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The Role of Shock Induced Defect Structure in Spall Failure JUSTIN WILKERSON, K.T. RAMESH, The Johns Hopkins University — Spall failure is a complex multiscale, multirate process. On the macroscale the process involves a period of shock compression followed by dynamic tension set up by the stress wave interactions. 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 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 multiscale predictive framework is developed to analyze the role of these time-dependent processes in the experimentally observed spall strength dependence on initial microstructure, preheated temperature, tensile loading rate, pulse duration, and shock stress magnitude.

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