Embodiments of the present invention provide a high-accuracy measurement method that, in the measurement of the concentration of fluorine gas contained in a halogen fluoride-containing gas using a mass spectrometer, reduces the amount of measurement errors that are caused by consumption of fluorine gas due to reactions with metal members such as a tube and a capillary and impurities on the gas passage.

Solution to Problem

[0009]

The present inventor and others conducted extensive studies in order to solve the issue mentioned above, and have found out that high-accuracy measurement can be made by, before measuring the concentration of fluorine gas contained in a halogen fluoride-containing gas by using a mass spectrometer, subjecting a tube and a capillary existing in a gas passage in an analysis apparatus to passivation treatment with a fluorine-containing gas in advance to form fluorine-based passive films in the interiors of the tube and the capillary, and removing internal impurities, and thus have completed the present invention. Aspects and embodiments of the present invention are defined below.

[0010]

According to a first aspect of the present invention, there is provided a method for measuring a concentration of

fluorine gas (F_2) contained in a halogen fluoride-containing gas by using an analysis apparatus having a halogen fluoride-containing gas supply source, a fluorine-containing gas supply source, a tube, a capillary, and a mass spectrometer, the method including, before measuring the concentration of fluorine gas, performing passivation treatment on the tube and the capillary by using a passivation gas containing a fluorine-containing gas supplied from the fluorine-containing gas supply source, the fluorine-containing gas is at least one kind of gas selected from the group consisting of F_2, NF_3, SF_6, and a halogen fluoride.

~~In an embodiment of the above method for measuring a concentration of fluorine gas, the fluorine-containing gas is at least one kind of gas selected from the group consisting of F_2, HF, NF_3, SF_6, and a halogen fluoride.~~

In an embodiment of the above method for measuring a concentration of fluorine gas, a temperature used to perform the passivation treatment is 70 to 500°C.

In an embodiment of the above method for measuring a concentration of fluorine gas, time to perform the passivation treatment is 1 to 5 hours.

In an embodiment of the above method for measuring a concentration of fluorine gas, a concentration of the fluorine-containing gas in the passivation gas is 8 to 100 volume%.

In an embodiment of the above method for measuring a

concentration of fluorine gas, the analysis apparatus further has a diluent gas supply source, and adjusts the concentration of the fluorine-containing gas in the passivation gas by using a diluent gas supplied from the diluent gas supply source.

In an embodiment of the above method for measuring a concentration of fluorine gas, the diluent gas is at least one selected from helium, argon, nitrogen gas (N_2), carbon dioxide, and carbon tetrafluoride.

In an embodiment of the above method for measuring a concentration of fluorine gas, a halogen fluoride contained in the halogen fluoride-containing gas is at least one selected from the group consisting of chlorine fluoride, chlorine trifluoride, bromine fluoride, bromine trifluoride, bromine pentafluoride, iodine fluoride, iodine trifluoride, iodine pentafluoride, and iodine heptafluoride.

According to a second aspect of the present invention, there is provided an apparatus for measuring a concentration of fluorine gas, the apparatus including a halogen fluoride-containing gas supply source, a fluorine-containing gas supply source, a tube, a capillary, and a mass spectrometer, in which the tube and the capillary have been subjected to passivation treatment with a passivation gas containing a fluorine-containing gas supplied from the fluorine-containing gas supply source, the fluorine-containing gas is at least one kind of gas selected from the group

consisting of F_2, NF_3, SF_6, and a halogen fluoride.

Advantageous Effects of Invention

[0011]

According to embodiments of the present invention, high-accuracy measurement can be made for the concentration of fluorine gas contained in a halogen fluoride-containing gas.

Brief Description of Drawings

[0012]

[Fig. 1] Fig. 1 is a schematic diagram of an example of an analysis apparatus used for measurement of the concentration of fluorine gas of the present invention.

Description of Embodiments

[0013]

Hereinbelow, one embodiment of the present invention is described in detail with reference to Fig. 1. The analysis apparatus used in the present invention is not limited to the analysis apparatus shown in Fig. 1. The one embodiment of the present invention is a method for measuring the concentration of fluorine gas (F_2) contained in a halogen fluoride-containing gas by using an analysis apparatus 10 having a

CLAIMS

[Claim 1]

A method for measuring a concentration of fluorine gas (F_2) contained in a halogen fluoride-containing gas by using an analysis apparatus having a halogen fluoride-containing gas supply source, a fluorine-containing gas supply source, a tube, a capillary, and a mass spectrometer,

the method comprising:

before measuring the concentration of fluorine gas, performing passivation treatment on the tube and the capillary by using a passivation gas containing a fluorine-containing gas supplied from the fluorine-containing gas supply source, ~~.~~

~~[Claim 2]~~

~~The method for measuring a concentration of fluorine gas according to claim 1, wherein~~

the fluorine-containing gas is at least one kind of gas selected from the group consisting of F_2, ~~HF,~~ NF_3, SF_6, and a halogen fluoride.

[Claim 2~~3~~]

The method for measuring a concentration of fluorine gas according to claim 1 ~~or 2~~, wherein

a temperature used to perform the passivation treatment is 70 to 500°C.

[Claim 34]

The method for measuring a concentration of fluorine gas according to ~~any one of~~ claim~~s~~ 1 or~~to~~ 2~~3~~, wherein

time to perform the passivation treatment is 1 to 5 hours.

[Claim 45]

The method for measuring a concentration of fluorine gas according to any one of claims 1 to 34, wherein

a concentration of the fluorine-containing gas in the passivation gas is 8 to 100 volume%.

[Claim 56]

The method for measuring a concentration of fluorine gas according to claim 45, wherein

the analysis apparatus further has a diluent gas supply source, and adjusts the concentration of the fluorine-containing gas in the passivation gas by using a diluent gas supplied from the diluent gas supply source.

[Claim 67]

The method for measuring a concentration of fluorine gas according to claim 45 or 56, wherein

the diluent gas is at least one selected from helium, argon, nitrogen gas (N_2), carbon dioxide, and carbon tetrafluoride.

[Claim 7~~8~~]

The method for measuring a concentration of fluorine gas according to any one of claims 1 to 6~~7~~, wherein

a halogen fluoride contained in the halogen fluoride-containing gas is at least one selected from the group consisting of chlorine fluoride, chlorine trifluoride, bromine fluoride, bromine trifluoride, bromine pentafluoride, iodine fluoride, iodine trifluoride, iodine pentafluoride, and iodine heptafluoride.

[Claim 8~~9~~]

An apparatus for measuring a concentration of fluorine gas, the apparatus comprising:

a halogen fluoride-containing gas supply source;

a fluorine-containing gas supply source;

a tube;

a capillary; and

a mass spectrometer,

wherein the tube and the capillary have been subjected to passivation treatment with a passivation gas containing a fluorine-containing gas supplied from the fluorine-containing gas supply source, the fluorine-containing gas is at least one kind of gas selected from the group consisting of F_2, NF_3, SF_6, and a halogen fluoride.