Study of the wavelength dependence of the soot absorption function using the two-excitation wavelength Laser Induced Incandescence: application to fluorescent species detection.

S. Bejaoui[1], R. Lemaire[2], E. Therssen[1], P. Desgroux[1]

[1]Laboratoire PC2A, UMR CNRS 8522, F-59655 Villeneuve d'Ascq, France
[2]EMDouai, EI, F-59500 Douai, France
salma.bejaoui@ed.univ-lille1.fr

In this work, wavelength dependence of the absorption function of soot was experimentally studied. We used a technique developed in our team which consists to heat similarly the soot particles using two different laser excitation wavelengths. Thus, using two lasers with the same temporal and spatial irradiance profiles, it is possible to find combinations of the both lasers energies, below sublimation regime activation, insuring that soot particles absorb the same energies, reach the same temperature and emit the same Laser Induced Incandescence (LII) radiation [1]. Laser at 1064 nm is always chosen as a reference excitation and compared with a UV-visible wavelength (λ_i) such as 266 nm, 355 nm, 532 nm. In this way we can deduce the relative evolution of the absorption function $\frac{E(m,\lambda_i)}{E(m,1064nm)}$ versus wavelength.

Experiments are investigated in a turbulent diffusion flame of pulverised diesel and in a premixed methane flame stabilized on a McKenna burner. It is found that up to 700 nm the emission signal due to PAH /soot precursor LIF interferes with the LII one. Interestingly no LIF emission could be identified above 700 nm. Therefore this spectral region appears very attractive to collect soot incandescence in flames containing PAH.

The two-excitation wavelength LII method has been checked for the first time using a narrow spectral detection set above 700 nm, by using several combinations of UV-visible and IR radiations. Soot particles heating was controlled either looking at the Planck function above 700 nm or controlling the decay rate of the LII temporal signals. Once similar heating is reached using any UV-vis radiation and the 1064 nm one, the method is used to get either the ratio of soot absorption functions, or the LIF spectra of soot precursors even in the presence of soot.

[1] Therssen E., Bouvier Y., Schoemaker-Moreau C., Mercier X., Desgroux P., Ziskind M., Focsa C. , Appl. Phys. B 89, 417-427 (2007).