Analysis of Filiform Corrosion on Coated Aluminium Alloys by FTIR Microspectroscopy and Scanning Kelvin Probe

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Filiform corrosion is an atmospheric corrosion process that occurs on coated metals such as aluminium alloys. It leads to the formation of thin thread like filaments full of corrosion products beneath the coating. Specific conditions are needed to initiate the corrosion process: coating defect, oxygen, aggressive ions such as chloride, high relative humidity. According to previous works and reviews on the subject[1-3], a differential aeration cell is established between the head and the tail of the filament during filiform corrosion. The anodic reaction is believed to take place in the head of the filament, whereas the cathodic reaction, oxygen reduction, primarily occurs in the back of the head. The driving force for the filiform corrosion is the potential difference between anodic and cathodic sites in the differential aeration cell. Although there are experimental supports for this mechanism, there are still uncertainties, primarily due to difficulties in obtaining electrochemical information during the corrosion process and lack of knowledge about the composition of the corrosion products in the filament.

The aim of this investigation is to provide more information on the mechanism of filiform corrosion on aluminium using two complementary techniques: the scanning Kelvin probe (SKP) and the Fourier Transformed Infra-Red (FTIR) microspectroscopy.

SKP can provide information about the potential distribution during corrosion processes on both bare and coated metals with a spatial resolution of approximately 50 μm[4, 5]. Here, SKP measurements have been performed in order to identify the anodic and cathodic sites on filaments formed on coated aluminium during atmospheric exposure.

FTIR microspectroscopy permits the identification of thin surface films of corrosion products both under ex-situ and in-situ conditions[6]. As the spatial resolution is similar to the SKP, this technique has provided information on the composition of corrosion products formed in the head and in the tail of the filaments. Aluminium chloride and/or aluminium oxychloride was identified in the head. The tail was composed of an aluminium hydroxide gel containing carbonate.

References

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