ANISOTROPIC LATTICE-STRAIN EVOLUTION AND PHASE TRANSFORMATION IN A COBALT-BASED SUPERALLOY UNDER UNIAXIAL LOADING

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The anisotropic response of individual crystallites in a polycrystalline matrix to mechanical loading is a longstanding question involving both experimental and modeling efforts. The elastic lattice strain anisotropy under applied load has been successfully described by using a unique orientation parameter, A_{hkl}, whereas the anisotropy induced by plastic deformation requires spherical harmonics to describe the grain-orientation dependence of intergranular strains. The aim of this paper is to combine these two approaches to evaluate elastic and plastic anisotropy of lattice strains developing under in-situ applied load. The analysis presented here includes the use of a modified version of the Kröner model and a polynomial expansion of spherical harmonics to capture the lattice-strain distribution in reciprocal space.

The material studied undergoes a martensitic strain-induced phase transformation from the face-centered-cubic (FCC) phase to the hexagonal-close-packed (HCP) phase. Since the phase transformation under stress is also highly dependent on grain orientation, the newly-developing phase introduces additional anisotropic grain redistribution that affects the measured lattice strains and the texture. While lattice strains are measured only in the FCC phase, this effect is captured through consideration of the effective stress, which is calculated within the context of the FCC lattice-strain analysis described above.

Acknowledgements: Funding was received from the Integrative Graduate Education and Research Training Program, and the International Materials Institutes Program, with Dr. C. J. Van Hartesveldt, Dr. D. Dutta, Dr. L. Clesceri, Dr. W. Jennings, and Dr. L. Goldberg, as program directors. Additional funding comes from the Tennessee Advanced Materials Laboratory, with Prof. E. Ward Plummer as the director.