Abstract Submitted
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Direct Numerical Simulation of a Cavity-Stabilized Ethylene/Air Premixed Flame[1] JACQUELINE CHEN, ADITYA KONDURI, HEMANTH KOLLA, Sandia National Laboratories, ANDREAS RAUCH, HARSHA CHELLIAH, University of Virginia — Cavity flame holders have been shown to be important for flame stabilization in scramjet combustors. In the present study the stabilization of a lean premixed ethylene/air flame in a rectangular cavity at thermochemical conditions relevant to scramjet combustors is simulated using a compressible reacting multi-block direct numerical simulation solver, S3D, incorporating a 22 species ethylene-air reduced chemical model. The fuel is premixed with air to an equivalence ratio of 0.4 and enters the computational domain at Mach numbers between 0.3 and 0.6. An auxiliary inert channel flow simulation is used to provide the turbulent velocity profile at the inlet for the reacting flow simulation. The detailed interaction between intense turbulence, nonequilibrium concentrations of radical species formed in the cavity and mixing with the premixed main stream under density variations due to heat release rate and compressibility effects is quantified. The mechanism for flame stabilization is quantified in terms of relevant nondimensional parameters, and detailed analysis of the flame and turbulence structure will be presented.

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