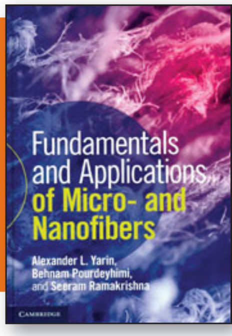


Fundamentals and Applications of Micro- and Nanofibers

Alexander L. Yarin, Behnam Pourdeyhimi, and Seeram Ramakrishna

Cambridge University Press, 2014
442 pages, $99.00
ISBN 978-1-107-06029-6

This is a comprehensive book on the technology of polymer and glass fibers, with an emphasis on the physical approach, intended for all levels of scientists, engineers, and students. The authors state in the preface that one intention of writing this book is to summarize their own results of research in this area. They write the book as a source book, comparable in scope and intention to the classic book in fiber science by A. Ziabicki, *Fundamentals of Fibre Formation* (Wiley, 1976). The authors did a wonderful job and produced a handy summary of the present status of micro- and nanofibers.

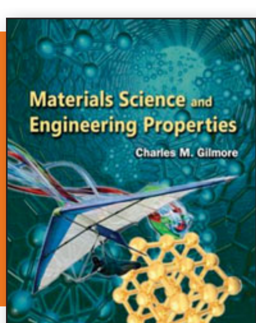
Chapter 1 briefly mentions major methods and underlying physics. However, major technologies for micro- and nanofibers, melt- and solution blowing, and electrospinning appeared in Ziabicki's book. In this regard, the present book is a logical extension of fiber science and engineering.

Chapters 2 and 3 provide backgrounds of the methodologies developed by the present authors for micro- and nanofibers. Chapters 4–6 occupy 65% of the book in terms of length, and cover blowing and electrospinning in great detail. The remainder of the book (chapters 7–11) is concerned mainly with applications, and covers such interesting topics as tensile properties, post-processing, nanofluid, military uses, novel roles in drug delivery, health supplements, and cosmetic facial masks. Apparently, however, major applications are yet to appear for micro- and nanofibers in order to play prominent roles in industry.

There is an absence of chemical formulae of polymers used for micro- and nanofibers throughout this book. Synthetic fibers are regarded as an application of polymer chemistry, and physical behaviors of synthetic fibers are interpreted in terms of chemical formulae of polymers, degrees of polymerization, and conformations of polymer chains. However, now I recognize another way of viewing them as an engineering material that can be described by viscoelastic behaviors, rheological flow properties, non-Newtonian fluid dynamics, and aerodynamics. Nevertheless, neither approach is correct by itself, as chemists are finding more and more evidence for nanoparticles being not only very large molecules but also showing behaviors and properties unique to the nano-size. A hybrid strategy of mixing the engineering approach mentioned in this book with the chemical approach is clearly desirable. An ideal example would be carbon nanotubes, which are nanofibers according to their shapes, but grow in the plasma state of carbon. Carbon fibers, established carbon materials being used with increasing frequency as structural materials for cars and airplanes, are also missing from this book.

In spite of the minor suggestions given, I recommend this book as a highly valuable milestone in the engineering approach to polymer fibers, including micro- and nanofibers.

***Reviewer: Eiji Ōsawa** is Professor Emeritus of Toyohashi University of Science and Technology and the President of NanoCarbon Research Institute Limited, Ueda, Japan.*



Materials Science and Engineering Properties

Charles M. Gilmore

Cengage Learning, 2014
704 pages, $155.49
ISBN 9781111988616

This is an excellent textbook for students or engineers who are majoring in materials science and engineering. This volume uses an integrated approach to explain the physical principles behind engineering behaviors. It contains15 printed chapters and three online chapters.

Chapter 1 introduces the brief history of materials science through different categories of ceramics, metals, polymers, and composites using examples of a ceramics figurine, cars, turbine engine, and advanced testing equipment. The scope of materials science is well-defined. Chapter 2 introduces the crystal structures and chemical bonding of engineering materials, which provide useful data and formula of atomic physics. Chapter 3 summarizes the most common defects in materials such as point, linear, and three-dimensional defects in materials. Chapter 4 introduces the rearrangement of atoms by using thermodynamics and kinetics principles, and covers how these principles affect heat and mass transfer properties. Chapter 5 thoroughly explains the classic phase-diagram theory in the most understandable way. Specifically, the phase diagrams for liquid polymers are introduced, which is really unique. Chapter 6 briefly introduces the mechanical behavior of materials, and chapter 7 follows up to introduce how to improve the mechanical properties. Chapter 8 very specifically introduces common engineering materials and their applications. The introduction of classifications

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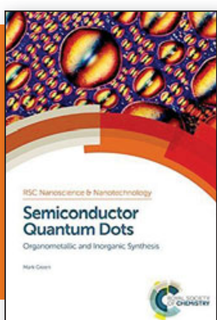
of primary commercial structure alloys, including aluminum, steel, iron, copper, magnesium, and titanium alloys as well as thermoplastics, provides engineers and designers with very useful guidelines to understand and identify the materials that can be used in their applications. Chapter 9 introduces the temperature effects on mechanical properties of materials in the manner of elasticity and plasticity. Chapter 10 introduces corrosion and some electrochemical applications. Chapter 11 gives a thorough discussion on fracture, fatigue, and cracking, including testing methods and life projections. Chapter 12 introduces composite materials and common failure modes. Chapter 13 switches gears to introduce more practical materials processing techniques (e.g., casting, welding, brazing, cold working). Chapter 14 introduces engineering materials selection criteria and valuable property databases. Chapter 15 summarizes the most advanced materials testing methods and techniques (e.g., x-ray, electron, and neutron diffractions; scanning electron microscopy, transmission electron microscopy, scanning tunneling microscopy, and atomic force microscopy).

Chapters 1–7 provide readers with knowledge to understand the basic theories of materials. Chapters 8–15 introduce engineering materials and the techniques that can be used to learn the physical properties, failures, and guidance of manufacturing processes. Online chapters 16–18 introduce semiconductors, magnetic materials, and photonic materials that are used in more advanced applications than the traditional industries.

This book is well organized in both content and format. It covers almost all of the up-to-date knowledge of materials science. The content is well presented with colorful photographs, sketches, and illustrations. The objective of each chapter and summary bullet points can easily help to capture the content of each chapter. The practice problems are divided into different levels for students, engineers, and subject matter experts. As a result, the book is not only suitable for students, but would also be a useful reference book or handbook during their ensuing careers.

***Reviewer: Yan Hong** of General Electric, USA.*



Semiconductor Quantum Dots: Organometallic and Inorganic Synthesis

Mark Green

RSC Publishing, 2014
295 pages, $230.00
ISBN 978-1-84973-985-6

The field of nanotechnology is growing. The tunability of nano-objects such as semiconductor quantum dots (SQDs) has spurred interest in chemical synthesis. In this regard, this book's arrival is timely. It groups the various synthesis techniques for popular SQDs, comprised of 295 pages distributed among seven chapters and a comprehensive subject index. Preparation methods for II–VI, II–V, and IV–VI SQDs are described in the first three chapters. The first chapter introduces and develops various organometallic routes to the synthesis of Zn and Hg chalcogenides and anisotropic growth of Cd-based chalcogenides such as tetrapods and their alloys. Properties of Group III phosphides, nitrides, arsenides, and antimonides, which have different optical properties compared to II–VI semiconductors, are discussed in chapter 2. This chapter also reviews the tuning of SQD properties via dehalosilylation reactions and non-coordinating solvent routes. It is shown that the quantum yield can be increased by varying precursors and their quantities. Anisotropic nanoparticles with rod-like morphologies have also been examined in terms of challenges faced during their synthesis. Lead-based chalcogenide properties and synthesis routes are outlined in chapter 3.

Chapter 4 deals with the synthesis of other chalcogenides and pnictide-based materials. Ternary copper-based chalcogenide core–shell and II3-V2 quantum dots include $CuInSe_2$ and Cd_3P_2, respectively, among many others. Chapter 5 discusses surface passivation by means of synthesizing an inorganic capping layer or a core–shell structure. This thorough chapter is of fundamental and practical interest. It describes Type I and Type II core shells and multiple shell structures targeting a higher quantum yield. There are also sections relating to III–V and IV–VI core–shell structures. Chapter 6 unfolds ligand chemistry and the purpose of ligands in shaping the nanoparticles. Chapter 7 describes the role that the capping agent or the surfactant plays in terms of its linkable functional moieties. Various surfactants have been brought to the reader's attention, namely amines and thiols, among others, along with surfactant exchanges based upon them.

The book also covers "green chemistry" synthesis aspects of SQDs and the use of biological molecules as capping agents, viz., DNA. Consideration is given to the toxicity of the solvents and the search for phosphine-free systems. Overall, the book is eye-catching with ample illustrations and interesting, as the chapter sequence is well conceived. Moreover, every chapter brings something new to the reader accompanied by historical facts pertaining to various SQD syntheses. As the book is clearly subtitled "synthesis" and is dedicated to organometallic and inorganic synthesis, it would be most suited to synthetic chemists. However, the physical properties of various SQDs also are well illustrated, and this volume is therefore of some interest to materials scientists and nanotechnologists.

***Reviewer: Protima Rauwel** of the University of Tartu, Estonia.*

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