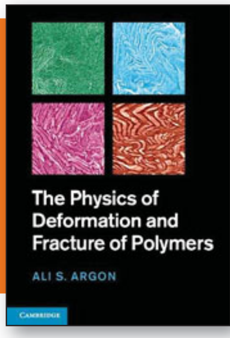


The Physics of Deformation and Fracture of Polymers
Ali S. Argon

Cambridge University Press, 2013
532 pages, $135.00
ISBN 9780521821841

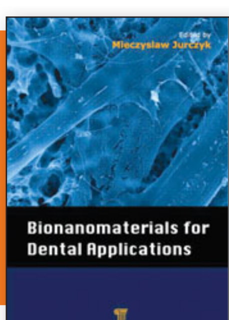
This is an excellent book on inelastic deformation and fracture of polymers from a mechanistic point of view. It is written by a leading researcher who has studied this subject at the Massachusetts Institute of Technology for more than 30 years. A large part of the book is based on the author's own contribution to the field. The book comprises 13 chapters and about 500 pages. It is concisely written yet contains sufficient details. This book is a good reference for graduate students as well as engineers in the field.

The first six chapters present a tutorial of polymer physics, including polymer chain structures, condensed states, rubber elasticity, and linear viscoelastic properties. The discussions of viscoelasticity and time-temperature superposition are insightful. Introduction of in elastic behavior of polymers starts with nonpolymeric glasses in chapter 7. This part concentrates heavily on the author's own research and addresses the general picture, such as kinematics of plasticity, nucleation of shear transformations, yielding, and post-yielding large plastic deformation. The presentation is beautiful. Chapters 8 and 9 include in-depth discussions of polymer rheology, plastic deformation and flow, kinetic models of yielding, temperature dependence, large strain deformation, and strain hardening. A number of amorphous and semicrystalline polymers are discussed individually and computer simulations of plastic deformation-induced texture development are described. Chapter 10 covers deformation instability in plastic flow, especially during necking and post-necking. Chapter 11 gives a useful description of crazing, including initiation, growth, and molecular mechanisms. Chapter 12 presents polymer material fracture behavior. Fracture, deformation at crack tips, crack propagation, and brittle-to-ductile transition of polymers are discussed comprehensively from mechanical and molecular points of view. Chapter 13 describes polymer toughening mechanisms based on crazing, plastic deformation, and cracking. Toughening with low molecular weight plasticizing diluents and dispersed rubber particles is discussed in good depth. The book also provides a nice collection of polymer property data.

This book could have been improved by incorporating an analysis of multiphase polymer toughening. Good progress has been made in analyzing toughening of plastics with rubber particles in the recent past, so it would have been appropriate to include this subject.

In summary, this book gives a coherent and insightful presentation of inelastic behaviors of polymers. It will be a lasting reference in the field.

Reviewer: ***SuPing Lyu*** *is a Principal Scientist at Medtronic Inc., Mounds View, Minn., USA.*



Bionanomaterials for Dental Applications
Editor: Mieczyslaw Jurczyk

Pan Stanford Publishing, 2012
406 pages, $149.95
ISBN 9789814303835 (Print)
ISBN 9789814303842 (e-Book)

This book introduces readers to the structure and characteristics of nanomaterials and their applications in dentistry. With currently available implant materials, the clinical failure rate varies from a few percent to over 10% and new materials are clearly needed. Nanomaterials offer the promise of higher strength, better bonding, less toxicity, and enhanced cytocompatibility, leading to increased tissue regeneration. Mieczyslaw Jurczyk, director of the Institute of Materials Science and Engineering at the Poznan University of Technology, Poland, has drawn from work in his laboratory and elsewhere in Poland to show that nanomaterials have important biological applications including in the stomatognathic system consisting of mouth, jaws, and associated structures. The book is written from a materials science and medical point of view and has 13 chapters and about 400 pages.

The book can be divided approximately into three sections: the first five chapters introduce nanobiomaterials, the next five chapters describe their dental applications, and the last chapters describe their biocompatibility. Chapter 3 is a compendium on metallic biomaterials such as stainless steel, cobalt alloys, and titanium alloys; bioactive, bioresorbable polymers; and composites and ceramic biomaterials. The "top-down" approach to producing nanomaterials such as high-energy ball-milling and severe plastic deformation, as well as Feynman's "bottom-up technique" of building atom by atom, are discussed in the next chapter. Subsequent chapters discuss each material in depth and point out how new architectures and properties emerge at the nanoscale.

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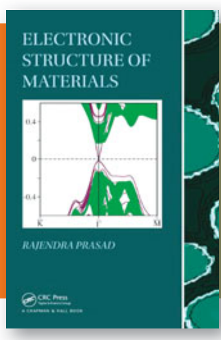
Chapter 8 is devoted to shape-memory materials, which now include not only NiTi but also polymers and magnetic materials. In order to improve bonding, nanomaterials can be used to synthesize implants with surface roughness similar to that of natural tissues. Chapter 9 is devoted to different surface treatments for Ti-based nanomaterials, such as anodic oxidation to improve the bioactivity of titanium and improve the corrosion resistance of porous titanium and its alloys. The use of carbon in various forms—nanoparticles, nanofibers, nanotubes, and thin films—is discussed next with emphasis on the microstructure and properties of these materials, their implant applications, and their interaction with subcutaneous tissues.

Nanomaterials can be used in preventive dentistry and therefore can reduce the amount of dental treatment that is necessary to maintain a healthy mouth as argued in chapter 11. In a subsequent chapter, the author explains osseointegration (i.e., direct bone-to-metal interface) from a biological point of view and early tissue response. The mechanism of the interaction between the implanted materials with the cellular protein in the tissues is described. The last chapter discusses the application of new nanostructured materials in permanent and bioresorbable implants, nanosurface dental implants, and nanostructured dental composite restorative materials.

This book not only focuses on nanomaterials but also on nanoengineering to achieve the best results in dentistry. It is recommended to anyone interested in nanomaterials and their applications in dental science. People with a background in materials, chemistry, physics, and biology will benefit from it.

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



Electronic Structure of Materials
Rajendra Prasad

Taylor & Francis/CRC Press, 2013
447 pages, $89.95
ISBN 978-1-4665-0468-4

This book gives an excellent introduction to the electronic structure of materials for newcomers to the field. Electronic structure plays a fundamental role in determining the properties of materials. In this book, the author takes a microscopic view of materials as composed of interacting electrons and nuclei, aiming at explaining the properties of materials. It will not be outdated for a long time, as it is written from the point of view of the basics.

The book comprises 20 chapters and 447 pages, divided into two parts. The first part (chapters 1–10) is concerned with the fundamentals and methods of electronic structure; the second part (chapters 11–20) deals with the applications of these methods. The exercises and important references are given at the end of chapters. A relatively long list of references is given at the end of the book. The author skillfully fuses these parts into a cohesive whole.

Chapter 1 gives a historical introduction and an overview of the electronic structure field. Chapter 2 explains quantum description of matter in terms of electrons and nuclei. Chapter 3 is devoted to density functional theory, which is the foundation for first-principles calculations. Chapter 4 introduces the basic energy-band theory. The following three chapters explain various methods of electronic structure calculations, such as pseudopotential, the Korringa–Kohn–Rostoker method, and augmented plane wave methods. Chapter 8 illustrates disordered alloys with approximations such as virtual crystal approximation, average *t*-matrix approximation, and so on. Chapter 9 provides first-principles molecular dynamics, and chapter 10 discusses several general principles associated with materials design.

Chapters 11–20 cover several applications of electronic structure. Chapter 11 discusses amorphous materials and Anderson localization. The next three chapters go into low-dimensional systems, including atomic clusters and nanowires (chapter 12); surfaces, interfaces, and superlattices (chapter 13); and graphene and nanotubes (chapter 14). Chapter 15 discusses quantum Hall effects and topological insulators. In chapters 16–20, the author discusses ferroelectrics and multiferroic materials, high-temperature superconductors, spintronic materials, battery materials, and materials in extreme environments, respectively.

This book provides a concise and comprehensive introduction to electronic structure of materials, from basic theories to research on specific materials. It is neither too advanced nor too simple, so it is very useful as a source of fundamental knowledge for theoretical calculations. As the author states, "it is aimed at the advanced undergraduate and graduate students who want to gain some understanding of electronic structure methods or want to use these tools in their research." The author has succeeded in doing this.

This book is written in a clear manner, can be well understood, and there are few errors in the text. I can recommend this book without hesitation to all interested in electronic structure of materials, particularly to those entering the field. It is written at a level appropriate to advanced undergraduate and graduate students. Also, it is a good book for researchers with a chemistry, physics, or materials background.

Reviewer: Jianguo Lu *is an Associate Professor at Zhejiang University, China.*

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