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A Review of: "Introduction to Materials Chemistry, by Harry R. Allcock"

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Book Review

Introduction to Materials Chemistry, by Harry R. Allcock, John Wiley & Sons, Inc., Hoboken, N.J., 2008; xviii + 432 pages; $100; ISBN 978-0-470-29333-1.

This is a book that grew out of a one-semester course in materials chemistry taken by advanced undergraduates and beginning graduate students in chemistry and related fields. The author is a distinguished scientist who has made important contributions in various areas of materials, especially inorganic polymers. The author deliberately excluded mathematical treatments in order to emphasize chemical concepts.

The book is organized into three parts including seventeen chapters (Part I, Introduction to Materials Science; Part II, Different Types of Materials; Part III, Materials in Advanced Technology), plus a 6-page Glossary and an Index. Each chapter finishes with a list of suggestions for further reading and a selection of study questions. Part I has chapters on materials chemistry, principles underlying materials chemistry, basic synthesis of inorganic and organic materials, and structure determination and techniques for materials characterization. Many readers will be disappointed in the lack of depth and detail in the latter chapter.

Part II has chapters that deal with molecular solids, polymers, glasses and ceramics, semiconductors, metals, and alloys, composites, and defects. The chapter on molecular solids gives a good introductory discussion of liquid crystals. The section on charge-transfer complexes calls TTF-TCNQ a semiconductor. It is a one-dimensional metal above 58°K with activated conductivity below that temperature. Question 12 at the end of the chapter terms the cocrystallization of such two component solids as rare. I would argue that with the considerable literature of organic donor-acceptor complexes and charge transfer salts as well as cocrystals that the formation of such solids is not rare. The discussion on molecular inclusion adducts (also two component solids) is particularly strong. The chapter on polymers does not include the naturally occurring ones such as silk or natural rubber; cellulose acetate and collagen are discussed in the penultimate chapter on biomedical materials.

Part III has chapters on semiconductors (inorganic and organic), superconductors, ionic conductors, membranes, optical and photonic materials, materials in surface science, biomedical materials, and materials in nanotechnology. Section 10B uses the terms "mobility" and "direct band gap," but does not define them. The discussion of polythiophenes in Section 10D4 would have been stronger if it included PEDOT and regioregular and regiorandom poly-3-alkylthiophenes. The discussion of a conduction mechanism for conducting polymers (Section 10D6) lacks the perspective that the materials are not crystalline. The discussion of solitons in the text differs from what is in Fig. 10.5. Section 10E2b uses the term "spun-cast" but does not define it. The term "synchrotron-type effect" is used but not explained in Section 11E. The discussion of optical polarizing filters in Chapter 14 would have benefited from inclusion of the Polaroid polyvinylalcohol/iodine material.

Typographical errors are present in significant numbers. Figure 2.10 represents metal ions as being surrounded by eight electrons. On page 45, reaction 20 is more likely to involve a metal-halogen exchange. On page 120, the structure given as methyl methacrylate is actually methyl acrylate. On page 121, the carbon–oxygen bonds of phthaloyl chloride are represented as single, not double, bonds. On page l22, it is not obvious that dimethylsilanediol would be considered a useful monomer for synthesis of silicone. The eight-membered ring given below is a much better precursor. On page 134, in Eq. 24, NaX_2 should be 2 NaX. On page l49, "phthalic dianhydride" should be pyromellitic dianhydride. On pages 184–185, the carbosilane is in reaction 8, and the polycarbosilane should have a Si-H bond. The ratio SiC:C:SiO_2 should probably be 1:0.78:0.22. On page 200, should Cr_2O_4 be Cr_2O_3? On page 204, Table 8.1 does not specify the reference electrode. In Table 10.1, ZnSe and CdS are redundant. On page 246, in Eq. 8, the pyrrole cation-radical should be a thiophene cation-radical, and in Eq. 9, the quinonediimine portion of the polyaniline structure is drawn incorrectly. On page 257, the polystyrene structures each contain and extra H atom. "Crystalline" is misspelled on page 340. On page 377, the formula in structure 16.11 is missing a subscript 2.

This book is a pioneering effort in the teaching of materials topics to undergraduates. Its presentation is at a good level for undergraduate chemistry students and other undergraduates in technical areas. It clearly covers all the major areas of modern materials research and technology. The suggestions for further reading will allow undergraduates and beginning graduate students to acquire background in areas

of interest to them. This volume is clearly a useful contribution to the literature of materials chemistry.

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