

The Healing Characteristics of Non-Chromate Corrosion Inhibitors for AA2024-T3 When Incorporated into Silane Films

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Introduction

Chromate-based inhibitor compounds are commonly used in corrosion protective coatings for aluminum alloys in aircraft structures. [1]. However, the replacement of hexavalent chromium is under active consideration because of its carcinogenicity and substantial contribution to environmental pollution. Numerous compounds have been examined to provide a chromate replacement. These compounds include molybdates, vanadium based compounds, rare earth salts, among others [2] [3] [4].

In this work silane films containing new inhibitors such as benzotriazole, tolytriazole, and cerium are compared with potassium dichromate.

Experimental Methods

Electrochemical impedance spectroscopy was applied to monitor the electrochemical properties of silane (bis-(3-triethoxysilyl propyl)tetra-sulfane) films containing benzotriazole, benzocarboxytriazole, tolytriazole, cerium nitrate and potassium dichromate in a concentration of 1000 ppm on AA2024-T3. The silanes films were prepared by mixing 5% of silane oil with 90% water and 5 % alcohol. They were dip coated and baked at T? for 24 hours. Artificial defects (e.g., scratches and pin-holes) were made through the silane films and investigated over time in 0.5 M sodium chloride solution in order to study the healing properties of the inhibitors. These methods are similar to those used by Hunter, et al. [5] This previous investigation revealed that the rate of recovery of the impedance following a physical breach was correlatable to the life expectancy of a coating system in a salt spray test.

Results and Discussion

Figure 1 shows the effect of the immersion in the impedance response of an AA2024 panel covered by a silane film containing 1000 ppm Ce(NO₃)₃. The electrode surface was scratched prior to the exposure to the electrolyte with a glass slide and two scratches of about 3 cm long and 0.1 mm wide were applied.

From the picture it is apparent the overall impedance dramatically decreases over time, which indicate that the inhibitor contained in the film does not provide significant corrosion protection in the form of healing when used in the concentration indicated above.

Detailed analysis of the spectra are in progress and will be presented.

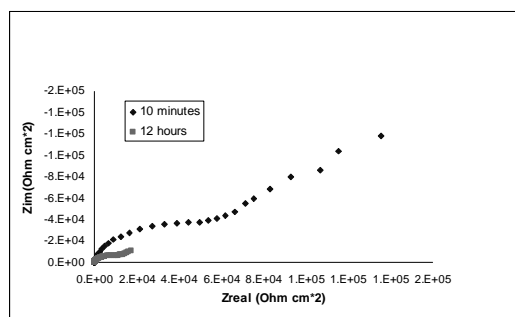


Figure 1 Impedance spectrum of a AA2024 alloys covered a silane film containing 1000ppm Ce(NO₃)₃ as a function of immersion time after scratching the electrode surface.

References

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