WHAT IS CLAIMED IS:

1. A method of processing substrate, comprising:

(a) forming a layer including a surface terminated with an element X on a surface of a substrate by supplying an element X-containing gas to the substrate which is set to have a first temperature;

(b) changing a surface termination with the element X on the surface of the layer to a surface termination with an element Y by supplying an element Y-containing gas to the substrate which is set to have a second temperature;

(c) desorbing the element Y constituting the surface termination with the element Y on the surface of the layer by setting the substrate to have a third temperature; and

(d) forming a film on the layer from which the element Y is desorbed, by supplying a film-forming gas to the substrate which is set to have a fourth temperature,

wherein the element X is a halogen, and

wherein the element Y is hydrogen or deuterium.

2. The method of Claim 1, wherein in (a), a surface with a Si-X termination is formed as the surface terminated with the element X, and

wherein in (b), the Si-X termination on the surface of the layer is changed to a Si-Y termination.

3. The method of Claim 2, wherein in (c), a Si-Y bond in the Si-Y termination on the surface of the layer is cut, and Si at the surface of the layer is made to have a dangling bond.

4. The method of Claim 1, wherein the second temperature is set to be higher than the first temperature, and

wherein the third temperature is set to be higher than the first temperature.

5. The method of Claim 4, wherein the fourth temperature is set to be equal to or lower than the first temperature.

6. The method of Claim 4, wherein the fourth temperature is set to be higher than the first temperature.

7. The method of any one of Claims 1 to 6, wherein the element X is chlorine.

8. The method of Claim 1, wherein in (a), a halosilane-based gas is supplied to the substrate as the element X-containing gas.

9. The method of Claim 1, wherein in (a), a chlorosilane-based gas is supplied to the substrate as the element X-containing gas.

10. The method of Claim 8, wherein in (a), a silicon hydride-based gas is further supplied to the substrate.

11. The method of Claim 10, wherein in (a), the halosilane-based gas and the silicon hydride-based gas are alternately supplied to the substrate.

12. The method of Claim 1, wherein in (b), at least one selected from the group of a hydrogen gas and a deuterium gas is supplied to the substrate as the element Y-containing gas.

13. The method of any one of Claims 1 to 6, wherein in (c), at least one selected from the group of supplying an inert gas to the substrate and evacuating a space in which the substrate exists is performed.

14. The method of any one of Claims 1 to 6, wherein in (d), at least one selected from the

group of a germanium-containing gas and a silicon-containing gas is supplied to the substrate as the film-forming gas.

15. The method of any one of Claims 1 to 6, wherein the second temperature and the third temperature are set to 400 degrees C or higher and 520 degrees C or lower.

16. The method of any one of Claims 1 to 6, wherein a pressure in a space in which the substrate exists is set to 500 Pa or more in (b) and (c).

17. The method of any one of Claims 1 to 6, wherein a processing time in (b) is equal to or longer than a processing time in (c).

18. A method of manufacturing a semiconductor device, comprising:

(a) forming a layer including a surface terminated with an element X on a surface of a substrate by supplying an element X-containing gas to the substrate which is set to have a first temperature;

(b) changing a surface termination with the element X on the surface of the layer to a surface termination with an element Y by supplying an element Y-containing gas to the substrate which is set to have a second temperature;

(c) desorbing the element Y constituting the surface termination with the element Y on the surface of the layer by setting the substrate to have a third temperature; and

(d) forming a film on the layer from which the element Y is desorbed, by supplying a film-forming gas to the substrate which is set to have a fourth temperature,

wherein the element X is a halogen, and

wherein the element Y is hydrogen or deuterium.

19. A substrate processing apparatus, comprising:

an element X-containing gas supply system configured to supply an element X-

containing gas to a substrate;

an element Y-containing gas supply system configured to supply an element Y-containing gas to the substrate;

a film-forming gas supply system configured to supply a film-forming gas to the substrate;

a temperature regulator configured to regulate a temperature of the substrate; and

a controller configured to be capable of controlling the element X-containing gas supply system, the element Y-containing gas supply system, the film-forming gas supply system, and the temperature regulator to perform a process including:

(a) forming a layer including a surface terminated with an element X on a surface of the substrate by supplying the element X-containing gas to the substrate which is set to have a first temperature,

(b) changing a surface termination with the element X on the surface of the layer to a surface termination with an element Y by supplying the element Y-containing gas to the substrate which is set to have a second temperature,

(c) desorbing the element Y constituting the surface termination with the element Y on the surface of the layer by setting the substrate to have a third temperature, and

(d) forming a film on the layer from which the element Y is desorbed, by supplying the film-forming gas to the substrate which is set to have a fourth temperature,

wherein the element X is a halogen, and

wherein the element Y is hydrogen or deuterium.

20. A program that causes, by a computer, a substrate processing apparatus to perform a process comprising:

(a) forming a layer including a surface terminated with an element X on a surface of a substrate by supplying an element X-containing gas to the substrate which is set to have a first temperature;

(b) changing a surface termination with the element X on the surface of the layer to a surface termination with an element Y by supplying an element Y-containing gas to the substrate which is set to have a second temperature;

(c) desorbing the element Y constituting the surface termination with the element Y on the surface of the layer by setting the substrate to have a third temperature; and

(d) forming a film on the layer from which the element Y is desorbed, by supplying a film-forming gas to the substrate which is set to have a fourth temperature

wherein the element X is a halogen, and

wherein the element Y is hydrogen or deuterium.