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Modeling of Streamer Discharges in Supersonic Flows for Combustion Applications DOUG BREDEN, University of Texas at Austin, LAXMINARAYAN RAJA, University of Texas at Ausin — Experiments in recent years have shown that high voltage, nanosecond pulsed plasma discharges are capable of enhancing combustion in supersonic fuel-air mixtures. At pressures near one atmosphere the plasma forms as a highly non-equilibrium, filamentary streamer discharge. The plasma decreases ignition delay time by producing highly reactive radicals such as atomic oxygen and electronically excited metastable species such as singlet delta oxygen. Our objective is to model single high-voltage pulses over nanosecond timescales to determine the relative importance of thermal heating versus plasma chemical reactions in enhancing combustion. This work is a continuation of previous work utilizing an expanded oxygen-hydrogen chemistry and a high pressure argon chemistry. We investigate 10 ns pulses with applied voltages ranging from 4-8 kV in Mach 3 oxygen-hydrogen and argon flows. The resulting plasma is weakly ionized with ion densities on the order of 10^{20} m^{-3} and O radical densities on the order of 10^{21} m^{-3}. The argon plasma streamers propagate over a larger distance compared to the oxygen-hydrogen streamers, with smaller streamers branching from the main streamers near the electrode. The oxygen-hydrogen streamers are highly electronegative with electrons present primarily in the streamer heads. Most gas heating taking place in the electrode near field region due to ion Joule heating.

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