mask during the etching of the multilayered film and, also, to improve the uniformity of the shape of the multiple openings formed in the multilayered film and the verticality of these multiple openings.

**[0008]** According to an aspect of the present invention, there is provided a method of etching a multilayered film of a processing target object. The multilayered film includes multiple silicon oxide films and multiple silicon nitride films alternately stacked on top of each other. The processing target object includes a mask provided on the multilayered film. The mask contains carbon. The mask is provided with multiple openings. The method is performed in a state that the processing target object is placed on an electrostatic chuck within a chamber of a plasma processing apparatus. The method includes performing a first plasma processing to etch the multilayered film; and performing a second plasma processing to further etch the multilayered film after the performing of the first plasma processing. In the performing of the first plasma processing and in the performing of the second plasma processing, to etch the multilayered film, plasma of a processing gas is generated within the chamber in a state that a temperature of the electrostatic chuck is set to be equal to or less than -15℃. The processing gas contains a hydrogen atom, a fluorine atom and a carbon atom and also contains a sulfur-containing gas. A second pressure of the chamber in the performing of the second plasma processing is set to be higher than a first pressure of the chamber in the performing of the first plasma processing such that a selectivity of an etching of the multilayer film to an etching of the mask in the second plasma processing is higher than the selectivity in the first plasma processing.

**[0009]** In the method, a deposit containing sulfur in the sulfur-containing gas is formed on the mask, and a shape of the multiple openings of the mask during the plasma etching is defined by the mask and the deposit thereon. A film of the deposit containing the sulfur is formed on the mask, having a relatively uniform film thickness. As a result, deformation of the

**WE CLAIM**

1. A method of etching a multilayered film of a processing target object,

wherein the multilayered film comprises multiple silicon oxide films and multiple silicon nitride films alternately stacked on top of each other,

the processing target object includes a mask which is provided on the multilayered film and which contains carbon,

the mask is provided with multiple openings,

wherein the method is performed in a state that the processing target object is placed on an electrostatic chuck within a chamber of a plasma processing apparatus, and the method comprises:

performing a first plasma processing to etch the multilayered film; and

performing a second plasma processing to further etch the multilayered film after the performing of the first plasma processing,

wherein, in the performing of the first plasma processing and in the performing of the second plasma processing, to etch the multilayered film, plasma of a processing gas is generated within the chamber in a state that a temperature of the electrostatic chuck is set to be equal to or less than -15℃,

the processing gas contains a hydrogen atom, a fluorine atom and a carbon atom and also contains a sulfur-containing gas, and

a second pressure of the chamber in the performing of the second plasma processing is set to be higher than a first pressure of the chamber in the performing of the first plasma processing such that a selectivity of an etching of the multilayer film to an etching of the mask in the second plasma processing is higher than the selectivity in the first plasma processing.

2. The method of Claim 1,

wherein the performing of the first plasma processing is conducted until openings having an aspect ratio, which is equal to or larger than half of a required aspect ratio of the openings to be formed in the multilayered film and smaller than the required aspect ratio, are formed in the multilayered film.

3. The method of Claim 1 or 2,

wherein the first pressure is equal to or lower than 2 Pascals, and the second pressure is equal to or higher than 3.333 Pascals.

4. The method of any one of Claims 1 to 3,

wherein the processing gas contains a hydrogen gas and a hydrofluorocarbon gas.

5. The method of any one of Claims 1 to 3,

wherein the processing gas contains a hydrogen gas, a CH2F2 gas, a SF6 gas and a HBr gas.