

INTERNAL STRESS GENERATION IN PURE TITANIUM DURING CYCLIC LOADING

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The cyclic loading responses of hexagonal alloys are commonly characterized by tensile/compressive yield asymmetry, underpinned by mechanical anisotropy at the granular level coupled with crystallographic texture. This anisotropy can lead to the generation of large intergranular microstresses and differing intergranular stress responses during tensile and compressive straining. This paper presents a neutron diffraction study to examine the case of forward followed by reverse loading in IMI-125 commercially pure titanium plate for comparison to recent results for other hexagonal metals. The plate exhibited moderately strong texture with basal poles oriented primarily along the transverse direction with respect to rolling. Neutron diffraction spectra were recorded during uniaxial loading tests performed in tension-compression and compression-tension along the plate transverse direction, and in tension-compression along the rolling direction. During straining along the transverse direction, large axial grain family lattice strains develop in the compressive part of the cycle, but are relieved during subsequent tensile loading. This behaviour is explained on the basis of the operation of a small degree of mechanical twinning. There is some evidence that twin formation is reversible. The results are discussed with comparison to the results of cyclic loading studies in magnesium alloys where mechanical twinning is the dominant deformation mode.