STIMULATED INFRARED EMISSION OF C_2H_2 NEAR 3000 cm^{-1} WITH CONTINUOUS-WAVE LASERS

MIKAEL SILTANEN, MARKUS METSÄLÄ, MARKKU VAINIO, and LAURI HALONEN, *Department of Chemistry, University of Helsinki, P.O. Box 55, FIN-00014 Helsinki, Finland*.

We have constructed a sensitive experimental setup that can directly probe stimulated emission arising from ro-vibrational transitions within the ground electronic state in gaseous C_2H_2. The setup has been used to record spectroscopic data on both symmetric and anti-symmetric vibrational states. The symmetric states cannot be observed in standard one-photon absorption experiments except as hot bands. We can determine the energies of the transitions near 3000 cm^{-1} with an accuracy that is better than 0.005 cm^{-1}. In practice, the accuracy is limited by our wavemeter. The system is based on a pump-probe setup of two narrow-line, continous-wave laser beams crossing inside a sample cell. The pump beam (around 13000 cm^{-1}) excites the molecules and is frequency locked to the sample cell, which also acts as an optical resonator greatly amplifying the pump beam. The probe beam (near 3000 cm^{-1}) is provided by an optical parametric oscillator. The intensity of the beam can vary slightly due to stimulated emission from the excited molecules as it makes a single pass through the sample cell. The stimulated emission is detected by repeatedly switching the pump beam on and off while measuring the intensity of the probe beam using phase-sensitive detection. Spectroscopic data are gathered by tuning the wavelengths of the beams.