

## Biomimetic Technologies Principles And Applications Woodhead Publishing Series In Electronic And Optical Materials

**Advances in Chemical Mechanical Planarization (CMP)** provides the latest information on a mainstream process that is critical for high-volume, high-yield semiconductor manufacturing, and even more so as device dimensions continue to shrink. The technology has grown to encompass the removal and planarization of multiple metal and dielectric materials and layers both at the device and the metallization levels, using different tools and parameters, requiring improvements in the control of topography and defects. This important book offers a systematic review of fundamentals and advances in the area. Part One covers CMP of dielectric and metal films, with chapters focusing on the use of particular techniques and processes, and on CMP of particular various materials, including ultra low-k materials and high-mobility channel materials, and ending with a chapter reviewing the environmental impacts of CMP processes. Part Two addresses consumables and process control for improved CMP, and includes chapters on the preparation and characterization of slurry, diamond disc pad conditioning, the use of FTIR spectroscopy for characterization of surface processes, and approaches for deflection characterization, mitigation, and reduction. Considers techniques and processes for CMP of dielectric and metal films Includes chapters devoted to CMP for particular materials Addresses consumables and process control for improved CMP

Current data centre networks, based on electronic packet switches, are experiencing an exponential increase in network traffic due to developments such as cloud computing. Optical interconnects have emerged as a promising alternative offering high throughput and reduced power consumption. **Optical Interconnects for Data Centers** reviews key developments in the use of optical interconnects in data centres and the current state of the art in transforming this technology into a reality. The book discusses developments in optical materials and components (such as single and multi-mode waveguides), circuit boards and ways the technology can be deployed in data centres. **Optical Interconnects for Data Centers** is a key reference text for electronics designers, optical engineers, communications engineers and R&D managers working in the communications and electronics industries as well as postgraduate researchers. Summarizes the state-of-the-art in this emerging field Presents a comprehensive review of all the key aspects of deploying optical interconnects in data centers, from materials and components, to circuit boards and methods for integration Contains contributions that are drawn from leading international experts on the topic

This book addresses the possibilities and challenges in mimicking biological membranes and creating membrane-based sensor and separation devices. Recent advances in developing biomimetic membranes for technological applications will be presented with focus on the use of integral membrane protein mediated transport for sensing and separation. It describes the fundamentals of biosensing as well as separation and shows how the two processes are working in a cooperative manner in biological systems. Biomimetics is a truly cross-disciplinary approach and this is exemplified using the process of forward osmosis will be presented as an illustration of how advances in membrane technology may be directly stimulated by an increased understanding of biological membrane transport. In the development of a biomimetic sensor/separation technology, both channels (ion and water channels) and carriers (transporters) are important. An ideal sensor/separation device requires the supporting biomimetic matrix to be virtually impermeable to anything but the solute in question. In practice, however, a biomimetic support matrix will generally have finite permeabilities to water, electrolytes, and non-electrolytes. These non-protein mediated membrane transport contributions will be presented and the implications for biomimetic device construction will be discussed. New developments in our understanding of the reciprocal coupling between the material properties of the biomimetic matrix and the embedded proteins will be presented and strategies for inducing biomimetic matrix stability will be discussed. Once reconstituted in its final host biomimetic matrix the protein stability also needs to be maintained and controlled. Beta-barrel proteins exemplified by the E. Coli outer membrane channels or small peptides are inherently more stable than alpha-helical bundle proteins which may require additional stabilizing modifications. The challenges associated with insertion and stabilization of alpha-helical bundle proteins including many carriers and ligand and voltage gated ion (and water) channels will be discussed and exemplified using the aquaporin protein. Many biomimetic membrane applications require that the final device can be used in the macroscopic realm. Thus a biomimetic separation device must have the ability to process hundred of liters of permeate in hours – effectively demanding square-meter size membranes. Scalability is a general issue for all nano-inspired technology developments and will be addressed here in the context biomimetic membrane array fabrication. Finally a robust working biomimetic device based on membrane transport must be encapsulated and protected yet allowing massive transport through the encapsulation material. This challenge will be discussed using microfluidic design strategies as examples of how to use microfluidic systems to create and encapsulate biomimetic membranes. The book provides an overview of what is known in the field, where additional research is needed, and where the field is heading.

**Rare Earth and Transition Metal Doping of Semiconductor Material** explores traditional semiconductor devices that are based on control of the electron's electric charge. This book looks at the semiconductor materials used for spintronics applications, in particular focusing on wide band-gap semiconductors doped with transition metals and rare earths. These materials are of particular commercial interest because their spin can be controlled at room temperature, a clear opposition to the most previous research on Gallium Arsenide, which allowed for control of spins at supercold temperatures. Part One of the book explains the theory of magnetism in semiconductors, while Part Two covers the growth of semiconductors for spintronics. Finally, Part Three looks at the characterization and properties of semiconductors for spintronics, with Part Four exploring the devices and the future direction of spintronics. Examines materials which are of commercial interest for producing smaller, faster, and more power-efficient computers and other devices Analyzes the theory behind magnetism in semiconductors and the growth of semiconductors for spintronics Details the properties of semiconductors for spintronics

**Materials, Devices and Applications**

**Interdisciplinary Expansions in Engineering and Design With the Power of Biomimicry**

**Electronics, Photonics and Energy Applications**

**Nature - Analogies - Technology**

**An overview for applications**

**Polymer Optical Fibres**

*Fundamentals and Applications of Nanophotonics* includes a comprehensive discussion of the field of nanophotonics, including key enabling technologies that have the potential to drive economic growth and impact numerous application domains such as ICT, the environment, healthcare, military, transport, manufacturing, and energy. This book gives readers the theoretical underpinnings needed to understand the latest advances in the field. After an introduction to the area, chapters two and three cover the essential topics of electrodynamics, quantum mechanics, and computation as they relate to nanophotonics. Subsequent chapters explore materials for nanophotonics, including nanoparticles, photonic crystals, nanosilicon, nanocarbon, III-V, and II-VI semiconductors. In addition, fabrication and characterization techniques are addressed, along with the importance of plasmonics, and the applications of nanophotonics in devices such as lasers, LEDs, and photodetectors. Covers electrodynamics, quantum mechanics and computation as these relate to nanophotonics Reviews materials, fabrication and characterization techniques for nanophotonics Describes applications of the technology such as lasers, LEDs and photodetectors

*This book provides the readers with a timely guide to the application of biomimetic principles in architecture and engineering design. As a result of a combined effort by two internationally recognized authorities, the biologist Werner Nachtigall and the architect Göran Pohl, the book describes the principles which can be used to compare nature and technology, and at the same time it presents detailed explanations and examples showing how biology can be used as a source of inspiration and "translated" in building and architectural solutions (biomimicry). Even though nature cannot be directly copied, the living world can provide architects and engineers with a wealth of analogues and inspirations for their own creative designs. But how can analysis of natural entities give rise to advanced and sustainable design? By reporting on the latest bionic design methods and using extensive artwork, the book guides readers through the field of nature-inspired architecture, offering an extraordinary resource for professional architects, engineers, designers and urban planners, as well as for university teachers, researchers and students. Natural evolution is seen throughout the book as a powerful resource that can serve architecture and design by providing innovative, optimal and sustainable solutions. Nature is the world's foremost designer. With billions of years of experience and boasting the most extensive laboratory available, it conducts research in every branch of engineering and science. Nature's designs and capabilities have always inspired technology, from the use of tongs and tweezers to genetic algorithms and autonomous legged robots. Taking a systems perspective rather than focusing narrowly on materials or chemistry aspects, *Biomimetics: Biologically Inspired Technologies* examines the field from every angle. The book contains pioneering approaches to biomimetics including a new perspective on the mechanization of cognition and intelligence, as well as defense and attack strategies in nature, their applications, and potential. It surveys the field from modeling to applications and from nano- to macro-scales, beginning with an introduction to principles of using biology to inspire designs as well as biological mechanisms as models for technology. This innovative guide discusses evolutionary robotics; genetic algorithms; molecular machines; multifunctional, biological-, and nano- materials; nastic structures inspired by plants; and functional surfaces in biology. Looking inward at biological systems, the book covers the topics of biomimetic materials, structures, control, cognition, artificial muscles, biosensors that mimic senses, artificial organs, and interfaces between engineered and biological systems. The final chapter contemplates the future of the field and outlines the challenges ahead. Featuring extensive illustrations, including a 32-page full-color insert, *Biomimetics: Biologically Inspired Technologies* provides unmatched breadth of scope as well as lucid illumination of this promising field.*

*Photodetectors: Materials, Devices and Applications* discusses the devices that convert light to electrical signals, key components in communication, computation, and imaging systems. In recent years, there has been significant improvement in photodetector performance, and this important book reviews some of the key advances in the field. Part one covers materials, detector types, and devices, and includes discussion of silicon photonics, detectors based on reduced dimensional charge systems, carbon nanotubes, graphene, nanowires, low-temperature grown gallium arsenide, plasmonic, Si photomultiplier tubes, and organic photodetectors, while part two focuses on important applications of photodetectors, including microwave photonics, communications, high-speed single photon detection, THz detection, resonant cavity enhanced photodetection, photo-capacitors and imaging. Reviews materials, detector types and devices Addresses fabrication techniques, and the advantages and limitations and different types of photodetector Considers a range of application for this important technology Includes discussions of silicon photonics, detectors based on reduced dimensional charge systems, carbon nanotubes, graphene, nanowires, and more

**Advanced Applications for Artificial Neural Networks**

**Fundamentals and Applications of Nanophotonics**

**Nanobiotechnology of Biomimetic Membranes**

**Extreme Biomimetics**

*Biologically Inspired Textiles*

*Biomimetic Membranes for Sensor and Separation Applications*

**Materials Characterization Using Nondestructive Evaluation (NDE) Methods** discusses NDT methods and how they are highly desirable for both long-term monitoring and short-term assessment of materials, providing crucial early warning that the fatigue life of a material has elapsed, thus helping to prevent service failures. **Materials Characterization Using Nondestructive Evaluation (NDE) Methods** gives an overview of established and new NDT techniques for the characterization of materials, with a focus on materials used in the automotive, aerospace, power plants, and infrastructure construction industries. Each chapter focuses on a different NDT technique and indicates the potential of the method by selected examples of applications. Methods covered include scanning and transmission electron microscopy, X-ray microtomography and diffraction, ultrasonic, electromagnetic, microwave, and hybrid techniques. The authors review both the determination of microstructure properties, including phase content and grain size, and the determination of mechanical properties, such as hardness, toughness, yield strength, texture, and residual stress. Gives an overview of established and new NDT techniques, including scanning and transmission electron microscopy, X-ray microtomography and diffraction, ultrasonic, electromagnetic, microwave, and hybrid techniques Reviews the determination of microstructural and mechanical properties Focuses on materials used in the automotive, aerospace, power plants, and infrastructure construction industries Serves as a highly desirable resource for both long-term monitoring and short-term assessment of materials

Microdroplet technology has recently emerged to provide new and diverse applications via microfluidic functionality, especially in various areas of biology and chemistry. This book, then, gives an overview of the principle components and wide-ranging applications for state-of-the-art of droplet-based microfluidics. Chapter authors are internationally-leading researchers from chemistry, biology, physics and engineering that present various key aspects of microdroplet technology -- fundamental flow physics, methodology and components for flow control, applications in biology and chemistry, and a discussion of future perspectives. This book acts as a reference for academics, post-graduate students, and researcher wishing to deepen their understand of microfluidics and introduce optimal design and operation of new droplet-based microfluidic devices for more comprehensive analyte assessments.

**Laser Additive Manufacturing: Materials, Design, Technologies, and Applications** provides the latest information on this highly efficient method of layer-based manufacturing using metals, plastics, or composite materials. The technology is particularly suitable for the production of complex components with high precision for a range of industries, including aerospace, automotive, and medical engineering. This book provides a comprehensive review of the technology and its range of applications. Part One looks at materials suitable for laser AM processes, with Part Two discussing design strategies for AM. Parts Three and Four review the most widely-used AM technique, powder bed fusion (PBF) and discuss other AM techniques, such as directed energy deposition, sheet lamination, jetting techniques, extrusion techniques, and vat photopolymerization. The final section explores the range of applications of laser AM. Provides a comprehensive one-volume overview of advances in laser additive manufacturing Presents detailed coverage of the latest techniques used for laser additive manufacturing Reviews both established and emerging areas of application

This book discusses the current direction of the research approach to extreme biomimetics through biological materials-inspired chemistry and its applications in modern technology and medicine. It is a resource covering topics of extreme (psychrophilic and thermophilic) biomineralization, solvothermal and hydrothermal chemistry of metal oxides and nanostructured composites, and bioinspired materials science in a diverse areas. The authors review the current advances in the extreme biomimetics research field and describe various approaches introduced and explored by their respective laboratories. • Details the basic principles of extreme biomimetics approach for design of new materials and applications; • Includes numerous examples of the hierarchical organization of hydrothermally or psychrophilically obtained biocomposites, structural bioscaffolds, biosculpturing, biomimetism, and bioinspiration as tools for the design of innovative materials; • Describes and details the principles of extreme biomimetics with respect to metallization of chemically and thermally stable biopolymers.

**Materials, Design, Technologies, and Applications**

**Conference proceedings 2020**

**Modeling, Characterization and Production of Nanomaterials**

**Nature-Based Innovation**

**Advances in Chemical Mechanical Planarization (CMP)**

**Optical Interconnects for Data Centers**

This book comprises the proceedings of the conference "Future Production of Hybrid Structures 2020", which took place in Wolfsburg. The conference focused on hybrid lightweight design, which is characterized by the combination of different materials with the aim of improving properties and reducing weight. In particular, production technologies for hybrid lightweight design were discussed, new evaluation methods for the ecological assessment of hybrid components were presented and future-oriented approaches motivated by nature for the development of components, assemblies and systems were introduced. Lightweight design is a key technology for the development of sustainable and resource-efficient mobility concepts. Vehicle manufacturers operate in an area of conflict between customer requirements, competition and legislation. Material hybrid structures, which combine the advantages of different materials, have a high potential for reducing weight, while simultaneously expanding component functionality. The future, efficient use of function-integrated hybrid structures in vehicle design requires innovations and constant developments in vehicle and production technology. There is a great demand, especially with regard to new methods and technologies, for "affordable" lightweight construction in large-scale production, taking into account the increasing requirements with regard to variant diversity, safety and quality.

**Industrial Wireless Sensor Networks: Monitoring, Control and Automation** explores the explosive growth that has occurred in the use of wireless sensor networks in a variety of applications during the last few years. As wireless technology can reduce costs, increase productivity, and ease maintenance, the book looks at the progress in standardization efforts regarding reliability, security, performance, power consumption, and integration. Early sections of the book discuss issues such as media access control (MAC), antenna design and site survey, energy harvesting, and explosion-proof design. Subsequent sections present WSN standards, including ISA100, ZigBee™, WiFi™, WirelessHART™ and 6LoWPAN, and the applications of WSNs in the oil and gas, chemical, food, and nuclear power industries. Reviews technologies and standards for industrial wireless sensor networks Considers particular applications for the technology and their ability to reduce costs, increase productivity, and ease maintenance Focuses on industry needs and standardization efforts regarding reliability, security, performance, power consumption, and integration.

**Polymer Optical Fibres: Fibre Types, Materials, Fabrication, Characterization, and Applications** explores polymer optical fibers, specifically their materials, fabrication, characterization, measurement techniques, and applications. Optical effects, including light propagation, degrading effects of attenuation, scattering, and dispersion, are explained. Other important parameters like mechanical strength, operating temperatures, and processability are also described. Polymer optical fibers (POF) have a number of advantages over glass fibers, such as low cost, flexibility, low weight, electromagnetic immunity, good bandwidth, simple installation, and mechanical stability. Provides systematic and comprehensive coverage of materials, fabrication, properties, measurement techniques, and applications of POF Focuses on industry needs in communication, illumination and sensors, the automotive industry, and medical and biotechnology Features input from leading experts in POF technology, with experience spanning optoelectronics, polymer, and textiles Explains optical effects, including light propagation, degrading effects of attenuation, scattering, and dispersion

In this book, highly qualified multidisciplinary scientists grasp their recent researches motivated by the importance of artificial neural networks. It addresses advanced applications and innovative case studies for the next-generation optical networks based on modulation recognition using artificial neural networks, hardware ANN for gait generation of multi-legged robots, production of high-resolution soil property ANN maps, ANN and dynamic factor models to

combine forecasts, ANN parameter recognition of engineering constants in Civil Engineering, ANN electricity consumption and generation forecasting, ANN for advanced process control, ANN breast cancer detection, ANN applications in biofuels, ANN modeling for manufacturing process optimization, spectral interference correction using a large-size spectrometer and ANN-based deep learning, solar radiation ANN prediction using NARX model, and ANN data assimilation for an atmospheric general circulation model.

Microdroplet Technology

Encyclopedia of Renewable and Sustainable Materials

Advanced Bioimaging Technologies in Assessment of the Quality of Bone and Scaffold Materials

Biologically Inspired Technologies

Rare Earth and Transition Metal Doping of Semiconductor Materials

Biomimetics for Architecture & Design

Bionics transfers knowledge about biological models into technical applications and can thus be used for the development of technical products and innovations. It is one of the most exciting approaches for future technical and social innovation, since most of the knowledge from biology has not yet been used. In this essential, Kristina Wanieck summarizes the most important basics of bionics for their application in practice. In addition, the author describes an approach that is open to topics and problems - i.e. independent of a specific question. These basics should make it possible to use bionics for a wide variety of questions and projects. This book is a translation of the original German 1st edition *Bionik für technische Produkte und Innovation* by Kristina Wanieck, published by Springer Fachmedien Wiesbaden GmbH, part of Springer Nature in 2019. The translation was done with the help of artificial intelligence (machine translation by the service DeepL.com). A subsequent human revision was done primarily in terms of content, so that the book will read stylistically differently from a conventional translation. Springer Nature works continuously to further the development of tools for the production of books and on the related technologies to support the authors.

The solutions to technical challenges posed by flight and space exploration tend to be multidimensional, multifunctional, and increasingly focused on the interaction of systems and their environment. The growing discipline of biomimicry focuses on what humanity can learn from the natural world. *Biomimicry for Aerospace: Technologies and Applications* features the latest advances of bioinspired materials-properties relationships for aerospace applications. Readers will get a deep dive into the utility of biomimetics to solve a number of technical challenges in aeronautics and space exploration. Part I: *Biomimicry in Aerospace: Education, Design, and Inspiration* provides an educational background to biomimicry applied for aerospace applications. Part II: *Biomimetic Design: Aerospace and Other Practical Applications* discusses applications and practical aspects of biomimetic design for aerospace and terrestrial applications and its cross-disciplinary nature. Part III: *Biomimicry and Foundational Aerospace Disciplines* covers snake-inspired robots, biomimetic advances in photovoltaics, electric aircraft cooling by bioinspired exergy management, and surrogate model-driven bioinspired optimization algorithms for large-scale and complex problems. Finally, Part IV: *Bio-Inspired Materials, Manufacturing, and Structures* reviews nature-inspired materials and processes for space exploration, gecko-inspired adhesives, bioinspired automated integrated circuit manufacturing on the Moon and Mars, and smart deployable space structures inspired by nature. Introduces educational aspects of bio-inspired design for novel and practical technologies Presents a series of bio-inspired technologies applicable to the field of aerospace engineering Provides an introduction to nature-inspired design and engineering and its relevance to planning and developing the next generation of robotic and human space missions

Nano-scale materials have unique electronic, optical, and chemical properties which make them attractive for a new generation of devices. Part one of *Modeling, Characterization, and Production of Nanomaterials: Electronics, Photonics and Energy Applications* covers modeling techniques incorporating quantum mechanical effects to simulate nanomaterials and devices, such as multiscale modeling and density functional theory. Part two describes the characterization of nanomaterials using diffraction techniques and Raman spectroscopy. Part three looks at the structure and properties of nanomaterials, including their optical properties and atomic behaviour. Part four explores nanofabrication and nanodevices, including the growth of graphene, GaN-based nanorod heterostructures and colloidal quantum dots for applications in nanophotonics and metallic nanoparticles for catalysis applications. Comprehensive coverage of the close connection between modeling and experimental methods for studying a wide range of nanomaterials and nanostructures Focus on practical applications and industry needs, supported by a solid outlining of theoretical background Draws on the expertise of leading researchers in the field of nanomaterials from around the world

This book describes the current state of research and development in biomimetic membranes for nanobiotechnology applications. It takes an international perspective on the issue of developing biotechnology applications from an understanding of the biomimetic membrane at the nanoscale. The success of these applications relies on a good understanding of the interaction and incorporation of macromolecules in membranes and the fundamental properties of the membrane itself.

Techniques and Applications

Principles and Emerging Applications in Biology and Chemistry

Basics and Applications

Technologies for economic and functional lightweight design

Biomimetic Technologies

Architecture Follows Nature-Biomimetic Principles for Innovative Design

*Biomimetic engineering takes the principles of biological organisms and copies, mimics or adapts these in the design and development of new materials and technologies. Biomimetic Technologies reviews the key materials and processes involved in this groundbreaking field, supporting theoretical background by outlining a range of applications. Beginning with an overview of the key principles and materials associated with biomimetic technologies in Part One, the book goes on to explore biomimetic sensors in more detail in Part Two, with bio-inspired tactile, hair-based, gas-sensing and sonar systems all reviewed. Biomimetic actuators are then the focus of Part Three, with vision systems, tissue growth and muscles all discussed. Finally, a wide range of applications are investigated in Part Four, where biomimetic technology and artificial intelligence are reviewed for such uses as bio-inspired climbing robots and multi-robot systems, microrobots with CMOS IC neural networks locomotion control, central pattern generators (CPG's) and biologically inspired antenna arrays. Includes a solid overview of modern artificial intelligence as background to the principles of biomimetic engineering Reviews a selection of key bio-inspired materials and sensors, highlighting their current strengths and future potential Features cutting-edge examples of biomimetic technologies employed for a broad range of applications This book explores the structure-property-process relationship of biomaterials from engineering and biomedical perspectives, and the potential of bio-inspired materials and their applications. A large variety of natural materials with outstanding physical and mechanical properties have appeared in the course of evolution. From a bio-inspired viewpoint, materials design requires a novel and highly cross*

disciplinary approach. Considerable benefits can be gained by providing an integrated approach using bio-inspiration with materials science and engineering. The book is divided into three parts; Part One focuses on mechanical aspects, dealing with conventional material properties: strength, toughness, hardness, wear resistance, impact resistance, self-healing, adhesion, and adaptation and morphing. Part Two focuses on functional materials with unique capabilities, such as self-cleaning, stimuli-response, structural color, anti-reflective materials, catalytic materials for clean energy conversion and storage, and other related topics. Part Three describes how to mimic natural materials processes to synthesize materials with low cost, efficient and environmentally friendly approaches. For each chapter, the approach is to describe situations in nature first and then biomimetic materials, fulfilling the need for an interdisciplinary approach which overlaps both engineering and materials science.

Biomimetics is an innovative paradigm shift based on biodiversity for sustainability. Biodiversity is not only the result of evolutionary adaptation but also the optimized solution of an epic combinatorial chemistry for sustainability, because the diversity has been acquired by biological processes and technology, including production processes, operating principles, and control systems, all of which differ from human technology. In the recent decades, biomimetics has gained a great deal of industrial interest because of its unique solutions for engineering problems. In this book, researchers have contributed cutting-edge results from the viewpoint of two types of industrial applications of biomimetics. The first type starts with engineering tasks to solve an engineering problem using biomimetics, while the other starts with the knowledge of biology and its application to engineering fields. This book discusses both approaches. Edited by Profs. Masatsugu Shimomura and Akihiro Miyauchi, two prominent nanotechnology researchers, this book will appeal to advanced undergraduate- and graduate-level students of biology, chemistry, physics, and engineering and to researchers working in the areas of mechanics, optical devices, glue materials, sensor devices, and SEM observation of living matter. Mimicking nature - from science fiction to engineering reality Humans have always looked to nature's inventions as a source of inspiration. The observation of flying birds and insects leads to innovations in aeronautics. Collision avoidance sensors mimic the whiskers of rodents. Optimization algorithms are based on survival of the fittest, the seed-picking process of pigeons, or the behavior of ant colonies. In recent years these efforts have become more intensive, with researchers seeking rules, concepts, and principles of biology to inspire new possibilities in materials, mechanisms, algorithms, and fabrication processes. A review of the current state of the art, *Biomimetics: Nature Based Innovation* documents key biological solutions that provide a model for innovations in engineering and science. Leading experts address a wide range of topics, including: Artificial senses and organs Mimicry at the cell-materials interface Multiscale modeling of plant cell wall architecture and tissue mechanics The making of biomimetic composites Electroactive polymer (EAP) actuators as artificial muscles EAP-based refreshable braille displays Biomimetic optics from the angles of biology and plants Biomimicry of flying birds, insects, and marine biology Applications of biomimetics in manufacturing, products, and medicine Robotics, including the development of human-like robots Biologically inspired design as a tool for interdisciplinary education The biomimetic process in artistic creation The final chapter outlines the challenges to biomimetic-related innovation and offers a vision for the future. A follow-up to *Biomimetics: Biologically Inspired Technologies (2005)*, this comprehensive reference methodically surveys the latest advances in this rapidly emerging field. It features an abundance of illustrations, including a 32-page full-color insert, and provides extensive references for engineers and scientists interested in delving deeper into the study of biomimetics.

Principles and Applications

Synthesis, Magnetic Properties and Room Temperature Spintronics

Industrial Wireless Sensor Networks

Engineered Biomimicry

Fibre Types, Materials, Fabrication, Characterisation and Applications

Laser Technology in Biomimetics

**Wireless MEMS Networks and Applications** reviews key emerging applications of MEMS in wireless and mobile networks. This book covers the different types of wireless MEMS devices, also exploring MEMS in smartphones, tablets, and the MEMS used for energy harvesting. The book reviews the range of applications of wireless MEMS networks in manufacturing, infrastructure monitoring, environmental monitoring, space applications, agricultural monitoring for food safety, health applications, and systems for smart cities. Focuses on the use of MEMS in the emerging area of wireless applications Contains comprehensive coverage of the range of applications of MEMS for wireless networks Presents an international range of expert contributors who identify key research in the field

**Engineered Biomimicry** covers a broad range of research topics in the emerging discipline of biomimicry. Biologically inspired science and technology, using the principles of math and physics, has led to the development of products as ubiquitous as Velcro™ (modeled after the spiny hooks on plant seeds and fruits). Readers will learn to take ideas and concepts like this from nature, implement them in research, and understand and explain diverse phenomena and their related functions. From bioinspired computing and medical products to biomimetic applications like artificial muscles, MEMS, textiles and vision sensors, *Engineered Biomimicry* explores a wide range of technologies informed by living natural systems. *Engineered Biomimicry* helps physicists, engineers and material scientists seek solutions in nature to the most pressing technical problems of our times, while providing a solid understanding of the important role of biophysics. Some physical applications include adhesion superhydrophobicity and self-cleaning, structural coloration, photonic devices, biomaterials and composite materials, sensor systems, robotics and locomotion, and ultra-lightweight structures. Explores biomimicry, a fast-growing,

*cross-disciplinary field in which researchers study biological activities in nature to make critical advancements in science and engineering Introduces bioinspiration, biomimetics, and bioreplication, and provides biological background and practical applications for each Cutting-edge topics include bio-inspired robotics, microflyers, surface modification and more Biomimetics, in general terms, aims at understanding biological principles and applying them for the development of man-made tools and technologies. This approach is particularly important for the purposeful design of passive as well as functional biomaterials that mimic physicochemical, mechanical and biological properties of natural materials, making them suitable, for example, for biomedical devices or as scaffolds for tissue regeneration. The book comprehensively covers biomimetic approaches to the development of biomaterials, including: an overview of naturally occurring or nature inspired biomaterials; an in-depth treatment of the surface aspects pivotal for the functionality; synthesis and self-assembly methods to prepare devices to be used in mineralized tissues such as bone and teeth; and preparation of biomaterials for the controlled/ sustained release of bioactive agents. The last part reviews the applications of bioinspired materials and principles of design in regenerative medicine such as in-situ grown bone or cartilage as well as the biomimetic techniques for soft tissue engineering. The comprehensive scope of this book makes it a must-have addition to the bookshelf of everyone in the fields of Materials Science/Engineering, Nanotechnologies / Nanosciences, Medical Sciences, Biochemistry, Polymer Chemistry, and Biomedical Engineering. Biomimetic engineering takes the principles of biological organisms and copies, mimics or adapts these in the design and development of new materials and technologies. Biomimetic Technologies reviews the key materials and processes involved in this groundbreaking field, supporting theoretical background by outlining a range of applications. Beginning with an overview of the key principles and materials associated with biomimetic technologies in Part One, the book goes on to explore biomimetic sensors in more detail in Part Two, with bio-inspired tactile, hair-based, gas-sensing and sonar systems all reviewed. Biomimetic actuators are then the focus of Part Three, with vision systems, tissue growth and muscles all discussed. Finally, a wide range of applications are investigated in Part Four, where biomimetic technology and artificial intelligence are reviewed for such uses as bio-inspired climbing robots and multi-robot systems, microrobots with CMOS IC neural networks locomotion control, central pattern generators (CPG's) and biologically inspired antenna arrays. Includes a solid overview of modern artificial intelligence as background to the principles of biomimetic engineering Reviews a selection of key bio-inspired materials and sensors, highlighting their current strengths and future potential Features cutting-edge examples of biomimetic technologies employed for a broad range of applications*

*Laser Additive Manufacturing*

*Biomimetics for Technical Products and Innovation*

*Biomimetic Principles and Design of Advanced Engineering Materials*

*Optofluidics, Sensors and Actuators in Microstructured Optical Fibers*

*Biomimicry for Aerospace*

*Biomimetics*

Encyclopedia of Renewable and Sustainable Materials provides a comprehensive overview, covering research and development on all aspects of renewable, recyclable and sustainable materials. The use of renewable and sustainable materials in building construction, the automotive sector, energy, textiles and others can create markets for agricultural products and additional revenue streams for farmers, as well as significantly reduce carbon dioxide (CO<sub>2</sub>) emissions, manufacturing energy requirements, manufacturing costs and waste. This book provides researchers, students and professionals in materials science and engineering with tactics and information as they face increasingly complex challenges around the development, selection and use of construction and manufacturing materials. Covers a broad range of topics not available elsewhere in one resource Arranged thematically for ease of navigation Discusses key features on processing, use, application and the environmental benefits of renewable and sustainable materials Contains a special focus on sustainability that will lead to the reduction of carbon emissions and enhance protection of the natural environment with regard to sustainable materials

This book provides a perspective on the current status of bioimaging technologies developed to assess the quality of musculoskeletal tissue with an emphasis on bone and cartilage. It offers evaluations of scaffold biomaterials developed for enhancing the repair of musculoskeletal tissues. These bioimaging techniques include micro-CT, nano-CT, pQCT/QCT, MRI, and ultrasound.

Lasers are progressively more used as versatile tools for fabrication purposes. The wide range of available powers, wavelengths, operation modes, repetition rates etc. facilitate the processing of a large spectrum of materials at exceptional precision and quality. Hence, manifold methods were established in the past and novel methods are continuously under development. Biomimetics, the translation from nature-inspired principles to technical applications, is strongly multidisciplinary. This field offers intrinsically a wide scope of applications for laser based methods regarding structuring and modification of materials. This book is dedicated to laser fabrication methods in biomimetics. It introduces both, a laser technology as well as an application focused approach. The book covers the most important laser lithographic methods and various biomimetics application scenarios ranging from coatings and biotechnology to construction, medical applications and photonics.

Due to their impressive performance biological adhesives have inspired the development of superior industrial adhesives. Biological adhesives often provide elegant solutions to engineering and biomedical requirements and are expected to inspire future technological innovations for adhesives for use in hostile conditions. Containing a selection of papers presented at the 1st International Conference on Biological and Biomimetic Adhesives, this book will showcase the latest advances in the chemical and structural characterisation of adhesives, the mechanical testing of adhesives and theory, fabrication and applications of biomimetic adhesives. Following the work of COST Action TD0909, the aim is to gain greater understanding of the mode of action of biological adhesives to allow successful

development of improved synthetic counterparts. Appealing to a wide range of researchers in biology, chemistry, physics and engineering, the title provides the background and drive to improve scientific and technological progress in this important area.

Industrial Biomimetics

Biomimetic Sensor Technology

Technologies and Applications

Biological and Biomimetic Adhesives

Wireless MEMS Networks and Applications

Challenges and Opportunities

**This book deals with biomimetic sensors that can quantify taste and smell - the electronic tongue and nose. Of all sensor technologies, these have been widely considered as the most difficult to realise and the development of these sensors significantly contributes to the understanding of the reception mechanisms in gustatory and olfactory systems. The author begins by dealing with the basic principles of measurement and multivariate analysis. Reception mechanisms in biological systems are briefly reviewed. Several types of biosensor, including enzyme-immobilized membranes, SPR, the quartz resonance oscillator and IC technologies are explained in detail. This book is the first to focus on artificial taste and smell sensors and also reviews conventional biosensors, such as enzyme sensors, in detail.**

**Combining the positive characteristics of microfluidics and optics, microstructured optical fibres (MOFs) have revolutionized the field of optoelectronics. Tailored guiding, diffractive structures and photonic band-gap effects are used to produce fibres with highly specialised, complex structures, facilitating the development of novel kinds of optical fibre sensors and actuators. Part One outlines the key materials and fabrication techniques used for microstructured optical fibres. Microfluidics and heat flows, MOF-based metamaterials, novel and liquid crystal infiltrated photonic crystal fibre (PCF) designs, MOFs filled with carbon nanotubes and melting of functional inorganic glasses inside PCFs are all reviewed. Part Two then goes on to investigate sensing and optofluidic applications, with the use of MOFs in structural sensing, sensing units and mechanical sensing explored in detail. PCF's for switching applications are then discussed before the book concludes by reviewing MOFs for specific nucleic acid detection and resonant bio- and chemical sensing. Provides users with the necessary knowledge to successfully design and implement microstructured optical fibres for a broad range of uses Outlines techniques for developing both traditional and novel types of optical fibre Highlights the adaptability of microstructured optical fibres achieved via the use of optofluidics, sensors and actuators, by presenting a diverse selection of applications**

**Applying Properties of Animals Skins to Inspire Architectural Envelopes Biology influences design projects in many ways; the related discipline is known as biomimetics or biomimicry. Using the animal kingdom as a source of inspiration, Ilaria Mazzoleni seeks to instill a shift in thinking about the application of biological principles to design and architecture. She focuses on the analysis of how organisms have adapted to different environments and translates the learned principles into the built environment. To illustrate the methodology, Mazzoleni draws inspiration from the diversity of animal coverings, referred to broadly as skin, and applies them to the design of building envelopes through a series of twelve case studies. Skin is a complex organ that performs a multitude of functions; namely, it serves as a link between the body and the environment. Similarly, building envelopes act as interfaces between their inhabitants and external elements. The resulting architectural designs illustrate an integrative methodology that allows architecture to follow nature. "Iliara Mazzoleni, in collaboration with biologist Shauna Price, has developed a profound methodology for architectural and design incentives that anticipates and proposes novel ways to explore undiscovered biological inspirations for various audiences."**

—Yoseph Bar-Cohen

**Polymer Engineering focuses on the preparation and application of polymers in several hot topics such as artificial photosynthesis, water purification by membrane technologies, and biodiesel production from wastewater plants. The authors not only describe the latest developments in polymer science, but also support these experimental results by computational chemistry and modelling studies.**

Photodetectors

Advancing Nanobiomaterials and Tissue Engineering

Polymer Engineering

Biomimetic Approaches for Biomaterials Development

Materials Characterization Using Nondestructive Evaluation (NDE) Methods

Monitoring, Control and Automation

*People have been finding inspiration in nature in solving their problems, from the very beginning of their existence. In the most general sense, biomimicry, defined as "inspire from the nature," has brought together the engineers and designers nowadays. This collaboration creates innovative and creative outcomes that encourage people with their interdisciplinary relationships. Accordingly, the aim of this book is to bring together different works or developments on biomimetics in interdisciplinary relationship between different areas, especially biomimicry, engineering, and design. The twenty-first century has conceived many new and amazing designs. The book in your hands will surely be an important guide to take a quick look at the future possibilities.*

*This book compiles all aspects of biomimetics from fundamental principles to current technological advances and their future trends in the development of nanoscale biomaterials and*

tissueengineering. The scope of this book is principally confined to biologically-inspired design of materials and systems for the development of next generation nanobiomaterials and tissueengineering. The book addresses the state-of-the-art of research progress in the applications of the principles, processes, and techniques of biomimetics. The prospective outcomes of current advancements and challenges in biomimetic approaches are also presented. Biomimetic materials are those inspired from nature and implemented into new fibre and fabric technologies. Biologically inspired textiles explores the current state of the art in this research arena and examines how biomimetics are increasingly applied to new textile technologies. Part one discusses the principles, production and properties of biomimetics. Chapters include recombinant DNA technologies and their application for protein production, spinning of fibres from protein solutions and structure/function relationships in spider silk. The second part of the book provides a review of the application of biomimetics to a range of textile applications, including the design of clothing and self cleaning textiles. Written by a distinguished team of international authors, Biologically inspired textiles is a valuable reference for textile technologists, fibre scientists, textile manufacturers and others in academia. Discusses the principles, production and properties of biomimetics Reviews the application of biomimetics to a range of textile disciplines Chapters explore recombinant DNA technologies, spinning of fibres and structure/function relationships in spider silk