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Ignition, Flame Structure and Near-Wall Burning in Transverse Hydrogen Jets in Supersonic Crossflow[1] MIRKO GAMBA, M. GODFREY MUNGAL, RONALD K. HANSON, Stanford University — The work aims at investigating near-wall ignition and flame structure in transverse underexpanded hydrogen jets in high-enthalpy supersonic crossflows generated in an expansion tube. Crossflow conditions are held fixed at M=2.4, $p = 40\ kPa$ and $T \approx 1400\ K$, while jet-to-crossflow momentum flux ratios J in the range $0.3 - 5.0$ are considered. Schlieren and OH^* chemiluminescence imaging are used to characterize flow structure, ignition and flame penetration, while the instantaneous reaction zone is identified with planar laser-induced fluorescence imaging of OH on side- and plan-view planes. The upstream separation length is found to scale as $J^{0.44}D$ (D jet diameter). Similarly, the ignition point x_{ig} strongly depends on J: x_{ig} tends to a limiting value of $\sim 22D$ as $J \to 0$, and the flame is anchored in the upstream recirculation region and lee-side of the jet for $J > 3$. Flame penetration is well described by the traditional form $k\,(x/DJ)^m$ where both k and m are found to depend on J but these parameters reach a limiting value of $k \approx 1$ and $m \approx 0.3$ for $J > 2$. The roles of the unsteady bow shock, the separation and recirculation regions on the near-wall ignition, stabilization and mixing at large J are discussed.

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