Development of a TDLAS sensor for temperature and concentration measurements of H_2O in high speed and high temperature reacting flows[1]. SUZANNE L. SHEEHE, Los Alamos National Laboratory, SEAN O'BYRNE, The University of New South Wales, Canberra, Australia. –

The development of a sensor for simultaneous water concentration and water temperature measurements in high speed rarefied flows is presented. Water is a desirable target sensing species because it is a primary product in combustion systems; both temperature and concentration profiles can be used to assess both the extent of the combustion reaction system and the flow field characteristics. Temperature provides valuable information on combustion efficiency and heat exchange in a flow field. Accurate measurements are therefore highly desirable. This work focuses on the accuracy of the sensor which uses a vertical-cavity surface emitting laser (VCSEL) scanned at 50 kHz from 7172 to 7186 cm^{-1}. Temperatures and concentrations are extracted from the collected spectra by fitting theoretical spectra to the experimental data using a nonlinear least squares fitting routine. The theoretical spectra are generated using GENSPECT in conjunction with line parameters from the HITRAN 2012 database. To validate the theoretical spectra, experimental spectra of H_2O were obtained at known temperatures (290-550 K) and pressures (~ 30 torr) in a heated static gas cell. The results show that some theoretical lines deviate from the experimental lines. New line-strengths are calculated assuming that the line assignments and broadening parameters in HITRAN are correct. This data is essential for accurate H_2O concentration and temperature measurements in reacting flows at low pressure and high temperature conditions.

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