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*Book Reviews**

An Introduction to Ultrathin Organic Films from Langmuir-Blodgett to Self-Assembly. By Abraham Ulman, Corporate Research Laboratories, Eastman Kodak Company. Academic Press Inc., San Diego and London, 1991. xxiii + 442 pp. $65.00. ISBN 0-12-708230-1.

In 1966 George L. Gaines, Jr. published his monograph entitled, *Insoluble Monolayers at Liquid-Gas Interfaces*, which provided the first comprehensive review of the literature in this field, along with a limited theoretical background and some current applications. At the time the text was an essential tool for workers in the field, providing, as it did, the first clear picture of what had been achieved and where the main problems lay. In the twenty six years that have elapsed since Gaines' monograph, publications in the field have multiplied many times, completely new areas have developed, numerous new experimental techniques have been employed and a significant new emphasis on potential applications is evident.

If any text can claim to be the successor to that of Gaines, it is clearly this one. This, in spite of the fact that only about ten percent of the book deals with films at the air-water interface reflecting the intense interest in either Langmuir-Blodgett or Self-Assembled films on solid substrates. Following the introduction which includes a useful set of general references, the text divides itself into five parts or chapters. *Part 1* surveys and outlines the theory, advantages and limitations of the wide range of analytical tools used to evaluate thin films and their surface properties. *Part 2* deals with Langmuir-Blodgett films including a treatment of monolayers at both the air-water and the oil-water interface. Review of these films is broken down into the various molecular types including the very important polymeric films. *Part 3* treats the more recently developed field of Self-Assembled monolayers and multilayers with an emphasis on the most frequently studied alkane, silane and alkanethiol films. *Part 4* discusses, at least in outline, the various theoretical attempts to model monolayer systems, comparing and contrasting the different approaches. *Part 5* lists and evaluates the existing and potential applications of both Langmuir-Blodgett and Self-Assembled films. Finally Ulman concludes his text with a refreshing and subjective review of the field and its possible future directions.

First of all it is clear that, for both researchers in the field and those planning to enter the field, this book is a must. No other text at this time offers such a comprehensive review of thin organic films. In addition to the general references already mentioned, each section is copiously referenced in a near comprehensive way up to and including the year 1990. The numerous citations and their sometimes conflicting results are a strength, but also a weakness of the text. A strength, in that a broad overview of the field is presented, a weakness, in that a clear conclusion

* Unsigned book reviews are by the Book Review Editor.

is not always reached when the experimental data from differing sources lead to differing conclusions. To be sure, in part, this confusion arises frequently when investigators fail to adequately characterize their films or use differing analytical techniques that provide different answers. Unfortunately, one approach that might have helped, that of preceding the experimental data with theoretical models that would help interpret such data, *i.e.*, having Part 4 before Parts 2 and 3, was not taken. Instead the reader must return to Parts 2 and 3 to see what light the theoretical approaches throw on experimental results.

The text does contain a number of typographical slips, but no more than one might expect in a first edition. In addition there are errors of content, some of which are evident, e.g. (p. 109) "a very hydrophobic surface that is completely wetted by water" or, describing second harmonic photon generation, as producing a *proton* with twice the frequency of the original photons. Some errors appear to be transcribed from the original reference as witness the acceptance of too high a rate of oxidation of cholesterol films (p. 121) or citing the Clausius-Clapeyron equation when it is the Clapeyron equation that applies. One persistent error that appears in describing polymer films is the reference to molecules where residue or repeat unit is what is meant. Finally, both figures (2.7 and 2.41) schematically depicting surface pressure/area per molecule isotherms, mislabel phases in a rather serious way.

The strength of the text clearly lies in the discussion and interpretation of self-assembled monolayers and multilayers (Parts 3 and 4 as well as the final comments), perhaps a reflection on the personal background of the author. Two aspects are strongly emphasized: that, in spite of the many synthetic organic thin film variations already formulated, this field has only begun to investigate the numerous possibilities of which they are capable, and that, in the appraisal of compositional and structural characteristics, there is a need to utilize a multitechnique approach in order to clarify actual and/or apparent discrepancies in the future literature.

If the number of applications so far allowed for such films has been limited, it is not necessarily because the objectives are unattainable, but rather because, in spite of the efforts of the past two and a half decades, much remains to be done. In this regard, Ulman has a clear picture of the current state of the field and where it should be heading. I end this review by repeating that, in spite of the text's problems, this is the only one available that attempts to discuss thin organic films, both in depth and comprehensively, and is therefore a necessary text for those involved with, or planning to be involved with the field. I only hope that, in view of the numerous continuing number of publications in this field, that the author will consider a second edition before too much time has elapsed.

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Magnetic Molecular Materials, edited by D. Gatteschi, O. Kahn, J. S. Miller, and F. Palacio, NATO ASI Series E: Applied Sciences, Vol. 198; Kluwer Academic Publishers, Dordrecht, Boston, London, 1991; xi + 411 pages; $144.00.

This book is the proceedings of the NATO Advanced Research Workshop on Magnetic Molecular Materials held at "Il Ciocco," Castelvecchio Pascoli, Lucca, Italy, October 28–November 2, 1990. The volume consists of a preface, 25 chapters (dealing with overviews, characterization of organic, organometallic, and inorganic materials, and detailed physical studies), three reports of round table discussions, a list of participants, and an index. For the uninitiated, the materials under discussion in this work are less well-defined than molecular metals of the TTF-TCNQ or $(BEDT\text{-}TTF)_2X$ classes.

Inclusion Compounds, J. L. Atwood, J.E.D. Davies and D. D. MacNicol eds.; Oxford University Press, 1991; Volume 4.

The fourth volume of this excellent series devoted to the inclusion compounds deals with some of the most recent aspects of the host-guest chemistry involving organic hosts. Both crystalline and soluble adducts are discussed in detail, with very wide bibliographic notes.

As a chemist long interested in crystalline inclusion compounds I cannot conceal my perplexity at the extension of the term "inclusion compounds" to include complexes which are stable in water or in other solvents. In a strict sense an inclusion compound forms when the guest molecules occupy the cavities existing in a crystalline host lattice and the host-guest interactions are essentially steric in origin, i.e., related to the shape and dimensions, and not to the chemical nature of the two components. A lot of examples exist which conform to this definition. In other cases, however, the steric interaction is coupled with a specific chemical interaction, with the result of an increased stability of the adduct. This is the case of coordinatoclathrates, in agreement with the nomenclature proposed by E. Weber a few years ago and widely used in this book.

In general terms, one can say that a continuum exists between pure clathrates and the usual coordination complexes, and the limit to which we can properly speak of inclusion compounds is a matter of convenience rather than of definition. In this discussion even the presence of a crystalline phase can be considered as a non-necessary condition: the role of the crystal lattice may be assumed by the single host molecules, provided they possess suitable geometric and functional features. A new class of inclusion compounds, that of molecular-type (or unimolecular) inclusion compounds should therefore be considered beside the classical lattice-type (or multimolecular) clathrates.

These remarks seem to be necessary in order to understand the scope of the book and the choice of topics, which are all of primary importance in today's chemical research.

The volume contains 11 chapters written by well known experts in the field and mainly covers the synthetic and structural aspects of these systems, as well as some of their possible applications. Each chapter is devoted to a particular host or to a set of similar hosts, including alicyclic diols, calixarenes, acetylenic alcohols, binaphthyl derivatives, cyclophanes, crown ethers, cryptands and others. Emphasis is often given to the diffractometric results, while very little is reported about other techniques of structural analysis. In particular no examples of solid state NMR spectra are reported (however the editors announce a chapter on this topic in the fifth volume). Special attention is given to the methods of optical resolution through formation of crystalline inclusion compounds. In the case of soluble complexes, interest is focused on their binding ability with alkaline and transition metal cations and, to a lesser extent, to their biomimetic activity.

The level of the various chapters is in general very high, some of them make very pleasant reading, others are more obscure due to the high number of chemicals involved or to the use of very specific jargon. In conclusion this is a book very useful to anyone involved in the host-guest chemistry; it should not be missing in any good scientific library.

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Solid Polymer Electrolytes Fundamentals and Technological Applications, Fiona M. Gray, VCH Publishers, New York

Polymer electrolytes are ionically conducting, solvent-free materials which are usually formed by incorporating a salt into a polymer matrix. The best known systems are based on polyethers as these are capable of dissolving a variety of salts at high concentrations and yield materials with the highest conductivities. Although these materials have been known for many years the true starting point for the current interest was 1978 when Michel Amand suggested that they might be used as the electrolytes in solid state batteries. The specific conductivities of the materials (in most of the early work these were polyethylene oxide-salt complexes) were not exceptionally high, however this was compensated by easy fabrication as very thin films with attractive mechanical properties. In particular, they were flexible and not subject to cracking, a failure to some of the ceramic candidates for battery electrolytes. Since 1978 there has been an immense research effort in polymer electrolytes with a prime technological goal of producing a viable lithium secondary battery. This has involved the study of a wide range of potential polymer electrolytes often using novel systems. An aim of the basic research has been to understand the detailed mechanism of ion transport.

This book by Fiona Gray is the first attempt to produce an introductory text on polymer electrolytes. In addition, to quote the author, other objectives are to "give the more familiar (reader) a comprehensive account and objective analysis of the subject." In my opinion Ms. Gray has only limited success in achieving all these goals. This is partly due to the very nature of the topic and partly due to the approach that has been adopted.

Some areas of science rapidly reach a level of maturity that they can be critically and usefully surveyed after a decade. This is not the case with polymer electrolytes and this presents problems for any author aiming at an introductory level text. Firstly, there is the problem that sample variations can strongly affect experimental results. The potential sources of sample variation are many for polymer electrolyte films; polymer molecular weight, polymer decomposition, level of impurities, susceptibility to the atmosphere (particularly moisture), nature of the solvent used to produce film, thermal history, etc. As a consequence contradictory results have been reported for some properties, in some cases properties that are crucial to a deeper understanding. The question of materials characterization has been addressed in some of the more recent work and is now recognized as a major problem. The approach taken in this book is to quote all the available data. This is unbiassed but also uncritical and could leave the unitiated very confused.

The theoretical issues in modelling polymer electrolytes are proving difficult due to their complexity. The concentration of salt in polymer is usually very high, well outside the range where simple electrolyte solution theory is applicable. It is now realized that the motion of the ions is coupled to the motion of the polymer chain and will not be modelled by a simple analytical theory. Theoretical progress will be slow with computer simulation possibly offering the best long-term approach. This book adequately describes the various models that have been proposed, but again the reporting is somewhat uncritical.

The newcomer to this topic will find the sequence of chapters not especially helpful. In particular, the opening chapter deals with devices and contains a lot of technical information on topics such as battery performance. It would have been more logical to set the scene with a description of materials, basic behaviour and preparation.

A good feature of the book is its thoroughness in the coverage of the literature; there can be few papers on polymer electrolytes that do not appear in the reference lists. Some topics are dealt with particularly well, for example the range of materials is well-documented and the approaches to achieve improved ionic conductivity. Descriptions of experimental techniques are rather brief but there are adequate references to primary texts. The sections on potential applications are good and cover all the latest developments.

In spite of some of the above comments I would recommend this book. Provided newcomers are persistent and thoroughly read through the book they will acquire the basic information on the topic that can take them into the specialized research literature. For workers in the field the comprehensive literature coverage will make this a book they will always want at hand.

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Liquid-Crystalline Polymers, edited by R. A. Weiss and C. K. Ober; American Chemical Society Symposium Series No. 435, 1990; x + 508 pages: ISBN 0-8412-1849-8; $99.95.

This volume was developed from a symposium held at the 198th National Meeting of the American Chemical Society at Miami Beach, Florida, September 10–15, 1989. The editors seek to provide a broad view of the directions that research in liquid-crystalline polymers is taking in industrial and academic laboratories, and their introductory chapter is a useful overview. The book consists of 32 chapters divided into the following seven sections: Synthesis of Main-Chain Liquid-Crystalline Polymers; Synthesis of Side-Chain Liquid-Crystalline Polymers; Physics of Liquid-Crystalline Polymers: Networks; Physics of Liquid-Crystalline Polymers: Texture and Structure; Physics of Liquid-Crystalline Polymers: Transitions and Properties; Applications of Liquid-Crystalline Polymers: Rheology and Processing Behavior; Applications of Liquid-Crystalline Polymers: Blends.

Organic Molecules for Nonlinear Optics and Photonics, edited by J. Messier, F. Kajzar and P. Prasad; NATO ASI Series E, Vol. 194; Kluwer Academic Publishers, Dordrecht, Boston, 1991; xiv + 544 pages; ISBN 0-7923-1181-7; $174.00.

This book is the proceedings of the NATO Advanced Research Workshop on Organic Molecules for Nonlinear Optics and Photonics held at La Rochelle, France, August 26–September 1, 1990. The book consists of 37 chapters divided into four sections as well as a list of participants, working group reports on materials (mostly second order), third order effects and materials, and theoretical issues. The four main sections are titled "Theory of Optical Hyperpolarizability in Organic Molecules," "Organic Molecules for Second Order Nonlinear Optical Effects," "Third Order Effects in Thin Films and in Solutions," and "Noncentrosymmetric Thin Films for Quadratic Optics and Waveguiding Devices." The report of the theoretical working group is noteworthy for contrasting interpretations involving localized structural changes (bipolarons, solitons) with those involving virtual excited states in a fixed geometry and also for emphasizing that for condensed phase calculations, virtual excited states should be described as excitons.

Inorganic and Organometallic Polymers with Special Properties, edited by Richard M. Laine, NATO ASI Series E, vol. 206, Kluwer Academic Publishers, Dordrecht, Boston, 1992, xx + 435 pages; ISBN 0-7923-1514-6; $137.00.

This book contains the proceedings of the NATO Advanced Research Workshop on Inorganic and Organometallic Polymers with Special Properties held at Cap d'Agde, France, September 9–14, 1990. It is the third volume on this general topic edited by R. M. Laine. It consists of a list of authors and participants, 26 chapters divided into 7 sections (Framework Science, Polymer Synthesis, Magnetic Materials, Conducting and Electronic Materials, Preceramic Materials, Nonlinear Optical Materials, Characterization), and a Report to NATO. The work contained in the book is dedicated to the memory of the late Donald R. Ulrich of the U.S. Air Force Office of Scientific Research.

Macromolecular Assemblies in Polymeric Systems, edited by Pieter Stroeve and Anna C. Balazs, American Chemical Society Symposium Series No. 493, 1992; ISBN 0-8412-2427-7; ix + 326 pages; $79.95.

This book was developed from a symposium held at the 201st National Meeting of the American Chemical Society, Atlanta, Georgia, April 14–19, 1991. The editors seek to deal with assemblies which occur in nature or which may be fabricated by self-assembly, Langmuir-Blodgett deposition, corona-onset poling, organic molecular beam epitaxy and other techniques. The range of application of such assemblies goes from drug delivery systems to the engineering of nonlinear optical devices. The book consists of twenty-four chapters, including an overview by the editors, 12 chapters of Monolayers and Multilayer Films, 6 chapters on Three-Dimensional Systems, two chapters on Scanning Probe Microscopy of Macromolecular Assemblies, and three chapters on Polymers and Liquid Crystals, as well as author, affiliation and subject indices.

Organic Crystal Chemistry, edited by J. B. Garbarczyk and D. W. Jones, Oxford University Press, International Union of Crystallography Crystallographic Symposia, 1991; xi + 203 pages; ISBN 0-19-855383-8; $55.00.

This volume contains the proceedings of the 7th Symposia on Organic Crystal Chemistry held at Poznan-Rydzyna, Poland, 14–17 August, 1989. The book consists of a preface and 15 chapters on a variety of current topics by authors from Germany, Hungary, Israel, Poland, U.K., and U.S.A. There are no indices. In an introductory chapter, D. W. Jones offers a useful overview to the topics of the

following chapters. The chapter by J. Bernstein provides interesting examples of structure-spectra relationships in polymorphic systems, and the chapter by Shimon, *et al.* details examples of "tailor-made" solvents and surface interactions on crystal growth and dissolution. The chapter by Boese, *et al.* describes apparatus to obtain diffraction quality crystals in a cryostat and directly on a diffractometer, as well as the results of studies using this apparatus on crystals of strained aromatics such as cyclopropanes. While most chapters deal with single crystal studies using x-ray sources, two pursue somewhat different themes. Finnery and Wilson describe both single crystal and powder studies using the pulsed neutron source ISIS at the Rutherford Appleton Lab in the U.K. Paukszta, *et al.* describe effects of electric fields on polymorphism in isotactic polypropylene. Finally, Jones offers a brief summarizing chapter of a round-table discussion on the topics collaboration, data bases, emerging topics, and new techniques.