

WHAT IS CLAIMED IS:

1. An etching method of etching a silica-based residue containing a base component formed in an SiO₂ film, comprising:

selectively etching the silica-based residue at a first temperature by supplying an HF gas and at least one of an H₂O gas and an alcohol gas to a target substrate having the SiO₂ film, on which the silica-based residue is formed; and

removing an etching residue caused by the selectively etching the silica-based residue, after the selectively etching the silica-based residue, wherein the removing an etching residue includes:

a first process of supplying, to the target substrate at the first temperature, an H₂O gas or an alcohol gas to react with a fluorine component of the etching residue and generate HF that is to be volatilized without heating the target substrate; and

a second process of heating the target substrate to a second temperature that is higher than the first temperature after the first process, wherein the first temperature is within a range of 10 to 30 degrees C.

2. The method of Claim 1, wherein the silica-based residue containing the base component is formed when removing a silicon nitride film formed on the target substrate by wet etching using thermal phosphoric acid.

3. The method of Claim 1 or 2, wherein the SiO₂ film is a CVD-SiO₂ film formed by CVD.

4. The method of Claim 3, wherein the target substrate further has a block SiO₂ film having a lower density than the CVD-SiO₂ film and formed by CVD, supporting the CVD-SiO₂ film, and wherein a plurality of CVD-SiO₂ films extend at intervals from the block SiO₂ film.

5. The method of any one of Claims 1 to 4, wherein the selectively etching the silica-based residue is performed by supplying the HF gas and at least one of the H₂O gas and the alcohol gas in a chamber in which the target substrate is disposed, and the first process of the removing an etching residue is performed by stopping the supply of the HF gas and supplying only the H₂O gas or the alcohol gas to the chamber in a state in which the target substrate is disposed in the chamber.
6. The method of any one of Claims 1 to 5, wherein the selectively etching the silica-based residue is performed under a condition of a pressure of 133 to 666 Pa.
7. The method of any one of Claims 1 to 6, wherein in the selectively etching the silica-based residue, a flow rate ratio (volume ratio) of the H₂O gas or the alcohol gas to a total amount of the HF gas+H₂O gas or alcohol gas is within a range of 10 to 50%.
8. The method of any one of Claims 1 to 7, wherein in the first process of the removing an etching residue, a flow rate of the H₂O gas or the alcohol gas is within a range of 100 to 1,000 sccm.
9. The method of any one of Claims 1 to 8, wherein a time period of the first process of the removing an etching residue is within a range of 5 to 60 seconds.
10. The method of any one of Claims 1 to 9, wherein the second temperature is within a range of 150 to 230 degrees C.
11. The method of any one of Claims 1 to 10, wherein a time period of the second process of the removing an etching residue is within a range of 30 to 600 seconds.

12. The method of any one of Claims 1 to 11, wherein the etching residue contains the fluorine component and a base component, and the fluorine component is removed from the etching residue in the first process of the removing an etching residue and the remainder of the etching residue is removed in the second process of the removing an etching residue.

13. A method of removing an etching residue containing a fluorine component and a base component adhered to an SiO₂ film, comprising:

removing the fluorine component by supplying, to a target substrate having the SiO₂ film at a first temperature, an H₂O gas or an alcohol gas to react with the fluorine component of the etching residue and generate HF that is to be volatilized without heating the target substrate; and

removing the remainder of the etching residue by heating the target substrate to a second temperature that is higher than the first temperature after the removing the fluorine component, wherein the first temperature is within a range of 10 to 30 degrees C.

14. The method of Claim 13, wherein a time period of the removing the fluorine component is within a range of 5 to 60 seconds.

15. The method of any one of Claims 13 and 14, wherein the second temperature is within a range of 150 to 230 degrees C.

16. The method of any one of Claims 13 to 15, wherein a time period of the removing the remainder is within a range of 30 to 600 seconds.