ABSTRACT

Sol-Gel protective coatings have shown excellent chemical stability, oxidation control and enhanced corrosion resistance for metal substrates. Further, this method is an environmentally friendly.

For the coatings of either Al_2O_3 or Cr_2O_3 or MgO, the respective salt ($AlCl_3$ or $CrCl_3$ or $MgCl_2$) and Citric acid (metal to Citrate ratio ~ 1:2) were taken as precursor. These were dissolved in 1:1 ratio of distilled water and ethylene glycol solvents. The pH value was kept around 2.3- 2.5 by adding HNO_3 and NH_4OH in the above solutions. The solutions were subjected to heating near 70 °C for 20 h to transfer them into gel. The gels were applied on the metal substrates (e.g. Copper, Steel, Nickel super alloy and Titanium) and heated in Ar atmosphere at 700 °C to get coatings of oxides.

The XRD analysis of the coated surface suggests the formation of oxides such as Al_2O_3 or Cr_2O_3 or MgO on steel and Ti substrates. It is observed that only Cr_2O_3 could get coated over Ni-superalloy. In contrast, none of the oxides could coat over Cu surface. The average thickness of the coating layers was found to be ~ 20-30 μm from scanning electron microscope. The energy dispersive x-ray spectroscopy (EDS) of the coated surface confirms the presence Al_2O_3 or Cr_2O_3 or MgO on the metallic surfaces.

The microhardness value at 50 g load for Cr_2O_3 coated steel sample was ~ 640 VHN which was almost twice than that of uncoated one (~ 330 VHN). Similarly, the hardness value improved for Ni-superalloy coated with Cr_2O_3. Nevertheless, the hardness values of coated and uncoated copper samples remain unaltered which confirmed that there was no coating on Cu surface.