Comparison between Modeled and Measured Time-Resolved LII Signals and Soot Temperatures in a Laminar Premixed Flame

S. Bejaoui, S. Batut, E. Therssen, P. Desgroux
Laboratoire PC2A, UMR CNRS 8522, F-59655 Villeneuve d'Ascq, France
salma.bejaoui@ed.univ-lille1.fr

F. Liu, K. A. Thomson, G. J. Smallwood
National Research Council, Building M-9, 1200 Montreal Road, Ottawa, ON., Canada

LII experiments were conducted in a laminar premixed flame established with a McKenna burner at atmospheric pressure burning a mixture of methane, oxygen, and nitrogen with an equivalence ratio of 2.15 and with a flame stabilizer of stainless steel plate placed at 20 mm above the burner. A Nd:YAG laser at 1064 nm with a repetition rate of 10 Hz was used to produce a top-hat laser beam with a 6 ns pulse duration (FWHM) as the excitation source. Time-resolved LII signals were measured at 610 nm (20 nm FWHM) using a PMT at different locations in the flame and at different laser fluences. Soot temperature measurements were also conducted through recording LII spectra with a spectrograph at different locations along the flame centerline and different laser fluences. TEM analyses of soot sampled at HAB = 12 and 15 mm were also carried out to provide primary particle diameter distribution and average number of primary particles in an aggregate for LII model calculations.

Preliminary model calculations suggest that the base model LII developed at NRC was able to reproduce the experimental resolved LII signals accurately in the low-fluence regime; however, large discrepancies between the model and the experimental results occur at high fluences. To understand the role of physical and chemical processes that were not incorporated into the NRC LII model, annealing and photodesorption were implemented and their effects on the LII model results were investigated. This study is aimed at improving the NRC LII model at high laser fluences through a detailed comparison between the experimental LII results and the modeled LII results.