Art materials through the spectroscopic looking glass

Demetrios Anglos

Department of Chemistry, University of Crete and IESL-FORTH
anglos@chemistry.uoc.gr

The study and conservation of works of art and antiquities are essential for knowing, understanding and preserving our cultural heritage (CH). From the scientific standpoint, a meaningful study of CH objects relies largely on our capabilities to determine the composition of composite materials, understand corrosion or degradation processes and apply efficient conservation treatments. And as it turns out, this is a highly challenging task, considering the inherently complex, multi-component nature of materials in such objects, which calls for elaborate and quite often case-specific analysis and conservation procedures. Furthermore, given the value and sensitivity of works of art, analysis needs to be carried out in as non-invasive a manner as possible, often directly on the object itself or, in certain cases, on increasingly small samples.

In recent years, analytical spectroscopies based on the use of laser sources have been proven capable to illuminate complex diagnostic problems. By tuning the wavelength of the laser source and/or by controlling the flux of photons it is possible to realize many different types of light-matter interactions and therefore to probe the composition of materials from different perspectives. Linear and non-linear spectroscopies, remote sensing methods and laser-assisted sampling-excitation schemes evidence the versatility offered by laser sources. To illustrate how art materials can be looked at through the spectroscopic "looking glass", examples will be described from the use of two straightforward analytical methods: Laser-induced breakdown spectroscopy (LIBS) and Raman microscopy. Emphasis will be placed on the development of mobile and hybrid instrumentation that permit the collection of enhanced analytical information as well as access to highly valued artworks and objects in museums or excavation sites.

References

1. "Lasers in the analysis of cultural heritage materials " D. Anglos, S. Georgiou, C. Fotakis, *Journal of Nano Research* **8**, 47-60 (2009)
2. "Studying pigments on painted plaster in Minoan, Roman and Early Byzantine Crete. A multi-analytical technique approach" P. Westlake, P. Siozos, A. Philippidis, Ch. Apostolaki, B. Derham, A. Terlixi, V. Perdikatsis, R. Jones, D. Anglos *Analytical Bioanalytical Chemistry*, **402**, 1413-1432 (2012); doi: 10.1007/s00216-011-5281-z
3. "Adapting and testing a portable Raman spectrometer for SERS analysis of amino acids and small peptides" A. Brambilla, A. Philippidis, A. Nevin, D. Comelli, G. Valentini, D. Anglos, *J. Molec. Structure* **1044**, 121-127 (2013); dx.doi.org/10.1016/j.molstruc.2012.12.060
4. "Comparative Study of Laser Induced Breakdown Spectroscopy and Mass Spectrometry for the Analysis of Cultural Heritage Materials" O. Kokkinaki, C. Mihesan, M. Velegrakis, D. Anglos, *J. Molec. Structure* **1044**, 160-166 (2013); dx.doi.org/10.1016/j.molstruc.2013.01.069