Materials Science Using Submicron X-ray Diffraction in 2-D and 3-D

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New x-ray techniques for mapping the structure of materials with submicron spatial resolution in both 2- and 3-dimensions will be described. Our approach uses intense, focused white synchrotron x-ray microbeams. Essentially, we obtain x-ray Laue patterns from submicron volumes, allowing us for the first time to nondestructively map the microstructure within individual grains of polycrystalline samples. The analysis provides real-space maps of the **local** lattice structure, crystallographic orientation (texture), and the strain tensor.

In 2-D, this technique is well-suited for mapping deposited films. Compared with electron backscattering, x-rays have increased angular resolution, greater penetration and no charging effects. We have applied these x-ray techniques to the study of the epitaxial growth of oxide films on rolling-assisted biaxially textured Ni substrates (RABiTS) and I will present temperature-dependent results explaining crystallographic tilting and microstrains in heteroepitaxial oxide films. In 3-D, an x-ray crystal microscope has been developed and demonstrated. I will describe our initial 3-D studies of Cu deformation under nanoindentation and direct mapping of grain growth in polycrystalline aluminum.