Surface Evolution and Hydrophobicity of Sulphide Patinas on Bronze: Linking Chemistry, Morphology, and Corrosion Behavior

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Over time, changes in the hydrophobicity of sulphide patinas on bronze, produced by the torch application of potassium sulphide to achieve a brown color, have been observed. This study aims to explore the relationship between corrosion protection, surface wettability, and the morphology of corrosion products.

Natural patinas formed through long-term atmospheric exposure are typically porous and hydrophilic, particularly when they contain basic copper sulfates or chlorides. In contrast, artificial patinas produced under controlled conditions can be tailored in composition and structure, resulting in variable contact angles and surface properties.

Two bronze alloys of different compositions were examined. Potassium sulphide was applied using the same process to ensure consistency. Patina properties were monitored over a six-month period.

Corrosion potential and polarization resistance were measured monthly, along with contact angle assessments. During most significant changes, field-emission scanning electron microscopy with identical location spectroscopy was conducted to observe surface evolution.

X-Ray diffraction Pattern analysis and Time-of-Flight Secondary Ion Mass Spectrometry (ToF-SIMS) were employed to provide additional insights into the formed surface's properties. Surface changes were examined during patina formation and after one week of exposure to a controlled laboratory environment, to investigate whether carbonate species contribute to increased hydrophobicity in aged patinas.

The work presents a detailed analysis of the interrelations between surface roughness, environmental conditions, patina morphology, electrochemical behavior, and the chemical composition of the topmost layer on the bronze sulfide patina.