CLAIMS

1. A substrate processing method comprising:

providing a substrate with at least one substrate surface comprising a first material comprising a metal; and

oxidizing the first material to form an expanded first material, wherein oxidizing the first material comprises exposing the first material to an oxidizing agent at a pressure greater than or equal to 2 bar.

2. The method of claim 1, wherein the metal is selected from the group consisting of W, Ru, Ta, Ir, Co, Mo, Ti, Rh, Cu, Fe, Mn, V, Nb, Hf, Zr, Y, Al, Sn, Cr, La and combinations thereof.

3. The method of claim 2, wherein the first material consists essentially of W.

4. The method of claim 1, wherein the oxidizing agent comprises one or more of O_2, N_2O, H_2O, CO_2, O_3, H_2O_2, CO, halogens, and peracids.

5. The method of claim 1, wherein oxidizing the first material is performed at a temperature less than or equal to 425 °C.

6. The method of claim 5, wherein the first material consists essentially of W and oxidizing the first material is performed at a pressure in a range of 2 bar to 15 bar.

7. A substrate processing method comprising:

providing a substrate with at least one substrate surface comprising a first material comprising tungsten; and

oxidizing the first material to expand the first material straight up from the substrate to form an expanded first material, wherein oxidizing the first material comprises exposing the first material to an oxidizing agent comprising one or more

of H_2O, O_2, N_2O, O_3, CO_2, CO, or H_2O_2, at a pressure greater than or equal to 2 bar.

8. The method of claim 7, wherein the oxidizing agent consists essentially of H_2O.

9. The method of claim 7, wherein oxidizing the first material is performed at a temperature less than or equal to 425 °C.

10. The method of claim 7, wherein oxidizing the first material is performed by a thermal process without plasma.

11. The method of claim 7, wherein oxidizing the first material is performed at a pressure greater than or equal to 10 bar.

12. The method of claim 7, wherein the expanded first material comprises WO_3.

13. A method of substrate processing comprising:

providing a substrate with a substrate surface with at least one feature formed therein, the at least one feature extending a distance into the substrate from the substrate surface and having a sidewall and a bottom;

forming a tungsten-containing film on the substrate surface and in the at least one feature;

removing the tungsten-containing film from the substrate surface outside of the at least one feature; and

oxidizing the tungsten-containing film to form a tungsten oxide pillar which extends from the at least one feature, wherein oxidizing the tungsten-containing film comprises exposing the substrate to an oxidizing agent comprising one or more of H_2O, O_2, N_2O, O_3, CO_2, CO, or H_2O_2, at a pressure greater than or equal to 2 bar.

14. The method of claim 13, wherein the tungsten-containing film consists essentially of tungsten.

15. The method of claim 13, wherein the tungsten-containing film comprises a tungsten sub-oxide having an average tungsten oxidation state in a range of greater than 0 to less than +6.

16. The method of claim 13, wherein removing the tungsten-containing film from the substrate is performed by chemical-mechanical planarization.

17. The method of claim 13, wherein the tungsten-containing film is removed so that a top of the tungsten-containing film is coplanar with the substrate surface outside the feature.

18. The method of claim 13, wherein the oxidizing agent consists essentially of H_2O.

19. The method of claim 13, wherein the tungsten oxide pillar comprises WO_3.

20. The method of claim 13, wherein the tungsten oxide pillar comprises a tungsten sub-oxide having an average tungsten oxidation state in a range of greater than 0 to less than +6.