

Edited by Jim Huang, Peter R. Chang,  
Ning Lin, and Alain Dufresne

# Polysaccharide-Based Nanocrystals

Chemistry and Applications



Chemical Industry Press

# Polysaccharide Based Nanocrystals Chemistry And Applications

**Vineet Kumar, Praveen Guleria, Nandita  
Dasgupta, Shivendu Ranjan**



## **Polysaccharide Based Nanocrystals Chemistry And Applications:**

**Polysaccharide-Based Nanocrystals** Jin Huang, Peter R. Chang, Ning Lin, Alain Dufresne, 2015-03-09 Polysaccharide nanocrystals are an emerging green nanoinredient nanomaterial with high crystallinity obtained by acid hydrolysis of biomass based polysaccharides. They are of scientific and economic significance owing to their abundance, biodegradation potential and fascinating functional performance. This versatile class of materials can be used in nanocomposites such as rubber or polyester and in functional materials such as drug carriers, bio-inspired mechanically adaptive materials or membranes, to name but a few. This book encompasses the extraction, structure, properties, surface modification, theory and mechanism of diverse functional systems derived from polysaccharide nanocrystals. This highly sought after trendy book is currently the only monograph devoted to the most current knowledge pertaining to this exciting subject area. It is ideal for researchers and stakeholders who wish to broaden and deepen their knowledge in the fast moving and rapidly expanding R D field of polymeric materials.

**Polysaccharide-based Nanocrystals** Peter R. Chang, Ning Lin, Alain Dufresne, 2014 Polysaccharide nanocrystals can be derived from the renewable resources cellulose, chitin or starch which makes them ideal candidates for Green Materials Science. This versatile material class can be used in nanocomposites such as rubber or polyester and in functional materials such as drug carriers, bio-inspired mechanically adaptive materials or membranes. Moreover, polysaccharide based nanomaterials are environmentally friendly due to their intrinsic biodegradability. With its interdisciplinary approach, the book gives a thorough introduction to extraction, structure, properties, surface modification, theory and mechanism of diverse functional systems derived from polysaccharide nanocrystals. This highly sought after trendy book is currently the only monograph devoted to the most current knowledge pertaining to this exciting subject area. It is ideal for researchers and stakeholders who wish to broaden and deepen their knowledge in the fast moving and rapidly expanding R D field of polymeric materials.

*Handbook of Composites from Renewable Materials, Physico-Chemical and Mechanical Characterization* Vijay Kumar Thakur, Manju Kumari Thakur, Michael R. Kessler, 2017-01-26 The Handbook of Composites From Renewable Materials comprises a set of 8 individual volumes that brings an interdisciplinary perspective to accomplish a more detailed understanding of the interplay between the synthesis, structure, characterization, processing, applications and performance of these advanced materials. The handbook covers a multitude of natural polymers, reinforcement fillers and biodegradable materials. Together the 8 volumes total at least 5000 pages and offers a unique publication. This 3rd volume of the Handbook is solely focused on the Physico-Chemical and Mechanical Characterization of renewable materials. Some of the important topics include but not limited to structural and biodegradation characterization of supramolecular PCL/HAP nano-composites, different characterization of solid bio fillers based agricultural waste material, poly ethylene terephthalate reinforced with hemp fibers, poly lactic acid thermoplastic composites from renewable materials, chitosan based composite materials, fabrication and characterization of the use of flax fiber reinforced polymer (FFRP) composites in the externally reinforced structures for seismic retrofitting, monitored by transient thermography and optical techniques, recycling and reuse of fiber reinforced polymer wastes in concrete composite materials, analysis of damage in hybrid composites subjected to ballistic impacts, biofiber reinforced acrylated epoxidized soybean oil (AESO) biocomposites, biopolyamides and high performance natural fiber reinforced

biocomposites impact of recycling on the mechanical and thermo mechanical properties of wood fiber based HDPE and PLA composites lignocellulosic fibers composites an overview biodiesel derived raw glycerol to value added products thermo mechanical characterization of sustainable structural composites novel pH sensitive composite hydrogel based on functionalized starch clay for the controlled release of amoxicillin preparation and characterization of biobased thermoset polymers from renewable resources influence of natural fillers size and shape into mechanical and barrier properties of biocomposites composite of biodegradable polymer blends of PCL PLLA and coconut fiber the effects of ionizing radiation packaging composite materials from renewable resources physicochemical properties of ash based geopolymer concrete a biopolymer derived from castor oil polyurethane natural polymer based biomaterials physical and mechanical properties of polymer membranes from renewable resources

**Sustainability of Biomass through Bio-based Chemistry** Valentin Popa, 2021-03-21 The process of photosynthesis is a potential source of energy and bioproducts Renewable sources of polymeric materials offer an answer to maintaining sustainable development of economically and ecologically attractive technology The innovations in the development of materials from biopolymers preservation of fossil based raw materials complete biological degradability reduction in the volume of garbage and compostability in the natural cycle climate protection through reduction of carbon dioxide released and the application possibilities of agricultural resources for the production of bio green materials are some of the reasons why such materials are attracting public interest FEATURES Discusses waste from urban areas forestry and agricultural processes specifically grown crops such as trees starch crops sugar crops hydrocarbon plants and oils and finally aquatic plants such as water seaweeds and algae which can be used as raw materials for sustainable development Presents recent advances in the development of some specifically chemical components of biomasses for a sustainable future Focuses on lignocellulose as a source of bio based products Draws upon expertise from various countries Describes how upgraded and integrated biomass processing may reduce the risks associated with the COVID 19 pandemic Valentin I Popa is professor emeritus of Wood Chemistry and Biotechnology at Gheorghe Asachi Technical University of Iasi Romania

*Functional Starch and Applications in Food* Zhengyu Jin, 2018-09-19 This book discusses functional starch and its applications in food focusing on starches with possible health benefits or novel applications Covering slowly digested starch resistant starch porous starch starch microemulsions microcrystalline starch and noncrystallization starch and their applications this book provides a valuable reference for graduate students and research professionals in the food and chemical industries

**Polysaccharides** Bhasha Sharma, M. Enamul Hoque, 2023-12-14 Polysaccharides offer unique and valuable functional properties persisting in technological importance and poised to grow more critical due to sustainability demands and emerging applications in medical and life sciences This book presents comprehensive information about carbohydrate polymers providing readers with an enhanced appreciation of carbohydrate structure and function a new enzyme library and extraction strategies that will help to advance a number of

exciting domains of research including genomics proteomics chemical synthesis materials science and engineering Key Features Details the source production structures properties and current and potential applications of polysaccharides Discusses general strategies of isolation separation and characterization of polysaccharides Describes botanical algal animal and microbial sources of polysaccharides Demonstrates the importance of carbohydrates in new lead generation Highlights the range of possibilities for polysaccharides to make real world impact Biopolymer-Based Metal Nanoparticle Chemistry for Sustainable Applications Mahmoud Nasrollahzadeh,2021-03-05 Biopolymers are becoming an increasingly important area of research as traditional chemical feedstocks run low and concerns about environmental impacts increase One area of particular interest is their use for more sustainable development of metal nanoparticles Biopolymer Based Metal Nanoparticle Chemistry for Sustainability Applications Volume 2 reviews key uses of biopolymers and biopolymer based metal nanoparticles for a range of key sustainability focused applications After providing contextual examples of applications across the fields of food science biomedicine and biochemistry the book goes on to explore further sustainability focused applications of Biopolymer Based Metal Nanoparticles in such important areas as catalysis environmental science biosensing and energy Provides an overview of biopolymer based metal nanoparticles for a wide range of applications Provides technological details on the synthesis of natural polymer based metal nanoparticles Explores the role of biopolymer based metal nanoparticles for more sustainable catalytic processes **Food, Medical, and Environmental Applications of Polysaccharides** Kunal Pal,Indranil Banerjee,Preetam Sarkar,Arindam Bit,Doman Kim,Arfat Anis,Samarendra Maji,2020-12-03 Food Medical and Environmental Applications of Polysaccharides provides a detailed resource for those interested in the design and preparation of polysaccharides for state of the art applications The book begins with an introductory section covering sources chemistry architectures bioactivity and chemical modifications of polysaccharides Subsequent parts of the book are organized by field with chapters focusing on specific applications across food medicine and the environment This is an extremely valuable book for researchers scientists and advanced students in biopolymers polymer science polymer chemistry biomaterials materials science biotechnology biomedical engineering cosmetics medicine food science and environmental science This important class of biopolymer can offer attractive properties and modification potential enabling its use in groundbreaking areas across food medical and environmental fields The book will be of interest to scientists R D professionals designers and engineers who utilize polysaccharide based materials Presents comprehensive information of the polymeric structures and properties that can be developed from polysaccharides Offers systematic coverage of classification synthesis and characterization enabling targeted design and preparation of polysaccharides for specific applications Explores advanced methods for novel applications across food medicine and the environment

*Bioinspired and Biomimetic Polymer Systems for Drug and Gene Delivery* Zhongwei Gu,2015-03-09 Here front line researchers in the booming field of nanobiotechnology describe the most promising approaches for bioinspired drug delivery

encompassing small molecule delivery delivery of therapeutic proteins and gene delivery The carriers surveyed include polymeric proteinaceous and lipid systems on the nanoscale with a focus on their adaptability for different cargoes and target tissues Thanks to the broad coverage of carriers as well as cargoes discussed every researcher in the field will find valuable information here

**Innovation in Nano-polysaccharides for Eco-sustainability** Preeti Singh, Kaiser Manzoor, Saiqa Ikram, Pratheep Kumar Annamalai, 2021-10-08 Innovation in Nano polysaccharides for Eco sustainability From Science to Industrial Applications presents fundamentals advanced preparation methods and novel applications for polysaccharide based nanomaterials Sections cover the fundamental aspects of polysaccharides and nano polysaccharides including their structure and properties surface modification processing and characterization Key considerations are explained in detail including the connection between the substituents of polysaccharides and their resulting physical properties renewable resources their sustainable utilization and specific high value applications such as pharmaceuticals photocatalysts energy and wastewater treatment and more This is a valuable resource for researchers scientists and advanced students across bio based polymers nanomaterials polymer chemistry sustainable materials biology materials science and engineering and chemical engineering In industry this book will support scientists R D and engineers looking to utilize bio based materials in advanced industrial applications Covers the fundamentals mechanisms preparation methods unique properties and performance of nano polysaccharide materials Explores sustainable applications of nano polysaccharides in areas such as pharmaceuticals energy and wastewater treatment Addresses key challenges including the implementation of sustainable concepts in chemical design and paths to scalability and commercialization

**Handbook of Composites from Renewable Materials, Nanocomposites** Vijay Kumar Thakur, Manju Kumari Thakur, Michael R. Kessler, 2017-03-28 This unique multidisciplinary 8 volume set focuses on the emerging issues concerning synthesis characterization design manufacturing and various other aspects of composite materials from renewable materials and provides a shared platform for both researcher and industry The Handbook of Composites from Renewable Materials comprises a set of 8 individual volumes that brings an interdisciplinary perspective to accomplish a more detailed understanding of the interplay between the synthesis structure characterization processing applications and performance of these advanced materials The Handbook comprises 169 chapters from world renowned experts covering a multitude of natural polymers reinforcement fillers and biodegradable materials Volume 7 is solely focused on the Nanocomposites Science and Fundamentals of renewable materials Some of the important topics include but not limited to Preparation characterization and applications of nanomaterials from renewable resources hydrogels and its nanocomposites from renewable resources preparation of chitin based nanocomposite materials through gelation with ionic liquid starch based bionanocomposites biorenewable nanofiber and nanocrystal investigation of wear characteristics of dental composite reinforced with rice husk derived nanosilica filler particles performance of regenerated cellulose vermiculite nanocomposites fabricated via ionic liquid preparation structure properties and

interactions of the PVA cellulose composites green composites with cellulose nanoreinforcements biomass composites from bamboo based micro nanofibers synthesis and medicinal properties of polycarbonates and resins from renewable sources nanostructured polymer composites with modified carbon nanotubes organic inorganic nanocomposites derived from polysaccharides natural polymer based nanocomposites cellulose whisker based green polymer composites poly lactic acid nanocomposites reinforced with different additives nanocrystalline cellulose halloysite based bionanocomposites nanostructured composites based on biodegradable polymers and silver nanoparticles starch based biomaterials and nanocomposites green nanocomposites based on PLA and natural organic fillers and chitin and chitosan based nanocomposites

*Functionalized Nanomaterials* Vineet Kumar, Praveen Guleria, Nandita Dasgupta, Shivendu Ranjan, 2021-07-28 Nanomaterials contain some unique properties due to their nanometric size and surface functionalization. Nanomaterial functionalization also affects their compatibility to biocompatibility and toxicity behaviors environment and living organism. This makes functionalized nanomaterials a material with huge scope and few challenges. This book provides detailed information about the nanomaterial functionalization and their application. Recent advancements, challenges and opportunities in the preparation and applications of functionalized nanomaterials are also highlighted. This book can serve as a reference book for scientific investigators, doctoral and post doctoral scholars, undergrad and grad. This book is very useful for multidisciplinary researchers, industry personnel, s, journalists and policy makers. Features: Covers all aspects of Nanomaterial functionalization and its applications. Describes and methods of functionalized nanomaterials synthesis for different applications. Discusses the challenges, recent findings and cutting edge global research trends on functionalization of nanomaterials and its applications. It discusses the regulatory frameworks for the safe use of functionalized nanomaterials. It contains contributions from international experts from multiple disciplines.

Green Micro- and Nanocomposites Sabu Thomas, Abitha V. K., Hanna J Maria, 2023-10-20 Green materials derived from renewable resources are increasingly being advocated for sustainable development due to rising environmental consciousness, waste management difficulties, depleting fossil resources and rising oil prices, to name a few. Renewable green resources such as starch and cellulose polymers, natural fibers, vegetable oils, wood bark, cotton wool and silk have been utilized for food, furniture and clothing for thousands of years. They have only recently undergone a revival as one of the most cost effective alternatives to synthetic polymers in a variety of industrial applications including building and construction, automotive, packaging, films and paper coating as well as biomedical uses. The primary drawbacks of synthetic polymers such as the release of toxic gases and vapors during incineration and the difficulty in disposing of them have prompted extensive research on new green polymeric materials with special focus on the use of biopolymers derived from renewable resources for green composite applications. This book gives a true reflection of the vast area of research in green composites as it has contributions from internationally recognized experts in the field of green polymer materials representing a wide range of disciplines, backgrounds and expertise.

**Polysaccharide based Nano-Biocarrier in Drug Delivery** Tapan Kumar Giri, Bijaya Ghosh, 2018-09-03 This book discusses various fundamental aspects of polysaccharide based nano biocarrier drug delivery systems and its application in the delivery of small molecules proteins peptides oligonucleotides and genes It also discusses advances in drug delivery systems in treatment of cancer cardiovascular pulmonary and infectious diseases

**Biopolymer Grafting: Synthesis and Properties** Vijay Kumar Thakur, 2017-09-27 Biopolymer Grafting Synthesis and Properties presents the latest research and developments in fundamental of synthesis and properties of biopolymer based graft copolymers The book presents a broad overview of the biopolymer grafting process along with trends in the field It also introduces a range of grafting methods which lead to materials with enhanced properties for a range of practical applications along with the positives and limitations of these techniques The book bridges the knowledge gap between the scientific principles and industrial applications of polymer grafting This book covers synthesis and characterization of graft copolymers of plant polysaccharides functional separation membranes from grafted biopolymers and polysaccharides in alternative methods for insulin delivery Recent trends and advances in this area are discussed assisting materials scientists and researchers in mapping out the future of these new green materials through value addition to enhance their use Introduces polymer researchers to a promising rapidly developing method for modifying naturally derived biopolymers Provides a one stop shop covering synthesis properties characterization and graft copolymerization of bio based polymeric materials Increases familiarity with a range of biopolymer grafting processes enabling materials scientists and engineers to improve material properties and widen the range of potential biopolymer applications

**Handbook of Nanocellulose and Cellulose Nanocomposites** Hanieh Kargarzadeh, Ishak Ahmad, Sabu Thomas, Alain Dufresne, 2017-03-02 An up to date and comprehensive overview summarizing recent achievements the state of the art and trends in research into nanocellulose and cellulose nanocomposites Following an introduction this ready references discusses the characterization as well surface modification of cellulose nanocomposites before going into details of the manufacturing and the self assembly of such compounds After a description of various alternatives including thermoplastic thermosetting rubber and fully green cellulose nanocomposites the book continues with their mechanic and thermal properties as well as crystallization and rheology behavior A summary of spectroscopic and water sorption properties precedes a look at environmental health and safety of these nanocomposites With its coverage of a wide variety of materials important characterization tools and resulting applications this is an essential reference for beginners as well as experienced researchers

**Food Hydrocolloids** Yapeng Fang, Hongbin Zhang, Katsuyoshi Nishinari, 2021-05-18 The book introduces the definition classification source and structure of hydrocolloids and provides a comprehensive description of their functionalities and food related applications The emphasis is put on the basic concepts and mechanisms underlying functionalities and the new developments in fundamental knowledge and practice The book would be useful for students or professionals working in the fields of food science technology and biopolymers etc It would



help to organize hydrocolloids knowledge in a more systematic framework and enlighten further profound investigations

**Biocompatible Hybrid Oxide Nanoparticles for Human Health** Inna V. Melnyk, Miroslava Vaclavikova, Gulaim A. Seisenbaeva, Vadim G. Kessler, 2019-06-30 *Biocompatible Hybrid Oxide Nanoparticles for Human Health From Synthesis to Applications* explores the synthesis structure properties and applications of functionalized oxide nanoparticles The book shows the applications of materials depending on their composition and structure with a focus on silicon titanium and iron oxides each of which was chosen because of their unique features including silica because it is chemically resistant to most organic solvents harmless to living organisms can thicken flowable formulations and increase the strength of materials titania for its unique chemical optical electrophysical and bactericidal properties and iron containing materials because they possess important magnetic properties Shows how oxide nanoparticles are being used to solve current problems in the fields of environmental protection medicine and in the creation of smart materials Includes case studies that explore the major characteristics and applications of silica titania and iron oxide nanomaterials Discusses the use of biocompatible oxide nanostructures in the development of new sensing technology

**Handbook of Nanocelluloses** Ahmed Barhoum, 2022-07-15 This Handbook covers the fundamental aspects experimental setup synthesis properties and characterization of different nanocelluloses It also explores the technology challenges of nanocelluloses and the emerging applications and the global markets of nanocelluloses based systems In particular this book Covers the history of nanocelluloses types and classifications fabrication techniques critical processing parameters physical and chemical properties surface functionalization and other treatments to allow practical applications Covers all recent aspects of nanocelluloses technologies from experimental set up to industrial applications Includes new physical chemical and biological techniques for nanocelluloses fabrication in depth treatment of their surface functionalization and characterization Discusses the unique properties of nanocelluloses that can be obtained by modifying their diameter morphology composition and dispersion in other materials Discusses the properties and morphology of several kinds of dispersion in polymeric materials such as micro nanofiberated cellulose cellulose nanofibers cellulose nanocrystals amorphous cellulose nanoparticles and hybrid cellulose nanomaterials Presents the different techniques for dispersion and self assembly of polymeric materials critical parameters of synthesis modelling and simulation and characterization methods Highlights a wide range of emerging applications of nanocelluloses e g drug delivery tissue engineering medical implants medical diagnostics and therapy biosensors catalysis energy harvesting energy storage water waste treatment papermaking textiles construction industry automotive aerospace and many more Provides an outlook on the opportunities and challenges for the fabrication and manufacturing of nanocelluloses in industry Provides an in depth look at the nature of nanocelluloses in terms of their applicability for industrial uses Provides in depth insight and review on most recent types of nanocelluloses based systems of unique structures and compositions Highlights the challenges and interdisciplinary perspective of nanocelluloses based

systems in science biology engineering medicine and technology incorporating both fundamentals and applications Demonstrates how cutting edge developments in nanofibers translate into real world innovations in a range of industry sectors This Handbook is a valuable reference for materials scientists biologists physicians chemical biomedical manufacturing and mechanical engineers working in R D industry and academia who want to learn more about how nanocelluloses based systems are commercially applied     *Polysaccharide Nanoparticles* Jayachandran Venkatesan,Se-Kwon Kim,Sukumaran Anil,Rekha P. D,2022-01-11 Polysaccharide Nanoparticles Preparation and Biomedical Applications provides detailed information on polysaccharides nanoparticles in terms of their synthesis and applications Naturally occurring polysaccharides are widely used as food materials particularly in Asia Different kinds of polysaccharide materials are available from nature with various resources such as crustaceans and algae The exploration and exploitation of polysaccharides nanoparticles from natural resource is at the heart of this book which also explores the synthesis preparation and applications of polysaccharides nanoparticles for tissue engineering and food applications This is an important reference for materials scientists and bioengineers who are looking to gain a greater understanding on how polysaccharides nanoparticles are being used for a variety of biomedical applications Explains the major synthesis and preparation methods of polysaccharide based nanoparticles Demonstrates how polysaccharides nanoparticles are being used for a range of biomedical applications including tissue engineering drug delivery and biosensors Assesses the major challenges and risks of using polysaccharides nanoparticles safely and effectively

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