

Responsive Polymer Materials

Vitaliy V. Khutoryanskiy, Theoni K. Georgiou

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 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 microfibers. 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 fibers 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 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 Stimuli-Responsive Polymers Amber Marie Hubbard.2019 Responsive Polymer Surfaces Danging Liu, Dirk J. Broer, 2017-07-14 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 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 Smart Stimuli-Responsive Polymers, Films, and Gels Liang Hu, Yongfeng Gao, Michael J. applications Serpe, 2022-08-08 Smart Stimuli Responsive Poymers 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

Temperature-Responsive Polymers Vitaliy V. Khutoryanskiy, Theoni K. Georgiou, 2018-08-20 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 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 **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

Responsive Polymer Materials Book Review: Unveiling the Power of Words

In some sort of driven by information and connectivity, the power of words has be evident than ever. They have the ability to inspire, provoke, and ignite change. Such may be the essence of the book **Responsive Polymer Materials**, a literary masterpiece that delves deep in to the significance of words and their effect on our lives. Written by a renowned author, this captivating work takes readers on a transformative journey, unraveling the secrets and potential behind every word. In this review, we will explore the book is key themes, examine its writing style, and analyze its overall impact on readers.

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