

## X-RAY SCATTERING FACILITIES AT NANOMICROSCOPY CENTER IN AALTO UNIVERSITY

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The Nanomicroscopy Center in the framework of the OtaNano infrastructure at Aalto University is a unique facility in Finland, offering easy access to top-notch electron microscopes, atomic force microscopes, and x-ray scattering devices for users from all over the world with reasonable usage prices. While the focus of the center is on electron microscopes, the small-angle x-ray scattering (SAXS) instrument of the facility has paid a key role as a complementary tool for studying statistical averages of nanostructures.

In 2016, the Nanomicroscopy Center started operating a new Rigaku SmartLab x-ray diffractometer in its premises at Otaniemi, Espoo. This diffractometer is a fine tool in addition to the SAXS device by giving access especially to thin film samples and large angles. The Rigaku SmartLab diffractometer with a 9 kW rotating Cu anode covers a multitude of techniques:

- powder diffraction,
- x-ray reflectivity (XRR),
- thin film x-ray diffraction (XRD),
- pole figure analysis,
- reciprocal space mapping,
- grazing-incidence XRD (GIXRD) and SAXS (GISAXS) at medium angles,
- single fiber XRD measurements in transmission (with focusing optics),
- in-plane XRD,
- XRD on liquid surfaces,
- SAXS at medium angles in 2D, and
- residual stress analysis.

A 2-dimensional HyPix-3000 detector with 100  $\mu\text{m}$  pixel pitch reduces the collection time for the spectra compared to conventional point detectors. The detector can collect intensities close to a beamstop down to scattering vector length  $q = 0.08 \text{ \AA}^{-1}$  (up to about 8 nm in real space) and hence facilitates a nice overlap of collectable angle ranges with the transmission-SAXS instrument.

An easy exchange and automated optics alignment between a multilayer mirror (Cu  $K\alpha_1$  and  $K\alpha_2$ ) and a Ge (220) double bounce monochromator (Cu  $K\alpha_1$ ) makes the compromise between choosing either a narrow wavelength band or high intensity easy for each experiment with the Rigaku SmartLab instrument.

In-situ measurement chambers based on two Linkam heating/cooling stages with temperature range -196 – 600  $^{\circ}\text{C}$  are also available in 2017.