Crosslinked Monolayers for Enhanced Corrosion Protection of Bronze and Its Patina

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Bronze artifacts often develop natural or artificially applied patinas that serve both decorative and protective functions. However, these layers remain vulnerable to degradation in polluted environments, leading to surface damage and aesthetic loss. Conventional protective coatings often fail to provide a balance between environmental compatibility and long-term performance. This study explores an alternative corrosion protection strategy based on self-assembled monolayers (SAMs) of behenic acid and their transformation into polymer nanocoatings (PNCs) via gamma-induced crosslinking[1]. The coatings were applied to bronze and chemically prepared patinas based on formulations used for regional bronze sculptures.

A multidisciplinary characterization approach was employed, combining spectroscopy (FTIR-ATR, Raman), microscopy (SEM-EDS, metallography), electrochemical testing (EIS, Tafel analysis), contact angle measurements, and visual assessment (colorimetry). The patinas were structurally distinct, dominated by Cu_7S_4 or mixed copper chlorides (atacamite/paratacamite). Electrochemical studies were conducted on freshly prepared and UV-aged samples. SAM coatings initially reduced corrosion rates across all sample types but lost effectiveness over time due to molecular desorption. In contrast, crosslinked PNCs exhibited long-term protective performance with minimal electrochemical degradation. The same coatings were also applied to ancient Roman coins, with surface behavior confirmed by colorimetry and contact angle measurements.

1. K. Marušić, E. Pezić, N. Matijaković Mlinarić, P. Dubček, J. Sancho-Parramon, D. Kralj, B. Mihaljević, *Small,* **2023**, 19/30, 2301104.