Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Mechanism of Gaseous Detonation Propagation Through Reactant Layers Bounded by Inert Gas RYAN HOUIM, University of Florida —

Vapor cloud explosions and rotating detonation engines involve the propagation of gaseous detonations through a layer of reactants that is bounded by inert gas. Mechanistic understanding of how detonations propagate stably or fail in these scenarios is incomplete. Numerical simulations were used to investigate mechanisms of gaseous detonation propagation through reactant layers bounded by inert gas. The reactant layer was a stoichiometric mixture of C_2H_4/O_2 at 1 atm and 300K and is 4 detonation cells in height. Cases where the inert gas temperature was 300, 1500, and 3500 K will be discussed. The detonation failed for the 300 K case and propagated marginally for the 1500 K case. Surprisingly, the detonation propagated stably for the 3500 K case. A shock structure forms that involves a detached shock in the inert gas and a series of oblique shocks in the reactants. A small local explosion is triggered when the Mach stem of a detonation cell interacts with the compressed reactants behind one of these oblique shocks. The resulting pressure wave produces a new Mach stem and a new triple point that leads to a stable detonation. Preliminary results on the influence of a deflagration at the inert/reactant interface on the stability of a layered detonation will be discussed.

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Date submitted: 31 Jul 2017 Electronic form version 1.4