SM18L_10955

XXI International Congress of Theoretical and Applied Mechanics
Warsaw, Poland, August 15–21, 2004

Simulation of Dynamic Polycrystalline Thermoelastoviscoplasticity and Fracture

John D. Clayton

Impact Physics, U.S. Army Research Laboratory

Presented is a constitutive framework for addressing the dynamic response of polycrystalline microstructures, posed in a thermodynamically consistent manner and accounting for finite deformations, rate dependence of flow stress, thermal softening, thermal expansion, heat conduction, and thermoelastic coupling. Assumptions of linear and square-root dependencies, respectively, of stored energy and flow stress upon the total dislocation density enable calculation of the time-dependent fraction of plastic work converted to heat energy. Fracture at grain boundary interfaces is represented by cohesive zones. Dynamic finite element simulations demonstrate the influences of texture, morphology, and interfacial strengths on the deformation and failure behaviors of an actual two-phase material system consisting of comparatively brittle pure tungsten grains (BCC) embedded in a more ductile matrix of tungsten-nickel iron alloy (FCC). Aspects associated with constitutive modeling of the homogenized material system, including a macroscopic theory for finite anisotropic damage deformation, are discussed in light of the computational results.

View the extended summary