

Zhenyu Li · Ce Wang

One-Dimensional Nanostructures Electrospinning Technique and Unique Nanofibers

One Dimensional Nanostructures Electrospinning Technique And Unique Nanofibers Springerbriefs In Materials

Ashok Vaseashta, Nimet Bölgen



One Dimensional Nanostructures Electrospinning Technique And Unique Nanofibers Springerbriefs In Materials:

One-Dimensional nanostructures Zhenyu Li,Ce Wang,2013-03-21 One Dimensional Nanostructures Electrospinning Technique and Unique Nanofibers is a comprehensive book depicting the electrospinning technique and related 1D unique electrospun nanofibers The first part of the book focuses on electrospinning technique with chapters describing Electrospinning setup electrospinning theories and related working parameter The second part of the book describes in detail specific topics on how to control the electrospun fiber properties such as how to control the fiber direction how to control the fiber surface morphology how to control the fiber structure and how to construct 3D structures by electrospun fibers The final part of the book depicts the applications of the electrospun nanofibers with sections describing in detail specific fields such as electrospun nanofiber reinforcement filtration electronic devices lithium ion batteries fuel cells biomedical field and so on One Dimensional Nanostructures Electrospinning Technique and Unique Nanofibers is designed to bring state of the art on electrospinning together into a single book and will be valuable resource for scientists in the electrospinning field and other scientists involved in biomedical field mechanical field materials and energy field Dr Zhenyu Li is an associate professor at the Dept of Chemistry Jilin University Changchun P R China Currently he also holds the position in Australian Future Fibres Research Innovation Centre Institute for Frontier Materials Deakin University Geelong Victoria Australia Dr Ce Wang is a professor at the Dept of Chemistry Jilin University Changchun P R China

Electrospun Biomaterials for Tissue Engineering and Drug Delivery Applications Inamuddin,Tariq Altalhi,Maha Khan,2025-05-30 Electrospun Biomaterials for Tissue Engineering and Drug Delivery Applications introduces the fundamental principles of electrospinning and provides an understanding of the electrospinning process including the selection of polymers solvent systems and processing parameters to achieve desired properties Tissue engineering applications of electrospun nanofibers across a wide range of tissues and organs is covered including bone cartilage skin blood vessels and more This book also explores the growing role of electrospun biomaterials in wound dressings and controlled drug delivery systems reviewing a broad selection of material classes such as starch cellulose chitosan and gelatin Electrospun Biomaterials for Tissue Engineering and Drug Delivery Applications is a useful resource for researchers and postgraduate students working in the fields of biomaterials tissue engineering and pharmaceutical sciences Divided into four distinct sections this book guides the reader systematically from fundamental principles of electrospinning through to each specialized application Provides troubleshooting for the challenges and toxicity aspects of electrospun biomaterials as well as reviews successful electrospun products on the market Covers a wide range of electrospun materials for tissue engineering and drug delivery including collagen dextran hyaluronic acid and more

Electrospun Materials and Their Allied Applications Inamuddin,Rajender Boddula,Mohd Imran Ahamed,Abdullah M. Asiri,2020-05-27 The aim of this book is to explore the history fundamentals manufacturing processes optimization parameters and applications of electrospun materials The book includes various types

of electrospun materials such as antimicrobial smart bioinspired systems It focuses on the many application areas for electrospun materials such as energy storage and harvesting catalysis biomedical including gene delivery and tissue engineering separation adsorption and water treatment technologies packaging The book emphasizes the enhanced sustainable properties of electrospun materials with the challenges and future developments being discussed in detail The chapters are written by top class researchers and experts from throughout the world *Electrospun Polymers and Composites* Yu Dong, Avinash Baji, Seeram Ramakrishna, 2020-10-24 Electrospun Polymers and Composites Ultrafine Materials High Performance Fibres and Wearables reviews the latest technological developments and innovations in electrospun polymers and composites highlighting the multifunctionality of these ultrafine materials as high performance fibers The book s chapters investigate a wide range of different electrospinning applications including drug delivery tissue scaffolding fiber reinforcement and nanofiltration with a particular focus on shape memory effect and the wearable characteristics of electrospun polymers and composites This will be a valuable reference resource for research and for industrial communities working in the field of electrospinning Covers two important material systems in electrospun materials including electrospun polymers and composites Emphasizes areas in shape memory effect and wearable features of electrospun polymers and composites Presents a multidisciplinary work that will attract a wide spectrum of readers in chemical engineering biomedical engineering chemistry pharmacy environmental science materials science and engineering as well as mechanical and electrical engineering **21st Century Nanostructured Materials** Phuong Pham, 2022-04-20 Nanostructured materials NMs are attracting interest as low dimensional materials in the high tech era of the 21st century Recently nanomaterials have experienced breakthroughs in synthesis and industrial and biomedical applications This book presents recent achievements related to NMs such as graphene carbon nanotubes plasmonic materials metal nanowires metal oxides nanoparticles metamaterials nanofibers and nanocomposites along with their physical and chemical aspects Additionally the book discusses the potential uses of these nanomaterials in photodetectors transistors quantum technology chemical sensors energy storage silk fibroin composites drug delivery tissue engineering and sustainable agriculture and environmental applications **Industrial Applications of Marine Biopolymers** Parappurath Narayanan Sudha, 2017-07-06 Industrial Applications of Marine Biopolymers presents different classes of marine biopolymers and their industrial applications demonstrating the precious value of ocean resources to society This timely volume discusses the exceedingly useful polymers derived from these materials that are biodegradable biocompatible and at times water soluble Direct use or chemically modified forms of such biomaterials have many chemical sites making them suitable for varied types of industrial applications In addition this book also addresses current global challenges of conservation including extended drought conditions and the need for improved agricultural methods together with new bio medical developments It is suitable for anyone who has an interest in the industrial applications of biopolymers *Thermal and Nonthermal*

Encapsulation Methods Magdalini Krokida, 2017-09-27 Encapsulation is a topic of interest across a wide range of scientific and industrial areas from pharmaceuticals to food and agriculture for the protection and controlled release of various substances during transportation storage and consumption Since encapsulated materials can be protected from external conditions encapsulation enhances their stability and maintains their viability This book offers a comprehensive review of conventional and modern methods for encapsulation It covers various thermal and nonthermal encapsulation methods applied across a number of industries including freeze drying spray drying spray chilling and spray cooling electrospinning electrospraying osmotic dehydration extrusion air suspension coating pan coating and vacuum drying The book presents basic fundamentals principles and applications of each method enabling the reader to gain extended knowledge The choice of the most suitable encapsulation technique is based on the raw materials the required size and the desirable characteristics of the final products

Electrospinning Tomasz Arkadiusz Tanski, Pawel Jarka, 2022-08 This book is a summary of the latest knowledge in the field of electrospinning technology including a detailed description of the method as well as the influence of its parameters on the structure and properties of manufactured materials Currently electrospinning is one of the most promising methods for the reproducible production of one dimensional nanostructures such as nanowires nanofibers and fibrous mats with high purity and dimensional accuracy Chapters address such topics as electrospun fibrous mats in the development of active food packaging production of structured nanofibers from natural sources and biomass waste as an alternative source of polymeric materials in electrospinning technology and more

Electrospun Nanofibers Ashok Vaseashta, Nimet Bölgen, 2022-07-14 This book presents the development of electrospun materials fundamental principles of electrospinning process controlling parameters electrospinning strategies and electrospun nanofibrous structures with specific properties for applications in tissue engineering and regenerative medicine textile water treatment sensor and energy fields This book can broadly be divided into three parts the first comprises basic principles of electrospinning process general requirements of electrospun materials and advancement in electrospinning technology the second part describes the applications of electrospun materials in different fields and future prospects while the third part describes applications that can be used in advanced manufacturing based on combining electrospinning and 3D printing Electrospinning is the most successful process for producing functional nanofibers and nanofibrous membranes with superior chemical and physical properties The unique properties of electrospun materials including high surface to volume ratio flexibility high mechanical strength high porosity and adjustable nanofiber and pore size distribution make them potential candidates in a wide range of applications in biomedical and engineering areas Electrospinning is becoming more efficient and more specialized in order to produce particular fiber types with tunable diameter and morphology tunable characteristics having specific patterns and 3D structures With a strong focus on fundamental materials science and engineering this book provides systematic and comprehensive coverage of the recent developments and novel perspectives of electrospun materials This comprehensive

book includes chapters that discuss the latest and emerging applications of nanofiber technology in various fields specifically in areas such as wearable textile biomedical applications energy generation and storage water treatment and environmental remediation and sensors such as biomarkers in healthcare and biomedical engineering Despite all these advancements there are still challenges to be addressed and overcome for nanofiber technology to move towards maturation Electrospun Nanofibers Kunal Mukherjee, Massachusetts Institute of Technology. Department of Materials Science and Engineering, 2008 One dimensional nanostructures have several attractive material properties compared to their bulk counterparts and have found applications in many novel devices They have especially shown promise in the fields of renewable energy generation and environmental monitoring by improving solar cells and gas sensors However difficulties in large scale manufacturing of these nanostructures have prevented most of these devices from entering the marketplace Electrospinning is a simple versatile and scalable technique to fabricate one dimensional nanostructures in the form of nanofibers It has recently been successfully used to produce semiconducting metal oxide nanofibers which have been used in chemiresistive gas sensors and dye sensitized solar cells Electrospun gas sensors and solar cells have already been shown to perform better than many of its competitors in a very short period of time This coupled with low manufacturing costs and well protected intellectual property makes electrospinning a good candidate to bring the advantages of one dimensional nanostructures into the marketplace

Advanced Nanofibrous Materials Manufacture Technology based on Electrospinning Yanbo Liu, Ce Wang, 2019-04-23 This book comprehensively addresses advanced nanofiber manufacturing based on electrospinning technology The principles relationships between process parameters and structure morphology and performance of electrospun nanofibers and nanomaterials and the methods for enhanced field intensity and uniform distribution are discussed The electric field intensity and distribution during electrospinning is also analyzed based on finite element analysis on both the needle and the needleless electrospinning Furthermore the modification techniques for improved nanomaterials strength are covered aiming to provide effective avenues towards the manufacture of stronger nanofiber or nanomaterial products *Electrospinning: Nanofabrication and Applications* Bin Ding, Xianfeng Wang, Jianyong Yu, 2018-11-12 Electrospinning Nanofabrication and Applications presents an overview of the electrospinning technique nanofabrication strategies and potential applications The book begins with an introduction to the fundamentals of electrospinning discussing fundamental principles of the electrospinning process controlling parameters materials and structures Nanofabrication strategies including coaxial electrospinning multi needle electrospinning needleless electrospinning electro netting near field electrospinning and three dimensional macrostructure assembling are also covered Final sections explore the applications of electrospun nanofibers in different fields and future prospects This is a valuable reference for engineers and materials scientist working with fibrous materials and textiles as well as researchers in the areas of nanotechnology electrospinning nanofibers and textiles Explores controllable fabrication of electrospun nanomaterials and their multifunctional applications Explains the electrospinning

technique as used in nanofabrication and nanofibers Outlines the applications of electrospun nanofibrous materials in tissue engineering filtration oil water separation water treatment food technology supercapacitors sensors and so on

Nanofibers Tong Lin, 2011-11-14 As an important one dimensional nanomaterial nanofibers have extremely high specific surface area because of their small diameters and nanofiber membranes are highly porous with excellent pore interconnectivity These unique characteristics plus the functionalities from the materials themselves impart nanofibers with a number of novel properties for advanced applications This book is a compilation of contributions made by experts who specialize in nanofibers It provides an up to date coverage of in nanofiber preparation properties and functional applications I am deeply appreciative of all the authors and have no doubt that their contribution will be a useful resource for anyone associated with the discipline of nanofibers

Needleless Electrospinning of Nanofibers Xungai Wang, Tong Lin, 2013-11-14 The book covers the basic electrospinning theory electrospinning technologies that have potential for large scale production of nanofibers and the functional applications of electrospun nanofibers in different fields An important needleless electrospinning technique using a rotary fiber generator such as ball cylinder disc and wire coil and the effects of the fiber generator its shape and dimension as well as operating parameters on electrospinning performance fiber morphology and productivity are described A method to calculate the electric field and analyze electric field profiles in an electrospinning zone is provided The influence of the fiber collector on fiber quality is also discussed

Electrospinning Method Used to Create Functional Nanocomposites Films Tomasz Tański, Paweł Jarka, Wiktor Matysiak, 2018-09-12 The most effective method of producing nanofibres is the technology of producing in the electrostatic field which does not require the use of complicated procedures and equipment Electrospinning allows to produce 1D nanostructures on an industrial scale in a relatively easy and quick way The method of electrospinning shares the most features with classical technologies in obtaining synthetic fibres that enable forming and generating a stream of previously dissolved or melted polymer and its coaxial stretching combined with the transition of the polymer from a liquid state to a solid state In view of the large application possibilities of electrospun fibres electrospinning is enjoying a dynamically growing interest of scientists which can be proven by the increasing trend of scientific publications

Electrospinning Technique and Its Application for Solar Cells, Batteries and Biotechnology Dharani Sabba, 2017-11 Nanostructures owing to their shape and size exhibit unique electrical optical thermal and magnetic properties in contrast to their bulk counterparts Hence they attract great attention in various spheres of research They can be synthesized using top down or bottom up approaches respectively In top down approach macroscopic materials are subjected to various processing techniques such as ball milling lithography etc to form nanomaterials Whereas in the bottom up approach the process starts at the atomic level leading to self assembly owing to physical forces prevalent at atomic level to form larger stable structures Some of the bottom up approaches include epitaxial growth atomic layer deposition colloidal dispersion electrospinning The bottom up approaches are economical than

the top down approaches These nanostructures can be classified as 0 D 1 D and 2 D Nanoclusters are generally termed as 0 D while nanorods nanotubes nanofibers are termed as 1 D nanostructures Nanodiscs nanobelts or nanoplates are designated to be 2 D nanostructures Electrospinning is a very old technique which attracted scientific interest in recent years due to its capability of producing continuous 1D nanostructures from micrometer to nano meter range using a plethora of materials By electrospinning 1D nanostructures such as nanobelts mesoporous nanobers nanotubes etc can be synthesized These electrospun nanostructures inherent properties of high porosity and high surface area owing to the precursors used during their fabrication Initially electrospinning was chiefly used to fabricate polymeric nanostructures but with continual research efforts and advancements in design nanostructures of composite and inorganic materials can be synthesized Consequently the electrospun nanostructures are being explored for various applications such as generation of solar energy storage of energy in batteries tissue scaffolding for biomedical applications biosensors etc This book is a compilation of research articles and reviews related to the application of various electrospun nanostructures in the field of harvesting solar energy battery and biotechnology Chapters 1 5 are compilation of research articles highlighting electrospun nanofibers in harvesting solar energy Furthermore these articles briefly explain the processing parameters advantages and disadvantages of electrospun nanofibers Chapter 5 elucidates the formation of 3 D hierarchical nanostructures from the electrospun nanofibers the mechanism of formation characterization and their application in solid state dye sensitized solar cells Chapters 6 9 showcase application of electrospun nanomaterials as electrodes and nanofibrous membrane as separator in lithium ion batteries Chapters 10 13 provide the reader with valuable information on assaying the properties of the electrospun nanostructures which make them ideal candidates for various applications as described in other sections of this book This information is vital as it enables the reader to reflect upon and devise new strategies for advanced material design and applications Chapter 10 focuses on the properties of the widely used semiconductor material titanium dioxide in photovoltaics While chapters 11 12 and 13 underline the relation between the processing parameters and precursor properties to the final product s characteristics Chapters 14 23 are compilation of articles on the advancements in medical field using electrospun nanostructures as biosensors anti bacterial dressing for wounds tissue engineering and drug delivery to specific targets For tissue engineering as described in chapter 22 a plethora of natural synthetic polymers have been used in conjunction with carbon nanotubes graphene oxides and other classes of hydrocarbons While in chapter 21 the use of electrospun scaffold in vascular grafts nerve tissue bone tissue and ligament tissue engineering has been expounded This book which is a compilation of review articles as well as latest developments in the field of energy and its storage and biotechnology using nanostructures which are synthesized by a versatile route electrospinning enables the reader to comprehend the synthesis techniques and tailoring of the properties of these nanomaterials to integrate them into advanced technologies It appeals to a wide range of audience from chemistry material science engineering and biotechnology

Electrospun Nanofibers for Energy and Environmental Applications Bin Ding, Jianyong Yu, 2014-04-10 This book offers a comprehensive review of the latest advances in developing functional electrospun nanofibers for energy and environmental applications which include fuel cells lithium ion batteries solar cells supercapacitors energy storage materials sensors filtration materials protective clothing catalysis structurally colored fibers oil spill cleanup self cleaning materials adsorbents and electromagnetic shielding This book is aimed at both newcomers and experienced researchers in the field of nanomaterials especially those who are interested in addressing energy related and environmental problems with the help of electrospun nanofibers Bin Ding PhD and Jianyong Yu PhD are both Professors at the College of Materials Science and Engineering Donghua University China

Electrospinning Scaffold Fabrication of Polymer Nanofibers and Sensors for Tissue Engineering Applications Dennis LeRoy Edmondson, 2013 Well ordered one dimensional nanostructures nanofibers are enabling important new applications in textile energy structural environmental and bioengineering applications such as sensors transducers and energy harvesters due to their unique anisotropic properties Through electrospinning polymeric ceramic or metallic solutions can be ejected from an electrically charged syringe needle spinneret at an appropriate flow rate collection distance and voltage to form nanofiber filaments A substantial electrical field gradient of 6 000 to 25 000 volts is required depending on solution type in the space between the charged syringe needle spinneret and an electrically grounded collection electrode As solution flows from the syringe needle Coulomb forces created by electrical charge on fibers can extend the stream into a fine continuous group of filaments The short transition from spinneret blunt needle tip to the stream occurs through formation of a Taylor cone droplet at an angle of around 30 degrees to the needle tip axis which is a common characteristic for charged fluids in motion within electric field gradients The electric field gradient accelerates the filament stream onto a collecting target of opposite polarity between eight and thirty centimeters away For best circumstances the polymeric solution should be dry upon reaching the grounded collecting electrode to yield a dry fibrous mat Resultant fiber diameter or shape porosity morphology and other characteristics can be controlled through modifying electrospinning solution material composition voltage solution flow rate natural or forced electric field strength and distance between spinneret needle and fiber collector geometry The collector component is very significant to the electrospinning process as the fiber collector geometry can be altered to control fiber deposition orientation Electrospinning fabrication equipment designed for manufacturing nanofibers especially for highly aligned fibers can be used to develop effective scaffolds for cell proliferation and chemical attachment Many electrospinner variations have been tried in the effort to create a bio cellular scaffold environment on which cells can proliferate The ability to promote substantial cell growth on an artificial scaffold brings research closer to fabrication of difficult organs such as heart neural conduits intestinal tissue and skeletal structure to name but a few Current laboratory and clinical trials focused on bladder and kidney are searching for the ideal technique for creating a fully functioning replacement organ by identifying the most reliable

polymer fiber cell compatibility scaffold that will both support cell proliferation and be biodegradable A key aspect is developing a consistent method of aligning fibers through electrospinning However the challenges in large scale production of highly aligned and uniform nanofibers limit the scope of their applications and commercialization This dissertation presents a powerful yet economical approach that integrates the concepts of stationary parallel electrode gap method with centrifugal polymer dispersion to produce nanofibers with a high degree of alignment and uniformity at large scale This approach was first demonstrated with polyvinylidene fluoride to illustrate how the experimental parameters regulate fiber production and piezoelectric response leading to the production of aligned nanofibers up to four inches in length Further work with chitosan and polyethylene oxide a natural and a synthetic polymer demonstrated the versatility of the system The now patented centrifugal electrospinning technology presented here has already opened new avenues of invention through mass production of aligned nanofibers allowing development of novel sensors One novel device under development is a spiral coiled biosensor Biotelemetry has become an important part of medical research for advancing patient care by remotely monitoring continuing biological processes and physiological functions Current biotelemetry systems are complex and require multiple electronic components to function for example battery sensor element and transmitter circuit Another significant concern of current biotelemetry devices is direct wire coupling of the in vivo portion to external supporting equipment Without the need for a power supply the spirally coiled sensors in the nanofiber bundle generate and transmit an electrical signal wirelessly in response to deflections The sensor is encapsulated within a thin biocompatible polymer shell of polydimethylsiloxane PDMS providing device integrity and moisture isolation The results suggest that such a sensor can potentially function as both mechanical and biotelemetry sensors for various in vitro and in vivo biomedical applications The following chapters discuss how combining technologies of selected organic polymer materials and fiber electro spinning apparatus with cell immobilization procedures determines electrospun fiber mat effectiveness Several examples demonstrate how a solution of electrospun biocompatible nanofibers composed of polymer s can be used to control time rate of degradation and produce a nanofiber scaffold structure supporting attachment and proliferation of cells of interest for in vitro application They show in detail how cells combined with artificial extra cellular matrix ECM of desirable biocompatible and biodegradable characteristics are important to tissue engineering research Several polymers both natural and synthetic including alginate chitosan polyethylene oxide PEO polycaprolactone PCL and piezoelectric polyvinylidene fluoride PVDF compositions for electrospinning are presented Piezoelectric nanofibers that could offer many useful applications were electrospun Solutions having different composition ratios producing random and semi aligned nanofibers through standard electrospinning collector electrode techniques are discussed as is a newly developed aligned fiber electrospinner that uses centrifugal force with pneumatic assistance to produce a highly viscous solution rendering the fibers electrospinnable A novel biotelemetry sensor owes its embryonic beginnings to highly aligned nanofibers created through centrifugal electrospinning

Through these techniques simple highly aligned piezoelectric polyvinylidene fluoride and tetrafluoroethane nanofibers can be fabricated to function as a standalone power source sensor and transmitter

Electrospinning and Electrospraying Sajjad Haider, Adnan Haider, 2019-12-11 This book focuses on the recent advancements in the process parameters research and applications of electrospinning and electrospraying The first chapter introduces the techniques and the effect of the parameters on the morphology of the nanofiber and nanoparticles and then the subsequent chapters focus on the applications of these techniques in different areas This book will attract a broad audience including postgraduate students and industrial and academic investigators in sciences and engineering who wish to enhance their understanding of the emerging technologies and use this book as reference

Electrospinning Joachim H. Wendorff, Seema Agarwal, Andreas Greiner, 2012-02-08 Electrospinning is from the academic as well as technical perspective presently the most versatile technique for the preparation of continuous nanofibers obtained from numerous materials including polymers metals and ceramics Shapes and properties of fibers can be tailored according to the demand of numerous applications including filtration membranes textiles catalysis reinforcement or biomedical This book summarizes the state of the art in electrospinning with detailed coverage of the various techniques material systems and their resulting fiber structures and properties theoretical aspects and applications Throughout the book the current status of knowledge is introduced with a critical view on accomplishments and novel perspectives An experimental section gives hands on guidance to beginners and experts alike

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