

WHAT IS CLAIMED IS:

1. A plasma etching method comprising:
 - 5 generating a first plasma from a first processing gas using a first radio frequency power, the first processing gas containing a fluorine-containing gas and a hydrogen-containing gas, and excluding bromine-containing gas;
 - 10 etching a laminated film with the first plasma so as to form an etching opening in the laminated film, the laminated film including a first silicon-containing film layer and a second silicon-containing film layer that is different from the first silicon-containing film layer;
 - 15 generating a second plasma from a second processing gas using a second radio frequency power after etching the laminated film with the first plasma, the second processing gas containing a bromine-containing gas, and
 - 20 etching the laminated film with the second plasma, wherein
 - the etching with the first plasma and the etching with the second plasma are performed via a mask
 - 25 on the laminated film,
 - unevenness is formed on a side wall of the etching opening at an interface of the first silicon-containing film layer and the second silicon-containing film layer during the etching with the
 - 30 first plasma, and
 - the unevenness is removed during the etching with the second plasma.

2. The plasma etching method according to claim 1, wherein the etching with the first plasma and the etching with the second plasma are performed under
5 a temperature less than or equal to -30°C .

3. The plasma etching method according to claim 1, wherein the second processing gas includes the
10 first processing gas.

4. The plasma etching method according to claim 1, wherein the second processing gas includes a
15 processing gas that is different from the first processing gas.

5. The plasma etching method according to
20 claim 1, wherein
a radio frequency power that is greater than the first radio frequency power or the second radio frequency power is further applied in at least one of the etching with the first plasma or the etching with the
25 second plasma.

6. The plasma etching method according to claim 1, wherein the fluorine-containing gas is CF_4 and
30 the hydrogen-containing gas is H_2 .

7. The plasma etching method according to claim 1, wherein the bromine-containing gas is HBr.

5 8. The plasma etching method according to claim 1, wherein the first silicon-containing film layer is a silicon oxide layer, and the second silicon-containing film layer is a silicon nitride film layer.

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9. The plasma etching method according to claim 1, wherein a capacitively coupled plasma processing apparatus is used to perform the plasma etching method.

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10. The plasma etching method according to claim 1, wherein an inductively coupled plasma processing apparatus is used to perform the plasma etching method.

11. The plasma etching method according to claim 1, wherein a mask film having an opening is formed on the laminated film.

12. The plasma etching method according to claim 1, wherein the laminated film consists of alternating layers of the first silicon-containing film layer and the second silicon-containing film layer.

13. The plasma etching method according to claim 1, wherein at least one of the first radio frequency power and the second radio frequency power is a continuous wave.

14. The plasma etching method according to claim 1, wherein at least one of the first radio frequency power and the second radio frequency power is a pulse wave.

5 15. The plasma etching method according to claim 1, wherein the etching with the first plasma and the etching with the second plasma, which is performed after the etching with the first plasma, are each performed once.

10 16. The plasma etching method according to claim 1, wherein after the etching with the first plasma is performed, the first radio frequency power is not turned off and continues to be applied during the etching
15 with the second plasma.

17. The plasma etching method according to claim 5, wherein the radio frequency power is a continuous wave.

20 18. The plasma etching method according to claim 5, wherein the radio frequency power is a pulse wave.

19. A plasma etching method comprising:
25 preparing a laminated film including a first silicon-containing film layer and a second silicon-containing film layer that is different from the first silicon-containing film layer;

 etching the laminated film with a first plasma
30 containing fluorine and hydrogen so as to form an opening in the laminated film, and excluding bromine; and

 etching the laminated film with a second plasma containing bromine after etching the laminated

film with the first plasma;
wherein

the etching with the first plasma and the
etching with the second plasma are performed via a mask
5 on the laminated film,

unevenness is formed on a side wall of the
etching opening at an interface of the silicon-containing
film layer and the second silicon-containing film layer
during the etching with the first plasma, and
10 the unevenness is removed during the etching
with the second plasma.

20. A plasma etching method comprising:
preparing a laminated film including a first
15 silicon-containing film layer and a second
silicon-containing film layer that is different from the
first silicon-containing film layer in a chamber;

supplying a first gas that contains
fluorine-containing gas and hydrogen-containing gas, and
20 excluding bromine-containing gas, into the chamber; and
applying a first radio frequency power in the
chamber so as to form an etching opening in the laminated
film;

supplying a second gas that contains a
25 bromine-containing gas into the chamber; and
applying a second radio frequency power in the
chamber;
wherein

etching of the laminated film is performed via
30 a mask on the laminated film,

unevenness is formed on a side wall of the
etching opening at an interface of the first
silicon-containing film layer and the second

silicon-containing film layer during the application of the first radio frequency in the chamber, and

the unevenness is removed during the application of the second radio frequency in the chamber.