ELECTRON-MEDIATED VIBRATION-ELECTRONIC ENERGY TRANSFER IN OPTICALLY PUMPED PLASMAS [a]

E. PLÖNJES, P. PALM, J.W. RICH, I. ADAMOVICH, *Department of Mechanical Engineering, The Ohio State University, Columbus, OH 43210*; W. URBAN, *Institut für Angewandte Physik, Universität Bonn, 53115 Bonn, Germany*.

The paper discusses experiments on vibration-to-electronic energy transfer in CO laser pumped CO-Ar and CO-N_2 plasmas. The CO molecules absorb the laser radiation on the lowest 10 vibrational transitions and transfer energy to high vibrational states by vibration-vibration energy exchange collisions. Ionization in these strongly nonequilibrium plasmas occurs by an associative ionization mechanism in collisions of two highly excited CO molecules. Removal of the electrons from the optically pumped plasmas using a saturated Thomson discharge results in a substantial reduction of the UV/visible radiation from the plasma (CO fourth positive bands, NO γ bands, CN violet bands, and C_2 Swan bands).This effect occurs even though electron removal results in an increase of the high vibrational level populations of the electronic ground state CO($X^1\Sigma$, v $\sim$ 15-35). On the other hand, deliberate electron density increase by adding small amounts of O_2 or NO to the optically pumped CO-Ar plasmas produces a substantial increase of the UV/visible radiation intensity, which correlates with the electron density. The experiments strongly suggest that the V-E energy transfer process CO($X^1\Sigma \rightarrow A^1\Pi$), and, possibly, analogous processes populating radiating excited electronic states of NO, CN, and C_2, are mediated by free electrons, which are created in the absence of an electric field, with low initial energies. This effect occurs at ionization fractions as low as $n_e/N \sim 10^{-9} - 10^{-7}$.

[a] The research is funded by the AFOSR Space Propulsion and Power Program under Grant No. F49620-01-0017