Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Rate-dependent scaling laws for spall failure JUSTIN WILKERSON, University of Texas at San Antonio, KT RAMESH, Hopkins Extreme Materials Institute — Here we derive simple bounds on the growth rate of voids considering the combined retarding effects of micro-inertia and dislocation kinetics. We make use of these bounds to derive simple scaling laws capable of predicting the strong rate-dependence of spall strength. We show that the rate-sensitivity exponent for spall strength is bounded to below 6/7 when micro-inertia is the dominant retarding effect on void growth. However, under conditions in which the void growth is predominately governed by dislocation kinetics the rate-sensitivity exponent may rise to a maximum value of 1. With these scaling laws in hand, we go on to further explore the role of microstructure on spall strength. Though simple, the derived scaling laws compare well with experimental measurements and prove useful in shedding light on some of the more perplexing observations associated with spall failure. In particular, the scaling laws are helpful in understanding the somewhat anomalous dependence of spall strength on pre-existing microstructure, e.g. grain size and purity content.

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Date submitted: 06 Nov 2015 Electronic form version 1.4