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Study on Turbulent Premixed Flame Regimes with Ignition Using a Reactor Assisted Turbulent Slot Burner SANG HEE WON, CHRISTOPHER REUTER, Princeton University, BRET WINDOM, University of Colorado Colorado Springs, YIGUANG JU, Princeton University — Turbulent premixed flames of n-heptane/air and toluene/air mixtures affected by ignition have been experimentally investigated by using a reactor-assisted turbulent slot (RATS) burner at two burner temperatures, 450 K and 700 K. Turbulent burning velocities (ST) and flame structures have been measured by the simultaneous OH and CH2O planar laser-induced fluorescence (PLIF) imaging at various equivalence ratios and turbulent Reynolds numbers. Three distinct turbulent premixed flame regimes are identified for n-heptane/air mixture; chemical frozen (CF) regime at low temperature, low temperature ignition (LTI) regime, and high temperature ignition (HTI) regime for respectively lean and rich conditions at 700 K. For CF regime, the measured turbulent burning velocities of n-heptane and toluene at 450 K follow a conventional correlation of turbulent intensity (defined as u'/SL). In LTI regime, substantial changes in chemical composition alter the laminar flame speed and transport property, leading to rapid increase of turbulent burning velocity. In HTI regime, it is found that the turbulent premixed flame structure is significantly modified by the appearance of volumetric ignition kernel structures associated with the transition from LTI to HTI. The turbulent premixed flame regime in HTI is no longer represented by the thin reaction zone regime. The measured turbulent burning velocities in HTI regime increase substantially as increasing ignition Damkőhler number over those in LTI regime.

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