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ORIGINAL ARTICLE

A study on photothermal waves in an unbounded semiconductor medium with cylindrical cavity

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Abstract The theory of coupled plasma, thermal, and elastic waves was used to investigate the wave propagation on semiconductor material with cylindrical cavity during photothermoelastic process. An unbounded material, elastic semiconductor containing a cylindrical cavity with isotropic and homogeneous thermal and elastic properties has been considered. The inner surface of cavity is constrained, and the carrier density is photogenerated by an exponentially decaying pulse boundary heat flux. The eigenvalue approach, together with Laplace transform techniques, was used to obtain the analytical solutions. Numerical computations have been done for a silicon-like semiconductor material, and the results are presented graphically to estimate the effect of the coupling between the plasma, thermal, and elastic waves. The graphical results indicate that the thermal activation coupling parameter is an important phenomenon and has a great effect on the distribution of field quantities.

Keywords Laplace transformation · Semiconducting material · Eigenvalue approach · Cylindrical cavity

1 Introduction

At the start, we qualitatively consider the effect of the incident laser beam on a semiconductor with band gap energy E_g. An 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 relax to one of the unfilled states near

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