and in the second region by etching the processing target object. Further, when performing this etching process, it is also required to form the spaces having desirable shapes in the first region and the second region while suppressing a decrease of an etching rate.

SUMMARY

[0006] In one exemplary embodiment, an etching method of etching a first region and a second region of a processing target object is provided. The first region includes a multilayered film in which first dielectric films and second dielectric films are alternately stacked, and the second dielectric films are silicon nitride films. The second region includes a single-layered silicon oxide film, and the processing target object includes a mask provided with openings on the first region and the second region. The etching method includes (i) mounting the processing target object on an electrostatic chuck provided within a processing vessel of a plasma processing apparatus; (ii) generating plasma of a first processing gas containing a fluorocarbon gas and an oxygen gas within the processing vessel (hereinafter, referred to as "first plasma process"); and (iii) generating plasma of a second processing gas containing a hydrogen gas, nitrogen trifluoride gas and a carbon-containing gas within the processing vessel (hereinafter, referred to as "second plasma process"). Here, a temperature of the electrostatic chuck is set to a first temperature in the generating of the plasma of the first processing gas, and the temperature of the electrostatic chuck is set to a second temperature lower than the first temperature in the generating of the plasma of the second processing gas.

[0007] The etching by the plasma of the first processing gas is characterized in that an etching rate of the second region is higher than an etching rate of the first region. Further, in the etching by the plasma of the first processing gas, when the temperature of the processing target

WE CLAIM

1. An etching method of etching a first region and a second region of a processing target object, the first region including a multilayered film in which first dielectric films and second dielectric films are alternately stacked, the second dielectric films being silicon nitride films, the second region including a single-layered silicon oxide film, and the processing target object including a mask provided with openings on the first region and the second region, the etching method comprising:

mounting the processing target object on an electrostatic chuck provided within a processing vessel of a plasma processing apparatus;

generating plasma of a first processing gas containing a fluorocarbon gas and an oxygen gas within the processing vessel; and

generating plasma of a second processing gas containing a hydrogen gas, nitrogen trifluoride gas and a carbon-containing gas within the processing vessel,

wherein a temperature of the electrostatic chuck is set to a first temperature in the generating of the plasma of the first processing gas, and

the temperature of the electrostatic chuck is set to a second temperature lower than the first temperature in the generating of the plasma of the second processing gas.

2. The etching method of Claim 1,

wherein the generating of the plasma of the first processing gas and the generating of the plasma of the second processing gas are performed consecutively.

3. The etching method of Claim 1,

wherein the second processing gas further contains a hydrogen bromide gas.

4. The etching method of Claim 1, further comprising:

generating plasma of a third processing gas containing a fluorocarbon gas and an oxygen gas within the processing vessel,

wherein the processing target object includes, as a base of the first region and the second region, an underlying layer made of silicon or tungsten,

the generating of the plasma of the first processing gas and the generating of the plasma of the second processing gas are performed until immediately before the underlying layer is exposed, and

the temperature of the electrostatic chuck is set to a third temperature higher than the first temperature in the generating of the plasma of the third processing.

5. The etching method of Claim 1,

wherein a sequence including the generating of the plasma of the first processing gas and the generating of the plasma of the second processing gas is repeated multiple times.