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Unveiling ASTRA: A Versatile tender XAS workhorse beamline at SOLARIS Synchrotron

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The ASTRA beamline at SOLARIS synchrotron (Krakow, Poland) has demonstrated significant scientific impact since its inception, attracting researchers across diverse fields. Although recently established as a bending magnet beamline, ASTRA has facilitated over 70 experiments within its initial 18 months of user operation.

ASTRA, an acronym for "Absorption Spectroscopy beamline for Tender energy Range and Above," specializes in X-ray absorption spectroscopy (XAS)[1]. The beamline operates within a photon energy range of 1 to 15 keV, with a specialization in the 1.8 - 12 keV range, encompassing both tender and partial hard X-ray energies. Beam monochromatization is achieved through a modified Lemonnier type double crystal monochromator (DCM) operating under high vacuum conditions. The DCM accommodates various crystal types to cover the operational energy range, including Ge(422), Ge(220), Si(111), Ge(111), InSb(111), Beryl($10^{-}10$), and organic potassium acid phthalate (100) + multilayer, with crystal pair exchange achievable in under one hour[2].

The beamline's capabilities enable XANES/EXAFS spectral measurements at K-edges of elements from Si to Se, as well as L-edges up to Bi and select M-edges of heavier elements including U. This versatility enables investigations of a wide spectrum of materials. XAS spectra acquisition is possible in both transmission and fluorescence modes. An X-ray camera enhances sample positioning, thereby improving data quality and result reliability.

Experimental control is managed through the custom-developed AstraLibra software, featuring an intuitive interface and advanced functionalities. The beamline has successfully implemented specialized cells for liquid phase and dynamic environment (in situ and operando) measurements, even within the tender energy range. Current developments include the integration of XAS with Raman spectroscopy, enabling XAS and Raman measurements at the beamline during a single beamtime.

The presentation will elucidate the technical aspects of the ASTRA beamline and showcase selected results from both ex-situ and in-situ experiments, demonstrating its significant contributions to materials science and related fields. Future beamline developments, considering community interests, will also be discussed.

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References

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