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St. Petersburg, Russia, June 25–29, 2012

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15TH INTERNATIONAL CONFERENCE ON LASER OPTICS

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LASER INDUCED FLUORESCENCES APPLICATION TO THE ANALYSIS OF CRUST IN MONUMENTS

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The laser induced fluorescence (LIF) technique has been already proved to be a powerful diagnostic tool for artworks. The aim of this work is to validate LIF measurements to detect the different detrimental effects of the environmental conditions on the materials and to discriminate among biofilms from microorganisms and crust from smog or pollutants, in order to optimize the restorers interventions.

In this work, the LIF spectroscopy has been employed to analyze stony materials of interest for cultural heritage and the performances of this technique as diagnostic tool for this kind of material have been investigated. To this aim, several samples of different materials like stones coming from the Cathedral of Seville, different Churches and Civil Buildings of particular interest for cultural heritage have been collected. The scanning LIF system developed at the ENEA of Frascati has been used to analyse the samples. The experimental conditions have been chosen based on previous laboratory and field experiences and the measurements have been carried out on the specimens by means of 266 nm excitation wavelength.

The line scanning system has operated in two operating mode: reflectance and fluorescence. Reflectance measurements are made by performing a scan while the laser is off and the sample is exposed to the light emitted by a NIST traceable lamp The result gives for each pixel of the scanned area the reflectance spectrum, from which the CIE/lab coordinates can be computed once the system is calibrated against a reference surface. The samples were placed on a holder for LIF measurements. The acquisition system was placed at than 3.5m distance from the target and several images acquired with a spatial resolution of approximately 0.0025m. The scan size was 128 pixels width, 120 pixels height and 250 spectral channels from 200nm to 800nm; the nominal spectral resolution of 2.5nm. The UV laser was operated at 266 nm. The most relevant spectral features are identified by Principal Component analysis.

Fihure 1 Shows comparison between front and rear face of stony samples respectively on left and right LIF false color images (R420, G370, B340). Three group of samples can be detected: a) samples with blue false color in the images, that are mainly formed by biocrust, b) samples mainly composed with crust and deposits with yellow or green colour, c) samples with no diference between faces. These clasifications of samples are mainly according to the results obtained by petrographical microscopy and EDX-SEM. When these reslus are combined with LIF, the comparison between LIF spectra in both faces allow to detect new diferent cases, 1) Strong UV emission from the crust, no additional visible absorption, samples due to biocontamination, 2) UV emission combined with strong visible absorption, samples weathered by bio contamination and strong pollution, 3) samples with selective UV absorption with weak visible fluorescence, also possible bio contamination alone, and 4) samples with no change in spectral shape, it could be due to weak pollution.

LIF and reflectance measures seems a very powerful technique in this preliminary experimental results, to discriminate the presence of biocrust and crusts/deposits with more sensitive that naked-eye analysis performed at 3.5m distance from monuments.

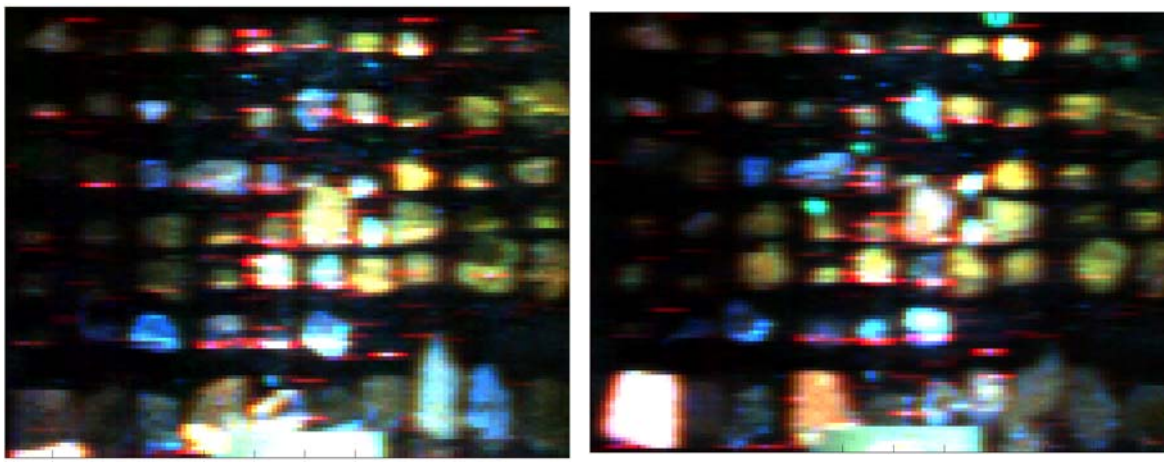

Figure 1 – Comparison between front and rear face of stony samples respectively on left and right LIF false color images (R420, G370, B340) obtained upon excitation at 266 nm.

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