BEHAVIOUR OF LASER INDUCED INCANDESCENCE WITH HIGH FLUENCE LONG LASER PULSE DURATION

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Work-In-Progress Abstract

Laser Induced Incandescence (LII) is an experimental technique that has been extensively used for in-flame measurement of soot properties. The traditional laser used for LII has been Nd:YAG laser with 5-10 ns pulse durations. The present study investigates an unexpected LII signal behaviour in the form of a secondary peak observed when using long laser pulse duration in the range of hundreds of ns (cf. Fig. 1). Temporal LII signals at varying fluences (up to 4.5 J/cm^2) and pulse durations of 100, 200, and 450 ns have been analyzed. Based on the dataset collected (ca. 50 cases), it was found that the presence of the secondary peak is not pulse duration dependent, as it occurs above a fluence threshold comprised between 1.16 and 1.8 J/cm^2, for all cases, and that irradiance (W/cm^2) is clearly not a representative parameter of that transition.
Although an explanation based on theoretical grounds has not been found, the study shows that the phenomenon is independent of pulse duration and that its appearance correlates with laser fluences of approximately 1.1 J/cm^2 (cf. Fig. 2). Artificial signal generated by the experimental procedures cannot be excluded, but if so could not be identified. One hypothesis is the behavior is an amplified effect of the phenomenon observed in the literature where new particles were created from the molecular cloud during high laser fluence LII. Since LII using long pulse durations are not widely used, but present a true potential in relation to sensor technology, this unexpected LII behaviour, either physically linked to the laser-soot interaction or induced by experimental flaw, should be further understood.

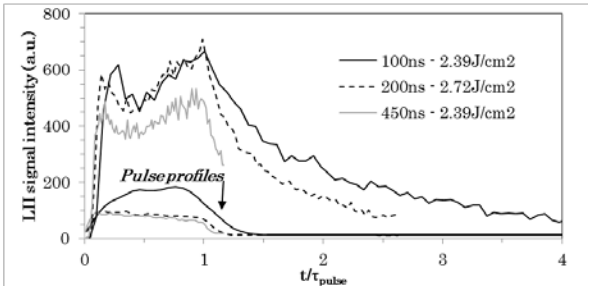

Fig. 1: High fluence time resolved LII at with 3 pulse durations.

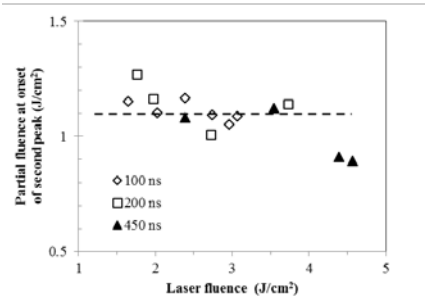

Fig. 2 Laser energy at the onset of the secondary peak