METHOD OF PROCESSING SUBSTRATE, METHOD OF MANUFACTURING SEMICONDUCTOR DEVICE, SUBSTRATE PROCESSING APPARATUS, AND PROGRAM

TECHNICAL FIELD

[0001] The present disclosure relates to a method of processing a substrate, a method of manufacturing a semiconductor device, a method of processing a substrate, a substrate processing apparatus, and a program.

BACKGROUND

[0002] As a process of manufacturing a semiconductor device, a process of selectively growing and forming a film on a surface of a specific one base among a plurality of types of bases exposed on a surface of a substrate (this process is also hereinafter referred to as selective growth or selective film formation) may be carried out (for example, Patent Document 1).

PRIOR ART DOCUMENTS

PATENT DOCUMENTS

[0003] Patent Document 1: Japanese laid-open publication No. 2013-243193

SUMMARY

PROBLEM TO BE SOLVED BY THE INVNETION

[0004] The present disclosure intends to provide a technique capable of simplifying a process of manufacturing a semiconductor device.

MEANS TO SOLVE THE PROBLEM

[0005] According to embodiments of the present disclosure, there is provided a technique that includes: (a) supplying an adsorption suppressor to a substrate having a surface on which a first base and a second base are exposed under a first temperature to adsorb the adsorption suppressor on a surface of one base of the first base and the second base; (b) thermally annealing the

WHAT IS CLAIMED IS:

1. A method of processing a substrate, comprising:

(a) supplying an adsorption suppressor to the substrate, whose surface has a first base, a second base and a third base, under a first temperature to adsorb the adsorption suppressor on a surface of the second base and a surface of third base;

(b) annealing the substrate under a second temperature higher than the first temperature after adsorbing the adsorption suppressor on the surface of the second base and the surface of the third base; and

(c) forming a film on a surface of the first base by supplying a film-forming gas to the annealed substrate under a third temperature lower than the second temperature,

wherein an adsorption state of the adsorption suppressor adsorbed on the surface of the third base in (a) includes chemical adsorption.

2. A method of processing a substrate, comprising:

(a) supplying an adsorption suppressor to the substrate, whose surface has a first base, a second base and a third base, under a first temperature to adsorb the adsorption suppressor on a surface of the second base and a surface of the third base;

(b) annealing the substrate under a second temperature higher than the first temperature after adsorbing the adsorption suppressor on the surface of the second base and the surface of the third base; and

(c) forming a film on a surface of the first base by supplying a film-forming gas to the annealed substrate under a third temperature lower than the second temperature,

wherein an adsorption state of the adsorption suppressor adsorbed on the surface of the third base in (a) is more stable than an adsorption state of the adsorption suppressor adsorbed on the surface of the second base in (a).

3. A method of processing a substrate, comprising:

(a) supplying an adsorption suppressor to the substrate, whose surface has a first base, a second base and a third base, under a first temperature to adsorb the adsorption suppressor on a surface of the second base and a surface of the third base;

(b) annealing the substrate under a second temperature higher than the first temperature after adsorbing the adsorption suppressor on the surface of the second base and the surface of the third base; and

(c) forming a film on a surface of the first base by supplying a film-forming gas to the annealed substrate under a third temperature lower than the second temperature,

wherein the first base includes an oxygen-free and metal element-containing film, the second base includes an oxygen-free and semi-metal element-containing film, and the third base includes an oxygen-containing film.

4. A method of processing a substrate, comprising:

(a) supplying an adsorption suppressor to the substrate, whose surface has a first base, a second base and a third base, under a first temperature to adsorb the adsorption suppressor on a surface of the second base and a surface of the third base;

(b) annealing the substrate under a second temperature higher than the first temperature after adsorbing the adsorption suppressor on the surface of the second base and the surface of the third base; and

(c) forming a film on a surface of the first base by supplying a film-forming gas to the annealed substrate under a third temperature lower than the second temperature,

wherein the first base includes a conductive metal element-containing film, the second base includes a nitride film, and the third base includes an oxide film.

5. A method of processing a substrate, comprising:

(a) supplying an adsorption suppressor to the substrate, whose surface has a first base, a second base and a third base, under a first temperature to adsorb the adsorption suppressor on a surface of the second base and a surface of the third base;

(b) annealing the substrate under a second temperature higher than the first temperature after adsorbing the adsorption suppressor on the surface of the second base and the surface of the third base; and

(c) forming a film on a surface of the first base by supplying a film-forming gas to the annealed substrate under a third temperature lower than the second temperature,

wherein the first base includes a transition metal-containing film, the second base includes a silicon- and nitrogen-containing film, and the third base includes a silicon- and oxygen-containing film.

6. The method of any one of Claims 1 to 5, where in (a), the adsorption suppressor is adsorbed on the surface of the second base while the adsorption suppressor is suppressed from being adsorbed on the surface of the first base.

7. The method of any one of Claims 1 to 6, wherein (a) is performed under a condition that the adsorption suppressor does not undergo gas phase decomposition.

8. The method of any one of Claims 1 to 7, wherein an adsorption state of the adsorption suppressor adsorbed on the surface of the second base in (a) includes physical adsorption.

9. The method of Claim 8, wherein in (b), the adsorption state of the adsorption suppressor adsorbed on the surface of the second base is shifted to chemical adsorption.

10. The method of any one of Claims 1 to 9, wherein in (b), an adsorption state of the adsorption suppressor adsorbed on the surface of the second base is changed to an adsorption state more stable than the adsorption state of the adsorption suppressor adsorbed on the surface of the second base in (a).

11. The method of any one of Claims 1 to 10, wherein in (c), the film is formed on the surface of the first base while the film is not formed on the surface of the second base.

12. The method of any one of Claims 1 to 11, wherein in (c), the film is formed on the surface of the first base while the film is not formed on the surface of the second base and not formed on the surface of the third base.

13. A method of processing a substrate, comprising:

(a) supplying an adsorption suppressor to the substrate, whose surface has a first base and a second base, under a first temperature to adsorb the adsorption suppressor on a surface of the second base;

(b) annealing the substrate under a second temperature higher than the first temperature after adsorbing the adsorption suppressor on the surface of the second base; and

(c) forming a film on a surface of the first base by supplying a film-forming gas to the annealed substrate under a third temperature lower than the second temperature,

wherein the first base includes an oxygen-free and metal element-containing film, and the second base includes an oxygen-free and semi-metal element-containing film.

14. The method of any one of Claims 1 to 13, wherein at least one selected from the group of (a), (b), and (c) is performed under a non-plasma atmosphere.

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

(a) supplying an adsorption suppressor to a substrate, whose surface has a first base, a

second base and a third base, under a first temperature to adsorb the adsorption suppressor on a surface of the second base and a surface of the third base;

(b) annealing the substrate under a second temperature higher than the first temperature after adsorbing the adsorption suppressor on the surface of the second base and the surface of the third base; and

(c) forming a film on a surface of the first base by supplying a film-forming gas to the annealed substrate under a third temperature lower than the second temperature,

wherein an adsorption state of the adsorption suppressor adsorbed on the surface of the third base in (a) includes chemical adsorption.

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

(a) supplying an adsorption suppressor to the substrate, whose surface has a first base, a second base and a third base, under a first temperature to adsorb the adsorption suppressor on a surface of the second base and a surface of the third base;

(b) annealing the substrate under a second temperature higher than the first temperature after adsorbing the adsorption suppressor on the surface of the second base and the surface of the third base; and

(c) forming a film on a surface of the first base by supplying a film-forming gas to the annealed substrate under a third temperature lower than the second temperature,

wherein an adsorption state of the adsorption suppressor adsorbed on the surface of the third base in (a) is more stable than an adsorption state of the adsorption suppressor adsorbed on the surface of the second base in (a).

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

(a) supplying an adsorption suppressor to the substrate, whose surface has a first base and a second base, under a first temperature to adsorb the adsorption suppressor on a surface of the second base;

(b) annealing the substrate under a second temperature higher than the first temperature after adsorbing the adsorption suppressor on the surface of the second base; and

(c) forming a film on a surface of the first base by supplying a film-forming gas to the annealed substrate under a third temperature lower than the second temperature,

wherein the first base includes an oxygen-free and metal element-containing film, and the second base includes an oxygen-free and semi-metal element-containing film.

18. A substrate processing apparatus comprising:

an adsorption suppressor supply system configured to supply an adsorption suppressor to the substrate;

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

a heater configured to heat the substrate; and

a controller configured to be capable of controlling the adsorption suppressor supply system, the film-forming gas supply system, and the heater to perform a process including: (a) supplying the adsorption suppressor to a substrate, whose surface has a first base, a second base and a surface of the third base, under a first temperature to adsorb the adsorption suppressor on a surface of the second base and a surface of the third base; (b) annealing the substrate under a second temperature higher than the first temperature after adsorbing the adsorption suppressor on the surface of the second base and the surface of the third base; and (c) forming a film on a surface of the first base by supplying the film-forming gas to the annealed substrate under a third temperature lower than the second temperature,

wherein an adsorption state of the adsorption suppressor adsorbed on the surface of the third base in (a) includes chemical adsorption.

19. A substrate processing apparatus comprising:

an adsorption suppressor supply system configured to supply an adsorption suppressor to the substrate;

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

a heater configured to heat the substrate; and

a controller configured to be capable of controlling the adsorption suppressor supply system, the film-forming gas supply system, and the heater to perform a process including: (a) supplying the adsorption suppressor to a substrate, whose surface has a first base, a second base and a third base, under a first temperature to adsorb the adsorption suppressor on a surface of the second base and a surface of the third base; (b) annealing the substrate under a second temperature higher than the first temperature after adsorbing the adsorption suppressor on the surface of the second base and the surface of the third base; and (c) forming a film on a surface of the first base by supplying the film-forming gas to the annealed substrate under a third temperature lower than the second temperature,

wherein an adsorption state of the adsorption suppressor adsorbed on the surface of the third base in (a) is more stable than an adsorption state of the adsorption suppressor adsorbed on the surface of the second base in (a).

20. A substrate processing apparatus comprising:

an adsorption suppressor supply system configured to supply an adsorption suppressor to the substrate;

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

a heater configured to heat the substrate; and

a controller configured to be capable of controlling the adsorption suppressor supply system, the film-forming gas supply system, and the heater to perform a process including: (a) supplying the adsorption suppressor to a substrate, whose surface has a first base and a second base, under a first temperature to adsorb the adsorption suppressor on a surface of the second base; (b) annealing the substrate under a second temperature higher than the first temperature after adsorbing the adsorption suppressor on the surface of the second base; and (c) forming a

film on a surface of the first base by supplying the film-forming gas to the annealed substrate under a third temperature lower than the second temperature,

wherein the first base includes an oxygen-free and metal element-containing film, and the second base includes an oxygen-free and semi-metal element-containing film.

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

(a) supplying an adsorption suppressor to a substrate, whose surface has a first base, a second base and a third base, under a first temperature to adsorb the adsorption suppressor on a surface of the second base and a surface of the third base;

(b) annealing the substrate under a second temperature higher than the first temperature after adsorbing the adsorption suppressor on the surface of the second base and the surface of the third base; and

(c) forming a film on a surface of the first base by supplying a film-forming gas to the annealed substrate under a third temperature lower than the second temperature,

wherein an adsorption state of the adsorption suppressor adsorbed on the surface of the third base in (a) includes chemical adsorption.

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

(a) supplying an adsorption suppressor to the substrate, whose surface has a first base, a second base and a third base, under a first temperature to adsorb the adsorption suppressor on a surface of the second base and a surface of the third base;

(b) annealing the substrate under a second temperature higher than the first temperature after adsorbing the adsorption suppressor on the surface of the second base and the surface of the third base; and

(c) forming a film on a surface of the first base by supplying a film-forming gas to the annealed substrate under a third temperature lower than the second temperature,

wherein an adsorption state of the adsorption suppressor adsorbed on the surface of the third base in (a) is more stable than an adsorption state of the adsorption suppressor adsorbed on the surface of the second base in (a).

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

(a) supplying an adsorption suppressor to the substrate, whose surface has a first base and a second base, under a first temperature to adsorb the adsorption suppressor on a surface of the second base;

(b) annealing the substrate under a second temperature higher than the first temperature after adsorbing the adsorption suppressor on the surface of the second base; and

(c) forming a film on a surface of the first base by supplying a film-forming gas to the annealed substrate under a third temperature lower than the second temperature,

wherein the first base includes an oxygen-free and metal element-containing film, and the second base includes an oxygen-free and semi-metal element-containing film.