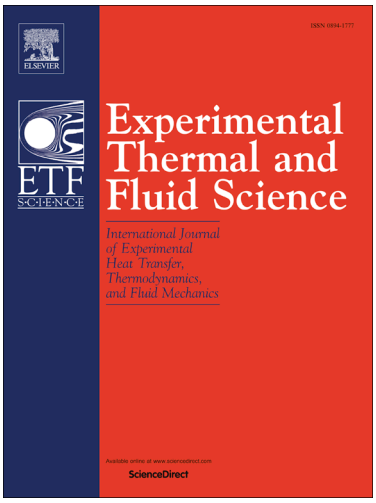

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Experimental Investigation of Flame Propagation and Stabilization in a Meso-Combustor with Sudden Expansion

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***Abstract*—Combustion of gaseous fuels in a meso-scale combustor duct with a sudden expansion is studied experimentally. Premixed mixtures of methane-air and propane-air are considered. Different flame states are observed, namely, travelling flames within the duct, steady/oscillating flame within or at the exit of the duct, and no ignition. The travelling flames suffer quenching either head-on at the sudden expansion or along the walls of the duct. Regime transitions across these flame states are mapped comprehensively over a wide range of operating conditions. The time scale of propagation of the travelling flames corresponds to transient heat conduction in the duct wall material, regardless of the manner of quenching experienced by the flame. These flame speeds relative to the unburned mixture are below the adiabatic flame speed due to the flame-wall interaction, but follow the same trend with equivalence ratio as the latter. Across the regime transition from the wall-quenched travelling flame to the steady/oscillating flame in the duct, the flame propagation slows down abruptly with slight increase in the duct Reynolds number to allow adequate time for significant heating of the wall and upstream reactants that enables the flame stabilization. The location of flame stabilization, however, follows the same trend as the location of wall-quenching, as the Reynolds number is increased. The final locations of the wall-quenched and the stable/oscillatory flames are further downstream of the flow recirculation zone at the sudden expansion.**

Keywords: Meso-combustion, sudden expansion, flame quenching, flame stabilization/propagation.