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Unsteady plasma fluid simulations in reacting flow TIERNAN CASEY, JYH-YUAN CHEN, Univ of California - Berkeley, JIE HAN, FABRIZIO BISETTI, PAUL ARIAS, HONG IM, King Abdullah University of Science and Technology — As partially ionized environments, flames possess the potential to admit plasma behavior when the degree of ionization is sufficiently high. As such, the flame behavior can be susceptible to augmentation by applied electric fields. Experiments observing flame stabilization and ignition enhancement under applied electric fields suggest that the dynamics and chemistry of electrons play an important role in catalyzing favorable reactions by exciting relevant neutral species to excited states. This is particularly true when the electric field strength is sufficient to accelerate electrons to such energies that they are no longer in thermal equilibrium with the surrounding neutrals. To investigate these processes, we formulate a multi-fluid governing system of transport equations to account for the non-equilibrium electrons by partitioning the mixture - whilst explicitly re-coupling the component fluids using data determined from solutions to the Boltzmann kinetic equation. A fully-compressible DNS reacting flow solver, S3D, is modified to solve for the charged species transport and time-resolved electric field for applied potentials. We present simulation results for laminar premixed methane flames with a view of informing investigations of microwave-assisted ignition.

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