Study on galvanic corrosion behavior between conductive coatings and metal substrate

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Coatings play a crucial role in safeguarding around 90% of materials against corrosion. However, surface defects are inevitable during the formation of the coating. While research on the corrosion failure behavior of organic coatings has been extensive, study on the galvanic corrosion behavior between conductive coatings and metal substrates remains limited. In this study, graphite coatings were applied to the surface of 2024 aluminum alloy. The study aimed to examine the galvanic corrosion behavior between them, clarify the corrosion failure mechanism of the coating system, and analyze the transport process of corrosive media within the coating.

The main conclusions are as follows: the average potential difference between the 2024 aluminum alloy and the graphite coating was approximately 0.76 *V/SCE*, with a galvanic current density of 8.06×10^{-4} $\mu A/cm^2$. The corrosion failure process of the conductive coating system can be divided into three stages based on the characteristics of EIS. Correspondingly, the transport behavior of the corrosive medium (primarily water) within the coating also undergoes three stages. Initially, the conductive coating system exhibited two time constants. With the increasing of immersion time, the formation of a corrosion product film introduced a third time constant, indicating the arrival of chloride ions at the surface of the 2024 aluminum alloy. In the later stages, the conductive coating system reverted to two time constants, which is attributed to the disappearance of chloride ions leading to the absence of capacitive loop in the high frequency. Simultaneously, due to the blocking effect of the graphite laminating structure on the permeation of corrosive media, the Warburg impedance is always accompanied throughout the entire immersion period.

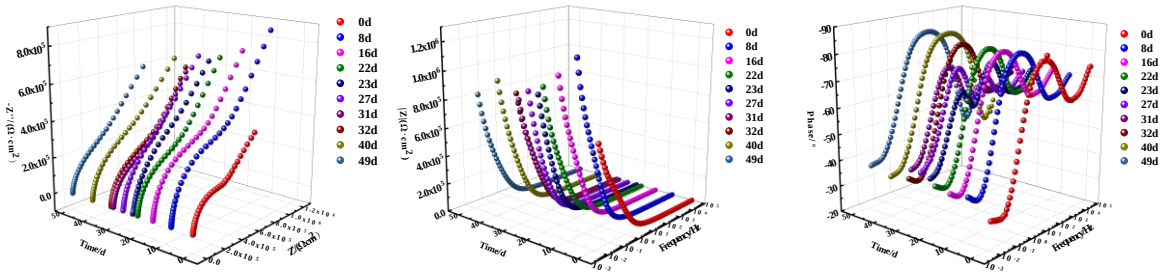

Fig.1 Evolution of Electrochemical Impedance Spectroscopy

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