Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Thermal-Chemical Instability in Plasma-Assisted Combustion[1]
HONGTAO ZHONG, MIKHAIL SHNEIDER, Department of Mechanical and Aerospace Engineering, Princeton University, MIKHAIL MOKROV, Institute for Problems in Mechanics, Russian Academy of Sciences, YIGUANG JU, Department of Mechanical and Aerospace Engineering, Princeton University — In the flow of weakly ionized plasma, the transition from a diffusive volumetric discharge to a contracted localized filament is called plasma thermal instability. Traditionally, plasma thermal instability is controlled by the well-known thermal-ionization mechanism. However, endothermic/exothermic chemical reactions may bring new couplings between the reactive flow of weakly ionized plasma and chemical kinetics. In this work we developed a one-dimensional numerical model and studied the dynamics of thermal-chemical instability in a reactive mixture. Several key parameters including flow speed, gas pressure, initial temperature and mixture compositions are identified and discussed for their influence on triggering the thermal-chemical instability. This work will fill the knowledge gap in understanding the chemical kinetic effect on plasma instability in combustible mixtures and provide support for the future development of volumetric plasma ignition for ultra-lean combustion in advanced engines.

[1]This work was supported by NSF and DOE Grant on plasma instability and plasma chemistry

Hongtao Zhong
Department of Mechanical and Aerospace Engineering, Princeton University

Date submitted: 27 Jul 2019 Electronic form version 1.4