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Two-color Laser-Induced Fluorescence thermometry applied to droplets: investigation of the droplet's size influence.

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Abstract

A new insight into the two-color LIF laser-induced fluorescence (LIF) is presented. The principle of the LIF technique is to induce the fluorescence of a tracer previously seeded in the liquid of interest. The two-color LIF technique was widely developed in the case of monodisperse droplets. The use of two spectral bands allows calculating a ratio of fluorescence intensities that depends only on temperature. When polydisperse and small droplets are involved, the two-color LIF technique cannot be used directly. Indeed, it appears that le droplet diameter combined with the tracer concentration influence widely the fluorescence signal and can induce a serious bias in the temperature measurement. The purpose of the present paper is to present further investigations about the potential influence of droplet size on the spectral distribution of the fluorescence intensity. The investigations have been conducted for two tracers, sulforhodamine B and Pyrromethene597-8C9. Single droplets with variable sizes, have been considered. A significant variation of the fluorescence ratio as a function of the droplet diameter is found, especially for the smallest droplets. For the biggest droplets, the fluorescence ratio tends to be equal to the one measured in a cell. In parallel, a study of the fluorescence spectra highlights a modification of the spectral distribution of the fluorescence intensity according to the droplet size. Furthermore, the increase of the fluorescent dye concentration tends to decrease significantly the influence of the droplet size on the fluorescence ratio. Finally, it is demonstrated that the crossed influences of the droplet size and fluorescent dye concentration can be summarized by a function depending on a single parameter written $C^{1/3}D$.

Key words:
Sprays, Laser-Induced Fluorescence, Temperature, Measurement techniques

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