

## **Micro-XRF analysis of metal alloys: From the laboratory calibration towards in-situ analyses**

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Handheld or mobile XRF spectrometers are employed as a routine analytical tool in the most of the museum conservation laboratories for performing non-invasive analyses. In particular, the micro-XRF analysis of metal artefacts utilizing exciting x-ray beams with spot sizes at the range of about 50-100 micrometers presents features that comply with certain requirements, namely minimum intervention (if necessary) on the surface and the possibility to characterize small decoration features or very localized regions, such as solderings, elucidating thus the manufacturing process. Moreover, the contribution to the diagnosis of surface alteration products offers invaluable help to the implementation of conservation practices. However, the rapid evolution of micro-XRF spectrometry applications was not followed with adequate standardization of the technique in terms of the calibration, the operating-measurement procedures and in general of best practices. In mobile micro- and milli-probe XRF analysis of metal alloys the precision and accuracy in the quantitative analysis or the influence of the heterogeneity and polycrystalline texture of metal alloys, are issues still open for discussion and consideration<sup>1,2</sup>.

Applications from in-situ XRF campaigns conducted by INP-Demokritos at various Mediterranean museums' metal collections<sup>2</sup> (Palace Armoury Museum in Malta, Damascus Archaeological Museum in Syria, Yarmouk University in Jordan and the Ancient Messene museum in Greece), but also by the IAEA Seibersdorf laboratories in cooperation with the Kunsthistorisches Museum (KHM) and Vienna University of Technology will be presented<sup>3</sup>. Questions related to the raw metal composition, manufacturing process (gilding, surface decoration and finishing), type and distribution of corrosion products were addressed in these studies. Laboratory calibration measurements provided optimization of the measuring conditions, whereas a Fundamental Parameter (FP) based approach was developed for the quantification accounting properly for the x-ray lens transmission efficiency. Finally, simple empirical quantification schemes have been also studied and evaluated for certain type of alloys (like the Cu-Sn binary alloys), in order to assess to which extent a standardized procedure is applicable in quantitative XRF analysis.

### **References**

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