

The Scanning Transmission X-Ray Microscope at SOLARIS optimized for fast scanning and environmental experiments

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The SOLARIS National Synchrotron Radiation Centre is a 1.5 GeV 3rd generation synchrotron located in Krakow, Poland. As a low energy storage ring, this facility is going to specialize in building its beamlines mostly in the soft X-ray region. One of them is the DEMETER beamline, on which the Scanning Transmission X-ray Microscopy (STXM) is located. This beamline is a classic Plane Grating Monochromator (PGM) design with an Elliptically Polarizing Undulator (EPU) as a source and works in 100-2000 eV photon energy range. The STXM microscope has been designed and built in-house. The main goal of the design is to provide a flexible microscope that can be easily reconfigured to a specific experiment (for materials engineering, Earth and environmental science, biology, electrochemistry, etc., when ultra-high vacuum conditions are not required). Microscope's relatively compact chamber enables faster sample load/unload and more economical purging with pure He, in case a sample cannot be subjected to vacuum.

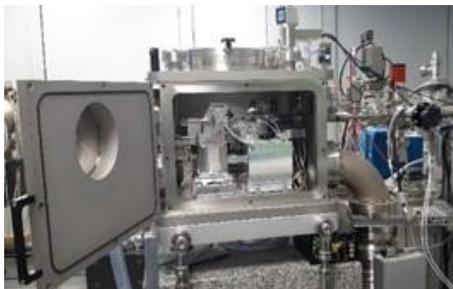


Figure 1. The STXM end station in SOLARIS

This STXM design is based on the Advanced Light Source (ALS) beamline 5.3.2 STXM [1] but there is a significant difference. The microscope does not have sample stages in the z direction (along the X-ray beam). It has the Order Sorting Aperture (OSA) motion in this direction, instead. This modification reduces sample vibration and helps in the focusing procedure. Additionally, a custom high efficiency Field Programmable Gate Array (FPGA) is used there for timing, acquisition and fast shutter control.

This STXM is operating on a modern undulator beamline, therefore acquisition time of a single-pixel can be even shorter than 1ms, enabling fast scanning and low radiation damage. To maintain the sample position at a level of several nm, especially with changing X-ray energy, we use a laser interferometer in a closed feedback loop. This STXM design is suitable for a commercial electrochemical cell system manufactured by Hummingbird Scientific, in which "operando-study" experiments can be performed using a potentiostat and a microfluidic pump. Thanks to the use of an undulator with variable polarization, it is also possible to perform measurements using the XMCD or XMLD effect for magnetic samples.

Apart of our STXM design and capability details, some example results of interesting experiments will be presented.

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References:

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