Books



Nanotechnology



Small Systems. By Ben Rogers, Sumita Pennathur, and Jesse Adams. CRC/Taylor & Francis, Boca Raton 2007. 328 pp., hardcover \$ 89.95.—ISBN 978-0-8493-8207-6

Understanding

Teaching nanotechnology is probably as difficult as the subject is multifaceted and ill-defined. One may want to keep it a class for advanced chemistry, physics, and materials science students, in order to be able to apply knowledge already well-grounded in quantum mechanics, solid-state physics, and inorganic chemistry to small systems. Alternatively, an introductory nanotechnology class designed for nonspecialists represents an opportunity to reach out with a trendy topic. In this case, the challenge faced by the teacher (or the author, respectively) amounts to conveying efficiently and without oversimplification enough scientific background that will allow one to get a feeling for the marvels of very small objects, their specialties, and their limitations. Nanotechnology: Understanding Small Systems rises to this very challenge.

Understanding such systems is described in ten chapters, which formally divide the book thematically. In this way, students are not forced to go through several chapters on fundamentals (the boring part, they might say) before actually coming to the applications (the fun section, so to speak). Instead, the authors establish a constant and quite vivifying exchange between the basic principles and the instruments or effects of nanoscience. Thus, the discussion of the Lennard-Jones potential is followed by the description of scanning probe microscopy, and quantum confinement by single-electron transistors. The thematic approach inherently leads to some arbitrary separations: for example, an idea of the different types of chemical bonding is given in Chapter 4, whereas the Schrödinger equation is only introduced in Chapter 5; the vapor-liquid-solid growth of nanowires also belongs to Chapter 4, although no thermodynamics appear until Chapter 7. The phenomena of the nanoscale are treated quantitatively, that is, all relevant equations are presented; however, the mathematic formalism is deliberately kept at a minimum. In particular, calculus and complex numbers are practically absent (except in Chapter 9). This choice forces the authors to present most of the fundamental equations in an ad hoc manner, which is not only less satisfying for the reader, but sometimes even unnecessarily causes complications (e.g. explanation of the wave functions involved in tunneling without the complex exponential function, and of the density of states without the concept of derivative).

The choice of topics to be treated in this introductory textbook was probably the most difficult that the authors had to make. They picked wisely, and the result is a very fortunate balance in which fluorescent quantum dots, semiconductor nanowires, catalytic porous materials, and lasers based on multilayers all have their place. So do atomic force microscopy, electron microscopy, nearfield techniques, and scanning tunneling methods. The book opens with an introduction (Chapter 1) in which the reader is made aware of some historical aspects and of the societal impact of nanoscience. The second chapter describes the scaling laws that cause the special properties of very small objects. Chapter 3 furnishes an overview of quantum mechanics, while Chapter 4 describes chemical bonding and presents some of the structures of interest to nanoscientists. The mechanics of oscillators are covered in Chapter 5, which concludes with a description of scanning tunneling microscopy and atomic force microscopy. In Chapter 6, one is familiarized with the electronic structure of solids and with quantum confinement, and Chapter 7 is dedicated to heat transfer. Light-matter interactions are treated in Chapter 8, including paragraphs dedicated to near-field methods and to photonic crystals. The book concludes in a somewhat unexpected direction, with fluid mechanics in Chapter 9 and finally "nanobiotechnology". Whether or not the machinery of a living cell should be considered as nanotechnology is debatable; however, the peculiarities of "life at low Reynolds number" certainly have broad implications.

Both the content and the form of the book are chosen so as to reach a wide readership. To many, the informal language will be easier to read than the accurate, concise, and dry style that is conventional in purely scientific writing. Some, of course, may not consider the metaphors involving caviar, basketball, and bingo as indispensable, nor descriptions such as "wiggling stuff", "crisscrossing patterns of energy", and "crowd of churning nanoscale substance" as particularly enlightening. Figures are used abundantly to loosen-up the text, convey the information visually, and most importantly contribute to a more intuitive understanding of small systems. Each chapter concludes with a short summary and about 30 "homework exercises", some short ones meant to reiterate the main messages of the chapter and some longer which allow one to ponder about the concepts before applying them. The "back-of-the-envelope" examples worked out at various points throughout the text are probably the most welcome feature of the textbook. Following them, the readers can practice juggling with orders of magnitudes and familiarize themselves with nanoscale objects.

Among the aspects not covered in the book, the magnetism of nanostructures, electrochemical preparative techniques, and an overview of lithographic methods are probably the most prominent. Nevertheless, by the time the last page is reached, the reader has obtained an excellent overview of the themes of nanotechnology—the scientific principles behind it, the topics of importance in research and development, the main types of interesting structures, and the

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techniques used to study them. In this respect, *Nanotechnology: Understanding Small Systems* will fully satisfy the curious high-school student who wants to know what "nano" is all about. We can also recommend it as an excellent reference text for introductory college classes dedicated to freshmen or students outside of the natural sciences. Those whose interest has been piqued by reading the book will be prepared to take a full load of classes in physics, chemistry, or materials science.

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Deutsche Bunsen-Gesellschaft für Physikalische Chemie

awards the first

van't Hoff Prize

The van't Hoff Prize was established in 2008 by Gerhard Ertl in remembrance of the first Nobel Prize winner in chemistry Jacobus Henricus van't Hoff. The award consists of a Silver Medal, a Certificate and an amount of 20.000. It will be presented at the 108th Annual General Meeting of the German Bunsen-Society from 21-23 May 2009 in Cologne.

The prize will be awarded to an active scientist for outstanding and sustained contributions to the field of Physical Chemistry. Suitable candidates of high international visibility in their research field will be evaluated with respect to the scientific quality of their research. There are no restrictions on age, nationality or country of residence, but candidates should preferentially come from a German-speaking region in Europe. Candidates do not need to be members of the DBG.

The merits of a particular candidate should be brought to the attention of the selection panel by means of a nomination sent to the DBG. The nomination should be accompanied by a supporting statement describing fully the outstanding contributions made by the candidate, including biographical details and a list of publications. Self-nominations are not possible.

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