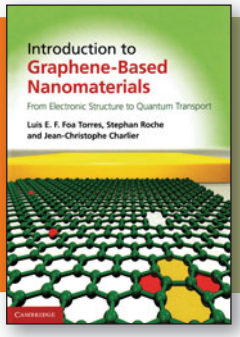


Introduction to Graphene-Based Nanomaterials: From Electronic Structure to Quantum Transport

Luis E.F. Foa Torres, Stephan Roche, and Jean-Christophe Charlier

Cambridge University Press, 2014
419 pages, $90.00
ISBN 978-1-107-03083-1

Graphene is a single layer of carbon and may be considered as one layer of the graphite structures. Nowadays, besides monolayer graphene, bi- or multilayer varieties are also well known. These two-dimensional objects curl up to form carbon nanotubes. Graphene and carbon nanotubes comprise a new class of materials that are scientifically and technologically of extreme importance. This book deals with solid-state physics applied to this class of materials, ranging, as mentioned in the subtitle, from "electronic structure to quantum transport." The content and structure of this book make it necessary that the reader has an advanced knowledge of theoretical solid-state physics.

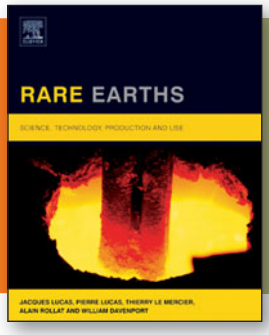
The book is divided into seven chapters plus four chapters in the appendix. Each chapter starts with a short introduction and ends with suggestions for further reading. Additionally, at the end of each chapter, typical for a textbook to be used in parallel to university lectures, problems are included.

The book begins with a description of the electronic structure. Interestingly, the authors describe not only the "idealized" structure, but also the occurrence of lattice defects, pentagons, and heptagons, instead of hexagons, which are the basis of the graphene structure. The influence of these lattice defects and impurities on the electronic structure and transport properties is described in great detail. Unfortunately, these considerations were not extended to mechanical properties, as polymer composites with graphene or carbon nanotubes as filler show extremely promising mechanical properties. The majority of the book is devoted to quantum transport phenomena. These phenomena are treated in different systems, well ordered and disordered ones; doped and undoped graphene and carbon nanotubes; and, what is most interesting and very new, electron transport in amorphous graphene.

The final four chapters in the appendix describe mathematical methods to perform the calculations in connection with electronic structure and transport phenomena connected to graphene and related materials. It is important to mention that the authors make the computational codes available for readers at their homepages. As is necessary for an excellent book in sciences, there is a long list of a few hundred references at the end of the book. Even though the list of keywords at the end of the book is really long, it was obviously unavoidable to have many different references (up to ca. 70) for one keyword.

If a student or scientist already has basic theoretical knowledge, this is an excellent book for those interested in this special carbon-based material.

Reviewer: Dieter Vollath *is CEO of NanoConsulting, Stutensee, Germany.*



Rare Earths: Science, Technology, Production and Use

Jacques Lucas, Pierre Lucas, Thierry Le Mercier, Alain Rollat, and William Davenport

Elsevier, 2014
407 pages, $174.25
ISBN 978-0-444-62735-3

Rare earths have been widely discussed in the popular press and at conferences because of their strategic importance, especially in clean energy technologies, but a reliable source of information that can raise the level of debates has been missing. This book fills the void. By a careful selection of topics, it meets its stated objective of describing the state of the art as of early 2014 on rare-earths occurrence, extraction, atomic structure, technology, applications, use, and recycling.

The first two chapters give an overview of the importance of rare earths, and data on production, use, and price, as well as volatility. Ores containing bastnäsite, monazite, and xenotime minerals and cation adsorption clays are industrially important. The ways these are processed to obtain usable forms such as oxides and metals are described in chapters 3–7. A special feature is the number of flow sheets and photographs the authors have thoughtfully provided in addition to equations.

The electronic structure of rare earths is an important topic (covered in chapter 8), and the 4*f* electron configuration determines their properties, including magnetic and optical behavior, as explained subsequently. Chapters 9–17 discuss applications in catalysis (ceria with platinum group metals), batteries (lanthanum, cerium, praseodymium, neodymium-nickel in cathodes), alloys (e.g., cast iron, magnesium), magnets (iron-neodymium-boron and samarium-cobalt), glass polishing (ceria), luminescent materials in fluorescent lamps (lanthanum, yttrium, cerium, europium, and terbium), optical-fiber amplifiers (erbium) and medical sensors (gadolinium, cerium, lutetium, and terbium), and lasers (ytterbium and neodymium). In each case, the underlying principles are discussed. The recycling techniques developed for materials used as above are discussed next. The

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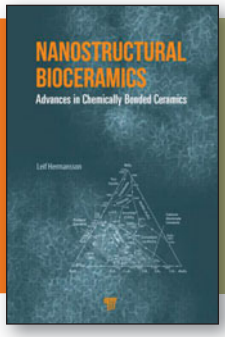
concluding chapter 19 predicts an unstable situation until 2020, with one country dominating production, but holds out hope for new mines and substitutions for rare earths so that we are less dependent on them. The substitutes are often less green. An exception is the light-emitting diode, which has higher energy efficiency and is a replacement for fluorescent lighting containing rare-earth phosphors.

Each chapter starts with a list of objectives and ends with a summary. The book is well illustrated with 6–18 figures per chapter and has a 10-page section containing color photographs. The references (49) and suggested readings (50) are current up to 2014 and adequate, but not extensive, considering the information explosion in this topic. The book is recommended for graduate students with a background in condensed-matter physics, chemistry, and metallurgy; scientists; researchers in materials industries; and the wider audience interested in strategic materials.

China gave up the quota system this year and the hybrid electric car—the poster boy of rare earths—uses less of them in its recent versions. However, efforts to develop new sources, more efficient processes, recycling technologies, and substitutes are not expected to slow down. The outcome of these efforts will hopefully be covered in future editions. This readable book takes you through mines, extraction plants, research labs, pilot plants, factories, and recycling plants, on four continents. Enjoy the journey!

Reviewer: N. Balasubramanian *is an independent research scholar working in Bangalore, India.*



Nanostructural Bioceramics: Advances in Chemically Bonded Ceramics
Leif Hermansson

Pan Stanford, 2014
158 pages, $129.95
ISBN 9789814463430

This book is an excellent introduction to the field of bionanomaterials for the researcher as well as the newcomer to the field. It introduces readers to the structure and characteristics of new bioceramics, chemically bonded nanobioceramics, and their interaction with tissues *in vivo* and *in vitro*, posing the question: What determines the biocompatibility and the toxicity of such new inserts in human bodies? The book thoroughly explains chemically bonded bioceramics from a chemical composition and mineralogy point of view and early tissue response, providing researchers with comprehensive knowledge about nanobioceramics for practical applications. It is written from a combined materials chemistry, mineralogy, and medical perspective, and comprises 14 chapters and 158 pages.

The first chapter is an introduction to classifications of ceramics, stable and resorbable chemically bonded bioceramics, and their relationship with other biomaterials. Chapter 2 goes through the structure of hard tissue, and how chemically bonded bioceramics interact *in vivo* through the contact zone with hard tissues. In chapter 3, several types of mechanisms and chemical reactions describe how the chemically bonded bioceramics are processed, including a discussion of the proper time for curing. Chapter 4 details the different types of additives that comprise active complementary binders, processing agents, and fillers. Chapter 5 covers the necessary characterizations and investigations of different types of chemically bonded bioceramics. Chapter 6 explains the formation mechanisms and the solubility products of some of the nanostructure phases developed in some chemically bonded bioceramics. Chapter 7 describes how nanostructures influence properties and mechanical strength, including crystal size and porosity structure. Chapter 8 introduces an overview of the importance of nanostructures, including nanocrystals and nanoporosity in relation to bioactivity, anti-bacterial properties, microleakage, hemocompatability, and controlled drug delivery. Chapter 9 details using chemically bonded bioceramics in dental applications, such as dental cements, endodontic therapy, dental fillings, and dental implant coatings. Chapter 10 focuses on orthopedic applications of chemically bonded bioceramics such as calcium aluminate-based orthopedic materials and their coatings. Chapter 11 introduces the possibility of using chemically bonded bioceramics as carriers for drug delivery and the carrier for controlling drug release. Chapter 12 explains the clinical studies and evaluations of the orthopedic biomaterials, including diagnosis, indications, surgical procedure, symptoms, case studies, and testing on patient groups. Chapters 13 and 14 serve as a summary and overview of the classifications, applications, and some general properties of biomaterials. Hermansson includes a potential evolution of nanostructural chemically bonded ceramics as biomaterials in the coming decades.

Areas for improvement are to use high-resolution images for several of the figures and to include reference numbers for all figures and tables. Also, Hermansson repeats the same acknowledgments after each chapter, while it may make more sense to include one detailed acknowledgments section. Overall, this book will serve as an important addition to the libraries of those interested in materials processing and will stimulate new applications of bioceramics.

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

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