Structure and stabilization mechanism of a microjet methane diffusion flame near extinction

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Abstract

The flame structure and stabilization mechanism of a microjet methane diffusion flame
near extinction are numerically investigated using multi-component transport model coupled
with GRI-Mech 3.0 chemical kinetic mechanisms. The small flame size and intensive heat
loss to the burner wall suggest that the microjet flame may always operate in a severe
condition near extinction with distinct stabilization feature. Of particular interest is the
flame structure in the standoff region, as it would directly relate to the mixing, diffusion, and
chemical kinetic processes as well as flame stabilization. Computed results show that near
extinction the fuel burns in a diffusion flame, in contradiction to a simple jet flame prediction.
Neither a double flame nor a triple flame is observed in the computed structures, suggesting
that the standoff flame is stabilized by the hot zone that connects to the reaction kernel,
through the formation of HO2 layer and subsequent key radical reactions.

Keyword：Microjet diffusion flame, Stabilization mechanism, Extinction limit.