

Marine biomineralization as MICI process.

A basis for new anticorrosion surface treatments

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The development of sustainable corrosion protection strategies is a major challenge in materials engineering, particularly for metallic structures exposed to marine environments. While microorganisms are traditionally regarded as contributors to corrosion processes, their potential role in Microbiologically Influenced Corrosion Inhibition (MICI) remains largely underexplored. The objective of this presentation is to highlight the potential of MICI mechanisms as a novel pathway for corrosion protection solutions, with particular emphasis on biomineralization processes.

After a brief overview of MICI concepts and the biological mechanisms involved in corrosion inhibition, selected examples of research lines developed in this field will be presented. Special attention will be given to marine biomineralization phenomena, which emerge as key mechanisms enabling the development of stable and protective interfacial layers on metallic substrates, thereby improving the corrosion resistance.

The presentation will then focus on our own work, addressing the influence of marine microbiological activity on the corrosion behaviour of the AA5083 aluminium alloy. Experimental results obtained under natural marine exposure conditions show that the presence of marine microbial communities is associated with the development of a surface layer that modifies the corrosion behaviour of the alloy. The results indicate that extracellular polymeric substances enriched in sulfated polysaccharides produced by marine algae contribute to the formation of mineral phases such as layered double hydroxides. The combined presence of biological material and mineral compounds leads to the formation of an organic–inorganic layer which correlates with a measurable improvement in corrosion resistance.

This work provides experimental evidence that marine microorganisms may be exploited as functional contributors to corrosion protection, rather than being exclusively associated with detrimental effects. By integrating materials science, microbiology, and surface engineering, the study outlines a multidisciplinary approach that may enable the development of bio-inspired and potentially sustainable surface corrosion protection strategies.

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