Spectroscopic techniques in cultural heritage diagnostic

Case studies

1. Studies on ancient mortars

- Mortar fragments from the Norman Adrano Castle (Catania, Sicily)
- Element maps acquired on a 50x50 matrix (2500 LIBS spectra) with a lateral resolution of 100 µm for a total scanned area of 25 mm².
- Qualitative maps
- Application of Self-Organizing Map neural network for the determination of the different classes of materials in the samples
- Calibration Free LIBS for quantitation
- The composition of the sample can be obtained with a precision of ±1% on the major elements
- Allow to discriminate the distribution of binder (dark areas) and aggregates present in mortar (bright areas)

2. Studies on historical textiles

- Identification of both the organic and inorganic fraction of colourants for their complete characterization and to assess the technologies used in their production.
- The basic idea of this work: to demonstrate the feasibility of analyzing textiles aqueous extracts by Surface Enhanced Laser-Induced Breakdown Spectroscopy (SENLIBS) for trace elements identification.
- Here SENLIBS analysis revealed the presence of Fe, Al and Cu as textile mordants.

3. Studies on madder lakes

- Comparison of micro-destructive and non-destructive methods for the comprehensive characterization of the organic and inorganic fraction of reference madder lakes.
- Linseed oil, rabbit glue and gypsum were used for mock-ups preparation

On-fiber SERS analysis of natural dyes in historical textiles

Chemical analysis of organic colorants

- Laser Ablation Synthesis in Solution of metal nanoparticles
- ND-YAG Laser
- Control PC
- Nanoparticles Colloid
- Metal Target

On-fiber analysis

- For SERS analysis, 5 µL of Ag nanomaterials are dried with hot air on a glass slide. The process is repeated 5 times.
- The dried nanomaterials are rubbed on the fiber surface
- The fiber is then fixed to a glass slide and analyzed.

On-fiber LIBS analysis to evaluate the amount of silver on the sample: after SERS, the fiber is cleaned with few microliters of sodium citrate solution

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