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BRAGG PROJECTION PTYCHOGRAPHY ON LOW-DIMENSIONAL MATERIALS

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X-ray diffraction has long been used to investigate the properties of materials such as crystalline thin films. X-rays have the advantage over more surface-sensitive imaging modalities, such as atomic force microscopy, electron microscopy or photoemission electron microscopy because they can penetrate the entire sample. Bragg projection ptychography (BPP) is a coherent x-ray diffraction imaging technique which combines the advantages of scanning microscopy with the phase contrast of X-ray ptychography. Our research applies it for high resolution imaging of the phase-shifted crystalline domains associated with epitaxial growth. The distinct advantages of BPP are that the spatial extent of the sample is arbitrarily-defined, it is also non-destructive and it gives potentially diffraction limited spatial resolution at high brilliance 3rd generation synchrotron radiation facilities. Here we demonstrate the application of BPP for revealing the domain structure caused by epitaxial misfit in a nanostructured metallic thin film. Experimental coherent diffraction data were collected from a niobium thin film, epitaxially grown on a sapphire substrate as the beam was scanned across the sample. The data were analysed by BPP using a carefully selected combination of refinement procedures. The resulting image shows a close packed array of epitaxial domains, shifted with respect to each other due to misfit between the film and its substrate. Bragg coherent imaging methods have the "dark field" advantage that they only consider signals from the parts of the sample that are contributing to the Bragg peak; all other sources of scattering and contributions from other components of the sample are suppressed.

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