HYBRID SOL-GEL COATINGS DOPED WITH CERIUM-NANOCONTAINERS FOR ACTIVE CORROSION PROTECTION OF ALUMINUM ALLOYS

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Abstract

Aluminum alloy 2024 (AA2024) is widely used as an important material for aerospace industry. Therefore, with high copper content, AA2024 is susceptible to corrosion, especially pitting or intergranular corrosion. Generally, the pre-treatments exploiting the Cr (VI) compounds have been considered as the most effective conversion layers for protection against corrosion of this alloy due to the strong oxidation properties of Cr (VI). Unfortunately, as they cause problems on human health and the environment, new pre-treatments for corrosion protection have been actively developed in the last decade. This work presents a new approach to develop protective pre-treatment for AA2024 based on the inhibitor efficiency of cerium ions which are considered as a promising alternative to replace chromate compounds.

In this study, the inhibition properties of cerium salts for improving the anti-corrosion performance of AA2024 have been characterized by polarization curves and EIS measurements. Cerium ions were inserted into nanoclays platelets by cationic-exchange reactions (CeMMT). XRD analysis proved the presence of cerium ions intercalated into clay structure. EIS measurements and polarization curves highlighted a high corrosion inhibition effect of cerium-modified nanoclays. This effectiveness can be related to the release of 60% of cerium ions from CeMMT structure in sodium chloride as determined by UV-VIS measurements. Scanning Vibrating Electrode Technique and salt spray test made on scratched sol-gel samples indicated a self-healing effect of cerium ions which provide an active corrosion protection to aluminum substrate. EIS measurements revealed that hybrid sol-gel films doped with CeMMT improve barrier properties and anticorrosion protection of aluminum 2024 substrate.

Results of this research indicated that sol-gel films incorporating cerium-nanocontainers can give an active corrosion protection to AA2024.

Keywords. Sol-gel, AA2024, corrosion, montmorillonite, cerium salts, EIS.