

EIS analysis of the degradation process of AA5083/polyurethane coating system at dynamic seawater/air interfacial zone and full immersion zone

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Abstract This study focuses on the degradation mechanisms of polyurethane coatings under dynamic waterline conditions and the influence of coating thickness on the failure process. A more refined physical model has been established based on the micro-heterogeneity of the coating. By constructing an experimental setup simulating the dynamic seawater/air interface and using electrochemical impedance spectroscopy (EIS) technology, this study compares the electrochemical behaviors of polyurethane coatings of different thicknesses in the fully submerged zone and waterline zone of simulated seawater. The experimental results indicate that the distribution of coating resistivity, dielectric constant, and pore resistance are significantly affected by the alternation of wet and dry conditions, with the failure rate of polyurethane coatings in the dynamic waterline zone being faster than in the fully submerged zone. By analyzing EIS data, different distribution characteristics of coating resistivity along the thickness under various conditions have been revealed. This research provides valuable scientific evidence for a deeper understanding of the electrochemical behavior of polyurethane coatings and the exploration of their failure mechanisms, which has significant practical implications for the development of high-performance anti-corrosion coatings.

Keywords Polyurethane Coating, Dynamic Waterline, Electrochemical Impedance Spectroscopy (EIS), Physical Model.

Reference

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