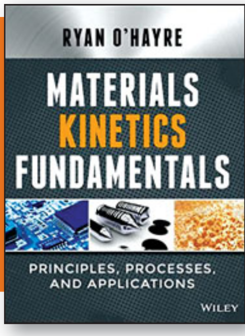


Materials Kinetics Fundamentals: Principles, Processes, and Applications

Ryan O'Hayre

Wiley, 2015

312 pages, $115.00 (e-book $92.99)

ISBN 978-1-118-97289-2

O'Hayre's textbook on materials kinetics serves as a concise introduction to the topic. The book is intended for use in a third- or fourth-year undergraduate class, and is well suited both in terms of the depth of topical coverage as well as writing style that maintains student interest. The writing style is somewhat less formal than in other textbooks on this topic, and more complicated math is often skipped in the interest of moving more quickly to practical outcomes. In addition, the book continually ties fundamental concepts to a range of applications. At the end of each chapter are a brief summary and a short list of questions that could be assigned as homework.

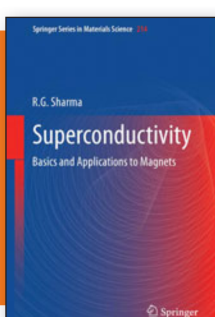
The book is split roughly in half. The first half, "Kinetic Principles," begins with two chapters that introduce the topic of materials kinetics and then review the foundational thermodynamics. The principles that are reviewed include thermodynamic potentials, reaction equilibrium constants, and calculations of various units of concentration. This review might be unnecessary in a curriculum that offers thermodynamics and kinetics in a well-integrated sequence.

The heart of the first half comes in the next two chapters. Chapter 3 discusses chemical kinetics, starting with zero-, first-, and second-order homogeneous reactions and then moving to heterogeneous reactions. Chapter 4 discusses transport kinetics. Continuum approaches are given first, with content centered on Fick's first and second laws. Next, atomistic approaches are summarized, largely to show how diffusivities can be derived from first principles in ideal gases and solids.

The book's second half is entitled "Applications of Materials Kinetics," and consists of three chapters. Chapter 5 deals with kinetics at the gas–solid interface, including adsorption, gaseous corrosion, and various thin-film deposition methods. Chapter 6 discusses phase transformations, solidification, nucleation, and growth. Finally, a brief chapter 7 considers microstructural evolution. Of the book's little more than 100 figures, there is a much greater density of them in this second half.

The writing style, figures, and worked examples are consistently good and will appeal to undergraduates. There are numerous asides that add depth and interest to the topics. For example, snowpack evolution and avalanches are used to highlight the effects of gas–solid kinetics. If the book has a fault, it is that it can be a bit too brief. The microstructural evolution chapter, in particular, could have more extended discussion. The book seems about the right length for a one-semester undergraduate course if the instructor chooses to focus on only the topics given here. Instructors who may wish to branch out to other topics or take some of the included topics to more depth may find some aspects lacking. This textbook is non-intimidating and focuses on the many aspects of materials (and not just chemical or physical) kinetics. I would recommend a graduate student in materials science to start with a more rigorous text, provided that their undergraduate background was in chemistry, physics, or other aligned field.

Reviewer: ***Joshua Hertz*** *is an assistant teaching professor in the College of Engineering, Northeastern University, USA.*



Superconductivity: Basics and Applications to Magnets

R.G. Sharma

Springer, 2015

414 pages, $179.00 (e-book $139.00)

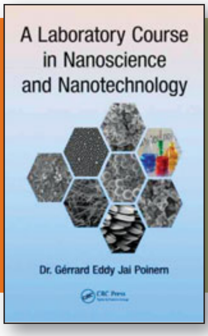
ISBN 978-3-319-13712-4

This is an excellent book for young researchers who want to get a clear knowledge about low-temperature measurements and experimental techniques, magnetic applications, and superconductivity. The most attractive aspect of this book is that it covers the basic phenomenon of low-temperature physics, magnetism, and superconductivity with the help of a combined experimental and theoretical approach with very clear illustrations in 10 chapters.

The first chapter gives a brief introduction about how to liquefy gases and achieve low temperatures to pK with pictorial representation of experimental setups and different processes (Linde–Hampson liquefaction cycle to the recent developments in achieving low temperatures with Kamerlingh Onnes's success story of liquefying helium and the discovery of superconductivity). Phenomena and the physical properties of superconducting materials, as well as the utilization of such phenomena to make superconducting devices, are discussed clearly in chapter 2. Basic concepts such as the Meissner effect, energy gap, and flux quantization are also covered. The occurrence of Type II superconductivity in alloys and compounds is explained, starting with Abrikosov's concept in chapter 3. Chapter 4 gives an overview of cuprate superconductors starting with the very first superconductor Y-Ba-Cu-O and different families of superconductors. Correlations between the crystal structures and the superconductivity of different types of superconductors are explained well with their crystal structure models. Commercialization of the first superconducting wires and their applications are also demonstrated. Theories such as London's, BCS, and the Ginzburg–Landau theory are briefly reviewed in chapter 5. Possible superconducting materials for magnetic applications are given in chapter 6. Processes to make superconducting wires for commercial applications are illustrated with clear phase diagrams. Chapter 7 discusses do-it-yourself superconducting magnets.Superconducting magnets for accelerators and their historic developments (e.g., Tevatron, HERA) are given in chapter 8. A photograph taken at CERN gives the reader a feeling of what the superconducting accelerator looks like. Images and pictorial representations along with basic concepts are given for different types of superconducting magnets in cyclotrons. Chapter 9 is about utilization of superconducting magnets in fusion reactors. Fusion mechanisms and machines based on tokamak concepts (e.g., T-7, Tore Supra) are discussed. Futuristic machines (W7-X and IGNITOR) and their functionalities and designs are also discussed with illustrations. In chapter 10, applications of magnetic materials in medical and other fields are described.

The references are adequate and up to date. This book can be useful for master's level students, and to some extent for bachelor's level students as a reference for the fundamentals of superconductivity, applications, and designs of superconducting. I strongly recommend this book to all scientists interested in superconductivity.

***Reviewer: K. Kamala Bharathi** of the National Institute of Standards and Technology/University of Maryland, USA.*



A Laboratory Course in Nanoscience and Nanotechnology

Gérrard Eddy Jai Poinern

CRC Press, 2014
260 pages, $55.96 (e-book $31.00)
ISBN 978-1-4822-3103-8

In these days of virtual reality, online courses, and streaming videos, the concept of a laboratory manual requiring students to don lab coats and learn about nanoscience by doing it is not only refreshing, but bold. This text, referred to by the author as a laboratory manual, provides a set of simple experiments that introduce some selected topics of nanoscience.

The manual consists of six chapters. The first two chapters introduce and define nanoscience and nanotechnology, as well as describe different kinds of nanomaterials and their syntheses. The third chapter covers some characterization techniques. The fourth chapter is a general discourse on laboratory safety and preparing a report. The fifth chapter is the real heart of the book: 12 different experiments are detailed. Out of these, eight involve a synthesis procedure, such as biosynthesis of silver nanoparticles, or reverse micelle synthesis of zinc sulfide nanoparticles. In addition, there are experiments on surface effects (superhydrophobicity) and microscopy—scanning electron and atomic force microscopies (SEM and AFM). The sixth and last chapter suggests in a general way some nanoscience projects.

Each lab begins with an introduction containing details of general interest on the material being synthesized or phenomenon studied. This is followed by a brief synopsis—"Key Concepts" —of the lab. The experimental section lists all reagents and supplies required for the work, and specific safety precautions. The experimental procedure is then laid out carefully, both with pictorial descriptions of the different steps, and in tabular fashion with each step in the table including space for observations and comments to be completed by the student. General suggestions for further analysis appear at the end, and finally a bibliography of relevant reading material is included.

It is a pity that the great care and detail taken with experimental description was not exercised in the overall writing of this book. Mistakes such as giving the carbon–carbon distance in the honeycomb lattice as 14.4 nm or 28.3 nm depending on direction (p. 29), stating "Speed of sound in 1 second = 343 m" (Table 1.2), or confusing text (e.g., the definition of nanotechnology is a tautology: "the modification, usage, knowledge, and development of nanomaterials, nanotools, nanomachines, and nanosystems …") will puzzle the typical student. The section on different analytical techniques is also inadequate (e.g., the description of AFM probes is unclear and contradictory; scanning electron microscopy is relegated only to a high vacuum environment, ignoring the current popularity of environmental SEM and even more recent ambient SEMs; light microscopy is treated at the diffraction limit, without mention of the recent development of super resolution microscopy). Also, in the laboratory section, there is repetition of introductory descriptions to techniques that already appeared in chapter 2. Finally, although the manual is promoted as suitable for undergraduate or even graduate level, it lacks the rigor expected at a university level. The approach taken and questions asked are completely phenomenological, lacking any quantitative spectroscopic or microscopic analysis, statistical analysis, nor is there comparison with any theory.

Despite these shortcomings, with proper classroom guidance, the experiments described here, coupled with anecdotal examples the author provides of utility of nanoparticles, could serve as a good basis for a full laboratory course.

***Reviewer: Sidney Cohen** of the Weizmann Institute of Science, Israel.*

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