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Electrochemical study of the microbially-induced surface modifications on a 5083 aluminium alloy in marine environment

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Al-Mg alloys are commonly used in marine environment, even though they are susceptible to localized corrosion in such an aggressive environment. Therefore, anticorrosive coatings are used to improve their corrosion behavior. The present study is carried out as part of the ANR MICOATEC project selected in 2019; it ambitions to develop a new anticorrosive coating technology for metal protection based on a biomimetic strategy. In this framework, the modified surface due to the exposure of Al-Mg alloys to a marine environment has to be studied, and its electrochemical properties evaluated in order to check whether the modified surface can be considered as an efficient anticorrosive coating. This is the aim of the present work.

The material used in the present study is a 5083 aluminum alloy. It has been exposed to marine environment at GENES for different durations, i.e. 15 days, 1 and 2 months. The electrochemical properties of the modified surfaces, following the exposure to marine environment, were investigated by performing open circuit potential (OCP) measurements, polarization tests and electrochemical impedance spectroscopy (EIS) measurements. Two electrolytes were selected, i.e. a 0,5 M NaCl solution and a 10^{-1} M Na_2SO_4 + 10^{-3} M NaCl solution. Prior to each polarization test, a 30min exposure to the electrolyte at OCP was performed. Concerning EIS, measurements were performed after 1h, 24h, 72h, 168h, 240h, 288h and 350h of immersion.

Electrochemical tests were combined with surface observations and analyzes in order to correlate the electrochemical properties of the modified surface to its morphology and structure, by taking into account parameters such as the conditions and the duration of exposure to the marine environment. The final aim is to understand the mechanisms linked to the surface modifications and to assess the anticorrosion properties of these modified surfaces. This knowledge will be the basis needed to enable the artificial replication of the modified surface as an anti-corrosive coating.

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