

Science And Technology Of Polymer Nanofibers

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Nanofibers and Nanotechnology in Textiles
Synthesis and Characterization of Polymer/Graphene Electrospun Nanofibers Anthony L. Andrade Dario Pisignano Darrell H. Reneker Anthony L. Andrade Arkadii Arinstein Seeram Ramakrishna Toshimi Shimizu Rangasamy Jayakumar United States. National Technical Information Service Murali Gorantla Arkadii Arinstein Mehdi Afshari A. Sezai Sarac Mohammad Reza Abidian Zhai Norizah Abdul Rahman P. Brown Farshad Barzegar
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applications of polymer nanofibers explore a comprehensive review of the practical experimental and technological details of polymer nanofibers with a leading new resource applications of polymer nanofibers delivers a complete introduction to the basic science of polymer nanofibers as well as a review of their diverse applications the book assesses their potential for commercialization and presents contributions from leading experts emphasizing their practical and technological details new and up to date research findings are presented throughout the book in areas including filters fabric energy fuel cells batteries sensors biomedicine drug delivery tissue engineering and wound dressings the book also presents a fulsome analysis of the

technology of electrospinning the most convenient and scalable technique for nanofiber production it also provides readers with practical information on relevant surface modification techniques applications of polymer nanofibers effectively balances theoretical background with practical applications of the technology including insights into polymer nanofiber materials that will be useful for advanced students and researchers students researchers and industry professionals will also enjoy the inclusion of a thorough introduction to electrospinning parameters and resulting nanofiber characteristics including theoretical and practical considerations an exploration of textile applications of nanofibers like protective clothing filter fabrics wearable devices functional fabrics and biomedical textiles a review of nanofiber mats as high efficiency filters including filtration developments filters made with nanofibers and the future outlook for nanofiber filters a treatment of nanofiber based chemical sensors including sensor materials approaches to nanofiber sensor design and gravimetric nanofiber sensors perfect for researchers and graduate students studying polymer science and engineering chemical engineering materials science and nanotechnology applications of polymer nanofibers will also earn a place in the libraries of industrial researchers concerned with electrospinning air filtration fabrics drug delivery catalysis and biomedicine

research into polymer nanofibers has increased significantly over the last decade prompting the need for a comprehensive monograph examining the subject as knowledge of their properties and potential applications has increased postgraduate students and researchers new to the field will benefit from the from materials to applications approach to the book which examines the physio chemical properties in detail demonstrating how they can be exploited for a diverse range of applications including the production of light and wound dressings techniques for the fabrication notably electrospinning are discussed at

length this book provides a unique and accessible source of information summarising the last decade of the field and presenting an entry point for those entering the field and an inspiration to established workers the author is currently the national coordinator for several research projects examining the applications of polymer nanofibers alongside active international collaborations

polymeric nanofibers will showcase recent developments in the production characterization and emerging use of nanofibers made from different polymers for a variety of purposes although it has been difficult to produce polymer fibers in the laboratory electrospinning now makes it easier electrospinning an electrohydrodynamical process for making thin polymer fibers with diameters in the range from around one nanometer to several thousands of nanometers is simple and cost effective interest in other specialized routes to polymer nanofibers including chemical synthesis conventional textile fiber spinning gas blowing and other methods has been stimulated by the recent progress in electrospinning scientists and engineers in fields such as filtration biomaterials biomedical devices chemical analysis catalysis aerospace fiber reinforced composites energy conversion protective clothing agriculture and others can produce experimental quantities of nanofibers in their own laboratories from a wide variety of polymers of interest to them the number of papers and patents in electrospinning has grown at a rapid rate during the past decade more than doubling each year since 1999

discover new and emerging applications of polymer nanofibers alongside the basic underlying science and technology with discussions exploring such practical applications as filters fabrics sensors catalysts scaffolding drug delivery and wound dressings the book provides polymer scientists and engineers with a comprehensive practical how to reference moreover the

author offers an expert assessment of polymer nanofibers near term potential for commercialization among the highlights of coverage is the book s presentation of the science and technology of electrospinning including practical information on how to electrospin different polymer systems

discussing the electrospinning process the book covers in great depth the current research interest in nanoscience and nanotechnology especially electrospinning of polymer nanofibers the main distinction of the proposed book from others devoted to the electrospinning process is in the consideration of the problem in question from the physical point of view focusing on physical aspects the book contains physical basics regarding the unique features of electrospun polymer nanofibers and the electrospinning resulting in fabrication of these nanofibers

the research and development of nanofibers has gained much prominence in recent years due to the heightened awareness of its potential applications in the medical engineering and defense fields among the most successful methods for producing nanofibers is the electrospinning process in this timely book the areas of electrospinning and nanofibers are covered for the first time in a single volume the book can be broadly divided into two parts the first comprises descriptions of the electrospinning process and modeling to obtain nanofibers while the second describes the characteristics and applications of nanofibers the material is aimed at both newcomers and experienced researchers in the area

this text was ranked by isi as having the highest impact factor of all publications within polymer science it is a collection of concise reports on the physics and chemistry of polymers

multiscale fibrous scaffolds in regenerative medicine by sowmya srinivasan r jayakumar k p chennazhi erica j levorson antonios g mikos and shantikumar v nair stem cells and nanostructures for advanced tissue regeneration by molamma p prabhakaran j venugopal laleh ghasemi mobarakeh dan kai guorui jin and seeram ramakrishna creating electrospun nanofiber based biomimetic scaffolds for bone regeneration by eleni katsanevakis xuejun wen and ning zhang synthetic biopolymer nanofibrous composites as dynamic tissue engineering scaffolds by j a kluge and r l mauck electrospun fibers as substrates for peripheral nerve regeneration by jörg mey gary brook dorothée hodde and andreas kriebel highly aligned polymer nanofiber structures fabrication and applications in tissue engineering by vince beachley eleni katsanevakis ning zhang xuejun wen electrospinning of biocompatible polymers and their potentials in biomedical applications by pitt supaphol orawan suwantong pakakrong sangsanoh sowmya srinivasan rangasamy jayakumar and shantikumar v nair electrospun nanofibrous scaffolds current status and prospects in drug delivery by m prabaharan r jayakumar and s v nair biomedical applications of polymer silver composite nanofibers by r jayakumar m prabaharan k t shalumon k p chennazhi and s v nair

electrospun nanofibers second edition covers advances in the electrospinning process including the characterization testing and modeling of electrospun nanofibers and electrospinning for particular fiber types and applications this new edition includes sections on biomedical tissue engineering and drug applications of electrospun nanofibers offering systematic and comprehensive coverage for academic researchers industry professionals and postgraduate students working in the field of fiber science electrospinning is the most commercially successful process for the production of nanofibers and rising demand is driving research and development in this field electrospinning is becoming more efficient and more specialized in order to

produce particular fiber types such as bicomponent and composite fibers patterned and 3d nanofibers carbon nanofibers and nanotubes and nanofibers derived from chitosan provides systematic and comprehensive coverage on the manufacturing properties and applications of nanofibers covers recent developments in nanofibers materials including electrospinning of bicomponent chitosan carbon and conductive fibers brings together expertise from academia and industry to provide comprehensive up to date information on nanofiber research and development offers systematic and comprehensive coverage for academic researchers industry professionals and postgraduate students working in the field of fiber science

conjugated polymer composites with high dielectric constants are being developed by the electronics industry in response to the need for power grounded decoupling to secure the integrity of high speed signals and to reduce electromagnetic interference electrically conducting polymers are materials that simultaneously possess the physical and chemical properties of organic polymers and the electronic characteristics of metals multifunctional micro and nanostructures of conjugated polymers such as of pyrrole have received great attention in recent years because they can polymerize easily and have high conductivity and good thermal stability they however have some disadvantages such as brittleness and hard processability which can be overcome by developing their nanocomposites nanofiber materials with different dielectric properties can be made from conjugated polymer composites and used in the electronics industry in sensors and batteries for electrical stimulation to enhance nerve regeneration process and for constructing scaffolds for nerve tissue engineering electrospinning is a versatile technique that is used to produce ultrathin continuous fibers with high surface to volume and aspect ratios from a variety of materials including polymers composites and ceramics conductive materials in fibrillar shape may be advantageous compared

with films because of their inherent properties such as anisotropy high surface area and mechanical strength they are of particular interest in electroactive composites as they can be efficiently distributed in an insulating polymer matrix to improve both electrical and mechanical properties combination of electrical properties with good mechanical performance is of particular interest in electroactive polymer technology this book covers the general aspects of electrospinning and discusses the fundamental concepts that can be used to produce nanofibers with the help of mathematical models and equations it also details the methods through which different polymeric structures can be included in conjugated polymers during electrospinning to form composites or blends of conjugated polymer nanofibers

conducting polymer cp nanofibers have recently received great attention due to their high surface area per volume and extensive porosity combined with unique properties such as high electrical conductivity or fluorescence these materials are being considered for a range of novel applications including biomedical applications among the techniques used for the preparation of polymer nanofibers electrospinning is a simple fast and relatively cheap technique the focus of this thesis is to develop conducting polymer micro nanofibers with a well defined morphology using electrospinning and to investigate their potential in two areas of biomedical applications tissue engineering and dna sensing two classes of conducting polymers polyaniline pani and poly p phenylene vinylene ppv were used in this study to produce cp nanofibers soluble copolymers of aniline ani and m aminobenzoic acid m aba were synthesized to improve the solubility of pani the properties of these polymers were characterized and studied using a range of techniques the solubility of the copolymers increased with an increase in the m aba content conversely the conductivity of the copolymers was lowered the average molecular weight of the copolymers as

determined by gel permeation chromatography was found to decrease from 13 800 to 1 640 g mol 1 with an increase of m aba content in the copolymer from 0 2 to 0 8 by contrast ft ms results revealed that homopolymerization of m aba formed oligomers rather than polymeric chains based upon a consideration of the solubility and electrical conductivity of the copolymers an ani to m aba copolymer ratio of 60 40 was chosen for electrospinning with the biocompatible and biodegradable polymer poly lactic acid pla these polymers were electrospun with mean fiber diameters of 100 400 nm ftir raman spectroscopy and conductivity measurements confirmed the incorporation of conducting co polymers within the pla based nanofibers the elastic modulus of a single nanofiber was examined using a nanoindenter instrument for the first time the nanoindentation results obtained on the individual nanofibers revealed that the elastic moduli of the nanofibers were much higher at the surface than in the inner fiber core these fibers thereby provide cells with stiff sub micron sized fibers as anchoring points on a substrate of high porosity the conductive nature of these composite nanofibers offers exciting opportunities for electrical stimulation of cells human adipose derived stem cells hasc were used in this work to evaluate the biocompatibility of the nanofibers an important characteristic of a scaffold in tissue engineering the cell culture results showed that the composite nanofibers supported hasc adhesion and proliferation to a similar degree as control surfaces namely electrospun pla nanofibers and tissue culture treated glass substrates tcs depending on the fiber composition the cells initially displayed some variation in the extent of focal adhesions fas after three days of culturing but after one week all of the samples showed similar cell densities and morphologies a luminescent conducting polymer a ppv derivative poly 6 6 2 methyl 5 e 4 e prop 1 en 1 yl styryl 1 4 phenylene bis oxy dihexanoic acid pdmp was electrospun into nanofibers using the same method as described above pla was again chosen for electrospinning with pdmp in various pla pdmp compositions the morphology of the novel pla pdmp composite nanofibers was studied extensively

using a scanning electron microscope sem the composite nanofibers were also used to construct a simple oligonucleotide odn sensor where capture probe odns capodn were covalently grafted onto the residual carboxylic acid functionalities of the composite nanofibers the dna sensing results revealed that significant non specific interactions occur which can be prevented to some extent by changing the dye attached to the signal probe the results also indicate the potential of such nanofibers to be used as biodegradable biosensor

nanotechnology is revolutionising the world of materials this important book reviews methods of nanofiber production discusses the nanofabrication of carbon nanotubes and nanocomposites for particular high performance applications and analyses nanocoatings and surface modification techniques

polymer nanofibers have attracted a lot of industrial interest in the past decade in general these fibers need to be thermally stable for many applications such as in the aerospace industry however most of these polymer nanofibers suffer from low temperature degradation limiting their use in many potential applications graphene which is one sheet of graphite has unique properties such as high conductivity and high thermal stability this exceptional material can be incorporated into the polymer nanofibers as nanofillers in order to enhance their thermal properties the aim of this dissertation is to investigate the effect of adding graphene nanofillers into the polymer fiber on the resulting fibers thermal properties for that purpose polyvinyl alcohol pva a non conductive polymer and a different source of graphene namely graphene foam expendable graphite and graphite powder were used the growth technique was the electrospinning technique includes the amount of pva in the water solvent the flow rate the applied voltage the growth time and the tip collector distance in summary it has been optimized that the best

conditions for growth of fibers will be as follows pva concentration will be fixed at 10 wt flow rate will be 3 ml h applied voltage will be 30 kv growth time of 60 s and tip collector distance will be fixed at 12 cm the resulted pva fibers from these conditions were smooth continuous and hollow with diameter ranging between 190 340 nm while pva graphene nano fibers are much thinner with diameter ranging between 132 235 nm when the same parameters were used with only graphene concentration varied the fiber obtained with pva showed a hollow structure which is desirable for incorporation of graphene nanofillers the dispersion of the different source of graphene sheets in the starting pva solution showed enhanced thermal stability compared to the pva fibers alone furthermore an increase in the thermal stability is observed with increasing concentration of graphene nanofillers this work shows the promising use of graphene as nanofillers for pva fibers this can be expended to other non conductive and conductive polymers in order to broaden the application of these fibers in the industries where thermal stability is a prerequisite

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