Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Modeling of the Cellular Structure of Detonation in Liquid Explosives LUKE EDWARDS, University of Arizona, MARK SHORT, Los Alamos National Laboratory — Detonation waves propagating in some liquid explosives such as nitromethane (NM) are known to exhibit complex cellular patterns reminiscent of those observed in gaseous explosives. Such cellular structures in NM/diluent mixtures have been recorded by framing camera images (Fickett and Davis 1979). The origins of such instabilities are disputed, ranging from hydrodynamically generated instabilities to failure waves propagating into the detonation reaction zone from the NM/confiner boundary. Detonation front shapes measurements by streak camera imaging in NM/diluent mixtures, on the other hand, mostly show smoothly curved shock fronts, which appear to contradict the observed presence of cellular instabilities. We also know that detonations in NM mixtures are carbon rich, which results in a spatially elongated zone of carbon coagulation behind a much thinner main reaction layer. In this work, we examine the potential origin of the observed cellular detonation instabilities in NM mixtures via an asymptotic theory that explicitly accounts for the long carbon coagulation region. The theory explores why the presence of cellular instabilities may not manifest themselves on the detonation shock front.

Mark Short
Los Alamos National Laboratory

Date submitted: 26 Jul 2019 Electronic form version 1.4