WHAT IS CLAIMED IS:

1. A method of processing a substrate, comprising:

etching a crystalline film formed on a substrate by performing:

(a) supplying a boron-containing gas to the crystalline film;

(b) supplying a halide gas to the crystalline film; and

(c) supplying a gas having a hydrogen group to the crystalline film after (b),

wherein in the act of etching the crystalline film, (a), (b) and (c) are performed non-simultaneously a predetermined number of times.

2. The method of Claim 1, wherein in the act of etching the crystalline film, (a) and (b) are sequentially performed.

3. The method of Claim 1, wherein in the act of etching the crystalline film, (c) is performed after (a) and (b).

4. The method of Claim 1, wherein in the act of etching the crystalline film, (a), (b), and (c) are sequentially performed.

5. The method of Claim 1, further comprising (d) forming the crystalline film by heating an amorphous film formed on the substrate to a predetermined crystallization processing temperature and crystallizing the amorphous film.

6. The method of Claim 5, wherein in (d), the crystalline film is formed by performing a heat treatment on the amorphous film having a first film thickness, and

wherein in the act of etching the crystalline film, the etching on the crystalline film is performed until the crystalline film has a second film thickness smaller than the first film thickness.

7. The method of Claim 6, wherein the crystallization processing temperature for crystallizing the amorphous film having the first film thickness is lower than a temperature required for crystallizing the amorphous film having the second film thickness.

8. The method of Claim 7, wherein the act of etching the crystalline film is performed at a temperature equal to or lower than the crystallization processing temperature.

9. The method of Claim 5, wherein the amorphous film is formed by performing a cycle a predetermined number of times, the cycle including non-simultaneously supplying a precursor gas and a reaction gas to the substrate.

10. The method of any one of Claims 1 to 9, wherein the crystalline film is at least one selected from the group of an oxide film and a nitride film.

11. The method of any one of Claims 1 to 9, wherein the crystalline film is at least one selected from the group of a metal oxide film and a metal nitride film.

12. The method of any one of Claims 1 to 9, wherein the boron-containing gas is a halide gas.

13. The method of Claim 9, wherein the gas having the hydrogen group and the precursor gas are gases identical to each other.

14. The method of any one of Claims 1 to 13, wherein the gas having the hydrogen group is a gas having a hydrocarbon group.

15. A substrate processing apparatus, comprising:

a process chamber in which a substrate is processed;

a boron-containing gas supply system configured to supply a boron-containing gas to

the substrate in the process chamber;

a halide gas supply system configured to supply a halide gas to the substrate in the process chamber;

a hydrogen group-containing gas supply system configured to supply a gas having a hydrogen group to the substrate in the process chamber; and

a controller configured to be capable of controlling the boron-containing gas supply system, the halide gas supply system, and the hydrogen group-containing gas supply system so as to perform etching a crystalline film formed on the substrate by performing:

(a) supplying the boron-containing gas to the crystalline film;

(b) supplying the halide gas to the crystalline film; and

(c) supplying the gas having the hydrogen group to the crystalline film after (b),

wherein in the act of etching the crystalline film, (a), (b) and (c) are performed non-simultaneously a predetermined number of times.

16. A program that causes, by a computer, a substrate processing apparatus to perform a process for etching a crystalline film formed on a substrate:

(a) supplying a boron-containing gas to the crystalline film;

(b) supplying a halide gas to the crystalline film; and

(c) supplying a gas having a hydrogen group to the crystalline film after (b),

wherein in the act of etching the crystalline film, (a), (b) and (c) are performed non-simultaneously a predetermined number of times.

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

etching a crystalline film formed on a substrate by performing:

(a) supplying a boron-containing gas to the crystalline film;

(b) supplying a halide gas to the crystalline film; and

(c) supplying a gas having a hydrogen group to the crystalline film after (b)

wherein in the act of etching the crystalline film, (a), (b) and (c) are performed non-simultaneously a predetermined number of times.