Polychromatic Microdiffracion Measurements of Mesoscale Structure and Dynamics

Gene Ice[1], Bennett C. Larson[2], *[1]Metals and Ceramics Division Ridge National Laboratory, Oak Ridge Tn 37831-6118. [2]Condensed Matter Science Division, Oak Ridge National Laboratory, Oak Ridge TN 37831.* E-mail: IceGE@ornl.gov

Polychromatic x-ray microdiffraction combined with differential aperture microscopy is a powerful new method for studying the local crystallographic structure of materials. This approach extends single-crystal methods to virtually all materials including materials characterized by heterogeneity at the atomic *and* mesoscopic length scales. Defects such as grain boundaries, surfaces, precipitates, second phases, strain, dislocations, vacancies, interstitials, site substitutions and other disruptions of perfect periodicity all have signatures best studied using single crystal methods. Here we describe emerging x-ray microbeam techniques that exploit "single-crystal like" x-ray diffraction measurements on subgrains in typical polycrystalline materials. We show how polychromatic and tunable monochromatic measurements on small sample volumes can bring single-crystal techniques to real materials and reveal their atomic and mesoscopic defect structures. This emerging revolution in materials science is certain to address long-standing issues of materials behavior.

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