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Observations of stress-coupled grain boundary migration in nanocrystalline thin films

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ABSTRACT

Stress-coupled grain boundary migration has been shown to be an active deformation mechanism in a number of nanocrystalline metals. Ex situ tensile and hardness testing have proven to be valuable tools in uncovering the existence of stress-coupled grain boundary migration and ascertaining the role of shear stress, but these ex situ experiments cannot provided detailed information about the microstructure as it evolves. In contrast, emerging in situ techniques such as TEM-based Precession Assisted Crystal Orientation Mapping and SEM-based Transmission Kikuchi Diffraction now allow for nanoscale observations of individual grains and grain boundaries. Conducting in situ mechanical tests in conjunction with orientation mapping provides quantitative mechanistic information about grain boundary migration and greatly facilitates comparisons with computer simulations. Key parameters of interest to this study include the effect of grain boundary character and chemistry on the coupling factor, grain boundary mobility, and attendant mechanical response of nanocrystalline metals.