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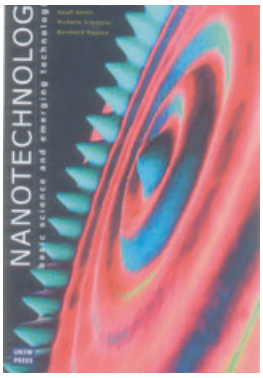
Small Technology from a Big Country

*Paul Mulvaney**



Nanotechnology—Basic Science and Applications

K. Kannangara, B. Raguse, M. Simmons, G. Smith and M. Wilson
UNSW Press 2001, 270 pp.
ISBN 0-86840-437-3
Softcover, $AU 45

Nanotechnology (NT) is not just a buzzword. It is scientific miscegenation, homogenizing disparate fields through its promise of a future technological haven. Not surprisingly, textbooks on nanoscale physics, chemistry, engineering and biology are appearing at an ever-faster rate. Nevertheless, few books have actually attempted to paint the entire NT landscape—it is simply too broad. Yet this new book attempts to do just that and generally succeeds in its efforts. The five co-authors are all eminent Australians and internationally recognized leaders in their fields, which endows the book with clarity, vision and perspicacity.

Specialist NT texts generally assume the reader already appreciates the impact of 'molecular nanotechnology' on our everyday lives, but it is difficult to comprehend the breadth of 'disruptive influences' nanotechnology could have over the next 20 to 30 years. This book explains the excitement of NT and attempts to lure the reader into the various potential applications of NT through gentle technical introductions. It is didactic but succinct, keeping to the path of making the cutting edge in disparate areas equally accessible. The book is pitched squarely at undergraduate students and the general scientific community.

The book's structure is natural and logical. It begins with a little history, the inevitable references to Feynman and Drexler, though the concept of nanotechnology predates these gentlemen by decades. The second chapter explains the workings of various instruments for nanoscale studies Chapter 3 covers nanomaterials; this is discussed in broad terms, noting that there are five ways to make nanomaterials—chemical vapour deposition, sol–gel, electrodeposition, ball milling and plasma arc processes as well as natural sources. What about direct chemical precipitation and arrested growth—the simplest and most common method in the literature? Chapter 4 covers the plethora of carbon-based materials, the routes of synthesis and the nomenclature used to describe the folding of carbon into nanotubes. Chapter 5 begins the discussion of nanostructuring with 'molecular mimicry' and this chapter introduces devices such as molecular switches and rotors. Chapter 6 is titled 'nanobiometrics' and focuses on self-assembly and the parallels between artificial nanostructures and biological nanoscale structures. It discusses the idea of interfacing technology to living cells, and heralds the advent of devices such as biosensors and DNA based computing. Optical effects are the topic of chapter 7, including the control of light, designer materials for photon manipulation on the nanoscale and the development of large-scale surfaces for solar energy conversion or reflectivity modulation. Interestingly, the classical area of 'nanoelectronics' is relegated to chapter 8, which perhaps highlights the way NT has moved away from its technical and etymological origins and become a broad-based science in its own right. This chapter is at a more advanced level, which reflects the more highly developed, commercial nature of nanoelectronics. From Moore's Law, we move into lithography and fabrication, illustrated with semiconductor devices such as MOSFETs, then from classical to quantum effects. The chapter closes with an introduction to the concepts underlying the quantum computer, which is lucid and instructive. The wrap-up in a book like this is tricky. It is clear that new ideas are emerging faster than we can anticipate but the authors have managed to embrace the panoply of developments succinctly in chapters 9 and 10: nanorobots, NEMS, green manufacturing, ageless materials, nanomedicine, society and the inevitable ethical dilemmas brought on by the insatiable greed for ever more sophisticated technology.

At 270 pages, this book is not an encyclopaedia, but detailed enough to be the basis for undergraduate courses. It is well laid out and moderately priced.

The book falls flat occasionally. The level of explanation and background varies. For example, explaining the elements of the periodic table is probably too elementary, while little semiconductor physics is presented as background to the chapters on solid-state electronics. Furthermore, most of the references are to current, highly technical publications, which are likely to be beyond anyone who needs a refresher on these elements in the first place.

The number of downloaded images is disappointing, since they generally do not reproduce well, and there is a tendency for overzealous cutting-and-pasting. The image of the famous quantum corral appears at least 13 times.

Yet overall, the book is sparkling and enthusiastic in its presentation and the style is invigorating. The authors are quite impartial in their coverage, linking zeolite synthesis and quantum computing with organic-chemistry-inspired topological entities such as rotaxanes and biomimetrics.

Only in the field of nanotechnology can references to *2001*: *A Space Odyssey* and *The Hitchhikers Guide to the Galaxy* get equal footing with standard scientific citations... But despite loitering occasionally between fact and fantasy, this book is going to be an ideal and popular entry for those wanting to embark on a voyage of scientific nanodiscovery. I certainly recommend it for undergraduate classes and courses and for those wanting to get a feel for NT.

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