

IMPACT OF DIFFERENT STRENGTHENING MECHANISMS ON INTERGRANULAR STRAINS IN DEFORMED ALUMINUM ALLOYS

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The presence of intergranular strains in grains of different crystallographic orientations in deformed polycrystalline samples due to inhomogeneous deformation is widely recognized. These intergranular stresses add to the residual and applied stresses and complicate residual stress analyses in deformed materials. A further complication is that the intergranular stresses are dependent on the direction relative to the deformation direction. However, the effects of various types of strengthening mechanisms in different alloys, such as aluminum on the generation of intergranular strains, have not been studied systematically.

In this study, lattice strain responses for different (*hkl*) reflections in a series of Al alloys under uniaxial tensile load up to 7% plastic strain were measured *in-situ* by neutron diffraction. Samples of precipitation-strengthened Al-2024, Al-7075-T6, Al-6061, and solid-solution strengthened Al-5083 alloys were studied. Both Al-2024 and Al-7075-T6 show similar lattice strain responses. The (200) reflection for Al-2024 shows the largest response with residual strains, upon unloading from 150 MPa, of -1,000 $\mu\epsilon$ and +850 $\mu\epsilon$ parallel and transverse to the tensile axis, respectively. The corresponding strain magnitudes for Al7075-T6 are slightly smaller with values of -700 $\mu\epsilon$ and +720 $\mu\epsilon$. The behavior of the solid-solution strengthened Al-5083 differs from the precipitation-strengthened alloys with the largest residual strain found in reflection (311), not the (200), with -1,000 $\mu\epsilon$ along the tensile axis. Lattice strains for the other reflections in Al-5083 are within $\pm 300 \mu\epsilon$ for both the longitudinal and transverse directions compared to the other alloys. The differences between the alloys and the implications for measurements of residual stresses by single *hkl* methods will be discussed.

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