WHAT IS CLAIMED IS:

1. An etching method in a chamber of a plasma processing apparatus, the method comprising:

(a) providing, in the chamber, a substrate including an etching target film and a mask on the etching target film, the mask comprising at least one metal selected from the group consisting of tungsten, molybdenum, ruthenium, titanium, indium, gallium, and zinc; and

(b) etching the etching target film using plasma generated from a process gas including a hydrogen fluoride gas,

wherein (b) includes generating plasma from a declogging gas at a first flow rate, and generating plasma from the declogging gas at a second flow rate smaller than the first flow rate.

2. The etching method according to claim 1, wherein

the mask comprises a carbide or a silicide of the at least one metal.

3. The etching method according to claim 1, wherein

the mask comprises at least one selected from the group consisting of Ru, WSi, TiN, Mo, and InGaZnO.

4. The etching method according to claim 3, wherein

the mask further comprises at least one selected from the group consisting of silicon, carbon, and nitrogen.

5. The etching method according to claim 1, wherein

the process gas further includes a phosphorus-containing gas.

6. The etching method according to claim 5, wherein

the phosphorus-containing gas includes a phosphorus halide gas.

7. The etching method according to claim 5, wherein

the phosphorus-containing gas comprises at least one of fluorine or chlorine.

8. The etching method according to claim 1, wherein

the process gas includes the hydrogen fluoride gas with a highest flow rate of non-inert components of the process gas.

9. The etching method according to claim 1, wherein

the process gas further includes at least one gas selected from the group consisting of a tungsten-containing gas, a titanium-containing gas, and a molybdenum-containing gas.

10 The etching method according to claim 5, wherein

the process gas further includes oxygen-containing gas.

11. The etching method according to claim 1, wherein

(b) includes setting a temperature of a substrate support supporting the substrate to 0 °C or lower.

12. The etching method according to claim 1, wherein

the etching target film includes at least one selected from the group consisting of a silicon oxide film, a silicon nitride film, a polysilicon film, and a film stack including at least two of

the silicon oxide film, the silicon nitride film, or the polysilicon film.

13. The etching method according to claim 1, wherein

the etching target film is a silicon-containing film, a carbon-containing film, or a metal oxide film.

14. An etching method in a chamber of a plasma processing apparatus, the method comprising:

(a) providing, in the chamber, a substrate including an etching target film and a mask on the etching target film, the mask comprising at least one metal selected from the group consisting of tungsten, molybdenum, ruthenium, titanium, indium, gallium, and zinc; and

(b) etching the etching target film using plasma generated from a process gas including a hydrogen fluoride gas, wherein

the etching target film is a film stack including a silicon oxide film and a silicon nitride film, and (b) includes (b1) etching the silicon oxide film and (b2) etching the silicon nitride film, and

(b) includes controlling a temperature of the substrate to be higher in (b2) than in (b1), and wherein the control of the temperature includes:

(A) controlling a temperature of a heat-transfer fluid to be supplied to a channel in a substrate support to be identical in (b1) and (b2); and

(B) at least one selected from the group consisting of

(I) controlling a duty ratio of a source radio frequency signal to be provided to the chamber to be greater in (b2) than in (b1);

(II) controlling a duty ratio of a bias signal to be provided to the substrate support to be greater in (b2) than in (b1); and

(III) controlling a voltage to be provided to an electrostatic chuck in the substrate support to be lower in (b2) than in (b1).

15. An etching method in a chamber of a plasma processing apparatus, the method comprising:

(a) providing, in the chamber, a substrate including an etching target film and a mask on the etching target film, the mask comprising at least one selected from the group consisting of tungsten, molybdenum, ruthenium, titanium, indium, gallium, and zinc; and

(b) etching the etching target film using plasma including a hydrogen fluoride species,

wherein (b) includes generating plasma from a declogging gas at a first flow rate, and generating plasma from the declogging gas at a second flow rate smaller than the first flow rate.

16. The etching method according to claim 15, wherein

the hydrogen fluoride species is generated from at least one of a hydrogen fluoride gas or a hydrofluorocarbon gas.

17. The etching method according to claim 15, wherein

the hydrogen fluoride species is generated from a hydrofluorocarbon gas having at least

two carbon atoms.

18. The etching method according to claim 15, wherein

the hydrogen fluoride species is generated from a mixture gas including a hydrogen source and a fluorine source.

19. A plasma processing system, comprising:

a plasma processing apparatus including a chamber; and

a controller, the controller being configured to perform control to cause operations including

(a) providing, in the chamber, a substrate including an etching target film and a mask on the etching target film, the mask comprising at least one metal selected from the group consisting of tungsten, molybdenum, ruthenium, titanium, indium, gallium, and zinc, and

(b) etching the etching target film using plasma generated from a process gas including a hydrogen fluoride gas,

wherein (b) includes generating plasma from a declogging gas at a first flow rate, and generating plasma from the declogging gas at a second flow rate smaller than the first flow rate.

20. The etching method according to claim 1, wherein (b) comprises:

generating plasma from the process gas including the declogging gas at the first flow rate to etch the etching target film and remove deposits formed on a sidewall of the mask; and

generating plasma from said process gas including the declogging gas at the second flow rate to etch the etching target film and remove deposits formed on the sidewall of the mask.

21. The etching method according to claim 1, wherein the process gas further includes a phosphorus-containing gas, and the declogging gas includes a gas that reacts with phosphorus to generate a volatile compound.

22. The etching system according to claim 15, wherein (b) comprises:

generating plasma from the process gas including the declogging gas at the first flow rate to etch the etching target film and remove deposits formed on a sidewall of the mask; and

generating plasma from said process gas including the declogging gas at the second flow rate to etch the etching target film and remove deposits formed on the sidewall of the mask.

23. The etching system according to claim 15, wherein the process gas further includes a phosphorus-containing gas, and the declogging gas includes a gas that reacts with phosphorus to generate a volatile compound.

24. The etching system according to claim 19, wherein (b) comprises:

generating plasma from the process gas including the declogging gas at the first flow rate to etch the etching target film and remove deposits formed on a sidewall of the mask; and

generating plasma from said process gas including the declogging gas at the second flow rate to etch the etching target film and remove deposits formed on the sidewall of the mask.

25. The etching system according to claim 19, wherein the process gas further includes a phosphorus-containing gas, and the declogging gas includes a gas that reacts with phosphorus to generate a volatile compound.

26. An etching method in a chamber of a plasma processing apparatus, the method comprising:

(a) providing, in the chamber, a substrate including an etching target film and a mask on the etching target film, the mask comprising at least one selected from the group consisting of tungsten, molybdenum, ruthenium, titanium, indium, gallium, and zinc; and

(b) etching the etching target film using plasma including a hydrogen fluoride species, wherein

the etching target film is a film stack including a silicon oxide film and a silicon nitride film, and (b) includes (b1) etching the silicon oxide film and (b2) etching the silicon nitride film, and

(b) includes controlling a temperature of the substrate to be higher in (b2) than in (b1), and wherein the control of the temperature includes:

(A) controlling a temperature of a heat-transfer fluid to be supplied to a channel in a substrate support to be identical in (b1) and (b2); and

(B) at least one selected from the group consisting of:

(I) controlling a duty ratio of a source radio frequency signal to be provided to the chamber

to be greater in (b2) than in (b1);

(II) controlling a duty ratio of a bias signal to be provided to the substrate support to be greater in (b2) than in (b1); and

(III) controlling a voltage to be provided to an electrostatic chuck in the substrate support to be lower in (b2) than in (b1).

27. A plasma processing system, comprising:

a plasma processing apparatus including a chamber; and

a controller, the controller being configured to perform control to cause operations including

(a) providing, in the chamber, a substrate including an etching target film and a mask on the etching target film, the mask comprising at least one metal selected from the group consisting of tungsten, molybdenum, ruthenium, titanium, indium, gallium, and zinc, and

(b) etching the etching target film using plasma generated from a process gas including a hydrogen fluoride gas, wherein

the etching target film is a film stack including a silicon oxide film and a silicon nitride film, and (b) includes (b1) etching the silicon oxide film and (b2) etching the silicon nitride film, and

(b) includes controlling a temperature of the substrate to be higher in (b2) than in (b1), and wherein the control of the temperature includes:

(A) controlling a temperature of a heat-transfer fluid to be supplied to a channel in a substrate support to be identical in (b1) and (b2); and

(B) at least one selected from the group consisting of:

(I) controlling a duty ratio of a source radio frequency signal to be provided to the chamber to be greater in (b2) than in (b1);

(II) controlling a duty ratio of a bias signal to be provided to the substrate support to be greater in (b2) than in (b1); and

(III) controlling a voltage to be provided to an electrostatic chuck in the substrate support to be lower in (b2) than in (b1).