Invited Lecture

Archaeometrical contribution of synchrotron beamlines.

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The proposed talk will relate to the study of cultural and natural heritage materials carried out at the SOLEIL synchrotron, where a dedicated scientific section named *Cultural Heritage* promotes research activities in this field. It aims at the optimization of methodological research and development of synchrotron-based techniques to maintain state-of-the-art experimental setups for the study of complex ancient objects [1]. Furthermore, it dynamizes scientific exchanges with the SOLEIL user's community by providing an entry point for related scientific questions. Research topics mainly concern the technological know-how of ancient societies [2,3], conservation issues [4] or palaeontological studies [5]. These topics will be illustrated by different scientific issues that require specific experimental approaches.

Illustrations will be mainly drawn from experiments realised on the DiffAbs beamline, where data on the physico-chemical properties of ancient materials can be obtained by combining different techniques in different modalities, thanks to the versatility of the beamline: X-ray diffraction (XRD), X-ray fluorescence (XRF) and absorption spectroscopies (XANES, EXAFS), as well as derived techniques. Using the available rotation of the unique 2D CirPAD circular hybrid pixel detector, it is possible to obtain classical intensity vs 2theta diagrams in an extending angular range (up to 135°) but also information on sample texture by measuring intensity variation along the diffraction rings azimutal direction. In the case of medieval armour examination, such data provides crucial information on manufacturing techniques thanks to the link between heat treatment, microstructure and crystal structure [3]. Elsewhere, the continuous mode *Flyscan*, which synchronises the sample scanning with the data collection from several detectors, allows to map heterogeneous samples with high resolution on a short timescale (a few milliseconds). This mapping approach, which can synchronise XRF and XRD measurements, is well illustrated in the study of mineralisation processes and fossil anatomy [5] or to determine the composition of composite artefacts of museum collection [4].

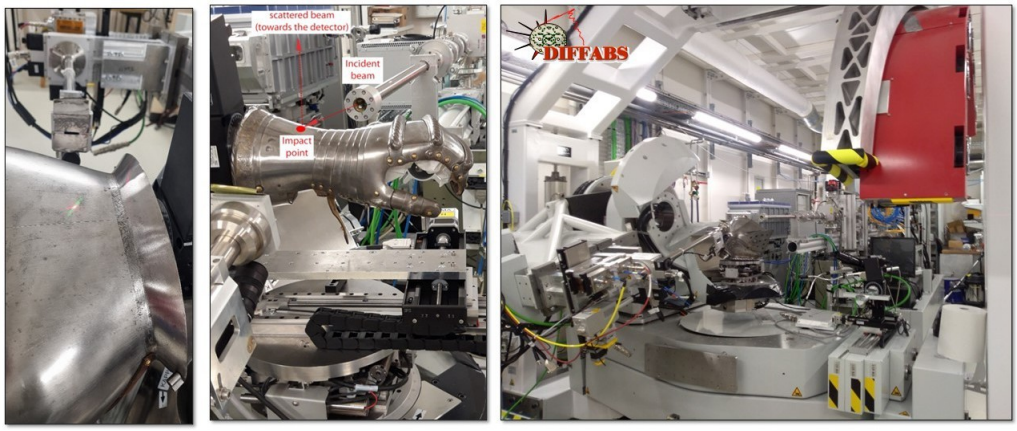

Figure 1. SR-XRD set up on armour elements on DiffAbs beamline, synchrotron SOLEIL.

[1] Reguer S. et al. Synchrotron Radiation News (2022).

[2] Hamon C. et al. Archaeological and Anthropological Sciences, (2020).

[3] Bérard E. et al. Eur. Phys. J. Plus, (2023).

[4] Gordon J. et al. Proceedings of ICOM-CC METAL, (2019).

[5] Gueriau P. et al. Journal of the Royal Society Interface, (2020).

Julie Gordon, Pierre Gueriau, Philippe Joly, Sebastian Schöder, Laurent Tranchant, Philippe Dillmann, Jean- Paul Itié.