Analysis of Thermal Damage in a Laser-Irradiated Based on the Non-Fourier Model

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Abstract—A modified non-Fourier equation of bio-heat transfer based on the second-order Taylor expansion of dual-phase-lag model is proposed to estimating thermal damage in a laser-irradiated biological tissue. This non-Fourier bio-heat transfer equation involves the mixed-derivative terms and the high-order derivatives of temperature with respect to time. The thermal damage in the tissue is assessed with the rate process equation. The effects of blood perfusion and metabolic heat generation on thermal response and thermal damage are explored. There are mathematical difficulties in dealing with such a problem. A hybrid numerical scheme is extended to solve the present problem. The deviations of the results from the bio-heat transfer equation based on the linear form of the dual-phase-lag model are presented and discussed.

Keywords—Bio-heat transfer, Dual-phase-lag mode, Laplace transform, Scattering tissue