Book Reviews

Interfaces in Crystalline Materials. By A. P. Sutton (University of Oxford) and R. W. Balluffi (MIT). Oxford University Press: New York. 1995. xxvii + 819 pp. $165. ISBN 0-19-851385-2.

This book is one of the series of Monographs on the Physics and Chemistry of Materials. The authors are widely recognized authorities in the field of crystalline interfaces, and they have compiled an encyclopedic reference that is remarkable in both its breadth and its depth. As a consequence of its comprehensiveness, the book is lengthy but well worth the price. It is organized very logically into four major parts: Interfacial Structure, Interfacial Thermodynamics, Interfacial Kinetics, and Interfacial Properties. Successive parts build upon previous ones, but not so much as to prevent one from profitably reading only specific sections. Each part is divided into roughly three chapters. The chapters all end with an extensive list of references that give the reader an effective entree to the literature for more detailed information.

The part of Interfacial Structure begins with a chapter on the Geometry of Interfaces that introduces representations of bicrystals, symmetry, and classifications of isolated interfacial line defects. The next chapter, Dislocation Models for Interfaces, explains the proliferation of classification schemes for interfacial dislocation arrays and problems associated with describing interface dislocations and then provides a very lucid explanation of the approach based upon stress-generator/stress-annihilator dislocations. It also covers the Frank−Bilby and O-lattice theories and their applications to general interfaces. The third chapter, Models of Interatomic Forces at Interfaces, reflects the increasing importance of computer simulations in the study of interface structure. It summarizes the various descriptions of atomic interactions and the assumptions made in many widely-used models. Part I ends with a chapter on Models and Experimental Observations of Atomic Structure that surveys interfaces between a variety of boundary types including grain boundaries, diffuse interfaces, and sharp heterophase boundaries in metallic, ionic, covalent, and semiconductor crystals.

Part II, Interfacial Thermodynamics, opens with a chapter on thermodynamic descriptions of interfaces. Classical concepts are covered as well as topics usually restricted to technical papers or symposia (e.g., interfacial stress and strain, the capillarity vector, and diffusion potentials in systems containing interfaces). Next is a brief chapter on 2-dimensional Interface Phases and Phase Transitions, and a chapter on Segregation of Solute Atoms to Interfaces. The latter describes the salient features of interface segregation and then addresses the available models for segregation including physical, atomistic, and statistical-mechanical approaches.

The third part of the book addresses Interfacial Kinetics. This topic is divided into chapters on Diffusion at Interfaces, Conservative Motion of Interfaces, and lastly, Non-conservative Motion of Interfaces: Interfaces as Sources/Sinks for Diffusional Fluxes of Atoms. Coverage of theories is extensive; review of the experimental literature is selective.

The fourth and final part of the book addresses Interfacial Properties. It includes a chapter on Electronic Properties of Interfaces, and one on Mechanical Properties of Interfaces. Given the large number of topics that could be included under these headings, the authors have chosen to limit attention to fundamental or mechanistic aspects rather than issues related to engineering applications.

Overall, *Interfaces in Crystalline Materials* is an excellent reference for researchers interested in almost any aspect of interfaces in crystalline materials. The authors present current theories and recent experiments in a clear fashion and provide a helpful perspective on the development of the field that makes the book very readable. Despite their pedagogical writing style, the level of the book is perhaps above that of an introductory graduate course; some of the concepts require a working knowledge of crystallography, crystal defects, thermodynamics, or solid state physics beyond that of many new graduate students. Nevertheless, the book's breadth and comprehensive coverage make it invaluable to a wide audience and ensure it will become a classic materials science text.

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Comphrehensive Organic Functional Group Transformations, Volumes 1−7. Edited by Alan R. Katritzky, Otto Meth-Cohn, and Charles W. Rees. Elsevier: Amsterdam. 1996. 7500+ pp. $6846.00. ISBN 0-08-040604-1.

The editors of *Comprehensive Organic Functional Group Transformations* (COFGT) offer the following summary of the work: "COFGT is designed to provide the first point of entry to the literature for synthetic organic chemists, together with an unrivalled source for anyone interested in less common, obscure, or unknown functional groups". Such a statement inspires both great respect for those who would attempt such a Herculean project and great expectations for the product. Although disappointing in some respects, COFGT nevertheless offers an innovative and potentially useful tool to users of synthetic organic methodology.

The most distinguishing feature of COFGT is its product-based organization. To exploit this organizational scheme, readers would begin their search on the basis of the functional group they wish to produce, rather than the reaction they wish to perform, or the starting materials they wish to employ. In keeping with this principle, the six synthesis volumes consist of the following titles, which refer to product functionality: (1) Carbon with No Attached Heteroatoms; (2) Carbon with One Heteroatom Attached by a Single Bond; (3) Carbon with One Heteroatom Attached by a Multiple Bond; (4) Carbon with Two Heteroatoms, Each attached by a Single Bond; (5) Carbon with Two Attached Heteroatoms with at Least One Carbon-to-Heteroatom Multiple Link; and (6) Carbon with Three or Four Attached Heteroatoms. (Volume 7 consists of author and subject indexes.) The ordering of chapters within a volume is intimately tied to a logically-developed hierarchy based, in decreasing order of prioirty, on (1) the coordination number (or hybridization) of the carbon atom involved in the functional group and (2) the identity of the heteroatom in the functional group. In the case of ambifunctional groups, discussions are located in the volume and chapter with the highest possible number. At the lowest organizational level, material within chapters is variously grouped by reaction type, starting material, or type of bond formed.

As an illustration of this organization, Volume 2 is subdivided into three major sections covering the production of single-bonded carbon−heteroatom functionalities linked directly to sp^3-, sp^2-, and sp-hybridized carbon atoms, in that order. Groups of chapters within each section then generally appear in order of decreasing heteroatom period (halogens first, metals last). Individual chapters are then arranged in order of increasing heteroatomic mass.

This organizational hierarchy is ideally suited to those interested in the one-step installation of a particular functional group. Chapters dealing with the construction of common functional groups such as alcohols, amines, and carboxylic acids were easily located. It was even apparent, after some consideration, where to look for information on less-common functional groups.

Although innovative, logical, and helpful, the organization of material presents some disadvantages. Readers interested in overviews of reaction classes or surveys of transformations of particular functional groups may not find such discussion. Furthermore, the formation of some functional groups is discussed in multiple chapters, as is the case with aldehydes (the preparations of alkyl, α,β-unsaturated, and aryl aldehydes occupy separate chapters).

In difficult cases and for readers unfamiliar with the organization of COFGT, a consistent and comprehensive subject index would be extremely valuable. For the most part, information was readily located in the cumulative subject index of Volume 7. However, incomplete listings and an irritating lack of cross-referencing hampered the use of the index in some cases. A degree of subject familiarity and patience may therefore be prerequisites to using the index as a guide to COFGT.

The sheer volume of COFGT makes it impossible to evaluate the work as a whole for its comprehensiveness. Areas which were checked for breadth and depth ranged from excellent to lackluster in their coverage, and a surprising irregularity of quality was found. In the excellent category, the treatment of cyanohydrin formation in Chapter 18 of Volume 3 exhaustively catalogues important preparative methods dating back to 1832, provides up-to-date references to newer methods (up to 1993), and includes a very thorough separate discussion of stereoselective methods for cyanohydrin preparation. This summary truly qualifies as "comprehensive". At the other end of the spectrum, the entire discussion of the carbonyl-ene reaction in Chapter 2 of Volume 2 consists of a very limited four-sentence entry citing only four specialized studies. More disturbingly, references to two landmark reviews are omitted, even though they were within the apparent literature cutoff date for the discussion (1993).

No explicit statements regarding literature cutoff date, either by the editors or by individual contributors, were found. Many chapters seem to contain literature citations into 1993 or 1994, and some even go as far as 1995. Nevertheless, the apparent literature cutoff date can vary markedly among chapters. Thus, Chapter 3 of Volume 1, dealing with C−C multiple bond reduction, contains few references past 1990 and apparently none later than 1993 (although significant uncited developments took place in this field between 1990 and 1993). In contrast, Chapter 21 of Volume 3, handling isocyanides, includes references as late as 1995.

A very helpful feature of COFGT is the referencing system. Superscripted numbers have been abandoned in favor of a simple code which provides journal title, year, and page number without the intermediacy of a bibliography. For example, "⟨83JA5935⟩" replaces a superscript/bibliography entry combination citing "*J. Am. Chem. Soc.* **1983**, 5935". This system is particularly convenient when several articles are of interest. Full bibliographic entries appear at the end of each volume, as does the key for journal codes.

Given the rapid pace of change and the importance of synthetic organic chemistry, an easy-to-use and comprehensive source for up-to-date information in this field is needed and would be widely welcomed. Although COFGT does not fill such a need on every count, it can be recommended as a possibly worthwhile starting point for those requiring information on the construction of functional groups.

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Handbook of Lipid Research. Volume 8. Lipid Second Messengers. Edited by Robert M. Bell (Duke University), John H. Exton (Vanderbilt University), and Stephen M. Prescott (University of Utah). Plenum: New York and London. 1996. xiii + 316 pp. $89.50. ISBN 0-306-45174-3.

When second messengers first appeared as part of the biochemical menage in the novel characters c-AMP and c-GMP, it was impossible to foresee the intricacies that would later develop. Here in this compendium of stop and go signals one takes a ride on lipids from the glycerol family through the sphingosine family to the prostaglandins, a virtually exhaustive array of molecules, most of which were long held to serve only as membrane material, energy storage, or insulation. Now, within the last two decades, components of these common lipids have been shown to act as second messengers involved in signal communication for a number of systems of almost unbelievable sophistication.

Some of the chapters include a historical perspective on development of specific molecules as messengers, but all discuss recent evidence which brings these systems to the forefront of current research. The information herein will serve as an invaluable resource for those involved in lipid research as well as providing up-to-date insights for interested parties in biochemistry and other science disciplines. The presentations are enjoyable to read and are easily followed. The figures throughout this work were very helpful and consistent with the text; one notable exception was the de novo pathway for platelet-activating factor synthesis. There is a significant amount of overlap between some sections; however, this is only to be expected when one considers the close relationships between these lipid signal molecules and some common patterns of communication.

Several of these signal molecules are derived from glycerol-based phospholipids. Diacylglycerol (DAG) and inositol triphosphate (IP3) are pervasive characters, but phosphatidic acid and lysophosphatidic acid are also prominent. Ceramide and sphingosine are putative actors, and the prostaglandins show their stuff in the last chapter. Other important participants are protein kinase C, tyrosine kinase, phosphatidylinositol 3-kinase, and the G proteins. Studies in this area are complicated by finding that these molecules are located at various sites in the cell, on opposing leaflets of membranes, and that profiles vary with tissue type. To place these signal molecules in an appropriate position in the cell to elicit their effect, translocation must occur in some cases. Beyond this, one must consider the varying routes by which these signal molecules may be generated, the reactions by which they may be recycled, and the regulation of the enzymes along both of these pathways.

Molecules from the glycerol-based phospholipid family have been studied more than others at the present time. Protein kinase C is the best characterized target for diacylglycerol, and it has been found in eleven or twelve different isoforms which are classified as one of three types. DAG is interwoven with protein kinase C and promotes its translocation to the plasma membrane for activation. DAG can be formed via hydrolysis of phosphatidylinositol-4,5-diphosphate by phospholipase C which also yields inositol triphosphate. The membrane bound DAG then activates protein kinase C while soluble IP_3 acts to increase intracellular calcium. By another route, hydrolysis of phosphatidylcholine with phospholipase D produces phosphatidic acid (also a messenger) and choline. The resulting phosphatidic acid through action of phosphatidic acid phosphohydrolyase yields DAG and phosphate but in this case without IP_3. Activation of protein kinase C by DAG may inhibit phospholipase C and activate the phospholipases D and A_2. Phospholipase A_2 acting on phosphatidylcholine produces free fatty acid (arachidonic acid is a major species) and lysolipid, both of which enhance protein kinase C activity. Further, DAG exists as a family of compounds which vary in their attached acyl groups, and these individual DAGs may act at different targets. Also, lurking in all of this is the fact that phorbol esters, known as tumor promoters, typically mimic DAG in its actions.

In another series of events, phosphatidylinositol 3-kinase (PI 3-kinase) was found to produce phosphatidylinositol-3,4-diphosphate and phosphatidylinositol-3,4,5-triphosphate which are activators of a protein kinase C and are implicated in cell growth and transformation. In one case, activation of PI 3-kinase is stimulated by platelet-derived growth factor through a tyrosine kinase, and phosphorylation of tyrosine is the event which promotes translocation of PI 3-kinase. One type of subunit of PI 3-kinase interacts with a sequence containing phosphorylated tyrosine, and the other type contains serine/threonine kinase activity. Brought out in various discussions in this sections are SH2 and SH3 domains, proline-rich sequences, bcr homology, phosphotyrosine, heterotrimeric G proteins, and small G proteins.

The DAG analog in the sphingolipid family, ceramide, although not as well studied has been reported to have a role as a second messenger. Evidence indicates that this involves changing the phosphorylation state of target molecules and that ceramide accomplishes this through a ceramide-activated protein phosphatase and a ceramide-activated protein kinase. Regulation of sphingomyelinase and ceramidase may also be a factor in this signal pathway. Ceramide appears to be involved in mediating growth suppression of cells through various routes, as well as mediating inflammation and immune response. Still less information is available concerning the roles of sphingosine which has been reported to affect a number of cell systems.

The information still to be derived from investigations into the signal-communicating abilities of these molecules seems unlimited. Platelet-activating factor (PAF), PAF-like mimetics, and prostaglandins are topics of considerable interest which have found no space for comment in this brief review. So much for the general belief that the world revolves around proteins, carbohydrates, and nucleic acids. It appears as though the lipid family is a fat storehouse containing plenty of new, interesting, and unknown delicacies.

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