

Responsive Polymer Materials

**Miguel de la Guardia, Francesc A.
Esteve-Turrillas**



Responsive Polymer Materials:

Responsive Polymer Materials Sergiy Minko, 2006-01-18 This new book offers practical insights into the latest developments in responsive polymers i.e. polymers engineered to alter structure and properties in response to environmental inputs The book features original design methodological and application data Chemists biochemists and electronic engineers will find here important new material to understand and characterize molecular and submolecular assemblies that enable the fabrication of switch driven polymer systems Beginning from basic research and moving to single molecular design the contributors illuminate switching in self assembled aggregates of polymer chains These analyses are extended to the switching changing of macroscopic properties in bulk and thin films The book demonstrates how the properties of responsive polymers such as morphology wetting behavior adhesion roughness permeability etc can be modified to create and improve biomedical devices chemical sensors microfluidic devices drug delivery systems adhesion systems and self regulating colloids For specialists investigating the potential of molecular and submolecular polymer design this book is essential Synthesis of New and Improved Stimuli-Responsive Polymer Materials Erin Askounis, 2020 Stimuli responsive polymers are materials that undergo physical or chemical properties changes triggered by light temperature mechanical force insertion of small molecules electric fields magnetic fields or pH Stimuli responsive materials can be designed for a desired physical response such as compression shape change or variable stiffness and have been used in coatings sensors drug delivery self healing and mechanical actuators Some stimuli responsive materials utilize several trigger mechanisms to amplify and increase the resulting change in physical properties For example cellulose polymer nanocomposites exhibit stiffness changes triggered by both water and temperature to increase the modulus differential of the material The modulus ranges from GPa range to the low MPa range with the assistance of the dual stimuli technique Although this modulus differential is large for applications in biomaterials the low end modulus of the material must be in the kPa range to limit mechanical mismatch of an implant for practical use Another category of stimuli responsive materials is dielectric elastomer materials electric field responsive materials that expand and contract with an applied voltage Rather than change stiffness these materials change shape When sandwiched between two compliant electrodes and an electric field is applied the material is compressed by the attraction of the opposite charges formed on the electrodes With electro response these materials are useful in soft robotics applications however commercially available dielectric elastomer materials require prestretching for high actuation performance and are incapable of molecular modification Additionally dielectric elastomers are difficult to process due to the crosslinked nature a controlled synthetic approach to more precisely design molecular architectures is desired Overall these materials can be precisely tuned to respond to triggers based on the application requirements Synthesizing and optimizing new stimuli responsive materials that are precisely tuned opens the door for expanded applications in fields such as biomedicine or soft robotics The research outlined in this dissertation focuses on the synthesis and fabrication of novel stimuli responsive

polymer materials to address challenges previously outlined The main body of this dissertation describes new cellulose polymer composite materials with ultra wide stiffness range new dielectric elastomers with high actuation performance without prestretch and new BAB triblock copolymers with variable stiffness The first chapter surveys current stimuli responsive polymer materials technology with a focus on thermo responsive photo responsive electro responsive and dual responsive materials The second chapter outlines research aimed to increase the modulus differential in cellulose composite materials using a thermo responsive variable stiffness polymer and cellulose microfibrils The resulting composite utilizes two stimuli the first is temperature to soften the stiff polymer matrix by melting the crystalline segments to form a soft crosslinked polymer The second stimulus is the addition of water to nullify the reinforcing network formed by percolating cellulose fibrils and further soften the material The material exhibits an ultra wide modulus differential from 1 GPa down to 40 kPa stimulated by water and temperature An ultra wide modulus range allows for further applications development with potential for biomedical devices The third chapter outlines a new dielectric elastomer DE material that exhibits performance similar to commercially available materials in an aim to address the limitations of prestretching and to introduce DEs capable of modification A bimodal interpenetrating crosslinked network was established by combining a short chain di functional acrylate monomer with a long chain high molecular weight di functional acrylate monomer to form a material with mechanical properties similar to commercially available DEs Additional mono functional diluents were added to further tune the electro mechanical properties and improve performance The new DE exhibited maximum actuation strains near 200% and rapid response over 100% strain at 2 Hz The new DE material exhibits performance higher than other synthetic dielectric elastomer and opens the door to optimization of DE materials for a new generation of polymer actuator materials The fourth and last chapter of the main text presents a comparison study of three different length BAB triblock copolymers in an aim to synthesize a triblock copolymer for use as a bistable electroactive polymer BSEP BSEP materials are stiff at room temperature and softened at elevated temperature to actuate as dielectric elastomers BSEP is typically processed by bulk polymerization making it difficult to modify post fabrication In the BAB polymer described a two sided RAFT chain transfer agent was synthesized for symmetrical synthetic processing using poly ethylene glycol for high stiffness at room temperature and increased flexibility at elevated temperature The poly stearyl acrylate B blocks were then incorporated to add further stiffness at room temperature and control the material microstructure Of the three BAB copolymers synthesized two exhibited variable stiffness from 1 GPa to 10 kPa with spherulite microstructural formations confirmed by optical and scanning electron microscopy By introducing a controlled synthetic pathway using RAFT living polymerization these materials can be finely tuned for specific properties before and after fabrication

Smart Polymers and Their Applications
Maria Rosa Aguilar, Julio San Román, 2019-02-15 *Smart Polymers and Their Applications* Second Edition presents an up to date resource of information on the synthesis and properties of different types of smart polymers including temperature pH

electro magnetic and photo responsive polymers amongst others It is an ideal introduction to this field as well as a review of the latest research in this area Shape memory polymers smart polymer hydrogels and self healing polymer systems are also explored In addition a very strong focus on applications of smart polymers is included for tissue engineering smart polymer nanocarriers for drug delivery and the use of smart polymers in medical devices Additionally the book covers the use of smart polymers for textile applications packaging energy storage optical data storage environmental protection and more This book is an ideal technical resource for chemists chemical engineers materials scientists mechanical engineers and other professionals in a range of industries Includes a significant number of new chapters on smart polymer materials development as well as new applications development in energy storage sensors and devices and environmental protection Provides a multidisciplinary approach to the development of responsive polymers approaching the subject by the different types of polymer e g temperature responsive and its range of applications

Stimuli-responsive Polymer-based Materials and Devices for Controlled and Triggered Release of Small Molecules Siyuan Guo, 2020 This thesis covers the general scope of stimuli responsive polymers and the concept of controlled drug delivery with special focus on controlled triggered release applications of temperature responsive poly N isopropylacrylamide pNIPAm based hydrogels microgels their assemblies and composites Chapter 2 focuses on investigating the methodology and mechanism of a controlled release system i e a pNIPAm based microgel based assembly Surface modification was utilized to build a chemical barrier to control the molecular interchange between the inside and the outside of the device The small molecule diffusion behaviors of the device were studied and mathematical models were used to describe the behaviors Chapter 3 focuses on the development of a small molecule controlled release system based on the stimuli responsive hydrogel microgel composite HMC In this work the small hydrophilic molecule release kinetics were tuned by changing the chemical composition of the material and the mechanism of the controlled release was investigated based on the interactions between the small molecules and the polymer materials As a further study of the HMC in controlled drug delivery applications Chapter 4 discusses the idea of applying the HMC to a multi drug controlled release system In addition four appendices A B C and D have been added to the end of this dissertation They contain supporting information for the main chapters previous related work done before my PhD program and preliminary experimental results on related research projects

Responsive Polymer Surfaces Danqing Liu, Dirk J. Broer, 2017-11-06 Adopting an integrated approach this book covers experiments theory and emerging applications In the first part surfaces are described that change from flat to either a random corrugated or to a well structured structure while the second part deals with those surface structures integrated in the coating surface where the structures change their shape or dimension when addressed by an external trigger A variety of materials are addressed including liquid crystal polymers hydrogels hard acrylates and soft silicones The whole is rounded off by a discussion of various applications including surface controlled flows in microfluidic systems Of interest to chemists and engineers researchers in industry and

academia as well as those working in the paint industry and hydrodynamics **Stimuli-Responsive Polymers** Amber

Marie Hubbard,2019 **Stimuli-responsive Materials** Marek W. Urban,2016 Covers the scientific principles

developments and recent technological advances of stimuli responsive materials for those new to and active in the field

Responsive Materials and Methods Ashutosh Tiwari,Hisatoshi Kobayashi,2013-09-30 The development of finely tuned materials that adjust in a predictable manner by specific environment change is the recent arena of materials research It is a newly emerging supra disciplinary field with huge commercial potential Stimuli responsive materials answer by a considerable change in their properties to small changes in their environment Responsive materials are becoming increasingly more prevalent as scientists learn about the chemistry and triggers that induce conformational changes in materials structures and devise ways to take advantage of and control them Responsive Materials and Method offers state of the art of the stimuli responsive materials and their potential applications This collection brings together novel methodologies and strategies adopted in the research and development of responsive materials and technology *Smart*

Stimuli-Responsive Polymers, Films, and Gels Liang Hu,Yongfeng Gao,Michael J. Serpe,2022-08-02 Smart Stimuli Responsive Polymers Films and Gels Discover the most important developments in synthesis simulation and applications of a fascinating compound class There exist a range of natural materials that respond to environmental changes by altering their physical or chemical properties known as stimuli responsive polymers these substances are responsive to light temperature pressure and more The study of these so called smart polymers is essential to a range of application fields many of which have generated cutting edge research in recent decades A comprehensive introduction to the subject is therefore well timed Smart Stimuli Responsive Polymers Films and Gels provides an introduction to these polymers and their applications It includes producing these polymers through synthetic approaches simulating their responses to different stimuli and applying these materials in different industries and research capacities Written to serve the requirements of advanced students and senior researchers alike this timely work will drive years of research in this vital field In Smart Stimuli Responsive Polymers Films and Gels readers will also find Treatment of mechanoresponsive photoresponsive and ionizing radiation responsive polymers Applications in emerging fields such as sensors biomedicine catalysis and more Interdisciplinary research into the properties and responses of these vital compounds Smart Stimuli Responsive Polymers Films and Gels promises to become a seminal work for chemists materials scientists and industrial researchers seeking to incorporate these materials into a variety of industrial and research areas *Advanced Technologies and Polymer Materials for Surgical Sutures* Sabu Thomas,Phil

Coates,Ben Whiteside,Blessy Joseph,Karthik Nair,2022-09-29 Polymeric materials offer a high level of versatility due to the range of applications possible within the biomedical and clinical fields including wound closure particularly in comparison to metals or ceramics These specialised materials also allow for a diverse array of therapeutic effects Although there have been advances in improving polymeric materials for surgical sutures there is little information available regarding improving the

therapeutic value of sutures and advanced technologies used to implement this improvement Advanced Technologies and Polymer Materials for Surgical Sutures provides thorough coverage on suture materials with improved mechanical and therapeutic properties that can improve quality of life chapter topics include drug releasing kinetics of sutures shape memory polymer sutures and future trends This book is a useful resource for academics and researchers in the materials science and biomedical engineering fields as well as professionals in biomaterials and biotextiles development and clinicians looking to learn more about suture material properties and suture body interactions Depicts recent advances in both the therapeutic effects of polymer based sutures as well as the various manufacturing techniques employed in the production of sutures Offers an interdisciplinary approach covering material properties and engineering technologies as well as an understanding of the biological properties of sutures such as suture body interactions Comprehensive coverage allows both experienced researchers in the area and new entrants such as clinicians to learn more about this important topic

Temperature-Responsive Polymers Vitaliy V. Khutoryanskiy, Theoni K. Georgiou, 2018-06-01 An authoritative resource that offers an understanding of the chemistry properties and applications of temperature responsive polymers With contributions from a distinguished panel of experts Temperature Responsive Polymers puts the focus on hydrophilic polymers capable of changing their physicochemical properties in response to changes in environmental temperature The contributors review the chemistry of these systems and discuss a variety of synthetic approaches for preparation of temperature responsive polymers physicochemical methods of their characterisation and potential applications in biomedical areas The text reviews a wide variety of topics including The characterisation of temperature responsive polymers Infrared and Raman spectroscopy Applications of temperature responsive polymers grafted onto solid core nanoparticles and much more The contributors also explore how temperature responsive polymers can be used in the biomedical field for applications such as tissue engineering This important resource Offers an important synthesis of the current research on temperature responsive polymers Covers the chemistry the synthetic approaches for presentation and the physiochemical method of temperature responsive polymers Includes a review of the fundamental characteristics of temperature responsive polymers Explores many of the potential applications in biomedical science including drug delivery and gene therapy Written for polymer scientists in both academia and industry as well as postgraduate students working in the area of stimuli responsive materials this vital text offers an exploration of the chemistry properties and current applications of temperature responsive polymers

Polymer Materials with Smart Properties Maria Bercea, 2013 The design of smart materials based on different natural and synthetic polymers represents one of the most attractive research areas over the last several years Many efforts have been carried out to find new solutions for developing stimuli responsive polymers sensitive to different triggers which have a fast and reversible non linear response to small changes of external stimuli or environmental conditions In combination with other organic inorganic macromolecular compounds new composite materials owning multifunctional properties can be

designed Thus the inorganic nanoparticles incorporated into a polymer matrix provide novel functionalities to hydrogels and tuneable properties This book reviews recent advances and developments of various classes of stimuli responsive polymer materials different type of hydrogels for biomedical and pharmaceutical devices scaffolds for tissue regeneration and stimuli responsive sensors or separation processes

Design and Application of Intelligent Thermally Conductive Materials Wei Feng,2025-03-14 *Design and Application of Intelligent Thermally Conductive Materials* is a current comprehensive reference resource providing information on the structure design and application of these newly developed materials in various contexts together with an analysis of future trends and applications The author presents a detailed description of the application of these intelligent materials to a wide range of uses and also of their particular importance in the development and application of advanced chips It provides postgraduates and senior undergraduates with an essential overview of thermal conductivity from which to appreciate the descriptions of intelligent thermal conductivity For all readers including researchers industry professionals and technicians in the field chapters on the structure design development and performance of intelligent thermal conductive materials provide essential information While the potential future demand for these materials is enormous the author indicates where developmental technical and production bottlenecks may occur The possible use of intelligent thermal conductive materials in a wide range of contexts is discussed together with their potential for energy saving and resource conservation Focuses on the newly evolving field of intelligent thermal conductive materials a new type of functional materials designed for rapid heat diversion and management that enables autonomous response to the thermal environment using intelligent thermal conductivity control Covers a broad range of topics relating to these newly developed materials from the structure of the basic materials to the design and application of intelligent materials Discusses the application capacity for this type of intelligent or smart material Provides updates on potential bottlenecks to the development design related technology and production of these materials

Handbook of Smart Materials in Analytical Chemistry Miguel de la Guardia,Francesc A. Esteve-Turrillas,2019-01-24 A comprehensive guide to smart materials and how they are used in sample preparation analytical processes and applications This comprehensive two volume handbook provides detailed information on the present state of new materials tailored for selective sample preparation and the legal frame and environmental side effects of the use of smart materials for sample preparation in analytical chemistry as well as their use in the analytical processes and applications It covers both methodological and applied analytical aspects relating to the development and application of new materials for solid phase extraction SPE and solid phase microextraction SPME their use in the different steps and techniques of the analytical process and their application in specific fields such as water food air pharmaceuticals clinical sciences and forensics Every chapter in *Handbook of Smart Materials in Analytical Chemistry* is written by experts in the field to provide a comprehensive picture of the present state of this key area of analytical sciences and to summarize current applications and research literature in a critical way Volume 1 covers New Materials for Sample

Preparation and Analysis Volume 2 handles Analytical Processes and Applications Focuses on the development and applications of smart materials in analytical chemistry Covers both methodological and applied analytical aspects for the development of new materials and their use in the different steps and techniques of the analytical process and their application in specific fields Features applications in key areas including water air environment pharma food forensic and clinical Presents the available tools for the use of new materials suitable to aid recognition process to the sample preparation and analysis A key resource for analytical chemists applied laboratories and instrument companies Handbook of Smart Materials in Analytical Chemistry 2V Set is an excellent reference book for specialists and advanced students in the areas of analytical chemistry including both research and application environments Smart and Functional Soft Materials Xufeng Dong, 2019-11-13 During the past 100 years a large number of new materials have been developed which provide us with various tools wares clothes etc with good properties but low weight and low cost Recently smart soft materials that can respond to an external stimulus such as an electric field magnetic field sound light temperature pH and so on as well as functional soft materials that are electronically magnetically or thermally conductive have attracted considerable attention They have application potentials in various fields To some extent they are the way to fulfill most of the black technology described in the world of science fiction This book introduces several smart soft materials and functional soft materials which are of interest to scholars in related fields *Switchable and Responsive Surfaces and Materials for Biomedical Applications* Johnathan Zhang, 2014-12-11 Surface modification of biomaterials can ultimately determine whether a material is accepted or rejected from the human body and a responsive surface can further make the material smart and intelligent Switchable and Responsive Surfaces and Materials for Biomedical Applications outlines synthetic and biological materials that are responsive under different stimuli their surface design and modification techniques and applicability in regenerative medicine tissue engineering drug delivery medical devices and biomedical diagnostics Part one provides a detailed overview of switchable and responsive materials and surfaces exploring thermo responsive polymers environmentally responsive polyelectrolytes and zwitterionic polymers as well as peptide based and photonic sensitive switchable materials Further chapters include a detailed overview of the preparation and analysis of switchable polymer brushes and copolymers for biomedical application Part two explores the biological interactions and biomedical applications of switchable surfaces where expert analysis is provided on the interaction of switchable surfaces with proteins and cells The interaction of stimuli sensitive polymers for tissue engineering and drug delivery with biosurfaces is critiqued whilst the editor provides a skillful study into the application of responsive polymers in implantable medical devices and biosensors A comprehensive overview of switchable and responsive materials and surfaces Includes in depth analysis of thermo responsive polymers photonic sensitive materials and peptide based surfaces Detailed exploration of biological interactions of responsive and switchable surfaces covering stimuli sensitive polymers for drug delivery surfaces with proteins cells and application of polymers in medical devices

Encyclopedia of Polymer Applications, 3 Volume Set Munmaya Mishra, 2018-12-17 Undoubtedly the applications of polymers are rapidly evolving Technology is continually changing and quickly advancing as polymers are needed to solve a variety of day to day challenges leading to improvements in quality of life The Encyclopedia of Polymer Applications presents state of the art research and development on the applications of polymers This groundbreaking work provides important overviews to help stimulate further advancements in all areas of polymers This comprehensive multi volume reference includes articles contributed from a diverse and global team of renowned researchers It offers a broad based perspective on a multitude of topics in a variety of applications as well as detailed research information figures tables illustrations and references The encyclopedia provides introductions classifications properties selection types technologies shelf life recycling testing and applications for each of the entries where applicable It features critical content for both novices and experts including engineers scientists polymer scientists materials scientists biomedical engineers macromolecular chemists researchers and students as well as interested readers in academia industry and research institutions

Advanced Materials for Membrane Fabrication and Modification Stephen Gray, Toshinori Tsuru, Yoram Cohen, Woei-Jye Lau, 2018-08-30 Membranes are an energy efficient separation technology that are now the basis for many water treatment and food processing applications However there is the potential to improve the operating performance of these separations and to extend the application of membranes to energy production gas separations organic solvent based separations and biomedical applications through novel membrane materials This book contains 20 chapters written by leading academic researchers on membrane fabrication and modification techniques and provides a comprehensive overview on the recent developments of membrane technology Membranes can be manufactured from a range of materials including polymeric compounds and ceramic materials and both these materials are considered in the book There are 5 chapters on water and wastewater membranes that cover the fabrication of thin film TFC composite membranes for nanofiltration NF reverse osmosis RO forward osmosis FO applications stimuli responsive membranes electrospun membranes porous ceramic membranes and polymeric ultrafiltration UF manufacture and modification There are another 6 chapters on gas separation that consider carbon membranes zeolite membranes silica template and metal oxide silica membranes TFC membranes silica membranes and metal organic framework MOF membranes Zeolite membranes are also considered for organic solvent applications as are solvent resistant membranes manufactured by phase inversion ceramic supported composite membranes and ceramic NF membranes The emerging areas of membranes for energy and biomedical applications have 3 and 2 chapters respectively Energy applications consider ion exchange membranes for use in fuel cells membranes for electrodialysis and membranes for use in microbial fuel cells For biomedical applications the chapters focus on hemodialysis membranes and redox responsive membranes

Photoactive Functional Soft Materials Quan Li, 2018-11-12 This book covers the design synthesis properties and applications of functional photoactive soft materials including aspects of polymers block copolymers

elastomers biomaterials liquid crystals chemical and physical gels colloids and host guest systems It combines in a unified manner authoritative accounts describing various structural and functional aspects of photoactive soft materials Photoactive Functional Soft Materials Preparation Properties and Applications Brings together the state of the art knowledge on photoactive functional soft materials in a unified manner Covers a vibrant research field with tremendous application potential in areas such as optoelectronics photonics and energy generation Appeals to a large interdisciplinary audience because it is highly useful for researchers and engineers working on photonics optoelectronics imaging and sensing nanotechnology and energy materials Photoactive Functional Soft Materials Preparation Properties and Applications focuses on the design and fabrication of photoactive functional soft materials for materials science nanophotonics nanotechnology and biomedical applications *Functional Polymers* Raja Shunmugam,2017-05-08 This new book covers the synthetic as well application aspects of functional polymers It highlights modern trends in the field and showcases the recent characterization techniques that are being employed in the field of polymer science The chapters are written by top notch scientists who are internationally recognized in the field The chapters will highlight the modern trend in the field

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