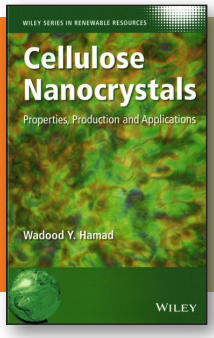


Cellulose Nanocrystals: Properties, Production and Applications

Wadood Y. Hamad

Wiley, 2017
312 pages, $140.00 (e-book $112.99)
ISBN 978-1119968160

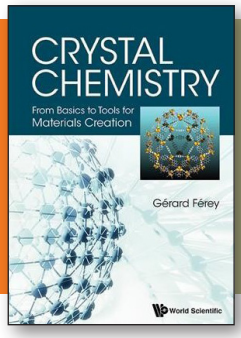
This book is part of the Wiley Series in Renewable Resources. It is an excellent introduction for students, researchers, and newcomers in the field of cellulose material chemistry, properties, and applications as a renewable and green resource. The text introduces readers to the structure, extraction, properties, and applications of the different types of cellulosic nanomaterials processing techniques. The book thoroughly explains the distinct chemistry of cellulose, including the different extraction processing techniques. It provides researchers with comprehensive knowledge supported with illustrations and includes tables of useful materials properties, in particular, mechanical properties. The references are adequate and up to date, and the text is written from the combined perspective of physical chemistry and materials engineering.

The first chapter introduces the historical background of cellulose biopolymer and hierarchical materials as green nanostructured materials that can replace different types of toxic nanostructured materials. The second chapter deals with physical, chemical, anisotropic, and mechanical properties of cellulose fibers and their relationships with structure and morphology. Chapter 3 delves into the fundamentals of hydrolytic extraction of cellulose nanocrystals and their stability. It also introduces reaction kinetics, yield optimization, reproducibility, and different conditions of the extraction processes.

Chapter 4 details different characterization techniques, such as x-ray diffraction, ultraviolet spectroscopy, and nuclear magnetic resonance of cellulose crystalline solids and the relationship between their properties and structure. The chapter also describes the effects of different conditions and/or parameters on the morphology and microstructure of cellulose nanocrystals, such as the effects of sonication, solution concentration, temperature, surface charge, and ionic strength of their suspensions. Chapter 5 covers the different applications of cellulose nanocrystals as a type of green reinforcement in compatible polymer matrix and other composite systems. The chapter also introduces different physical, chemical, and physiochemical methods of surface functionalization of cellulose nanocrystals to increase compatibility with the polymer matrix, depending on the polymer matrices to be used. The chapter includes comments on different modeling theories and factors affecting the mechanical properties of cellulose nanocrystals that reinforce different types of polymer nanocomposites. The book does not include problem sets or homework for students.

Compared to other books on the topic, this book is different in that it focuses on a new type of material dependent on the natural resources of cellulose nanofibers as a kind of green composite material. Overall, this book will serve as an important addition to the libraries of those interested in green composites and renewable resources, and will stimulate interest in a new generation of materials such as green composites and bioinorganic materials friendly to the environment.

***Reviewer: Walid M. Daoush**, Helwan University, Egypt.*



Crystal Chemistry: From Basics to Tools for Materials Creation

Gérard Férey

World Scientific, 2017
200 pages, $98.00 (softcover $55.00)
ISBN 978-981-3144-18-7

This is a book for crystal chemistry lovers. It is beautifully produced and is comprised of seven chapters. The first four are a useful introduction to the topic, and the remaining three delve into different ways of looking at structures, with an emphasis on the concepts of the author and some colleagues (in particular, Michael O'Keeffe, Bruce Hyde, and Sten Andersson). All of the figures are available on the Internet if you show proof of purchase of the book.

Chapter 1 begins with the polyhedral approach to structure building, which is familiar to chemistry undergraduates. This leads to building blocks, cubes, and unit cells. The chapter clearly explains simple cubes, body-centered cubes, face-centered cubes, the seven crystalline systems, and the idea of interstitial sites and radius ratios. Chapter 2 describes symmetry, space groups, and miller indices. This is a good introduction for the following chapters.

A discussion of various common structures begins in chapter 3, starting with rutile. The description includes the joining of polyhedra and the calculation of bond distances. The author is somewhat dismissive of computer programs, and there is no mention of Crystallographic Information Files (CIFs). The latter omission is surprising, as they are required by most publications that include new structures. Today's students need to understand the fundamentals, but also modern methods of crystal chemistry. There is also no mention of TiO_2 polymorphs, anatase and

https://doi.org/10.1557/mrs.2018.140 Published online by Cambridge University Press

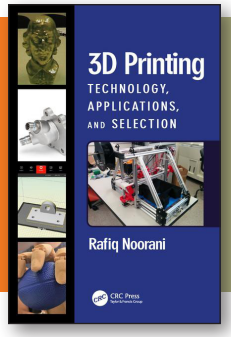
brookite, but the author discusses in detail the various structures of tungsten bronzes (first formed by Wöhler, but here referred to as Magnéli bronzes). He also states that there are distinct W^{5+} and W^{6+} ions in the bronzes, and that the electrons hop from one ion to another, rather than there being free electrons and the color is derived from the free electrons. Despite these weaknesses, this is overall a strong and readable chapter introducing most of the major structural types, including spinel, layered halides, perovskites, and pyrochlore.

Chapter 4 extends the discussion of chapter 3 into distorted structures, again using a polyhedral approach: Tilting, disorder, and superstructures, among others, are used as examples of nonideality. Point defects are briefly described. These are followed by a short description of extended defects, such as the shear planes found on reduction of the tungsten and molybdenum oxides.

The last three chapters are devoted mostly to different approaches of looking at and describing structures, including the net, rod, brick, and spin approaches. These are likely to be of most interest to the experienced chemist/crystallographer rather than the student. The book finishes with an appendix describing the various polyhedra, with all the angles and distances given; there are also drawings of the shapes necessary to construct the various polyhedra. At the end, there is a bibliography of "useful books" (dating from 1970 to 1996) and "some pioneering articles" (1948–2012) in the field.

As noted previously, this is a book for the lover of crystal chemistry written by one of the pioneers of solid-state chemistry. It is a personal viewpoint; therefore, it lacks the modern use of a computer in crystal chemistry, either for looking at structures or for the creation of new structures and materials. It also lacks a set of discussion questions that might be useful for the classroom.

***Reviewer: M. Stanley Whittingham**, Distinguished Professor, Chemistry and Materials Science & Engineering, Binghamton University, The State University of New York, USA.*



3D Printing: Technology, Applications, and Selection

Rafiq Noorani

CRC Press, 2017

271 pages, $99.95 (e-book $89.96)

ISBN 9781498783750

To serve current and future manufacturing needs, rapid prototyping by printing materials into complex shapes using advanced manufacturing is expected to realize an order of magnitude increase in its use and utility. This is true across multiple engineering and technical disciplines. This book contains details of three-dimensional (3D) printing as currently implemented, as well as how the technology is positioned to address current and future manufacturing, aerospace, and medical applications.

The book provides an entry-level introduction to the field of 3D printing, focusing significantly on the software and hardware implementation of current printers in the market. This includes the technical details of designing, engineering, and using an actual printer. Among the vast number of emerging additive manufacturing texts, this book is unique in its intention to educate the inexperienced reader or hobbyist on 3D printing for design and manufacturing purposes.

The book starts with an introduction to 3D printing and how a printer works, in chapters 1 and 2. Chapters 3–5 are comprehensive overviews of how to design and calibrate a printer, including details on configuring software, hardware, automation, and materials (e.g., metals and oxides). The text differentiates itself from previous literature by educating the reader on the technology and programmatic setup of a 3D printer, providing details on hardware and programming routines at a beginner's level. The author utilizes instructive figures, tables, and a detailed appendix, which includes MATLAB routines for implementing 3D printing. At the conclusion of each chapter, a summary and questions are provided to recapitulate each chapter in the context of fundamental principles and engineering. These summaries also form the foundation for later chapters focused on combining 3D printing with the rapid prototyping cycle.

The final chapters (6–10) logically extend the text to provide advice and insight on combining techniques in tandem for reverse engineering and rapid prototyping. Each of the basic implemented approaches are well explained, and the author guides the reader on how to effectively combine 3D printing technology with reverse engineering. The utility of the text shines in these later chapters, guiding the reader on how to utilize advanced imaging tools, considering both surface and volumetric replications, with a basic familiarity of the limitations and advantages of each to meet prototyping and fabrication goals. Although full-scale production and fabrication are not discussed in detail, logical extensions are provided throughout the later chapters that can address these challenges in complex part design.

The author indicates that 3D printing is well positioned for selective rapid prototyping. This text provides a foundational education to the reader on the implementation of printing, as well as on technical skills required to use the latest generation of printers. I recommend this book as a monograph that goes beyond textbook material for any individual currently looking into or working toward using 3D printing.

***Reviewer: Jeffery Aguiar**, Idaho National Laboratory, USA.*

https://doi.org/10.1557/mrs.2018.140 Published online by Cambridge University Press