

The atlas, an apt description, is a listing of the peak wavenumbers and assignments of virtually every known polyurethane, its precursors and model compounds. What it does not give is any of the experimental techniques required to produce the spectra. The book is, therefore, for the specialist.

The atlas is divided into three parts: model compounds, polyurethanes, and biomedical polyurethanes. In addition a set of appendices has been added. These include a chemical compound index, a frequency index, and a chemical group correlation chart. The term "polyurethane" covers a wide range of chemical entities including poly(ester urethanes); poly(ester urethane ureas); poly(ether urethanes); and poly(ether urethane ureas). All are included, together with their low molecular weight analogues.

Each page in the main section of the book gives the chemical structure of the compound being described, its chemical/polymer components (polyol soft segment, isocyanate and chain extender) and a listing of the wavenumber and assignment. Sources are referenced throughout.

It would be difficult to fault the book as a work of reference. The section on biomedical polyurethanes could be particularly useful in this rapidly expanding field. It is also a must for everyone working in a laboratory with an infra-red spectrometer.

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### **Plastics Films, (3rd Ed.)**

*J. H. Briston*

Longman Scientific, Harlow, Essex,  
1989, 434 pages, £29.00  
ISBN 0-582-01490-5

This is the third edition of a book which has become a well known text to students in the plastics and packaging industries. The original format has been retained but extensively revised and updated to cover advances in materials and conversion processes during the past six years.

After a brief introduction, the book divides into four parts: film-forming materials; manufacture and properties of films; conversion of films; and applications. Part 1 contains six chapters, providing a good outline of the structures, properties and applications of the wide range of industrially important film-forming polymeric materials. These chapters contain a great deal of information and are a valuable source of reference. Part 2 is the major section of the book, and Chapter 8 describes the major techniques for manufacturing film.

Explanations of complex machinery are easy to understand and are assisted by clear diagrams. Chapters 9 and 10 discuss the mechanical, chemical and physical properties of plastics films that are important to the end use of the material and for the packaging operations. Also included are various test methods that are used for the measurement of such properties. Two chapters, on the key topics of Health Safety and Organolepsis, have been re-written by Dr Leonard Katan and considerably updated. Given the current concerns about irradiation as a method of food sterilization/preservation, I am surprised that greater emphasis is not given to this topic. There is good coverage of the legislative aspects of food packaging materials, with sections on the law in various countries world-wide. This part finishes with a nice chapter on choice of materials.

Part 3 contains six chapters on the conversion of films. Again, the author has provided good coverage and clear descriptions of techniques. This edition includes new or expanded sections on modern processes. The final part covers, in seven chapters, a range of applications for plastics films, and certain environmental issues. Packaging forms the largest outlet for plastics films, and this topic is given appropriate weighting. The book is completed with a series of four appendices on: properties of plastics films (a table of data); identification of film materials (a summary of test methods); trade names (a list); and additives for plastics films (a description of the various types used). Many, but not all, chapters contain recommendations for further reading, and there is an adequate index.

Overall, this is a book that I shall continue to use and recommend to students seeking knowledge of plastics films.

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### **Photoreactive Polymers: The Science and Technology of Resists**

*A. Reiser*

John Wiley and Sons,  
Chichester, 1989, 409 pages,  
£35.85,  
ISBN 0-471-85550-2

This book has arisen from the author's experiences in teaching graduate and post-graduate courses. He has also participated in courses in surface coatings science and technology for industrial materials scientists and engineers.

The science and technology of resists

is of increasing importance. It draws from, and contributes towards, the ever important topic of reactive, curable systems based on excitation by electromagnetic radiation in the u.v. range and in particular radiation in electron beam curing.

The text is stated to be designed to give a balanced view of the subject as it now stands and, at the same time, promote an understanding of the perennial challenge of material science: 'to meet the demands of new technology by the successful design of new materials'. Careful scrutiny of the text clearly demonstrates that the author has more than fulfilled his objectives. The text is timely, well written, balanced and comprehensive. It is presented in a sympathetic and logical manner.

Each of the ten chapters is accompanied by a comprehensive and up-to-date bibliography. The detail given in the chapters, together with the rigour of treatment reflects the intended audience.

In chapter one (20 pages, 22 references) we are treated to a brief history of resists with emphasis on the early history of resists, synthetic photopolymers and photofabrication.

Chapter two (42 pages, 69 references) deals with the physical chemical and the photochemical aspects of crosslinking processes as encountered in negative photoresist systems. Attention is given to the reactions of excited chromophores including those encountered in water-processable resists and resists based on photoinduced polarity changes. The physical chemical aspects which are considered include gel point exposure and photographic sensitivity, quantum yield studies and the physical chemical features of resist processing.

Chapter three (36 pages, 84 references) is concerned with relevant features of the photophysics and photochemistry as experienced by solid polymers. Topics dealt with include excimers, energy transfer phenomena and migration phenomena, spectral excitation, and electron transfer sensitization. Special attention is given to the photochemistry of amorphous solids of significance to the development of resists, in a manner which is sympathetic in style, yet thorough.

Chapter four is the first of the chapters dealing with the chemistry and technology of photoresist systems and methodology. It is concerned with the broad topic of photoinitiated polymerization. It is reasonably comprehensive (77 pages, 159 references), taking the classical presentation line. Thus, photofragmentation, H-abstraction and ligand exchange approaches are dealt with. Kinetic aspects are considered as are photopolymerizations carried out in amorphous solids and in the crystalline phase. The subjects of photoinitiated step-growth polymerization (thiol-ene) and of photoinitiated cationic polymerization (onium

salts and oxirane monomers), (ferrocene like iron/arene complexes) are covered. Very useful provision is given to practical photo-initiation systems in a section which is supported by a strong bibliography.

Chapter five (47 pages, 71 references) deals with positive resists based on diazonaphthoquinones as seen in their inhibition of the dissolution of phenolic resins in aqueous alkali and the photochemical transformation of diazonaphthoquinones into indene carboxylic acids. The chemistry of diazonaphthoquinones is considered in detail as are the relevant resin systems and their resist characteristics.

Chapter six (25 pages, 25 references) carries the rather off-putting title 'The Rudiments of Imaging Science'. In fact it is a gem of an introduction to a somewhat complex subject area and one that is often mishandled, but not in this case. The topics of sensitometry of imaging materials, image degradation and spread functions and resolution in optical pattern transfer are dealt with in a highly coherent manner.

Chapters seven to ten inclusive are concerned with the nature of the energy input and, as such, form an invaluable sub-section to the book.

Chapter seven (41 pages, 75 references) deals with the physics and chemical aspects of deep u.v. lithography. Negative resist systems and positive resist systems are considered from the point of view of ionization and excitation caused by the incident deep u.v. energy. Here, degradation must be considered, which it is, alongside photoinduced polymerization.

Characterization methods of relevance are considered and useful examples provided.

Chapter eight (40 pages, 105 references) is concerned with electron beam lithography, one of the newer lithographic patterning methods which employ ionizing radiation (electrons, X-rays, ions) as the information carrier. Electron beam lithography is perhaps the most advanced of these methods. The chapter is well supported by an up-to-date bibliography and useful examples. The treatment given to radiation chemistry, radiation-chemical processes and the radiation chemistry of polymers will not satisfy purists in these topics. However, the style and content fits in well with the specific subject area. This is especially true when consideration is given to the intended audience.

Chapter nine (23 pages, 62 references) considers the role of X-ray and ion beams in lithographic processes. In principle, X-ray lithography combines the high resolution of electron beams with the large-area exposure mode and good wafer throughput of optical lithography. The principles of the technique are dealt with as is the methodology as applied to negative X-ray resists and to positive X-ray resists. The chapter, though short, gives the feeling of excitement which the topic engenders.

Chapter ten (34 pages, 95 references) is perhaps best thought of as two chapters, combined for convenience. The topics involved are multilayer techniques and plasma processing, both areas of ever-increasing importance. The tech-

niques are explained in a clear and concise manner, the emphasis being placed rather on the physical/physics aspects than on the inherent chemistry. However, several viable systems are considered. The bibliography is adequate and modern.

The diagrams throughout the text are of a high standard, giving good support to the excellent text which is, incidentally, remarkably free from typographical and other trivial errors. The one criticism of this reviewer concerns the contribution made by the publishers. The paper upon which the text is printed, coupled with the ink used has resulted in definite strike-in problems arising. The paper is too thin for a text of this quality. The slightly off-white paper, with its lack of body causes an unfortunate lack of clarity which is annoying. Thus, pages 98 and 99 can be read through page 97. This is a general feature of the text.

Despite this problem, I recommend this text to those whose interests lie in the science, technology and practice of photocuring, photoimaging and so on. It is a valuable contribution to a science area which is continually increasing in national and international importance. Equally, it will be of immense value to those who teach and/or wish to appreciate the science and technology of surface coatings in general and resist systems in particular.

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