PREFACE: HEAT TRANSFER IN BIOMEDICINE

Heat transfer plays an important role in living systems as it regulates the body temperature. A large number of biomedical applications associate with heat transfer, include bioheat transfer, biopreservation, cryosurgery, cryobiology, thermal evolution, hyperthermia, hypothermia, thermal ablation, laser ablation, photodynamic therapy, etc. Nowadays, a fast growth of research on heat transfer in biomedicine has been noted.

This special issue is aimed at reviewing the most recent developments and research efforts in the field of the authors' expertise, with the purpose of providing guideline for future research directions. The issue includes an overview of challenges and opportunities in heat/mass transfer in biopreservation by Devireddy. The scientific field of biopreservation can be broadly classified into three distinct but interrelated research areas: cryopreservation, desiccation, and freeze-drying. They involve emerging and evolving fields of biospecimen procurement, preservation, and banking, as well as the processing of cells and tissues. In tumor cryosurgery, many critical issues exist in the modeling of bioheat transfer due to the existence of phase change. Deng and Liu discussed several numerical strategies to deal with these issues. The bioheat transfer with phase change in biological tissues is not only critical during the freezing and thawing processes, but also in evaporation and ablation processes.

Lasers have already become irreplaceable clinical tools/therapies of modern medicine. The first mode of interaction of laser with tissue is radiative heat transfer. The advent of ultrafast lasers opened up a new window for cutting-edge laser applications/therapies in biomedicine. Guo and Hunter provided a review of emerging applications in optical tomography, plasma-mediated ablation, grafted tissue microprocessing for transplantation, etc. In particular, advances in the computational modeling of ultrafast radiative transfer are discussed. Various numerical solution methodologies, along with their contributing works, advantages and challenges, are presented. Thermal analysis of laser–tissue interaction and characterization of extent of damage are reviewed by Sajjadi et al. An experimental study is presented, using a focused beam from an ultra-short pulsed laser to ablate the subcutaneous tumors with minimal thermal and mechanical damage. Analysis of the distribution and time course of appearance of heat shock proteins provides a valuable means to understand the spatial and temporal effects of laser irradiation on processes in tissue on its destruction and healing.

The present issue is the first special issue on heat transfer in biomedicine, and we hope that it may be the beginning of a series that will periodically stimulate researchers to publish original and review articles reporting how heat transfer research advances and impacts biomedical engineering and biotechnology.

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