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Ce post-treatment and aging time on the corrosion resistance of AA2024-T3 anodized in TSA and sealed with hybrid coatings

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Cr-based anodizing and surface treatments are the benchmark for protection of Al alloys in aircrafts. Despite self-healing properties and good corrosion resistance, chromate compounds are toxic for health and the environment; therefore, following other industrial sectors, the use of these chemicals for surface treatment will soon be prohibited in the aerospace industry. Anodizing in tartaric-sulfuric acid (TSA) is a promising environment compliant alternative, which is already being used at industrial level. However, the corrosion resistance of the anodized layer alone is not sufficient to guarantee the required safety levels for an aircraft and more complex systems should be employed. In this study, the corrosion resistance of AA2024-T3 specimens anodized in TSA and subsequently post-treated in a Ce-H2O2 solution and sealed by a hybrid sol–gel coating (3-glycidoxypropyltrimethoxysilane and tetraethoxysilane), with different hydrolysis solution aging time, was investigated by means of global (EIS) and local (LEIS) electrochemical impedance spectroscopy. The solution aging time was also studied by means of FTIR. EIS experiments demonstrated that the Ce post-treatment enhanced the performance of the sol-gel protection system; moreover, corrosion protection was enhanced with increased hydrolysis solution aging time and long-term corrosion protection was achieved for hydrolysis solution aged for up to six months. On the other hand, LEIS revealed self-healing ability for the Ce post-treated samples. The morphology of the sealed anodic films, their thicknesses and the Ce distribution after corrosion testing were evaluated by field emission scanning electron microscopy (FE-SEM). The relatively long shelf life of the hydrolysis solution is a good prospect for industrial use of the proposed treatment.