NANOSCIENCE COLLOQUIUM

APS-U: new opportunities for structural analysis using high-energy x-rays

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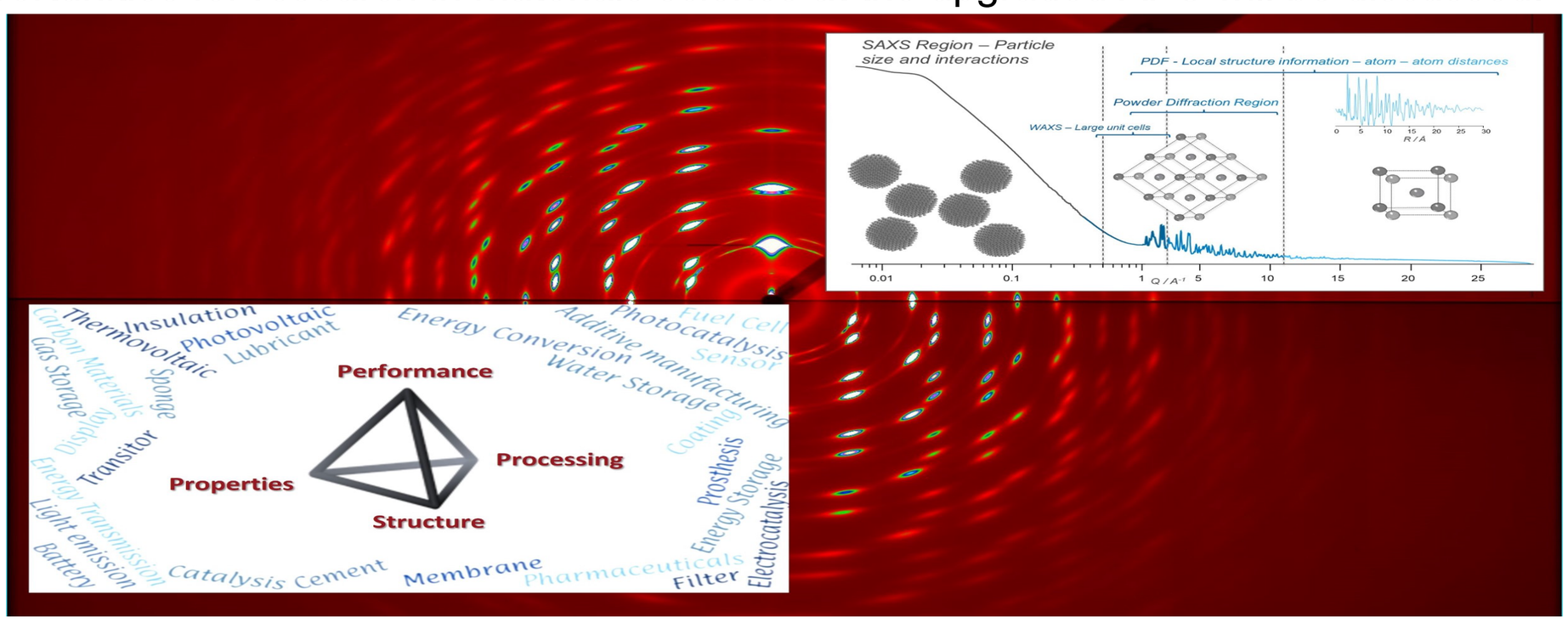
Abstract:

The Structural Science (SRS) group at the Advanced Photon Source (APS) operates a suite of five high-energy x-ray (HEX) scattering beamlines. These beamlines are specifically designed for enabling a wide range of in situ and operando experiments, ranging from synthesis of materials to the understanding the interaction of the atomic order with the macroscopic properties in functional materials. Additionally, operando studies of complex real devices are enabled with a high level of standardization. Over the past few years, this program has experienced significant demand and has contributed to over 350 publications annually, showcasing the profound impact of HEX diffraction on both fundamental and applied sciences.

After the upgrade of the APS to a 4th generation storage ring, the enhancement of beamline 11-ID-D will extend the capabilities to the combination of small angle x-ray scattering (SAXS) and total scattering for pair distribution function (PDF) analysis and also focusing in the nanometer regime. Consequently, this enhancement will bridge the length-scale gap between resolution in reciprocal and real space, thereby providing a comprehensive understanding of material structures. The multimodal setups and photon energies ranging between 26 keV and 120 keV, coupled with the highest flux, will empower the performance of complex in situ and operando diffraction experiments. The primary focus will be on two critical aspects: firstly, the discovery of novel materials through automated panoramic syntheses, and secondly, the precise mapping of local atomic ordering during operation with high-spatial resolution. A primary goal is to decipher the influence of inhomogeneities and interfaces on macroscopic performance, particularly within energy storage and conversion systems.

Upcoming opportunities for research in materials science at the upgraded APS will be discussed.



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