International Journal of Computational Materials
Science and Engineering
Vol. 5, No. 3 (2016) 1650016 (13 pages)

DOI: 10.1142/S2047684116500160

A dual phase lag model on photothermal interaction in an unbounded semiconductor medium with cylindrical cavity

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Received 9 May 2016
Accepted 3 August 2016
Published 2 September 2016

In the present paper, the theory of generalized photo-thermoelasticity under dual phase lag model has been applied to study the coupled thermal, plasma and elastic waves on unbounded semiconductor medium with cylindrical cavity. The bounding surface of the cavity is traction free and loaded thermally by exponentially decaying pulse boundary heat flux. By using Laplace transform and the eigenvalue approach methodology, the solutions of all variables have been obtained analytically. Numerical computations have been done for silicon-like semiconductor material, and the results are displayed graphically to show the difference between the dual phase lag (DPL) model, Lord and Shulman's theory (LS) and the classical dynamical coupled theory (CT).

Keywords: Dual-phase lag model; Laplace transform; cylindrical cavity; semiconducting material.

1. Introduction

At the start, considering qualitatively, what is the effect of the incident a laser beam on a semiconductor with band gap energy E_g? Electron will be excited from the valence band to an energy level ($E - E_g$, where E is the energy of the incident photon) above the conduction band edge only if $E > E_g$. The photoexcited free carriers will relaxe to one of the unfilled states near the bottom of the conduction band through non-radiative transitions. Then, a recombination process will tack place through the formation of electron-hole pairs. Before the recombination, there are electron and hole plasma. The density of this plasma is controlled by the diffusion