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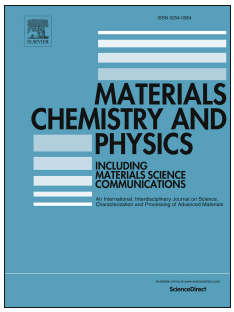

Characterisation of typical patinas simulating bronze corrosion in outdoor conditions

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Characterisation of typical patinas simulating bronze corrosion in outdoor conditions

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Abstract

In order to bring the treatment of historical bronze monuments in line with proper engineering practice and cultural heritage regulations, the standardisation of artificially aged surfaces that are comparable with natural ones is still to take place. In this aim, this investigation reports a comparative study of corroded quaternary bronze samples produced by accelerated ageing tests, simulating the unsheltered and sheltered exposure conditions mainly affecting outdoor bronze monuments. The effects of run off in a dropping test (unsheltered simulation) and the exposure to stagnant acid rain in a wet & dry test (sheltered simulation) on a bronze surface were studied. A multi-analytical approach was performed including conventional analytical methods, such as a microscopy examination coupled with elemental and structural analyses of the surface. In addition, a focused ion beam (FIB) was used to produce cross-sections in the size range up to a few tens of nanometres. It is evidenced that the corrosion layers, forming a nano-porous structure, are linked to a decuprification process marked by the preferential dissolution of Cu and Zn and the formation of a Sn-O species network within the barrier layer. A correlation between the tin content of the alloy and the corrosion amplitude is shown: the anodic areas are related to the lowest tin-content part of the alpha phase (in the centre of the

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