# DOWNLOAD PDF SOOT MODELING OF A TURBULENT NON-PREMIXED ETHYLENE/AIR JET FLAME

## Chapter 1 : Flowfield Imaging Lab : Research

*All turbulent non-premixed ethylene/air flames considered in this work have a similar geometry, as shown in Fig. 1(a). Pure ethylene enters into quiescent air through a nozzle and combustion takes place at atmospheric pressure (open configuration).*

Clemens sponsored by the National Science Foundation and SERDP The study seeks to experimentally quantify the mixture fraction and soot-volume fraction fields, and kinematics in the near-field soot-inception region of a low-strain jet flame using simultaneous diagnostics including planar laser-induced fluorescence PLIF of krypton Kr , in conjunction with stereoscopic particle image velocimetry sPIV and laser-induced incandescence LII. Planar laser-induced fluorescence of Kr enables the imaging of a conserved scalar in the flow. The resulting fluorescence is collected at  The inclusion of sPIV and calibrated LII with the Kr PLIF allows for measurements of the local velocity field and soot volume fractions, respectively, crucial for understanding the formation and transport of soot within the flame. Initial results with krypton PLIF indicate minimal distortion of the measured radial concentration profiles for seeding concentration up to 4 percent krypton by mole fraction with notable distortion becoming apparent at the jet exit due to both absorption of the exciting radiation and self-quenching of the fluorescence for increasing concentration. Furthermore, contamination of the fluorescence signal due to the presence of polycyclic aromatic hydrocarbons PAHs was found to be negligible in the soot inception region, though the intermittent soot structures affected the extinction of the incident exciting radiation to some extent. Jet flame is established through a stainless steel tube of internal diameter 1 cm and length cm. The co-flow air passes through a nozzle with a contraction ratio of 2. Schematic diagram of the flow facility. The images below show instantaneous planar laser induced incandescence images of C2H4 jet and C2H4-N2-Kr jet left two images , a polycyclic aromatic hydrocarbon PAH fluorescence image top panel on the right , and a krypton PLIF image bottom panel on the right. LII image of the C2H4 jet flame. Image of the PAH fluorescence. Image of the laser-induced Kr fluorescence. An analysis of the raw fluorescence signal indicates a strong negative correlation between the observed PLIF signal and the soot volume fraction within the stoichiometric velocity surface of the flame, indicative of the transport of fuel-lean and soot-rich fluid or conversely, fuel-rich and soot-lean within the shear layers of the flame, and trending to a null correlation within the potential core where the soot concentration is at a minimum. It was also found that the regions of highest soot volume fraction are present in regions of low strain. Further analysis of this data will allow for a quantitative measurement of the mixture fraction in addition to spatial correlations with temperature, strain rate, and soot volume fraction within this region. The opposed jet simulation was used to covert the measured Krypton PLIF signal to temperature and mixture fraction information. State relationship and normalized fluorescence signal from strained flame simulation. Ongoing Work Current research is being focused on studies of soot production in flames burning alternative jet fuels such as n-dodecane and m-xylene. Diagnostics such as laser-induced incandescence, particle image velocimetry and planar laser-induced fluorescence are being used to study these flames.

## Chapter 2 : Flowfield Imaging Lab : Research

*The size, morphology, and volume fraction of soot particles within the fuel-rich regions of a non-premixed turbulent jet flame fueled by ethylene/air at atmospheric pressure were investigated.*