on reactions occurring in the condensed phase which are not predictable from the thermal behaviour of the polymer and of additives heated separately.

Considering the specialized nature of this series the cost is not beyond the reach of individuals or groups who have particular interests in this wide field and the individual style of reporting makes the articles quite readable.

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New Elastomer Synthesis for High Performance Applications

J. E. McGrath, G. L. Wilkes, T. C. Ward, A. D. Broske, B. Lee, I. Yilgor, D. J. Bradley, J. M. Hoover and T. E. Long
Noyes Data Corporation, Park Ridge, USA, 1988, x+118 pages, $36
ISBN 0-8155-1156-6

This book emanates from work carried out by the well known polymer group at Virginia Polytechnic Institute in Blacksburg, the sponsors of the research appears to have been the US Army Tank-Automotive Command. Its format is that of a technical report in that Objectives, Conclusions and Recommendations are set out in the first seven pages. The remainder of the text is headed as Discussion, and consists of five sections dealing with: (1) a laboratory scale, low pressure reactor for living polymerization; (2) hydrogenation of model elastomers; (3) investigation of organolithium initiators; (4) ion containing copolymers; (5) morphology and properties of poly(urea-urethane) elastomers. The last of these sections is the largest being some 30 pages in length.

The material is presented with a sparse style with much emphasis on the how to approach rather than what if speculations. However, the section on organolithium initiators deals with the kinetics of formation of a difunctional initiator formed by reacting sec-butyl lithium with 1,3-bis(phenylethenyl) benzene, and is a classic example of the type of work pioneered by Szwarc. The use of the initiator to prepare polymers is also briefly discussed. The section on ionomeric copolymers reviews the problems in making such materials and concentrates on development of free radical emulsion copolymerization of sodium *p*-styrene sulphonate with butyl acrylate and anionic copolymerization of styrene with isobutyl methacrylate. In the latter case, the final ionomer was prepared by subsequent partial hydrolysis using potassium superoxide. Structure–property relationships are at the heart of the section on poly(urea-urethane) elastomers. The potential difficulties in the synthesis of these materials and the means by which these are overcome are detailed. This is then followed by the full gamut of materials testing and characterization methods on the series of elastomers produced with varying urea content. The tests involve stress–strain curves, dynamic mechanical analysis, differential scanning calorimetry whilst the characterization methods are both wide-angle and small-angle X-ray scattering. Again, the material is presented in a very direct fashion and any difficulties encountered in obtaining the data or the magnitude of errors of physical quantities is not discussed. Consequently, one has to view interfacial thickness parameters of *ca.* 1–2 Å with some caution due to the sensitivity of such values to the data treatment method used.

This book certainly exemplifies the interdisciplinary nature of polymer science and is perhaps a model for putting over scientific facts cogently, lucidly and with clarity without too much of the academic speculation which often leads to serendipitous discoveries. Consequently, it should probably be necessary reading for new entrants to the polymer industry at the research and development end of the business. It is probably also true that there is little of a revolutionary nature here and therefore will not command a wide readership. Notwithstanding these comments, it is a well written publication of its type.

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Photophysics of Polymers

C. E. Hoyle and J. M. Torkleson (Eds.)
Americal Chemical Society, Washington DC, USA, 1987, xi+531 pages, USA and Canada $99.95; Export $119.95
ISBN 0-8412-1439-5

This book consists of 36 chapters arising from a symposium sponsored by the Division of Polymer Chemistry of The American Chemical Society held in Anaheim, California, in September 1986. The chapters are arranged within seven headings starting with four overviews. The first is a short chapter by Hoyle on 'Polymer Photophysics' followed by more substantial overviews by Winnik on 'Study of Complex Polymer Materials: Fluorescence Quenching Techniques', by Frank, and Zin on 'Morphology in Miscible and Immiscible Polymer Blends: Interplay of Polymer Photophysics and Polymer Physics' and by Morawetz on 'Applications of Fluorescence Techniques for the Study of Polymer Solutions'.

These overviews are followed by 10 contributions under the title 'Polymer Dynamics and Complexation' which discuss many aspects of polymer dynamics in a variety of polymers using a wide range of techniques, many involving time-dependent and steady-state luminescence measurements. Thus, Monnerie *et al.* in their paper 'Spectroscopic Investigation of Local Dynamics in Polybutadienes' use the fluorescence anisotropy decay technique and ^{13}C spin-lattice magnetic relaxation to investigate local dynamics at temperatures which are 60 K above the glass–rubber transition temperature. While Winnik reports how intramolecular fluorescence quenching processes can be used to study 'Excluded Volume Effects on Polymer Cyclization'. In the chapter 'Time-Resolved Optical Spectroscopy as a Probe of Local Polymer Motions', Waldow *et al.* use a picosecond holographic grating technique to observe the local segmental dynamics of anthracene-labelled polyisoprene in dilute solutions. Horie reviews in his article various mechanisms for non-exponential decay of phosphorescence on much longer time scales, typically milliseconds, showing how this may be related to dynamics in polymer solids. Fluorescence probes and markers feature in three chapters, namely 'Fluorescence Probes for the Study of Solvation and Diffusion of Reagents in Network Polymers' by Shea *et al.*, 'Light-Induced Conformational Changes of Polymers in Solution and Gel Phase' by Irie and 'Luminescence Studies of Molecular Motion in Poly(n-butyl acrylate)' by Toynbee and Soutar. A similar approach was reported by Hayashi *et al.* who have bonded a twisted intramolecular charge-transfer compound to poly(methyl methacrylate) and shown the luminescence to be sensitive to both the polarity and the microviscosity of the surroundings. The final two chapters in this section deal with the 'Electronic Spectroscopy of bis (4-dimethyl aminophenyl), Squaraine' and 'Specific Interactions of (+)-Catechin and (−)-Epicatechin with Polymers that contain the L-Propyl Residue' by Law and Bergmann and Marrice, respectively.

The following three articles 'Excimer Photophysics of Macromolecular Scintillators' by Birch *et al.*, 'Configurational and Conformational Aspects of Intramolecular Excimer Formation' by De Schryver *et al.* and 'Photophysics of 1,5-Naphthalene Diisocyanate-Based Polyurethanes' by Hoyle and Kim, are grouped together under the title 'Excimer Photophysics'. In the first of these articles, it is demonstrated that even good fits to fluorescence decays often still provide an incomplete description. In the

second, the photophysical behaviour of the singlet excited state is shown to be strongly influenced by the configuration and the conformational distribution within each configuration. The third of these papers shows that both steady state and transient fluorescence spectroscopy indicate the existence of intramolecular excimer formation in naphthalene diisocyanate-based polyurethanes.

Three of the ten papers dealing with 'Energy Migration' make use of transient fluorescence spectroscopy. Philips discusses 'Complex Decay of Fluorescence in Synthetic Polymers' in his article on nanosecond time scales while Kauffman *et al.* use both nanosecond and picosecond time scales whilst examining 'Electronic Energy Relaxation in Aromatic Vinyl Homopolymers', while Peterson *et al.* use time-resolved fluorescence depolarization spectroscopy to examine 'Ensemble Average Conformation of Isolated Polymer Coils in Solid Blends'. Use is made of delayed fluorescence in the papers by Burkhart and Caldwell on the 'Influence of Chromophore Organization on Triplet Energy Migration in Amorphous Polymer Solids' and by Klöpffer on 'Aromatic Polymers in Dilute Solid Solutions' where he also makes use of phosphorescence spectra and quenching. The use of quenchers and traps is also exploited in three of the papers in this section on 'Triplet Antenna Effect in Poly(acetonaphthyl methacrylate)' by Holden and Safarzadeh-Amiri, 'Excited-State Singlet Energy Transport in Polystyrene' by Coulter *et al.* as well as in the paper entitled 'Exciton Migration in Copolymers of Acenaphthylene' by Cabaness *et al.* Interchromophoric interactions in the excited states of a new class of polypeptides have been studied by static and dynamic fluorescence spectroscopy including circular polarized fluorescence spectroscopy by Sisido, while MacCallum questioned the 'Significance of Energy Migration in the Photophysics of Polystyrene'.

There are six chapters dealing with the 'Photophysics of Polyelectrolytes'. The experimental techniques reported are somewhat similar to those mentioned earlier except for the paper entitled 'Polymer Models for Photosynthesis' by Guillet *et al.* where electron spin resonance measurements are reported, and in the articles entitled 'Complex Formation Between Poly(acrylic acid) and Poly(ethylene glycol) in Aqueous Solution' by Oyama *et al.*, where pyrene excimer fluorescence is monitored. Excimer to monomer ratios are also made use of in the paper by Chu and Thomas entitled 'Interaction of Cationic Species with Polyelectrolytes'. The other two papers in this section by Ghiggino *et al.* on 'Kinetic Spectroscopy of Relaxation and Mobility in Synthetic Polymers' and by Bai *et al.* on 'Alternating Copolymers of 2-Vinylnaphthalene and Methacrylic Acid in Aqueous Solution' report measurements using time-resolved luminescence and the effect of quenchers on fluorescence lifetimes, intensities and spectra respectively.

Finally, there are two small sections, one dealing with 'Luminescent Polymerization Probes' with two articles, the first by Wang *et al.* on the 'Fluorescence Monitoring of Viscosity and Chemical Changes During Polymerization' and by Sung on 'Application of Reactive Dye Labeling Technique for Cure Characterization of Epoxy Networks'. The final section deals with the 'Photophysics of Silicon-Based Polymers' and includes two papers by Harrah and Zeigler on 'Emission Spectra of Polysilylenes' concluding that the triplet is the immediate precursor to photochemistry and by Johnson and McGrane on 'Spectroscopic and Photophysical Properties of Poly(organosilylenes)'.

The volume is well produced and many or the articles are first class. A wide range of topics and techniques are reported. Experts in the field will find it useful and others will gain an impression of the breadth of this rapidly growing area. The volume concludes with a useful subject index.

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Molecular Engineering of Ultrathin Polymeric Films

P. Stroeve and E. Franses (Eds.)
Elsevier Applied Science, New York, 1978, vi+412 pages, £75
ISBN 1 85166 159 X

This book records the proceedings of a Workshop on the Molecular Engineering of Ultrathin Polymeric Films held in Davis, California in February 1987. The tital of the book is very misleading. Of the 23 articles in the book only seven have any significant polymeric content and two of these discuss polymer films which many would not classify as ultrathin. In addition, the few articles which set out to discuss the subject of molecular engineering are rather speculative. A more accurate title might be 'The Physics and Chemistry of Organic Thin Films'. The prospective purchaser may also be put off by the fact that most of the articles have already been published in the journal *Thin Solid Films* as sections 1 and 2 of Volume 152. There certainly are workshops and conferences where the proceedings can be usefully duplicated in a journal and a separate book; in this case the papers cover such a variety of topics that republication is probably only useful to the delegates of the conference.

The book includes two papers primarily devoted to polymer chemistry. The chemistry of polymeric photoresists and the synthesis of liquid crystal polymers are comprehensively reviewed in one, while the other describes the epitaxial polymerization of *p*-terphenyl on alkali halide crystals. Two papers concentrate on the versatile polydiacetylenes. Tubule microstructures of phospholipid diacetylenes have been polymerized and then metallized; the hollow multilayered cylinders had typical dimensions of 0.5 μm in diameter by 25 μm long. In another paper the non-linear optical properties of polydiacetylene Langmuir–Blodgett films are described. The use of a non-linear effect, second harmonic generation, as a probe of poled polymer films is also reported. Two more papers review the preparation, characterization and application of Langmuir–Blodgett films and liposomes made from preformed polymeric amphiphiles. The book concludes with a prediction for the future of ordered polymeric thin films, including their application in OPTIMUL, the optical multiport computer.

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Classical Light Scattering from Polymer Solutions

P. Kratochvil
Elsevier, Amsterdam, 1988, xi+334 pages, US $117.00
ISBN 0-444-42890-9

The application of light scattering to the characterization of polymers in dilute solution, effectively falls into two broad classes, based upon the physical principles of measurement. The first concerns measurement of the intensity continuously scattered by the medium. This is called 'intensity scattering' or 'classical light scattering'. The second involves measurement of the continuous flickering or fluctuation in the intensity which accompanies local molecular motions. Measurements are made on a faster time scale and the method is generally referred to as 'photon correlation spectroscopy' or 'fluctuation light scattering'.

In the mid-1960s, intensity light scattering was at its scientific zenith. The methodology was being advanced and papers were appearing in the scientific literature at a great rate. By far the greatest number were in the application of the method to study the molecular weight, size, conformation and interactions of macromolecules and polymers. During the following decade, classical intensity scattering became consolidated and the academically