurality of chambers **74**. The top surface of the upper portion **60** is coupled to the top cover **20** to enclose the plurality of depressions **64**, hence forming a plurality of channels **65**. For illustration purposes, the top cover **20** is removed in Figure 7 to show the flow of the cleaning fluid in the plurality of depressions **64**. The air flow is represented by the arrows indicated with the reference character **8**. The plurality of

conduits **76** connect the plurality of channels **65** to the plurality of chambers **74**, thereby allowing the air to flow **8** from the plurality of channels **65** to the plurality of chambers **74**.

[0027] Referring to Figures 8 and 9, a chamber **74** disposed in sidewall **72c** is coupled to an end cover **50**. In particular, the chamber **74** is enclosed by the end cover **50** to form a reservoir **75**. The reservoir **75** has a V-shaped groove **79**, wherein the groove **79** tapers to a fissure. The reservoir **75** receives air from the conduit **76** and evenly distributes the air to the fissure, wherein the fissure is configured to release a stream of air directed at the wafer cassette **10**. The fissure is referred hereinafter as an outlet **78**. In addition, the groove **76** provides a Venturi effect for the air flow **8** at the reservoir **75**, wherein the pressure of air flow **8** increases as the groove **79** tapers to the outlet **78**. As a result, there is a pressure drop before the groove **79**, thus facilitating the flow **8** of air from the conduit **76** to the reservoir **75**. Furthermore, the Venturi effect increases the speed of the air released through the outlet **78**, thus creating a “jetting effect” of the stream of air directed on the wafer cassette **10**.

[0028] Similarly, the other walls (**72a**, **72b**, **72d**, **72e**) are coupled to the end cover **50** to enclose the plurality of chambers **74** and form a plurality of reservoirs **75**. The plurality of reservoirs **75** having a plurality of outlets **78**, wherein the plurality of outlets **78** are configured to direct the stream of air around the wafer cassette **10**. Specifically, the plurality of outlets **78** are configured to provide 360° all-round release of the stream of air onto the wafer cassette **10**. The plurality of walls (**72a**, **72b**, **72c**, **72d**, **72e**) can be coupled to the end cover **50** by conventional bolts and nuts, or any other similar forms of connection.

[0029] The operation of the processing system **1** will now be described. A transport means (not shown) is used to transport the wafer cassette **10** from a pre-processing station to the processing system **1**, wherein the processing system **1** can be situated in a clean room environment. The transport means is programmable to align the wafer cassette **10** with respect to the processing apparatus **4**. Specifically, the alignment process ensures that the two openings **62** of the processing apparatus **4** receive the wafer cassette **10**. As discussed above, the servo motor **2** is operable to move the processing apparatus **4** with respect to the wafer cassette **10** in a direction parallel to the axis A-A. This allows the openings **62** of the processing apparatus **4** to receive the wafer cassette **10**. Furthermore, the apertures **22** of the top cover **20** allow the wafer cassettes to protrude through, thus

allowing the plurality of outlets **78** to direct streams of air onto the entire wafer cassette **10**. As a result, the processing apparatus **4** provides more effective drying of the wafer cassette **10**.

[0030] After the wafer cassette **10** is maneuvered into the openings **62** of the processing apparatus **4**, air is injected into the plurality of inlets **66**. As mentioned above, an air supply source (not shown) is coupled to the plurality of inlets **66** to deliver the air to the processing apparatus **4**. A pressure regulator can be optionally coupled to the supply source to regulate the pressure of the air injected into the plurality of inlets **52**.

[0031] In Figure 7, air injected into the plurality of inlets **66** disposed at the upper portion **60** of the enclosure **40** flows to the plurality of channels **65**. The plurality of channels **65** in the upper portion **60** distribute the air to the plurality of conduits **76**, wherein the plurality of conduits **76** transfer the air to the plurality of reservoirs **75** in the lower portion **70**. Thereafter, the plurality of reservoirs **75** regulate the air received from the plurality of conduits **76** and release the air through the plurality of outlets **78**. As discussed above, the plurality of outlets **78** are configured to provide 360° all-round release of the stream of air onto the wafer cassette **10**, thereby drying the wafer cassette **10** effectively. Furthermore, the servo motor **2** drives the processing apparatus **4** to receive the wafer cassette **10** or withdraw from the wafer cassette **10**, thus facilitating the stream of air released onto the entire wafer cassette **10** to progress in directions parallel to the axis A-A.

[0032] Furthermore, the two openings **62** facilitate the circulation of the air released therein, thus increasing the drying effect on the wafer cassette **10**. As a result, the drying cycle time is reduced. In addition, the processing system **1** can be programmed to control the speed and movement of the processing apparatus **4** with respect to the wafer cassette **10**, thereby providing a more effective drying process for the wafer cassette **10**. This reduces the drying cycle time, thus providing greater efficiency for the processing system **1**. After the drying process is completed, the processing apparatus **4** is moved away from the wafer cassette **10** to allow the wafer cassette **10** to be transported to other stations. The drying process can be repeated for any subsequent wafer cassettes **10**.

[0033] The processing apparatus **4** according to the afore-described embodiment is configured to receive one wafer cassette **10** to be dried, but it may also be so configured

that two or more wafer cassettes **10** can be accommodated therein simultaneously and dried in one drying cycle.

[0034] While the above description discusses the use of the processing system **1** to dry wafer cassettes **10**, it can be appreciated by one skilled in the art that the processing system **1** can be further used for cleaning wafer cassettes **10**, or the like. In particular, the processing system **1** can be adjusted to receive cleaning fluids for cleaning the wafer cassettes. The cleaning fluid can either be in a liquid or gaseous form. Nevertheless, the principles of releasing the air to dry the wafer cassette are applicable in releasing fluid to clean the wafer cassette.

[0035] While the present invention has been described with reference to particular embodiments, it will be understood that the embodiments are illustrative and that the invention scope is not so limited. Alternative embodiments of the present invention will become apparent to those having ordinary skill in the art to which the present invention pertains. Such alternate embodiments are considered to be encompassed within the spirit and scope of the present invention. Accordingly, the scope of the present invention is described by the appended claims and is supported by the foregoing description.

CLAIMS

1. An apparatus for cleaning or drying a media handling device, the apparatus comprising:

a top cover;

a plurality of bottom panels;

an enclosure disposed between the top cover and the plurality of bottom panels, wherein the enclosure is configured to circumferentially enclose the media handling device, the enclosure having a top surface and a bottom surface; wherein

the top surface having a plurality of depressions, and wherein the top surface is coupled to the top cover to enclose the plurality of depressions, thereby creating a plurality of channels; and

the bottom surface having a plurality of chambers, wherein the plurality of chambers are coupled to the plurality of channels by a plurality of conduits; and

wherein the plurality of bottom panels are coupled to the bottom surface to enclose the plurality of chambers, thereby creating a plurality of reservoirs, the plurality of reservoirs having a plurality of outlets configured to circumferentially surround the media handling device; and

wherein the plurality of channels receive and distribute a fluid to the plurality of reservoirs via the plurality of conduits, wherein the plurality of reservoirs regulate the fluid and evenly distribute the fluid to the plurality of outlets, and wherein the plurality of outlets are configured to release streams of fluid around the media handling device, thereby effectively cleaning or drying the media handling device.

2. The apparatus according to claim 1, wherein a plurality of grooves are formed at the connections between the plurality of chambers and the plurality of bottom panels, wherein the plurality of grooves taper to form the plurality of outlets.

3. The apparatus according to claim 2, wherein the plurality of grooves facilitate the fluid flow from the plurality of conduits to the plurality of outlets, thereby providing a jetting effect of the fluid released onto the media handling device by the plurality of outlets.

4. The apparatus according to claim 1, wherein the enclosure further comprises a plurality of inlets coupled to the plurality of depressions, wherein the plurality of inlets allows the injection of fluid into the plurality of depressions.
5. The apparatus according to claim 4 further comprising a fluid supply source coupled to the plurality of inlets via a fluid pressure regulator, wherein the fluid supply source delivers the fluid to the plurality of inlets, and wherein the fluid pressure regulator controls the pressure of fluid supplied to the plurality of inlets.
6. The apparatus according to claim 5, wherein the fluid can be either gas or liquid.
7. The apparatus according to claim 1 further comprising a seal disposed between the top cover and the top surface of the enclosure, wherein the seal prevents the leakage of fluid from the plurality of channels in the top surface.
8. The apparatus according to claim 1, wherein the top cover comprises a plurality of apertures, wherein the plurality of apertures are configured to allow the media handling device to protrude thereof.
9. The apparatus according to claim 1, wherein the enclosure can be configured to receive a plurality of media handling devices for cleaning or drying.
10. A system for cleaning or drying a media handling device, the system comprising:
 - an apparatus comprising,
 - a top cover;
 - a plurality of bottom panels;
 - an enclosure disposed between the top cover and the plurality of bottom panels, wherein the enclosure is configured to circumferentially enclose the media handling device, the enclosure having a top surface and a bottom surface; wherein

the top surface having a plurality of depressions, and wherein the top surface is coupled to the top cover to enclose the plurality of depressions, thereby creating a plurality of channels; and

the bottom surface having a plurality of chambers, wherein the plurality of chambers are coupled to the plurality of channels by a plurality of conduits; and

wherein the plurality of bottom panels are coupled to the bottom surface to enclose the plurality of chambers, thereby creating a plurality of reservoirs, the plurality of reservoirs having a plurality of outlets configured to circumferentially surround the media handling device; and

wherein the plurality of channels receive and distribute a fluid to the plurality of reservoirs via the plurality of conduits, wherein the plurality of reservoirs regulate the fluid and evenly distribute the fluid to the plurality of outlets, and wherein the plurality of outlets are configured to release streams of fluid around the media handling device, thereby effectively cleaning or drying the media handling device;

an actuator coupled to the upper portion of the apparatus;

a servo motor coupled to the actuator; and

wherein the servo motor is operable to move the actuator, thereby moving the apparatus, wherein the apparatus is movable to enclose the media handling device for cleaning or drying.

11. The system according to claim 10, wherein a plurality of grooves are formed at the connections between the plurality of chambers and the plurality of bottom panels, wherein the plurality of grooves taper to form the plurality of outlets.

12. The system according to claim 11, wherein the plurality of grooves facilitate the fluid flow from the plurality of conduits to the plurality of outlets, thereby providing a jetting effect of the fluid released onto the media handling device by the plurality of outlets.

13. The system according to claim 10, wherein the enclosure further comprises a plurality of inlets coupled to the plurality of depressions, wherein the plurality of inlets allows the injection of fluid into the plurality of depressions.

14. The system according to claim 13 further comprising a fluid supply source coupled to the plurality of inlets via a fluid pressure regulator, wherein the fluid supply source delivers the fluid to the plurality of inlets, and wherein the fluid pressure regulator controls the pressure of fluid supplied to the plurality of inlets.

15. The system according to claim 14, wherein the fluid can be either gas or liquid.

16. The system according to claim 10 further comprising a seal disposed between the top cover and the top surface of the enclosure, wherein the seal prevents the leakage of fluid from the plurality of channels in the top surface.

17. The system according to claim 10, wherein the top cover comprises a plurality of apertures, wherein the plurality of apertures are configured to allow the media handling device to protrude thereof.

18. The system according to claim 10, wherein the enclosure can be configured to receive a plurality of media handling devices for cleaning or drying.

19. The system according to claim 10, wherein the actuator is coupled to the cleaning apparatus via a mounting bracket;

20. The system according to claim 10 further comprising a transfer mechanism for transporting the wafer cassette to the cleaning apparatus.