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The Role of Defect Kinetics on Spall Failure JUSTIN WILKERSON, K.T. RAMESH, Johns Hopkins University — Spall failure is a complex multiscale, multirate process. During the shock compression, the material undergoes a myriad of shock stress magnitude and pulse duration dependent microscopic processes that may include dislocation multiplication, nucleation, trapping, pile-up, annihilation, recovery, cell evolution, as well as vacancy generation and clustering. In addition to shock hardening the material, this new shock induced defect structure seeds the material with new potential void nucleation sites that may be activated during the proceeding period of dynamic tensile loading. Upon nucleation, the voids undergo dynamic growth to coalescence, constrained by inertia and viscoplastic resistance to deformation. A predictive micromechanical model is developed to analyze the role of these time-dependent processes in the experimentally observed spall strength dependence on initial microstructure, preheat temperature, tensile loading rate, and shock stress magnitude. In addition, simple spall strength scaling laws that capture the essential physics and microstructure dependence will be presented.

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