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Shear Stress Behavior in Mesoscale Simulations of Granular Materials DON FUJINO, ILYA LOMOV, EFREM VITALI, TARABAY ANTOUN, LLNL — 3D mesoscale simulations of shock propagation in porous solids and powder have been performed with the hydrocode GEODYN. The results indicate that voids can have a profound effect on the stress state in the material behind the shock front. The simulations can explain experimentally observed quasielastic precursors in reshock profiles that are difficult to interpret in the context of the classical elastic-plastic theory. This effect persists even at extremely low porosity values, down to 0.01% by volume. Stress relaxation is pronounced in simulations involving wave propagation, but is not observed in uniform ramp loading. Thus this relaxation mechanism is non-local in nature and continuum models may not be inadequate for its description. Simulations show that response of highly porous powders are dominated by deviatoric stress relaxation in the shock regime. We propose an enhancement which can be easily integrated into most existing porous material continuum models for modeling the shock-induced relaxation phenomena observed in the mesoscale simulation. The model calculates microkinetic energy generated by dynamic loading and store it as an internal state variable. The rate of production and dissipation of microkinetic energy is calibrated based on the mesoscale results. The augmented continuum model represent deviatoric stress behavior observed under different loading regimes.

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