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DEVELOPMENT OF 3D X-RAY STRUCTURAL MICROSCOPY USING WHITE X-RAY MICROBEAMS

B. C. Larson, W. Yang, G. E. Ice, J. Z. Tischler, J. D. Budai, N. Tamura, K.-S. Chung, J.-S. Chung
Oak Ridge National Laboratory
P. O. Box 2008
Oak Ridge, Tennessee 37831

W. P. Lowe
Howard University
Washington, DC

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We have developed white x-ray microbeam techniques that provide the ability to measure the orientation, phase, size, and full stress/strain tensor of crystalline materials with micron resolution in three-dimensions. White and monochromatic (interchangeable) synchrotron x-ray beams are focused to ~0.5 micron diameter using elliptically figured K-B mirrors on the MHATT-CAT beamline at the Advanced Photon Source. 3D structural microscopy has been achieved through the development of new techniques for collecting diffraction patterns with micron resolution along the direction of the microbeam in the sample. The experimental techniques developed and analysis methods used will be described and the 3D microstructural capabilities will be demonstrated through micron resolution measurements of strain gradients in thin Si single crystals bent cylindrically to ~5 mm radii. Applications of this technique to the investigation of the structure and evolution of materials on mesoscopic length scales will be discussed.

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