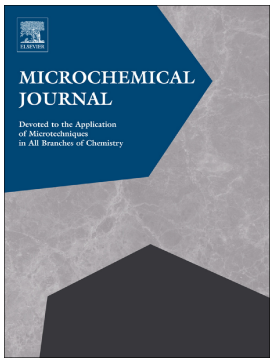

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A novelty for Cultural Heritage material analysis: Transmission Electron Microscope (TEM) 3D Electron Diffraction Tomography applied to Roman glass *tesserae*

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Abstract

We present a novel electron diffraction technique (Automated precession 3D diffraction tomography - ADT) based on a Transmission Electron microscope (TEM) to precisely determine unit cell parameters, Space Group symmetry and atomic structure of various pigment /opacifier crystallites of submicron dimensions and commonly present in colored Roman glass *tesserae*. Such technique can operate at nanometer scale and it is possible to distinguish even between mineralogical phases of similar/same chemical composition, but different crystal structures.

Keywords: Electron Diffraction Tomography, Precession Electron Diffraction, Electron Crystallography, TEM, glass *tesserae*, opacifiers

1. Introduction

The scientific study of colors and constituent materials in ancient glasses,ceramics , decorated pottery etc., is an issue of great importance in archaeometric research due to its association with manufacturing and production information and finally to the so-called *chaîne opératoire* choices and processes.

To tackle the above issues, the field of archaeometry makes use of the analytical information of an array of instrumentations, (e.g. X-Ray Fluorescence (XRF), Raman spectroscopy, X-Ray Diffraction (XRD), Secondary Image Mass Spectrometry (SIMS) or Electron Probe Microscopy Analysis (EPMA)); in all such techniques when the research aims are towards the study of the various phases and their association to the final coloration there is lack of straightforward answers due to the complexity and heterogeneity of the historical materials exhibit. All the previous mentioned analytical techniques operate only at 1-0.3 micron resolution scale, where the acquired data are usually not conclusive due to the possible co-existence of many (nm size) phases present and probably interfering within the analyzed (micron size) volume; as a result, data/signals coming from a particular crystal location may in fact be influenced from a number of other surrounding crystals contribution.