Spatiotemporally resolved corrosion protection of AA2024-T3 by a lithium-based conversion layer

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Abstract

Lithium salts have been intensively investigated as a viable alternative in the development of environmentally friendly and sustainable corrosion inhibitors for the corrosion protection of aerospace aluminum alloys. Lithium ions are crucial in stabilizing the reaction products, leading to the formation of a protective multilayer structure. Prior studies have focused on studying the corrosion protection of the protective layer using traditional electrochemical methods. However, local electrochemical characteristics of its final spatially resolved protective behavior upon exposure to corrosive conditions were yet unknown.

Using Scanning Electrochemical Microscopy (SECM) and electrochemical noise (EN) measurements, complemented by FIB-SEM analysis, it was found that areas around intermetallic phases (IMPs) represented weak spots due to an insufficient generation of a protective inner dense layer. For the freshly formed conversion layer, both the top and the inner layer underwent a gradual dissolution upon exposure to a relatively dilute NaCl solution within 2 h due to their chemical instability. For the ambiently-aged conversion layer, most corrosion activity around IMPs was related to the S-phase and large constituent phases, due to their intrinsic electrochemical instability and inherently lower local conversion layer quality, respectively. Moreover, S-phase-related corrosion activity lasted approximately 8 h due to fast dealloying, whereas reactions induced by large constituent particles remained active over the entire re-immersion period of 12 h.

Keywords Lithium inhibitor, SECM, Electrochemical noise, Conversion layer

Reference

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