

An in-depth approach for studying the interactions between metal surfaces and protecting materials in cultural heritage applications

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The development of novel protective materials for metal artworks requires careful evaluation of their interactions with the metal surface. Beyond the degradation caused by environmental pollutants and degrading airborne species, the application of conservation materials can sometimes provoke unwanted chromatic discoloration due to the stability loss of the coatings. This can detrimentally affect the aesthetic integrity of precious artworks. Therefore, evaluation tests must be properly designed to assess the full range of interactions between metals and protective systems over both the short and the long term.

Here, we propose a methodological overview for evaluating interactions between metal surfaces and protective coatings or corrosion inhibitors. Specifically, we present the different information on the coatings performances that can be obtained from accelerated and natural ageing treatments, highlighting their respective strengths and limitations in simulating the indoor degrading environment to which artifacts are subjected in museums or storage rooms [1,2]. We address the challenge of how to effectively reproduce in short-term laboratory experiments the material interactions that occur in the long-term. Furthermore, we briefly illustrate the role of immersion treatments as a rapid and effective method to acquire supplementary data, complementing the information derived from traditional electrochemical measurements, particularly when assessing the performance of corrosion inhibitors on bronze surfaces.

The information obtained with the previous experiments was used to optimize the formulation of a novel class of protective coatings. These waterborne formulations are based on biopolymers from waste products and are specifically designed to align with the principles of green chemistry and to substitute hazardous materials traditionally used in conservation. The results from our specifically designed tests allowed us to develop transparent coatings with enhanced anticorrosion properties, capable of protecting metal surfaces from indoor degradation in the long-term.

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[2] C. Giuliani, M. Pascucci, C. Riccucci, E. Messina, M. Salzano de Luna, M. Lavorgna, G.M. Ingo and G. Di Carlo, *Prog. Org. Coat.*, 122, 138 (2018).