Nano-Bio-Sensing

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Editor

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Foreword by Giovanni De Micheli

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Foreword

Much of our economy and way of living will be affected by nanotechnologies in the decade to come and beyond. Mastering materials at the molecular level and their interaction with living matter opens up unforeseeable horizons. Still much of the potentials of nano-biotechnology is untapped. Although we understand most basic principles of molecular interaction, the transformation of scientific results into robust technologies that can support health care and environment protection has still to take place. In other words, we are at the verge of a technological revolution that will bring to us a multitude of bio-electronic devices that interact with biological systems through intelligent – and possibly distributed – means of computation. The recent strong interest about cyber-physical systems is motivated by this trend.

This book reviews the principles and practice of nano-bio-sensing. It covers extensively the basic principles of interaction of living matters with detectors and the transduction principles. It reviews surface science as well as electrical and optical technologies for bio-sensing. Nano-scale effects, inducing quantum confinement, are specifically addressed along with their benefits, such as the amplification of sensing phenomena, yielding devices with higher sensitivity. Specific importance is given to low-power sensing techniques, as well as nonconventional means for powering the sensors, which may be very useful for implanted biosensors. Moreover, fault-tolerant bio-sensing systems are described. Overall, various physical, chemical, and electrical effects contribute jointly to enable the construction of a new generation of nano-bio-sensors.

The importance of this research field should not be underestimated. The healthcare sector will soon be able to benefit from real-time sensors – *in the body* and *on the body* – that can predict specific pathologies and give the opportunity of preventive treatment. Pharmacology will be positively affected by means of creating rational and personalized drugs that can be tuned to the characteristics of the patient. Nutrition science and practice will benefit from advances in sensors to enable the monitoring of the consumption of nutrients in the right combination and

quantity for the expected effort. Positive impact of these methods can be measured, for example, in the training of sportsmen and in managing the attention span of youths. A combination of electro-sensing technologies can rationalize work and living spaces, enabling better working and living conditions and specifically longer autonomy to the elderly. Similarly, these technologies can be used to monitor the environment, to protect us from infections and pollution, and raise the level of security of individuals and communities. All these important and ethical goals are addressed by some research programs, most notably by the Swiss *nano-tera.ch* initiative which I am leading.

Given the intrinsic scientific merits of nano-bio-sensing and its wide projected impact on society, I believe that this book provides the reader with an important guide through the various technologies. It represents a key reference point for both scientists and engineers.

EPFL Lausanne, 2010 Giovanni De Micheli

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