The inhibiting action of different species on AA2024/graphite galvanic coupling models studied by SVET

Leonardo BERTOLUCCI COELHO[1], Marie-Georges OLIVIER[1]

[1] *University of Mons, Belgium*

Aluminium alloys and Carbon Fibre-Reinforced Polymers (CFRP) are among the most important aeronautical materials nowadays. However, the junction of both materials is frequently problematic due to the nobility disparity existing between aluminium and the carbon fibres [1,2]. Such multi-material assemblies create favourable conditions for galvanic corrosion, which can become a limiting factor in many complex aeronautical parts. With the recent advances of local electrochemical techniques, information regarding galvanic corrosion can be spatially resolved at micro scales. In particular, the Scanning Vibrating Electrode Technique (SVET) is presented as a monitoring approach suitable for galvanic coupling analyses [3,4,5,]. In parallel, aeronautics has an urgent interest in new corrosion inhibitors because of the environmental regulations concerning Cr(VI), whose use must be completely abolished starting from 2017 according to European directives.

In this work, SVET was employed in order to locally study the galvanic corrosion characteristics of AA2024/CFRP galvanic coupling. Two different AA2024/graphite galvanic coupling models were designed by exposing the cross sections of 1 mm thick AA2024 plates. The reason for employing bulk graphite electrodes rather than an actual CFRP material is that carbon fibres are typically 3 µm in diameter, being below the spatial resolution of SVET. Moreover, in case of modelling galvanic corrosion with CFRP, an uncertainty concerning the quantity of carbon fibres electrically connected to the alloy would make difficult the founding of a fair basis for comparison. One first model was constructed by mounting a graphite rod (3 mm in diameter) in parallel to an alloy plate (cut in 1 cm length), with a 2 mm gap between them. Next, considering that CFRP foils are typically a few hundred of microns thick, the second model made use of a 100 µm thick graphite foil in order to achieve a more realistic configuration. In this case, both the graphite foil and the AA2024 plate were cut in 0.5 cm length and were mounted in parallel to each other respecting a 1 mm gap. Then, the inhibitive effects brought by different inhibitor systems were evaluated in neutral aerated NaCl solutions.

Quantitative data obtained from SVET can be used to estimate inhibition efficiency and different approaches can be applied on this purpose. In the present case, the integration of cathodic current densities was performed from the experimental datain order to obtain the total cathodic current related to the graphite electrode. This total current was then used to calculate the inhibition efficiency obtained in the presence of different inhibitors.

[1] M. Serdechnova et al. Electrochem. Commun. 41 (2014) 51–54.

[2] H. Saadaoui, et al. Composites Part A. 32 (2001) 585 - 589.

[3] S. Kallip et al. Electrochem. Commun. 20 (2012) 101–104.

[4] A.C. Bastos et al. Port. Electrochim. Acta. 21 (2003) 371–387.

[5] L.B. Coelho et al. Corros. Sci. 110 (2016) 143–156.