NEAR-INFRARED EMISSION SPECTROMETRY MEASUREMENTS FOR NONINTRUSIVE SOOT DIAGNOSTICS IN FLAMES

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ABSTRACT. Present study focuses on measurement of line-of-sight emission intensity spectra in the near-infrared range by Fourier Transform Infrared spectrometry for use in tomographic soot diagnostics. Measurements were carried out on an axisymmetric, laboratory grade, ethylene/air diffusion flame within 1.1-1.7 μm (9000-6000 cm^{-1}) spectral range. Description of the measurement and calibration methodology is followed by description of noise and uncertainty assessment procedures. A novel noise characterization approach which accounts for both spectral and spatial fluctuations was introduced. Measured intensities were utilized to infer soot temperature and volume fraction profiles from an inversion technique based on gray refractive index assumption. Predictions at flame axis are found to be in reasonable agreement with properties reported in literature for similar flames but steep volume fraction peaks at the flame edges are not sufficiently captured due to expected effects of large beam diameter, suggesting that present configuration requires improvement in terms of spatial resolution.
Keywords: soot, tomography, diagnostics, FTIR, spectroscopy, diffusion flames, noise, calibration