INFLUENCE OF DIFFERENT PEO REGIMES AND SOL-GEL SEALING ON THE CORROSION RESISTANCE OF ALUMINIUM ALLOYS

José RAKOTONIRINA 1,2, Alex MONTAGNE 2, Marie-Georges OLIVIER 1

1. Materials Science Department, Faculty of Engineering, University of Mons, 20 Place du Parc, 7000 Mons, Belgium
2. LAMIH, CNRS, UMR 8201, Université Polytechnique Haut-de-France, 59313 Valenciennes, France

Plasma Electrolytic Oxidation (PEO) is primarily used as a surface treatment technique to improve the corrosion resistance and mechanical properties of aluminium alloys. This innovative and environmentally friendly process uses plasma micro-discharges, generated through the application of high current density in an electrolytic solution, to produce an oxide layer on the metallic surface. However, PEO coatings exhibit inherent porosity and micro-cracks, which can compromise both corrosion protection and mechanical durability. In this study, a pulsed bipolar DC generator was used to achieve two PEO regimes by controlling the ratio charge quantity (RCQ), defined as the ratio of positive to negative charge. The arc regime (RCQ > 1) resulted in rougher surfaces with larger pores and micro-cracks, while the soft regime (RCQ < 1) produced smoother, more uniform coatings with finer pores, which significantly influenced the sol-gel sealing process. The oxide layers were characterized using Scanning Electron Microscopy (SEM) and X-ray Diffraction (XRD), while its corrosion resistance was assessed by Electrochemical Impedance Spectroscopy (EIS). Despites the PEO coatings imperfections, optimizing electrical parameters and combining PEO with sol-gel treatments offer outstanding potential to enhance the corrosion resistance of aluminium alloys. Future research will investigate the hardness and wear resistance of the coatings.

Keywords: Aluminium alloys, Plasma Electrolytic Oxidation, Sol-gel

Acknowledgments

Authors gratefully acknowledge the financial support from both the University of Mons and the Université Polytechnique Haut-de-France.