The application of laser diagnostic techniques for temperature and species concentration measurements in microjet flames

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Abstract

This paper summarizes the development and application of laser diagnostic techniques for temperature
and species concentration measurements in microjet hydrogen diffusion flames. Characteristics of microjet
hydrogen diffusion flames produced from various diameter (d = 0.2, and 0.48 mm) tubes are investigated
using non-intrusive UV Raman scattering coupled with LIPF technique. Simultaneous, temporally and
spatially resolved point measurements of temperature, major species concentrations (O2, N2, H2O, H2), and
absolute hydroxyl radical concentration (OH) are made in the microflames for the first time. In addition,
photographs and 2-D OH imaging techniques are employed to illustrate the flame shapes and reaction zones.
Several important features are identified from the detailed measurements of microflames. Comparisons
between the predicted and measured data indicate that the trends of temperature, major species, and OH
distributions are properly modeled. However, the code does not properly predict the air entrainment and
pre-heating enhanced thermal-diffusive effects. Therefore, thermal diffusion for light species and different
combustion models might need to be considered in the simulation of microflame structure.

Keyword：Microjet flames, Raman scattering, LIPF, Numerical simulation