

X-ray absorption spectroscopy and archaeological materials

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X-ray absorption spectroscopy (XAS) is a powerful tool in materials science for determining local atomic structure and chemistry. It can equally well be applied to ancient materials to better understand their manufacture and preservation. A review of recent XAS studies is presented, illustrating the use of soft and hard x-ray spectroscopy at *L* and *K* absorption edges to elucidate archaeological problems.

Copper based salts have been used throughout islamic and medieval periods to create gold like lustre finishes on ceramic goods. X-ray spectroscopy at the copper *K*-edge has been used to identify copper oxidation and the ratio of copper metal to oxide as a function of copper/silver content. The technique can be applied to both genuine artifacts and modern reproductions, enabling tests to be performed to verify the original manufacture process and the chemistry involved^[1]. Using microfocussed beams has enabled these measurements to be made across the pattern of particular decorations, yielding information on the natural variation of the decoration.

Iron based black gloss ceramics predate the copper lustreware, and was much in evidence in ancient Greece. Soft X-ray XAS at the Fe *L*-edge has been used to highlight the different oxidation states evident in different finishes of black gloss. Comparisons with reference spectra of known oxidation state has enabled grouping of artifacts of similar appearance and provided insights into their respective provenances^[2].

Waterlogged archaeological wood is known to contain relatively large quantities of sulphur. Without proper treatment this sulphur can be catalysed to acid, with obvious damaging consequences. Whilst the pathway for this reaction is not yet well understood, x-ray spectroscopy of the S *K*-edge is proving important in determining the oxidation state of sulphur in recovered timbers from vessels such as the Mary Rose^[3].

References

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