

# Synchrotron radiation and cultural heritage: a portfolio of techniques at Elettra

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The use of synchrotron radiation for the analysis of samples of historical and artistic importance has been increasing over the past years, and experiments related to the study of our cultural heritage (CH) have been routinely performed at many beamlines of Elettra, which now offers a platform dedicated to CH researchers in order to support both the proposal application phase and the experiment, from sample preparation to data analysis.

**TwinMic**, the European Soft X-ray Transmission and Emission Microscope, integrates the advantages of complementary scanning and full-field imaging modes into a single instrument. This microscope station has been designed as highly modular in its optical configuration and specimen environment.

**X-Ray Fluorescence** is a highly versatile beamline working in an energy range between 2 and 14 keV. The beamline is optically designed to present beam parameters needed for high level measurements in spectroscopy as well as in microscopy. The beamline hosts an ultra-high vacuum chamber, in partnership with the IAEA, which will allow the synergistic application of various X-Ray Fluorescence techniques.

The flexible design of the **MCX** beamline allows a wide range of non-single crystal diffraction experiments relevant for the cultural heritage, from phase identification to atomic structural studies. Several powder diffraction techniques that can be applied to cultural heritage materials.

**SYRMEP**, the X-ray microimaging and microtomography station, is a highly flexible beamline allowing the analysis of samples in both absorption and phase contrast mode. The versatility of this instrument has attracted researchers from different communities, from restoration and conservation to art history, archaeology and paleoanthropology.

The **XAFS** beamline, provides microscopic structural information through the analysis of a sample X-ray absorption spectrum, with unique applications in the field of cultural heritage. It is a powerful local structural probe, which does not require long-range order.

UV resonant Raman spectroscopy performed at **IUVS** beamline has been demonstrated to be a powerful tool for obtaining a detailed compositional characterization of pigments. UV resonant Raman scattering constitutes an alternative spectroscopic approach for achieving a non-destructive identification of the main pigmenting agents.

Infrared Microscopy techniques at **SISSI** beamline offer the possibility to correlate the sample morphological features with its vibrational local pattern at diffraction limited spatial resolution. Chemical information on both organic and inorganic constituents of art pieces can be obtained at SISSI, exploiting several sampling methodologies, suitable for probing thin sections and material surface properties as well.

The Scanning photoelectron microscope (SPEM) hosted at the **ESCA microscopy** beamline allows to combine chemically surface sensitive measurements with high spatial resolution. A beam spot down to 120 nm and energy sensitivity within 180 meV has opened the opportunity to perform surface micro-characterization. The experimental apparatus allows to carry out a manifold of experiments, aiming at quantitative and qualitative chemical characterization of morphologically complex materials.