Article

Hyperspectral Imaging as Powerful Technique for Investigating the Stability of Painting Samples

Giuseppe Bonifazi [1] , **Giuseppe Capobianco** [1] , **Claudia Pelosi** [2,*] and **Silvia Serranti** [1]

[1] Department of Chemical Engineering Materials & Environment, Sapienza, Rome University, Via Eudossiana 18, 00184 Rome, Italy; giuseppe.bonifazi@uniroma1.it (G.B.); giuseppe.capobianco@uniroma1.it (G.C.); silvia.serranti@uniroma1.it (S.S.)

[2] Department of Economics, Engineering, Society and Business Organization, Laboratory of Diagnostics and Materials Science, University of Tuscia, Largo dell'Università, 01100 Viterbo, Italy

* Correspondence: pelosi@unitus.it; Tel.: +39-0761-357673

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Abstract: The aim of this work is to present the utilization of Hyperspectral Imaging for studying the stability of painting samples to simulated solar radiation, in order to evaluate their use in the restoration field. In particular, ready-to-use commercial watercolours and powder pigments were tested, with these last ones being prepared for the experimental by gum Arabic in order to propose a possible substitute for traditional reintegration materials. Samples were investigated through Hyperspectral Imaging in the short wave infrared range before and after artificial ageing procedure performed in Solar Box chamber under controlled conditions. Data were treated and elaborated in order to evaluate the sensitivity of the Hyperspectral Imaging technique to identify the variations on paint layers, induced by photo-degradation, before they could be detected by eye. Furthermore, a supervised classification method for monitoring the painted surface changes, adopting a multivariate approach was successfully applied.

Keywords: Hyperspectral imaging; painting samples; retouching pigments; watercolours; multivariate analysis

1. Introduction

Hyperspectral imaging (HSI) is a diagnostic tool deserving great interest in the field of cultural heritage due to its non-invasive character and to the possibility of obtaining a lot of information with a single technique [1–3]. If coupled with chemometric techniques, it allows for gathering qualitative and/or quantitative information on the nature and physical-chemical characteristics of the investigated materials, and to combine imaging with spectroscopy for evaluating the distribution of materials on the surfaces [4–9]. By using classification methods, already applied in other research fields, it is possible to create a predictive model that is able to identify little variations of the painting layers due to the degradation phenomena of the constituent materials [10–15]. In conservation of cultural heritage, these classification methods could have great relevance because they allow to monitor in real time the surface changes by observing the spectra variation in respect to the calibration dataset. For these reasons, in the present work, HSI was applied with the aims to evaluate the sensitivity of the technique in order to identify the variations on paint layers, induced by photo-degradation, before they could be observed by eye and to use, following a multivariate based approach, the supervised classification methods for monitoring the painted surface changes [8,9]. As paint samples, a set of commercial watercolours was chosen together with various powder pigments, mainly iron oxide based materials, which were mixed with gum Arabic, without any additive, in order to verify their possible use in painting retouching. Iron oxide based pigments were chosen, as they are stable and widely used for