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

TECHNICAL FIELD

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

BACKGROUND

[0002] A patterning technique is also becoming miniaturized according to miniaturization of large scale integrated circuits (hereinafter, referred to as "LSIs"). As the patterning technique, for example, a hard mask or the like is used, but it is difficult to apply a method of exposing a resist to separate an etching region and a non-etching region due to the miniaturization of the patterning technique. For this reason, an epitaxial film such as silicon (Si) or silicon germanium (SiGe) is selectively grown and formed on a substrate such as a silicon (Si) wafer (for example, see Patent Documents 1 and 2).

PRIOR ART DOCUMENTS

PATENT DOCUMENTS

[0003] Patent Document 1: Japanese laid-open publication No. 2003-100746

Patent Document 2: Japanese laid-open publication No. 2015-122481

SUMMARY OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0004] Some embodiments of the present disclosure provide a technique capable of selectively forming a film on a substrate.

MEANS TO SOLVE PROBLEM

WHAT IS CLAIMED IS:

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

organically terminating a first region, which includes a silicon layer, of a substrate by supplying an adsorption control agent containing an organic ligand to the substrate that includes the first region and a second region including a silicon oxide layer and a silicon nitride layer formed on a surface of the substrate while regulating a temperature of the substrate to 300 degrees C or higher and 500 degrees C or lower; and

selectively growing a film on the second region by supplying a deposition gas to the substrate.

2. The method according to Claim 1, wherein the organic ligand contains an alkyl group.

3. The method according to Claim 1, wherein the organic ligand is alkylamine.

4. The method according to any one of Claims 1 to 3, wherein a ligand contained in the deposition gas and the organic ligand are respectively selected from electrically negative ligands.

5. The method according to any one of Claims 1 to 4, wherein the organic ligand is adsorbed on the first region, while the deposition gas is not adsorbed on the organic ligand, and

wherein in the act of organically terminating the first region, the organic ligand is adsorbed on the first region.

6. The method according to any one of Claims 1 to 5, wherein in the act of organically

terminating the first region, a kind of the organic ligand is selected depending on a composition of the first region.

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

organically terminating a first region of a substrate by supplying an adsorption control agent containing an organic ligand to the substrate that includes the first region and a second region, which is different in composition from the first region, formed on a surface of the substrate while regulating a temperature of the substrate depending on a composition of the first region; and

selectively growing a film on the second region by supplying a deposition gas to the substrate,

wherein the first region includes a silicon oxide layer, and

wherein, in the act of organically terminating the first region, the temperature of the substrate is regulated to 100 degrees C or higher and 250 degrees C or lower.

8. The method according to Claim 157, wherein the second region includes a silicon nitride layer.

9. The method according to Claim 7, wherein the organic ligand contains an alkyl group.

10. The method according to Claim 7, wherein the organic ligand is alkylamine.

11. The method according to any one of Claims 7 to 9, wherein a ligand contained in the deposition gas and the organic ligand are respectively selected from electrically negative ligands.

12. The method according to any one of Claims 7 to 10, wherein the organic ligand is adsorbed on the first region, while the deposition gas is not adsorbed on the organic ligand, and

wherein in the act of organically terminating the first region, the organic ligand is adsorbed on the first region.

13. The method according to any one of Claims 7 to 11, wherein in the act of organically terminating the first region, a kind of the organic ligand is selected depending on a composition of the first region.

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

organically terminating a first region, which includes a silicon layer and a silicon oxide layer, of a substrate by supplying an adsorption control agent containing an organic ligand to the substrate including the first region and a second region, which is different in composition from the first region, formed on a surface of the substrate while regulating a temperature of the substrate to 100 degrees C or higher and 250 degrees C or lower; and

selectively growing a film on the second region by supplying a deposition gas to the substrate.

15. A substrate processing apparatus, comprising:

a process chamber configured to accommodate a substrate including a first region and a second region formed on a surface of the substrate, the first region including a silicon layer, and the second region including a silicon oxide layer and a silicon nitride layer;

a heating system configured to heat the process chamber;

a first gas supply system configured to supply an adsorption control agent containing an organic ligand to the process chamber;

a second gas supply system configured to supply a deposition gas to the process

chamber; and

a controller configured to be capable of controlling the first gas supply system, the second gas supply system, and the heating system to perform a process, the process comprising:

organically terminating the first region by supplying the adsorption control agent while regulating a temperature of the substrate in the process chamber to 300 degrees C or higher and 500 degrees C or lower; and

selectively growing a film on the second region by supplying the deposition gas to the substrate.

16. A substrate processing apparatus, comprising:

a process chamber configured to accommodate a substrate;

a heating system configured to heat the process chamber;

a first gas supply system configured to supply an adsorption control agent containing an organic ligand to the process chamber;

a second gas supply system configured to supply a deposition gas to the process chamber; and

a controller configured to be capable of controlling the first gas supply system, the second gas supply system, and the heating system to perform a process in the process chamber, the process comprising:

organically terminating a first region, which includes a silicon oxide layer, of athe substrate by supplying the adsorption control agent to the substrate including the first region and a second region, which is different in composition from the first region, formed on a surface of the substrate while regulating a temperature of the substrate depending on a composition of the first region; and

selectively growing a film on the second region by supplying the deposition gas to the substrate,

wherein, in the act of organically terminating the first region, the temperature of the substrate is regulated to 100 degrees C or higher and 250 degrees C or lower.

17. The substrate processing apparatus according to Claim 16, wherein the second region includes a silicon nitride layer.

18. A substrate processing apparatus, comprising:

a process chamber configured to accommodate a substrate;

a heating system configured to heat the process chamber;

a first gas supply system configured to supply an adsorption control agent containing an organic ligand to the process chamber;

a second gas supply system configured to supply a deposition gas to the process chamber; and

a controller configured to be capable of controlling the first gas supply system, the second gas supply system, and the heating system to perform a process, the process comprising:

organically terminating a first region, which includes a silicon layer and a silicon oxide layer, of the substrate by supplying the adsorption control agent to the substrate including the first region and a second region, which is different in composition from the first region, formed on a surface of the substrate while regulating a temperature of the substrate depending on a composition of the first region; and

selectively growing a film on the second region by supplying the deposition gas to the substrate,

wherein, in the act of organically terminating the first region, the temperature of the substrate is regulated to 100 degrees C or higher and 250 degrees C or lower.

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

organically terminating a first region, which includes a silicon layer, of a substrate by supplying an adsorption control agent containing an organic ligand to the substrate accommodated in a process chamber of the substrate processing apparatus and including the first region and a second region, which includes a silicon oxide layer and a silicon nitride layer, formed on a surface of the substrate while regulating a temperature of the substrate to 300 degrees C or higher and 500 degrees C or lower; and

selectively growing a film on the second region by supplying a deposition gas to the substrate.

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

organically terminating a first region of a substrate by supplying an adsorption control agent containing an organic ligand to the substrate accommodated in a process chamber of the substrate processing apparatus and including the first region and a second region, which is different in composition from the first region, formed on a surface of the substrate while regulating a temperature of the substrate depending on a composition of the first region; and

selectively growing a film on the second region by supplying a deposition gas to the substrate,

wherein the first region includes a silicon oxide layer, and

wherein, in the act of organically terminating the first region, the temperature of the substrate is regulated to 100 degrees C or higher and 250 degrees C or lower.

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

organically terminating a first region, which includes a silicon layer and a silicon oxide layer, of a substrate by supplying an adsorption control agent containing an organic ligand to the substrate accommodated in a process chamber of the substrate processing apparatus and including the first region and a second region, which is different in composition from the first region, formed on a surface of the substrate while regulating a temperature of the substrate to 100 degrees C or higher and 250 degrees C or lower; and

selectively growing a film on the second region by supplying a deposition gas to the substrate.

22. A method of processing a substrate, comprising:

organically terminating a first region, which includes a silicon layer, of the substrate by supplying an adsorption control agent containing an organic ligand to the substrate including the first region and a second region, which includes a silicon oxide layer and a silicon nitride layer, formed on a surface of the substrate while regulating a temperature of the substrate to 300 degrees C or higher and 500 degrees C or lower; and

selectively growing a film on the second region by supplying a deposition gas to the substrate.

23. A method of processing a substrate, comprising:

organically terminating a first region of the substrate by supplying an adsorption control agent containing an organic ligand to the substrate including the first region and a second region, which includes a silicon nitride layer, formed on a surface of the substrate while regulating a temperature of the substrate depending on a composition of the first region; and

selectively growing a film on the second region by supplying a deposition gas to the substrate,

wherein the first region includes a silicon oxide layer, and

wherein, in the act of organically terminating the first region, the temperature of the substrate is regulated to 100 degrees C or higher and 250 degrees C or lower.

24. A method of processing a substrate, comprising:

organically terminating a first region, which includes a silicon layer and a silicon oxide layer, of the substrate by supplying an adsorption control agent containing an organic ligand to the substrate including the first region and a second region, which is different in composition from the first region, formed on a surface of the substrate while regulating a temperature of the substrate to 100 degrees C or higher and 250 degrees C or lower; and

selectively growing a film on the second region by supplying a deposition gas to the substrate.