Study on Layered Corrosion Structure of Bronze Artifacts: A Case study of Bronze objects from Yejiashan Cemetery in Hubei Province, China

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Bronze artifacts are subjected to various environmental factors during the prolonged burial process, resulting in a continuous corrosion process and the formation of a corrosion layer on their surfaces with a highly complex structure. This layered corrosion structure can vary depending on factors, such as the burial environment, the alloy composition of the bronze, and the casting microstructure. Different corrosion structures can exhibit distinct protective or detrimental effects on the metallic substrate of bronze objects. Therefore, studying the corrosion structure of bronze artifacts is crucial for assessing their stability and evaluating their preservation condition. This study first summarizes the main types and general patterns of layered corrosion structures in bronze artifacts based on the literatures[1-3]. Then bronze artifacts excavated from *Yejiashan* Cemetery, Suizhou city, Hubei province, were investigated as a case study. The corrosion structures of the bronze artifacts from *Yejiashan* were examined using optical microscopy, scanning electron microscopy-energy dispersive X-ray spectroscopy, Raman spectroscopy and X-ray diffraction. The results indicated the presence of two types of corrosion structures. Type I corresponds to a four-layered structure including an external layer, a non-metallic layer, an altered layer and an intergranular corroded layer, with the original surface preserved. The thickness of the non-metallic layer ranges from 8 to 57μm，and the pseudocrystals of the alloy can be observed on the surface. The main components of this layer are tin oxide and some copper salts. In the altered layer, the α phase corroded preferentially and (α+δ)

eutectoid was preserved. Type Ⅱ consists of two layers with a light green outer layer and red-brown or green and blue inner layer. The original surface has been destroyed. The major corrosion products include tin oxide, malachite, azurite and cuprite. The formation mechanisms of the two types of corrosion structures are also discussed.

Keywords bronze artifacts, layered corrosion structure, Yejiashan, SnO_2, corrosion nodule

Reference

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