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Discharge Kinetics of N_2–O_2 Laser Generated Plasma Channels
HAROLD LADOUCEUR, ANDREW BARONAVSKI, TZVETELINA PETROVA, NRL — We study both experimentally and theoretically the effects of recombination and attachment of different N_2–O_2 gas compositions upon the plasma channel dynamics at one atmosphere. The time-dependent DC electrical conductivity technique [1] has been applied to determine the electron density decay. The rate constants have been determined from the electron balance equation by curve fitting of voltage-time measurements over the decay time interval. The measured electron density decay time for air is hundreds of nanoseconds while for pure nitrogen it is much longer, about 2 μs. For air, we derive an attachment rate $\eta_{air} = 1.39 \times 10^7$ s^{-1} and an electron-ion recombination rate $\beta_{air} = 1.02 \times 10^{-8}$ cm^{3}s^{-1}. In order to investigate in details the kinetics of N_2–O_2 gas mixture we developed a time-dependent collisional-radiative model based upon the numerical solution of the electron Boltzmann equation for the electron energy distribution function. It is coupled with the time-dependent balance equations of electrons, atomic and molecular ions under consideration, and various nitrogen and oxygen species in ground and excited states. The validity of the model was verified by comparison of the swarm parameters derived from the model with experimental parameters for pure oxygen, pure nitrogen, and air.
[1] H.D. Ladouceur at al., Optics Communications, **189** (2001) 107
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