CLAIMS

1. A method of drying a semiconductor substrate, the method comprising:

applying a drying agent to a semiconductor substrate, wherein the drying agent wets the semiconductor substrate;

pressure-sealing the semiconductor substrate within the chamber;

heating the chamber housing the semiconductor substrate to a temperature above an atmospheric pressure boiling point of the drying agent until vapor-liquid equilibrium between liquid and vapor phases of the drying agent is reached within the chamber; and

venting the chamber, wherein the venting vaporizes the drying agent liquid phase from the semiconductor substrate.

2. The method of drying a semiconductor substrate of claim 1, further comprising:

heating the chamber housing the semiconductor substrate, the heating causing vapor and liquid phases of the drying agent to reach equilibrium of vapor partial pressure and liquid saturation pressure; and

continuing to heat the chamber housing the semiconductor substrate to a temperature of at least about 100º C.

3. The method of drying a semiconductor substrate of claim 1, wherein the drying agent is miscible with water.

4. The method of drying a semiconductor substrate of claim 3, wherein the drying agent comprises isopropyl alcohol.

5. The method of drying a semiconductor substrate of claim 1, wherein the semiconductor substrate comprises patterned features having an aspect ratio greater than 5, and wherein the drying agent wets the patterned features completely.

6. The method of drying a semiconductor substrate of claim 1, wherein applying the drying agent fully displaces water from the semiconductor substrate.

7. The method of drying a semiconductor substrate of claim 6, wherein applying the drying agent comprises one or more operations fully displacing any fluid except for the drying agent from the semiconductor substrate.

8. The method of drying a semiconductor substrate of claim 1, wherein the heating is performed by:

hermetically closing the chamber with the semiconductor substrate including the applied drying agent housed within the chamber;

heating the chamber causing equilibrium to be reached between the drying agent liquid and vapor phases; and

heating the chamber to the temperature above the atmospheric pressure boiling point of the drying agent.

9. The method of drying a semiconductor substrate of claim 1, further comprising purging the chamber with an inert precursor subsequent the venting.

10. A method of drying a semiconductor substrate, the method comprising:

applying a drying agent to the semiconductor substrate within a chamber, wherein the drying agent wets the semiconductor substrate;

sealing the chamber;

heating the chamber in which the semiconductor substrate is housed to cause an equilibrium to be reached between liquid and vapor phases of the drying agent, wherein the heating maintains at least a portion of the drying agent in a liquid form; and

exposing the chamber to vacuum conditions, wherein the vacuum conditions evaporate and purge the drying agent from the chamber.

11. The method of drying a semiconductor substrate of claim 10, wherein heating the chamber is performed to a temperature below about 150º C.

12. The method of drying a semiconductor substrate of claim 10, further comprising:

subsequent exposing the chamber to vacuum, venting the chamber to atmospheric conditions.

13. The method of drying a semiconductor substrate of claim 12, further comprising:

purging the chamber with air or an inert gas.

14. The method of drying a semiconductor substrate of claim 10, wherein the drying agent comprises isopropyl alcohol or acetone.

15. The method of drying a semiconductor substrate of claim 10, wherein exposing the chamber to vacuum conditions comprises reducing the pressure within the chamber from atmospheric conditions to a pressure of less than about 100 Torr.

16. The method of drying a semiconductor substrate of claim 15, wherein reducing the pressure within the chamber occurs in a time period of less than about 5 minutes.

17. The method of drying a semiconductor substrate of claim 1, wherein heating the chamber includes increasing the temperature within the chamber and maintaining the vapor-liquid equilibrium of the drying agent along a boiling point curve for the drying agent.

18. The method of drying a semiconductor substrate of claim 1, wherein venting the chamber includes reducing the pressure within the chamber to reduce surface tension of the drying agent and to overcome meniscus forces.

19. The method of drying a semiconductor substrate of claim 1, wherein the drying agent is characterized by a surface tension of less than about 25 mN/m at about 21 ºC.

20. The method of drying a semiconductor substrate of claim 10, wherein exposing the chamber to vacuum conditions includes reducing the pressure within the chamber below atmospheric conditions along a boiling point curve for the drying agent.