Enhancing Corrosion Resistance of Al-Mg Alloys through Biomineralization

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In recent decades, new emerging microbiological technologies have been studied, based on the recognition that microorganisms can inhibit corrosion by different mechanisms, the so-called MICI (microbiologically influenced corrosion inhibition), opening up different lines of research. In this context, biomineralization has been attracting the attention of researchers, with an increasing number of studies showing that different types of mineralized layers formed on metal surfaces can reduce the risk of corrosion.

In this framework, the MICOATEC project aims to study solutions based on mineralization influenced by marine microorganisms. Several AA5083 alloy samples were immersed at the Genoa Outdoor Experimental Marine Station (GEMS) for different periods of time and solar exposure (light and dark sides). Post-test characterization using a range of complementary techniques (SEM/EDX, XPS, ToF-SIMS) provided new insights into modifications of AA5083 surfaces. On the dark side, an Al/Mg oxide/hydroxide layer was formed, allowing Cl^- penetration. Pitting attack was observed after immersion. On the light side, a dual layer structure was formed, in which a hydrated Mg-rich outer layer with extracellular polymeric substances (EPS) on the top has proven to play a role in the corrosion inhibition process as a barrier to the penetration of Cl^-. A first assessment of the corrosion resistance properties was performed by a natural atmospheric exposure test (marine/industrial outdoor test site, Sines-Portugal) allowing to confirm that the dark side showed a more severe localized attack and that the hydrated Mg-rich outer layer naturally formed on the light side showed to improve the corrosion resistance. A comparative study of the corrosion resistance was performed using artificial salt fog test (ISO 9227) to assess the behaviour of hydrated Mg-rich biomineralized layer formed on Al-Mg surfaces versus commercial conversion treatments. After 1000 hours of test, the Al-Mg samples with the biomineralized layer showed no significant degradation.

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