Investigating the Anisotropic Effect of Soluble Hydrogen on Plasticity in Low-Symmery Alpha-Uranium

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Abstract

Hydrogen embrittlement is a long-standing metallurgical challenge observed in numerous metallic systems, including uranium. Alpha-uranium has a low symmetry (orthorhombic) crystal structure that accommodates strain by mechanisms limited by crystallography or temperature. To examine the effect of hydrogen on plasticity, compression test were conducted with the loading axis parallel to either the through thickness (TT) direction or within the rolling plane (RP), which exhibit different crystallographic textures and primary deformation mechanisms. Pre-charging with hydrogen did not significantly alter the macroscopic stress-strain response of samples with RP texture but did increase strength of samples with TT texture. Characterization by electron backscatter diffraction has also revealed a significant difference in twinning behavior in samples charged with hydrogen. Further, analysis of stress relaxation tests along the TT direction suggest hydrogen could affect deformation substructure formation and subsequent resistance to defect motion.

Keywords: Hydrogen embrittlement, low, symmetry, anisotropy, twinning

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