COHERENT IR-UV DOUBLE-RESONANCE SPECTROSCOPY

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We demonstrate a set of two-color techniques, called laser-induced fluorescence (TC-LIF), polarization spectroscopy (TC-PS), and resonant four-wave mixing (TC-RFWM), that involve an IR laser to pump specific ground state ro-vibrational transitions and a UV laser to probe electronic transitions from the labeled lower levels. We use the hydroxyl radical in an atmospheric-pressure flame and the methyl radical formed by photolysis at high and low pressures to compare spectral line shapes, signal scaling relations, and optical saturation for the different techniques. With multi-mode 1.5-ns laser pulses, TC-PS and TC-RFWM have detection limits of 5×10^{12} OH and 2×10^{13} CH_3 (per cm^3 per quantum state). Significant collisional effects occur with samples at 1 atm. We discuss the application of these techniques to time-resolved measurements of radical concentration in complex reacting flows.