Atom and Radical Effects in $CO-N_2-He$ Molecular Laser Plasmas

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The time evolution of charged and neutral particles in a high pressure $CO-N_2-He$ molecular laser plasma has been analytically described. The model used in this description couples a rate equation code to a non-Boltzmann electron energy distribution code which generates the electron rate coefficients for the rate equation code accounting for elastic, inelastic and superelastic electron processes.

In the time development of the molecular plasma, atomic and radical species are produced which generally affect laser performance. These species, notably O, N, and CN, participate in the chemistry of tze plasma and degrade laser output through energy transfer processes. In addition to the nominal $CO-N_2-He$ laser systems, additive species (e.g. O_2, NO, Xe) have been found to substantially enhance laser performance in small concentrations and decrade performance in higher concentrations. The enhancement is due to direct effects on the plasma electron density while in higher concentrations, laser performance is degraded due to the participation of the additives or additive derived fragments in the plasma chemistry of CO.

In this paper, the time behavior of the charged and neutral species concentrations in the $CO-N_2-He$ molecular laser plasma with and without additive species and including the non-Boltzmann electron energy distribution will be discussed. In particular, the specific role of O, N, and CN in the plasma chemistry will be analyzed.

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