Two-dimensional time-domain finite-difference analysis for dynamic thermoelastic equations coupled with dual-phase-lag heat conduction model

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Abstract

This report presents the results of applying the time-domain finite-difference technique to numerically solve a two-dimensional plane problem based on the dynamic thermoelastic equation combined with a two-phase lag heat conduction model. Two-dimensional discretized equations consisting of particle velocity, stress, and temperature components were formulated, and a stability analysis was then performed to ensure the accuracy of the solution obtained herein. Since the well-known von Neumann stability analysis cannot be applied to our problem, the effect of the combination of the number of time steps (M) and the number of space steps (N1, N2) on the numerical solution error was investigated. Based on the numerical results, a stability formula suitable for our problem was derived. Then, the propagation and reflection behaviors of heat and elastic waves were analyzed under the stability formula for a problem involving a crack-like defect in a two-dimensional plate. These results will lead to a promising technology to improve the high-precision detection of microdefects in semiconductors, for example, which has become a problem in recent years.

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