A Multimodal Analytical Workflow for Cultural Heritage at the SISSI-Bio Laboratory of Elettra Sincrotrone Trieste

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Cultural Heritage materials are intrinsically heterogeneous systems composed of organic and inorganic components that have undergone complex ageing and degradation processes. Their characterization therefore requires analytical strategies capable of investigating chemical composition, morphology, and elemental distribution across multiple spatial scales.

The SISSI-Bio Laboratory at Elettra Sincrotrone Trieste has developed an integrated analytical workflow combining optical microscopy, FTIR microscopy, Optical Photothermal Infrared (O-PTIR) spectroscopy with simultaneous Raman acquisition, and nano-FTIR microscopy, where the choice of the most suitable analytical technique is guided by the nature of the sample and the spatial resolution required to address the specific research question. Through collaborations with other Elettra and CERIC Partner Facilities, these approaches can be complemented by micro-XRF, micro-CT, PIXE, and SEM-EDX, providing comprehensive molecular, elemental, and structural information while minimizing sample consumption and preserving valuable Cultural Heritage objects.

The workflow has been applied to a broad range of archaeological and historical materials, including paleontological remains, archaeological bones, paper, parchment, tattooed skin, daguerreotypes, and painted materials. The combination of spectroscopic, elemental, and imaging techniques enables the identification of original materials and alteration products, the characterization of conservation treatments and burial-related processes, and the correlation of chemical composition with microstructural features.

The integration of complementary analytical capabilities within the CERIC-ERIC infrastructure offers a powerful framework for addressing complex Cultural Heritage questions that cannot be fully resolved by a single technique. In this context, SISSI-Bio acts as a versatile platform for interdisciplinary research, connecting expertise and instrumentation across Elettra and CERIC Partner Facilities to support the study of material composition, degradation mechanisms, manufacturing technologies, and conservation strategies.

Short bio:
Stani Chiaramaria is beamline scientist at the SISSI-Bio Beamline and SISSI-Bio Offline Laboratory at Elettra Sincrotrone Trieste. She is specialised in archaeometry and diagnostic investigation and characterization of Cultural Heritage materials using advanced spectroscopic techniques, particularly infrared spectroscopy. Her research focuses on understanding the composition, degradation processes, and conservation of artworks and historical materials in collaboration with archaeologists, conservators, museum curators, universities, and research institutions.