Heat Wave Propagation in a Thin Film Irradiated by Ultra-short Laser Pulses

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Abstract

A thermal wave solution of a hyperbolic heat conduction equation in a thin film is developed on the basis of the Green's function formalism. Numerical computations are carried out to investigate the temperature response and the propagation of the thermal wave inside a thin film due to a heat pulse generated by ultra-short laser pulses with various laser pulse durations and thickness of the film.

Figures

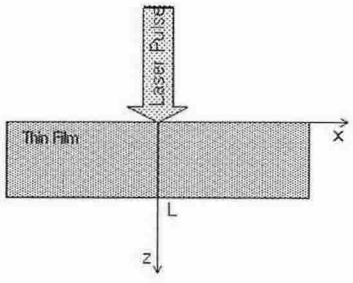

Figure 1. Schematics of short-pulse laser heating system.

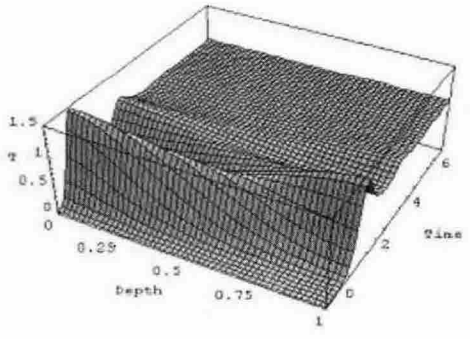

Figure 2. Temperature profile in a film with $\eta_L = 1$, $\Delta\eta = 0.1$, and $\xi_p = 0.4$.

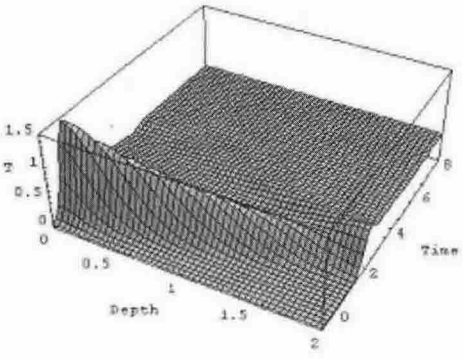

Figure 3. Temperature profile in a film with $\eta_L = 2$, $\Delta\eta = 0.1$, and $\xi_p = 0.4$.

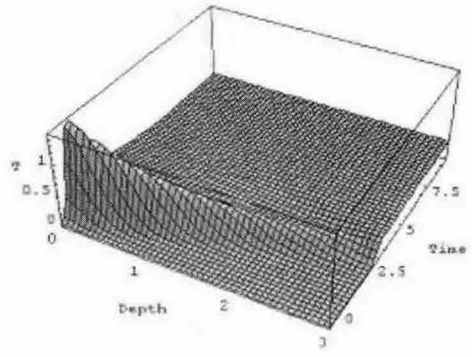

Figure 4. Temperature profile in a film with $\eta_L = 3$, $\Delta\eta = 0.1$, and $\xi_p = 0.4$

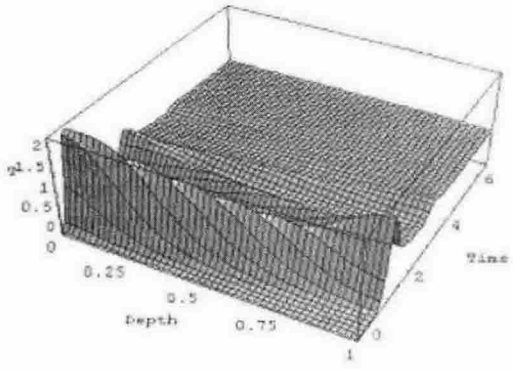

Figure 5. Temperature profile in a film with $\eta_L = 1$, $\Delta\eta = 0.1$, and $\xi_p = 0.2$

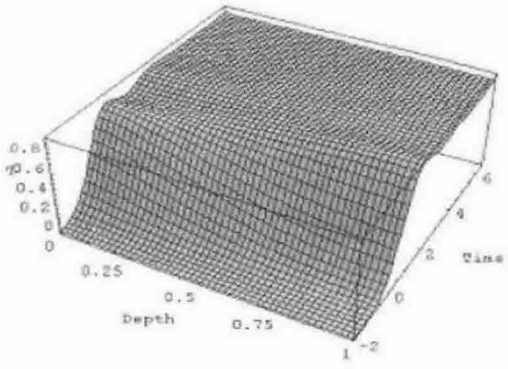

Figure 6. Temperature profile in a film with $\eta_L = 1$, $\Delta\eta = 0.1$, and $\xi_p = 1.0$.

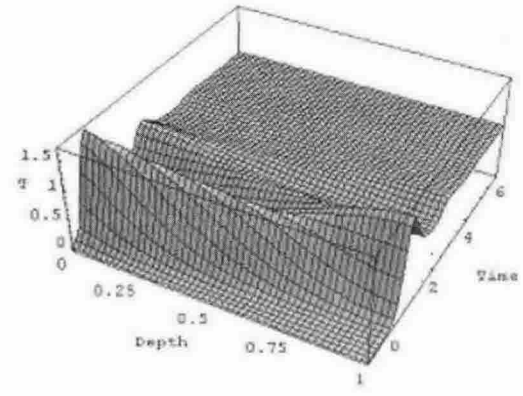

Figure 7. Temperature profile in a film with $\eta_L = 1$, $\Delta\eta = 0.02$, and $\xi_p = 0.4$.

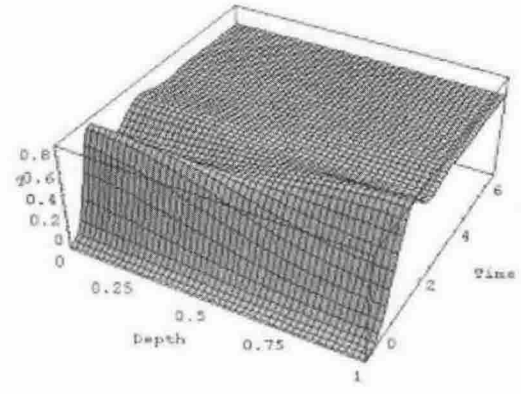

Figure 8. Temperature profile in a film with $\eta_L = 1$, $\Delta\eta = 0.5$, and $\xi_p = 0.4$.