

【DESCRIPTION】

【TITLE OF INVENTION】 APPARATUS FOR TREATING PERFLUORINATED COMPOUND USED IN SEMICONDUCTOR OR DISPLAY MANUFACTURING PROCESS

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BACKGROUND

Field

[1] The present disclosure relates to an apparatus for treating perfluorinated compound gas used in semiconductor or display manufacturing process.

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Description of Related Art

[2] In the semiconductor and display industries, large amounts of perfluorinated compound gases have been used for etching, etc., and it is very important to treat used perfluorinated compounds.

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[3] The apparatus for treating used perfluorinated compounds should be spatially compact and have high treatment efficiency so that it could be installed in the semiconductor and display manufacturing places.

SUMMARY

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[4] An object to be provided by an exemplary embodiment of the present disclosure is an apparatus for treating perfluorinated compound gas used in semiconductor or display manufacturing process.

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[5] According to an aspect, there is provided an apparatus for treating perfluorinated compound gas used in semiconductor or display manufacturing process. The apparatus includes a first structure which forms a first space, introduces(inflows) and preheats to-be-treated gas, and discharges treated gas to the outside, a second structure which forms a second

space, heats and treats the preheated to-be-treated gas from the first structure, and generates treated gas, a first connector for delivering the preheated to-be-treated gas from the first structure to the second structure, and a second connector for delivering the treated gas treated from the second structure to the first structure. The first structure includes a heat exchanger for preheating to-be-treated gas with the treated gas, and the second structure includes a heater for heating the preheated to-be-treated gas, and a catalyst unit for treating the heated to-be-treated gas.

[6] According to another aspect, each of the first structure and the second structure may be lengthily extended in a first extension direction, and the first structure and the second structure may be disposed to face each other in a longitudinal direction thereof.

[7] According to yet another aspect, the first connector may be lengthily extended in the first extension direction, move the preheated to-be-treated gas from the first structure to a direction along the first extension direction, and then deliver the preheated to-be-treated gas to the second structure.

[8] According to still another aspect, the first connector may include a rectangular pipe of which cross section includes short sides and long sides, any one of a pair of long sides of the pipe may stick to the second structure, and the length of the long side may be 3 times to 10 times of the length of the short side.

[9] According to still yet another aspect, the second space in the second structure may be divided into, a first subspace where the heater is placed, a second subspace where the catalyst unit is placed, and a third subspace which delivers the treated gas treated from the catalyst unit to the second connector. The first subspace, the second subspace and the third subspace may be sequentially disposed along a second direction which is opposite to the first direction.

[10] According to still yet another aspect, the second space may be a cuboid shape, and the catalyst unit may include a pair of perforated plates which face each other and are spaced apart

along the first extension direction and a catalyst layer packed between the pair of perforated plates.

[11] According to still yet another aspect, the second structure may include a case which forms the second space and is made of stainless steel, an insulation layer formed inside of the case and a castable layer which is formed inside of the case and contains more than 90wt% Al₂O₃.

[12] According to still yet another aspect, in the heat exchanger, the treated gas may move in the first direction, and the to-be-treated gas may move in the second direction.

[13] According to still yet another aspect, the first structure may further include at least one of a first inspection door installed in an inlet location of the treated gas which is supplied to the heat exchanger, a second inspection door installed in an outlet location of the preheated to-be-treated gas, and a third inspection door installed in an outlet location of the treated gas that has passed through the heat exchanger.

[14] According to still yet another aspect, the apparatus may further include an external case which is of a rectangular form and accommodates the first structure and the second structure.

[15] According to an exemplary embodiment of the present disclosure, there is provided an apparatus to treat used perfluorinated compound in semiconductor and display manufacturing process.

BRIEF DESCRIPTION OF THE DRAWING

[16] FIG. 1 is a diagram illustrating a perspective view of a treatment apparatus according to an exemplary embodiment of the present disclosure,

[17] FIGS. 2 and 3 are diagrams illustrating a first structure in the treatment apparatus according to an exemplary embodiment of the present disclosure,

[18] FIGS. 4 and 5 are diagrams illustrating a second structure in the treatment apparatus according to an exemplary embodiment of the present disclosure,

5 [19] FIGS. 6 and 7 are diagrams illustrating flow of to-be-treated gas in the treatment apparatus according to an exemplary embodiment of the present disclosure, and

[20] FIGS. 8 and 9 are diagrams illustrating a simulation result of a catalyst unit in the treatment apparatus according to an exemplary embodiment of the present disclosure.

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DETAILED DESCRIPTION

[21] Hereinafter, the present disclosure will be described in detail with reference to the accompanying drawings.

[22] The present disclosure relates to an apparatus for treating perfluorinated compound gas, and more particularly, to an apparatus for treating perfluorinated compound gas used in
15 semiconductor or display manufacturing process.

[23] Perfluorinated compound gas (PFCs gas) contains large amount of fluorine, and what are representatively and currently used in the industrial areas may be classified into organic gases such as CF₄, C₂F₆ and C₃F₈ and inorganic gases such as NF₃ and SF₆. However, perfluorinated compound gas of the present disclosure is not limited thereto.

20 [24] Hereinafter, the treatment apparatus according to the present disclosure is described with reference to FIGS. 1 to 5.

[25] FIG. 1 is a diagram illustrating a perspective view of a treatment apparatus according to an exemplary embodiment of the present disclosure, FIGS. 2 and 3 are diagrams illustrating a first structure in the treatment apparatus according to an exemplary embodiment of the

present disclosure, and FIGS. 4 and 5 are diagrams illustrating a second structure in the treatment apparatus according to an exemplary embodiment of the present disclosure.

[26] A treatment apparatus 1 includes a first structure 10, a second structure 20, and a first connector 30 and a second connector 40. The first structure 10 and the second structure 20 are connected each other through the first connector 30 and the second connector 40.

[27] The first structure 10, the second structure 20, and the first connector 30 are lengthily extended according to a first extension direction.

[28] The second structure 20 has an approximately lengthily extended cuboid shape.

[29] The first structure 10 includes a heat exchanger 11, a to-be-treated gas inlet 12, a treated gas outlet 13 and a preheating gas outlet 14.

[30] The heat exchanger 11 is an approximately lengthily extended cuboid shape along the first extension direction but is not limited thereto. The heat exchanger 11 may be made of Inconel or Hastelloy material to prevent corrosion due to hydrofluoric acid and heat, etc.

[31] In the heat exchanger 11, heat exchange takes place between the hot temperature treated gas supplied through the second connector 40 and the low temperature to-be-treated gas supplied through the to-be-treated gas inlet 12. The hot temperature treated gas and the low temperature to-be-treated gas move in opposite directions each other where heat exchange occurs. The specific configuration of the heat exchanger 11 may be prepared in various forms so that hot temperature gas and low temperature gas could exchange heats.

[32] The to-be-treated gas inlet 12 and the treated gas outlet 13 are vertically extended. From other exemplary embodiments, the top of the to-be-treated gas inlet 12 and the treated gas outlet 13 may be placed lower than the second structure 20, that is, within the height of the second structure 20.

[33] As shown in FIG. 3, there are installed in the first structure 10 a first inspection door 151 installed in an inlet location of the treated gas which is supplied to the heat exchanger 11,

a second inspection door 152 installed in an outlet location of the preheated to-be-treated gas, and a third inspection door 153 installed in an outlet location of the treated gas that has passed through the heat exchanger 11. Inspection and maintenance may be easily performed using the first inspection door 151 when differential pressure occurs in the heat exchanger 11, and inspection and maintenance may be easily performed using the second inspection door 152 and the third inspection door 153 when foreign materials occur on the plate of the heat exchanger 11 due to moisture and powders.

[34] The second structure 20 includes a heater 21, a catalyst unit 22 and a case unit 23.

[35] The second space which is formed by the case unit 23 is a long cuboid shape, and a first subspace, a second subspace, and a third subspace are sequentially disposed therein along a second direction. Adjacent subspaces contact each other, and each subspace is a cuboid shape.

[36] The heater 21 is placed in the first subspace and heats the to-be-treated gas introduced through the first connector 30. The heater 21 includes a heater rod 211 and a flow control plate 212. The to-be-treated gas moves in the second direction in a zig-zag pattern by a plurality of flow control plates 212.

[37] The heater rod 211 may be made of Inconel or Hastelloy material to prevent corrosion due to hydrofluoric acid and heat, etc. The heater rod 211 may be heated using an electric heat or a burner.

[38] The catalyst unit 22 is placed in the second subspace and includes perforated plates 221 and a catalyst layer 222. The perforated plates 221 are provided as a pair so that the catalyst layer 222 is placed between the perforated plates 221. A catalyst is placed on the catalyst layer 222. The main component of the catalyst is, but is not limited thereto, alumina (Al_2O_3) which is a composite oxide based on alumina. The catalyst may be in pallet form, trilobe form or honeycomb form.

[39] The treated gas treated from the catalyst layer 222 is introduced into the third space, where a connection pipe 242 to be connected to the second connector 40 is formed.

[40] The case unit 23 includes a case 231, an insulation layer 232, and a castable layer 233.

The insulation layer 232 is formed inside of the case 231, and the castable layer 233 is formed

inside of the insulation layer 232. The castable layer 233 contains more than 90wt% Al_2O_3 , blocks heat loss from the outside and prevents damage due to hydrofluoric acid corrosion.

The remainder of the castable layer 233 may include silica. The case 231 may be made of

low-cost stainless steel material by the castable layer 233. The insulation layer 232 may

contain more than 50% Al_2O_3 , and the content of Al_2O_3 may be lower than or equal to that of

the castable layer 233.

[41] The first connector 30 connects the preheating gas outlet 14 of the first structure 10 and the heater 21 of the second structure 20.

[42] The first connector 30 is lengthily extended in the first extension direction and includes a rectangular pipe of which cross section includes short sides and long sides. One of a pair of

long sides of the pipe sticks to the second structure 20. And the length of the long side may be 2 times to 15 times or 3 times to 10 times of the length of the short side.

[43] The second connector 40 supplies the treated gas introduced through the connection pipe 242 to the heat exchanger 11.

[44] Although not shown, the treatment apparatus 1 may further include an external casing accommodating the first structure 10 and the second structure 20.

[45] In the treatment apparatus 1 described above, the first structure 10 and the second structure 20 face so as to face their longitudinal directions each other and stick together. The

first connector 30 includes a flat rectangular shaped pipe which sticks to the second structure 20 so that the gap between the first structure 10 and the second structure 20 is minimized or

deleted. In addition, the second structure 20 is integrally formed, and thus, spatial efficiency

is high because heating, treatment and discharge of the to-be-treated gas are performed within the second space.

[46] Hereinafter, the flow of the to-be-treated gas according to an exemplary embodiment of the present disclosure is described with reference to FIGS. 6 and 7.

5 **[47]** The to-be-treated gas is introduced to the first structure 10 through the to-be-treated gas inlet 12. While moving the to-be-treated gas from the heat exchanger 11 to the second direction, heat is exchanged with the treated gas which is moving to the first direction. The to-be-treated gas preheated through the heat exchange (preheated gas) is supplied to the first connector 30 through the preheating gas outlet 14.

10 **[48]** The preheating gas moves from the first connector 30 to the first direction, and then, is supplied to the heater 21 of the second structure 20. The preheating gas vertically moves by the flow control plate 212 of the heater 21 and moves in the second direction. The preheating gas is heated by the heater rod 211 during the movement process. The heated to-be-treated gas is decomposed and treated by the catalyst unit 222 and discharged through the
15 connection pipe 242. The temperature of the heater 21 may be 800 to 850°C, and the temperature after the catalyst unit 22(at third subspace) may be 650 to 750°C.

[49] Like this, spatial efficiency is very high because heating, treatment, and discharge of the to-be-treated gas are performed within a single space called the second space in the second structure 20.

20 **[50]** The discharged treated gas is supplied to the first structure 10 through the connection pipe 242 and the second connector 40 and preheats the to-be-treated gas while moving from the heat exchanger 11 to the first direction. The treated gas passed through the heat exchanger 11 is discharged to the outside through the treated gas outlet 13. The efficiency of the heat exchanger 11 may be 60 to 75%. The temperature of the preheated gas may be 400 to 500°C
25 in order to prevent condensation due to moisture.

[51] FIGS. 8 and 9 are drawings illustrating a simulation result of a catalyst unit in the treatment apparatus according to an exemplary embodiment of the present disclosure.

[52] The simulation conditions are like the following.

[53] Gas inlet temperature: 730°C

5 [54] Flow rate: approximately 5 CMM

[55] Catalyst layer differential pressure: approximately 120 mmH₂O

[56] Gas outlet temperature: 675°C

[57] FIG. 8 shows the case that both perforated plates are disposed in vertical direction, i.e. a vertical passage, and FIG. 9 shows the case that both perforated plates are disposed in
10 horizontal direction like the present exemplary embodiment of the present disclosure, i.e. a horizontal passage. In the case of FIG. 9, it may be seen that the gas flow is stably performed from the inlet to the outlet.

[58] The present disclosure described above is not limited to the above-described exemplary embodiments and the attached drawings, and it will be apparent to a person skilled
15 in the art to which the present disclosure pertains that various modifications and changes are possible within a scope that does not depart from the technical spirit of the present disclosure.

What is claimed is:

1. An apparatus for treating perfluorinated compound gas used in semiconductor or display manufacturing process, the apparatus comprising:

5 a first structure which forms a first space, introduces and preheats to-be-treated gas, and discharges treated gas to the outside;

a second structure which forms a second space, heats and treats the preheated to-be-treated gas from the first structure, and generates treated gas;

10 a first connector for delivering the preheated to-be-treated gas from the first structure to the second structure; and

a second connector for delivering the treated gas treated from the second structure to the first structure,

wherein the first structure includes a heat exchanger for preheating to-be-treated gas with the treated gas, and

15 the second structure includes,

a heater for heating the preheated to-be-treated gas; and

a catalyst unit for treating the heated to-be-treated gas.

20 2. The apparatus of claim 1, wherein each of the first structure and the second structure is lengthily extended in a first extension direction, and the first structure and the second structure are disposed to face each other in longitudinal directions thereof.

25 3. The apparatus of claim 2, wherein the first connector is lengthily extended in the first extension direction, moves the preheated to-be-treated gas from the first structure to a direction along the first extension direction, and then delivers to the second structure.

4. The apparatus of claim 3, wherein the first connector includes a rectangular pipe of which cross section includes short sides and long sides, any one of a pair of long sides of the pipe sticks to the second structure, and the length of the long side is 3 times to 10 times of the length of the short side.

5. The apparatus of claim 4, wherein the second space in the second structure is divided into,

a first subspace where the heater is placed;

a second subspace where the catalyst unit is placed; and

a third subspace which delivers the treated gas treated from the catalyst unit to the second connector, and

the first subspace, the second subspace and the third subspace are sequentially disposed along a second direction which is opposite to the first direction.

6. The apparatus of claim 5, wherein the second space is a cuboid shape, and the catalyst unit includes,

a pair of perforated plates which face each other and are spaced apart along the first extension direction; and

a catalyst layer packed between the pair of perforated plates.

7. The apparatus of claim 5, wherein the second structure includes,
a case which forms the second space and is made of stainless steel;
an insulation layer formed inside of the case; and

a castable layer which is formed inside of the case and contains more than 90wt% Al₂O₃.

8. The apparatus of claim 7, wherein in the heat exchanger,

5 the treated gas moves in the first direction, and
the to-be-treated gas moves in the second direction.

9. The apparatus of claim 7, wherein the first structure further includes at least one of,
a first inspection door installed in an inlet location of the treated gas which is supplied

10 to the heat exchanger,

a second inspection door installed in an outlet location of the preheated to-be-treated
gas, and

a third inspection door installed in an outlet location of the treated gas that has passed
through the heat exchanger.

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10. The apparatus of claim 1, further comprising:

an external case which is of a rectangular form and accommodates the first structure
and the second structure.