# Combination of High Spatial Resolution LII and LOSA measurements for determination of soot volume fraction and PAH concentration in laminar diffusion flames

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Line-of-sight-attenuation (LOSA) is a well-established soot diagnostic valuable for soot volume fraction [1] and the method of laser-induced incandescence (LII) has become a common way for in-situ particle-size measurements and visualization of particle volume fractions in a wide range of applications [2].

In this work a co-annular burner was used to produce a laminar ethylene/air non-premixed flame at the standard Gülder conditions. For the LOSA measurements, a tungsten strip lamp (450–1000 nm) was used as light source. The transmission and emission signal of the flame were both detected with a spectrometer (Jarell-Ash Monospec 18), configured to measure in the wavelength range of 450–900 nm and a CCD camera (Princeton Instrument-Spectrum MM System) with a spectral resolution of 6.7 nm per pixel on the detector plane.

For the high spatial resolution LII (HSRLII) measurements a frequency-doubled Nd:YAG laser (Big Sky Ultra CFR) was used as light source. The incandescence signal was detected at 445 and 750 nm with fast photomultipliers. The probe volume had a height of 200 µm and a width of 100 µm.

The HSRLII measurements were performed as radial scans at a number of HABs. The soot volume fractions determined with HSRLII were compared to those determined with LOSA at 3 different wavelengths. For the LOSA data, the attenuation is due to soot absorption, soot precursors (PAH) absorption, and scattering. The latter two phenomena are also wavelength-dependent. As a result, the SVFs determined from the LOSA data are always slightly higher than those for HSRLII data.

With the HSRLII the volume fraction of the soot was measured precisely and with the comparison to the scattering-corrected LOSA data, the difference between the SVFs of both measurement techniques indicates the contribution of polycyclic aromatic hydrocarbons (PAHs) as soot precursors in the volume. As the HSRLII and LOSA produced radially resolved measurements at different HABs, two dimensional distributions for the volume fractions of soot and relative PAHs can be constructed. With this information the region of soot formation can also be identified. The HSRLII measurements also give the primary particle diameters for the soot particles.

1. K. A. Thomson, M. R. Johnson, D. R. Snelling, and G. J. Smallwood, "Diffuse-light two-dimensional line-of-sight attenuation for soot concentration measurements," Appl. Opt. **47,** 694-703 (2008).

2. C. Schulz, B. F. Kock, M. Hofmann, H. Michelsen, S. Will, B. Bougie, R. Suntz, and G. Smallwood, "Laser-induced incandescence: recent trends and current questions," Appl. Phys. B **83,** 333–354 (2006).