Abstract Submitted
for the SHOCK19 Meeting of
The American Physical Society

Analysis of Plate Impact and Hopkinson Bar Experiments for RDX Single-Crystals FRANCIS ADDESSIO, DARBY LUSCHER, NISHA MOHAN, MARC CAWKWELL, BEN MORROW, Los Alamos National Laboratory, CHRIS MEREDITH, US Army Research Laboratory, KYLE RAMOS, Los Alamos National Laboratory — Thermomechanical constitutive models have been developed for interpreting experiments for single-crystals of RDX. The models are developed for the large deformation of materials and including the effects of nonlinear elasticity, plastic slip, phase transformations, and brittle damage. The constitutive models are based on the multiplicative decomposition of the deformation gradient and they have been applied to both plate impact and recent Split Hopkinson Pressure Bar (SHPB) experiments. For the plate impact experiments, pressures below and above the 3.8 GPa a to γ transformation pressure were accessed. Free energies have been developed for the a and γ-polymorphs of RDX that provide the driving force for the transformation in our simulations. A phenomenological thermal activation model was employed to model the plastic slip. Crystal orientation and thickness were considered and good agreement with the experimental data was obtained. A constitutive model that combines anisotropic linear elasticity, plastic slip, and brittle damage was developed to understand recent SHPB experiments on oriented RDX single crystals. A finite number of discrete cracks were included to model damage evolution. Crack growth but no nucleation processes were included in the model. The effects of plastic slip and crack friction were investigated systematically. Good accord with the measured stress-strain curves was obtained during the failure of the samples.

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Date submitted: 26 Feb 2019 Electronic form version 1.4