Innovative strategies for the corrosion inhibition in metal artefacts and concrete monuments

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The degradation processes that typically occur in unique and valuable artefacts and monuments can irreversibly compromise their conservation status and modify their appearance due to the formation of alteration products and reactive compounds. The preservation of cultural heritage still represents a critical issue and the development of high-performance materials that satisfy the demanding requirements related to environmental sustainability and cost-effectiveness is a serious challenge for the scientific community.

At present, concerns related to the degradation of both ancient and modern copper-based works of art are still relevant and the most effective protective materials are commonly based on the use of toxic corrosion inhibitors and large amounts of harmful organic solvents for their application and removal. Therefore, innovative approaches to fulfil the protective, aesthetic and safety requirements are demanding.

In this context, within the EU H2020 Nanorestart project “NANOmaterials for the REStoration of works of ART”, we have focused our attention on the development of smart nanostructured coatings able to provide an “active” protection of modern metal works of art and easy to be applied and removed by using not toxic water-based solvents. To achieve a long-lasting and safe protection, we have developed innovative coatings based on environmentally friendly polymers and stimuli responsive nanocontainers for a tailored release of the corrosion inhibitors. Thanks to their superior performance with respect to commercial benchmarks, the developed materials have been applied on real works of art in collaboration with Peggy Guggenheim conservators.

A similar approach based on smart nanocarriers will be applied to the conservation of concrete monuments within the EU H2020 InnovaConcrete project “Innovative materials and techniques for the conservation of 20th century concrete-based cultural heritage”. Corrosion inhibitors, properly selected to protect the steel bars, have been confined into nanocarriers in order to be released under stimuli related to corrosion processes occurring in reinforced concrete. To achieve a long-lasting protective efficacy, these nanocarriers acting as a inhibitor reservoir will be incorporated into appropriate consolidants thus producing innovative multifunctional protective systems.

After validation at laboratory scale, the InnovaConcrete products will be applied and validated on XX century concrete monuments identified as representative case studies.