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Structure and stabilization of hydrogen-rich transverse jets in a vitiated turbulent flow SGOURIA LYRA, Sandia National Laboratories, BENJAMIN WILDE, Georgia Institute of Technology, HEMANTH KOLLA, Sandia National Laboratories, JERRY SEITZMAN, TIM LIEUWEN, Georgia Institute of Technology, JACQUELINE CHEN, Sandia National Laboratories — Results are presented from a joint experimental and numerical study of the flow characteristics and flame stabilization of a hydrogen rich jet injected into a turbulent, vitiated crossflow of lean methane combustion products. Simultaneous high-speed stereoscopic PIV and OH PLIF measurements are obtained alongside 3D direct numerical simulations of inert and reacting JICF with detailed H_2/CO chemistry. Under the investigated conditions an autoigniting, burner-attached flame initiates uniformly around the burner edge. Significant asymmetry is observed between the reaction zones located on the windward and leeward sides, due to the substantially different scalar dissipation rates. The unsteady dynamics of the windward shear layer are explored to elucidate the important flow stability implications arising in the reacting JICF. Vorticity spectra extracted from the windward shear layer reveal that the reacting jet is globally unstable and features two high frequency peaks, including a fundamental mode whose Strouhal number of ~ 0.7 agrees well with previous non-reacting JICF stability studies. Chemical explosive mode analysis shows that the entire windward shear layer, and a large region on the leeward side, are highly explosive prior to ignition and are dominated by non-premixed flame structures after ignition. The predominantly mixing limited nature of the flow after ignition is confirmed by the Takeno flame index, showing that $\sim 70\%$ of the heat release occurs in non-premixed regions.

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