DEVELOPMENT OF INTERGRANULAR STRAINS IN INCONEL 690

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The development of lattice strains was measured *in situ* during compression in three test directions and tension in two test directions in specimens machined from a thick-walled Inconel 690 tube. Time-of-flight and constant wavelength neutron diffraction techniques were used for the compression and tension tests respectively. The measurements were carried out during sequential loading and unloading of the specimens with the scattering vector directed either parallel or perpendicular to the applied stress for each direction of testing. Strong anisotropic elastic and plastic responses were observed, giving rise to intergranular constraints after unloading. Lattice strain development was modeled using an elasto-plastic polycrystalline model (EPSC). The calculations showed that the lattice strains for some lattice planes are very sensitive to the distribution of crystal axes orthogonal to the measurement direction. Hence errors of a few degrees in the experimentally determined orientation distribution functions could account for apparently large discrepancies between some of the measurements and the calculations. EPSC calculations were combined with orientation maps obtained by electron-back scattered diffraction to visualize the distribution of integranular constraints as a function of orientation.