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Spectral database of Renaissance fresco pigments by LIBS, LIF and colorimetry

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The fast analysis and recognition of fresco pigments by optical methods that are non destructive or with very low invasiveness is an important issue. In fact, the more information on surface materials of a fresco are given to the restorers, the better the restoration works can be carried out. In particular, the used pigments, the followed procedure and eventual successive application of consolidants or modern pigments are the most enquired queries that chemists and physicists receive from art historians, archaeologists and restorers for dating, assignment and investigation of ancient artworks. During the last decade laser techniques, as Laser Induced Breakdown Spectroscopy (LIBS) and Laser Induced Fluorescence (LIF), have been recognized as unique tools for Cultural Heritage study mainly due to the offered advantages of in situ applicability, capability of remote analysis, of minimum or no invasiveness, and as far as LIBS is concerned, possibility to perform surface and stratigraphic analysis with high sensitivity for a very large number of elements, including light atoms. In the present work, a set of about 60 fresco samples made with pigments and binders typical of the Renaissance period in Rome has been characterized by LIBS, LIF and colorimetric measurements in order to build as much as possible a complete database. With the main goal to provide the restorers and art historians with a useful tool for the study of ancient frescoes, the samples have been made in agreement with the Cennino Cennini recipes for both materials and procedures. In particular, much attention has been paid to the geographic origin and chemical composition of plaster (intonachino) and pigment components. LIBS measurements have been carried out at 1064 nm, while LIF ones have been performed using two wavelengths (355 and 266 nm), in order to compare the different induced fluorescence emissions. Afterwards, the obtained spectral data have been processed by means of multivariate analysis methods in order to find the most significant features that can help in fast characterization and recognition of real unknown specimens. The simultaneous use of these various diagnostic techniques is essential in order to obtain a sharper interpretation of the results, as for instance, the certain recognition of different pigments related to their chemical classes that a colorimetric response couldn't definitely give by itself. Moreover, the concurrent optic techniques have given the possibility to extract the various spectral responses either due to the interaction between pigments and binders, or due to the mix of the same pigments at several concentrations.

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