CLAIMS

~~*What is claimed is:*~~

1. A method of controlling contamination on a substrate, the method comprising:

(a) either (i) processing a frontside of the substrate, thereby causing formation of contamination on a backside of the substrate, or (ii) receiving the substrate with contamination on the backside of the substrate, the contamination comprising a metal; and

(b) after (a), heating the substrate in a post-processing bake process, wherein heating the substrate reduces a concentration of the metal on the backside of the substrate.

2. The method of claim 1, wherein processing the frontside of the substrate comprises at least one process selected from the group consisting of: developing a layer of photoresist; in-situ cleaning the substrate; pulling a mandrel in a patterning application; smoothing a feature on the substrate; and descumming a layer of photoresist.

3. The method of claim 2

wherein (a) comprises either (i) developing the layer of photoresist on the substrate, or (ii) receiving the substrate with a layer of photoresist developed on the frontside of the substrate and contamination on the backside of the substrate,

wherein the metal in the contamination originates from the layer of photoresist on the frontside of the substrate, and

wherein the post-processing bake process of (b) is a post-development bake process that occurs when the layer of photoresist is at least partially developed.

4. The method of claim 3, wherein during the post-development bake process of (b), the substrate is baked at a temperature between about 160-300°C for a duration between about 1-10 minutes.

5. The method of claim 3, further comprising exposing the substrate to a processing gas, the processing gas comprising at least one gas selected from the group consisting of N_2, H_2, Ar, He, Xe, and combinations thereof.

6. The method of claim 3, further comprising exposing the substrate to a reactive processing gas to increase a volatility of a metal-containing material on the substrate, the metal containing material comprising the metal.

7. The method of claim 3, further comprising exposing the substrate to a reactive processing gas to increase a stability of a metal-containing material on the substrate, the metal containing material comprising the metal.

8. The method of claim 3, further comprising exposing the substrate to a reactive processing gas selected from the group consisting of a chlorine-containing gas, an oxygen-containing gas, a fluorine-containing gas, ammonia (NH_3), hydrogen iodide (HI), diatomic iodine (I_2), and combinations thereof.

9. The method of claim 8, wherein the substrate is exposed to the chlorine-containing gas and the chlorine-containing gas comprises at least one gas selected from the group consisting of BCl_3, Cl_2, HCl, $SiCl_4$, $SOCl_2$, PCl_3, and combinations thereof.

10. The method of claim 8, wherein the substrate is exposed to the oxygen-containing gas and the oxygen-containing gas comprises at least one gas selected from the group consisting of O_2, O_3, H_2O, SO_2, CO_2, CO, COS, H_2O_2, NO_x, and combinations thereof.

11. The method of claim 8, wherein the substrate is exposed to the fluorine-containing gas, the fluorine-containing gas comprising at least one gas selected from the group consisting of HF, $C_xF_yH_z$, NF_3, SF_6, F_2, and combinations thereof.

12. The method of claim 3, further comprising exposing the substrate to plasma to increase a volatility of a metal-containing material on the substrate, the metal containing material comprising the metal.

13. The method of claim 3, further comprising exposing the substrate to plasma to increase a stability of a metal-containing material on the substrate, the metal containing material comprising the metal.

14. The method of claim 3, further comprising exposing the substrate to plasma generated from a plasma generation gas comprising at least one gas selected from the group consisting of diatomic hydrogen (H_2), diatomic nitrogen (N_2), argon, helium, krypton, methane (CH_4), an

oxygen-containing gas, a fluorine-containing gas, a chlorine-containing gas, a hydrogen halide, and combinations thereof.

15. The method of claim 14, wherein the plasma generation gas comprises the oxygen-containing gas, the oxygen-containing gas comprising at least one gas selected from the group consisting of O_2, O_3, CO, CO_2, COS, SO_2, NO_x, H_2O, and combinations thereof.

16. The method of claim 14, wherein the plasma generation gas comprises the fluorine-containing gas, the fluorine-containing gas comprising at least one gas selected from the group consisting of NF_3, CF_4, CH_3F_3, CH_2F_2, CHF_3, F_2, SF_6, and combinations thereof.

17. The method of claim 14, wherein the plasma generation gas comprises the chlorine-containing gas, the chlorine-containing gas comprising at least one gas selected from the group consisting of BCl_3, Cl_2, HCl, $SiCl_4$, $SOCl_2$, PCl_3, and combinations thereof.

18. The method of claim 14, wherein the plasma generation gas comprises (i) the diatomic hydrogen (H_2), and (ii) at least one of diatomic nitrogen (N_2) or a noble gas.

19. The method of claim 3, wherein heating the substrate in the post-development bake process reduces the concentration of the metal on the backside of the substrate by at least an order of magnitude.

20. The method of claim 3, further comprising exposing the substrate to plasma, wherein heating the substrate in the post-development bake process and exposing the substrate to plasma reduces the concentration of the metal on the backside of the substrate by at least two orders of magnitude.

21. The method of claim 3, further comprising exposing the substrate to light to reduce a concentration of the metal on the backside of the substrate.

22. The method of claim 21, wherein the light comprises at least one of UV wavelengths, visible wavelengths, or IR wavelengths.

23. The method of claim 22, wherein the light is provided via an IR lamp or a plurality of LEDs, wherein the substrate is heated to a temperature between about 250-400°C for a duration of about 60 seconds or less while the substrate is exposed to the light.

24. The method of claim 3, wherein heating the substrate in the post-development bake process begins while the layer of photoresist is still being developed on the substrate.

25. The method of claim 3, further comprising transferring the substrate from a first processing chamber to a second processing chamber after (a), such that (a) occurs in the first processing chamber and (b) occurs in the second processing chamber.

26. The method of claim 3, wherein (a) occurs in a processing chamber, the method further comprising heating the processing chamber to a temperature of about 40°C or greater while the layer of photoresist is developed in (a).

27. The method of claim 3, wherein (a) occurs in a processing chamber, the method further comprising purging the processing chamber while maintaining the processing chamber at a temperature of about 100°C or greater, the purge occurring after (a).

28. The method of claim 27, the method further comprising sweeping the processing chamber with inert gas, wherein the purge and the sweeping are part of a pump purge sequence.

29. The method of claim 3, further comprising performing a wet clean on the backside of the substrate after (a) and (b).

30. The method of claim 29, wherein performing the wet clean on the backside of the substrate further reduces the concentration of the metal on the backside of the substrate by at least an order of magnitude.

31. The method of claim 29, wherein the wet clean also cleans a bevel edge region on the frontside of the substrate.

32. The method of claim 29, wherein performing the wet clean on the backside of the substrate comprises exposing the backside of the substrate to dilute HF.

33. The method of claim 32, wherein performing the wet clean on the backside of the substrate further comprises exposing the backside of the substrate to dilute HCl or to a standard clean 1 solution comprising NH_4OH, H_2O_2, and H_2O.

34. The method of claim 3, wherein the layer of photoresist is formed using dry deposition.

35. The method of claim 3, wherein the layer of photoresist is formed using wet deposition.

36. The method of claim 3, wherein the layer of photoresist is developed using dry processing.

37. The method of claim 36, wherein the layer of photoresist is developed using halogen-containing chemistry.

38. The method of claim 3, wherein the layer of photoresist is developed using wet processing.

39. The method of claim 3, wherein the post-development bake process of (b) occurs in a processing chamber, and wherein the following conditions are used during the post-development bake process of (b):

(i) a pressure in the processing chamber is maintained between about 0.01-1 Torr,

(ii) a chlorine-containing gas is provided to the processing chamber at a rate of about 200-10,000 sccm for a duration between about 1-10 minutes,

(iii) a temperature of one or more components of the processing chamber are maintained between about 20-150°C, and

(iv) the substrate is not exposed to plasma during (b).

40. The method of claim 3, wherein the layer of photoresist is developed in (a) in a processing chamber, wherein (b) occurs in the same processing chamber as (a), the method further comprising purging the processing chamber using the following conditions:

(i) a pressure in the processing chamber is between about 0.01-1 Torr,

(ii) a flow of purge gas is provided to the processing chamber at a rate between about 200-10,000 sccm, the purge gas comprising at least one gas selected from the group consisting of diatomic nitrogen (N_2), a noble gas, and combinations thereof, the purge gas being provided to the processing chamber for a duration between about 1-10 minutes, and

(iii) one or more components of the processing chamber are maintained between about 100-300°C, and a substrate support within the processing chamber is maintained between about 120-300°C.

41. The method of claim 3, wherein (a) occurs in a first processing chamber and (b) occurs in a second processing chamber, wherein the following conditions are used during the post-development bake process of (b):

(i) a pressure in the second processing chamber is between about 0.1-760 Torr,

(ii) a flow of gas is provided to the second processing chamber at a rate of about 200-10,000 sccm for a duration between about 1-10 minutes, wherein the substrate is exposed to the flow of gas, the flow of gas comprising at least one of air, diatomic nitrogen (N_2), diatomic oxygen (O_2), water (H_2O), a noble gas, or a combination thereof, and

(iii) the substrate is baked at a temperature between about 140-300°C.

42. The method of claim 3, further comprising exposing the substrate to plasma in a processing chamber under the following conditions:

(i) a pressure in the processing chamber is between about 0.1-1 Torr,

(ii) a plasma generation gas is provided at a rate between about 50-5,000 sccm for a duration between about 3-30 seconds, the plasma generation gas comprising at least one gas or gas mixture selected from the group consisting of (a) H_2, (b) H_2 and N_2, (c) H_2 and a noble gas, (d) N_2, without H_2, (e) a noble gas, without H_2, (f) an oxygen-containing gas, (g) a fluorine-containing gas, and (h) combinations thereof, and

(iii) plasma is generated from the plasma generation gas and the substrate is exposed to the plasma.

43. The method of claim 3, wherein at least one of (a) and (b) occurs in a processing chamber, the method further comprising cleaning the processing chamber to remove the metal from interior surfaces of the processing chamber.

44. The method of claim 43, wherein the processing chamber is cleaned using the following conditions:

(i) a pressure in the processing chamber is between about 0.1-10 Torr,

(ii) a plasma comprising H radicals is exposed to the processing chamber, wherein the H radicals react with the metal on the interior surfaces of the processing chamber to form a metal hydride,

(iii) the plasma is generated using an RF power between about 300-4,000 Watts, and

(iv) the processing chamber is maintained between about 25-250°C.

45. The method of claim 43, wherein the processing chamber is cleaned using the following conditions:

(i) a pressure in the processing chamber is between about 0.1-10 Torr, and is cycled between a lower pressure and a higher pressure as part of a pumping and purging process,

(ii) the processing chamber is not exposed to plasma during cleaning,

(iii) a gas flow is provided to the processing chamber during cleaning, the gas flow comprising at least one gas selected from the group consisting of diatomic nitrogen (N_2), diatomic oxygen (O_2), a noble gas, and combinations thereof, and

(iv) the processing chamber is maintained between about 25-250°C.

46. The method of claim 3, further comprising performing a wet clean on the backside of the substrate using the following conditions:

(i) in a first step, the substrate is exposed to a first cleaning solution provided at a rate of about 1-3 L/min, the first cleaning solution comprising dilute HF,

(ii) in a second step, the substrate is exposed to a second cleaning solution provided at a rate of about 1-3 L/min, wherein the second cleaning solution comprises a solution selected from the group consisting of dilute HCl, standard clean 1, and combinations thereof,

(iii) the first step and second step together have a duration between about 20-300 seconds, and

(iv) the substrate is maintained between about 15-60°C.

47. The method of claim 3, wherein the concentration of the metal on at least one of the backside or bevel edge region of the substrate is reduced by at least an order of magnitude to about 1E11 atoms/cm^2 or less.

48. The method of claim 47, wherein the concentration of the metal on at least one of the backside or bevel edge region of the substrate is reduced by at least an order of magnitude to about 1E10 atoms/cm^2 or less.

49. The method of claim 3, wherein the metal is tin.

~~50. A system for processing a substrate, the system comprising:~~

~~a processing chamber;~~

~~an inlet to the processing chamber for introducing gas and/or plasma to the processing chamber;~~

~~an outlet to the processing chamber for removing materials from the processing chamber;~~

~~a heater;~~

~~a substrate support; and~~

~~a controller configured to cause any one or more of the methods of claims 1-49 or otherwise described herein.~~

~~51~~50. A system for processing a substrate, the system comprising:

a processing chamber;

an inlet to the processing chamber for introducing gas and/or plasma to the processing chamber;

an outlet to the processing chamber for removing materials from the processing chamber;

a heater;

a substrate support; and

a controller configured to cause:

(a) either (i) processing a frontside of the substrate, thereby causing formation of contamination on a backside of the substrate, or (ii) receiving the substrate with contamination on the backside of the substrate, the contamination comprising a metal; and

(b) after (a), heating the substrate in a post-processing bake process, wherein heating the substrate reduces a concentration of the metal on the backside of the substrate.

~~52~~51. The system of claim ~~51~~50, wherein processing the frontside of the substrate comprises at least one process selected from the group consisting of: developing a layer of photoresist; in-situ

cleaning the substrate; pulling a mandrel in a patterning application; smoothing a feature on the substrate; and descumming a layer of photoresist.

~~53~~52. The system of claim ~~52~~51, wherein the controller is configured to cause (a) by causing either (i) developing the layer of photoresist on the substrate, or (ii) receiving the substrate with a layer of photoresist developed on the frontside of the substrate and contamination on the backside of the substrate,

wherein the metal in the contamination originates from the layer of photoresist on the frontside of the substrate, and

wherein the post-processing bake process of (b) is a post-development bake process that occurs when the layer of photoresist is at least partially developed.

~~54~~53. The system of claim ~~53~~52, wherein (a) and (b) both occur in the same processing chamber.

~~55~~54. The system of claim ~~53~~52, wherein (a) occurs in the processing chamber, and (b) occurs in a second processing chamber, the second processing chamber being a different processing chamber than the processing chamber.

~~56~~55. The system of claim ~~53~~52, further comprising a plasma generator configured to provide plasma in the processing chamber.

~~57~~56. The system of claim ~~56~~55, wherein the plasma generator is a remote plasma generator such that the plasma is generated at a first location outside of the processing chamber and delivered to a second location inside the processing chamber.