Contribution ID: **714** Type: **Oral**

NO PLIF flow visualization and time-resolved temperature distribution measurements in laser induced breakdown plumes

Thursday 27 June 2019 13:30 (30 minutes)

Achieving higher fuel efficiency and reducing NO_x emissions from internal combustion engines and gas turbine requires operation at lower equivalence ratios, when ignition and flameholding may become unstable. A similar problem occurs during ignition of supersonic flows, when ignition delay time may become comparable with the flow residence time and fuel-air mixing time in the combustor. Laser Induced Breakdown (LIB) is being studied as a promising non-intrusive approach to initiate combustion and enhance fuel-air mixing at these conditions. The objective of the present work is to characterize the flow induced by laser breakdown at near atmospheric pressure, and to measure the temperature distribution in the breakdown-induced plume.

The time evolution of the temperature profile of a laser breakdown plume was studied by Planar Laser Induced Fluorescence (PLIF) at 226 nm. The 2^{nd}-harmonic output of an Nd:YAG laser (47 mJ/pulse) produced optical breakdown in a slow flow at near atmospheric pressure. The delay time between the LIB and PLIF laser pulses was varied to monitor the time evolution of the breakdown-induced plume.

For characterization of the induced flow, the laser-induced depletion of NO in a 1000 ppm NO-N_2 mixture at 600 Torr was imaged for ensembles of laser shots at varying LIB-PLIF time delays up to 500 µs. Statistical analysis of the plume boundary for the individual laser shots reveals stochastic behavior at time delays longer than 100 µs, with little or no shot-to-shot reproducibility.

Time resolved, two-dimensional temperature profiles in dry air at 600 Torr were inferred from the intensity ratio of PLIF images of two rotational lines obtained by exciting NO generated in the laser breakdown plasma. Images of the two rotational transitions of the NO($X^2\Pi, v' = 0 \rightarrow A^2\Sigma^+, v'' = 0$) ${}^QR_{12} + Q_2$ band, $J'' = 6.5$ and $J'' = 12.5$, are averaged over 600-1200 laser shots. Peak temperatures over 1200 K are detected in the plume at time delays up to 500 µs.

Authors: Dr VAN DEN BEKEROM, Dirk (The Ohio State University); Mr JANS, Elijah (The Ohio State University); Prof. ADAMOVICH, Igor (The Ohio State University)

Presenter: Dr VAN DEN BEKEROM, Dirk (The Ohio State University)

Session Classification: 4.3 Radiation Physics & X-ray Lasers and 4.5 Laser Produced Plasmas

Track Classification: 4.5 Laser Produced Plasmas