Proceedings of CHT-15
ICHMT International Symposium on Advances in Computational Heat Transfer

May 25-29, 2015, Rutgers University, Piscataway, USA

CHT-15-049

NUMERICAL STUDY OF HEAT TRANSFER IN LASER IRRADIATED BIOLOGICAL TISSUE WITHIN THE FRAMEWORK OF DUAL-PHASE-LAG HEAT CONDUCTION MODEL USING LATTICE BOLTZMANN METHOD

Shashank Patidar[*], Sumit Kumar[+], Atul Srivastava[+§], Suneet Singh[*]
*Department of Energy Science and Engineering,
[+]Department of Mechanical Engineering
Indian Institute Technology, Bombay, Powai, Mumbai-400076, India
[§]Correspondence author. Email: atulsr@iitb.ac.in

ABSTRACT The present study is concerned with numerical investigation of thermal response of laser irradiated biological tissue during laser-based photo-thermal therapy. The concept of the Lattice Boltzmann Method (LBM) is extended to analyze transport of short-pulse radiation within the body of the tissue phantom which has been considered as the participating medium. In order to determine the two-dimensional temperature distribution inside the tissue medium, the radiative transfer equation (RTE) has been coupled with the energy equation based on dual phase lag (DPL) heat conduction framework. The coupled RTE and DPL-based numerical code developed in the present work has been benchmarked against the results published in the literature for the same operating parameters. The present study is important in context of optimizing the efficiency of photo thermal therapy since DPL heat conduction model predicted significantly different temperature in tissue from hyperbolic and Fourier's heat conduction model. Effect of phase lag in heat flux (τ_q) and phase lag in temperature gradient (τ_T) on the temperature distribution inside the laser irradiated tissue has been analyzed.