Heterogeneous deformation in $\alpha$-Ti alloys at the microscale

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ABSTRACT

Detailed characterization of full field deformation at the microstructural length scale is important for understanding local damage nucleation and failure mechanisms during heterogeneous deformation, and their impact on macroscopic mechanical properties. In the current study, an experimental method combining in-situ mechanical testing, electron backscatter diffraction (EBSD), and scanning electron microscopy with digital image correlation (SEM-DIC) was applied to study the multiscale deformation behavior of forged and annealed polycrystalline $\alpha$-Ti alloys with various Al content. Microstructural information (EBSD) and its evolution during loading was compared with continuous tracking of full-field deformation (SEM-DIC) during thermomechanical loading to examine the effect of microstructure heterogeneity such as microtexture, grain size and orientation, and alloying concentration on deformation and damage mechanisms during tensile deformation. Post-test processing for drift and spatial distortion correction allowed for accurate measurement of the displacement field.