

WHAT IS CLAIMED IS:

1. A method of manufacturing a semiconductor device, comprising:
forming a film on a substrate by performing, a predetermined number of times,
forming a first layer by supplying a halogen-free precursor, which includes Si-N bonds and Si-H bonds and contains an amino group, to the substrate under a condition in which the precursor is pyrolyzed when the precursor exists alone,
wherein in the act of forming the first layer, a deactivating agent for deactivating intermediates generated by pyrolyzing the precursor is supplied to the substrate together with the precursor, and a supply flow rate of the deactivating agent is set to be between 4 times and 30 times larger than a supply flow rate of the precursor, and
wherein the act of forming the first layer is performed under a condition in which a supply rate controlling of the intermediates becomes more dominant than a surface reaction rate controlling of the intermediates.
2. The method of Claim 1, wherein in the act of forming the first layer, a portion of the intermediates is deactivated by the deactivating agent, and another portion of the intermediates other than the portion of the intermediates is adsorbed on a surface of the substrate.
3. The method of Claim 1 or 2, wherein in the act of forming the first layer, the intermediates deactivated by the deactivating agent are discharged from a space in which the substrate exists, without contributing to a reaction for forming the first layer.
4. The method of any of Claims 1 to 3, wherein the act of forming the first layer is performed under a condition of the supply rate controlling of the intermediates.
5. The method of any of Claims 1 to 3, wherein a degree of the supply rate controlling of the intermediates in the act of forming the first layer becomes lower by the deactivating

agent than a degree of the supply rate controlling of the intermediates when the precursor exists alone.

6. The method of any of Claims 1 to 5, wherein in the act of forming the first layer, the deactivating agent is caused to collide with a portion of the intermediates, and another portion of the intermediates other than the portion of the intermediates is caused to collide with a surface of the substrate without colliding with the deactivating agent.

7. The method of any of Claims 1 to 6, wherein the act of forming the first layer is performed under a condition in which a portion of the intermediates collides with the deactivating agent, and another portion of the intermediates other than the portion of the intermediates collides with a surface of the substrate without colliding with the deactivating agent.

8. The method of any of Claims 1 to 7, wherein in the act of forming the first layer, a portion of the intermediates is changed to a state in which the portion is difficult to be adsorbed on a surface of the substrate, and another portion of the intermediates other than the portion of the intermediates is adsorbed on the surface of the substrate.

9. The method of any of Claims 1 to 8, wherein the act of forming the first layer is performed under a condition in which a portion of the intermediates is changed to a state in which the portion is difficult to be adsorbed on a surface of the substrate and another portion of the intermediates other than the portion of the intermediates is adsorbed on the surface of the substrate.

10. The method of any of Claims 1 to 9, wherein the act of forming the first layer is performed under a condition in which a mean free path where the intermediates and the deactivating agent collide with each other is smaller than a distance between an object on which an intermediate located at a position closest to a surface of the substrate is adsorbed

and the surface of the substrate.

11. The method of any of Claims 1 to 10, wherein in the act of forming the film, the film is formed on each of a plurality of substrates at a time, and

wherein the act of forming the film is performed under a condition in which a mean free path where the intermediates and the deactivating agent collide with other is smaller than a distance between adjacent substrates.

12. The method of any of Claims 1 to 11, wherein the deactivating agent includes an N-containing gas expressed by a general formula NR_3 , wherein R is a hydrogen atom or an alkyl group.

13. The method of Claim 12, wherein in the act of forming the first layer, N of the NR_3 is bonded to an element constituting a portion of the intermediates, and another portion of the intermediates other than the portion of the intermediates is adsorbed on a surface of the substrate.

14. The method of any one of Claims 1 to 13, further comprising forming a second layer by supplying a reactant to the substrate to modify the first layer,

wherein the act of forming the film includes performing, the predetermined number of times, a cycle which non-simultaneously performs the act of forming the first layer and the act of forming the second layer.

15. The method of Claim 14, wherein the precursor further contains C,
wherein the reactant is an oxidizing agent,
wherein the first layer is a layer containing Si, C, and N,
wherein the second layer is a layer containing Si, O, C, and N, and
wherein the film is a film containing Si, O, C, and N.

16. A substrate processing apparatus, comprising:
- a process chamber in which a substrate is processed;
 - a heater configured to heat the substrate in the process chamber;
 - a precursor supply system configured to supply a halogen-free precursor, which includes Si-N bonds and Si-H bonds and contains an amino group, to the substrate in the process chamber;
 - a deactivating agent supply system configured to supply a deactivating agent for deactivating intermediates generated by pyrolyzing the precursor to the substrate in the process chamber; and
 - a controller configured to be capable of controlling the heater, the precursor supply system, and the deactivating agent supply system so as to perform a process in the process chamber, the process including:
 - forming a film on the substrate by performing, a predetermined number of times, forming a first layer by supplying the precursor to the substrate under a condition in which the precursor is pyrolyzed when the precursor exists alone,
 - wherein in the act of forming the first layer, the deactivating agent is supplied to the substrate together with the precursor, and a supply flow rate of the deactivating agent is set to be between 4 times and 30 times larger than a supply flow rate of the precursor, and
 - wherein the act of forming the first layer is performed under a condition in which a supply rate controlling of the intermediates becomes more dominant than a surface reaction rate controlling of the intermediates.
17. A program that causes, by a computer, a substrate processing apparatus to perform a process in a process chamber of the substrate processing apparatus, the process comprising:
- forming a film on a substrate by performing, a predetermined number of times, forming a first layer by supplying a halogen-free precursor, which includes Si-N bonds and Si-H bonds and contains an amino group, to the substrate under a condition in which the precursor is pyrolyzed when the precursor exists alone,

wherein in the act of forming the first layer, a deactivating agent for deactivating intermediates generated by pyrolyzing the precursor is supplied to the substrate together with the precursor, and a supply flow rate of the deactivating agent is set to be between 4 times and 30 times larger than a supply flow rate of the precursor, and

wherein the act of forming the first layer is performed under a condition in which a supply rate controlling of the intermediates becomes more dominant than a surface reaction rate controlling of the intermediates.

18. The method of any of Claims 1 to 15, wherein in the act of forming the first layer, the supply flow rate of the deactivating agent is set to be between 10 times and 30 times larger than the supply flow rate of the precursor.

19. The method of any of Claims 1 to 15, wherein in the act of forming the first layer, the supply flow rate of the deactivating agent is set to be between 10 times and 20 times larger than the supply flow rate of the precursor.