

Preface

Numerous miniaturized DNA microarray, DNA chip, Lab on a Chip and biosensor devices have been developed and commercialized. Such devices are improving the way many important genomic and proteomic analyses are performed in both research and clinical diagnostic laboratories. The development of these technologies was enabled by a synergistic combination of disciplines that include microfabrication, microfluidics, MEMS, organic chemistry and molecular biology. Some of these new devices and technologies utilize sophisticated microfabrication processes developed by the semiconductor industry. Microarrays with large numbers of test sites have been developed which employ photolithography combinatorial synthesis techniques or ink jet type printing deposition methods to produce high-density DNA microarrays. Other microarray technologies have incorporated microelectrodes to produce electric fields which are able to affect the transport and hybridization of DNA molecules on the surface of the device. As remarkable as this generation of devices and technological appears, the advent of new nanoscience and nanofabrication techniques will lead to even further miniaturization, higher integration and another generation of devices with higher performance properties. Thus, in some sense these devices and systems will follow a similar evolution as did microelectronics in going from 8 bit, to 16 bit to 32 bit technology. Where feature sizes for integrated components of microelectronic devices is now well into the submicron scale, nanoscale biodevices will soon follow. Likewise, the potential applications for this new generation of micro/nanoarray, lab on a chip and nanosensor devices is also broadening into areas of whole genome sequencing, biowarfare agent detection, and remote environmental sensing and monitoring. Today the possibility of making highly sophisticated smart micro/nano scale in-vivo diagnostic and therapeutic delivery devices is being seriously considered.

Nevertheless, considerable problems do exist. Unfortunately, many applications for these bioresearch or biomedically related devices do not have the large consumer markets that will drive and fund their development. The economic forces which drive the development of high volume retail consumer microelectronic and optoelectronic devices (such as computers, cell phones, digital cameras, and fiber optic communications), are not there for most bioresearch or biomedical devices. Thus, it is very common to see so-called “good” technologies in the bioresearch and biomedical device area fail somewhere along the arduous path to commercialization. This is particularly true for any biomedical device or system which has to go through the regulatory process. Frequently, the problem relates to the inability to economically manufacture a viable device for commercialization as opposed to a working prototype device. Thus, a key aspect for achieving final success for our new

generation of bioresearch and biomedical micro/nano biodevices will be the corresponding development of both viable and efficient nanofabrication and micro/nano integration processes.

The Volume II: Micro/Nano Technologies for Genomics and Proteomics presents a wide range of exciting new science and technology, and includes key sections on DNA micro/nanoarrays which additional chapters on peptide arrays for proteomics and drug discovery, new dielectrophoretic cell separation systems and new nanofabrication and integration processes; advanced microfluidic devices for the human genome project (whole genome sequencing); and final section on nanoprobe for imaging and sensing. Overall this volume should be of considerable value for a wide range of multidisciplinary scientists and engineers who are either working in or interested in bionanotechnology and the next generation of micro/nano biomedical and clinical diagnostic devices.

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BioMEMS and Biomedical Nanotechnology

Volume II: Micro/Nano Technologies for Genomics and
Proteomics

Editor-in-chief: Ferrari, M. - Ozkan, M.; Heller, M. (Eds.)

2007, XXIV, 540 p., Hardcover

ISBN: 978-0-387-25564-4