GAS PURGE DEVICE AND GAS PURGE METHOD

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to gas purge of a container in which semiconductor substrates or the like are accommodated.

Description of the Related Art

[0002] Articles such as semiconductor substrates or reticles are accommodated in a container such as a FOUP or a reticle pod, and the container is transported by a transporting device and is stored in a stocker, an automated warehouse, or the like. In this regard, a purge gas such as nitrogen gas or clean dry air is supplied from a nozzle into the container via a gas inlet part in order to prevent contamination and oxidation of the articles and the like. The gas inlet part is made of, for example, an elastic circular material and has a hole in the center. With respect to the supply of the purge gas, Patent Literature 1 (JP 2012-248785) proposes introducing the purge gas into a container via a nozzle configured to move up and down with an air cylinder.

Citation List

Patent Literature

[0003] Patent Literature 1: JP2012-248785

SUMMARY OF THE INVENTION

Problem to be solved

[0004] In Patent Literature 1, the contact pressure between the nozzle and the gas inlet part is maintained in a substantially constant range due to the air pressure by the air cylinder. On the other hand, if a fixed nozzle is put in contact with the gas inlet part of

the container, the contact pressure changes due to a variation in the weight of the container depending on, for example, the presence or absence of semiconductor substrates, a variation in the height of the gas inlet part, or the like. Furthermore, the increases in the sizes of the semiconductor substrates have increased the weights of the containers. Therefore, pressed marks of the nozzle often remain on the surface of the gas inlet part made of an elastic material, and the gas inlet part often get scratches. If the gas inlet part gets the nozzle mark or the scratch by the nozzle, the purge gas may leak due to the nozzle mark or the scratch by the nozzle on the gas inlet part, when the container has been transported and is newly put in contact with another nozzle. Furthermore, the gas inlet part and the nozzle are sometimes caught by each other due to the nozzle mark or the scratch by the nozzle, the container is prevented from sliding, and this possibly causes a failure in positioning of the container.

[0005] It is an object of the present invention to prevent a gas inlet part of a container from getting a nozzle mark or a scratch due to the pressure of a nozzle and to prevent the gas inlet part from adhering to the nozzle.

Means for Solving the Problem

[0006] The gas purge device according to the present invention positions a container and comprises a nozzle to introduce a purge gas into a gas inlet part, made of an elastic material, provided on a bottom of the container, and provided with a circular bottom surface and a gas inlet hole in a center of the bottom surface,

the nozzle is provided with a planar top end surface having a size equal to or greater than that of the bottom surface of the gas inlet part and a nozzle hole located in a center of the top end surface and having a size equal to or smaller than that of the gas inlet hole of the container, and

the top end surface is roughened or made of a lubricative material and thereby supports the gas inlet part slidably.

[0007] Furthermore, a gas purge method according to the present invention positions a

container and introduces a purge gas from a nozzle into a gas inlet part, made of an elastic material, provided on a bottom of the container, and provided with a circular bottom surface and a gas inlet hole in a center of the bottom surface,

the nozzle has a planar top end surface having a size equal to or greater than that of the bottom surface of the gas inlet part, and a nozzle hole located in a center of the top end surface and having a size equal to or smaller than that of the gas inlet hole of the container, and thereby the nozzle applies a contact pressure to an entire surface of the gas inlet part except for the gas inlet hole, and

the top end surface is roughened or made of a lubricative material and thereby the gas inlet part is made slidable with respect to the top end surface.

[0008] According to the present invention, the nozzle has a planar top end surface having a size equal to or greater than that of the bottom surface of the gas inlet part, and a nozzle hole located in a center of the top end surface and having a size equal to or smaller than that of the gas inlet hole of the container. Accordingly, the contact pressure with the nozzle is substantially uniformly applied to the entire surface of the gas inlet part, and thus the surface of the gas inlet part made of an elastic material does not get a nozzle mark or a scratch by the nozzle. This prevents leakage of the purge gas from the boundary between the nozzle and the gas inlet part and improves the durability of the container.

[0009] If the gas inlet part is in contact with a smooth top end surface of the nozzle over a large area, sometimes they adhere to each other. This prevents positioning of the container and may cause a transfer error of the container in extreme cases. Furthermore, the positional accuracy of the container is made low, and leakage of the purge gas may occur. In contrast thereto, when the top end surface is roughened for example, by glass bead blasting, cutting work, or the like, the adhesion will not be likely to occur. In this specification, the feature that the gas inlet part is slidable means that the gas inlet part may slide with respect to the nozzle due to a force exerted on the

container at the time of positioning. The roughening makes the gas inlet part and the top end surface slidable with each other. By a top end surface made of a lubricative material, for example, a fluororesin such as Teflon (a registered trademark), instead of roughening, the adhesion is also prevented. In this specification, descriptions regarding the gas purge device are applicable to the gas purge method.

[0010] Preferably, the top end surface has a diameter equal to or greater than that of the gas inlet part, and the nozzle hole has a diameter equal to or smaller than that of the gas inlet hole. Here, regarding a circular top end surface and a circular gas inlet part, the diameters mean those of the circles. When the top end surface and the gas inlet part are, for example, square and are not circular, the sizes mean the vertical or lateral sizes of the square shapes, the diagonal sizes, or the like. The feature that the top end surface has a diameter equal to or greater than that of the gas inlet part means that, when they are overlapped concentrically one above the other, the gas inlet part does not protrude to the outside from the top end surface. Furthermore, the feature that the nozzle hole has a diameter equal to or smaller than that of the gas inlet hole means that, when they are overlapped concentrically one above the other, the nozzle hole does not protrude from the gas inlet hole.

[0011] Preferably, the top end surface is configured to be made in contact with the entire surface of the gas inlet part except for the gas inlet hole, to support the gas inlet part, to apply a uniform contact pressure from the nozzle to the entire surface of the gas inlet part except for the gas inlet hole, to make the gas inlet part slidable with respect to the top end surface, and thereby to prevent adhesion between the gas inlet part and the top end surface for the accurate positioning of the container.

[0012] When the top end surface is made of a lubricative material, wear of the lubricative material may be caused. However, if the top end surface is roughened, then, the top end surface may be made of an antioxidative metal such as stainless-steel, and roughening for example, by cutting work, glass bead blasting, or the like are usable to

the surface. Therefore, the top end surface with roughening affords an improved durability compared with the top end surface made of a lubricative material. Accordingly, it is preferable that the top end surface is roughened, in order to lengthen the life of the nozzle.

[0013] More preferably, the gas purge device further comprises a rack support and positioning members provided on the rack support, the positioning members are configured to make the container positioned on the rack support, and the nozzle is fixed on the rack support at a fixed height so as not to move up and down. When gas purge devices are provided in a stocker, an automated warehouse, or the like, the number of the gas purge devices is large, and the fixed nozzles are advantageous. According to the invention, fixing the height of the nozzle does not cause the gas inlet part to get a nozzle mark or a scratch by the nozzle, and therefore the gas purge device of the present invention is appropriate for use in a stocker, an automated warehouse, or the like.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] FIG. 1 is a plan view illustrating a gas purge device according to an embodiment.

FIG. 2 is a front view illustrating main parts of a container and the gas purge device.

FIG. 3 is a cross-sectional view taken in a vertical direction illustrating main parts of a gas inlet part of the container and a nozzle of the gas purge device.

FIG. 4 is a cross-sectional view taken in a vertical direction illustrating the main part of the nozzle, with a surface-treated top end of the nozzle shown enlarged in circles with a dashed-dotted line.

FIG. 5 is a plan view illustrating a top end of a nozzle according to a comparative example.

FIG. 6 is a cross-sectional view taken in a vertical direction illustrating a main

part of a nozzle according to a modification.

FIG. 7 is a cross-sectional view taken in a vertical direction illustrating a main part of a nozzle according to another modification.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0015] Hereinafter, the best mode for implementing the present invention will be described. The scope of the invention should be construed according to the understanding of a person skilled in the art based on the description of the claims, in view of the description of the specification and well known techniques in this field.

Embodiments

[0016] FIGS. 1 to 7 illustrate various embodiments. Gas purge devices 2 are provided in, for example, a stocker or an automated warehouse and are configured to position and store containers in which semiconductor substrates, reticles, or the like are accommodated and to introduce a purge gas into the containers. The reference numeral 4 denotes a rack support supported by supporting pillars 5 of the stocker. For example, three pins 6 as the positioning members protrude from the rack support 4 and are configured to be kinematically coupled with positioning grooves of the container for positioning the container. The reference numeral 8 denotes a nozzle for introducing a purge gas, and one or two nozzles are provided so as to protrude upward from the rack support 4. The nozzle 8 has, in its top end, a circular top end surface 9 with a circular nozzle hole 10 in the center thereof. Furthermore, the material of the nozzle 8 is, for example, a durable stainless-steel, and a pipe 12 for supplying the purge gas is connected to the nozzle 8. The nozzle 8 is fixed to the rack support 4, neither moves up nor down, and neither slides in the horizontal direction.

[0017] As shown in FIG. 2, on the bottom of a container 20 is provided three groove members 21 located substantially at the vertices of a equilateral triangle in a plan view

on the bottom. With kinematical coupling to V-shaped grooves of the groove members 21, the three pins 6 of the gas purge device 2 position the container 20 with respect to the rack support 4. The bottom of the container 20 is provided with one or more support members 24 to the bottom of which a gas inlet part 25 made of an elastic material is attached. When the container 20 is positioned with respect to the rack support 4, the nozzle 8 and the gas inlet part 25 are aligned and a purge gas from the pipe 12 is introduced into the container 20.

[0018] FIG. 3 illustrates the contact between the nozzle 8 and the gas inlet part 25, the material of the nozzle 8 is, for example, a stainless-steel. The top end surface 9 is planar and circular in a plan view, and is provided with the nozzle hole 10 in the center thereof. Furthermore, the gas inlet part 25 is made of a gasket rubber or the like, circular when viewed from the bottom, and has a gas inlet hole 26 in the center thereof. The top end surface 9 has an outer diameter R2 equal to or greater than an outer diameter R1 of the gas inlet part 25, and the nozzle 1 has a diameter $\phi 2$ equal to or smaller than a diameter $\phi 1$ of the gas inlet hole 26, so that the entire surface of the gas inlet part 25 except for the gas inlet hole is put in contact with the top end surface 9. When the outer edge of the gas inlet part is chamfered, the outer diameter of the top end surface of the nozzle is made equal to or greater than the outer diameter of the flat portion of the gas inlet part. With this measure, the entire surface of the gas inlet part 25 is put in contact with the top end surface 9, uniform pressure is applied to the gas inlet part 25, and thus, when the container 20 is stored on the rack support 4 for a long period, the gas inlet part 25 does not get any nozzle mark or any scratch by the nozzle.

Conventionally, top end surfaces are with the shape of a ring, instead of a circle, or the shape of a circle whose outer diameter is smaller than the outer diameter of the gas inlet part, and thus the gas inlet part 25 may get a mark of a nozzle or a scratch by the nozzle.

[0019] The gas inlet part 25 is made of an elastic material, the top end surface 9 is a planar surface, and the contact area between them is large. Therefore, the gas inlet part

25 and the top end surface 9 may adhere to each other. For avoiding the adhesion, the top end surface 9 is provided with recesses and projections in an area 41 enclosed by a dashed-dotted line in a vertical cross-sectional view and in an area 42 enclosed by a dashed-dotted line in a plan view as is shown in FIG. 4. Their shapes are, for example, circular or spiral. The recesses and projections have a height/depth of, for example, in the order of several tens of micrometers, and are easily formed by cutting work or the like. Roughening the top end surface 9 prevents the adhesion to the gas inlet part 25.

[0020] Alternatively, as a flat surface 9' shown in an area 43 with a dashed-dotted line in the lower left part of FIG. 4, roughening of the surface with glass bead blasting or the like may be performed. Also in this case, recesses and projections of the roughened surface are of the order of several tens of micrometers to several hundreds of micrometers. Radial grooves 31 in a top end surface 9" in FIG. 5 are not preferable because they may cause leakage of a purge gas.

[0021] The top end surface may be made of a lubricative material, instead of being roughened. A nozzle 40 of FIG. 6 is made of a fluororesin (for example, Teflon (a registered trademark)), and the reference numeral 51 denotes a top end surface. In FIG. 7, a lubricative coating 52 made of Teflon (a registered trademark) is provided on the top end surface of the stainless-steel nozzle 8. The modifications of FIGS. 6 and 7 are the same as the embodiment of FIGS. 1 to 5 except that the top end surface is made of a lubricative material.

[0022] The gas purge device 2 may be further provided with, in addition to the nozzle 8 for introducing the purge gas, a nozzle for discharging the purge gas. In this case, similarly to the gas inlet part 25, a gas outlet part made of an elastic material and having a circular shape with an outlet hole in the center is provided on the container 20 and is to be put in contact with the discharge nozzle. In this case, it is preferable that the discharge nozzle have the same configuration as that of the nozzle 8 of the embodiment. Namely, it is preferable that the top end surface of the discharge nozzle has an outer

diameter equal to or greater than an outer diameter of the gas outlet part, and the outlet hole in the center of the discharge nozzle has a diameter equal to or smaller than a diameter of the outlet hole of the gas outlet part. Moreover, it is preferable that the top end surface of the discharge nozzle is roughened or be made of a lubricative material.

List of Reference Numerals

[0023]

2 Gas purge device, 4 Rack support, 5 Supporting pillar, 6 Pins

8 Nozzle, 9, 9' Top end surface, 10 Nozzle hole, 12 Pipe

20 Container, 21 Groove member, 24 Support member, 25 Gas inlet part

26 Gas inlet hole, 31 Radial groove, 40 Nozzle

41 to 43 Area, 51 Top end surface, 52 Lubricative coating

WHAT IS CLAIMED IS:

1. A gas purge device positioning a container and comprising a nozzle to introduce a purge gas into a gas inlet part, made of an elastic material, provided on a bottom of the container, and provided with a circular bottom surface and a gas inlet hole in a center of the bottom surface:

wherein the nozzle is provided with a planar top end surface having a size equal to or greater than that of the bottom surface of the gas inlet part and a nozzle hole located in a center of the top end surface and having a size equal to or smaller than that of the gas inlet hole of the container, and

wherein the top end surface is roughened or made of a lubricative material and thereby supports the gas inlet part slidably.

2 The gas purge device according to claim 1,

wherein the top end surface has a diameter equal to or greater than that of the gas inlet part, and the nozzle hole has a diameter equal to or smaller than that of the gas inlet hole.

3. The gas purge device according to claim 2,

wherein the top end surface is configured to be made in contact with an entire surface of the gas inlet part except for the gas inlet hole, to support the gas inlet part, to apply a uniform contact pressure from the nozzle to the entire surface of the gas inlet part except for the gas inlet hole, to make the gas inlet part slidable with respect to the top end surface, and thereby to prevent adhesion between the gas inlet part and the top end surface for the positioning of the container.

4. The gas purge device according to any one of claims 1 to 3,

wherein the top end surface is roughened.

5. The gas purge device according to any one of claims 1 to 4, further comprising:

a rack support; and

positioning members provided on the rack support,

wherein the positioning members are configured to make the container positioned on the rack support, and

wherein the nozzle is fixed on the rack support at a fixed height so as not to move up and down.

6. A gas purge method positioning a container and introducing a purge gas from a nozzle into a gas inlet part, made of an elastic material, provided on a bottom of the container, and provided with a circular bottom surface and a gas inlet hole in a center of the bottom surface:

wherein the nozzle has a planar top end surface having a size equal to or greater than that of the bottom surface of the gas inlet part and a nozzle hole located in a center of the top end surface and having a size equal to or smaller than that of the gas inlet hole of the container, and thereby the nozzle applies a contact pressure to an entire surface of the gas inlet part except for the gas inlet hole, and

wherein the top end surface is roughened or made of a lubricative material and thereby the gas inlet part is made slidable with respect to the top end surface.

7. The gas purge method according to claim 6,

wherein the top end surface is made in contact with the entire surface of the gas inlet part except for the gas inlet hole and is made to apply a uniform contact pressure from the nozzle to the entire surface of the gas inlet part except for the gas inlet hole, and thereby a mark and a scratch by the nozzle on the gas inlet part are prevented from

being generated, and

wherein the gas inlet part is made slidable with respect to the top end surface, and thereby adhesion between the gas inlet part and the top end surface is prevented for the positioning of the container.