

<<皮肤热力学与皮肤热疼痛>>

图书基本信息

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前言

Advances in laser, microwave and similar technologies in medicine have led to recent developments of thermal treatments for disease and injury, involving skin tissue. In spite of the widespread use of thermal therapies in dermatology, they do not draw upon the detailed understanding of the biothermomechanical-neurophysiological behaviour, for none exists to date, even though each behavioural facet is somewhat established and understood. In view of this dilemma, a new research area emerges, which is the subject of this book: "Introduction to Skin Biothermomechanics and Thermal Pain". This area is highly interdisciplinary, involving the subjects of engineering, biology and neurophysiology. This book is focused on the introduction of this new research area. According to the schematic relationship between the areas involved, this book is divided into four parts: PART I. Skin bioheat transfer and thermal damage; PART II. Skin biomechanics; PART III. Skin biothermomechanics; PART IV. Skin thermal pain.

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内容概要

Introduction to Skin Biothermomechanics and Thermal Pain introduces the study of coupled bio-thermo-mechanical and neural behavior of skin tissue in response to thermal and mechanical loads. The research in this book focuses on the theoretical modeling and experimental investigation of heated skin tissue in order to provide a predictive framework for thermal therapies of diseased tissue in clinics. Furthermore, by developing solution tools, it focuses on changes in treatment parameters leading to more effective therapies. The book is intended for researchers and scientists in Bioengineering, Heat Transfer, Mechanics, Biology and Neurophysiology, as well as clinicians.

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However, classical grips which apply a pressure on the sample ends lead to a slippage of the sample if the pressure is too low, or damage of the sample near the grips if the pressure is too high [147]. Gluing the samples to the grip can be successfully done for very thin samples. However, if samples are too thick there is shear between the fixed sample sides and the sample core, giving a complex pattern of strain in this region [159] and the inner fibers of the sample are less strained than the fibers at the surface. Despite the reduced slippage or failure of connective tissue at the clamping site, a non-uniform loading pattern may occur, with uneven fiber recruitment of the tissue under tension and the constraint on the extracellular fibers at the bounds of the sample is induced [149], which will result in low measurement precision and non-repeatability [146].

Suture Due to the drawbacks of clamping described above, many researchers have used suture [161], where a specimen is attached to loading assemblies by several continuous loops of medical suture per edge since using thin threads allow the free expanding of sample edges in the lateral direction [13], as shown in Figure 6.3. However, suturing sample edges might result in a discontinuous load transfer to the underlying fibrous network since only discrete groups of fibers within the vicinity of the suture attachment point are loaded [149].

Waldman & Lee [149] compared the dynamic biaxial mechanical response of soft biological tissue samples under suturing and clamping under the same conditions. It was found that the tissue samples appeared to be stiffer and less extensible when mechanically tested with clamped sample edges, as opposed to when tested with sutured sample edges; and suture attachment methods demonstrated minimal boundary effects where four suture attachments are sufficient to obtain uniform stress field in biaxial testing. The same results have also been obtained by Sun et al. [140], who found that there were strong boundary effects with the clamped methods, which resulted in the fact that the inner region was not fully loaded and therefore not fully stretched and makes the tissue appear to be substantially stiffer.

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