Iranian Journal of Physics Research, Vol. 23, No. 4, 2024
DOI: 10.47176/ijpr.23.4.51690

Optimization of some input parameters of a pulsed TEA CO_2 laser based on the generalized Landau-Teller equations

S Panahibakhsh, A Koushki*, and Z Rajabi

Photonic and Quantum Technologies Research school, Nuclear Science and Technology Research Institute, P.O.BOX: 14395-836, Tehran, Iran

E-mail: akoushki@aeoi.org.ir

(Received 28 May 2023 ; in final form 15 October 2023)

Abstract

In this paper, the six-temperature kinetic model based on the generalized Landau-Teller equations is used to optimize a pulsed TEA CO_2 laser input parameters. This model was numerically solved by regarding the equations governing the electrical discharge media to obtain the density of electrons. In this study, for the first time, the dissociation of the CO_2 molecule and the production of CO as a time evaluation equation were dynamically coupled with other rate equations. The time behavior of the discharge current and voltage and laser output pulse power was simulated for CO_2:N_2:He gases mixture ratio, which are 1:1:3, respectively. Also, the optimum values of the input parameters including the reflectivity of the output mirror, the capacity of the pre-ionization capacitor, and the capacity and charging voltage of the storage capacitor were calculated to obtain the maximum output peak power. The obtained results are significant in the optimum design of TEA CO_2 oscillators.

Keywords: TEA CO2 laser, gas ratio, CO2 dissociation, six-temperature kinetic model, the Landau-Teller equations

For full article, refer to the Persian section