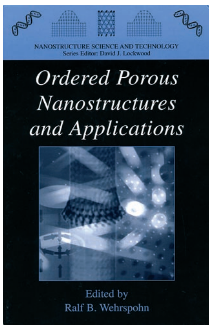
## *Ordered Porous Nanostructures and Applications*




Edited by *Ralf B. Wehrspohn*. Springer, New York 2005. 218 pp., hardcover € 54.95.—ISBN 0-387-23541-8

There is currently a great deal of interest in porous nanostructures, particularly nanostructures that display long-range order in one or more dimensions. In this book, Ralf Wehrspohn has assembled timely contributions from leading researchers whose expertise is focused on ordered porous materials. The book has been divided somewhat arbitrarily into synthesis and applications sections, although most of the chapters contain elements of both. The book emphasizes electrochemical synthesis as a means of fabrication, and it covers materials in which the long-range order is imposed artificially (using conventional photolithography or other externally imposed stimuli) and materials that self-order during their synthesis. As with many edited books, the scope, depth, and style of individual chapters varies with the authors. Overall, I found this to be a very informative book for both experts and newcomers to the field.

The main emphasis of the book is on porous semiconductors (in particular silicon), although there are also chapters on porous alumina, ordered porous polymeric films, and colloidal crystals. Two chapters are devoted to the synthesis of macroporous silicon, covering methods for electrochemically etching n- and p-type silicon, respectively. The n-type silicon chapter is written by Volker Lehmann, who is often justifiably cited as the founder of the area of macroporous silicon science and technology. Jean-Noel Chazalviel and François Ozanam contribute the chapter on p-type silicon. Both chapters provide an authoritative overview of preparation methods and current theories of pore formation in silicon, although the chapter on n-type silicon is rather brief.

The macroporous silicon "synthesis" chapters are nicely complemented by "applications" chapters on the use of macroporous silicon in photonic and MEMS devices. The chapter on macroporous silicon photonic crystals is contributed by Ralf Wehrspohn and Joerg Schilling. Although this chapter is placed in the "applications" section, it provides a nice theoretical overview, but gives only a few concrete examples of practical applications. The chapter devoted to the use of porous silicon in micromachining, by French and Ohji, provides an excellent overview. It describes many reported examples of microstructures that can be fabricated using porous silicon as a template or sacrificial layer. This chapter has a rather weak introductory section, but the reader can refer to the chapters of Lehmann, Chazalviel, and Ozanam for more accurate details.

Foll, Langa, Carstensen, Christophersen, and Tiginyanu provide a thorough introduction to the electrochemical synthesis of ordered macroporous materials based on the Groups III–V semiconductors. While not as ubiquitous as silicon, the III–V materials provide unique electronic and optical properties that are essential for many applications. This chapter is very well written and comprehensive, with many examples from the literature. Both lithographically imposed and spontaneously ordered structures are described, and the factors leading to self-ordering are well laid-out.

Hideki Masuda contributes an excellent chapter on ordered porous alumina made by anodic corrosion of aluminum. This chapter supplies a fabulous overview of the materials fabrication parameters that the author uses to form ordered pores with round, square, or triangular cross-sections. This self-ordering system generates some of the most striking electron microscope images of the entire book. Masuda also introduces several methods to fill these alumina pores with other materials, a topic further elaborated by Wehrspohn in his chapter on nickel nanowire arrays.

Co-authored by Kornelius Nielsch and Riccardo Hertel, Wehrspohn's second contribution to the book is devoted to nickel nanowire arrays prepared by electrodeposition into porous alumina templates. This chapter gives a nice summary of the work in the area, but it would have been more useful to the reader if it had also provided a résumé of the different methods and materials that have been used to fill pores in porous alumina. For example, the work of Charles Martin, briefly mentioned in Masuda's chapter, provides many nice examples of applications in membrane separations, biosensors, and drug delivery. While much of Martin's work was not focused on ordered porous arrays, it would have provided readers outside the field with a useful perspective. As Masuda mentions in his chapter, the imposition of order in these porous systems can, in many cases, provide improved performance relative to the unordered porous structures.

The enormous body of literature on colloidal crystals is represented by the chapter of Greulich-Weber and Marsman, which focuses on silica-based systems. The chapter provides an in-depth review of colloidal crystals, and gives a good description of the growth, interactions, and dynamics of structures based on colloidal building blocks. This well-referenced chapter contains just slightly less than the number of references of the other eight chapters combined. Despite this, colloidal systems based on polymers, such as those in Sandy Asher's work on crystalline colloidal arrays, are not represented in this chapter or in Govor's chapter devoted to polymeric systems. This latter chapter places its emphasis on honeycomb polymer-network membranes. Govor's chapter is not meant to provide comprehensive coverage of the polymer literature, and it is disappointing that this is the only chapter devoted to the large body of work on ordered polymeric systems.

In summary, this is an informative and timely book that describes the most important methods of synthesis and applications of ordered porous nanostructures. It is a good, though not comprehensive, reference work for researchers working in the field of ordered porous materials.

*Michael J. Sailor*
Department of Chemistry and Biochemistry
University of California, La Jolla (USA)

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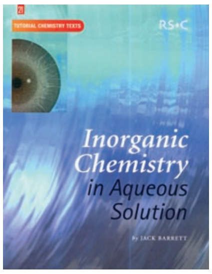
## *Inorganic Chemistry in Aqueous Solution*




By *Jack Barrett*. Royal Society of Chemistry, Cambridge 2004. 184 pp., softcover £ 14.95.—ISBN 0-85404-471-X

This is Number 21 in the RSCs series of *Tutorial Chemistry Texts*, and both author and publisher are to be congratulated on a job well done.

Two introductory chapters on water itself give clear accounts of its structure and solvating characteristics. They are followed by chapters on the forms of ions in solution, on thermodynamics and electrode potentials (a difficult topic that is very clearly put across), and on the stabilities (actually redox stabilities) of ions in solution. Then come three chapters of descriptive chemistry on the elements of the s and p blocks, the d block, and the f block. The emphasis of these three is on "periodicity", and the trends and comparisons are well brought out. One cannot expect too much descriptive detail in a work of under 200 pages, but in fact a great deal has been achieved, and the level seems just right for the target audience—which I take to be mainly second-year undergraduates, though that doesn't seem to be made clear. The aims of each chapter are set out in tabular form, the discussions are punctuated with worked examples, and there are further study problems with answers at the back of the book.

There is a strong emphasis on systematization and explanation, using thermodynamic analyses to identify factors that contribute to particular chemical properties, such as solubility of salts or standard reduction potentials of metal ions. At a deeper level of interpretation, molecular orbitals and, where relevant, relativity theory, are deployed.

At times I was wishing for more pictures and fewer numbers. Frost (volt-equivalent) diagrams are often more directly informative than Latimer diagrams, though both have their uses. To take one small example, in describing the structure of $[Mo_2(OH_2)_8]^{4+}$, no doubt the Mo–Mo bond is quadruple, and the description of the electron-count is clear, but is it not more clear to point out the eclipsed conformation of the $Mo_2$–$O_8$ skeleton, in contrast to the staggered conformation of, say, $C_2Cl_6$?

Mention of an oxygen-free molecule underlines what this book does not contain. It is, almost exclusively, an account of the elements in their states coordinated with water, as broadly defined to include oxo and hydroxo complexes and oxyacids. The strength of Brönsted acids, including the hydrogen halides, is almost the only topic beyond this. Lewis acids and bases get a mention but hardly more, so although the factors affecting the stability of HF are well explained (including the recent discovery that in aqueous media the dominant species is actually the ion pair $[H_3O]^+F^-$), there is nothing on the halide complexes of the metals, even through in some aqueous solutions of "salts" the complexes and ion pairs may be the dominant species.

But it is best to do one job well, and if the last remark is a criticism, it really expresses the hope that another good book, on coordination chemistry in aqueous solution, is still to come. This is an excellent text, well written and attractively produced.

*Roderick Cannon*
School of Chemical Sciences
University of East Anglia
Norwich (UK)