WHAT IS CLAIMED IS:

1. A substrate processing method comprising:

(a1) providing a substrate including a silicon-containing film in a chamber;

(a2) supplying a processing gas including HF gas into the chamber;

(a3) etching the silicon-containing film with plasma generated from the processing gas, thereby forming a recess in the silicon-containing film; and

(a4) controlling a partial pressure of the HF gas such that the partial pressure of the HF gas is decreased with an increase of an aspect ratio of the recess.

2. The substrate processing method according to claim 1, wherein in (a4), the partial pressure of the HF gas is decreased by decreasing a pressure in the chamber.

3. The substrate processing method according to claim 1, wherein in (a4), the partial pressure of the HF gas is decreased by adding a dilution gas in the chamber.

4. The substrate processing method according to claim 1, wherein in (a4), the partial pressure of the HF gas in the chamber is decreased by supplying a reactive gas that reacts with an element contained in molecules of the HF gas to scavenge the molecules of the HF gas, into the chamber.

5. The substrate processing method according to claim 4, wherein the reactive gas is a chlorine-containing gas.

6. The substrate processing method according to claim 5, wherein the chlorine-

containing gas is at least one gas selected from the group consisting of Cl_2 gas, HCl gas, $CHCl_3$ gas, CH_2Cl_2 gas, CH_3Cl gas, CCl_4 gas, BCl_3 gas, $SiCl_4$ gas, SiH_2Cl_2 gas, and Si_2Cl_6 gas.

7. The substrate processing method according to claim 1, wherein in (a4), the partial pressure of the HF gas in the chamber is decreased by decreasing a flow rate of the HF gas supplied into the chamber.

8. The substrate processing method according to any one of claims 1 to 7, wherein in (a3), the partial pressure of the HF gas is controlled to a first partial pressure,

in (a4), the partial pressure of the HF gas is controlled to a second partial pressure lower than the first partial pressure, and

(a3) and (a4) are alternately repeated.

9. The substrate processing method according to claim 8, wherein in (a3) repeated alternately with (a4), the first partial pressure is controlled to gradually decrease with the increase of the aspect ratio of the recess.

10. The substrate processing method according to any one of claims 1 to 9, wherein the processing gas includes a carbon-containing gas.

11. The substrate processing method according to claim 10, wherein the carbon-containing gas is at least one gas selected from the group consisting of fluorocarbon gas and hydrofluorocarbon gas.

12. The substrate processing method according to claim 11, wherein the fluorocarbon

gas is at least one gas selected from the group consisting of CF_4 gas, C_2F_2 gas, C_2F_4 gas, C_3F_8 gas, C_4F_6 gas, C_4F_8 gas, and C_5F_8 gas.

13. The substrate processing method according to claim 11, the hydrofluorocarbon gas is at least one gas selected from the group consisting of CHF_3 gas, CH_2F_2 gas, CH_3F gas, C_2HF_5 gas, $C_2H_2F_4$ gas, $C_2H_3F_3$ gas, $C_2H_4F_2$ gas, C_3HF_7 gas, $C_3H_2F_2$ gas, $C_3H_2F_6$ gas, $C_3H_2F_4$ gas, $C_3H_3F_5$ gas, $C_4H_5F_5$ gas, $C_4H_2F_6$ gas, $C_4H_2F_8$ gas, $C_5H_2F_6$ gas, $C_5H_2F_{10}$ gas, and $C_5H_3F_7$ gas.

14. The substrate processing method according to any one of claims 1 to 13, wherein the processing gas includes at least one gas selected from the group consisting of a phosphorus-containing gas, a sulfur-containing gas, and a boron-containing gas.

15. The substrate processing method according to claim 14, wherein the phosphorus-containing gas is at least one gas selected from the group consisting of PF_3 gas, PF_5 gas, POF_3 gas, HPF_6 gas, PCl_3 gas, PCl_5 gas, $POCl_3$ gas, PBr_3 gas, PBr_5 gas, $POBr_3$ gas, PI_3 gas, P_4O_{10} gas, P_4O_8 gas, P_4O_6 gas, PH_3 gas, Ca_3P_2 gas, H_3PO_4 gas, and Na_3PO_4 gas.

16. The substrate processing method according to claim 1, wherein the processing gas further includes a phosphorus-containing gas and a chlorine-containing gas,

the phosphorus-containing gas is at least one gas selected from the group consisting of PF_3 gas, PF_5 gas, POF_3 gas, HPF_6 gas, PCl_3 gas, PCl_5 gas, $POCl_3$ gas, PBr_3 gas, PBr_5 gas, $POBr_3$ gas, PI_3 gas, P_4O_{10} gas, P_4O_8 gas, P_4O_6 gas, PH_3 gas, Ca_3P_2 gas, H_3PO_4 gas, and Na_3PO_4 gas, and

the chlorine-containing gas is at least one gas selected from the group consisting of Cl_2 gas, HCl gas, $CHCl_3$ gas, CH_2Cl_2 gas, CH_3Cl gas, CCl_4 gas, BCl_3 gas, $SiCl_4$ gas,

SiH_2Cl_2 gas, and Si_2Cl_6 gas.

17. The substrate processing method according to claim 16, wherein the processing gas further includes at least one carbon-containing gas selected from the group consisting of fluorocarbon gas and hydrofluorocarbon gas.

18. The substrate processing method according to claim 14, wherein the sulfur-containing gas is at least one gas selected from the group consisting of SF_6 gas, SO_2 gas, and COS gas.

19. The substrate processing method according to claim 14, wherein the boron-containing gas is at least one gas selected from the group consisting of BCl_3 gas, BF_3 gas, BBr_3 gas, and B_2H_6 gas.

20. The substrate processing method according to any one of claims 1 to 19, wherein the silicon-containing film includes at least one film selected from the group consisting of a silicon oxide film, a silicon nitride film, and a polysilicon film.

21. The substrate processing method according to any one of claims 1 to 20, wherein the silicon-containing film is a silicon oxide film, a multilayer film of a silicon oxide film and a silicon nitride film, or a multilayer film of a silicon oxide film and a polysilicon film.

22. The substrate processing method according to any one of claims 1 to 21, wherein in (a4), the partial pressure of the HF gas is estimated by monitoring a light emission state of the plasma, and the estimated partial pressure of the HF gas is controlled to decrease.

23. A substrate processing method comprising:

(b1) providing a substrate including a silicon-containing film in a chamber;

(b2) supplying a processing gas including a gas capable of producing an HF species into the chamber;

(b3) etching the silicon-containing film with plasma generated from the processing gas, thereby forming a recess in the silicon-containing film; and

(b4) controlling a partial pressure of the HF species such that the partial pressure of the HF is decreased with an increase of an aspect ratio of the recess.

24. A substrate processing method comprising:

(c1) providing a substrate including a silicon-containing film in a chamber;

(c2) supplying a processing gas including an etchant which is at least one gas selected from the group consisting of a gas containing fluorine, a gas containing carbon and fluorine, and a gas containing carbon, hydrogen, and fluorine, into the chamber;

(c3) etching the silicon-containing film with plasma generated from the processing gas, thereby forming a recess in the silicon-containing film; and

(c4) changing a partial pressure of the etchant with an increase of an aspect ratio of the recess.

25. A substrate processing method comprising:

(a1) providing a substrate including a silicon-cotaining film in a chamber;

(a2) supplying a first processing gas including HF gas into the chamber;

(a3) ething the silicon-containing film with plasma generated from the first processing gas;

(a4) supplying a second processing gas including HF gas into the chamber, a parital pressure of the HF gas of the second processing gas being different from a partial pressure

of the HF gas of the first processing gas; and

(a5) further etching the silicon-containing film with plasma generated from the second processing gas.

26. A substrate processing apparatus comprising:

a chamber including a gas supply port and a gas discharge port;

a substrate support provided in the chamber;

a plasma generator configured to generate plasma from a processing gas supplied into the chamber;

and a controller,

wherein the controller is configured to execute a process including:

(d1) placing a substrate including a silicon-containing film on the substrate support,

(d2) supplying a processing gas including HF gas into the chamber,

(d3) generating plasma from the processing gas, and etching the silicon-containing film with the generated plasma, thereby forming a recess in the silicon-containing film, and

(d4) controlling a partial pressure of the HF gas such that the partial pressure of the HF is decreased with an increase of an aspect ratio of the recess.