

ID24-EBS project: a hard X-ray crystal analyser combined with a micro-focused beam for XAS/XES measurements

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We have developed and commissioned a five crystal analysers spectrometer for high energy resolution X-ray emission detection on the ESRF EXAFS beamline BM23. The spectrometer is combined with the BM23 microXAS station, leading to a unique coupling between an X-ray micro beam ($4 \times 4 \mu\text{m}^2$) with five spherically bent single crystals of 100 mm diameter, arranged in a 0.5 m Rowland geometry [1]. It covers Bragg angles ranging from 65° to 89° and operates from 5 to 25 keV, with an energy resolution varying from 0.5 to 5 eV.

The five crystal analysers spectrometer allows performing high energy resolution fluorescence mapping, high energy resolution fluorescence detected (HERFD), X-ray Emission Spectroscopy (XES) and resonant inelastic X-ray scattering (RIXS). The spectrometer has been used to study the structural chemistry of gold in natural arsenian pyrite (FeS_2) and arsenopyrite (FeAsS) [2]. In these minerals, the systematic co-occurrence of Au and As poses a challenge for measuring the Au L_3 -edge X-ray absorption spectra because the Au $L\alpha$ emission line is partly (pyrite) to totally (arsenopyrite) obscured by the intense As $K\alpha$ line.

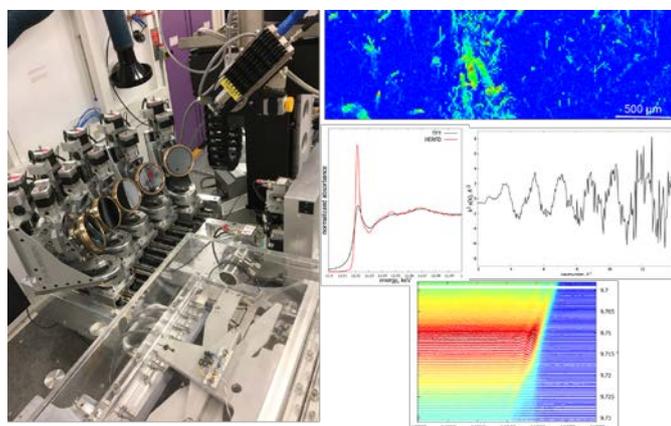


Figure 1 : The five crystal analysers spectrometer combined with the BM23 microXAS station

The new instrument will be fully operational and available for users after the ESRF - Extremely Brilliant Source (EBS) upgrade. The spectrometer will be installed on the new XAS beamline ID24-DCM. The beamline will provide a tailored flux up to 10^{13} photons s^{-1} and a spatial resolution down to $1 \mu\text{m}$ full width. In combination with the new crystal analyser spectrometer the beamline will allow users to study extremely diluted and heterogeneous samples. This work was supported by the French National Research Agency (ANR) under Grant ANR-10-EQPX-27-01 (EcoX Equipex).

References

- [1] - M. Rovezzi *et al.*, Rev. Sci. Instrum. **88**(1):013108 (2017).
- [2] - M. Merkulova *et al.*, ACS Earth Space Chem. **3**, 1905 (2019).