



X-ray microscopy, imaging and coherence at MAX IV, in soft and hard X-rays

Karina Thånell
MAX IV Laboratory (MAX IV), Sweden

The two main beamlines for X-ray microscopy at MAX IV Laboratory in Sweden are SoftiMAX and NanoMAX. Together they span both the soft X-ray (275-2500 eV) and hard X-ray (5-28 keV) regime, with a diverse set of techniques.

SoftiMAX [1] supports two branch line: one for scanning transmission x-ray microscopy (STXM) and Ptychography with a 20-60 nm Fresnel zone plate focus, and one modular line for coherent and full-field techniques that require a larger beam size (up to 20 micron), like holography and coherent diffraction imaging (CDI), as well as X-ray photon correlation spectroscopy. The latter supports an in house end-station as well as user end-stations on an open port.

NanoMAX [2] has two inline X-ray microscopy stations, with spot sizes down to 30 nm, featuring different capabilities to allow for diversity in sample environments and experiment optimization. Techniques offered at NanoMAX are: STXM, X-ray fluorescence (XRF) mapping, small/wide angle X-ray scattering (SAXS/WAXS) mapping, CDI and ptychography in forward and Bragg direction, nano(ptycho)-tomography, and X-ray inline holography.

The flexibility and diversity of both beamlines and their end-stations enable a wide range of scientific areas to benefit, giving nanoscale information on chemical, structural and magnetic properties of samples from advanced & quantum materials to environmental & life sciences. Complementarity to X-ray microscopy is, moreover, offered through the Mjølner platform: a double infrared (IR) sub-micron microscope lab with an atomic force microscope combined with IR spectroscopy (AFM-IR) and an O-PTIR (optically probed photothermal IR) instrument.

With thanks to both teams (current and past members) I will present some of the key features and design principles of the beamlines, as well as the latest updates and upgrades supporting X-ray microscopy at MAX IV.

References:

- [1] Jorg Schwenke, Karina Thanell, Igor Beinik, Linus Roslund, Tolek Tyliczszak, SoftiMAX - A new Soft X-ray Microscopy and Coherent Imaging Beamline at the MAX IV Facility., *Microscopy and Microanalysis*, Volume 24, Issue S2, 1 August 2018, Pages 232–233, <https://doi.org/10.1017/S143192761801351X>
- [2] Ulf Johansson et al., “NanoMAX: the hard X-ray nanoprobe beamline at the MAX IV Laboratory” *J. Synchrotron Rad.* 28 (2021), 1935-1947, DOI: 10.1107/S1600577521008213