Study of threshold intensity dependence on the physical processes in the breakdown of N-2 by CO2 laser radiation

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Abstract

A modified numerical electron cascade model of Gamal and Abdel Moneim (1987 J. Phys. D: Appl. Phys. 20 757), previously developed by Evans and Gamal (1980 J. Phys. D: Appl. Phys. 3 1447), is used to calculate the breakdown threshold irradiance as a function of gas pressure when irradiating molecular nitrogen with a CO2 laser source under two different experimental conditions, namely, the presence and the absence of initial electron density in the focal volume before laser ignition (Camacho J J et al 2007 J. Phys. B: At. Mol. Opt. Phys. 40 4573). The model solves numerically the time-dependent Boltzmann equation for the electron energy distribution function (EEDF) and a set of rate equations that describe the rate of change of the population of excited states. The model is incorporated into a computer program to obtain the threshold irradiance, which is then compared with the measured ones given by Camacho et al. The comparison showed a reasonable agreement for the two experimental conditions. In addition, the study of the EEDF and its parameters revealed different influences on the physical processes in determining the threshold irradiance for nitrogen breakdown in the two selected gas pressure regimes.

Keywords

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