Preface

Bioelectronics was first published in 1912 and focused on measurement of electrical signals generated by the body, which is the basis of the electrocardiogram. In the 1960s two new trends appeared in bioelectronics. One was implantable electronic devices and systems, such as the pacemaker. The other was the study of electron transfer in electrochemical reactions. In 1970s-1980s, Erwin Neher and Bert Sakmann invented patch clamp and investigated the potential of cell membrane. In 1990s, bioelectronics went to single molecule level and molecular electronics appeared. In February 2009, the National Institute of Standards and Technology (NIST) of the U.S. Department of Commerce published *A Framework for Bioelectronics*: *Discovery and Innovation* and defined bioelectronics as "the discipline resulting from the convergence of biology and electronics". The convergence contains two aspects: one is to study the electronics phenomena in biological systems, including the electronic characters of biomolecules, the transmission and storage of information; the other is to solve biological problems with tools of electronics, such as acquisition and analysis of bioinformation, and the related biomedical detection techniques, sensors, instruments and therapeutic methods.

Today, the concept of bioelectronics is broaden and cross-disciplinary, especially when it is boosted by nanotechnology. In general, the content of bioelectronics covers acquisition system and detection system of bioinformation, modelling and simulation of biosystem, nanobiology, biochips and micro total analysis system (μTAS), and biomedical instrumentation. In the next five years, the rising of flexible bioelectronics and bioelectronics medicine as frontiers of bioelectronics will be anticipated. It allows wearable and implantable sensors, actuators and drug delivery systems, which will monitor the health of human, and intervene or treat diseases in real-time. Bioelectronics allows people to understand life more precisely and deeply, and engineering life more effectively and creatively. It has very close relationships with material science, electronics, nanotechnology, biology and medicine and thereby it is of great significance to the industry, medicine and security.

State Key Laboratory of Bioelectronics (SKLB), Southeast University of China, was founded in 1985 by Dr. Yu Wei, one of China's noted experts in electronics. The laboratory was conferred on the name of Chien-Shiung Wu Laboratory by the world-famous physicist Dr. Chien-Shiung Wu in 1992 and was approved as an open laboratory of molecular and biomolecular electronics by the Ministry of Education (MOE) of China in the same year. In 1997, the laboratory was renamed the Key Laboratory of Molecular and Biomolecular Electronics of the MOE. In 2005, the laboratory was promoted to the State Key Laboratory of Bioelectronics by the Ministry of Science and Technology of China, which represents the highest level of research in bioelectronics in China. The objective of the laboratory construction is to conduct frontier research in the light of the development of bioelectronics; to come up with innovative research methods and technologies by applying the rapid developments in information science with emphasis on the study of life process, related pathologensis and its medical application on the level of nanometers and molecules. Now, there are four main research directions—biomaterials and interfaces, biosensors and chips, genomics and bioinformatics, and biomedical imaging. The research activities in the laboratory focus on the fabrication of biomaterials and biodevices, acquisition and sensing of bioinformation, and application of bioinformation systems. The research fields cover the preparation of nano (molecular) materials, assembly and characterization of molecular ordered structures, application of bio/nano materials, nano (molecular) devices, implantable bioelectronic devices, detection of single molecule and single cell, biosensor, micro-array chip, microfluid biochip, bioinformatics, application of biomimic information processing system, modeling and using of brain information system, etc.

Over 30 years of fast development, lots of achievements are accomplished by SKLB. The faculties have published hundreds of articles in significant international academic journals like *Nature*, *Cell*, and *Nature Materials*, obtained dozens of provincial and ministerial awards, and held over 100 patents. The laboratory has organized many academic conferences and initiated fruitful cooperation with famous laboratories in United States, Japan, Germany, United Kingdom, France, Switzerland, etc. With all the endeavors of faculties, SKLB gains their leadership in gene sequencing, biochips and nano-medicine all over the country and pioneers in the frontier of bioelectronics in the world.

In order to fulfill the need of the national and local economic development, SKLB also has established five laboratories, i.e., Wuxi Biochip Key Laboratory, Suzhou Biomedical Materials and Technology Key Laboratory, Suzhou Environment and Biosafety Key Laboratory, and Nanjing Innovation Center of Strategic Biomedical Industry in collaboration with local governments, which contributed a lot to the innovation and development of cities in Jiangsu Province. In this year, SKLB also established Institute of Biomaterials and Device in alliance with six other province key laboratories in the field of biomedical engineering in Southeast University. This institute is affiliated with Jiangsu Industry Technology Research Institute, whose aim is to reform the construction of industry in Jiangsu Province and bridge the gap between fundamental research, application development and industrialization. By these affiliated laboratories and institutes, SKLB aims to transfer the original innovative research to the productivity, explores new models of innovation and addresses the innovation driven development.

2015 is the 30th anniversary of SKLB and the fast growing bioelectronics is also attracting more and more attention from people especially when "internet+health" is widely acknowledged and the fusion of "bio" and "electronics" is more and more deep. To celebrate this, this book was proposed and the recent progress of the aforementioned four directions was reviewed, which ranges from interfaces and materials to imaging and algorithms and covers all levels of bioelectronics. By this book, the readers could not only learn the research development of bioelectronics in China, but also the cutting edge technologies in the related fields of bioelectronics.

Zhongze Gu

December 30, 2015