ENERGY TRANSFER PROCESSES BETWEEN DIATOMIC MOLECULES IN OPTICALLY PUMPED PLASMAS [a]

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Energy transfer processes in collision between highly excited diatomic molecules and ionization of the molecules in energy pooling collisions are studied. In a CO-Ar, CO-Ar-N_2, or CO-Ar-O_2 gas mixture carbon monoxide is excited into low vibrational states $v = 1, ..., 10$ by absorption of CO laser radiation in an optical absorption cell. Vibration-vibration exchange pumping results in the diffusion of energy into very high vibrational states up to level $v = 40$. Also vibrational energy is transferred to the vibrational modes of N_2 and O_2. Ionization in optically pumped CO occurs by associative ionization mechanism in collisions of two excited CO molecules when their total vibrational energy exceeds the ionization energy. The effect of the electrons created in the plasma on the vibrational distribution function of CO and the influence of N_2 and O_2 is studied by FTIR spectroscopy on the $\Delta v = 2$ emission. Transfer of vibrational energy to electronic states is monitored using vacuum UV spectroscopy on the 4th positive emission of CO. Electron densities and ionization-rate coefficients are measured in a non-self-sustained, low electric field Thomson discharge. A kinetic model incorporating a coupled master equation for the CO, N_2, and O_2 vibrational level populations, and the Boltzmann equation for the electrons is compared to the experimental results.

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