Abstract Submitted
for the DFD05 Meeting of
The American Physical Society

Instabilities of Reverse Smolder Waves JOHN BUCKMASTER, ZHANBIN LU, MINYONG CHEN, LUCA MASSA, University of Illinois — We use numerical strategies to examine the stability of reverse smolder waves in the context of a model that can permit both fuel-rich and fuel-lean waves. The steady-state response for such waves, maximum temperature versus blowing rate, is characterized, for increasing blowing rate, by a fuel-rich branch of rising temperature followed by a fuel-lean branch of falling temperature, followed by quenching. The propagation speed at the quenching point is nonzero. For the parameters that we consider, the entire fuel-rich branch is unstable to 2-dimensional disturbances, but the dynamic consequences are modest. An interval of the fuel-lean branch whose left boundary is at the point of stoichiometry is stable, but the remainder of the branch, all the way to the quenching point, is unstable. These instabilities are destructive, and the contiguous smolder wave becomes fragmented. Tribrachial fragments can emerge, analagous to the tribrachial or triple flames familiar from gaseous edge-flame studies. Their emergence is characterized by a sharp rise in the maximum temperature, a rise that could lead to a transition to flaming (gas-phase) combustion.

John Buckmaster
University of Illinois

Date submitted: 01 Aug 2005 Electronic form version 1.4