Synthesis and properties of sol-gel based corrosion resistant nanocomposite coating

Supriya Nirmalkar and S.T. Aruna*
Surface Engineering Division
Council of Scientific and Industrial Research - National Aerospace Laboratories, HAL Airport Road, Bangalore 560017, India

Abstract

AA2024-T3 aluminium alloy is widely used in aircraft and aerospace industries because of its high strength to weight ratio. Due to the presence of intermetallic compounds in aluminum alloy they are more sensitive to localized corrosion after exposure to aggressive environments. Historically, chromate conversion coatings were used to prevent corrosion of aluminum alloys. But the presence of toxic hexavalent chromium compounds makes those coatings very hazardous to the environment. Among the various approaches employed as replacements, the sol-gel process is considered to be a promising alternative. Sol-gel coatings are mainly organic-inorganic hybrid materials in which the organic part improves the adhesion at the metal/coating interface and the inorganic part increases the hardness of the coating. Incorporation of corrosion inhibitors into the sol-gel films can improve the corrosion protection ability of the coatings.

The present work is aimed at producing corrosion resistant organic-inorganic hybrid nano-composite coatings containing ceria nano-particles synthesized by two methods (solution combustion synthesis and hydrothermal synthesis) on Aluminum alloy AA2024-T3. For comparison studies coatings have also been prepared from commercial ceria particles. A hybrid sol of 3glycidoxypropyltrimethoxysilane (GPTMS) and tetraethoxysilane (TEOS) was prepared. Ceria particles were used as the inhibitor source. Corrosion performance of coatings was evaluated using DC Polarization and Electrochemical Impedance Spectroscopy (EIS) and continuous salt spray (ASTM B117) test.

Among the coatings investigated in the present study, sol-gel coating containing solution combustion synthesized ceria particles exhibited improved corrosion resistance compared to other coatings as evident from continuous salt spray studies. More details regarding the corrosion performance of the sol-gel composite coatings will be discussed.

* Corresponding author
Tel.: +9180 25086250
Fax: (080) 2521-0113
E-mail address: aruna_reddy@nal.res.in