Planar Laser Induced Fluorescence (PLIF) with acetone seeding was applied to measure the scalar fields of an axisymmetric freejet and an inclined jet-in-crossflow as applicable to film cooling. From the scalar fields, jet-mixing and trajectory characteristics were obtained. In order to validate the technique, the canonical example of a nonreacting freejet of Reynolds Numbers 900-9000 was investigated. Desired structural characteristics were observed and showed strong agreement with computational modeling. After validating the technique with the axisymmetric jet, the jet-in-crossflow was tested with various velocity ratios and jet injection angles. Results indicated the degree of wall separation for different injection angles and demonstrate both the time-averaged trajectories as well as select near-wall concentration results for varying jet momentum fluxes. Consistent with literature findings, the orthogonal jet trajectory for varying blowing ratios collapsed when scaled by the jet-to-freestream velocity ratio and hole diameter, \( r_d \). Similar collapsing was demonstrated in the case of a non-orthogonal jet. Computational Fluid Dynamic (CFD) simulations using the OpenFOAM software was used to compare predictions with select experimental cases, and yielded reasonable agreement. Insight into the importance and structure of the counter rotating vortex pair and general flowfield turbulence was highlighted by cross validation between CFD and experimental results.

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Approved for distribution by Subith Vasu, Committee Chair, on March 19, 2015.

The public is welcome to attend.