Nanoscale Multimodal X-ray Imaging at NSLS-II

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The Hard X-ray Nanoprobe (HXN) Beamline at NSLS-II is designed and constructed to achieve ultra-high spatial resolutions for a wide range of general user experiments. The endstation x-ray microscope called Nano-Mii (Nanoscale Multimodal Imaging Instrument) offers choice of using either an x-ray zoneplate or a pair of multilayer Laue lenses (MLLs), so that each experiment can be tailored to specific experiment needs (i.e. spatial resolution, working distance for in-situ cells, energy ranges, etc). Presently, the MLLs provide a focused beam size down to ~12 nm for user experiments. A unique feature of Nano-Mii is that multimodal imaging data are collected for all experiments, so that the experimenters can visualize elemental distributions (through x-ray fluorescence), morphology distribution (through differential phase contrast (DPC) and/or ptychography). For crystalline samples, diffraction contrasts (material phases, lattice distortion, and strain) are also simultaneously imaged. These techniques can be used for 3D imaging through conventional tomographic reconstruction or 3D Bragg ptychography. Significant efforts have been made to streamline data analysis workflow for 3D imaging for user experiments. Recently, we achieved sub-10 nm resolution through tomographic reconstruction using ptychography dataset. The presentation will elaborate on a few examples of scientific applications and on-going development at the HXN beamline.