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Development of a tunable solid state laser for temperature measurement in combustion processes

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For a precise process control during flame synthesis of nanoparticles, reliable data about the combustion temperature is essential. In particle-laden flames, Two-Line Atomic Fluorescence (TLAF) can be utilized for temperature measurements by excitation and detection of signals from two atomic transitions [1]. To that end, coherent radiation sources are required. For high-energy outputs with a widely tunable wavelength, pulsed solid-state light sources are promising, especially for high speed measurements. Optical parametrical oscillators (OPO) using nonlinear crystals satisfy these requirements. Here, wavelengths within a range between 300 nm and 3 µm can be generated, depending on the pump laser and the crystal configuration [2]. Often, the broadband output is narrowed by optical seeding with narrowband diode lasers. In contrast, we show an unseeded OPO providing sufficient narrowband radiation, while maintaining the OPO versatility of a wide tuning range. Furthermore, a linear cavity provides the best trade-off between narrowband radiation and high output energy. For further improvements, an automated adjustment and control of the wavelength is achieved by motorization of the OPO. By these measures, the excitation system allows high signal-to-noise ratios for upcoming TLAF-measurements using indium in a laminar premixed flame for temperature measurements.

References

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