

COLLISIONAL X- AND A-STATE KINETICS OF CN USING TRANSIENT SUB-DOPPLER HOLE BURNING

MICHAEL L. HAUSE, TREVOR J. SEARS, and GREGORY E. HALL, *Chemistry Department, Brookhaven National Laboratory, Upton, New York 11973-5000.*

We examine the collisional kinetics of the CN radical using transient hole-burning and saturation recovery. Narrow velocity groups of individual hyperfine levels in CN are depleted ($X^2\Sigma^+$) and excited ($A^2\Pi$) with a saturation laser, and probed by a counterpropagating, frequency modulated probe beam. Recovery of the unsaturated absorption is recorded following abrupt termination of an electro optically switched pulse of saturation light. Pressure-dependent recovery kinetics are measured for precursors, ethane dinitrile, NCCN, and pyruvotrile, CH_3COCN , and buffer gases, helium, argon and nitrogen with rate coefficients ranging from $0.7\text{-}2.0 \times 10^{-9} \text{ cm}^3 \text{ s}^{-1} \text{ molec}^{-1}$. In the case of NCCN, recovery kinetics are for two-level saturation resonances, where the signal observed is a combination of X - and A -state kinetics. Similar rates occur for three-level crossover resonances, which can be chosen to probe selectively the hole-filling in the X state or the decay of velocity-selected A state radicals. However in the case of CH_3COCN , which has a dipole moment of 3.45 D, the X -state kinetics are faster than the A -state due to an efficient dipole-dipole rotational energy transfer mechanism as the X -state dipole moment is 1.5 D and the A -state dipole moment is 0.06 D. The observed recovery rates are 2-3 times faster than the estimated rotationally inelastic contribution and are a combination of inelastic and velocity-changing elastic collisions.

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