Abstract Submitted
for the SHOCK19 Meeting of
The American Physical Society

Single crystal plasticity model with deformation twinning for the high rate deformation of β-HMX MILOVAN ZECEVIC, DARBY LUSCHER, MARC CAWKWELL, FRANCIS ADDESSIO, Theoretical Division, Los Alamos National Laboratory, Los Alamos, NM, 87544, USA, KYLE RAMOS, Explosive Science and Shock Physics Division, Los Alamos National Laboratory, Los Alamos, NM, 87544, USA — Deformation twinning is an important deformation mechanism during loading along certain crystallographic directions of β-cyclotetramethylene tetranitramine (β-HMX). In this work, a finite strain thermomechanical model developed by Luscher et al. is extended to include twinning as a deformation mechanism in addition to plastic slip. The stress is derived from the free energy expression including a term representing equation of state. The crystal plasticity framework is used to divide the total strain into inelastic and elastic, where elastic part is used in expression for free energy. The twin systems are treated as pseudo slip systems and the shear rate on twin systems is evaluated in terms of the twin resistance and appropriate projections of the stress tensor. The model parameters were calibrated against a set of plate impact experiments performed on β-HMX by Dick et al. The remaining plate impact experiments are used to evaluate the predictive capability of the model. The quality of the model fits and predictions is discussed from physical and modeling perspective. Particularly, the role of twin modeling on results is highlighted. The model is used to explore relationship between propensity for twinning and crystal orientation, experimentally studied in Gallagher et al.

Milovan Zecevic
Theoretical Division, Los Alamos National Laboratory, Los Alamos

Date submitted: 19 Mar 2019 Electronic form version 1.4