Combustion Measurement of Counter Flow Diffusion Flame under High Pressure Using Coherant Anti-stokes Raman Scattering (CARS) Thermometry

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H_2-air combustion is widely employed in power generation systems and high speed propulsion systems which are high-pressure environments. Therefore, it is imperative to perform diagnostics in order to understand behaviors of H_2-air flames under high pressure to improve the design of systems such as those mentioned previously. In order to perform measurements at high pressure, a facility has been constructed for stabilizing steady-state, laminar counterflow diffusion flames (CFDFs). Both, qualitative and quantitative measurements will be performed in this high-pressure facility. Numerical simulations of high pressure, H_2-air flame structure are also being performed using COSILAB with finite chemistry reaction mechanisms. These simulations will be used to validate experimental results, specifically, nozzle centerline temperature profiles and flow strain rates at flame extinction. Temperature profiles in H_2-air CFDFs at 1 atm have been obtained using Vibrational coherent anti-Stokes Raman scattering (VCARS) technique and those results have been validated compared to numerical results. Strain rates at flame extinction were noted at atmospheric conditions and in the high pressure facility (2 atm to 10 atm for 17% H_2) and the results were compared against numerical results. Numerically, the temperature profiles of H_2-air flames CFDFs exhibited narrowing with increasing pressures. Also, at higher pressures higher peak temperatures were computed for 17% to 50 % H_2 at 10 SLPM. The strain rate at which flames went to extinction also increased with pressure (between 1 to 10 atm.). Numerical simulations and experimental results will further refine thermodynamic and hydrodynamic models used for simulating more realistic H_2-air combustion environments.