Thickness imaging of evaporating liquid water films by simultaneous Tracer LIF, Raman imaging and Diode Laser Absorption Spectroscopy

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Abstract

Knowledge about the thickness of liquid films is important, e.g., in flash boiling of fuel spray impingement on cylinder walls in internal combustion engines or of aqueous urea solutions and subsequent evaporation on exhaust pipes of Diesel engines during exhaust gas after-treatment in the selective catalytic reduction (SCR) of nitrogen oxides. For purposes of process optimization and for providing validation data in CFD-based modeling of these processes, non-intrusive, quantitative liquid film thickness measurement techniques are desired, which potentially provide two-dimensional imaging capabilities and/or high data rates for temporally resolved measurements of the liquid film thickness is required. In this work we present the application of two imaging-based laser-diagnostic techniques – laser-induced fluorescence (LIF) and spontaneous Raman scattering (RS) – as well as a point measurement method – near-infrared diode laser absorption spectroscopy (NIR-DLAS) – for the simultaneous measurement of liquid film thickness during the time-varying evolution of spray-deposited liquid water droplets on transparent surfaces, with specific applications in an air-fed flow duct.

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