VIBRATIONAL ENERGY TRANSFER STUDIES IN CO-PUMPED LIQUIDS

KATHERINE A. ESSENHIGH, J. WILLIAM RICH, and IGOR V. ADAMOVICH, *Department of Mechanical Engineering, The Ohio State University, Columbus OH. 43210-1107*.

New experimental results on vibrational energy transfer between diatomics in optically pumped cryogenic liquids is presented. Mixtures of carbon monoxide and nitrogen, diluted in liquid argon, are excited by the absorption of infrared radiation from a carbon monoxide laser, in a non-flowing cryogenic absorption cell at low temperatures, T = 87K. The mixtures studied consisted of 1 torr of CO of which 88% is $^{13}C^{16}O$ and 12% is $^{13}C^{18}O$, and a range of 10 to 1000 torr of nitrogen . The CO absorbs the laser radiation, and the energy is preferentially redistributed among the higher vibrational modes of the $^{13}C^{18}O$, up to level 40, by vibration-to-vibration collisional energy exchanges,

$$\text{CO(v)} + \text{CO(w)} \longrightarrow \text{CO(v-1)} + \text{CO(w+1)}.$$

In the carbon monoxide and nitrogen mixtures, vibrational energy exchanges occur between CO and N_2,

$$\text{CO(v)} + N_2\text{(w)} \longrightarrow \text{CO(v-1)} + N_2\text{(w+1)}.$$

In gas phase experiments, this energy exchange cannot be directly observed since nitrogen is infrared inactive. However, in the liquid phase due to high densities, nitrogen has a collision-induced dipole moment, and an emission spectrum can be observed. Results to be presented are the first overtone of CO in the range 2.3-3.7 microns, and the first 5 vibrational states of the nitrogen fundamental in the range 4.2-4.6 microns.