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Using Growth and Arrest of Richtmyer-Meshkov Instabilities and Lagrangian Simulations to Study High-Rate Material Strength MICHAEL PRIME, DIANE VAUGHAN, DEAN PRESTON, DAVID ORO, WILLIAM BUTTLER, Los Alamos National Laboratory — Rayleigh-Taylor instabilities have been widely used to study the deviatoric (flow) strength of solids at high strain rates. More recently, experiments applying a supported shock through mating surfaces (Atwood number = 1) with geometrical perturbations have been proposed for studying strength at strain rates up to 10^7/sec using Richtmyer-Meshkov (RM) instabilities. Buttler et al. [J. Fluid Mech., 2012] recently reported experimental results for RM instability growth but with an unsupported shock applied by high explosives and the geometrical perturbations on the opposite free surface (Atwood number = -1). This novel configuration allowed detailed experimental observation of the instability growth and arrest. We present results and detailed interpretation from numerical simulations of the Buttler experiments on copper. Highly-resolved, two-dimensional simulations were performed using a Lagrangian hydrocode and the Preston-Tonks-Wallace (PTW) strength model. The model predictions show good agreement with the data in spite of the PTW model being calibrated on lower strain rate data. The numerical simulations are used to 1) examine various assumptions previously made in an analytical model, 2) to estimate the sensitivity of such experiments to material strength and 3) to explore the possibility of extracting meaningful strength information in the face of complicated spatial and temporal variations of stress, pressure, and temperature during the experiments.

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