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Book Review of Inorganic Reactions in Water

Inorganic Reactions in Water by Ronald L. Rich

Springer-Verlag : Berlin, Germany , 2008 . 521 pp. ISBN 978-3540739616 . \$249.00

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Surface Science: Foundations of Catalysis and Nanoscience, Second Edition

by Kurt W. Kolasinski

John Wiley & Sons Ltd.: West Sussex, England, 2008. 500 pp. ISBN 978-0470033081 (paper) \$80; ISBN 978-0470033043 (hardbound) \$190

reviewed by C. M. Woodbridge

Surface Science: Foundations of Catalysis and Nanoscience is a comprehensive overview of modern surface science. It begins with a short essay about why one would study surface chemistry. In doing so, it also covers some history, economics, key results, origins of words, and notes for students (and instructors) about how the book is organized. I was hooked after this chapter. Kolasinski conveys his passion for the field as well as a sense of how interesting and far-reaching surface science is. After reading the introduction, I spent the rest of my weekend curled up on the couch with this book. Quite frankly, it was a great weekend read.

My three favorite things about the book are the writing style, the bibliography, and the “frontiers and challenges” sections near the end of each chapter. First, the writing: the author notes in the preface that he received feedback from students about how well written the book was. The best thing about Kolasinski's writing is that he simultaneously writes concisely and informatively. *Surface Science* is only eight chapters long, but these eight chapters take us from foundational material (structure, spectroscopic techniques, thermodynamics, kinetics, and adsorption processes) to real-world applications (liquid interfaces, heterogeneous catalysis, epitaxy, and laser and nonthermal chemistry) at a good pace and level of detail. The section on electron energy loss spectroscopy (EELS), for example, is approximately two pages long, but after reading it and the preceding pages on vibrational spectroscopy, readers should have a good idea about what EELS is, its advantages and disadvantages, and what EELS spectra look like. In short, this text is like a really great talk at a conference: enough information is presented to give readers a good foundation for the subject without either overwhelming them with detail or leaving them feeling deprived because the talk is too superficial.

The extensive bibliography is superb. Each chapter concludes with a section of further reading that lists key texts and papers, as well as a reference list that is more typically seen in review articles than in undergraduate textbooks. Students and readers new to the field of surface science should appreciate this comprehensive bibliography because they can readily find several articles or texts to read to learn more about a particular topic that catches their interest. The bibliography contains references to works both of historical importance as well as current literature.

Each chapter has a “frontiers and challenges” section near the end. Here Kolasinski provides his list of research questions and challenges that need to be addressed in order to make advances in a particular area. These sections provide students with direct evidence that surface science is a dynamic, still-developing field that needs their contributions. The challenges presented would also be a great

resource for instructors looking for topics for research papers or discussion-based sessions.

As an example, there is a short (~2.5 pages) section on the three-way automotive catalysts. Kolasinski takes us through the engineering concerns for this catalyst (including the costs of materials), why it is called such, the roles of each material in the catalyst, and known poisons for this catalyst. After reading this, I had a good feeling for this material and wanted to learn more. If students feel this after reading even a few sections of the text, the author has done great work. Finding more to read on the subject is facilitated by the in-text citations (three references) as well as the list of further reading materials (one specific reference about automotive catalysts and four others that are directly relevant). The “frontiers and challenges” section and the problems contained discussion points and specific problems for this section.

This text is a second edition. As such, it has been revised and expanded to include two new chapters: one on liquid interfaces and another on laser and nonthermal chemistry. The author's Web site is a good accompaniment to the text (1); it contains a list of errata to the second edition (minor typos or figure orientation issues), figures in PDF format, and supplemental information for each chapter. Additionally, instructors can contact the author via this Web site to obtain a solutions manual for the end-of-chapter problems. These problems include both conceptual questions and calculate—derive types of exercises. Some problems are also drawn from the current literature, which reinforces the reader's impression that surface science is an evolving field.

I would happily adopt this text in a surface science course for advanced undergraduate students or beginning graduate students. In fact, this is a book that I look forward to having on my bookshelf soon.

Literature Cited

1. Kurt W. Kolasinski's Web site is at <http://courses.wcupa.edu/kkolasinski/surfacescience/> (accessed Jan 2010)

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Introduction to Materials Chemistry

by Harry R. Allcock

John Wiley & Sons Ltd.: Hoboken, NJ, 2008. 492 pp. ISBN 978-0470293331 (hardbound). \$99.95

reviewed by C. M. Woodbridge

Introduction to Materials Chemistry by Harry R. Allcock contains a great deal of information in its pages. In the preface,

Allcock says the text focuses on a large spectrum of topics rather than in-depth coverage of a few topics, and on chemical concepts rather than equations. This approach makes the text a flexible book because students do not necessarily need to have two–three years of chemistry to take a course that uses it. Parts of the applications chapters as well as the descriptions of polymers, ceramics, and glasses could be brought into general chemistry courses. The text has a broader appeal than just to chemistry students. Any student with a year of introductory chemistry or physics who wishes to learn about materials science could learn something from a course in which *Introduction to Materials Chemistry* was used.

My own experience with materials science has involved mainly structure and bonding, physical properties, and spectroscopy. For me, sample preparation involved picking up the telephone to order whatever adsorbates or substrates I needed, so most of Chapter 2, Basic Synthesis and Reaction Chemistry, was new. This chapter in particular has added an additional dimension to the way I think about teaching materials science, and it has given me some new ideas to bring in to my general chemistry classes (for example, Figure 3.4, which shows how oil leads to polymers).

Each chapter ends with approximately a dozen study questions. Rather than the typical problems one might find in a chemistry text, these are conceptual questions. Some questions probe key vocabulary words: for example, Chapter 3 has questions that ask students to define “magic angle spinning”, “elastic modulus”, and “compliance”. Other questions are more open ended and may require some additional research. These study questions would all be great for starting classroom discussions.

Starting with Chapter 6, Polymers, each chapter has a section called Future Challenges In... or Unsolved Problems In.... These are the most interesting sections to read because they are quick snapshots of current research trends in each area. Incorporating sections like these in textbooks seems to be a new trend (if one can say a sample size of two constitutes a trend), but I like it. I think this is a great way to start exposing undergraduate students who may have to do a senior thesis project to research.

I enjoyed the last three chapters the most (Surface Science of Materials; Biomedical Materials; and Materials in Nanoscience and Technology) because they were the most readable. The author's broad brushstroke approach at the expense of depth makes the first 14 chapters a rather dry read. The early chapters are more encyclopedia-like. For example, Chapter 6, Section F is eight pages long; in these eight pages, key features and properties of approximately 24 polymers are described. These eight pages were very informative, but they did not capture my interest in the way the last three chapters or the sections on future challenges did.

I think *Introduction to Materials Chemistry* is a great text for looking up a specific topic and getting a quick snapshot of that topic. Its encyclopedic style reminds me of Herzberg's three volumes on molecular spectroscopy (1). In graduate school, I read all three volumes because they were on the reading list for a class. My professor told me no one ever reads Herzberg; they use it as a reference book. While I understood far more of *Introduction to Materials Chemistry* than I did when I read Herzberg for the first time, it was not an engaging read.

For example, I would not recommend this text for a conventional course in which students are expected to read Chapter 1 and come to class prepared to discuss it. However, I think this book would work well in the hands of an instructor

who could bring it to life by picking out some of the end-of-chapter questions and asking students to come to class prepared to discuss them. I also think it would be interesting to base a course only on Part III: Materials in Advanced Technology and discuss these chapters in some depth while using the first two parts as the reference or background material.

This is a book I would be happy to have on my bookshelf. I would use it for supplemental material or place it on reserve for students. I am not certain that I would adopt it as a stand-alone text for a course in materials chemistry. I am reasonably confident that I will not pack this book to take with me on vacation, but as with Herzberg's text, I am glad I read Allcock's *Introduction to Materials Chemistry* once, and I know where to find it when I need it.

Literature Cited

1. Herzberg, G. *Molecular Spectra and Molecular Structure*, Vols. 1–3, 2nd ed.; D. Van Nostrand Co.: New York, 1950.

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Inorganic Materials Synthesis and Fabrication

by John N. Lalena, David A. Cleary, Everett E. Carpenter, and Nancy F. Dean

Wiley-Interscience, John Wiley & Sons, Inc.: Hoboken, NJ, 2008. 303 pp. ISBN 978-0471740049 (hardbound); \$105 [Kindle Book edition available for download from Amazon Digital Services. ASIN B001AZTVWM. \$89.95]

reviewed by Les Pesterfield

Inorganic Materials Synthesis and Fabrication provides an introduction to all that is solid-state inorganic materials. From chapters on crystallographic factors and chemical energetics to comprehensive chapters on synthetic methods in the gas, liquid, and solid states, to final chapters covering synthesis and fabrication techniques of nanomaterials, this text covers it all.

The authors start with a fast-paced chapter on the importance of structure in determining the bulk properties of a solid and the use of crystallography in determining solid-state structures. The second chapter is a whirlwind discussion of chemical energetics with sections on equilibrium and nonequilibrium thermodynamics, bulk and surface energy considerations, and phase transformation kinetics. While well written, these two chapters are not for the novice. It is assumed that the reader has considerable familiarity with physical methods and chemical principles. The authors express their philosophy of the first two chapters best in an excerpt from a section on phase diagrams: “The following brief introduction is meant merely to encourage the reader to refer to any one of several available texts that offer

a range from introductory to comprehensive coverage of all aspects of phase equilibria”.

The real gems of the text are the middle three chapters on solid–vapor reactions, solid–liquid reactions, and solid–solid reactions, respectively. If you are new to inorganic materials synthesis, you will find these chapters helpful in guiding your research endeavors. The physical and chemical considerations involved in each type of synthetic method are covered in sufficient detail to give the reader an appreciation of the overall picture. Each chapter begins with a discussion of the fundamentals of the synthetic method under consideration followed by examples to illustrate key points. The authors do a good job defining terms and using figures to clarify synthetic techniques.

The tour concludes with chapters on nanomaterials synthesis and materials fabrication. The nanomaterials chapter succinctly covers both top-down physical fabrication and bottom-up chemical synthesis methodologies for nanomaterials. The final chapter provides an introduction to common fabrication techniques and an explanation of how the method of fabrication can influence the performance and suitability of a material for a specific application.

Overall, the text is well written. A unique feature is the inclusion of biographical sketches of individuals who have made important contributions to the synthesis and characterization of inorganic materials. The sketches are brief, usually less than one page, but provide an often-overlooked part of science and discovery: the human aspect. Each chapter ends with an extensive list of references for the reader who seeks further clarification on a topic. Using the text as a supplement in a graduate-level special topics course on inorganic materials is conceivable. A more likely use is as a reference for the professional chemist, physicist, material scientist, or engineer interested in starting research projects in the field of inorganic solid-state materials.

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Inorganic Reactions in Water

by Ronald L. Rich

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reviewed by Peter M. Smith

Ronald Rich has written an extensive review of the aqueous chemistry of the elements (including the transactinide or super-heavy elements). To say that Rich's effort is Herculean may be an

exaggeration, but not by much. He methodically and systematically considers the aqueous reactions of every element in water. The result is somewhat overwhelming.

The book is organized logically: Each group of the periodic table has its own chapter, and each element is then given a section of the chapter. The sections are broken out into subsections detailing an element's reactions with reagents derived from various other elements. The organization of the book is based on the periodic table and therefore electronic structure, whereas the emphasis of the content is on similarities and differences in chemical behavior regardless of electronic structure. If you are interested in descriptive inorganic chemistry, this is perhaps not a bad way to treat the material.

The book is extremely informative, and Rich has clearly dedicated himself to finding every possible aqueous reaction. Nonetheless, some aspects of the book prevent me from giving it a ringing endorsement. My biggest issue with the book is that much of the information on which it is based is not cited. Rich addresses this fact in the introduction. He acknowledges that he is forgoing inclusion of the tens of thousands of primary references so that he can use that space to include a greater variety of reactions. If you are reading this book for enjoyment, this argument makes sense. However, if you are interested in the technical information, then you will have a difficult time replicating the reactions described. As an example, in Section 10.2.1 (reactions of Pd, Pt, and Ds with reagents derived from hydrogen and oxygen) Rich states, “A small excess of H₂O₂, with dilute H₂SO₄ and K⁺, oxidizes [Pt(CN)₄]^{2−} partly on warming, cooling, and evaporating, to make the interesting, bronze-colored, electrically conducting, ionic solid, a linear polymer...” This is indeed interesting, but because the reference is not provided, I have no idea where this procedure may have been published or any information that would enable me to perform the reaction. Again, if you are a casual reader, this is acceptable. With that said, Rich does provide an extensive bibliography with hundreds of references in the introduction and after each chapter.

My second concern is that the book is inordinately text-heavy. There are no figures, tables, or charts in the main body of the book. The appendices do contain such graphics, and they are interesting and informative, but I think that Rich would have been better served by incorporating them into the main body of the book, if only to break up the text. As I stated previously, all of that text becomes overwhelming.

All in all, Rich has compiled the most impressive collection of information on aqueous inorganic reactions that I have ever seen. This book undoubtedly has a niche audience. If you have an interest in aqueous descriptive inorganic chemistry (which I do!) then you will want to see this book. But, at \$249, you might want to convince a library to purchase it first.

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