

Evaluating Laser Cleaning Tests on A Polychrome Wooden Sculpture: Optical Microscopy, Spectroscopic and Chromatographic Techniques

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Abstract

The detailed knowledge of artwork materials, their technology and preservation condition is crucial for any restoration practice. This study presents the preliminary analysis and the initial results of a series laser cleaning studies aiming to remove the outermost surface of oxidized varnish layers from a polychrome carved wooden fragment of a Post-Byzantine temple (18th c. BC). The wooden support is covered with ground layer that carries the paint layer. Gold leaf has also been used to decorate specific areas. The systematic analysis of the painting technique and the materials involved was conducted using optical microscopy (VLM staining and FLM), laser-induced background spectroscopy (LIBS), FTIR spectroscopy and chromatographic techniques (Gas Chromatography and HPLC).

A thorough study on cross sections of the various layers found on the wooden surface under the OM indicated the presence of an off-white ground layer, a blue paint layer and a green-tinted varnish layer. FLM observation and staining of cross-sections revealed the existence of two varnish layers, and the presence of proteinaceous and oil-based materials in the ground and paint layer.

LIBS analysis identified the paint materials and indicated the presence of aluminosilicates in the calcium based support. Triterpenic resin, gypsum, aluminosilicates with small quantities of protein-based material, and Prussian blue with lead white and proteinaceous material were traced by means of FTIR spectroscopy, while HPLC-fluo analysis detected proteinaceous material corresponding to egg yolk in the binding medium of the paint layer. FTIR spectroscopy and Gas Chromatography, confirmed the presence of diterpenic and triterpenic (possibly mastic) resins, with moderate amounts of oxidized components, in the varnish layer.

Preliminary laser cleaning trials were performed aiming at establishing the optimum parameters for the removal of the outermost layers of the oxidized varnish. Tests were carried out using a KrF Excimer laser emitting at 248nm (of ns pulse duration). OM confirmed the controlled removal of the outermost surface of the varnish layer while the detection of oxidation products of the diterpenic component of the resinous material with GC analysis stimulated further studies in order to explain this observation.

The synergistic use of microscopic examination and physicochemical analysis provided an efficient means for the characterization of the materials and the evaluation of the laser cleaning tests of the oxidized varnish layers. The complementary use of these techniques will be presented with emphasis on the understanding of the possible physicochemical changes that may be induced due to laser irradiation.

Keywords: laser cleaning; polychrome object;