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Advanced Functional Materials Series

丛书 丛书主编 师昌绪

Polysaccharide-Based Nanocrystals

Chemistry and Applications

聚多糖纳米晶——化学与应用

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

黄进 彼得·张荣贵 林宁 阿兰·迪弗雷纳 编著



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· 北京 ·

本书采用简明的语言、丰富的数据图表,阐明了来自天然生物质资源的聚多糖纳米晶的提取、结构、性质、化学修饰、材料制备等方面的理论知识和实践经验,总结了聚多糖纳米晶改性材料功能化、高性能化的研究思路和技术方案。不仅包含作者在过去十年中以保护环境和降低石油消耗为目标,围绕可再生、可生物降解的聚多糖纳米晶发展成为高性能材料及功能材料的研究工作的凝练,同时涵盖了国内外同行的优秀研究成果。

本书主要包括纤维素纳米晶、甲壳素纳米晶及淀粉纳米晶的制备、化学和物理改性、纳米复合材料和功能材料构建的相关理论和技术等内容,并且对聚多糖纳米晶的理论研究体系建立、应用拓展及发展方向等进行了展望。

本书可供生物质化学与化工、高分子科学、环境科学、材料科学、农业化学、纳米科学与技术等相关专业的研究生学习使用,也可作为相关科研工作者和工程技术人员的参考书。

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Advanced Functional Materials Series

先进功能材料丛书

Polysaccharide-Based Nanocrystals

聚多糖纳米晶

作者简介



黄进 博士，现任武汉理工大学化学化工与生命科学院教授，入选教育部新世纪优秀人才、江苏省高层次创新创业人才。研究领域涉及生物质资源高值化应用的材料化学基础，重点关注发展生物质材料的化学与物理方法及关键技术，在利用纤维素、甲壳素、木质素、淀粉、植物蛋白等天然高分子研制生物基复合材料和先进材料方向开展了系列研究工作。已发表SCI收录论文100余篇（h-因子26），主编和参编中英文专著和教材7部，获国家发明专利授权40余项。



Peter R. Chang 博士，现任加拿大农业与农业食品（Agriculture and Agri-Food Canada）萨斯卡通研究中心研究员、萨斯喀彻温大学化学与生物工程系（Department of Chemical and Biological Engineering, University of Saskatchewan）教授。研究方向主要致力于发展支撑生物经济的生物质资源高效应用与产品研发的关键技术，重点关注农业生物质基聚合物的表征方法与加工技术，研制了多种生物基塑料、生物基复合材料与纳米复合材料、生物材料等及其它工业产品，参与指导了农业食品和生物资源工业领域众多国际公司的研发工作。发表SCI收录论文120余篇（h-因子29），完成了90余项工业技术转让，主编或参编专著多部，获发明专利授权4项。



林宁 博士，现任武汉理工大学化学化工与生命科学院副教授。研究涉及生物质纳米粒子表面修饰方法学，重点关注聚多糖纳米晶复合材料体系的结构设计及其与性能的关系，致力于探索新材料在生物医学等领域的应用。发表SCI收录论文14篇，主编和参编中英文专著或教材4部。



Alain Dufresne 博士，现任法国格勒诺布尔国立综合理工学院（Grenoble Institute of Technology）造纸、印刷和生物材料国际学院（International School of Paper, Print Media and Biomaterials, Pagora）教授，曾任巴西里约热内卢联邦大学（Universidade Federal de Rio de Janeiro）和马来西亚国民大学（Universiti Kebangsaan Malaysia）客座教授。研究方向是利用来自可再生资源的纳米粒子研制高性能聚合物纳米复合材料，重点关注这类纳米复合材料的成型加工技术以及结构与性能表征与评价。发表学术论文200余篇（h-因子58），主编专著“Nanocellulose”并参编专著38部。

List of Contributors

Ishak Ahmad

School of Chemical Sciences and
Food Technology
Faculty of Science and
Technology
Universiti Kebangsaan Malaysia
(UKM)
43600, Bangi
Selangor
Malaysia

Debbie P. Anderson

BioProducts and Bioprocesses
National Science Program
Agriculture and Agri-Food
Canada
Government of Canada
107 Science Place
Saskatoon SK S7N 0X2
Canada

Peter R. Chang

Bioproducts and Bioprocesses
National Science Program
Agriculture and Agri-Food
Canada
Government of Canada
107 Science Place
Saskatoon SK S7N 0X2
Canada

and

Department of Chemical and
Biological Engineering
College of Engineering
University of Saskatchewan
Saskatoon SK S7N 5A9
Canada

Youli Chen

College of Chemistry, Chemical
Engineering and Life Science
Wuhan University of Technology
Luoshi Road 122
Wuhan 430070
China

Alain Dufresne

The International School of
Paper, Print Media, and
Biomaterials (Pagora)
Grenoble Institute of Technology
(Grenoble INP)
Domaine Universitaire, CS10065,
38402 Saint Martin d'Hères
France

Shiyu Fu

State Key Laboratory of Pulp and
Paper Engineering
South China University of
Technology
Guangzhou 510641
China

Fei Hu

College of Chemistry, Chemical
Engineering and Life Science
Wuhan University of Technology
Luoshi Road 122
Wuhan 430070
China

Jin Huang

College of Chemistry, Chemical
Engineering and Life Science
Wuhan University of Technology
Luoshi Road 122
Wuhan 430070
China

Hanieh Kargarzadeh

School of Chemical Sciences and
Food Technology
Faculty of Science and
Technology
Universiti Kebangsaan Malaysia
(UKM)
43600, Bangi
Selangor
Malaysia

Ning Lin

The International School of
Paper, Print Media, and
Biomaterials (Pagora)
Grenoble Institute of Technology
(Grenoble INP)
Domaine Universitaire
CS10065, 38402
Saint Martin d'Hères
France

Hou-Yong Yu

College of Materials and Textile
Zhejiang Sci-Tech University
928 Second Avenue, Xiasha
Higher Education Zone
Hangzhou 310018
China

Foreword

Since the beginning of the new century, the development of advanced biobased nanomaterials has been of significant interest in both academia and industry. Polysaccharide nanocrystals, mainly including rod-like cellulose nanocrystals, chitin nanowhiskers, and platelet-like starch nanocrystals, are highly crystalline rigid nanoparticles extracted from biosourced polymers that possess numerous advantages over inorganic nanoparticles. It has been reported that the diverse materials derived from polysaccharide nanocrystals will cover a broad range of properties that are useful in a wide range of applications, for example, in composites, electronics (flexible circuits), energy (flexible batteries, such as Li-ion and solar panels), packaging, coatings, detergents, adhesives, construction, pulp and paper, inks and printing, filtration, medicine and life science (scaffolds in tissue engineering, artificial skin and cartilage, wound healing, and vessel substitutes), optical devices (including reflective properties for security papers and UV or IR reflective barriers), rheological modifiers, and cosmetics. Since the first study on the use of cellulose nanocrystals as a reinforcing filler in nanocomposites about 20 years ago, a huge amount of literature has been devoted to research on polysaccharide nanocrystals in more than 1000 scientific publications.

As a relatively new research area, it is imperative to systematically assemble state-of-the-art technical accomplishments on polysaccharide nanocrystals, particularly with respect to physics, chemistry, materials science, processing, and engineering. This book covers extraction, structure, properties, and surface modification pertaining to polysaccharide nanocrystals. It provides an in-depth description of plastics and composites containing this unique biosourced nanoingredient in terms of structures, properties, manufacturing, and product performance. This book also describes the concept of functional nanomaterials based on polysaccharide nanocrystals and their potential applications. All chapters are contributed by leading experts who have both academic and professional credentials.

It is interesting to note that commercialization/utilization of polysaccharide nanocrystals (especially for cellulose nanocrystals) is finally catching on and is being pursued vigorously by industrial groups, notably in the United States, Canada, and Europe.

Upcoming R&D and relentless pursuit represent well-justified challenges and opportunities for bringing the next generation of polysaccharide nanocrystal-based materials into reality.

Preface

Biobased Polysaccharide Nanocrystals: Chemistry and Applications is the first book that systematically describes the chemistry, properties, processing, and applications of polysaccharide nanocrystals and the nanocomposites/nanomaterials thereby derived.

Development of biobased materials has experienced fast growth in the past two decades thanks to public concern over the environment, climate change, and the depletion of fossil fuels. Over the last 10 years or so, this team of authors has worked collectively and separately with these interesting and yet little known renewable and biodegradable polysaccharide nanocrystals in the cutting edge field of functional nanomaterials and nanocomposites. As such, we are eager to share our knowledge and experience with readers and stakeholders, particularly researchers from academia and industry, policy makers, and the business sector, to foster rapid exploitation and commercialization of these fascinating bioingredients and their derived products, including but not limited to nanocomposites/nanomaterials.

This book is intended to give the reader a comprehensive overview of the present knowledge relating to extraction, structure, properties, surface modification, and the newly derived material of polysaccharide nanocrystals. In addition, it provides an in-depth description of plastics, composites, and nanomaterials specifically procured from cellulose nanocrystals, chitin nanowhiskers, and starch nanocrystals. This is an excellent book for scientists, engineers, graduate students, and industrial researchers in the field of polymeric materials. This book also covers the most recent progress with respect to: (i) the development of a conceptual framework of polysaccharide nanocrystals; (ii) numerous applications in the design and manufacture of nanocomposites and functional nanomaterials; and (iii) the relationship between structure and properties.

The authors sincerely thank Chemical Industry Press and Wiley-VCH press for their kind encouragement and support throughout the project and for publishing this book in both English and Chinese. In addition, the authors wish to acknowledge the continued support toward our research from the National

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