Laser diagnostics to understand the formation of soot and the evolution of soot precursors

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ABSTRACT

Understanding and predicting the transition from gas-phase fuel species through to the formation of solid-phase soot is a significant challenge that despite many decades of research and significant progress, is still an active and growing research area. While significant progress has been made with ex-situ techniques, laser diagnostics offer the unique insights as well as the ability to make spatially and time-resolved measurements which are required to understand soot formation in turbulent systems. Laser-based techniques including scattering, fluorescence, laser-induced incandescence will be discussed to examine the transition from the fuel to soot precursors to solid-phase soot. Results will be discussed from both laminar flames and turbulent flames. The accurate measurement of temperature is also an important parameter in understanding the evolution of soot and soot precursors, however such measurements are particularly challenging given the wide temperature ranges encountered and the presence of solid-phase soot particles with a high scattering propensity in the flow in sooting flames. Temperature measurements utilising coherent anti-Stokes Raman spectroscopy with a picosecond dual pump approach to determine temperature and Raman active species concentration ratios will be discussed together with the advantages of this approach over other approaches in sooting flames.