

Tachung C. Yih • Ilie Talpasanu | editors



# MICRO AND NANO MANIPULATIONS FOR BIOMEDICAL APPLICATIONS

# Micro And Nano Manipulations For Biomedical Applications

**Yi Guo**



## **Micro And Nano Manipulations For Biomedical Applications:**

Engineered Cell Manipulation for Biomedical Application Misturu Akashi, Takami Akagi, Michiya Matsusaki, 2014-10-16

This book is the first to summarize new technologies for engineered cell manipulation. The contents focus on control of cellular functions by nanomaterials and control of three dimensional cell cell interactions. Control of cellular functions is important for cell differentiation maturation and activation which generally are controlled by the addition of soluble cytokines or growth factors into cell culture dishes. Target antigen molecules can be efficiently delivered to the cytosol of the dendritic cells using the nanoparticle technique described here and cellular functions such as dendritic cell maturation can be controlled easily and with precision. This book describes basic preparation of the nanoparticles activation control of dendritic cells immune function control and in vivo application for various vaccination systems. The second type of control that of cell cell interaction is important for tissue engineering in order to develop three dimensional cellular constructs. To achieve in vitro engineering of three dimensional human tissue constructs cell cell interaction must be controlled in three dimensions but typical biological cell manipulation technique cannot accomplish this task. An engineered cell manipulation technique is necessary. In this book the authors describe the fabrication of nanofilms onto cell surfaces development of three dimensional cellular multilayers and various applications of the cellular multilayers as three dimensional human models. This important work will be highly informative for researchers and students in the fields of materials science polymer science biomaterials medicinal science nanotechnology biotechnology and biology.

**Selected Topics in Micro/Nano-robotics for Biomedical Applications** Yi Guo, 2012-09-25. Micro Nano robotics for Biomedical Applications features a system approach and incorporates modern methodologies in autonomous mobile robots for programmable and controllable micro nano robots aiming at biomedical applications. The book provides chapters of instructional materials in micro nanorobotics for biomedical applications. The book features lecture units on micro nanorobot components and techniques including sensors actuator power supply and micro nano fabrication and assembly. It also contains case studies on using micro nano robots in biomedical environments and in biomedicine as well as a design example to conceptually develop a Vitamin pill sized robot to enter human s gastrointestinal tract. Laboratory modules to teach robot navigation and cooperation methods suitable to biomedical applications will be also provided based on existing simulation and robot platforms.

**Micro- and Nanomanipulation Tools** Yu Sun, Xinyu Liu, 2015-08-24. Combining robotics with nanotechnology this ready reference summarizes the fundamentals and emerging applications in this fascinating research field. This is the first book to introduce tools specifically designed and made for manipulating micro and nanometer sized objects and presents such examples as semiconductor packaging and clinical diagnostics as well as surgery. The first part discusses various topics of on chip and device based micro and nanomanipulation including the use of acoustic magnetic optical or dielectrophoretic fields while surface driven and high speed microfluidic manipulation for biophysical applications are also covered. In the second part of

the book the main focus is on microrobotic tools Alongside magnetic micromanipulators bacteria and untethered chapters also discuss silicon nano and integrated optical tweezers The book closes with a number of chapters on nanomanipulation using AFM and nanocoils under optical and electron microscopes Exciting images from the tiniest robotic systems at the nano level are used to illustrate the examples throughout the work A must have book for readers with a background ranging from engineering to nanotechnology

**Micro and Nano Techniques for the Handling of Biological Samples** Jaime Castillo-Leon, Winnie Edith Svendsen, Maria Dimaki, 2011-08-25 Several micro and nanomanipulation techniques have emerged in recent decades thanks to advances in micro and nanofabrication For instance the atomic force microscope AFM uses a nano sized tip to image push pull cut and indent biological material in air liquid or vacuum Using micro and nanofabrication techniques scientists can make ma

**Micro/Nanorobots in Nanobiotechnology** Fengtong Ji, Yue Dong, Tianlong Li, Katherine Villa, 2024-07-18 Micro nanorobots have emerged as functional agents and versatile tools for investigating the complex microenvironments within biological systems Operating at a scale comparable to cells these micro nanorobots offer controllable motion and customizable characteristics whilst swarming micro nanorobots exhibit exceptional efficiency robustness and adaptivity As a result these active particles hold significant potential for interacting with living cells diseased tissues and organs offering viable approaches to uncovering natural principles of development and addressing diseases such as drug tolerant infections and bacterial self organization To tackle these challenges functionalized micro nanorobots through active intervention can yield substantial effects on the development and treatment of cellular environments bacterial biofilms and tissue restoration In this regard we are organizing a special issue to delineate the current state of the art of micro nanorobots in biological contexts and to advance therapeutics by elucidating the underlying mechanisms in living systems In the contemporary era of advancing nanomedicine the utilization of micro nanorobots in clinical therapy is still in its nascent stages within the realm of modern healthcare Biomedical and biological environments hold immense promise as platforms for these active agents showcasing remarkable functionalities and efficacy in vitro ex vivo and in vivo Micro nanorobots have the capacity to emulate the behaviors of living cells particularly bacteria which play a crucial role in microbial infections thus impacting public health and medical devices These active agents possess the potential to overcome biological barriers and enable targeted therapies for various healthcare issues including the prevention and treatment of diseased tissues and biofilms which will significantly enhance the minimally invasive operations and remote treatments for the next generation human healthcare system The objectives of this research topic are threefold 1 to investigate the novel functionalities of micro nanorobots in biological contexts 2 to unravel the underlying principles of cell tissue and organ development and 3 to innovate active therapeutic approaches for addressing diseased tissues and microbial biofilms

*Ultrasonic Micro/nano Manipulations: Principles And Examples* Junhui Hu, 2014-03-13 Demands for high performance micro nano manipulations from the manufacture of microelectronic and photonic devices biomedical apparatus

nanoscience and nanotechnology renewable energy environment protection and high end appliances have been rapidly increasing in recent years However there are very few books on ultrasonic manipulation technology which is one of the important means in micro nano manipulations This unique title gives the basic physical principles of ultrasonic micro nano manipulations and highlights methods of implementing these principles The nonlinear effects of ultrasound are described in details after piezoelectric transduction and acoustic field are introduced and discussed Numerous important examples are given in this book to help readers better understand the applications of these principles and characteristics of ultrasonic manipulators utilizing these principles The examples cover the manipulations of micro solids nanoscale entities droplets and microfluid This indispensable book will contribute positively to the development and application of micro nano manipulation technology Biophotonic Manipulation Baojun Li,Yuchao Li,Hongbao Xin,2025-08-11 This book offers a thorough overview of the rapidly expanding field of biophotonic manipulation delving into topics such as the fundamentals of optical forces technologies of optical manipulation and their applications in the biomedical field The recent recognition of Arthur Ashkin with the Nobel Prize for his groundbreaking work on optical tweezers has sparked a renewed interest and importance in the realm of optical manipulation In response to this the authors present a timely and comprehensive book that focuses on the basics and uses of various optical manipulation technologies catering to a readership with a strong interest in this advancing field This book not only enhances readers current knowledge base but also serves as a valuable resource for researchers scientists and enthusiasts looking to gain a deeper understanding of the transformative power of optical manipulation

*Nano- and Microfabrication for Industrial and Biomedical Applications* Regina Luttge,2016-06-12 Nano and Microfabrication for Industrial and Biomedical Applications Second Edition focuses on the industrial perspective on micro and nanofabrication methods including large scale manufacturing the transfer of concepts from lab to factory process tolerance yield robustness and cost The book gives a history of miniaturization and micro and nanofabrication and surveys industrial fields of application illustrating fabrication processes of relevant micro and nano devices In this second edition a new focus area is nanoengineering as an important driver for the rise of novel applications by integrating bio nanofabrication into microsystems In addition new material covers lithographic mould fabrication for soft lithography nanolithography techniques corner lithography advances in nanosensing and the developing field of advanced functional materials Luttge also explores the view that micro and nanofabrication will be the key driver for a tech revolution in biology and medical research that includes a new case study that covers the developing organ on chip concept Presents an interdisciplinary approach that makes micro nanofabrication accessible equally to engineers and those with a life science background both in academic settings and commercial R D Provides readers with guidelines for assessing the commercial potential of any new technology based on micro nanofabrication thus reducing the investment risk Updated edition presents nanoengineering as an important driver for the rise of novel applications by integrating bio nanofabrication into microsystems **Microfluidic Technologies**

**for Human Health** Utkan Demirci, Robert Langer, Ali Khademhosseini, 2012 Ch 1 A microscale bioinspired cochlear like sensor Robert D White Robert Littrell and Karl Grosh ch 2 Systematic evaluation of the efficiencies of proteins and chemicals in pharmaceutical applications Morgan Hamon and Jong Wook Hong ch 3 Microfluidic glucose sensors Jithesh V Veetil und weitere ch 4 Applications of microfabrication and microfluidic techniques in mesenchymal stem cell research Abhijit Majumder und weitere ch 5 Patient specific modeling of low density lipoprotein transport in coronary arteries Ufuk Olgac ch 6 Point of care microdevices for global health diagnostics of infectious diseases Sau Yin Chin und weitere ch 7 Integrated microfluidic sample preparation for chip based molecular diagnostics Jane Y Zhang und weitere ch 8 Microfluidic devices for cellular proteomic studies Yihong Zhan and Chang Lu ch 9 Microfluidics for neuroscience novel tools and future implications Vivian M Hernandez and P Hande Ozdinler ch 10 Microfluidics on chip platforms as in vitro disease models Shan Gao Erkin Seker and Martin L Yarmush ch 11 Application of microfluidics in stem cell and tissue engineering Sasha H Bakhru Christopher Highley and Stefan Zappe ch 12 Microfluidic on the fly fabrication of microstructures for biomedical applications Edward Kang Sau Fung Wong and Sang Hoon Lee ch 13 Microfluidics as a promising tool toward distributed viral detection Elodie Sollier and Dino Di Carlo ch 14 Electrophoresis and dielectrophoresis for lab on a chip LOC analyses Yagmur Demircan Gurkan Yilmaz and Haluk Kulah ch 15 Ultrasonic embossing of carbon nanotubes for the fabrication of polymer microfluidic chips for DNA sample purification Puttachat Khuntontong Min Gong and Zhiping Wang ch 16 Ferrofluidics A Rezzan Kose and Hur Koser ch 17 Antibody based blood bioparticle capture and separation using microfluidics for global health ZhengYuan Luo und weitere ch 18 Applications of quantum dots for fluorescence imaging in biomedical research ShuQi Wang und weitere

**Knowledge-Based and Intelligent Information and Engineering Systems, Part I** Andreas Koenig, Andreas Dengel, Knut Hinkelmann, Koichi Kise, Robert J. Howlett, Lakhmi C. Jain, 2011-09-15 The four volume set LNAI 6881 LNAI 6884 constitutes the refereed proceedings of the 15th International Conference on Knowledge Based Intelligent Information and Engineering Systems KES 2011 held in Kaiserslautern Germany in September 2011 Part 1 The total of 244 high quality papers presented were carefully reviewed and selected from numerous submissions The 61 papers of Part 1 are organized in topical sections on artificial neural networks connectionists systems and evolutionary computation machine learning and classical AI agent multi agentsystems knowledge based and expert systems intelligent vision image processing and signal processing knowledge management ontologies and data mining

**Nano-optics and Near-field Optical Microscopy** Anatoly V. Zayats, David Richards, 2009 This groundbreaking book focuses on near field microscopy which has opened up optical processes at the nanoscale for direct inspection Further it explores the emerging area of nano optics which promises to make possible optical microscopy with true nanometer resolution This frontline resource helps you achieve high resolution optical imaging of biological species and functional materials You also find guidance in the imaging of optical device operation and new nanophotonics functionalities EBL

**Micro and Nanofabrication Using Self-Assembled**

**Biological Nanostructures** Jaime Castillo-León, Winnie Svendsen, 2014-09-09 Self assembled nanostructures based on peptides and proteins have been investigated and presented as biomaterials with an impressive potential for a broad range of applications such as microfabrication biosensing platforms drug delivery systems bioelectronics and tissue reparation Through self assembly peptides can give rise to a range of well defined nanostructures such as nanotubes nanofibers nanoparticles nanotapes gels and nanorods However there are challenges when trying to integrate these biological nanostructures in the development of sensing devices or drug delivery systems challenges such as controlling the size during synthesis the stability in liquid environments and manipulation In Micro and Nanofabrication Using Self assembled Biological Nanostructures the options and challenges when using self assembled peptide nanostructures in micro and nanofabrication are discussed The publication covers different ways to manipulate deposit and immobilize on specific locations these biological nanostructures in order to use them in the fabrication of new structures or as part of biosensing platforms Examples where researchers used biological nanostructures for those types of applications are provided Finally future applications are discussed as well as parameters to accelerate and expand the use of these biological building blocks in nano and micro fabrication processes by taking advantage of their impressive properties such as low cost and short synthesis time

**Manipulation of Nanoscale Materials** Katsuhiko Ariga, 2012-09-05 Techniques and strategies for the production of nanomaterials and nanostructures have developed to an advanced level However the concepts and methods needed to correctly architect these materials into viable applications remains seriously lacking This book introduces the concept of Nanoarchitectonics a term introduced by Dr Masakazu Aono to describe the correct manipulation of nanoscale materials in the creation of nano devices and applications With contributions from across the globe Manipulation of Nanoscale Materials presents a broad spectrum of nanomaterials and their applications Following an introductory chapter prepared by the editors the book is divided into three further sections of chapters detailing Nanoarchitectonics for Materials Development Materials Nanoarchitectonics for Bio Conjugates and Bio Applications Materials Nanoarchitectonics for Advanced Devices The first book in its field this is essential reading for anyone creating or deploying nanomaterials Fully referenced to the primary literature this title presents an excellent source of information and inspiration to the reader and should appeal to experienced materials scientists nanotechnologists and postgraduate students Dr Katsuhiko Ariga is the Director of Supermolecules Group and Principal Investigator of World Premier International WPI Research Center for Materials Nanoarchitectonics MANA the National Institute for Materials Science NIMS Dr Masakazu Aono is Director General of MANA and group leader of the nano system organization group MANA NIMS

**Manipulation of Multiphase Materials for Touch-less Nanobiotechnology** Sara Coppola, 2016-04-03 The thesis presents an original and smart way to manipulate liquid and polymeric materials using a pyro fluidic platform which exploits the pyro electric effect activated onto a ferroelectric crystal It describes a great variety of functionalities of the pyro electrohydrodynamic platform such as droplet

self assembling and dispensing for manipulating multiphase liquids at the micro and nanoscale The thesis demonstrates the feasibility of non contact self assembling of liquids in plane 1D using a micro engineered crystal improving the dispensing capability and the smart transfer of material between two different planes 2D and controlling and fabricating three dimensional structures 3D The thesis present the fabrication of highly integrated and automated lab on a chip systems based on microfluidics The pyro platform presented herein offers the great advantage of enabling the actuation of liquids in contact with a polar dielectric crystal through an electrode less configuration The simplicity and flexibility of the method for fabricating 3D polymer microstructures shows the great potential of the pyro platform functionalities exploitable in many fields from optics to biosensing In particular this thesis reports the fabrication of optically active elements such as nanodroplets microlenses and microstructures which have many potential applications in photonics The capability for manipulating the samples of interest in a touch less modality is very attractive for biological and chemical assays Besides controlling cell growth and fate smart micro elements could deliver optical stimuli from and to cells monitoring their growth in real time opening interesting perspectives for the realization of optically active scaffolds made of nanoengineered functional elements thus paving the way to fascinating Optogenesis Studies

**Nanomechanics of Materials and Structures** Tze-jer Chuang, 2006-02-10 This volume provides a critical assessment of the current state of the art in nanomechanics with particular application to mechanical properties and structural integrity associated with MEMS NEMS nanomanufacturing microelectronics nanotechnology biotechnology and microsystems It contains articles by leading international experts in these fields A special workshop summary identifies major gaps in present knowledge barriers to applications and critical research areas for rapid development of enabling technologies This book is an excellent reference book for both academic and industrial researchers working in the fields of nanotechnology biotechnology engineering nanotribology and mechanics materials science and engineering computer science and information technology It will also be of interest to those pursuing research in NEMS MEMS mesomanufacturing sensors actuators controllers micromotors and other microsystems in aerospace defense and military systems

**Engineering of Micro/Nano Biosystems** Gregory Barbillon, Alain Bosseboeuf, Kukjin Chun, Rosaria Ferrigno, Olivier Français, 2019-08-02 This tutorial book offers an in depth overview of the fundamental principles of micro nano technologies and devices related to sensing actuation and diagnosis in fluidics and biosystems Research in the MEMS NEMS and lab on chip fields has seen rapid growth in both academic and industrial domains as these biodevices and systems are increasingly replacing traditional large size diagnostic tools This book is unique in describing not only the devices and technologies but also the basic principles of their operation The comprehensive description of the fabrication packaging and principles of micro nano biosystems presented in this book offers guidance for researchers designing and implementing these biosystems across diverse fields including medical pharmaceutical and biological sciences The book provides a detailed overview of the fundamental mechanical optical



electrical and magnetic principles involved together with the technologies required for the design fabrication and characterization of micro nano fluidic systems and bio devices Written by a collaborative team from France and Korea the book is suitable for academics researchers advanced level students and industrial manufacturers Applied Engineering Sciences Wei Deng,2015-01-02 This proceedings volume contains selected papers presented at the 2014 AASRI International Conference on Applied Engineering Sciences held in Hollywood LA USA Contributions cover the latest developments and advances in the field of Applied Engineering Sciences Intelligent Biomaterials Zhe Liu,2025-07-10 This book presents the latest advances in intelligent biomaterials a fast developing area for disease diagnosis and treatments health management and rehabilitations In particular this book focuses on versatile types of emerging intelligent biomaterials as well as their multiple roles in smart biosensors tissue engineering medical meta data analysis micro nanorobotics and artificial intelligence based theranostics These state of the art technologies and updated knowledge are expected to reshape the future trend of biomaterials and more importantly integrate biomaterials and intelligence together as a single entity to serve human health improvements On this basis this book aims to elucidate the concept and domain of intelligent biomaterials and discuss on their cutting edge applications It will provide a vast readership including students scientists researchers and professional staff in the trans disciplinary community with a brand new viewpoint to learn about the frontiers of intelligent biomaterials **Robotics for Cell Manipulation and Characterization** Changsheng Dai,Guanqiao Shan,Yu Sun,2023-04-20 Robotics for Cell Manipulation and Characterization provides fundamental principles underpinning robotic cell manipulation and characterization state of the art technical advances in micro nano robotics new discoveries of cell biology enabled by robotic systems and their applications in clinical diagnosis and treatment This book covers several areas including robotics control computer vision biomedical engineering and life sciences using understandable figures and tables to enhance readers comprehension and pinpoint challenges and opportunities for biological and biomedical research Focuses on and comprehensively covers robotics for cell manipulation and characterization Highlights recent advances in cell biology and disease treatment enabled by robotic cell manipulation and characterization Provides insightful outlooks on future challenges and opportunities *Magnetic Materials, Processes, and Devices 13* C. Bonhôte,S. Brankovic,H. H. Gatzert,P. Hesketh,Y. Kitamoto,T. Osaka,G. Zangari,2015-04-30

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