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A NEW MINIATURIZED NEAR INFRARED SPECTROMETER FOR ON-SITE CULTURAL HERITAGE INVESTIGATIONS

G. Sciutto[1], E. Catelli[1], S. Prati[1], M. Valente[1], L. Gatti[1], E. Genorini[2], R. Mazzeo[1]

[1]*Microchemistry and Microscopy Art Diagnostic Laboratory, Department of Chemistry, University of Bologna, Ravenna, Italy*
[2]*VIAVI Solutions Italia SRL, Monza, Italy*

In the last decades, the technology of near infrared (NIR) spectrometers has grown rapidly by moving from laboratory benchtop instruments to portable devices that can be used on site. Subsequently, NIR spectroscopy has acquired increasing interest as a diagnostic tool for the non-invasive study of works of art in art galleries or museums, thus avoiding the movement of precious and fragile objects. However, the scenario of applications of NIR spectroscopy for the study of heritage objects are still wide and poorly explored. One of the most fascinating perspectives is the development of new compact systems for easy use on site also by conservators and restores. The miniaturization and cost reduction of spectrometers responds to end-user and producers' inquiries and are showing great potential to open new research topics in analytical technologies.
In the present research a new miniaturized NIR spectrometer prototype was proposed and evaluated for the characterization of different cultural heritage materials, such as paintings, bronze patinas, archaeological bones and cinematographic films. The NIR prototype system enables rapid information acquisition to guide restoration strategies, which must be supported in real time by quick and easy analytical procedures. Appropriate reflectance spectral databases, as well as tailor-made chemometric methods for classification and identification of materials, were implemented.
Among others, results show that the system, together with a multivariate analysis of spectroscopic data, is a reliable and fast method for the analytical characterization of historical film bases. The cinematographic films are constituted in general terms by a transparent polymeric base (consisting of cellulose nitrate, cellulose acetate or polyethylene terephthalate), whose correct identification is of fundamental importance to select the appropriate storage conditions.
The spectrometer has also been shown to be effective for the preliminary identification of collagen in bones. Indeed, rapid and non-invasive screening methods are usually needed to detect collagen in bones before being subjected to proteomic, radiocarbon and isotopic analyses to obtained information on identity, period, and diet/environment of ancient population and animal species.