

**Non-invasive analysis of archaeological glass:**  
study of composition and degradation through optical and  
thermography analyses

Francesca Micheletti<sup>1</sup>, Jacopo Orsilli<sup>1</sup>, Jacopo Melada<sup>2</sup>, Nicola Ludwig<sup>2</sup>,  
Marco Gargano<sup>2</sup>, Letizia Bonizzoni<sup>2</sup>

<sup>1</sup> *Master in conservation science for cultural heritage, Università degli Studi di Milano,  
via Mangiagalli 34, 20133 Milano (Italy)*

<sup>2</sup> *Dipartimento di Fisica Aldo Pontremoli, Università degli Studi di Milano, via Celoria  
16, 20133 Milano (Italy)*

Keywords: Roman glass, infrared thermography, XRF, FORS, glass degradation

Although glass is generally considered a stable material, after being buried for several centuries archaeological glass can show alteration and degradation patterns. An example is the presence of iridescent portions, mostly due to the interaction between the outer layers of the glass and the moisture present in the soil.

The research is focused on the study of an entire collection of I and II century AD Roman glasses held by Museo Civico Etnografico Archeologico Fanchini of Oleggio, Italy.

Chemical characterization (namely flux, chromophores and opacifiers determination) has been performed by a combination of X-Ray Fluorescence (XRF) and Fiber Optics Reflectance Spectroscopy (FORS) in the UV–Vis–NIR region.

Among the vessels, two samples show the typical iridescent patinas and Infra-Red Thermography (IRT) has allowed the mapping of these degraded areas. This IRT analysis has been applied following the active thermography approach, heating the vessels for a relatively short time using flash lamps (Pulsed Thermography). The flakes on the surface of the glass appear as thermal anomalies in response to the application of the thermal excitation pulse. In order to enhance the differences between the thermal anomalies and the undamaged glass, the thermogram sequences have been processed by high order statistical analysis. Its output is a single representative image (a skewnessgram or a kurtogram) which effectively allows the identification and the mapping of the degraded areas.

Name: Francesca Micheletti      Email: francesca.micheletti1@studenti.unimi.it