THE CLAIMS

What is claimed is:

1. A semiconductor manufacturing apparatus comprising metal surface susceptible to formation of oxide of said metal thereon, the metal surface configured to be contacted in operation of said apparatus with gas, solid, or liquid that is reactive with said metal oxide to form a reaction product that is deleterious to said apparatus and its operation,

wherein the metal surface is coated with a protective coating capable of preventing reaction of the coated surface with the reactive gas, solid, or liquid,

wherein the protective coating comprises multiple layers formed by atomic layer deposition, and

wherein the protective coating comprises one or more of coating materials selected from the group consisting of Al_2O_3; oxides of the formula MO, wherein M is Ca, Mg, or Be; oxides of the formula $M'O_2$, wherein M' is a stoichiometrically acceptable metal; and oxides of the formula Ln_2O_3, wherein Ln is a lanthanide element,

wherein the semiconductor manufacturing apparatus is a solid source delivery vaporizer for volatilization of a solid precursor material when the vaporizer is heated to provide a vapor stream that is dispensed from the vaporizer, the vaporizer having an interior volume including support surfaces therein for the solid material to be vaporized, wherein at least a portion of the support surface has the protective coating thereon.

2. The apparatus of claim 1 wherein the metal oxide reactive with the gas, solid, or liquid comprises at least one oxide of one or more of Cr, Fe, Co, and Ni.

3. The apparatus of claim 1, wherein the gas that is reactive with the metal oxide to form a reaction product that is deleterious to the apparatus and its use or operation, comprises Al_2Cl_6.

4. The apparatus of claim 1, wherein the protective coating comprises Al_2O_3.

5. The apparatus of claim 1, wherein Ln is La, Sc, or Y.

6. The apparatus of claim 1, wherein the protective coating comprises a metal oxide for which the free energy of reaction with the gas that is contacted with the metal surface in the use or operation of said apparatus, is greater than or equal to zero.

7. The apparatus of claim 1, wherein the protective coating comprises at least two metal oxides selected from the group consisting of titania, alumina, zirconia, oxides of the formula MO wherein M is Ca, Mg, or Be, oxides of the formula $M'O_2$, wherein M' is a stoichiometrically acceptable metal, and oxides of the formula Ln_2O_3 wherein Ln is a lanthanide element, La, Sc, or Y.

8. The apparatus of claim 1, wherein the protective coating has a thickness in a range of from 2 to 500 nm.

9. The apparatus of claim 1, wherein the solid precursor material is $AlCl_3$.

10. The apparatus of claim 1, wherein the metal surface coated with the protective coating comprises stainless steel.