STRUCTURE OF STRATIFIED TURBULENT FLOW IN A SWIRLING JET-FLAME

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Abstract: The paper reports the results of the experimental study of combustion effect on flow structure and stratification in a turbulent (Re = 5000) swirling jet. A high-speed particle image velocimetry system in stereoscopic configuration was used for the measurements of the instantaneous velocity field. Local gas density in the flame was evaluated on the basis of the local intensity of spontaneous Raman scattering by nitrogen molecules. The nonreacting jet was featured by a bubble-type vortex breakdown. Three cases of the turbulent reacting jet flow of the methane–air mixture were considered. The equivalence ratio was $\Phi = 0.7$, 1.4, and 2.5. In the latter case, combustion occurred in the form of a lifted flame and the flow structure and dynamics were similar to those without combustion, namely, a bubble-type recirculation zone was featured by intense flow precession near the nozzle exit. In the case of mixtures with $\Phi = 0.7$ and 1.4, the recirculation zone resembled shape of an inverted cone with weakly turbulent reverse flow inside.

Keywords: swirling jet; turbulent swirling flame; laser diagnostics; spontaneous Raman scattering

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