book reviews

Advances in Interpenetrating Polymer Networks Volume 1

D. Klempner and K. C. Frisch (Eds)
Technomic Publishing AG, Basel, Switzerland, 1989, 336 pages, SFr 165
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This paperback of 336 pages contains 13 articles, thus on average the contributions are of substantial length. They are apparently invited contributions, and the preface indicates that more volumes of the same general title are planned. Several of the articles are from established authorities and established research groups in the field of interpenetrating polymer networks (IPNs).

Understandably, much of the early work on IPNs was empirical in nature as new methods of formation and new materials were sought. However, quantitative and systematic studies regarding both formation and formulations are emerging and are reflected in articles in the book. Those by M. Song, Z. Jun, L. Yuwei, Z. Donghua and T. Xinyi (Kinetic effects in the formation of castor oil–polyurethane/epoxide–episulphide resin IPNs) and J.M. Widmaier and G. C. Meyer (Chemical aspects in the formation of IPNs) probe connections between the chemical kinetics of formation and structure and properties. Articles by B. McGarey (A small angle neutron scattering study of poly(dimethyl siloxane)/polydeuterostyrene sequential IPNs), B. Y. Li, X. P. Bi, D. Zhang and F. S. Wang (Forced compatibility and mutual entanglements in poly(vinyl acetate)/(poly(methyl acrylate) IPNs) and Yu. S. Lipatov (Microphase separation in IPNs and their viscoelasticity) tackle relationships between molecular behaviour and structure and properties.

Articles on newer IPN systems are contributed by P. V. Ika, H. L. Frisch and K. C. Frisch (A review of crosslinked polydiacetylenes and their IPNs with epoxy resin), S.-A. Chen and F.-H. Su (Polyether–polyurethane cationomer/poly(vinyl alcohol) thermoplastic IPNs: structure and properties), P. Penczek (IPNs, semi-IPNs and related systems based on unsaturated polyester resins) and D. Jia, L. Chen, B. Wu and M. Wang (IPNs based on polybutadiene-based polyurethane). A. B. Wojcik (Porous bend polymers as IPNs) and M. S. Silverstein and M. Narkis (Latex IPN domain elastomers) present articles on bead and latex IPN materials and F. S. Dyachovskii (Synthesis and properties of polyolefin compositions) discusses reactions on filler surfaces. L. H. Sperling (IPNs around the world) gives a brief survey of developments in IPNs which contains some useful references.

Collections of articles on IPNs usually cover a variety of chemical systems. This is true of the present volume. No attempt has been made to group the articles according to subject matter, so the volume as a whole lacks structure. However, the articles themselves are generally well-written and presented. They report interesting and up-to-date developments in the formation, structure, properties and understanding of IPNs. Each article also contains numerous references. The book is recommended for purchase.

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Luminescence Techniques in Solid State Polymer Research

L. Zlatkevich (Ed.)
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Luminescence is generally defined as light emission as a result of any process which can lead to excited states in the sample under study. The most obvious excitation is photon absorption, leading to fluorescence or phosphorescence. However, many other forms of excitation are possible, including high-energy irradiation, heat and mechanical stress. Our understanding of luminescence is variable. Phosphorescence and fluorescence are mostly very well understood, in contrast to luminescence from stressed or irradiated materials. Whatever the mechanism, luminescence can be detected with enormous sensitivity, because of the development of cheap single-photon counting electronics. This has meant a great interest in applying luminescence methods to problems where the extreme sensitivity is seen as outweighing the ill-defined emission mechanisms.

This book is an edited series of articles reviewing the state of the art luminescence studies of solid polymers. Rather like the methods themselves, it is a mixed bag, ranging from most useful to barely credible.

An introductory chapter by George reviews the main photochemical and photophysical mechanisms operating in solid polymers and for dissolved small-molecule probes. This is an excellent review, laying the basis for all that follows.

By far the most well understood luminescence processes are those where the excitation is by absorption of a photon, and the application of luminescence spectroscopy to polymers is reviewed by Allen and Owen. This is a useful review, which covers both the background theory and some useful practical applications in the analysis of polymers and their additives. A second chapter by the same authors gives an equally good review of the use of luminescence spectroscopy to detect photoinitiating groups and to monitor photo-oxidation.

Chemiluminescence, in which excited states are produced by chemical reactions, is a widely used analytical technique, relying on reactions which form excited states with high quantum efficiency. The oxidation of polymers is an example of a reaction which is chemiluminescent with very low quantum efficiency, so that the emission can be detected only with highly sensitive methods. These are the subject of two chapters, which together account for almost one-third of the book. A chapter by George is a conservative account of the application of chemiluminescence to polymer oxidation and suggests a number of ways in which this method can be applied. A second chapter, by Zlatkevich, is much more contentious. It is largely based on the application of a kinetic model for chemiluminescence to oxidation of a number of polymers, particularly polypropylene. I would take issue with a very large part of this chapter, since I believe that the arguments are based on unjustifiable assumptions and are used to draw unwarranted conclusions.

When a material is subject to mechanical stress, it may luminesce because of mechanical excitation (triboluminescence) or because of chemical reactions associated with bond scission (chemiluminescence). Of these, the latter is more common in stressed polymers and the stress-induced emission from epoxy resins and polyamides is reviewed by Monaco and Richardson, two of the main practitioners. At present, the methods are qualitative but interesting. This is a good review, which does not overstate its case.