Bragg Projection Ptychography of Nanostructured Thin Films with Nanofocused Hard X-rays

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X-ray Bragg projection ptychography (BPP) is a robust approach for imaging lattice strain and other structural perturbations in thin films by employing coherent diffraction imaging to enhance the structural sensitivity and resolution of nanofocused x-ray scanning diffraction microscopy [1,2]. This approach takes advantage of the fact that at the Bragg condition of a crystal, an observed area coherent diffraction pattern is the Fourier transform of a planar projection of the illuminated sample volume. Here, we will discuss how this projection property at a Bragg condition can be exploited with scanning coherent nano-focused x-ray diffraction and two-dimensional ptychographic phasing algorithms to image lattice features in thin films projected onto a two-dimensional plane. Bragg projection ptychography is well suited for studying structural heterogeneity in extended crystalline thin films. With relatively short acquisition times and nanoscale resolution, reconstructed planar projections of thin film samples contain in-plane structural information that is difficult to obtain by other imaging techniques. We will give experimental examples from our recent research and discuss the advantages and limitations of the technique.

[1] S.O. Hruszkewycz, et. al. “Quantitative nanoscale imaging of lattice distortions in epitaxial semiconductor heterostructures using nanofocused x-ray Bragg projection ptychography”, Nano Letters, 12, 5148 (2012).
[2] S.O. Hruszkewycz, et. al. "Imaging local polarization in ferroelectric thin films by coherent x-ray Bragg projection ptychography," Physical Review Letters, 110,177601 (2013).