On the Development of Short-Pulse Picosecond Rotational Coherent Anti-Stokes Raman Scattering

S.A. Steinmetz, M.J. Dunn, A.R. Masri
School of Aerospace, Mechanical and Mechatronic Engineering, The University of Sydney, N.S.W. 2006, AUSTRALIA
scott.steinmetz@sydney.edu.au

ABSTRACT

Rotational coherent anti-Stokes Raman scattering (RCARS) utilizing a 30 ps pulse duration laser is explored in this paper. The use of a near transform-limited 30 ps probe pulse in an RCARS system offers a unique balance of spectral and temporal properties that permits new measurements capabilities. With a 30 ps probe pulse, the suppression of non-resonant four-wave mixing with shorter delays between the probe and pump beams than a typical ~100 ps system can be employed. With reduced probe beam delays, stronger signal levels, reduced spectral heating and the measurement of fast decaying polyatomic molecules such as C_2H_4 without non-resonant interference can be achieved. The narrow spectral bandwidth of the 30 ps probe beam permits the dense RCARS spectra of molecules such as CO_2 to be resolved and also avoids spectral beating from being generated within of the bandwidth of the probe beam, a problem which complicates hybrid fs pump/ps probe RCARS systems. Suppression of the non-resonant signal with good spectral resolution and no evidence of spectral beating in pure ethylene and the complex environment of a CH_4/CO_2 diffusion flame is demonstrated.