

Probing the degradation mechanisms of artists' pigments by different 2D XANES-based approaches

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In the field of Heritage Science, chemical analysis are made complicated by the fact that objects consist of multilayered and heterogeneous networks composed of organic and inorganic compounds with amorphous and/or crystalline structures that undergo chemical transformations over time. In this context, the use of synchrotron radiation (SR)-based X-ray micro-spectroscopic methods, such as μ -XRF, μ -XANES and μ -XRD, has grown within the last decade due to their ability to provide elemental and molecular speciation information with spatial resolution down to the (sub)micrometer length scale. [1-3]

Currently, technological research perspectives call for a time acquisition reduction in order not only to render the 2D/3D mapping of large areas more feasible but also to avoid/minimize possible damages of samples induced by the exposure to SR X-ray beams.

Usually, three 2D XANES-based approaches are employed to gather chemical speciation information:

- i) analysis of one or more regions of interest by recording μ -XRF maps at a few different energies around the absorption edge of a specific element combined with the acquisition of a series of single-point XRF-mode μ -XANES spectra at a limited number of spots;
- ii) full-spectral XANES imaging in XRF-mode (using either traditional ED-XRF or fast X-ray detectors);
- iii) transmission-mode full-field XANES imaging.

These approaches have found a wide range of applications, such as the investigation of degradation mechanisms of different artists' pigments and of manufacturing processes of ceramics. [4-11]

In this contribution, the advantages and drawbacks of the three above-mentioned 2D XANES-based approaches in the context of the degradation processes of various artists' pigments, including chrome yellows, cadmium yellows and Prussian blues, will be presented. In particular, XANES/XRF data obtained at ESRF-ID21 beamline [3] from the investigation of artificially aged mock-up paints and paint micro-samples from original paintings will be discussed. These results will be integrated with those recorded directly at the surface of the paintings by means of non-invasive portable equipments.

References:

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