Abstract Submitted
for the SHOCK17 Meeting of
The American Physical Society

A physics-based framework for spall failure of single crystals THAO NGUYEN, University of Texas at San Antonio, D.J. LUSCHER, Los Alamos National Laboratory, JUSTIN WILKERSON, University of Texas at San Antonio — A framework for dislocation-based viscoplasticity and dynamic ductile failure has been developed to model high strain rate deformation and damage in single crystals. The rate-dependence of the crystal plasticity formulation is based on the physics of relativistic dislocation kinetics suited for extremely high strain rates. The damage evolution is based on the dynamics of void growth, which are governed by both micro-inertia as well as dislocation kinetics and dislocation substructure evolution. The resulting homogenized framework has been implemented into a commercially available finite element package, and a fairly extensive validation study against a suite of direct numerical simulations was carried out. The utility of the homogenized framework is further demonstrated through the mesoscale simulation of a polycrystal subject to dynamic loading. The simulations capture some key experimentally-observed features of damage localization along grain boundaries of particular misorientation.

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Date submitted: 23 Feb 2017 Electronic form version 1.4