Polymer Protein Conjugation Via A Grafting To Approach

Nanoarmoring of Enzymes: Rational Design of Polymer-Wrapped Enzymes is the latest volume in the Methods in Enzymology series and focuses on nanoarmoring of enzymes and the rational design of polymer-wrapped enzymes. Focuses on the nanoarmoring of enzymes Covers the rational design of polymer-wrapped enzymes Includes contributions from leading authorities working in enzymology Informs and updates on all the latest developments in the field of enzymology

This book covers a wide range of topics relating to carbon nanomaterials, from synthesis and functionalization to applications in advanced biomedical devices and systems. As they possess unique and attractive chemical, physical, optical, and even magnetic properties for various applications, considerable effort has been made to employ carbon nanomaterials (e.g., fullerenes, carbon nanotubes, graphene, nanodiamond) as new materials for the development of novel biomedical tools, such as diagnostic sensors, imaging agents, and drug/gene delivery systems for both diagnostics and clinical treatment. Tremendous progress has been made and the scattered literature continues to grow rapidly. With chapters by world-renowned experts providing an overview of the state of the science as well as an understanding of the challenges that lie ahead, Carbon Nanomaterials for Biomedical Applications is essential reading not only for experienced scientists and engineers in biomedical and nanomaterials areas, but also for graduate students and advanced undergraduates in materials science and engineering, chemistry, and biology.

With contributions by numerous experts

Globular proteins offer powerful solutions for addressing challenges in the fields of medicine, industry, defense, and energy. Enzymes perform reactions with high efficiency and specificity, allowing for minimal generation of undesired side products even while exhibiting rapid turnover-traits difficult to replicate in synthetic catalysts. These targets make proteins attractive tools for immobilization to form functional catalysts and sensors. Nevertheless, there are many challenges in creating these advanced materials. The activity of the protein must be retained, and control over the structure of the material is desirable. Protein-polymer block copolymers offer an attractive solution to these issues. These materials have been shown to selfassemble into ordered nanodomains while retaining protein activity. However, the phase behavior of these materials is not fully understood due to the complex nature of anisotropic interactions between the proteins. Within this thesis, a method for creating highly-active thin-film catalysts from myoglobin-PNIPAM bioconjugates is established by flow-coating these materials onto solid supports and then cross-linking them with glutaraldehyde. These catalysts exhibit considerable stability and perform reactions 5-10 times more efficiently than catalysts formed using other common immobilization techniques. However, the self-assembly and structural control of this catalyst was observed to be poor, and it was hypothesized that the poor self-assembly relative to mCherry and EGFP systems could be a consequence of the protein shape. In order to probe the effect of protein shape on self-assembly, a panel of mCherry bioconjugates with differing conjugation sites was studied using small-angle x-ray scattering. The self-assembly behavior of these conjugation site variants was observed to be robust with only minor differences in phase boundaries and observed phases resulting from the changes in conjugation site. However, observed changes in the domain spacing signaled that modifications to conjugation site offer control over protein orientation within the domains. Based on studies showing that polymer chemistry in bioconjugates has a significant effect on self-assembly, an attempt to quantify these protein-polymer interactions was made using contrast-variation small-angle neutron scattering on mCherry and polymer blends. This technique allows for decomposition of the scattering intensity into its component parts corresponding to correlations between the 3 different pairs of the 2 species in the blends. From this analysis, it was determined that the best ordering bioconjugates have primarily repulsive interactions that can be described using a depletion layer model. Lastly, the effect of protein properties was screened using a large library of bioconjugates made from 11 different proteins. The primary observed trend was that order increases as molecular weight increases, but a narrow region around 28-30 kDa was observed where bioconjugate ordering was significantly enhanced and additional nanostructures were accessible.

Synthesis of tailor-made functional polymers with controlled architecture is very challenging. The functional groups present in the monomer often either prevent polymerisation or lead to several side reactions. In this regard, reversible deactivation radical polymerisation (RDRP) techniques are useful tools to prepare macromolecular architectures with controlled molecular weight, architecture, and narrow dispersity. This book delineates the advances in the area of RDRP to prepare functional polymers for a wide range of applications like in self-healing, oil- and water-resistant coatings, controlled drug delivery systems and so on. The worthy contribution from renowned experts working in the area of RDRP makes this book invaluable to researchers in these important areas such as:Introduction and historical development of RDRP.Polymer-nanohybrid materials.Telechelic polymers with controlled end functionality.Functional polymers via a combination of RDRP and 'click' chemistry.Fluorinated polymers.Polymers for biomedical applications.The book will be of prime interest for polymer scientists as well as material scientists dealing with functional polymer synthesis for different applications. It will also be a good source of knowledge for researchers working on functional polymeric materials and their composites.

This book provides an up-to-date textbook suitable for a one-semester (or two-quarter) course in biomaterials at the junior/senior undergraduate and introductory graduate levels. While intended primarily for students in biomedical engineering degree programs, the book will also provide an indispensable resource for an interdisciplinary audience composed of medical and dental students, researchers in the biomedical industry, and students with science and engineering backgrounds who have an interest in biomaterials. The focus of the book centers on the fundamentals to aid students to understand the materials science of biomaterials and their interaction with cells and tissues. However, it also describes conventional and emerging applications to show how these fundamentals are applied. Each chapter is replete with data in the form of tables and illustrations, and concludes with homework, review and examination problems, and a list of references for further reading. Beginning with an introductory chapter that covers general aspects related to the history, properties and applications of biomaterials, and to the biomaterials industry, the book moves on to cover the following major topics: Materials science fundamentals; Classes of materials used as biomaterials; Degradation of biomaterials in the biological environment; Biocompatibility phenomena; Applications of biomaterials in medicine and dentistry.

An introduction to the state-of-the-art of the diverse self-assembly systems Self-Assembly: From Surfactants to Nanoparticles provides an effective entry for new researchers into this exciting

field while also giving the state of the art assessment of the diverse self-assembling systems for those already engaged in this research. Over the last twenty years, self-assembly has emerged as a distinct science/technology field, going well beyond the classical surfactant and block copolymer molecules, and encompassing much larger and complex molecular, biomolecular and nanoparticle systems. Within its ten chapters, each contributed by pioneers of the respective research topics, the book: Discusses the fundamental physical chemical principles that govern the formation and properties of self-assembled systems Describes important experimental techniques to characterize the properties of self-assembled systems, particularly the nature of molecular organization and structure at the nano, meso or micro scales. Provides the first exhaustive accounting of self-assembly derived from various kinds of biomolecules including peptides, DNA and proteins. Outlines methods of synthesis and functionalization of self-assembled nanoparticles and the further self-assembly of the nanoparticles into one, two or three dimensional materials. Explores numerous potential applications of self-assembled structures including nanomedicine applications of drug delivery, imaging, molecular diagnostics and theranostics, and design of materials to specification such as smart responsive materials and self-healing materials. Highlights the unifying as well as contrasting features of self-assembly, as we move from surfactant molecules to nanoparticles. Written for students and academic and industrial scientists and engineers, by pioneers of the research field, Self-Assembly: From Surfactants to Nanoparticles is a comprehensive resource on diverse self-assembly systems, that is simultaneously introductory as well as the state of the art.

?The series Topics in Current Chemistry Collections presents critical reviews from the journal Topics in Current Chemistry organized in topical volumes. The scope of coverage is all areas of chemical science including the interfaces with related disciplines such as biology, medicine and materials science. The goal of each thematic volume is to give the non-specialist reader, whether in academia or industry, a comprehensive insight into an area where new research is emerging which is of interest to a larger scientific audience. Each review within the volume critically surveys one aspect of that topic and places it within the context of the volume as a whole. The most significant developments of the last 5 to 10 years are presented using selected examples to illustrate the principles discussed. The coverage is not intended to be an exhaustive summary of the field or include large quantities of data, but should rather be conceptual, concentrating on the methodological thinking that will allow the non-specialist reader to understand the information presented. Contributions also offer an outlook on potential future developments in the field.

This book is devoted to the engineering of protein-based nanostructures and nanomaterials. One key challenge in nanobiotechnology is to be able to exploit the natural repertoire of protein structures and functions to build materials with defined properties at the nanoscale using “bottom-up” strategies. This book addresses in an integrated manner all the critical aspects that need to be understood and considered to design the next generation of nano-bio assemblies. The book covers first the fundamentals of the design and features of the protein building blocks and their self-assembly illustrating some of the most relevant examples of nanostructural design. Finally, the book contains a section dedicated to demonstrated applications of these novel bioinspired nanostructures in different fields from hybrid nanomaterials to regenerative medicine. This book provides a comprehensive updated review of this rapidly evolving field.

Polymer–Protein Conjugates: From Pegylation and Beyond helps researchers by offering a unique reference and guide into this fascinating area. Sections cover the challenges surrounding the homogeneity of conjugates, their purity and polymer toxicity on long-term use, and how to deal with the risk of immunogenicity. These discussions help researchers design new projects by taking into account the latest innovations for safe and site selective polymer conjugation to proteins. PEG has been the gold standard and likely will play this role for many years, but alternatives are coming into the market, some of which have already been launched. After five decades of improvements, the ideas in this book are entering into a new era of innovation because of the advances in genetic engineering, biochemistry and a better understanding of the results from clinical use of PEG conjugates in humans. Provides an overview on the state-of-the-art of protein polymer conjugation Presents both the pros and cons of polymer-protein conjugates from the point-of-view of their clinical outcomes Outlines advantages and potential risks of present technology based on PEG Offers new alternatives for PEG and new approaches for on site-selective protein modification Identifies future direction of research in this field

This reference/text covers fundamentals of peptide and protein drug delivery, including such considerations as synthesis, physical chemistry and biochemistry, analysis, proteolytic and transport constraints, pharmacokinetics, and pharmacodynamics; bioavailability from routes of administration, detai

Modifiable and Protein-Stabilizing Polymers Prepared Using Controlled Polymerization Techniques

Giving fundamental information on one of the most promising families of smart materials, electroactive polymers (EAP) this exciting new titles focuses on the several biomedical applications made possible by these types of materials and their related actuation technologies. Each chapter provides a description of the specific EAP material and device configuration used, material processing, device assembling and testing, along with a description of the biomedical application. Edited by well-respected academics in the field of electroactive polymers with contributions from renowned international experts, this is an excellent resource for industrial and academic research scientists, engineers, technicians and graduate students working with polymer actuators or in the fields of polymer science.

Thiazoles—Advances in Research and Application: 2012 Edition is a ScholarlyEditions™ eBook that delivers timely, authoritative, and comprehensive information about Thiazoles. The editors have built Thiazoles—Advances in Research and Application: 2012 Edition on the vast information databases of ScholarlyNews.™ You can expect the information about Thiazoles in this eBook to be deeper than what you can access anywhere else, as well as consistently reliable, authoritative, informed, and relevant. The content of Thiazoles—Advances in Research and Application: 2012 Edition has been produced by the world’s leading scientists, engineers, analysts, research institutions, and companies. All of the content is from peer-reviewed sources, and all of it is written, assembled, and edited by the editors at ScholarlyEditions™ and available exclusively from us. You now have a source you can cite with authority, confidence, and credibility. More information is available at http://www.ScholarlyEditions.com/.

The unique physico-chemical properties of cationic polymers and their ability to be easily modified make them attractive for many biological applications. As a result there is a vast amount of research focussed on designing novel natural or synthetic cationic polymers with specific biological functionality. Cationic Polymers in Regenerative Medicine brings together the expertise of leading experts in the field to provide a comprehensive overview of the recent advances in cationic polymer synthesis, modification and the design of biomaterials with different structures for

therapeutic applications. Chapters cover recent developments in novel cationic polymer based systems including poly(L-lysine), Poly(N,N-dimethylaminoethyl methacrylate) and cationic triazine dendrimers as well as cationic polymer-coated micro- and nanoparticles and cationic cellulose and chitin nanocrystals. Applications discussed in the book include drug and gene delivery, therapeutics in thrombosis and inflammation as well as gene therapy. Suitable both for an educational perspective for those new to the field and those already active in the field, the book appeals to postgraduates and researchers. The broad aspects of the topics covered are suitable for polymer chemists interested in the fundamentals of the materials systems as well as pharmaceutical chemists, bioengineering and medical professionals interested in their applications.

Polypeptide-Polymer Conjugates, by Henning Menzel Chemical Strategies for the Synthesis of Protein-Polymer Conjugates, by Björn Jung and Patrick Theato Glycopolymer Conjugates, by Ahmed M. Eissa and Neil R. Cameron DNA-Polymer Conjugates: From Synthesis, Through Complex Formation and Self-assembly to Applications, by Dawid Kedracki, Ilyès Safir, Nidhi Gour, Kien Xuan Ngo and Corinne Vebert-Nardin Synthesis of Terpene-Based Polymers, by Junpeng Zhao and Helmut Schlaad

Explore this one-stop resource for reversible addition-fragmentation chain transfer polymerization from a leading voice in chemistry RAFT Polymerization: Methods, Synthesis and Applications delivers a comprehensive and insightful analysis of reversible addition-fragmentation chain transfer polymerization (RAFT) and its applications to fields as diverse as material science, industrial chemistry, and medicine. This one-stop resource offers readers a detailed synopsis of the current state of RAFT polymerization. This text will inspire further research and continue the drive to an ever-increasing range of applications by synthesizing and explaining the more central existing literature on RAFT polymerization. It contains a beginner’s guide on how to do a RAFT polymerization before moving on to much more advanced techniques and concepts, like the kinetics and mechanisms of the RAFT process. The distinguished editors have also included resources covering the four major classes of RAFT agents and recent developments in processes for initiating RAFT polymerization. Readers will also benefit from the inclusion of: A thorough introduction to the mechanisms, theory, and mathematical modeling of RAFT Explorations of RAFT agent design and synthesis, dithioesters, dithiobenzoates, trithiocarbonates, xanthates, dithiocarbamates, macromonomer RAFT, and RAFT copolymerization Discussions of a variety of RAFT architectures, including multiblocks, combs, hyperbranched polymers, and stars Treatments of end group transformation, cationic RAFT, high-throughput RAFT, and RAFT in continuous flow An examination of sequence defined polymers by RAFT Perfect for organic chemists, polymer chemists, and materials scientists, RAFT Polymerization: Methods, Synthesis and Applications will also earn a place in the libraries of chemical engineers seeking a one-stop reference for this method of controlled radical polymerization with a wide range of applications in multiple areas.

Ethylene Glycols—Advances in Research and Application: 2013 Edition is a ScholarlyEditions™ book that delivers timely, authoritative, and comprehensive information about Chloral Hydrate. The editors have built Ethylene Glycols—Advances in Research and Application: 2013 Edition on the vast information databases of ScholarlyNews.™ You can expect the information about Chloral Hydrate in this book to be deeper than what you can access anywhere else, as well as consistently reliable, authoritative, informed, and relevant. The content of Ethylene Glycols—Advances in Research and Application: 2013 Edition has been produced by the world’s leading scientists, engineers, analysts, research institutions, and companies. All of the content is from peer-reviewed sources, and all of it is written, assembled, and edited by the editors at ScholarlyEditions™ and available exclusively from us. You now have a source you can cite with authority, confidence, and credibility. More information is available at http://www.ScholarlyEditions.com/.

Even after significant advances in polymerization and protein modification chemistries, the majority of polymeric biomaterials focus on poly(ethylene glycol) (PEG)-based monomers. Despite their widespread use, these polymers present concerns due to their non-biodegradable nature, the possibility of toxicity and immunogenicity, and their limited chemical functionality. Therefore, there is significant interest in the rational design of alternative polymers with specific chemical or biological properties. Specifically, approaches that allow for the rapid and divergent synthesis of a large number of biodegradable polymeric materials capable of functionalization would be broadly applicable. This dissertation focuses on novel degradable and modifiable polymers with applications in protein conjugation and stabilization. In Chapter 1, the history of protein-polymer conjugates for therapeutic use is outlined, from PEGylation techniques to next-generation conjugation strategies. Alternative polymer technologies and future directions of the field are also presented. In Chapter 2, the synthesis and biological application of a degradable trehalose glycopolymer is described. The polymer is shown to stabilize the therapeutic protein granulocyte colony stimulating factor (G-CSF) against heat stress. While the polymer was noncytotoxic, its degradation products inhibited cell proliferation at high concentrations. Chapter 3 details the development of poly(caprolactone)-based polyesters for protein stabilization. An alkene-substituted polyester was synthesized and modified using thiol-ene chemistry with thiols containing glucose, lactose, trehalose, PEG, and carboxybetaine units. The relative stabilizing ability of these side-chains toward G-CSF was assessed. Trehalose and carboxybetaine were found to maintain the most protein activity upon exposure to heat stress. We varied the size of these polymers and found a dependence on molecular weight, where longer polymers were more effective protein stabilizers. These materials and their degradation products were cytocompatible, yet exhibited minimal degradation in aqueous conditions. Chapter 4 describes the synthesis of trehalose- and carboxybetaine-funcitonalized polyesters and polycarbonates with tunable degradability, with half-lives from 10 hours to over 4 months. We expect these materials will be useful in the development of novel protein-polymer therapeutics. We also describe the development of novel PEG analogs using ring-opening metathesis polymerization (ROMP). Chapter 5 describes the synthesis of these PEG analogs and subsequent conjugation to the model protein lysozyme. Exploration of post-polymerization modifications to install thiols onto the unsaturated polymer backbone are also described.

Offers new strategies to optimize polymer reactions With contributions from leading macromolecular scientists and engineers, this book provides a practical guide to

polymerization monitoring. It enables laboratory researchers to optimize polymer reactions by providing them with a better understanding of the underlying reaction kinetics and mechanisms. Moreover, it opens the door to improved industrial-scale reactions, including enhanced product quality and reduced harmful emissions. Monitoring Polymerization Reactions begins with a review of the basic elements of polymer reactions and their kinetics, including an overview of stimuli-responsive polymers. Next, it explains why certain polymer and reaction characteristics need to be monitored. The book then explores a variety of practical topics, including: Principles and applications of important polymer characterization tools, such as light scattering, gel permeation chromatography, calorimetry, rheology, and spectroscopy Automatic continuous online monitoring of polymerization (ACOMP) reactions, a flexible platform that enables characterization tools to be employed simultaneously during reactions in order to obtain a complete record of multiple reaction features Modeling of polymerization reactions and numerical approaches Applications that optimize the manufacture of industrially important polymers Throughout the book, the authors provide step-by-step strategies for implementation. In addition, ample use of case studies helps readers understand the benefits of various monitoring strategies and approaches, enabling them to choose the best one to match their needs. As new stimuli-responsive and "intelligent" polymers continue to be developed, the ability to monitor reactions will become increasingly important. With this book as their guide, polymer scientists and engineers can take full advantage of the latest monitoring strategies to optimize reactions in both the lab and the manufacturing plant.

Functionalized polymers are macromolecules to which chemically bound functional groups are attached which can be used as catalysts, reagents, protective groups, etc. Functionalized polymers have low cost, ease of processing and attractive features for functional organic molecules. Chemical reactions for the introduction of functional groups in polymers and the conversion of functional groups in polymers depend on different properties. Such properties are of great importance for functionalization reactions for possible applications of reactive polymers. This book deals with the synthesis and design of various functional polymers, the modification of preformed polymer backbones and their various applications.

Thiol-X chemistries are already well established techniques, but it is only recently that they have been exploited for the functionalization and synthesis of polymers and other materials. As such, information on these techniques is scattered across the literature and Thiol-X Chemistries in Polymer and Materials Science is the first book to compile work specifically focussing on the application of thiol-based chemistries in materials design and synthesis. The book introduces the various thiol-X chemistries currently available and applications where they have been successfully used, including examples of 'click' processes, in polymerizations, polymer synthesis, and polymer modification. Short 'how to' sections within the chapters also provide general experimental techniques to employ the various chemistries described. Written by leading experts in the field, this book is a comprehensive resource for postgraduates, academics and industrial practitioners interested in polymer and materials applications.

The Concise Encyclopedia of Biomedical Polymers and Polymeric Biomaterials presents new and selected content from the 11-volume Biomedical Polymers and Polymeric Biomaterials Encyclopedia. The carefully culled content includes groundbreaking work from the earlier published work as well as exclusive online material added since its publication in print. A diverse and global team of renowned scientists provide cutting edge information concerning polymers and polymeric biomaterials. Acknowledging the evolving nature of the field, the encyclopedia also features newly added content in areas such as tissue engineering, tissue repair and reconstruction, and biomimetic materials.

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.

"... This reference integrates a historical perspective of materials engineering principles with biological interactions of biomaterials. Also provided within are regulatory and ethical issues in addition to future directions of the field, and a state-of-the-art update of medical and biotechnological applications. All aspects of biomaterials science are thoroughly addressed, from tissue engineering to cochlear prostheses and drug delivery systems. Over 80 contributors from academia, government and industry detail the principles of cell biology, immunology, and pathology. Focus within pertains to the clinical uses of biomaterials as components in implants, devices, and artificial organs. This reference also touches upon their uses in biotechnology as well as the characterization of the physical, chemical, biochemical and surface properties of these materials." -- Publisher's description.

This thesis covers the synthesis of conjugates of 2-Deoxy-D-ribose-5-phosphate aldolase (DERA) with suitable polymers and the subsequent immobilization of these conjugates in thin films via two different approaches. 2-Deoxy-D-ribose-5-phosphate aldolase (DERA) is a biocatalyst that is capable of converting acetaldehyde and a second aldehyde as acceptor into enantiomerically pure mono- and diyhydroxyaldehydes, which are important structural motifs in a number of pharmaceutically active compounds. Conjugation and immobilization renders the enzyme applicable for utilization in a continuously run biocatalytic process which avoids the common problem of product inhibition. Within this thesis, conjugates of DERA and poly(N-isopropylacrylamide) (PNIPAm) for immobilization via a self-assembly approach were synthesized and isolated, as well as conjugates with poly(N,N-dimethylacrylamide) (PDMAA) for a simplified and scalable spray-coating approach. For the DERA/PNIPAm-conjugates different synthesis routes were tested, including grafting-from and grafting-to, both being common methods for the conjugation. Furthermore, both lysines and cysteines were addressed for the conjugation in order to find optimum conjugation conditions. It turned out that conjugation via lysine causes severe activity loss as one lysine plays a key role in the catalyzing mechanism. [...]

Stimuli Responsive Polymeric Nanocarriers for Drug Delivery Applications, Volume One: Types and Triggers discusses, in detail, the recent trends in designing biodegradable and biocompatible single-responsive polymers and nanoparticles for safe drug delivery. Focusing on the most advanced materials and technologies, evaluation methods, and advanced synthesis techniques stimuli-responsive polymers, the book is an essential reference for scientists with an interest in drug delivery vehicles. Sections focus on innovation, development and the increased global demand for biodegradable and biocompatible responsive polymers and nanoparticles for safe drug delivery. Offers an in-depth look at the basic and fundamental aspects of alternative stimuli-responsive polymers, mechanisms, structure,

synthesis and properties Provides a well-defined categorization for stimuli-responsive polymers for drug delivery based on different triggering mechanisms Discusses novel approaches and challenges for scaling up and commercialization of stimuli-responsive polymers

Nanoscience or the science of the very small offers the pharmaceutical scientist a wealth of opportunities. By fabricating at the nanoscale, it is possible to exert unprecedented control on drug activity. This textbook will showcase a variety of nanosystems working from their design and construction to their application in the field of drug delivery. The book is intended for graduate students in drug delivery, physical and polymer chemistry, and applied pharmaceutical sciences courses that involve fundamental nanoscience. The purpose of the text is to present physicochemical and biomedical properties of synthetic polymers with an emphasis on their application in polymer therapeutics i.e., pharmaceutical nanosystems, drug delivery and biological performance. There are two main objectives of this text. The first is to provide advanced graduate students with knowledge of the principles of nanosystems and polymer science including synthesis, structure, and characterization of solution and solid state properties. The second is to describe the fundamentals of therapeutic applications of polymers in drug delivery, targeting, response modifiers as well as regulatory issues. The courses, often listed as Advanced Drug Delivery and Applied Pharmaceutics; Polymer Therapeutics; or Nanomedicine, are designed as an overview of the field specifically for graduate students in the Department of Pharmaceutical Sciences Graduate Programs. However, the course content may also be of interest for graduate students in related biomedical research programs. These courses generally include a discussion of the major principles of polymer science and fundamental concepts of application of polymers as modern therapeutics. All courses are moving away from the above mentioned course names and going by ‘pharmaceutical nanoscience or nanosystems’. This area of research and technology development has attracted tremendous attention during the last two decades and it is expected that it will continue to grow in importance. However, the area is just emerging and courses are limited but they are offered.

Comprehensive Supramolecular Chemistry II, Second Edition is a ‘one-stop shop’ that covers supramolecular chemistry, a field that originated from the work of researchers in organic, inorganic and physical chemistry, with some biological influence. The original edition was structured to reflect, in part, the origin of the field. However, in the past two decades, the field has changed a great deal as reflected in this new work that covers the general principles of supramolecular chemistry and molecular recognition, experimental and computational methods in supramolecular chemistry, supramolecular receptors, dynamic supramolecular chemistry, supramolecular engineering, crystallographic (engineered) assemblies, sensors, imaging agents, devices and the latest in nanotechnology. Each section begins with an introduction by an expert in the field, who offers an initial perspective on the development of the field. Each article begins with outlining basic concepts before moving on to more advanced material. Contains content that begins with the basics before moving on to more complex concepts, making it suitable for advanced undergraduates as well as academic researchers Focuses on application of the theory in practice, with particular focus on areas that have gained increasing importance in the 21st century, including nanomedicine, nanotechnology and medicinal chemistry Fully rewritten to make a completely up-to-date reference work that covers all the major advances that have taken place since the First Edition published in 1996

Explores bioconjugate properties and applications ofpolymers, dendrimers, lipids, nanoparticles, and nanotubes Bioconjugation has enabled breakthroughs across many areas ofindustry and biomedicine. With its emphasis on synthesis,properties and applications, this book enables readers tounderstand the connection between chemistry and the biologicalapplication of bioconjugated materials. Its detailed descriptionsof methods make it possible for researchers to fabricate and takefull advantage of bioconjugates for a broad range of applications.Moreover, the book sets the foundation for the development of newapplications, including assays, imaging, biosensors, drug delivery,and diagnostics. Chemistry of Bioconjugates features contributions from aninternational team of leading experts and pioneers in the field.These contributions reflect the authors’ firsthand laboratoryexperience as well as a thorough review of the current literature.The book’s six sections examine: General methods of bioconjugation Polymer bioconjugates Organic nanoparticle-based bioconjugates Inorganic nanomaterial bioconjugates, including metals andmetal oxides Cell-based, hydrogel/microgel, and glyco-bioconjugates Characterization, physico-(bio)chemical properties, andapplications of bioconjugates This comprehensive exploration of bioconjugates includesdiscussions of polymers, dendrimers, lipids, nanoparticles, andnanotubes. References at the end of each chapter serve as a gatewayto the most important original research findings and reviews in thefield. By drawing together and analyzing all the latest chemicalmethods and research findings on the physico-chemical andbiochemical properties of bioconjugates, Chemistry ofBioconjugates sheds new light on the significance and potentialof bioconjugation. The book is recommended for organic and polymerchemists, biochemists, biomaterial scientists, carbohydratechemists, biophysicists, bioengineers, and drug and gene deliveryscientists.

Polysaccharide Carriers for Drug Delivery presents the latest information on the selection of safe materials. Due to reported safety profiles on polysaccharides; they have been the natural choice for investigation. A wide variety of drug delivery and biomedical systems have been studied, however, the related information either concept-wise or application-oriented is scattered, therefore becoming difficult for readers and researchers to digest in a concise manner. This gathering of information will help readers easily comprehend the subject matter. Focuses on biopolysaccharide-based, distinct approaches for drug delivery applications Illustrates new concepts and highlights future scope for clinical development Provides comprehensive, up-to-date information on different aspects of drug delivery technology

Comprehensive Biomaterials brings together the myriad facets of biomaterials into one, major series of six edited volumes that would cover the field of biomaterials in a major, extensive fashion: Volume 1: Metallic, Ceramic and Polymeric Biomaterials Volume 2: Biologically Inspired and Biomolecular Materials Volume 3: Methods of Analysis Volume 4: Biocompatibility, Surface Engineering, and Delivery Of Drugs, Genes and Other Molecules Volume 5: Tissue and Organ Engineering Volume 6: Biomaterials and Clinical Use Experts from around the world in hundreds of related biomaterials areas have contributed to this publication, resulting in a continuum of rich information appropriate for many audiences. The work addresses the current status of nearly all biomaterials in the field, their strengths and weaknesses, their future prospects, appropriate analytical methods and testing, device applications and performance, emerging candidate materials as competitors and disruptive technologies, and strategic insights for those entering and operational in diverse biomaterials applications, research and development, regulatory management, and commercial aspects. From the outset, the goal was to review materials in the context of medical devices and tissue properties, biocompatibility and surface analysis, tissue engineering and controlled release. It was also the intent both, to focus on material properties from the perspectives of therapeutic and diagnostic use, and to address questions relevant to state-of-the-art research endeavors. Reviews the current status of nearly all biomaterials in the field by analyzing their strengths and weaknesses, performance as well as future prospects Presents appropriate analytical methods and testing procedures in addition to potential device applications Provides strategic insights for those working on diverse application areas such as R&D, regulatory management, and commercial development

This book is a printed edition of the Special Issue "Enzymes and Their Biotechnological Applications" that was published in Biomolecules

Protein therapeutics have become essential to the healthcare and pharmaceutical industries since the first recombinant proteins entered the clinic in the 1980s. Modification of proteins with polymers has traditionally been pursued as a means to improve protein stability and enhance pharmacokinetic properties. In addition to these benefits, polymer conjugation can also be utilized to control and modulate protein activity. The first polymer used for protein conjugation was poly(ethylene glycol) (PEG) in 1977. PEG is currently the only FDA-approved polymer for protein conjugation and 10 PEGylated protein drugs are currently on the market. This dissertation offers three modifications to traditional PEGylation, which allow for the modulation of protein activity. In the first example, masking and unmasking the

activity of a model protein, lysozyme, was achieved by incorporating both a reducible disulfide linkage between the polymer and the protein as well as incorporating degradable cyclic ketene acetal (CKA) moieties throughout the backbone of a PEG-like polymer (Chapter 2). Specifically 5,6-benzo-2-methylene-1,3-dioxepane and poly(ethylene glycol) methyl ether methacrylate (PEGMA) were copolymerized by reversible addition-fragmentation chain transfer polymerization (RAFT) facilitated by a cysteine-reactive, pyridyl disulfide (PDS) modified chain transfer agent (CTA). Two polymers, a small (Mn GPC = 10.9 kDa) and a large (Mn GPC = 20.9 kDa) PDS-pPEGMA-co-BMDO, were synthesized with reasonable control (dispersities ( ) = 1.34 and 1.71, respectively). The polymers were then conjugated to a thiol-enriched hen egg white lysozyme by disulfide exchange. Conjugation with the 10.9 kDa polymer resulted in a conjugate, which exhibited high initial activity (63%) while the larger conjugate activity was highly attenuated (20%). Lysozyme release from both polymers by reduction of the disulfide linkage and by hydrolytic cleavage, in basic media, of the polymer backbone was visualized by gel electrophoresis. Reduction of the disulfide conjugation linkage with glutathione resulted in an increase in protein activity for both conjugates. In the next example, site-specific chemical dimerization of fibroblast growth factor 2 (FGF2) with a PEG linker, of optimized length, resulted in a FGF2 homodimer with wound healing ability at exceptionally low concentrations (Chapter 3). Homodimers of FGF2 were synthesized through site-specific conjugation to both ends of poly(ethylene glycol) (PEG). FGF2 was conjugated to 2, 6, and 20 kDa vinyl sulfone bis-functionalized PEG, as well as to a small molecule and mono-functionalized PEG controls. The optimal linker length was determined by screening FGF2 dimer-induced proliferation of human dermal fibroblasts (HDF). The inter-cyteine distance was calculated to be approximately 70 A , which is similar in length to a 2 kDa PEG. FGF2-PEG2k-FGF2 induced greater fibroblast proliferation than FGF2 alone, all other dimers, and all monoconjugates, at each concentration tested, with the greatest difference observed at low (0.1 ng/mL) concentration. FGF2-PEG2k-FGF2 further exhibited superior activity compared to FGF2 for both proliferation and migration in human umbilical vein endothelial cells, as well as improved angiogenesis in vitro. Efficacy in an in vivo wound healing model was assessed in diabetic mice. FGF2-PEG2k-FGF2 increased granulation tissue and blood vessel density in the wound bed compared to FGF2. The results suggest that this rationally designed construct may be useful in chronic wound healing. Lastly, a block copolymer capable of noncovalent and releasable conjugation to histidine-6 tagged proteins, consisting of a PEG-based block and a Ni(II) nitriolotriacetic acid (NTA)-based block was synthesized (Chapter 4). The first block was synthesized via RAFT polymerization of a NTA monomer. The resulting polymer was then utilized as a macro-CTA for the polymerization of PEGMA, resulting in a pNTAMA-b-PEGMA, containing 9 NTAMA repeats and 8 PEGMA repeats, with number average molecular weight (Mn) (GPC) = 9.9 kDa and dispersity ( ) = of 4.5. The high dispersity indicates a lack of control, and disproportionation was further confirmed by 1H-NMR. Initial studies indicated that mono-NTA-His6 interactions are not sufficient for protein conjugation, therefore extension of this work towards a multi-valent approach may prove effective in the future.

Protein-polymer hybrid nanomaterials, designed for the targeted delivery of therapeutic anti-cancer agents, are at the forefront of research in biotechnology, nanotechnology, and cancer therapy. Conventional chemotherapeutics exhibit non-specific toxicity due to broad biodistribution; therefore developing nano-sized drug delivery vehicles for the targeted delivery of chemotherapeutics to tumors and cancer cells is important. Nanoparticles (ranging from 10-100 nanometers in size) accumulate in solid tumors and can be functionalized in order to encapsulate therapeutics and target cancer cells. Herein, the development of two classes of protein-polymer nanomaterials is described. Vaults are naturally occurring protein-cages measuring 42 x 42 x 75 nm in dimension with a hollow internal cavity. Vaults are non-immunogenic, readily expressed, and can be engineered. We have developed stimuli responsive vault-polymer conjugates. A protein reactive thermo-responsive poly(N-isopropylacrylamide) was prepared via reversible addition-fragmentation chain transfer (RAFT) polymerization and conjugated to the vault, resulting in a thermo-responsive vault nanoparticle (Chapter 2). Dual responsive vault nanoparticles have also been developed via conjugation of a pH- and thermo-responsive polymer, poly(N-isopropylacrylamide-co-acrylic acid), prepared by RAFT polymerization (Chapter 3). The design of nanoparticles was further explored by conjugating proteins to disulfide cross-linked poly(poly(ethylene glycol) methyl ether methacrylate) (pPEGMA) nanogels. Thiol-reactive nanogels were conjugated to thiol-enriched proteins via a simple disulfide exchange reaction (Chapter 4). Additionally, the development of new methods for protein-polymer conjugation is described. Ring opening metathesis polymerization (ROMP) was used for the preparation of protein-reactive unsaturated poly(ethylene glycol) (PEG) analogs (Chapter 5). These unsaturated PEG analogs were conjugated to proteins. Due to olefins present in the polymer backbone, the polymer can be degraded from the conjugated protein by exposure to Grubbs type metathesis catalysts. Furthermore, a ROMP grafting from approach has also been developed, whereby the protein streptavidin (SAv) was functionalized with a biotinylated ruthenium metathesis catalyst. The SAv macrocatalyst was then used in the ROMP of a tetraethylene glycol modified norbornene monomer to yield a well defined protein-polymer conjugate (Chapter 6). Lastly, the preparation of a telechelic, protein-reactive polymer by RAFT polymerization is described (Chapter 7). A Boc-protected aminooxy RAFT chain transfer agent (CTA) was synthesized and utilized in the polymerization of poly(ethylene glycol) methyl ether acrylate (PEGA). The resulting aminooxy functionalized pPEGA was then functionalized post-polymerization to install cysteine-reactive vinyl sulfone functionality on the polymer.

This book describes strategies and mechanism of reversible deactivation radical polymerization (RDRP) to synthesize functional polymers. Several approaches such as atom transfer radical polymerization and the combination of click chemistry and RDRP are summarized. Contributors from interdisciplinary fields highlight applications in nanotechnology, self-healing materials, oil and water resistant coatings and controlled drug delivery systems.

Since the publication of the first edition of Chemistry of Protein Conjugation and Cross-Linking in 1991, new cross-linking reagents, notably multifunctional cross-linkers, have been developed and synthesized. The completion of the human genome project has opened a new area for studying nucleic acid and protein interactions using nucleic acid cross-linking reagents, and advances have also been made in the area of biosensors and microarray biochips for the detection and analysis of genes, proteins, and carbohydrates. In addition, developments in physical techniques with unprecedented sensitivity and resolution have facilitated the analysis of cross-linked products. Updated to reflect the advances of the 21st century, this book offers: An overview of the chemical principles underlying the processes of cross-linking and conjugation A thorough list of cross-linking reagents published in the literature since the first edition, covering monofunctional, homobifunctional, heterobifunctional, multifunctional, and zero-length cross-linkers Reviews of the use of these reagents in studying protein tertiary structures, geometric arrangements of subunits within complex proteins and nucleic acids, near-neighbor analysis, protein-to-protein or ligand–receptor interactions, and conformational changes of biomolecules Discusses the application of immunoconjugation for immunoassays, immunotoxins for targeted therapy, microarray technology for analysis of various biomolecules, and solid state chemistry for immobilizations

This book is a comprehensive collaboration on intelligent polymers and coatings for industrial applications by worldwide researchers and specialists. The authors cover the basis and fundamental aspects of intelligent polymers and coatings, challenges, and potential mechanisms and properties. They include recent and emerging industrial applications in medical, smart textile design, oil and gas, electronic, aerospace, and automobile industries as well as other applications including microsystems, sensors, and actuators, among others. The authors discuss the potential for future research in these areas for improvement and growth of marketable applications of intelligent polymers and coatings.

This book provides readers with a one-stop entry into thechemistry of varied hybrids and applications, from a molecularsynthetic standpoint • Describes introduction and effect of organicstructures on specific support components (carbon-based materials,proteins, metals, and polymers). • Chapters cover hot topics including nanodiamonds,nanocrystals, metal-organic frameworks, peptide bioconjugates,

andchemoselective protein modification • Describes analytical techniques, with pros and cons,to validate synthetic strategies • Edited by internationally-recognized chemists fromdifferent backgrounds (synthetic polymer chemistry, inorganicsurfaces and particles, and synthetic organic chemistry) to pulltogether diverse perspectives and approaches