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Stability Of Aluminum Phosphate Coating For High Temperature Applications

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Abstract:

The aim of this study was to synthesize an amorphous aluminum phosphate coating for oxidation resistance. The aluminum phosphate precursor solution was prepared by sol–gel process and applied on AISI 304 stainless steel substrate using the dip coating technique. Phase composition analysis of the coating material was performed by X-ray diffractometer (XRD). The surface morphology of the coatings after annealing at 500 °C for 15 min was observed using scanning electron microscopy (SEM) analysis equipped with energy dispersive spectroscopy of characteristic X-rays (EDS). The microstructure of the synthesized powder was studied by transition electron microscopy (TEM). Study of amorphous to crystalline transformation was investigated by thermal-gravimetric and differential scanning calorimetry (TG-DSC). Oxidation resistance of the coatings was studied using an electrical furnace at 1100 °C for 100 h in air with weight measurements performed at regular intervals. According to SEM images a uniform, continuous and crack-free coating was achieved. TEM observations were in accordance with XRD results and revealed the amorphous structure of the coating after annealing at 500 °C for 15 min and amorphous-nanocrystalline structure after annealing at 1100 °C for 1 h. The thermal analysis of the coating material showed that the onset temperature of the amorphous to crystalline transformation was around 1050 °C. Weight change measurements after 100 h oxidation revealed that the weight change of the bare substrate was about 30 times greater than that of observed for the aluminum phosphate coating. So, the amorphous aluminum phosphate coating is capable of surface protecting of metals/alloys against oxidation.

Keywords: Aluminum phosphate; Amorphous- nanocrystalline; Coating; Sol-gel, Oxidation resistance.