Advanced Materials Series

ADVANCED BIOELECTRONIC MATERIALS



Ashutosh Tiwari Hirak K. Patra Anthony P.F. Turner



WILEY

Advanced Bioelectronic Materials

Edited by

Ashutosh Tiwari, Hirak K. Patra and Anthony P.F. Turner



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Advanced Materials Series

The Advanced Materials Series provides recent advancements of the fascinating field of advanced materials science and technology, particularly in the area of structure, synthesis and processing, characterization, advanced-state properties, and applications. The volumes will cover theoretical and experimental approaches of molecular device materials, biomimetic materials, hybrid-type composite materials, functionalized polymers, supramolecular systems, information- and energy-transfer materials, biobased and biodegradable or environmental friendly materials. Each volume will be devoted to one broad subject and the multidisciplinary aspects will be drawn out in full.

Series Editor: Dr. Ashutosh Tiwari

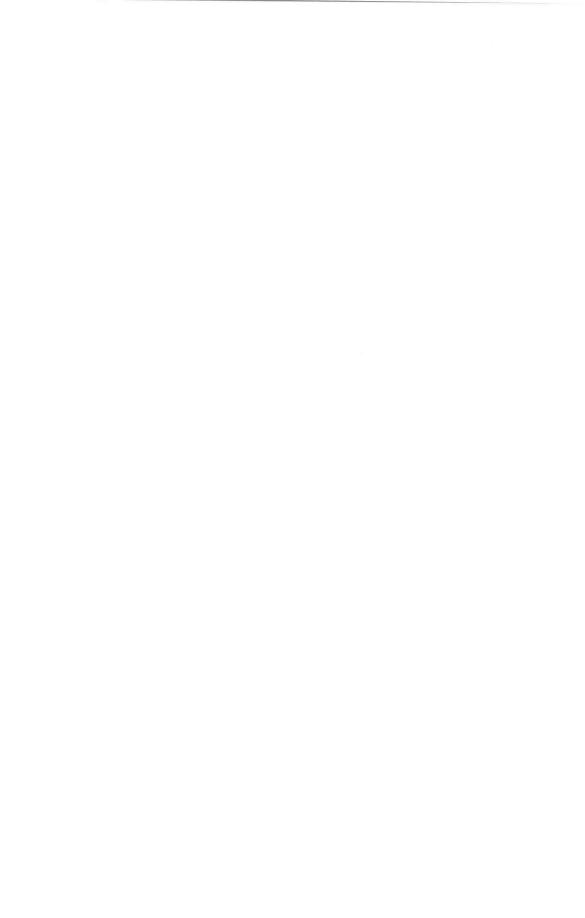
Biosensors and Bioelectronics Centre Linköping University SE-581 83 Linköping Sweden E-mail: ashutosh.tiwari@liu.se

Managing Editors: Revuri Vishnu and Sudheesh K. Shukla

Publishers at Scrivener Martin Scrivener(martin@scrivenerpublishing.com) Phillip Carmical (pcarmical@scrivenerpublishing.com) We dedicate this book to Prof. Anthony P. F. Turner on the occasion of his 65th birthday. It is because of his persistence, foresight and proficiency in establishing biosensor principles that millions of patients worldwide are benefiting.

To Tony for fathering biosensors and bioelectronics & for every kid who walks with him.

Ashu Hirak



The interface between electronics and medicine has resulted in extraordinary benefits for recent generations in clinical practice. The development of electrocardiography nearly a century ago can be considered a key milestone for chronicling the electrical activity of the heart, thus providing one of the defining moments in the field of cardiology. A similarly important advance was the development of the heart pacemaker, which has transformed the lives of millions of people and continues to serve an ever-aging population. The legacy of biomedical research at the interface between electrical engineering and human physiology has empowered these discoveries.

In recent times, however, "bioelectronics" has diversified into a multifarious and cross-disciplinary field. In this book, a selection of leading scientists and technology experts describe advances in nanoscale electronics and how they mesh with the bioengineering community to deliver specific applications. The contributors chronicle a wide span of opportunities, possibilities and challenges for this diverse interdisciplinary field. The principal themes of this volume on advanced bioelectronic materials are: miniaturization of bioelectronics, smart biosensing, and a systemic approach for the development of bioelectronics. The machinery and procedures that will facilitate these areas will also have a significant impact on other areas such as advanced security systems, forensics and environmental monitoring. The evolution of all these segments entails innovations in cross-cutting disciplines ranging from fabrication to application.

We hope that this collection of articles will help convince stakeholders from academia, government and industry to cooperate in developing a comprehensive bioelectronics roadmap to accelerate the commercialization of bioelectronic materials for novel biomedical devices. This work provides a comprehensive description of some of the emerging opportunities in bioelectronics facilitated by the development of novel materials. While it is challenging to evaluate the exact economic benefits from this technology at the current stage, a clear sense of the magnitude of the benefits to mankind and society are apparent.

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In order to reflect the promise of bioelectronics at this time, we have endeavored to include research that crosses several disciplines, including electronics, materials science, human physiology, chemistry and physics. It is intended for a wide spectrum of readers, offering perspectives on aspects of both fundamental and advanced materials of the field and covering:

- Molecular-electronic interfaces;
- Stimuli-responsive (mechanical, electrical, chemical and thermal) materials;
- Real-time monitoring of essential parameters to assess the state of biomolecules; and
- · Smart biosensing.

The successful translation of this multidisciplinary research to commercial reality needs a deep understanding at a very early stage of the interface between electronics and biology. This book addresses researchers in a range of sectors and disciplines who do not necessarily speak with the same 'language,' but who are willing to commit to a collaborative effort in areas such as this, where interdisciplinary contributions are key for success.

The Editors August 22, 2015 Ashutosh Tiwari Hirak K. Patra Anthony PF Turner

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