

APPARATUS AND METHOD FOR TREATING

BACKGROUND OF THE INVENTION

[0001] The present invention disclosed herein relates to a apparatus and
5 method for performing a plasma treatment on an object to be treated.

[0002] Since semiconductor apparatuses are very small and very sensitive
to external impacts, they are not transferred separately and are contained in a
receiving container that is called a tray. The tray has an almost flat rectangular
shape and has a plurality of pocket on the top surface thereof where semiconductor
10 products are received. The tray moves to a place of the next process by tray
conveying equipment.

[0003] Typical practical tray conveying equipment conveys a tray, where a
semiconductor package chip is loaded, to simple logistics moving equipment. Such
a apparatus sequentially transfers trays in order from the lowest one from an onloader
15 stacker where a plurality of trays having seated semiconductor packages are stacked
and tests whether the semiconductor packages in the tray are seated in a correct
direction and then transfers it.

[0004] In general, trays are formed of plastic material and thus have
relatively low heat resistance or durability. Especially, when semiconductor chips
20 are processed in a high temperature and high pressure processing unit, it is difficult
for trays to withstand such environmental conditions. Moreover, when
semiconductor chips loaded in a tray are carried in upside down during a conveying
process, their directions need to be rotated for a process treatment.

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SUMMARY OF THE INVENTION

[0005] The present invention provides a treatment apparatus and method for improving the process efficiency of objects to be treated by dualizing a tray having loaded objects to be treated into a conveying tray and a process tray to provide the process tray having strong heat resistance during a process treatment.

5 **[0006]** The present invention also provides a treatment apparatus and method for turning upside down objects to be treated to perform a smooth process treatment when the objects to be treated, which are loaded in a conveying tray, are carried in with the opposite direction to a process treatment of the objects to be treated.

10 **[0007]** Embodiments of the present invention provide apparatuses for treating an object to be treated. The apparatuses include: a loader unit carrying a conveying tray where a plurality of objects to be treated are disposed into a carrying-in unit; a dumping unit picking up the objects to be treated from the conveying tray and performing a dumping to load the objects to be treated into a process tray; a
15 treatment unit performing a treatment on the objects to be treated after the process tray where the objects to be treated are loaded is carried in; and a conveying unit conveying the conveying tray or the process tray between the carrying-in unit, the dumping unit, and the treatment unit.

[0008] In some embodiments, the conveying tray and the process tray may
20 be formed of different materials.

[0009] In other embodiments, the process tray may be formed of a stronger heat resistance material than the conveying tray.

[0010] In still other embodiments, the process tray may be formed of ceramic material and the conveying tray may be formed of plastic material.

[0011] In even other embodiments, the loader unit may include: a main loader picking up the conveying tray and carrying the picked up conveying tray into a standby unit; a sub loader picking up a cover member at a top of the conveying tray and positioning the picked up cover member at one side of the standby unit; and a
5 push member pushing the conveying tray having the cover member removed, from the standby unit toward the carrying-in unit.

[0012] In yet other embodiments, the dumping unit may include: a first dumping support where the conveying tray is disposed; a second dumping support where the process tray is disposed; and a dumping member transferring the objects to
10 be treated between the conveying tray and the process tray.

[0013] In further embodiments, the treatment unit may include: a process chamber having a space therein; a support member disposed inside the process chamber and supporting the process tray; and a plasma supply unit supplying plasma into the process chamber.

15 **[0014]** In still further embodiments, the conveying unit may include: a first conveying unit conveying the conveying tray between the carrying-in unit and the dumping unit; a second conveying unit carrying the conveying tray, where the objects are treated completely in the treatment unit and are loaded completely, to the outside of the dumping unit; and a third conveying unit conveying the process tray
20 between the dumping unit and the treatment unit.

[0015] In even further embodiments, the second conveying unit may convey the conveying tray where the dumping to the process tray is completed by the dumping unit to the outside of the dumping unit.

[0016] In yet further embodiments, the apparatuses may further include a standby part where the conveying tray carried out from the dumping unit stays temporarily after the dumping to the process tray is completed by the dumping unit.

[0017] In yet further embodiments, the apparatuses may further include a carrying-out unit carrying the conveying tray, where the objects are treated completely in the treatment unit and are loaded completely, to the outside of the apparatus.

[0018] In yet further embodiments, the apparatuses may further include a reverse unit reversing the objects to be treated.

[0019] In yet further embodiments, the carrying-in unit, the reverse unit, and the dumping unit may be sequentially disposed along a first direction.

[0020] In yet further embodiments, the treatment unit and the dumping unit may be disposed along a second direction vertical to the first direction as seen from the top.

[0021] In yet further embodiments, the conveying tray may include: a first conveying tray where the objects to be treated are loaded and carried in before the treatment; and an empty second conveying tray where no objects to be treated are loaded, wherein the reverse unit may include: a reverse support where the first conveying tray is disposed; a buffer support where the second conveying tray is disposed; and a reverse driving member rotating the first conveying tray and the second conveying tray on the first conveying tray by 180 degrees to allow the objects to be treated to be transferred and loaded from the first conveying tray to the second conveying tray.

[0022] In yet further embodiments, the apparatuses may further include: a radio frequency identifier indicating a type of the objects loaded into the first

conveying tray and configured to be detachable from the first conveying tray; and a radio frequency identification reader reading the radio frequency identifier, wherein the process tray may include: a first process tray where objects to be treated, which require a reverse in the reverse unit, are loaded; a second process tray where objects to be treated, which require no reverse in the reverse unit, are loaded, wherein the radio frequency identification reader may determine whether to provide the first process tray or the second process tray to the second dumping support and whether to carry the first conveying tray into the reverse unit, according to a reading result of the radio frequency identification reader.

10 **[0023]** In other embodiments of the present invention, provided are methods of treating an object to be treated. The methods include: carrying in a conveying tray where a plurality of objects to be treated are loaded; picking up the objects to be treated from the conveying tray and performing a dumping to load the objects to be treated into a process tray; and performing a treatment on the objects to be treated after the process tray where the objects to be treated are loaded is carried into a treatment unit.

[0024] In some embodiments, the conveying tray and the process tray may be formed of different materials.

20 **[0025]** In other embodiments, the process tray may be formed of a stronger heat resistance material than the conveying tray.

[0026] In still other embodiments, the process tray may be formed of ceramic material and the conveying tray may be formed of plastic material.

[0027] In even other embodiments, the methods may further include reversing the objects to be treated before the dumping of the objects to be treated.

[0028] In yet other embodiments, the conveying tray may include: a first conveying tray where the objects to be treated are loaded and carried in before the treatment; and an empty second conveying tray where no objects to be treated are loaded, wherein the reversing of the objects to be treated may include: positioning
5 the first conveying tray on a reverse support and positioning the second conveying tray on a buffer support; positioning the second conveying tray on the first conveying tray; and rotating the first conveying tray and the second conveying tray on the first conveying tray by 180 degrees at the same time.

[0029] In further embodiments, the process tray may include: a first process
10 tray where objects to be treated, which require a reverse in the reverse unit, are loaded; a second process tray where objects to be treated, which require no reverse in the reverse unit, are loaded, wherein the reversing of the objects to be treated may be performed selectively. The methods may further include determining whether to perform the reversing of the objects to be treated before the carrying in of the
15 conveying tray, wherein the determining of whether to perform the reversing of the objects to be treated may include: if the reverse is necessary, providing the process tray to the first process tray during the dumping of the objects to be treated and performing the reversing of the objects to be treated; and if the reverse is unnecessary, providing the process tray to the second process tray during the
20 dumping of the objects to be treated and not performing the reversing of the objects to be treated.

[0030] In still further embodiments, the determining of the objects to be treated may be performed by reading a radio frequency identification through a radio frequency identification reader, wherein the radio frequency identification indicates a

type of the objects loaded into the first conveying tray and is detachable from the first conveying tray.

BRIEF DESCRIPTION OF THE DRAWINGS

- 5 **[0031]** The accompanying drawings 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 drawings:
- 10 **[0032]** FIG. 1 is a plan view illustrating a treatment apparatus according to an embodiment of the present invention;
- [0033]** FIG. 2 is a sectional view illustrating a conveying tray conveyed by a loader unit of FIG. 1;
- [0034]** FIG. 3 is a plan view illustrating a conveying tray conveyed in a
- 15 treatment apparatus of FIG. 1;
- [0035]** FIG. 4 is a plan view illustrating a dumping unit of FIG. 1;
- [0036]** FIG. 5 is a sectional view illustrating a treatment unit of FIG. 1;
- [0037]** FIG. 6 is a perspective view illustrating a reverse unit of FIG. 1;
- [0038]** FIG. 7 is a plan view illustrating a carrying-out unit of FIG. 1; and
- 20 **[0039]** FIG. 8 is a flowchart illustrating a treatment method sequentially according to an embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

- [0040]** Hereinafter, various embodiments of the present invention will be
- 25 described with reference to the accompanying drawings. However, embodiments of

the present invention may be modified in various forms, and the scope of the present invention is not limited to the following embodiments. These embodiments are provided so that the present invention will be further completely described to those skilled in the art. Accordingly, the forms of elements in the drawings are
5 exaggerated for clarity of description.

[0041] Hereinafter, a treatment apparatus 10 according to an embodiment of the present invention will be described.

[0042] FIG. 1 is a plan view illustrating a treatment apparatus according to an embodiment of the present invention. Referring to FIG. 1, the treatment
10 apparatus 10 includes a loader unit 1000, a dumping unit 200, a treatment unit 3000, a conveying unit 4000, a reverse unit 5000, a standby unit 6100, a carrying-in unit 6200, a carrying-out unit 6400, a radio frequency identifier 8100, and a radio frequency identification reader 8200. The dumping unit 200, the carrying-out unit 6400, the reverse unit 5000, and the carrying-in unit 6200 are sequentially disposed
15 along one direction. A direction in which the dumping unit 200, the carrying-out unit 6400, the reverse unit 5000, and the carrying-in unit 6200 are arranged is referred to as a first direction 1 and a direction vertical to the first direction (when seen from the top) is referred to as a second direction 2. The dumping unit 2000 and the treatment unit 3000 are disposed along the second direction 2.

20 **[0043]** The loader unit 1000 carries a conveying tray 7200, where a plurality of objects 20 to be treated are loaded, into the carrying-in unit 6200. The loader unit 7200 moves along a rail provided on the treatment apparatus 10 with its length direction parallel to the first direction 1 to convey the conveying tray 7200 or to move a cover member on the conveying tray 7200. The loader unit 1000
25 includes a main loader 1100, a sub loader 1200, and a push member 1300.

[0044] FIG. 2 is a sectional view illustrating the conveying tray 7200 conveyed by the loader unit 1000 of FIG. 1. Referring to FIG. 2, a plurality of conveying trays 7200 are stacked vertically and conveyed by the loader unit 100.

[0045] The top of the conveying tray 7200 is covered by a cover member 7230. The cover member 7230 protects objects 20 to be treated on the uppermost conveying tray 7200 from external impacts.

[0046] The radio frequency identifier (for example, RFID) 8100 may be provided between the conveying tray 7200 and the cover member 7230.

[0047] Referring to FIG. 1 again, the main loader 1100 picks up the conveying tray 7200 from an entrance 6600 and carries the conveying tray 7200 into the standby unit 6100. Additionally, the main loader 1100 carries the conveying tray 7200 carried from the carrying-out unit 6400 to the entrance 6600.

[0048] The sub loader 1200 picks up the cover member 7230 on the top of the conveying tray 7200 to be carried in and then positions the cover member 7230 at one side 6500 of the standby unit 6100. Additionally, the sub loader 1200 picks up the cover member 7230 at one side 6500 of the standby unit 6100 and then covers the top of the conveying tray 7200 carried from the carrying-out unit 6400 with the cover member 7230.

[0049] The push member 1300 pushes the conveying tray 7200 without the cover member 7230 from the standby unit 6100 toward the carrying-in unit 6200. When a plurality of stacked conveying trays 7200 are provided to the standby unit 6100, the push member 1300 sequentially pushes the conveying trays 7200 in order from the lowest one toward the carrying-in unit 6200.

[0050] The dumping unit 2000 picks up the objects 20 to be treated from the conveying tray 7200 and performs dumping to load them into the process tray

7100. Additionally, the dumping unit 2000 picks up the objects 20 to be treated, which are treated completely by the treatment unit 3000, from the process tray 7100 and performs dumping to load them into the conveying tray 7200. The dumping unit 200 includes a first dumping support 2100, a second dumping support 2200, and
5 a dumping member 2300.

[0051] FIG. 3 is a plan view illustrating the conveying tray 7200 where the object 20 to be treated by the treatment apparatus 10 is disposed. Referring to FIG. 3, the conveying tray 7200 is provided in a roughly rectangular plate form. A plurality of objects 20 to be treated may be disposed on the top of the conveying tray
10 7200. The objects 200 to be treated are arranged in a matrix on the conveying tray 7200. The conveying tray 7200 supports a plurality of objects 20 to be treated when conveying the objects 20 to be treated between units of the treatment apparatus 10, excluding the treatment unit 300.

[0052] The process tray 7100 has a similar structure to the conveying tray
15 7200. The process tray 7100 is carried in or carried-out from the treatment unit 300, while a plurality of objects 20 to be treated are disposed on the process tray 7200.

[0053] The conveying tray 7200 and the process tray 7100 are formed of different materials. The process tray 7100 is formed of a stronger heat resistance material than the conveying tray 7200. For example, the process tray 7100 may be
20 formed of ceramic material and the conveying tray may be formed of plastic material. Unlike a typical treatment apparatus in which only objects are treated in a treatment unit, according to the treatment apparatus 10 of the present invention, a plurality of objects to be treated are loaded into the process tray 7100 formed of a strong heat resistance material and then are treated in the treatment unit 300. Thus, compared

to a typical treatment apparatus, a large amount of objects are treated at the same time.

[0054] FIG. 4 is a perspective view illustrating the dumping unit 2000 of FIG. 1. Referring to FIG. 4, the conveying tray 7200 is disposed on the first dumping support 2100. The process tray 7100 is disposed on the second dumping support 2200. The dumping member 7300 transfers the objects 20 to be treated between the conveying tray 7200 and the process tray 7100. For example, the dumping member 7300 moves in parallel to the first direction 1 and transfers the objects 20 to be treated. Simultaneously, along the second direction 2 by a predetermined interval, the conveying tray 7200 on the first dumping support 2100 moves from a first position 2110 to a second position 2120 and the process tray 7100 on the second dumping support 2200 moves from a third position 2210 to a fourth position 2220. Thereby, a portion where the objects 20 to be treated are disposed and a portion where the objects 20 to be treated are to be disposed are positioned at a place where the dumping member 7300 transfers the objects 20 to be treated.

[0055] Referring to FIG. 1 again, the treatment apparatus 10 may further include a standby part 6300. When the objects 20 to be treated in the conveying tray 7200 are sequentially dumped in the process tray 7100 by each conveying tray 7200, the first dumped conveying tray 7200 may stand by in the standby part 6300 until the dumping of a later conveying tray 7200 is completed. For example, when two conveying trays 7200 are dumped sequentially, while the objects 20 are treated in the treatment unit 3000, the later dumped conveying tray 7200 stands by on the first dumping support 2100 and the first dumped conveying tray 7200 stands by in the standby part 6300 until the dumping of the later conveying tray 7200 is completed. After the treatment is completed in the treatment unit 3000, the objects

20 to be treated are dumped from the process tray 7100 to the two conveying trays 7200 in the reverse order of dumping the objects 20 to the process tray 7100. The conveyance of the conveying tray 7200 between the first dumping support 2100 and the standby part 6300 may be performed by the second conveying unit 4200.

5 Accordingly, the objects 20 to be treated in the two conveying trays 7200 may be dumped and treated in the treatment unit 3000 simultaneously.

[0056] FIG. 5 is a sectional view illustrating the treatment unit 3000 of FIG.

1. Referring to FIG. 5, the process tray 7100 having loaded objects 20 to be treated are carried in the treatment unit 3000 and then a treatment is performed on the
10 objects 20 to be treated. The treatment unit 3000 may be a remote type plasma treatment unit.

[0057] The treatment unit 3000 includes a process chamber 3100, a support unit 3200, a shower head 3300, and a plasma supply unit 3400.

[0058] The process chamber 3100 provides a space where a process
15 treatment is performed. The process chamber 3100 has a body 3110 and a sealing cover 3120. The body 3110 has an open top surface and a space therein. An opening (not shown) through which the process tray 7100 having a plurality of objects 20 to be treated enters may be formed at the top of the sidewall of the body 3110 and may be opened/closed by a opening/closing member such as a slit door (not
20 shown). The opening/closing member closes the opening while the objects 20 are treated in the process chamber 3100 and opens the opening while the process tray 7100 is carried in the process chamber 3100 and carried out to the outside of the process chamber 3100.

[0059] A discharge hole 3111 is formed at the bottom wall of the body
25 3110. The discharge hole 3111 is connected to a discharge line 3112. The internal

pressure of the process chamber 3100 is adjusted and by-products generated from a process are discharged to the outside of the process chamber 3100 through the discharge line 3112.

[0060] The sealing cover 3120 is coupled with the top wall of the body 3110 and covers the open top surface of the body 3110 to seal the inside of the body 3110. The top end of the sealing cover 3120 is connected to the plasma supply unit 3400. A diffusion space 3121 is formed below the sealing cover 3120. The diffusion space 3121 becomes broader as it becomes closer to the shower head 3300. For example, the diffusion space 3121 has a reverse funnel form.

[0061] The support unit 3200 is disposed inside the process chamber 3100. The process tray 7100 having the objects 20 to be treated are disposed on the top surface of the support unit 3200. A cooling channel (not shown) where cooling fluid circulates may be formed inside the support unit 3200. The cooling fluid circulates along the cooling channel and cools the support unit 3200 and the process tray 7100. Power may be applied from a bias power 3210 to the support unit 3200 so as to adjust the treatment degree of the objects 20 to be treated by plasma. The power that the bias power 3210 applies may be radio frequency (RF) power. The support unit 3200 forms sheaths by a power that the bias power 3210 supplies and improves process capability by forming high density plasma in the area where the sheaths are formed.

[0062] The shower head 3300 is coupled with the top wall of the body 3110. The shower head 3300 may have a disc form and may be disposed in parallel to the top surface of the support unit 3200. The surface of the shower head 3300 may be formed of oxidized aluminum. Distribution holes 3310 are formed at the shower head 3300. The distribution holes 3310 may be formed at predetermined intervals

on the concentric circumference in order for uniform radical supply. Plasma diffused in the diffusion space 3121 flows into the distribution holes 3310. At this point, charged particles such as electronic or ions are trapped in the shower head 3300 and uncharged neutral particles such as oxygen radicals penetrate the
5 distribution holes 3310 to be supplied to the objects 20 to be treated. Additionally, the shower head 3300 may be grounded to form a path through which electrons or ions move.

[0063] The plasma supply unit 3400 generates plasma and supplies it to the inside of the process changer 3100. The plasma supply unit 3400 may be disposed
10 at the top of the process chamber 3100. The plasma supply unit 3400 includes an oscillator 3410, a waveguide 3420, a dielectric pipe 3430, and a process gas supply unit 3440.

[0064] The oscillator 3410 generates electromagnetic wave. The waveguide 3420 connects the oscillator 3410 and the dielectric pipe 3430 and
15 provides a path through which electromagnetic wave generated from the oscillator 3410 is delivered to the inside of the dielectric pipe 3430. The process gas supply unit 3440 supplies process gas to the inside of the dielectric pipe 3430. The process gas may include oxygen and nitrogen. Additionally, the process gas may include fluorine-based gas. A process supplied to the inside of the dielectric pipe 3430 is
20 excited to a plasma state by electromagnetic wave. Plasma flows into the diffusion space 3121 via the dielectric pipe 3430.

[0065] Referring to FIG. 1 again, the conveying unit 4000 conveys the conveying tray 7200 or the process tray 7100 between the carrying-in unit 6200, the dumping unit 2000, and the treatment unit 3000. The conveying unit 4000 includes

a first conveying unit 4100, a second conveying unit 4200, and a third conveying unit 4300.

[0066] The first conveying unit 4100 moves along a rail provided on the treatment apparatus 10 with its length direction parallel to the first direction 1 and conveys the conveying tray 7200. When objects 20 to be treated need to be reversed in the reverse unit 5000, the first conveying unit 4100 conveys the conveying tray 7200 between the carrying-in unit 6200 and the reverse unit 5000, between the reverse unit 5000 and the dumping unit 2000, or between the reverse unit 5000 and the carrying-out unit 6400. When objects 20 to be treated do not need to be reversed in the reverse unit 5000, the first conveying unit 4100 conveys the conveying tray 7200 between the carrying-in unit 6200 and the dumping unit 2000 or between the dumping unit 2000 and the carrying-out unit 6400.

[0067] The second conveying unit 4200 moves along a rail provided on the treatment apparatus 10 with its length direction parallel to the first direction 1 and conveys the conveying tray 7200. The second conveying unit 4200 and the first conveying unit 4100 are disposed sequentially along the second direction 2. The second conveying unit 4200 conveys the conveying tray 7200 between the dumping unit 2000 and the standby part 6300 or between the dumping unit 2000 and the carrying-out unit 6400. For example, the conveying tray 7200 where the objects 20 are treated completed in the treatment unit 3000 and are loaded completely may be conveyed to the carrying-out unit 6400 disposed outside the dumping unit 2000. Additionally, the second conveying unit 6400 may convey the conveying tray 7200, where dumping is completed to the process tray 7100 in the dumping unit 2000, to the standby part 6300 at the outside of the dumping unit 2000.

[0068] The third conveying unit 4300 moves along a rail provided on the treatment apparatus 10 with its length direction parallel to the second direction 2 and conveys the process tray 7100. The third conveying unit 4300 conveys the process tray 7100 between the dumping unit 2000 and the treatment unit 3000.

5 **[0069]** FIG. 6 is a perspective view illustrating the reverse unit 5000 of FIG. 1. Referring to FIGS. 1 and 6, the reverse unit 5000 reverses the objects 20 to be treated upside down. The reverse unit 5000 includes a reverse support 5100, a buffer support 5200, and a driving member 5300.

[0070] The conveying tray 7200 includes a first conveying tray 7210 and a
10 second conveying tray 7220.

[0071] The conveying tray 7200 includes the first conveying tray 7210 that has the objects 20 to be treated before treatment from the treatment unit 3000 and is conveyed into the treatment apparatus 10 and the second conveying tray 7220 that is provided in an empty state without the objects 20 to be treated.

15 **[0072]** The conveyed first conveying tray 7210 is disposed on the reverse support 5100. The empty second conveying tray 7220 is disposed on the buffer support 5200. The second conveying tray 7220 is picked up by the first conveying unit 4100 and then is disposed on the first conveying tray 7210 to allow the surface receiving the objects 20 to be treated to face the first conveying tray 7210.

20 **[0073]** The reverse driving member 5300 rotates the first conveying tray 7210 and the second conveying tray 7220 on the first conveying tray 7210 by 180 degrees at the same time to allow the objects 20 to be treated to transfer from the first conveying tray 7210 to the second conveying tray 7220 and to be loaded. According to an embodiment of the present invention, the reverse driving member
25 5300 includes a driver 5310, a driving axis 5320, and a fixing member 5330. The

driver 5310 generates a driving power for reversing the first conveying tray 7210 and the second conveying tray 7220. The driving axis 5320 delivers the driving power generated by the driver 5310 to the fixing member 5330. The fixing member 5330 fixes the first conveying tray 7210 and the second conveying tray 7220 mutually and
5 rotates the first conveying tray 7210 and the second conveying tray 7220 by 180 degrees by using the driving power delivered from the driving axis 5320. Unlike this, the reverse unit 5000 may reverse the objects 20 to be treated upside down through various methods.

[0074] FIG. 7 is a plan view illustrating the carrying-out unit 6400 of FIG.
10 1. Referring to FIGS. 1 and 7, the carrying-out unit 6400 carries the conveying tray 7200, where the objects 20 are completely treated in the treatment unit 3000 and are loaded, to the outside of a apparatus. The carrying-out unit 6400 is provided with its length direction parallel to the second direction 2. The carrying-out unit 6400 moves the conveying tray 7200 along the second direction 2. Accordingly, the
15 carrying-out unit 6400 conveys the conveying tray 7200 between a position at which the first conveying unit 4100 picks up the conveying tray 7200, a position at which the second conveying unit 4200 picks up the conveying tray 7200, and a position at which the loader unit 1000 picks up the conveying tray 7200. For example, the conveying tray 7200 conveyed from the dumping unit 2000 to the carrying-out unit
20 6400 by the first conveying unit 4100 or the second conveying unit 4200 moves to the position at which the loader unit 1000 picks up the conveying tray 7200 by the carrying-out unit 6400 in parallel to the second direction 2. Then, the conveying tray 7200 is carried to the outside of a apparatus by the loader unit 1000.

[0075] The process tray 7100 includes a first process tray 7110 and a
25 second process tray 7120. The first process tray 7110 is the process tray 7100

where the objects 20 that does not require reversal in the reverse unit 5000 are loaded.
The second process tray 7120 is the process tray 7100 where the objects 20 that do not require reversal in the reverse unit 5000 are loaded.

[0076] Referring to FIGS. 1 and 2 again, the radio frequency identifier 8100
5 indicates whether the reverse of the objects 20 disposed on the first conveying tray 7210 is required in the reverse unit 5000. The radio frequency identifier 8100 is detachable from the first conveying tray 7210. For example, the radio frequency identifier 8100 is attached to the bottom of the cover member 7230 and is picked up together with the cover member 7230 by the sub loader 1200 before being carried
10 into the carrying-in unit 6200 and then is positioned at one side 6500 of the standby unit 6100.

[0077] The radio frequency identification reader 8200 is provided at the entrance 6600 and reads the radio frequency identifier 8100 attached to the first conveying tray 7210 before it is carried into the standby unit 6100. The radio
15 frequency identification reader 8200 determines whether to provide the first process tray 7110 or the second process tray 7210 to the second dumping support 2200 and whether to provide the first conveying tray 7210 to the reverse unit 5000, according to the reading result. When the type of the process tray 7100 is determined, according to the result, the first process tray 7110 or the second process tray 7120 are
20 disposed on the second dumping support 2200 from the outside by a process tray conveying unit (not shown).

[0078] Hereinafter, for easy description of a treatment method, a treatment method according to an embodiment of the present invention is described by using the treatment apparatus 10 of FIG. 1.

[0079] FIG. 8 is a flowchart illustrating a treatment method sequentially according to an embodiment of the present invention. Referring to FIGS. 1 and 8, the treatment method includes determining whether the reverse of the object 20 to be treated is required in operation S1, carrying in the conveying tray 7200 having the loaded objects 20 to be treated in operation S2, reversing the objects 20 to be treated in operation S3, picking up the objects 20 to be treated from the conveying tray 7200 and loading them into the process tray 7100 in operation S4, performing a treatment on the objects 20 to be treated in the process unit 3000 in operation S5, and carrying out the objects 20 to the outside in operation S6.

[0080] In operation S1, it is determined whether the reverse of the objects 20 to be treated is required by reading the radio frequency identifier 8100 through the radio frequency identification reader 8200. The radio frequency identifier 8100 indicates the type of the objects 20 loaded into the first conveying tray 7210 and is detachable from the first conveying tray 7210. In operation S1, if the reverse is required, the process tray 7100 is provided to the first process tray 7110 to perform operation S3 and if the reverse is not required in operation S1, the process tray 7100 is provided to the second process tray 7120 not to perform operation S3.

[0081] In operation S2, the main loader 1100 conveys the first conveying tray 7210 provided at the entrance 6600 to the standby unit 6100. The sub loader 1200 picks up the cover member 7230 covering the top of the first conveying tray 7210 disposed at the standby unit 6100 and places the cover member 7230 at one side 6500 of the standby unit 6100. In this case, the radio frequency identifier 8100 is picked up together with the cover member 7230 and then is placed at one side 6500 of the standby unit 6100. Then, the push member 1300 pushes the first

conveying tray 7210 from the standby unit 6100 toward the carrying-in unit 6200. When a plurality of first conveying trays 7210 are stacked and provided, the push member 1300 sequentially pushes the first conveying trays 7210 one by one in order from the lowest one, from the standby unit 6100 toward the carrying-in unit 6200.

5 **[0082]** Operation S3 may be performed selectively if necessary. Operation S3 includes: preparing the first conveying tray 7210 on the reverse support 5100 and the second conveying tray 7220 on the buffer support 5200; placing the second conveying tray 7220 on the first conveying tray 7210; and simultaneously rotating the first conveying tray 7210 and the second conveying tray 7220 on the first
10 conveying tray 7210 by 180 degrees.

[0083] During the preparing of the conveying tray, if the object 20 to be treated needs to rotate, the first conveying unit 4100 conveys the first conveying tray 7210 on the carrying-in unit 6200 to the reverse support 5100. The empty second conveying tray 7220 is disposed on the buffer support 5200.

15 **[0084]** During the placing of the conveying tray, the first conveying unit 4100 picks up the second conveying tray 7220 on the buffer support 5200 and places it on the first conveying tray 7210 on the reverse support 5100. In this case, the second conveying tray 7220 is disposed on the first conveying tray 7210 to allow the surface receiving the objects 20 to be treated to face the first conveying tray 7210.

20 **[0085]** During the rotating of the conveying tray, the fixing member 5330 fixes the first conveying tray 7210 and the second conveying tray 7220 mutually. The first conveying tray 7210 and the second conveying tray 7220 rotate 180 degrees by the driving member 5300 at the same time, so that the top and bottom are reversed. Accordingly, the objects 20 to be treated are transferred from the first conveying tray
25 7210 to the second conveying tray 7220 and then are loaded.

[0086] In operation S4, if the reverse of the object 20 to be treated is required, the second conveying tray 7220, where the object 20 that is reversed in the reverse unit 5000 is loaded, is conveyed to the first position 2110 of the first dumping support 2100 by the first conveying unit 4100. If the reverse of the object 20 to be treated is not required, the first conveying tray 7210 carried into the carrying-in unit 6200 in operation S2 is conveyed to the first position 2110 of the first dumping support 2100 by the first conveying unit 4100. The dumping member 7300 transfers the objects 20 to be treated in a reciprocating manner in parallel to the first direction 1. Simultaneously, along the second direction 2 by a predetermined interval, the first conveying tray 7210 or the second conveying tray 720 on the first dumping support 2100 moves from a first position 2110 to a second position 2120 and the process tray 7100 on the second dumping support 2200 moves from a third position 2210 to a fourth position 2220. Thereby, a portion where the objects 20 to be treated are disposed and a portion where the objects 20 to be treated are to be disposed are positioned at a place where the dumping member 7300 transfers the objects 20 to be treated.

[0087] In operation S5, the process tray 7100 where the loading of the objects 20 to be treated is completed in operation S4 is conveyed to the support unit 3200 by the third conveying unit 4300. The treatment unit 3000 performs a treatment on the objects 20 to be treated on the process tray 7100 carried in the treatment unit 3000.

[0088] In operation S6, the process tray 7100 where the objects 20 treated completely by the treatment unit 3000 are loaded is conveyed to the dumping unit 2000 by the third conveying unit 4300. Then, the objects 20 are dumped to the conveying tray 7200. After dumping, the conveying tray 7200 where the objects 20

that requires reverse are loaded is reversed in the reverse unit 5000 and then is conveyed to the discharge unit 6400 and the conveying tray 7200 where the objects 20 that requires no reverse is immediately conveyed to the discharge unit 6400. The conveying tray 7200 disposed on the discharge unit 6400 moves by the
5 discharge unit 6400 in parallel to the second direction 2 and then is disposed at a position where the conveying tray 7200 is picked up by the loader unit 1000. Then, the sub loader 1200 picks up the cover member 7230 and covers the top surface of the conveying tray 7200 and the main loader 1100 carries the conveying tray 7200 covered by the cover member 7230 to the entrance 6600.

10 **[0089]** As mentioned above, according to a treatment apparatus and method of the present invention, by using the radio frequency identifier 8100 and the radio frequency identification reader 8200, it is determined whether the objects 20 to be treated requires reverse. If the reverse is required, the reverse is performed on the objects 20 to be treated. Therefore, both the objects 20 that require reverse or the
15 objects 20 that require no reverse may be treated. Additionally, the objects 20 to be treated are loaded to the process tray 7100 that is very resistant to heat and then are treated, so that a large number of the objects 20 may be treated at the same time.

[0090] According to an embodiment of the present invention, a treatment apparatus and method improve the process efficiency of objects to be treated by
20 dualizing a tray having loaded objects to be treated into a conveying tray and a process tray to provide the process tray having strong heat resistance during a process treatment.

[0091] Further more, according to an embodiment of the present invention, a processing apparatus and method turn upside down objects to be treated to perform
25 a smooth process treatment when the objects to be treated, which are loaded in a

conveying tray, are carried in with the opposite direction to a process treatment of the objects to be treated.

[0092] The above-disclosed subject matter is to be considered illustrative, and not restrictive, and the appended claims are intended to cover all such
5 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.

10

WHAT IS CLAIMED IS:

1. A apparatus for treating an object to be treated, the apparatus comprising:

5 a loader unit carrying a conveying tray where a plurality of objects to be treated are disposed into a carrying-in unit;

a dumping unit picking up the objects to be treated from the conveying tray and performing a dumping to load the objects to be treated into a process tray;

a treatment unit performing a treatment on the objects to be treated after the process tray where the objects to be treated are loaded is carried in; and

10 a conveying unit conveying the conveying tray or the process tray between the carrying-in unit, the dumping unit, and the treatment unit.

2. The apparatus of claim 1, wherein the conveying tray and the process tray are formed of different materials.

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3. The apparatus of claim 2, wherein the process tray is formed of a stronger heat resistance material than the conveying tray.

4. The apparatus of claim 3, wherein the process tray is formed of ceramic material and the conveying tray is formed of plastic material.

20

5. The apparatus of claim 1, wherein the loader unit comprises:

a main loader picking up the conveying tray and carrying the picked up conveying tray into a standby unit;

a sub loader picking up a cover member at a top of the conveying tray and positioning the picked up cover member at one side of the standby unit; and

a push member pushing the conveying tray having the cover member removed, from the standby unit toward the carrying-in unit.

5

6. The apparatus of claim 1, wherein the dumping unit comprises:

a first dumping support where the conveying tray is disposed;

a second dumping support where the process tray is disposed; and

a dumping member transferring the objects to be treated between the
10 conveying tray and the process tray.

7. The apparatus of claim 1, wherein the treatment unit comprises:

a process chamber having a space therein;

a support member disposed inside the process chamber and supporting the
15 process tray; and

a plasma supply unit supplying plasma into the process chamber.

8. The apparatus of claim 1, wherein the conveying unit comprises:

a first conveying unit conveying the conveying tray between the carrying-in
20 unit and the dumping unit;

a second conveying unit carrying the conveying tray, where the objects are treated completely in the treatment unit and are loaded completely, to the outside of the dumping unit; and

a third conveying unit conveying the process tray between the dumping unit
25 and the treatment unit.

9. The apparatus of claim 8, wherein the second conveying unit may convey the conveying tray where the dumping to the process tray is completed by the dumping unit to the outside of the dumping unit.

5

10. The apparatus of claim 1, further comprising a standby part where the conveying tray carried out from the dumping unit stays temporarily after the dumping to the process tray is completed by the dumping unit.

10 11. The apparatus of claim 1, further comprising a carrying-out unit carrying the conveying tray, where the objects are treated completely in the treatment unit and are loaded completely, to the outside of the apparatus.

12. The apparatus of any one of claims 1 to 11, further comprising a
15 reverse unit reversing the objects to be treated.

13. The apparatus of claim 12, wherein the carrying-in unit, the reverse unit, and the dumping unit are sequentially disposed along a first direction.

20 14. The apparatus of claim 13, wherein the treatment unit and the dumping unit are disposed along a second direction vertical to the first direction as seen from the top.

15. The apparatus of claim 12, wherein the conveying tray comprises:

a first conveying tray where the objects to be treated are loaded and carried
in before the treatment; and

an empty second conveying tray where no objects to be treated are loaded,
wherein the reverse unit comprises:

5 a reverse support where the first conveying tray is disposed;
a buffer support where the second conveying tray is disposed; and

a reverse driving member rotating the first conveying tray and the second
conveying tray on the first conveying tray by 180 degrees to allow the objects to be
treated to be transferred and loaded from the first conveying tray to the second
10 conveying tray.

16. The apparatus of claim 15, further comprising:

a radio frequency identifier indicating a type of the objects loaded into the
first conveying tray and configured to be detachable from the first conveying tray;

15 and

a radio frequency identification reader reading the radio frequency identifier,
wherein the process tray comprises:

a first process tray where objects to be treated, which require a reverse in the
reverse unit, are loaded;

20 a second process tray where objects to be treated, which require no reverse
in the reverse unit, are loaded,

wherein the radio frequency identification reader determines whether to
provide the first process tray or the second process tray to the second dumping
support and whether to carry the first conveying tray into the reverse unit, according
25 to a reading result of the radio frequency identification reader.

17. A method of treating an object to be treated, the method comprising:
carrying in a conveying tray where a plurality of objects to be treated are
loaded;
- 5 picking up the objects to be treated from the conveying tray and performing
a dumping to load the objects to be treated into a process tray; and
performing a treatment on the objects to be treated after the process tray
where the objects to be treated are loaded is carried into a treatment unit.
- 10 18. The apparatus of claim 17, wherein the conveying tray and the
process tray are formed of different materials.
19. The method of claim 18, wherein the process tray is formed of a
stronger heat resistance material than the conveying tray.
- 15 20. The method of claim 19, wherein the process tray is formed of
ceramic material and the conveying tray is formed of plastic material.
21. The method of claim 17, further comprising reversing the objects to
20 be treated before the dumping of the objects to be treated.
22. The method of claim 21, wherein the conveying tray comprises:
a first conveying tray where the objects to be treated are loaded and carried
in before the treatment; and
25 an empty second conveying tray where no objects to be treated are loaded,

wherein the reversing of the objects to be treated comprises:
positioning the first conveying tray on a reverse support and positioning the
second conveying tray on a buffer support;
positioning the second conveying tray on the first conveying tray; and
5 rotating the first conveying tray and the second conveying tray on the first
conveying tray by 180 degrees at the same time.

23. The method of claim 22, wherein the process tray comprises:
a first process tray where objects to be treated, which require a reverse in the
10 reverse unit, are loaded;
a second process tray where objects to be treated, which require no reverse
in the reverse unit, are loaded,
wherein the reversing of the objects to be treated is performed selectively,
further comprising determining whether to perform the reversing of the
15 objects to be treated before the carrying in of the conveying tray,
wherein the determining of whether to perform the reversing of the objects
to be treated comprises:
if the reverse is necessary, providing the process tray to the first process tray
during the dumping of the objects to be treated and performing the reversing of the
20 objects to be treated; and
if the reverse is unnecessary, providing the process tray to the second
process tray during the dumping of the objects to be treated and not performing the
reversing of the objects to be treated.

24. The method of claim 23, wherein the determining of the objects to be treated is performed by reading a radio frequency identification through a radio frequency identification reader, wherein the radio frequency identification indicates a type of the objects loaded into the first conveying tray and is detachable from the

5 first conveying tray.