CLAIMS

1. A method of creating an oxide layer over a surface of an object comprising aluminum, copper and magnesium for use in a semiconductor processing system, the method comprising:

providing the object, the object comprising a bulk material having:

a bulk copper concentration between about 0 % and about 0.1 % by weight; and

a bulk magnesium concentration greater than about 1.5 % by weight; and

oxidizing the surface of the object using a plasma electrolytic oxidation process to form the oxide layer comprising alumina and an oxide of magnesium.

2. The method of claim 1,

wherein the method further comprises depositing a layer of a second material on the surface of the object, the second material having a second copper concentration less than the bulk copper concentration; and

wherein the step of oxidizing the surface of the object using a plasma electrolytic oxidation process comprises oxidizing at least a portion of a thickness of the layer of second material.

3. The method of claim 2, further comprising increasing a magnesium concentration of the layer of second material before formation of the oxide layer.

4. The method of claim 3, wherein the magnesium concentration of the layer of second material is increased through an ablative transfer of magnesium.

5. The method of claim 2, wherein the step of oxidizing the surface of the object using a plasma electrolytic oxidation process comprises oxidizing at least a portion of the layer of second material.

6. The method of claim 2, wherein the step of oxidizing the surface of the object using a plasma electrolytic oxidation process comprises oxidizing through and beyond a thickness of the layer of second material into underlying bulk material of the object.

7. The method of claim 2, further comprising cleaning the surface of the object prior to depositing the layer of second material.

8. The method of claim 1, further comprising:

removing material from the surface of the object to a first depth after oxidizing the surface of the object using the plasma electrolytic oxidation process;

wherein a maximum copper concentration of the oxidized layer is about or less than about 5000 ppm after the material is removed from the surface of the object to the first depth; and

wherein a magnesium concentration at the first depth is at least about 4000 ppm.

9. The method of claim 1, further comprising extracting copper from the oxidized surface of the object.

10. A method of creating a protective layer over a surface of an object comprising aluminum, magnesium and copper for use in a semiconductor processing system, the method comprising:

providing the object, the object including:

a bulk material having a bulk copper concentration; and

an oxide layer produced using a plasma electrolytic oxidation process, the oxide layer having:

a copper concentration varying as a function of depth in the oxide layer with a maximum copper concentration being about or less than about 5000 ppm; and

a magnesium concentration varying as a function of depth in the oxide layer with a minimum magnesium concentration being more than about 4000 ppm; and

exposing a surface of the oxide layer to an excited gas comprising a halogen or to a plasma comprising a halogen to form magnesium halide in the oxide layer thereby creating the protective layer.

11. The method of claim 10, wherein the bulk copper concentration is greater than about 0.1 % by weight.

12. The method of claim 11, wherein the bulk magnesium concentration is less than about 1 % by weight.

13. A method for creating an oxide layer over a surface of an object comprising aluminum, copper and magnesium, the method comprising:

providing the object, the object including a bulk material having a bulk copper concentration by weight;

depositing a layer of a second material on the surface of the object, the second material having a second copper concentration smaller than the bulk copper concentration; and

oxidizing at least an outer thickness of the deposited layer using a plasma electrolytic oxidation process.

14. The method of claim 13, further comprising increasing a magnesium concentration of the layer of second material.

15. The method of claim 13, wherein the second material includes a magnesium concentration larger than the bulk magnesium concentration.

16. The method of claim 13, wherein oxidizing at least an outer thickness of the layer of second material using a plasma electrolytic oxidation process comprises oxidizing at least through an entire thickness of the deposited layer.

17. A method for creating an oxide layer over a surface of an object comprising aluminum, copper and magnesium, the method comprising:

providing the object, the object including a bulk material having a bulk copper concentration by weight and a bulk magnesium concentration by weight;

contacting the object with a layer of second material, the second material having a second copper concentration smaller than the bulk copper concentration;

heating the object to diffuse copper from the bulk material into the layer of second material;

removing the layer of second material from the object; and

oxidizing the surface of the object using a plasma electrolytic oxidation process.

18. The method of claims 17, wherein contacting the object with a layer of second material comprises depositing the layer of the second material on the surface of the object.

19. The method of claim 17, wherein contacting the object with a layer of second material comprises moving the layer of second material or the object until the second layer of material contacts the surface of the object.

20. The method of claim 19, wherein removing the layer of second material from the object comprises moving the layer of second material or the object at least until the second layer of material is separated from the surface of the object.

21. A method for treating a surface of an object comprising aluminum, copper and magnesium for use in a semiconductor processing system, the method comprising:

providing the object, the object comprising:

a bulk region comprising copper aluminum and magnesium; and

an oxide layer produced by a plasma electrolytic oxidation process and having:

a magnesium concentration that varies as a function of depth in the oxide layer; and

a copper concentration that each varies as a function of depth in the oxide layer with a maximum copper concentration of greater than about 5000 ppm at a first depth; and

removing a portion of the oxide layer beyond the first depth to a second depth, wherein the copper concentration at the second depth is about less than about 5000 ppm and the magnesium concentration at the second depth is greater than about 4000 ppm.

22. The method of claim 21, wherein the portion of the oxide layer is removed using a chemical-mechanical process.

23. The method of claim 21, wherein the portion of the oxide layer is removed using a mechanical process.

24. The method of claim 21, wherein the portion of the oxide layer is removed using chemical etching.

25. The method of claim 21, wherein the portion of the oxide layer is removed using an electrochemical-mechanical process.

26. A method for treating a surface of an object comprising aluminum, copper and magnesium for use in a semiconductor processing system, the method comprising:

providing the object, the object including:

a bulk region comprising copper and aluminum; and

an oxide layer produced by a plasma electrolytic oxidation process and having a copper concentration varying as a function of depth in the oxide layer; and

extracting copper from the oxide layer until a maximum copper concentration in the oxide layer is about or less than about 4000.

27. The method of claim 26, wherein the copper is extracted using a chemical process.

28. The method of claim 26, wherein the chemical process is an electrochemical process.

29. The method of claim 26, further comprising increasing a magnesium concentration in the oxide layer by an ablative transfer process.

30. The method of claim 26, further comprising increasing a magnesium concentration in the oxide layer by doping the oxide layer.

31. A method for treating a surface of an object, the method comprising:

providing an object, the object including:

a bulk region including aluminum and having a bulk copper concentration; and an oxide layer produced by a plasma electrolytic oxidation process and having:

a magnesium concentration varying as a function of depth in the oxide layer; and

a copper concentration varying as a function of depth in the oxide layer with a maximum copper concentration greater than the bulk copper concentration; and

applying energy to the object to diffuse copper at least until a maximum copper concentration of the protective layer is about or less than about 5000 ppm.

32. The method of claim 31, wherein applying energy to the object to diffuse copper comprises:

applying an electrical potential gradient across the oxide layer; and

heating the object to enhance diffusion of the copper.

33. The method of claim 32, wherein the electrical potential gradient across the oxide layer is between about 300 V and about 1000 V.

34. The method of claim 32, wherein the electrical potential gradient across the oxide layer is between about 30% and about 80% of the breakdown voltage of the oxide layer.

35. The method of claim 32, wherein heating the object to enhance diffusion of the copper comprises heating the object to a temperature between about 50 C and about 350 C.

36. The method of claim 32, wherein applying an electrical potential gradient across the oxide layer further includes providing an electrolyte adjacent the surface of the oxide layer for electrical connection to the surface of the object.

37. The method of claim 36, wherein the electrolyte is an electrically conductive polymer.

38. The method of claim 31, wherein applying energy to the object to diffuse copper comprises:

heating at least a portion of the object to a temperature in a temperature range between a minimum temperature that permits diffusion of the copper on a production time scale and a maximum temperature lower than a temperature that permits diffusion of magnesium on the production time scale; and

maintaining the portion of the object in the temperature range at least until a maximum copper concentration in the protective layer is about or less than about 5000 ppm.

39. The method of claim 38, wherein the temperature range is between about 150 C and 350 C degrees.

40. A plasma chamber for use with a reactive gas source, the plasma chamber comprising:

an inlet for receiving a gas;

at least one plasma chamber wall for containing the gas, the plasma chamber wall comprising:

a bulk material having a bulk copper concentration; and

an oxide layer produced using a plasma electrolytic oxidation process, the oxide layer having:

a copper concentration varying as a function of depth in the oxide layer with a maximum copper concentration being about or less than about 5000 ppm;

a magnesium concentration varying as a function of depth in the oxide layer with a minimum magnesium concentration being more than about 4000 ppm; and

an outlet for outputting a reactive gas generated by the interaction of the plasma and the gas.

41. A semiconductor process chamber for use with a reactive gas source, the process chamber comprising:

an inlet for receiving an excited gas or a plasma; and

at least one process chamber wall for containing the gas, the process chamber wall comprising:

a bulk material having a bulk copper concentration; and

an oxide layer produced using a plasma electrolytic oxidation process, the oxide layer having:

a copper concentration varying as a function of depth in the oxide layer with a maximum copper concentration being about or less than about 5000 ppm; and

a magnesium concentration varying as a function of depth in the oxide layer with a minimum magnesium concentration being more than about 4000 ppm.

CLAIMS

1. A method of creating an oxide layer over a surface of an object comprising aluminum, copper and magnesium for use in a semiconductor processing system, the method comprising:

providing the object, the object comprising a bulk material having:

a bulk copper concentration between about 0 % and about 0.1 % by weight; and

a bulk magnesium concentration greater than about 1.5 % by weight;

oxidizing the surface of the object using a plasma electrolytic oxidation process to form the oxide layer comprising alumina and an oxide of magnesium;

depositing a layer of a second material on the surface of the object, the second material having a second copper concentration less than the bulk copper concentration, the step of oxidizing the surface of the object using a plasma electrolytic oxidation process comprises oxidizing at least a portion of a thickness of the layer of second material; and

increasing a magnesium concentration of the layer of second material before formation of the oxide layer.

2. The method of claim 1, wherein the magnesium concentration of the layer of second material is increased through an ablative transfer of magnesium.

3. The method of claim 1, wherein the step of oxidizing the surface of the object using a plasma electrolytic oxidation process comprises oxidizing through and beyond a thickness of the layer of second material into underlying bulk material of the object.

4. The method of claim 1, further comprising cleaning the surface of the object prior to depositing the layer of second material.

5. The method of claim 1, further comprising:

removing material from the surface of the object to a first depth after oxidizing the surface of the object using the plasma electrolytic oxidation process;

wherein a maximum copper concentration of the oxidized layer is about or less than about 5000 ppm after the material is removed from the surface of the object to the first depth; and

wherein a magnesium concentration at the first depth is at least about 4000 ppm.

6. The method of claim 1, further comprising extracting copper from the oxidized surface of the object.

7. A method for creating an oxide layer over a surface of an object comprising aluminum, copper and magnesium, the method comprising:

providing the object, the object including a bulk material having a bulk copper concentration by weight and a bulk magnesium concentration by weight;

depositing a layer of a second material on the surface of the object, the second material having a second copper concentration smaller than the bulk copper concentration;

oxidizing at least an outer thickness of the deposited layer using a plasma electrolytic oxidation process; and

increasing the magnesium concentration of the layer of the second material before formation of the oxide layer.

8. The method of claim 7, wherein the second material includes a magnesium concentration larger than the bulk magnesium concentration.

9. The method of claim 7, wherein oxidizing at least an outer thickness of the layer of second material using a plasma electrolytic oxidation process comprises oxidizing at least through an entire thickness of the deposited layer.

10. A method for creating an oxide layer over a surface of an object comprising aluminum, copper and magnesium, the method comprising:

providing the object, the object including a bulk material having a bulk copper concentration by weight and a bulk magnesium concentration by weight;

contacting the object with a layer of second material, the second material having a second copper concentration smaller than the bulk copper concentration;

heating the object to diffuse copper from the bulk material into the layer of second material;

removing the layer of second material from the object; and

oxidizing the surface of the object using a plasma electrolytic oxidation process.

11. The method of claims 10, wherein contacting the object with a layer of second material comprises depositing the layer of the second material on the surface of the object.

12. The method of claim 10, wherein contacting the object with a layer of second material comprises moving the layer of second material or the object until the second layer of material contacts the surface of the object.

13. The method of claim 12, wherein removing the layer of second material from the object comprises moving the layer of second material or the object at least until the second layer of material is separated from the surface of the object.