Claims:

1. A method for coating inner surfaces of gas passages of a gas delivery system configured to deliver process gases into a chamber of a plasma processing system wherein semiconductor substrates are processed, the method comprising:

(a) flowing a fluidic precursor of a corrosion-resistant material through the gas passages and depositing a layer of the fluidic precursor to coat the inner surfaces of the gas passages;

(b) removing excess fluidic precursor from the inner surfaces;

(c) curing the deposited layer of the fluidic precursor to form a corrosion-resistant material coating;

wherein

the gas passages deliver process gases into the chamber of the plasma processing system; and

the fluidic precursor is a liquid.

2. A method for coating inner surfaces of gas passages of a gas delivery system configured to deliver process gases into a chamber of a plasma processing system wherein semiconductor substrates are processed, the method comprising:

(a) flowing a fluidic precursor of a corrosion-resistant material comprising one or more methacrylate esters through the gas passages and depositing a layer of the fluidic precursor to coat the inner surfaces of the gas passages;

(b) removing excess fluidic precursor from the inner surfaces by blowing dry nitrogen or dry air into the gas passages;

(c) curing the deposited layer of the fluidic precursor to form a corrosion-resistant material coating by baking the gas passages at a temperature of at least 100°C. and a pressure of 1 to 10 Torr in a vacuum oven or by maintaining the gas passages at ambient temperature and pressure for at least 24 hours;

wherein the gas passages deliver process gases into the chamber of the plasma processing system.

3. The method of claim 1, further comprising before flowing the fluidic precursor, cleaning the inner surfaces and drying the inner surfaces.

4. The method of claim 3, wherein:

the inner surfaces are cleaned with 10 to 20 wt. % nitric acid for 3 minutes and rinsing the interior surface with deionized water for at least 5 minutes; and

the inner surfaces are dried by blowing dry nitrogen or dry air through the gas passages and baking the gas passages at a temperature of at least 120°C. in a vacuum oven.

5. The method of claim 1, wherein the gas passages are in stainless steel tubing having an outer diameter of 0.25 inch or less.

6. The method of claim 5, wherein at least one stainless steel bellows is welded to the stainless steel tubing.

7. A method for coating inner surfaces of gas passages of a gas delivery system configured to deliver process gases into a chamber of a plasma processing system wherein semiconductor substrates are processed, the method comprising:

(a) flowing a fluidic precursor of a corrosion-resistant material through the gas passages and depositing a layer of the fluidic precursor to coat the inner surfaces of the gas passages;

(b) removing excess fluidic precursor from the inner surfaces;

(c) curing the deposited layer of the fluidic precursor to form a corrosion-resistant material coating;

wherein

the gas passages deliver gases into the chamber of the plasma processing system;

the gas passages are in stainless steel tubing having an outer diameter of 0.25 inch or less;

at least one stainless steel bellows is welded to the stainless steel tubing;

prior to welding the bellows to the tubing, coating inner surfaces of the bellows with a masking agent that prevents adhesion of the fluidic precursor; and

optionally, after the curing step, removing the masking agent from the inner surfaces of the bellows.

8. The method of claim 7, wherein the masking agent is photoresist, oil, silane and/or alkoxysilanes.

9. The method of claim 1, wherein steps (a)-(c) are repeated.

10. The method of claim 1, wherein the coating is resistant to halogen containing process gases.

11. The method of claim 1, wherein the corrosion-resistant material coating has a thickness of 0.0014 to 0.0034 inch.

12. A gas delivery system configured to deliver process gases into a chamber of a plasma processing system, the gas delivery system comprising gas passages whose inner surfaces are coated with a corrosion-resistant material coating formed by curing a layer of a fluidic precursor deposited on the inner surfaces.

13. The gas delivery system of claim 12, further comprising at least one stainless steel bellows welded to stainless steel tubing having the gas passages therein and inner surfaces of the bellows are not coated by the coating.

14. The gas delivery system of claim 12, wherein the gas passages are in stainless steel tubing having an outer diameter of 0.25 inch or less.

15. The gas delivery system of claim 12, wherein the coating is resistant to halogen containing process gases.

16. A plasma processing system comprising the gas delivery system of claim 12, wherein the gas delivery system delivers halogen containing process gases into a chamber of the plasma processing system and the process gases are energized into a plasma to process individual semiconductor substrates supported in the chamber.

17. The plasma processing system of claim 16, wherein the substrates are etched by the plasma.

18. The gas delivery system of claim 12, wherein the inner surfaces are coated by:

(a) flowing a fluidic precursor of a corrosion-resistant material through the gas passages and depositing a layer of the fluidic precursor to coat the inner surfaces of the gas passages;

(b) removing excess fluidic precursor from the inner surfaces;

(c) curing the deposited layer of the fluidic precursor to form a corrosion-resistant material coating.

19. The gas delivery system of claim 18, wherein: the fluidic precursor comprises one or more methacrylate esters; excess fluidic precursor is removed by blowing dry nitrogen or dry air into the gas passages; the deposited layer of the fluidic precursor is cured by baking the gas passages at a temperature of at least 100°C. and a pressure of 1 to 10 Torr in a vacuum oven or by maintaining the gas passages at ambient temperature and pressure for at least 24 hours.

20. The gas delivery system of claim 18, wherein the gas passages are in stainless steel tubing having an outer diameter of 0.25 inch or less.

21. The gas delivery system of claim 20, wherein at least one stainless steel bellows is welded to the stainless steel tubing.

22. The gas delivery system of claim 21, further comprising: prior to welding the bellows to the tubing, coating inner surfaces of the bellows with a masking agent that prevents adhesion of the fluidic precursor; and optionally, after the curing step, removing the masking agent from the inner surfaces of the bellows.

23. The gas delivery system of claim 21, wherein the coating is resistant to halogen containing process gases.

24. The gas delivery system of claim 12, wherein the corrosion-resistant material coating has a thickness of 0.0014 to 0.0034 inch.

We Claim:

1. A method for coating inner surfaces of gas passages of a gas delivery system configured to deliver process gases into a chamber of a plasma processing system, the method comprising:

(a) flowing a fluidic precursor of a corrosion-resistant material through the gas passages and depositing a layer of the fluidic precursor to coat the inner surfaces of the gas passages;

(b) removing excess fluidic precursor from the inner surfaces;

(c) curing the deposited layer of the fluidic precursor to form a corrosion-resistant material coating.

2. The method of Claim 1, wherein:

the fluidic precursor comprises one or more methacrylate esters;

excess fluidic precursor is removed by blowing dry nitrogen or dry air into the gas passages;

the deposited layer of the fluidic precursor is cured by baking the gas passages at a temperature of at least 100°C and a pressure of 1 to 10 Torr in a vacuum oven or by maintaining the gas passages at ambient temperature and pressure for at least 24 hours.

3. The method of Claim 1, further comprising before flowing the fluidic precursor, cleaning the inner surfaces and drying the inner surfaces.

4. The method of Claim 3, wherein:

the inner surfaces are cleaned with 10 to 20 wt.% nitric acid for 3 minutes and rinsing the interior surface with deionized water for at least 5 minutes; and

the inner surfaces are dried by blowing dry nitrogen or dry air through the gas passages and baking the gas passages at a temperature of at least 120°C in a vacuum oven.

5. The method of Claim 1, wherein the gas passages are in stainless steel tubing having an outer diameter of 0.25 inch or less.

6. The method of Claim 5, wherein at least one stainless steel bellows is welded to the stainless steel tubing.

7. The method of Claim 6, further comprising:

prior to welding the bellows to the tubing, coating inner surfaces of the bellows with a masking agent that prevents adhesion of the fluidic precursor; and optionally, after the curing step, removing the masking agent from the inner surfaces of the bellows.

8. The method of Claim 7, wherein the mask agent is photoresist, oil, silane and/or alkoxysilanes.

9. The method of Claim 1, wherein steps (a)-(c) are repeated.

10. The method of Claim 1, wherein the coating is resistant to halogen containing process gases.

11. The method of Claim 1, wherein the corrosion-resistant material coating has a thickness of 0.0014 to 0.0034 inch.

12. A gas delivery system configured to deliver process gases into a chamber of a plasma processing system, the gas delivery system comprising gas passages whose inner surfaces are coated with a corrosion-resistant material coating formed by curing a layer of a fluidic precursor deposited on the inner surfaces.

13. The gas delivery system of Claim 12, further comprising at least one stainless steel bellows welded to stainless steel tubing having the gas passages therein and inner surfaces of the bellows are not coated by the coating.

14. The gas delivery system of Claim 12, wherein the gas passages are in stainless steel tubing having an outer diameter of 0.25 inch or less.

15. The gas delivery system of Claim 12, wherein the coating is resistant to halogen containing process gases.

16. A plasma processing system comprising the gas delivery system of Claim 12, wherein the gas delivery system delivers halogen containing process gases into a chamber of the plasma processing system and the process gases are energized into a plasma to process individual semiconductor substrates supported in the chamber.

17. The plasma processing system of Claim 16, wherein the substrates are etched by the plasma.