

Novel soot volume fraction measurement through ratio-pyrometry and absolute light calibration

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Novel ratio pyrometry and absolute light calibration methods have been developed to obtain soot temperature and volume fraction in axisymmetric flames. A consumer digital single lens reflex camera has been fully characterized and utilized as a pyrometer. The incandescence from soot was imaged at the three wavelengths of the camera's color filter array (CFA). Temperatures were calculated by two-color ratio pyrometry using a lookup table approach. While temperatures can be extracted from color ratios, soot volume fraction requires an absolute light calibration of the detector. The absolute light intensity calibration was provided by a flame-heated S-type thermocouple. The spectral emissivity of S-type thermocouple wires (Pt and Pt-10% Rh) was measured in the visible range. The measured spectral emissivity, temperature, and diameter of the heated thermocouple wires allow them to serve as a light source with spectral radiance that can be calculated by Planck's law. Soot volume fraction measurements were carried out on four different flames with varying levels of soot loading. The results have been compared with previous LII results and excellent agreement has been achieved.