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Understanding Deformation-Induced Void Formation in Tantalum via EBSD

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Body-centered cubic (BCC) metals are technologically relevant in a number of applications, yet questions regarding fundamental details of their mechanical deformation behavior limit the ability to predict materials response and performance. This study has focused on understanding the early stages of failure in BCC tantalum, by analyzing deformation-induced void structures in tensile samples (1mm thick, ~30um grain size) pulled uniaxially to increasing levels of plastic strain. Scanning electron microscope (SEM) imaging and electron backscattered diffraction (EBSD) was used in two capacities to determine local conditions leading to void formation in interrupted tensile samples: (1) samples were polished to the mid-plane and SEM/EBSD was performed over void-containing regions (50-100 um wide), and (2) small volumes of void-containing material (~30x30x30 um) were analyzed in 3D via sequential FIB milling and EBSD. Voids as small as 30 nm in diameter were observed in samples strained past the ultimate tensile stress, with voids approaching 100 um in diameter in samples strained nearly to failure. Preliminary EBSD analysis suggests an influence of local microstructure, e.g. grain boundaries and misorientation gradients, on void formation.

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