

PL micro-imaging supported by FTIR mapping for the study of historical musical instruments

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Multi-layered coating systems of historical violins were investigated through PL micro-imaging and FTIR-ATR mapping to identify and characterize the materials used by the ancient Cremonese Masters.

Keywords: PL micro-imaging, FTIR-ATR mapping

1. Introduction

Coatings in historical bowed string instruments made in Cremona (Italy) during 17th and 18th C. are often multi-layered systems, where organic binders are variously mixed with inorganic materials to enhance the sound and the aesthetic features of the objects. [1] These materials were applied in superimposed coats in order to seal the wood porosity and prepare the surface to the application of the external varnish [2].

In this work, we propose to employ photoluminescence (PL) micro-imaging, with hyperspectral resolution, and FTIR mapping to fully characterize the different layers of the multi-layered system, with a specific focus on the interface between the ground coat and the wood [3].

2. Experimental

A set of different mock-ups and cross-sections from the Bracco small violin made by Lorenzo Storioni in 1793 were considered in the study to build and test the protocol.

The analytical campaign was carried out with:

- (i) an hyperspectral micro-imaging system made of an epifluorescence optical microscope equipped with pulsed laser excitation (3rd harmonic of a Q-switched Nd:YAG laser, 355nm) and a novel hyperspectral camera exploiting the Translating-Wedge-Based Identical Pulses eNcoding System (TWINS) [4];
- (ii) a FT-IR Nicolet iN10 MX mapping system working in ATR mode.

3. Preliminary results

An explorative study on a cross-section from the Bracco 1793 small violin is shown in Fig. 1. The sample stratigraphy (Fig. 1a) is composed of the spruce wood (A), the ground coat (B) and the original varnish layer (C). In addition, two other external restoration layers are visible (D, E).

Spectral similarity maps (Fig. 1b, 1c, 1d) of the PL emission, reconstructed on the basis of hyperspectral dataset, empower a better discrimination of the layers, peculiarly the penetration

depth of the ground among the wood fibres. The FTIR-ATR maps confirm the quality of the collected information.

4. Conclusion

In our knowledge, such a clear and selectively displaying is not possible with other non-destructive techniques. The preliminary results obtained with the PL micro-imaging stiffen the opportunity to use this non-invasive methodology as a powerful tool to the study of musical instruments coatings.

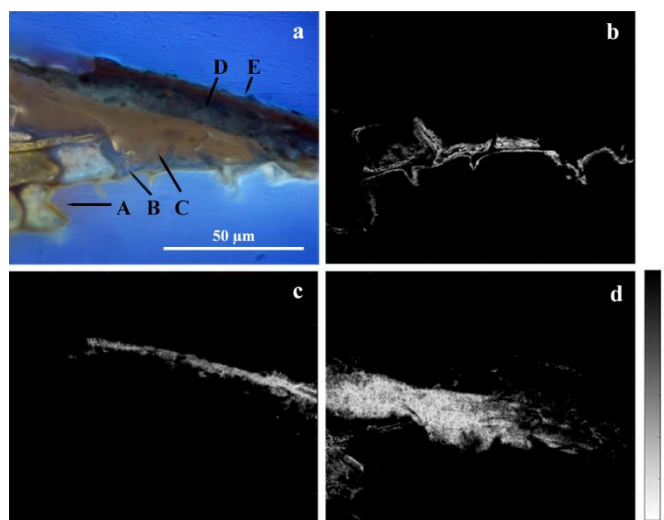


Fig. 1 The cross-section of the Bracco 1793 small violin observed under UV light with an optical microscope (a) and the same sample investigated with PL micro-imaging: the ground (b), the external varnish (c) and the original varnish layer (d) are identifiable.

References

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