Stevens Institute of Technology

Nanotechnology Graduate Program

BioMicroSystems: Labs and Fabs for Nano-Bio Technology

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Microfluidic, biological microsystems are particularly intriguing in providing new strategies to manipulate nano- and micro- scale components for applications in biotechnology and bio-assisted nanotechnology. We have demonstrated a unique platform for programmable assembly of biomolecules in biomicrosystems so as to reconstruct biomolecular reaction processes and sequences on a laboratory platform. Chitosan, a naturally-occurring, amine-rich biopolymer, is electrodeposited at predefined sites in a polymer-based microfluidic system. Such activated electrode sites support conjugation of proteins, enzymes, nucleic acids, and viruses while retaining their biofunctionality, such as DNA hybridization or enzyme catalysis. We have also developed a reusable microfluidics device and packaging technology to support multi-site bioreaction steps, employing fluidic, electrical, and optical networks to provide a platform for metabolic engineering and its applications. A primary target is to understand and re-engineer the quorum sensing phenomenon, involving the manufacture of small signaling molecules through an enzyme-catalyzed reaction sequence. Thus the biomicrosystem can then serve as an attractive testbed for discovery of drugs that can impede bacterial attack by interruption of the catalytic production of the signaling molecule. We are also pursuing other biological applications, including cell-based microsystems and their manifestations as intelligent chem/bio sensors and as models to assess health and environmental risk of nanoparticles.

Professor Gary Rubloff, a solid state and surface physicist, is Minta Martin Professor of Engineering and the founding Director of the Maryland Center for Integrated Nano Science and Engineering (M-CINSE) at the University of Maryland. His research includes a broad spectrum of topics from fundamental surface chemistry to its application in semiconductor materials, process, and equipment technology and manufacturing. Over the past few years he has emphasized chemical sensing and control applications and new approaches to biomolecular reactions in microfluidic systems. He has published over 175 papers and holds 19 patents and 6 IBM Invention Achievement Awards. He received the AVS Gaede-Langmuir Prize in 2000 and is a Fellow of APS and AVS. Before joining academia, he spent 20 years in research and management at IBM Yorktown Heights, NY, in the Physical Sciences, Silicon Technology, and Manufacturing Research departments. He joined academia in 1993 at NCSU and then 1996 at the University of Maryland, where he was Director of the Institute for Systems. In 2004 he became founding Director of the Maryland NanoCenter. He was also the founding Chairman. of the AVS Manufacturing Science and Technology Group from 1992-1997 and continues to serve on its Executive Committee. He has been a member of the Metrology Technical Working Group for the SIA's National Technology Roadmap for Semiconductors since its inception in 1994.

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