

Rapid analysis of marble treatments by laser induced fluorescence

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Abstract

Nowadays scientific study of Cultural Heritage accompanies most of the time historical artistic evaluation and an assessment of the conservation state by humanistic experts and restorers. Several laboratory methods with high sensitivity are well established (ICP-MS, FTIR,...), and many methods for in situ rough characterization of large surface are widely diffused (thermovision, UV photography,...), in addition to instrumentation for punctual analysis to be applied also in field (XRF, colorimetry, ...). However, the request for systems that can provide rapid detailed characterization on large surface in any storage conditions is still a hot topic. This is combined with the ever-increasing demand for digital material for documentation, fruition and study. Laser-based systems, and in particular LIF (Laser Induced Fluorescence), LIBS (Laser Induced Breakdown Spectroscopy) and Raman spectroscopy, due to the characteristics of these sources and the detectors to which they can be coupled, respond well to these needs. The TECFIS-DIM (Diagnostic and Metrology) Laboratory of the ENEA center of Frascati (Rome, Italy) in the last decade has put an effort to develop more and more compact and efficient laser systems for in situ material characterization on cultural heritage surfaces. Here two prototypal LIF systems have been used to characterize marble surfaces treated with ancient and modern materials and a rapid recognition and mapping method has been developed and tested thanks to the individuation of discriminant spectral features. Results are reported on test samples created in lab with known substances and *in situ* on real artworks.

Keywords

Laser spectroscopies, Laser Induced Fluorescence (LIF), marble, patinas, polymers

1. Introduction

Stone, and in particular marble, is among the most widespread materials for the production of cultural and archaeological heritage, dating back to the ancient world as well as to the Renaissance and even to more recent eras, particularly in the Mediterranean basin.

The most frequent problems and questions related to this kind of heritage are the individuation and the characterization of the original constituting materials, of the eventual surface treatments (intended to chemically modify the surface of the substrate) and patinas (ancient and modern), early diagnosis on bio-attacks and their classification and an evaluation of the state of health of the artifacts (1). Broad spectrum diagnostic techniques are, then, required. Spectroscopic methods assume in this frame a prominent role, due to their non-invasiveness and versatility (2) (3) (4). In particular, laser techniques in last decades have been