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When a copper-based artefact is buried in soil for a long time, the result is a corrosion patina characterised by complex chemical and metallurgical structures [1]. The study of these patinas requires the combination of several analytical techniques to characterise the corrosion products and to identify the degradation phenomena that have occurred during burial [2-3]. As a matter of facts, the interaction of the metallic artefacts with the archaeological environment plays an important role in the corrosion rate. Among the most widespread analytical techniques, non-destructive methods represent a very important tool for conservators and art historians to obtain valuable information about works of art without being too invasive. In the last decades, neutron imaging techniques have acquired great importance thanks to the results obtained in the Cultural Heritage field.
In this study, several artificially patinated Cu-based alloys with composition and microstructure like the one of archaeological artefacts were prepared in laboratory with the aim of providing a reference for neutron imaging. Firstly, several ingots with defined compositions (Cu-Zn, Cu-Sn, Cu-Sn-Pb) were prepared in laboratory. The final chemical composition was confirmed by Optical Emission Spectroscopy (OES) analysis. Afterwards, artificial patinas were produced on the samples surface by means of different chemical and electrochemical methods. The morphological and chemical characterisation of the artificial patinas was performed using Raman spectroscopy, X-ray diffraction (XRD) and Scanning Electron Microscopy (SEM). Finally, the samples were analysed with neutron imaging techniques (digital radiography and computed tomography). The aim of these measurements is to estimate the specific attenuation coefficient value and its spatial distribution in the samples, distinguishing between the alloy (inner part) and the patina (external part) which potentially have different density and composition in different areas. The goal is to determine the nature and properties of archaeological artefacts of unknown structure using the data obtained by analysing the Cu-based reference alloys. All neutron analyses were performed at the L.E.N.A. Centre in Pavia, where a thermal neutron reactor is available and a new facility for imaging studies has been recently developed in the framework of the CHNet-NICHE project and is currently under optimisation.

References

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