INVESTIGATION OF PHOTOPHYSICAL PROPERTIES OF FUEL TRACERS USED IN MIXING STUDIES OF REACTIVE AND NON-REACTIVE GASEOUS FLOWS

Figure 1: High pressure, high temperature gas flow cell for studying the fluorescence behaviour of fuel tracers using laser-induced fluorescence (LIF)

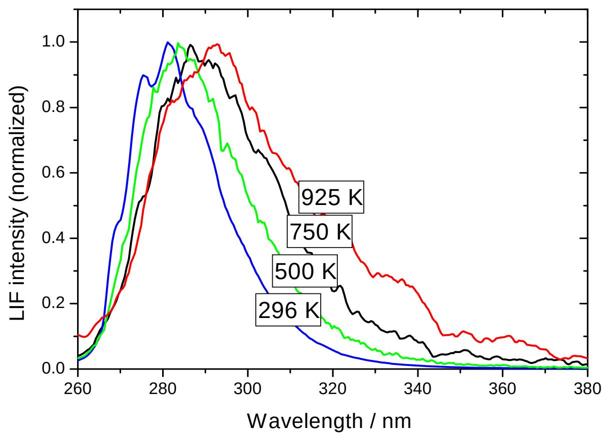

Figure 2: Temperature dependence of toluene fluorescence spectra excited with 248 nm radiation

The safe, clean and reliable operation of combustion devices depends largely on the precise control of fuel/air mixing processes prior to ignition. In addition, reduction of environmentally hazardous emissions requires after-treatment methods using exhaust gas recirculation and/or catalytic conversion of exhaust gases. Therefore, quantitative measurement techniques that characterize the state of the fresh gas mixture introduced into the engine cylinder are crucial tools for modern combustion science and engineering. Similarly, laser-optical techniques to visualize gas-mixing processes in the engine exhaust are equally important for quantitative optimization of reactive processes. Using fluorescent tracer molecules to visualize gaseous flows via laser-induced fluorescence (LIF) imaging is one of main diagnostic techniques to study mixing processes.

In experiments the pressure and temperature dependence of the LIF-signal intensity of typical tracer substances (toluene, naphthalene, 3-pentanone, etc.) in gaseous flows with nitrogen or air is investigated in a high-pressure, high-temperature cell depicted in Fig. 1. Excitation of the tracers is done in the ultraviolet using short pulsed Nd:YAG- or excimer lasers, and fluorescence is detected with intensified CCD-cameras and fast photomultipliers or a streak camera. The obtained data then allow the quantification of laser-induced fluorescence signal intensities of tracers in real flows.

This project covers the following subtasks:

- Introduction to optics and laser-based optical diagnostics
- Experimental study of spectrally resolved LIF intensities and their temporal signal decay using short-pulse ultraviolet laser excitation
- Post processing of image and time resolved data using commercial and home-made software tools

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