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2-D Mesoscale Predictions of Local Shock States in Aluminum
J.R. ASAY, S.K. DWIVEDI, Y.M. GUPTA, Institute for Shock Physics, Washington State University — Two-dimensional mesoscale simulations of 6061 Al alloy during planar reshock and unloading impact experiments show that the stress state achieved during initial shock loading deviates from 1-D elastic-plastic response. The stress state unloads from an equilibrium yield surface due to mesoscale phenomena such as collapse of micro-voids or local plastic rearrangements to attain lateral stress equilibrium near hard inclusions or hardened grain boundaries. The quasi-elastic longitudinal velocity profiles calculated for reshock or unloading are similar to experimentally measured profiles. Mesoscale heterogeneities causing the observed quasi-elastic response were found, in reducing order of importance, to be hardened grain boundaries, hard inclusions, micro-voids, and grain-to-grain property variation. These phenomena can be quantified through longitudinal and lateral velocity distributions and differences in the lateral stresses along mutually orthogonal directions. The results contrast with 1-D model predictions of uniaxial strain reloading and unloading. Work supported by DOE.

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