

The language used is understandable, although some of the occasional awkward constructions which interrupt the flow of the manuscript should have been eliminated at the editorial stage. The book is well produced, apart from the minor reservation noted above, and there are very few typographical errors.

It can reasonably be expected that this review will be well received and will stimulate much further work and discussion.

*W. J. Feast*

**ADVANCES IN POLYMER SCIENCE, Volume 38  
Polymerization Processes**  
Springer-Verlag, New York,  
Heidelberg, 1981, 170 pages,  
\$46.10. ISBN 0-387-10217-5.

Volume 38 of this series contains five articles written by separate authors. The articles vary in both their purpose and subject matter.

The first article, by N. Yamazaki and F. Higashi, deals with new condensation polymerisations which are promoted by phosphorus compounds. This is concerned largely with work which has been carried out by the authors during the last 10 years. The review sets out the reaction types in a systematic manner. It covers the formation of polyamides, polypeptides and polyesters. The discussion is concise and reasonably clear (34 references).

The second article by G. Silvestri, S. Gambino and G. Filardo discusses the electrochemical production of initiators for polymerisation processes. This deals with the synthesis of complex catalysts and the direct electrocatalysis of polymerization. The discussion is detailed and reviews the publication of many workers (133 references).

In the third article, M. Kamashi deals with the influence of solvents on the free-radical polymerisation of vinyl compounds. This is not merely a factual account but an historical review of the development of basic ideas. The reasons why rate coefficients depend on solvent type are discussed in a quantitative manner. The article is well-researched and presented clearly (146 references).

The fourth article, by A. A. Berlin, S. A. Volfson and N. S. Enikolpian is entitled 'Kinetics of Polymerization Processes'. Primarily, it is a review of work carried out in the Soviet Union during the last five years. Both ionic and free-radical polymerisation are covered. The variation of chain termination rate coefficients with radical size is treated in some detail and the possibilities of 'living' radical polymerizations are discussed. The article includes thermodynamic effects in the kinetics of ionic heterogeneous polymerization. In conclusion, there is a substantial quantitative discussion of models which may be used to describe polymerization processes. This is a useful review and the authors have been successful in relating recent Soviet work with work which has been carried out elsewhere (145 references).

The last article, by J. P. Kennedy and J. M. Delvaux, deals with the synthesis, characterisation and morphology of polybutadiene-polystyrene graft copolymers. Unlike the other sections of the book, this is an original account of new experimental research.

A study has been made in which polystyrene cations are grafted on to polybutadiene. Model reactions have been used as an aid to understanding the process. The effect of reaction conditions on the efficiency of graft formation is evaluated (40 references).

Obviously, this is a book for those who are familiar with polymerization processes already. The standard of work is high and generally the presentation is clear. In all cases, the references include recent publications; the papers were received by the editors between July 1979 and June 1980. Few readers will be concerned equally with all of the articles but those workers who specialise in one of the fields which is covered will find the consultation of the book worthwhile.

*B. W. Brooks*

**'Semiconducting Polymers'**  
*Marian Kryszewski*  
PWN-Polish Scientific  
Publishers, Warsaw, 1980

The contribution of Professor Kryszewski and his coworkers at the Polish Academy of Sciences in Lodz will be well known to those interested in semiconducting polymers. His many personal contacts both in the East and West are reflected in the authoritative way in which he is able to discuss the literature from a large number of research workers. The original Polish version of the book appeared in 1968. The English translation was prepared during the period 1970-74 and was rewritten and extended to include the literature which appeared during this period. Literature published in the period 1974-78 has been collected into a final chapter which is entitled 'Recent Trends'. This complements the first eight chapters and extends the discussion to cover more recent advances in selected topics. Professor Kryszewski has made a valiant effort to produce a comprehensive review of the literature for which he must be heartily congratulated. However, one feels that because of the volume of literature covered certain of the sections lack a directness required to maintain the reader's interest. As with any translation, the occasional lapse of syntax is to be expected. These are rare and the style of writing is in general good. For a book for its size 594 pages — the number of typographical errors are small, a few minor slips, such as Linschitz for Linschutz, occur but these will not distract the reader from an appreciation of the breadth and thoroughness of the coverage of the literature. The first three chapters are concerned with fundamentals and describe the general character of semiconducting polymers, their preparation and physical/chemical properties. These chapters are well organised and indexed allowing the reader to easily find the particular topic of interest. Chapters 4-8 deal with magnetic, catalytic activity, photoconductivity, biological semiconductors and methods of measurement of electrical and photoconductivity. Unlike the first three chapters the text is not as well divided into subsections and it is somewhat more difficult to access topics of particular interest. Chapter 9 complements the preceding chapters and reviews the literature from 1973 to 1978. It is divided into sub-sections similar to those used for the previous eight chapters and as such

reflects the general organisation of the book indicated above. A minor irritation was the use of italics for the references in this section. Instead of following on with the numerical order of references used in the previous chapters, a separated bibliography is used for this chapter and the references are distinguished by being in italics. This point is made in the preface. However, the reader may find himself a little confused since chapter 9 also contains references from the main body of the text, and differentiating between italic and normal numerals is not always easy. An additional point which would have eased reference to the data would have been the greater use of subheadings in this chapter. For instance, it is not directly obvious that the discussion of  $(SN)_x$  starts on page 442 and extends to 446, likewise polyacetylene pp. 446-454 and polydiacetylene pp. 454-455. Despite these minor criticisms, the reader should find this a very authoritative work in which the author has added his skill and experience to the discussion of many of the mechanistic points concerned with the interpretation of charge migration in these systems. I would anticipate that this text will be eagerly consulted by all interested in semiconducting polymers and should find a place in all University libraries. Unfortunately, any book on such an actively researched field is of necessity bound to be out of date before it is published. The growth of activity indicated by Professor Kryszewski into polyacetylenes, in fact, occurred and has attracted considerable interest with the appearance of the polymeric battery. For the reader interested in this particular area, a review by MacDiarmid<sup>1</sup> is strongly recommended. In conclusion, *Semiconducting Polymers* is a book well worth a read, and for the worker in this field may be considered to be the most recent authoritative reference on the subject, and as such an essential addition to their library.

<sup>1</sup> A. G. MacDiarmid and A. J. Heeger 'Organic metals and semiconductors: The Chemistry of Polyacetylene ( $CH_x$ ) and its derivatives', *Synthetic Metals*, 101-108 (1979:80)

*Richard A. Pethrick*

**MOLECULAR ELECTRO-OPTICS** Electro-optic Properties of Macromolecules and colloids in solution  
*Edited by Sonja Krause*  
Plenum Press (Volume B64  
NATO Advanced Study Institute Series) New York, 1981 — \$59.50.

Electro-optic investigations of polymers and colloids are not used on a routine basis to characterize their structure, but as this volume shows the techniques grouped under electro-optics are capable of supplying a variety of fundamental information intimately associated with structure. Kerr effect, electric linear dichroism and electrically induced fluorescence are related to molecular

anisometry, conformational changes (e.g. helix-coil) may be followed by electrical-optical rotation whilst electric field light scattering measurements enable calculation of dipole moments and rotatory relaxation times. All these subjects and others are dealt with in this book.

The contents of the book are the main lectures given at Rensselaer Polytechnic during a NATO Advance and Study Institute held in July 1980. There are twenty two separate contributions and between them they cover the whole subject range of physico-chemical electro-optic studies. Thorough discussions of Kerr effects (O'Konski, Jernigan and Miyazawa) and electric field light scattering (Jennings) are naturally present, accompanied by discussion of polarized fluorescence (Weill) and electric birefringence dynamics (Krause and O'Konski). Notwithstanding the title, the fundamental electro-optic theory of small molecules is surveyed in Buckingham, whilst a particularly interesting chapter on liquid crystals is authored by Dunmur.

Apart from these detailed reviews, several chapters deal with specific materials, e.g. proteins, polynucleotides, viruses, whilst Mandel provides a clear, up to date and enjoyable discussion of polyelectrolytes. A particularly welcome feature for those about to undertake electro-optic studies is a critical evaluation of apparatus and the factors governing choice given by O'Konski and Housier.

The price of circa £30 is not unreasonable by today's standards for a specialist book, and is recommended to all involved in electro-optic investigations.

Additionally the information contained in it, together with the detailed references, given, make this book a survey of current electro-optical theory and should therefore be in all libraries. For a book of this size (500 pages) there are few printing errors although page 81 has a photograph reproduced back-to-front.

*R. W. Richards*

## 'Principles of Polymer Morphology'

*D. C. Bassett*

Cambridge University Press,  
Hardback: £25, 251 pp.

This book is intended to serve as an introduction to the microstructure of semi-crystalline polymers for undergraduates, postgraduates and research workers in allied fields. In practice it gives a good background to the lamellar nature of polymer crystals, and to the organization of lamellae into larger structures such as spherulites. The examples and illustrations used are primarily of polyethylene, which perhaps reflects the fact that this is the polymer whose morphology has been studied in the greatest detail. More surprising perhaps is the emphasis placed on anabaric polyethylene (polyethylene crystallized at pressures in excess of 3Kbar).

The book is divided into nine chapters, at the end of each chapter one of two review articles are cited for those wishing to find out more about the subject. Apart from these review articles there are very few references given in the text, which tends to state what is known rather than who did what.

The first chapter deals with some of the fundamentals of polymer science, such as molecular and crystal structures and then describes briefly some of the more important techniques used in the study of the polymer morphology. The second chapter is concerned with the spherulites and their overall morphology; the theory of Keith and Padden proposed to account for the growth of spherulites is also outlined. In the third chapter the lamellar nature of polymers is properly introduced; particular emphasis is placed on the habits and sectorization of solution grown single crystals. The fourth chapter is concerned with the development of larger structures from lamellae. The various crystallographic forms which can arise are discussed before the development of three-dimensional structures is introduced. The latter part of the chapter is devoted to melt crystallization and the relation between lamellae and the spherulite texture.

The fifth chapter is concerned with the crystallization processes themselves, first it shows that crystallization occurs by a secondary nucleation process, then discusses fractionization and annealing and their effect on morphology. The sixth chapter is devoted to a brief description of the kinetic theory of crystallization as formulated by Hoffman and his coworkers. The derivations of the equations of both of the lamellar thickness, and of the growth rates are sketched. The seventh chapter is concerned with crystallization with chain extension, the bulk of this chapter deals with the structure and morphology of high pressure crystallized (anabaric) polyethylene. The achievement of chain extension in flowing systems is also briefly described. The eighth chapter deals with the relationship between the morphology and chemical behaviour; this includes a description of diffusion behaviour and of possible chemical reactions at fold surfaces. The effects of irradiation are also discussed. The final chapter deals very briefly with some aspects of mechanical behaviour as related to morphology.

Most aspects of polymer morphology are therefore dealt with in varying degrees of detail, reflecting the particular interests of the author. The book provides an introduction to polymer morphology, which is suitable for both post-graduate and undergraduate students, and new research workers, although at £25 it would be expensive as an undergraduate text-book.

*P. J. Barham*

## Low Temperature Properties of Polymers

*I. Perepech-o*

Pergamon 1980.

In two monographs Professor Igor Perepecho has reviewed the high and low temperature properties of amorphous and crystalline polymers. The first monograph is entitled 'Acoustic Methods of Investigating Polymers' and is a comprehensive survey of the literature upto 1972, it is available from MIR and was published in 1975. The second monograph, which is the subject of this review, was published in 1978 in Russian by MIR and subsequently has been released by Pergamon in English translation in 1980. Despite the apparently recent date of publication (of the latter monograph) the literature coverage of both monographs is the same and as such the monograph on the low temperature properties of polymers is approximately eight years out of

date on publication in its English translation. Despite these severe limitations, this monograph does make a useful contribution to the literature providing as it does a comprehensive coverage of some of the earlier and more obscure Russian literature.

The reader unfamiliar with the low temperature properties of polymers will find this monograph a useful introduction to the subject. The monograph presents an interesting slant to the literature, in which some rather less familiar contributors to the theory have slightly more prominence than in the usual literature on this subject. The monograph starts with a traditional approach, developing the Debye and Lifshitz theories of heat capacities and then discusses the various particularizations introduced to describe molecular systems. The specific heat measurements of polymers using traditional methods is described, the more recent developments in this area are not considered. Likewise the subsequent chapters which are concerned with thermal conductivity, thermal expansion electrical properties, nuclear magnetic resonance, dynamic mechanical and acoustic properties and viscoelastic measurements are all concerned with the data obtained from the now more classical techniques. The newer pulsed laser techniques for the exploration of thermal properties are not mentioned, the various omissions only emphasize the progress which has been made in this subject since 1972. Each chapter contains an appropriate discussion of crystalline and amorphous polymers and includes consideration of polyethylene, polytetrafluorethylene, polymethylmethacrylate and nylon. In the section on ultrasonics there is a obvious overlap with the first monograph, however it is clear that the author has to a large extent seen these as companion volumes and the general overlap is relatively small. It would be easy to list the various inadequacies in the book, for example its lack of a discussion on orientated polymers with their large and important anisotropy in thermal properties. Similarly despite that fact that various fluorinated polymers are discussed there is no coherent comparison of the variation of the Van der Waals interactions on the low temperature heat capacities. These and various related topics have all been the subject of extensive studies during the period 1977 1980 and the reader is strongly recommended to supplement this monograph with consultation of papers and reviews published in *Polymer* and other journals in the last eight years.

As a teaching text rather than as a research monograph, the reader will find it well presented and the style of presentation is good for a Russian text. There are very few sections where the reader will feel aware that this is a translation, the most obvious being the occasional use of Russian characters, sometimes unexplained in the text in reference to the original diagrams. It is obvious that the original art work has not been 'translated'.

Despite the obvious criticisms of the monograph the text can be unreservedly recommended as an introductory text on the subject and since it covers obscure literature it makes a valuable contribution to the review literature on the subject. Professor Perepecho is to be congratulated for his effort and it would be pleasing to see an upto date monograph to complement these in the future.

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