INVESTIGATION OF CARBONACEOUS PARTICLES BY USING LASER-INDUCED INCANDESCENCE MEASUREMENTS

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The study of combustion-generated particulate matter has received particular attention by the research community for different aspects such as the global climate change, environmental pollution and the effects on human health. The need to measure, characterize and monitor these particles emission triggered the interest for the development of advanced diagnostic techniques based either on their thermal or optical properties. Laser-Induced incandescence technique (LII) has been proved to be a powerful tool able to measure concentration and size of carbonaceous particles. Moreover, LII signals strongly depend on different parameters, such as optical and heat-exchange properties of the particles as well as the laser density energy. By using different laser density energies, the particle absorption properties, and consequently the nature of the detected particles, can be investigated.

In this work, two-colour LII measurements at different laser density energies have been performed in an ethylene diffusion flame. The behaviour of the LII signal with the laser density energy has been studied along the flame axis as well as along the annular soot layer. No significant difference has been observed on the layer by varying the height above the burner. On the contrary, as for the axial measurements, a different behaviour has been observed at 25 mm above the burner, suggesting that the particles under investigation have different optical and heat-exchange properties.

As a further investigation soot samples have been collected using thermophoretic sampling for morphological analysis. The primary particle diameter and the particle number density have been derived by processing the images obtained using the STEM detector of a Field Emission Gun Scanning Electron Microscope (FEG-SEM).

Finally, by considering the soot incandescence temperature at a given laser density energy, the gas/particle initial temperature as reported in the literature as well as the soot particles diameter and number density derived by the FEG-SEM analysis, information about the soot refractive index absorption function, E(m), at different locations in the flame have been obtained by applying a widely used LII model that can be found as a web interface.

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