The detonation structure and its impact on detonation limits predictions

M. I. Radulescu
University of Ottawa
Ottawa, Ontario, Canada

Abstract

All gaseous detonations take on a cellular structure with large departures from the steady 1D laminar ZND model. The present talk outlines the current understanding on how the departure from the steady model influences the dynamics of detonations with boundary losses and ultimately their limits. It is argued that there are two wide classes of detonation behavior. Detonations in which all gas reacts rapidly by auto-ignition behind the different elements of the cellular front are well predicted by the ZND model neglecting the non-steady cellular structure. We refer to these as *piece-wise laminar* detonations. In the second class, for more sensitive chemistry, the gas escapes auto-ignition via unsteady expansion behind the non-steady lead shocks and turbulent diffusive burning controls the burning rate. Large departures are found from the ZND model predictions for these *turbulent* detonations. We review the mechanisms controlling the generation of turbulence in detonations in the latter class, associated with the Mach reflections of strong shocks in low isentropic exponent gases.

This work reports recent findings obtained with PhD students Bijan Borzou, Brian Maxwell, Qiang Xiao and She-Ming Lau-Chapdelaine.

Correspondence to: matei@uottawa.ca