NANODIFFRACTION FROM PERFECT/WEAKLY-DEFORMED SINGLE CRYSTALS

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During the last decade advances in x-ray sources, optics, and detectors have enabled diffraction strain mapping in crystalline samples with micron/sub-micron resolution. Recent progress in mirrors, zone plates, and refractive lenses has pushed the frontier for hard x-ray focusing into the 25-50 nm range, and true nanometer sized beams (<10 nm) are envisioned in the near future by using novel optics, such as multilayer Laue lenses [1], advancing diffraction strain mapping techniques into the nanodiffraction regime. In addition to possessing a large divergence, a nanobeam typically has a high degree of spatial coherence, which requires a full wave theory, no ray tracing, to be used to study the propagation of the x-rays and the resulting diffraction pattern. We will present a theoretical description of wave propagation from a spatially coherent, divergent beam diffracted from a perfect or weakly deformed single crystal, and discuss the physical meaning of a nanodiffraction pattern. Experimental results of nanodiffraction images will also be presented.

[1] H. C. Kang, J. Maser, G. B. Stephenson, C. Liu, R. Conley, A. T. Macrander, and S. Vogt, Physical Review Letters 96, 127401 (2006)