SUMMARY

[0009] Accordingly, to form highly precise integrated circuits, the demands for ultra-pure chemical liquids, and the quality improvement and control of theses liquids become very critical. Specific key parameters targeted for quality improvement and control include: trace-metal reduction, liquid particle count reduction, on-wafer defect reduction, organic contaminant reduction, etc. All of these key parameters are shown to be impacted by a proper design and a requisite preparation of any apparatus or vessels that may come in contact with these liquids.

[0010] In view of the above, the present disclosure is to provide particularly a container for containing a raw material of a chemical liquid for semiconductor manufacturing and a method of preparing a container, wherein a high purity chemical liquid is produced with the number of unwanted particulates and the amount of metallic impurities in the chemical liquid are managed and limited within predetermined ranges. Hence, the occurrence of residue and/or particle defects is suppressed and the yield of semiconductor wafer is improved.

[0011] In accordance with some embodiments of the present disclosure, a container for containing a raw material of a chemical liquid includes an inner wall and a solvent-treated surface that comes in contact with the raw material.

[0012] According to certain exemplary embodiments, the inner wall is constructed with a stainless steel material or coated with a resin material and the raw material includes a solvent having a content of iron (Fe) or calcium (Ca) atoms of 1 ppb or less and a content of organic impurities of 10 mass ppm or less during a course of being contained in the container.

[0013] In accordance with some embodiments of the present disclosure, a method of preparing a container includes providing a container having an inner wall constructed with a stainless steel material or coated with or a resin material; treating the surface of the inner wall with water; and treating the surface of the inner wall with an organic solvent, wherein the organic solvent includes a solvent included in the raw material.

[0014] In accordance with some embodiments of the present disclosure, a method of preparing a container for carrying a chemical liquid includes providing a container having an inner wall with a microfinish surface; and treating a surface of the inner wall with a solvent.

[0015] According to the present disclosure, a container and a method of preparing a container are effectively designed and properly configured to obviate an introduction or generation of a wide range of organic and inorganic contaminants during the carrying, storing, or transporting of a raw material of a chemical liquid or a chemical product, hence, an ultra-high purity chemical liquid applicable in semiconductor manufacturing can be produced.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] Aspects of the present disclosure are best understood from the following detailed description when read with the accompanying figures. It is noted that, in accordance with the standard practice in the industry, various features are not drawn to scale. In fact, the dimensions of the various features may be arbitrarily increased or reduced for clarity of discussion.

[0063] In the present disclosure, the water used in treating the inner wall 104 or configuring the solvent-treated surface 106 of the inner wall 104 of the container 100 is deionized (DI) water, for example, high purity DI water having a resistivity up to18 mega Ohms (18,000,000 ohms). In some exemplary embodiments, the organic solvent used in treating the inner wall 104 or configuring the solvent-treated surface 106 of the inner wall 104 of the container 100 includes an organic solvent which is the same organic solvent or a similar type of organic solvent to be subsequently carried in the container. Further, in certain embodiments, the organic solvent used in treating the inner wall 104 has a content of iron (Fe) or calcium (Ca) atoms of 1 ppb or less and a content of organic impurities of 10 mass ppm or less, for example.

[0064] It is noted that the above examples are for illustrative purposes, and the present disclosure is not limited to the shown examples of a container for carrying, storing, or transporting a raw material of a chemical liquid used for the manufacturing of a semiconductor device and the like. The present disclosure also may relate to a container for carrying, storing, or transporting a chemical product used for the manufacturing a semiconductor device, or a manufacturing apparatus equipped with a container, a tank, a reaction vessel and the like applied in the manufacturing a semiconductor device.

[0065] [Method of Preparing a Container]

[0066] The second set of embodiments of the present disclosure relates to a method of preparing a container. Prior to a container being used for carrying, storing,

phenolic resin based material containing a phenol-formaldehyde-containing compound with a phenol-formaldehyde-containing coating agent.

[0068] Thereafter, the inner wall surface of the container 100 is treated with a solvent in Step 20. According to some embodiments, the container 100 is treated with water in Step 20A. The water used in treating the surface of the inner wall 104 of the container 100 is deionized (DI) water, for example, high purity DI water having a resistivity up to18 mega Ohms (18,000,000 ohms). The treatment of the container 100 with water includes, for example, dousing the interior of the container 100 with water using a nozzle or a spray ball; allowing the water to remain in and inundate the inner wall 104 of the container 100 for about 12 to 48 hours, for example, 24 to 36 hours or 36 to 48 hours; and draining the water from the container 100. The water treatment Step 20A is performed at ambient temperature and the amount of water used to inundate the container 100 is the amount needed to fill 90 volume % to 100 volume % of the container 100, for example. The dousing-inundating-draining of the water treatment Step 20A is performed at least once, and may be repeated for a few more cycles, for example, one, two, three, four, five or more cycles before proceeding to drying the container 100 in Step 30.

[0069] In other examples, the treatment of the container 100 with water in Step 20A includes fully or partially filling the container 100 with water, sloshing or agitating the water in the container continuously or intermittently; allowing the water to remain in and inundate the inner wall of the container for about 12 to 48 hours, such as 24 to 36 hours or 36 to 48 hours; and draining the water from the

treatment Step 20A is performed, followed by the organic solvent treatment Step 20B, before proceeding to the drying Step 30.

[0073] In accordance to these certain exemplary embodiments, the water treatment Step 20A may include one or more cycles of the dousing-inundating-draining or the filling-sloshing-inundating-draining using DI water, for example, high purity DI water having a resistivity up to18 mega Ohms (18,000,000 ohms); and the organic solvent treatment Step 20B may include one or more cycles of the filling-agitating-inundating-draining using the same organic solvent or a similar type of organic solvent contained in the raw material. In addition, the organic solvent treatment liquid used in Step 20B has a content of iron (Fe) or calcium (Ca) atoms of 1 ppb or less and a content of organic impurities of 10 mass ppm or less. Further, the drying of the container in Step 30 may be accomplished by, for example, air-drying, nitrogen-drying or blowing hot air into the container 100. It is noted that the sequence of the solvent treatment steps is not limited to the shown examples. In other exemplary embodiments, the organic solvent treatment Step 20B may be performed before the water treatment Step 20A.

[0074] It should be appreciated that the above examples are for illustrative purposes, and the present disclosure is not limited to the shown examples of a method of preparing a container for carrying, storing, or transporting a raw material of a chemical liquid applied in the manufacturing a semiconductor device and the like. The present disclosure may also relate to a method of preparing a container for carrying, storing, or transporting a chemical product applied in the manufacturing

of a semiconductor device and the like, or a method of preparing a manufacturing apparatus equipped with a container, a tank, a reaction vessel and the like applied in the manufacturing a semiconductor device.

[0075] [Examples]

[0076] The present disclosure will be more specifically described below based on the following examples. A material, a use amount, a ratio, treatment details, treatment procedures, and the like which will be described the following examples can be appropriately changed in a range without departing from the gist of the present invention. Accordingly, the range of the present disclosure should not be interpreted restrictively by the following examples.

[0077] <Solvents applied in Surface-Treatment >

[0078] The organic solvents used for the surface treatment of the inner wall of a container were, respectively, isopropyl alcohol (Solvent A), cyclohexanone (Solvent B), and PGMEA (Solvent C) in which all satisfied the prerequisites of having a content of iron (Fe) or calcium (Ca) atoms of 1 ppb or less and a content of organic impurities of 10 mass ppm or less. Alternatively speaking, the organic solvents applied in the surface treatment process were good purity grade products having limited amounts of metal, organic, and/or other types of impurities. The water used for the surface treatment of the inner wall was DI water having a resistivity up to18 mega Ohms.

[0079] < Trace Metal (ppb)>

[0080] Each treatment liquid sample was tested using ICP-MS (inductively coupled plasma mass spectrometry (ICP-MS). Using a Fujifilm developed method, each sample was tested for the presence of 26 metal species, the detection limit was metal specific, but the typical detection limits were in the range of 0.00010 - 0.030 ppb.

[0081] **<Evaluation Results>**

[0082] The effects of solvent treatment were examined, and the results were summarized in Tables 1-3 below.

[0083] To obtain the samples in Tables 1 and 2, water treatment (the dousing-inundating-draining treatment) was first performed on an inner wall of a stainless steel container. After the water treatment was completed, a first treatment liquid sample, namely a sample of the DI water used in the water treatment process, was collected and tested for trace metals. Thereafter, an organic solvent treatment (filling-agitating-inundating-draining treatment) was performed on the water-treated inner wall to passivate the inner wall of the container. After the organic solvent treatment was completed, a second treatment liquid sample, namely a sample of the organic solvent used in the organic solvent treatment process, was collected and tested for trace metals.

[0084] For the samples in Table 3, one cycle of water treatment was first performed on an inner wall of a stainless steel container. Thereafter, two cycles of organic solvent treatment were performed on the water-treated inner wall, wherein after each of the two cycles of the organic solvent treatment, samples, namely a first

WHAT IS CLAIMED IS:

1. A container for containing a raw material of a chemical liquid used for semiconductor manufacturing, the container comprising:

an inner wall, constructed with a stainless steel material or coated with a resin material; and

a solvent-treated surface of the inner wall, wherein the solvent-treated surface comes in contact with the raw material that includes a solvent having a content of iron (Fe) or calcium (Ca) atoms of 1 ppb or less and a content of organic impurities of 10 mass ppm or less during a course of being contained in the container.

2. The container of claim 1, the stainless steel material used in constructing the inner wall has a 2B surface finish or higher.

3. The container of claim 2, wherein the stainless steel material has an arithmetic average roughness Ra of 0.5μm or less.

4. The container of claim 1, wherein the inner wall is coated with a phenolic resin lining material.

5. The container of claim 1, wherein the solvent-treated surface comprises a water-treated surface, which is configured by treating a surface of the inner wall with deionized water.

6. The container of claim 1, wherein the solvent-treated surface comprises an organic solvent-treated surface, which is configured by treating a surface of the inner wall with the solvent included in the raw material.

7. The container of claim 1, wherein the solvent-treated surface comprises a water-organic solvent-treated surface, which is configured by treating a surface of the inner wall with deionized water, followed by treating the surface of the inner wall with the solvent included in the raw material.

8. The container of claim 1, wherein a material of the container includes stainless steel or carbon steel.

9. A method of preparing a container for containing a raw material of a chemical liquid, the method comprising:

providing a container having an inner wall that is constructed with a stainless steel material or coated with a resin material;

treating a surface of the inner wall with water; and

treating the surface of the inner wall with an organic solvent, wherein the organic solvent includes a solvent included in the raw material.

10. The method of claim 9, wherein the treating of the surface of the inner wall with the water comprises:

dousing an interior of the container with the water;

allowing the water to remain in the container for a first time period;

draining the water from the container; and

drying the container.

11. The method of claim 9, wherein the treating of the surface of the inner wall with the organic solvent comprises:

fully or partially filling the container with the organic solvent;

agitating or sloshing the organic solvent in the container;

allowing the organic solvent to remain in the container for a second time period;

draining the organic solvent from the container; and

drying the container.

12. The method of claim 9, wherein the treating of the surface of the inner wall with the organic solvent is performed after the treating of the surface of the inner wall with the water is completed.

13. The method of claim 12, wherein the treating of the surface of the inner wall with the water is performed at least once.

14. The method of claim 12, the treating of the surface of the inner wall with the organic solvent is performed at least once.

15. The method of claim 12, wherein a number of particles having a size of 40nm or more is 100 or less per 1 ml of the organic solvent used in the treating of the surface of the inner wall.

16. The method of claim 9, wherein the water used in treating the surface of the inner wall is deionized water having a resistivity up to18 mega Ohms.

17. The method of claim 9, wherein the organic solvent used in treating surface of the inner wall has a content of iron (Fe) or calcium (Ca) atoms of 1 ppb or less and a content of organic impurities of 10 mass ppm or less.

18. The method of claim 9, wherein the stainless steel material used in constructing the inner wall has a 2B surface finish or higher, and an arithmetic average roughness Ra of 0.5μm or less.

19. The method of claim 9, wherein the resin material used in coating the inner wall comprises a phenolic resin.

20. The method of claim 9, wherein the container is constructed with stainless steel or carbon steel.

21. The method of claim 9, wherein the organic solvent is select from the group consisting of methanol, ethanol, 1-propanol, isopropanol, monomethyl ether, propylene glycol monoethyl ether, propylene glycol monomethyl ether, propylene glycol monopropyl ether, propylene glycol monomethyl ether acetate, ethyl lactate,

methyl methoxypropionate, cyclopentanone, cyclohexanone, γ-butyrolactone, diisoamyl ether, butyl acetate, 4-methyl-2-pentanol, and a combination thereof.

22. A method of preparing a container for carrying a chemical liquid, the method comprising:

providing a container having an inner wall with a microfinish surface; and

treating a surface of the inner wall with a solvent.

23. The method of claim 22, wherein the inner wall is constructed with a stainless steel material having a 2B surface finish or higher.

24. The method of claim 22, wherein the inner wall is coated with a phenolic resin material.

25. The method of claim 22, wherein the step of treating the surface of the inner wall with the solvent comprises:

washing the surface of the inner wall with deionized water; and

washing the surface of the inner wall with an organic solvent, wherein the organic solvent includes at least one solvent contained in the chemical liquid.

26. The method of claim 25, wherein the step of washing the surface of the inner wall with the deionized water is performed for one or more times before

the step of washing the surface of the inner wall with the organic solvent for one or more times.