1. Record Nr. UNINA9910720556803321

Autore	Badilescu Simona
Titolo	BioMEMS : science and engineering perspectives / / Simona Badilescu, Muthukumaran Packirisamy
Pubbl/distr/stampa	Boca Rato : , : Taylor & Francis, , [2011] ©2011
Descrizione fisica	1 online resource (xvii, 329 pages)
Disciplina	660.6
Soggetti	BioMEMS
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Nota di contenuto	Machine generated contents note: 1.1. Introduction to BioMEMS -- 1.2. Application Areas -- 1.3. Intersection of Science and Engineering -- 1.4. Evolution of Systems Based on Size -- 1.5. Commercialization, Potential, and Market -- References -- 2.1. Introduction -- 2.2. Metals -- 2.3. Glasses and Ceramics -- 2.4. Silicon and Silicon-Based Surfaces -- 2.5. Polymers -- 2.6. Biopolymers -- 2.7. Organic Molecules (Functional Groups) Involved in the Formation of Self-Assembled Monolayers -- References -- Review Questions -- 3.1. Amino Acids -- 3.2. Polypeptides and Proteins -- 3.3. Lipids -- 3.3.1. Fatty Acids and Their Esters -- 3.3.2. Phospholipids -- 3.3.3. Lipoproteins -- 3.4. Nucleotides and Nucleic Acids -- 3.4.1. Nucleotides -- 3.4.2. Nucleic Acids -- 3.4.3. DNA Sensing Strategies -- 3.5. Carbohydrates -- 3.5.1. Introduction -- 3.5.2. Monosaccharides -- 3.5.3. Oligosaccharides and Polysaccharides -- 3.5.4. Biosensing Applications -- 3.6. Enzymes -- 3.6.1. Definition and Nomenclature 3.6.2. Mechanism of the Enzymatic Catalysis -- 3.6.3. Catalysis by RNA -- 3.6.4. Applications of Enzymes in Biotechnology and Biosensing -- 3.7. Cells -- 3.7.1. Cellular Organization -- 3.7.2. Cell Movement -- 3.7.3. Whole Cell Biosensors: Applications -- 3.8. Bacteria and Viruses -- 3.8.1. Bacterial Cell Structure -- 3.8.2. Virus Structure -- 3.8.3. Biosensors and BioMEMS Sensor Systems for the Detection of Pathogenic Microorganisms and Bacterial Toxins -- References -- Review Questions -- 4.1. Introduction -- 4.2. Plasma Treatment and Plasma-Mediated Surface

Modification -- 4.3. Surface Modifications Mediated by Self-Assembled Monolayers (SAMs) -- 4.4. Langmuir-Blodgett and Layer-by-Layer Assembly -- 4.5. Biosmart Hydrogels -- 4.6. Immobilization and Detection of Biomolecules by Using Gold Nanoparticles: Case Studies -- 4.6.1. Gold Nanoparticles Functionalized by Dextran -- 4.6.2. Gold Nanoparticles in Hybridization Experiments -- 4.6.3. Enhanced Biomolecular Binding Sensitivity by Using Gold Nanoislands and Nanoparticles -- 4.6.4. Study of Antigen-Antibody Interactions by Gold Nanoparticle Localized Surface Plasmon Resonance Spectroscopy 4.6.5. Array of Gold Nanoparticles for Binding of Single Biomolecules -- 4.7. Biomimetic Surface Engineering -- 4.8. Attachment of Proteins to Surfaces -- 4.9. Surface Modification of Biomaterials for Tissue Engineering Applications -- 4.10. Temperature-Responsive Intelligent Interfaces -- References -- Review Questions -- 5.1. Contact Angle -- 5.1.1. Introduction to Contact Angle and Surface Science Principles -- 5.1.2. Contact Angle Measurement -- 5.1.3. Evaluation of Hydrophobicity of the Modified Surfaces by Contact Angle Measurements: Case Studies -- 5.1.3.1. Sensitivity of Contact Angle to Surface Treatment -- 5.1.3.2. Contact Angle Measurements of Surfaces Functionalized with Polyethyleneglycol (PEG) -- 5.1.3.3. Study of Surface Wettability of Polypyrrole for Microfluidics Applications -- 5.1.3.4. Wetting Properties of an Open-Channel Microfluidic System -- 5.1.3.5. Contact Angle Analysis of the Interfacial Tension -- 5.2. Atomic Force Microscopy (AFM) -- 5.2.1. Basic Concepts of AFM and Instrumentation -- 5.2.2. AFM Imaging of Biological Sample Surfaces -- 5.2.2.1. Ex Situ and In Situ AFM Characterization of Phospholipid Layers Formed by Solution Spreading (Casting) on a Mica Substrate 5.2.2.2. Study of Bacterial Surfaces in Aqueous Solution -- 5.2.2.3. AFM Study of Native Polysomes of Saccharomyces in a Physiological Buffer Solution -- 5.2.2.4. Single DNA Molecule Stretching Experiments by Using Chemical Force Microscopy -- 5.2.2.5. AFM Measurements of Competitive Binding Interactions between an Enzyme and Two Ligands -- 5.2.2.6. Study of Antigen-Antibody Interactions by Molecular Recognition Force Microscopy (MRFM) -- 5.2.2.7. Study of Cancer Alterations of Single Living Cells by AFM -- 5.3. X-Ray Photoelectron Spectroscopy -- 5.3.1. Introduction -- 5.3.2. X-Ray Photoelectron Spectroscopy of Biologically Important Materials -- 5.3.2.1. Peptide Nucleic Acids on Gold Surfaces as DNA Affinity Biosensors -- 5.3.2.2. Application of XPS to Probing Enzyme-Polymer Interactions at Biosensor Interfaces -- 5.3.2.3. Detection of Adsorbed Protein Films at Interfaces -- 5.4. Confocal Fluorescence Microscopy -- 5.4.1. Introduction -- 5.4.2. Biological Confocal Microscopy: Case Studies -- 5.4.2.1. Bioconjugated Carbon Nanotubes for Biosensor Applications -- 5.5. Attenuated Total Reflection (Internal Reflection) Infrared Spectroscopy 5.5.1. Introduction: ATR-FTIR Basics -- 5.5.2. Applications of ATR-FTIR Spectroscopy to Biomolecules and Biomedical Samples: Case Studies -- 5.5.2.1. Hydration Studies of Surface Adsorbed Layers of Adenosine-5'-Phosphoric Acid and Cytidine-5'-Phosphoric Acid by Freeze-Drying ATR-FTIR Spectroscopy -- 5.5.2.2. Study of the Interaction of Local Anesthetics with Phospholipid Model Membranes -- 5.5.2.3. Assessment of Synthetic and Biologic Membrane Permeability by Using ATR-FTIR Spectroscopy -- 5.5.2.4. ATR Measurement of the Physiological Concentration of Glucose in Blood by Using a Laser Source -- 5.5.2.5. Application of ATR-FTIR Spectroscopic Imaging in Pharmaceutical Research -- 5.6. Mechanical Methods: Use of Micro- and Nanocantilevers for Characterization of Surfaces -- References -- Review Questions -- 6.1. Biosensors -- 6.1.1. Introduction -- 6.1.2. Classification: Case Studies -- 6.1.2.1. Enzyme-Based Biosensors --

6.1.2.2. Nucleic-Acid-Based Biosensors -- 6.1.2.3. Antibody-Based Biosensors -- 6.1.2.4. Microbial Biosensors -- 6.2. Immunoassays -- 6.2.1. Introduction 6.2.2. Enzyme-Linked Immunosorbent Assay (ELISA) -- 6.2.3. Microfluidic Immunoassay Devices -- 6.2.3.1. A Compact-Disk-Like Microfluidic Platform for Enzyme-Linked Immunosorbent Assay -- 6.2.3.2. Portable Low-Cost Immunoassay for Resource-Poor Settings -- 6.3. Comparison between Biosensors and ELISA Immunoassays -- References -- Review Questions -- 7.1. Basic Microfabrication Processes -- 7.1.1. Introduction -- 7.1.2. Thin-Film Deposition -- 7.1.3. Photolithography -- 7.1.4. Etching -- 7.1.5. Substrate Bonding -- 7.2. Micromachining -- 7.2.1. Bulk Micromachining -- 7.2.2. Surface Micromachining -- 7.2.3. High-Aspect-Ratio Micromachining (LIGA Process) -- 7.3. Soft Micromachining -- 7.3.1. Introduction -- 7.3.2. Molding and Hot Embossing -- 7.3.3. Micro Contact Printing ([]CP) -- 7.3.4. Micro Transfer Molding ([]TM) -- 7.3.5. Micromolding in Capillaries -- 7.4. Microfabrication Techniques for Biodegradable Polymers -- 7.5. Nanofabrication Methods -- 7.5.1. Laser Processing, Ablation, and Deposition -- 7.5.2. High-Precision Milling 7.5.3. Inductively Coupled Plasma (ICP) Reactive Ion Etching -- 7.5.4. Electron Beam Lithography -- 7.5.5. Dip Pen Nanolithography -- 7.5.6. Nanosphere Lithography (Colloid Lithography) -- 7.5.7. Surface Patterning by Microlenses -- 7.5.8. Electrochemical Patterning -- 7.5.9. Electric-Field-Assisted Nanopatterning -- 7.5.10. Large-Area Nanoscale Patterning -- 7.5.11. Selective Molecular Assembly Patterning (SMAP) -- 7.5.12. Site-Selective Assemblies of Gold Nanoparticles on an AFM Tip-Defined Silicon Template -- 7.5.13. Highly Ordered Metal Oxide Nanopatterns Prepared by Template-Assisted Chemical Solution Deposition -- 7.5.14. Wetting-Driven Self-Assembly: A New Approach to Template-Guided Fabrication of Metal Nanopatterns -- 7.5.15. Patterned Gold Films via Site-Selective Deposition of Nanoparticles onto Polymer-Templated Surfaces -- 7.5.16. Nanopatterning by PDMS Relief Structures of Polymer Colloidal Crystals -- References -- Review Questions -- 8.1. Introduction -- 8.2. Fluid Physics at the Microscale -- 8.3. Methods for Enhancing Diffusive Mixing between Two Laminar Flows 8.4. Controlling Flow and Transport in Microfluidic Channels -- 8.4.1. Physical Processes Underlying Electrokinetics in Electroosmosis Systems -- 8.4.2. Droplet Actuation Based on Marangoni Flows -- 8.4.3. Electrowetting -- 8.4.4. Thermocapillary Pumping -- 8.4.5. Surface Electrodeposition -- 8.5. Modeling Microchannel Flow -- 8.5.1. Introduction -- 8.5.2. The Finite Element Method -- 8.5.3. Simulation of Flow in Microfluidic Channels: Case Studies -- 8.5.3.1. Case 1: Silicon Microfluidic Platform for Fluorescence-Based Biosensing -- 8.5.3.2. Case 2: Numerical Simulation of Electroosmotic Flow in Hydrophobic Microchannels: Influence of Electrode's Position -- 8.5.3.3.
Case 3: Prediction of Intermittent Flow Microreactor System -- 8.5.3.4. Case 4: Modeling of Electrowetting Flow -- 8.6. Experimental Methods -- 8.6.1. Flow Visualization at Microscale -- 8.6.2. Fluorescent Imaging Method -- 8.6.3. Particle Streak Velocimetry -- 8.6.4. Particle Tracking Velocimetry -- 8.6.5. Micro Particle Imaging Velocimetry (PIV) -- 8.6.6. Micro-Laser-Induced Fluorescence (LIF) Method for Shape Measurements 8.6.7. Caged and Bleached Fluorescence -- References -- Review Questions -- 9.1. Introduction to Microarrays -- 9.2. Microarrays Based on DNA -- 9.2.1. Introduction to DNA Chips -- 9.2.2. Principles of DNA Microarray: The Design, Manufacturing, and Data Handling -- 9.2.3. Applications of DNA Microarrays -- 9.3. Polymerase Chain Reaction (PCR) -- 9.3.1. Introduction -- 9.3.2. PCR

Process -- 9.3.3. On-Chip Single-Copy Real-Time Reverse Transcription PCR in Isolated Picoliter Droplets: A Case Study 9.4. Protein Microarrays -- 9.4.1. Introduction -- 9.4.2. Fabrication of Protein Microarrays -- 9.4.3. Applications of Protein Arrays -- 9.5. Cell and Tissue-Based Assays on a Chip -- 9.6. Microreactors -- 9.6.1. Introduction -- 9.6.2. Microchannel Enzyme Reactors -- 9.6.3. Enzymatic Conversions: Case Studies -- 9.6.3.1. Glycosidase-Promoted Hydrolysis in Microchannels -- 9.6.3.2. Lactose Hydrolysis by Hyperthermophilic I3-Glycoside Hydrolase with Immobilized Enzyme -- 9.6.3.3. Photopatterning Enzymes inside Microfluidic Channels -- 9.6.3.4. Integrated Microfabricated Device for an Automated Enzymatic Assay -- 9.6.3.5. Silicon Microstructured Enzyme Reactor with Porous Silicon as the Carrier Matrix -- 9.6.3.6. Enzymatic Reactions Using Droplet-Based Microfluidics -- 9.6.4. Synthesis of Nanoparticles and Biomaterials in Microfluidic Devices -- 9.6.5. Microfluidic Devices for Separation 9.6.5.1. Separation of Blood Cells -- 9.6.5.2. Cell or Particle Sorting -- 9.7. Micro Total Analysis Systems (pTAS) and Lab-on-a-Chip (LOC) -- 9.8. Lab-on-a-Chip: Conclusion and Outlook -- 9.9. Microcanti lever BioMEMS -- 9.9.1. Introduction -- 9.9.2. Basic Principles of Sensing Biomechanical Interactions -- 9.9.3. Detection Modes of Biomechanical Interactions -- 9.9.3.1. Static Mode -- 9.9.3.2. Dynamic Mode -- 9.9.4. Location of Interaction in the Case of Mass-Dominant BioMEMS Devices -- 9.9.5. Location of Interaction for Stress-Dominant BioMEMS Devices -- 9.9.6. Fabrication and Functionalization of Microcantilevers -- 9.9.6.1. Case 1: Detection of Interaction between ssDNA and the Thiol Group Using Cantilevers in the Static Mode -- 9.9.6.2. Case 2: Specific Detection of Enzymatic Interactions in the Static Mode -- 9.9.6.3. Case 3: Detection of Enzymatic Interactions in the Dynamic Mode -- References -- Review Questions.

Sommario/riassunto

"As technological advancements widen the scope of applications for biomicroelectromechanical systems (BioMEMS or biomicrosystems), the field continues to have an impact on many aspects of life science operations and functionalities. Because BioMEMS research and development require the input of experts who use different technical languages and come from varying disciplines and backgrounds, scientists and students can avoid potential difficulties in communication and understanding only if they possess a skill set and understanding that enables them to work at the interface of engineering and biosciences.Keeping this duality in mind throughout, BioMEMS: Science and Engineering Perspectives supports and expedites the multidisciplinary learning involved in the development of biomicrosystems. Divided into nine chapters, it starts with a balanced introduction of biological, engineering, application, and commercialization aspects of the field. With a focus on molecules of biological interest, the book explores the building blocks of cells and viruses, as well as molecules that form the self-assembled monolayers (SAMs), linkers, and hydrogels used for making different surfaces biocompatible through functionalization. The book also discusses: Different materials and platforms used to develop biomicrosystems Various biological entities and pathogens (in ascending order of complexity) The multidisciplinary aspects of engineering bioactive surfaces Engineering perspectives, including methods of manufacturing bioactive surfaces and devices Microfluidics modeling and experimentation Device level implementation of BioMEMS concepts for different applications. Because BioMEMS is an application-driven field, the book also highlights the concepts of lab-on-a-chip (LOC) and micro total analysis system (oTAS), along with their pertinence to the emerging point-of-care (POC) and point-of-need (PON) applications"--

Provided by publisher. "Preface We are proud to present this book as an attempt to bridge different areas that constitute the field of biomicroelectromechanical systems (BioMEMS), often called biomicrosystems. The field of BioMEMS has been growing rapidly since the early 1990s due to the advancements in microtechnologies that could cater to the vast application requirements of bio areas. The potential of BioMEMS suits this technology for many applications, including clinical and environmental diagnostics, drug delivery, agriculture, nutrition, pharmaceuticals, chemical synthesis, etc. It is foreseen that BioMEMS will have a deep impact on many aspects of the life science operations and functionalities in the near future. Scientists and students that work in the field of BioMEMS will need to have knowledge and skills at the interface between engineering and biosciences. Development of a BioMEMS device usually involves many scientists and students from various disciplines, such as biosciences, medicine, biochemistry, engineering, physics, etc. One could anticipate many communication and understanding issues that would arise among these people with varied expertise and training. The methods, details, and languages of training are quite different for the students and researchers of engineering and biosciences. As a result, researchers and students involved with multidisciplinary projects like BioMEMS undergo an interesting and refreshing learning on multidisciplinary subjects along the project development. This book aims to support and expedite the multidisciplinary learning involved with the development of biomicrosystems, from both bioscience and engineering perspectives"--Provided by publisher.