

Book Review

Developments in Polymer Photochemistry – 1

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Anyone actively engaged in research can maintain detailed contact with only a limited area of the primary literature and must rely extensively on reviews to achieve an awareness of developments in a wider context. This volume, the first of a new review series, is presumably to be published in parallel with other "Developments Series" recently instituted by the same publishers and of which at least five other series are devoted to polymer-related topics. With the advent of this new series it would have been helpful if the publishers had defined some boundary conditions relevant to the contents of these various series; three of the articles in this volume could quite logically have been published in companion series. In future, should we expect to find articles on photochemical degradation of polymers in the polymer photochemistry series only or may such articles also appear in the polymer degradation series? With this recent and large expansion of review series it is only fair to issue some policy to guide potential readers, to avoid wasting the limited resources of institutional libraries and to avoid unnecessary proliferation of reviews. This is particularly pertinent since the potential subject matter is stated in the preface to include photopolymerization, photodegradation, photooxidation and photostabilization of polymers, optical and luminescence phenomena in polymers and the photochemistry of dyes and pigments in polymers.

This particular volume contains seven chapters on a somewhat disparate set of topics. The first, "Intermolecular energy transfer in polymers" (E. D. Owen), really contains nothing very new but may be useful as background material for those who are interested in other chapters but are unfamiliar with basic photochemistry. In contrast in the second chapter, "Studies of polymer structure and mobility by luminescence spectroscopy" (D. A. Holden and J. E. Guillet), advances in a rapidly developing subject area which touches on many aspects of polymer science are discussed. In a useful introduction these authors summarize briefly special factors relating to the photophysics of polymer systems. They discuss in some detail the results of various kinetic schemes for excimer formation and consider the influence of such factors as polymer structure, copolymer composition and chain coiling on the validities of the schemes. They also describe how in the last few years fluorescence studies have been used to investigate such topics as the dynamics of chain coiling in solution, intermolecular effects (densities of chain seg-

ments and interpenetration of coils in solution and in polyblends), micro-Brownian motion of polymers in solution and diffusion of small molecules in bulk polymer.

The remaining chapters have a more chemical bias. Of these the first (by J. C. Arthur, Jr.) is the only chapter in this volume devoted to polymer synthesis and deals with the specialized and limited topic of grafting onto cellulose; the article contains cursory accounts of the structure and photolysis of cellulose. There then follow two chapters on the currently important technological problems of polymer deterioration. One of these, photooxidation of polyolefins, is the process which causes embrittlement and mechanical failure of many everyday plastic articles and detracts from the reputation of plastics in the public eye. Specifically, in this chapter reactions in polyethylenes, polypropylene and polystyrene are considered. Although many features of these processes were established some years ago the authors (A. Garton, D. J. Carlsson and D. M. Wiles) give an up-to-date account of the subject and discuss some of the still contentious issues. They provide a critical discussion of the relative importance of various chromophores (usually present as a result of impurities and often incorporated during processing) in initiating photooxidation. Among the special factors which influence photooxidation kinetics in polymers is the heterogeneous nature of the partially crystalline polyolefins and the authors provide a lengthy discussion of this topic. The emphasis of the chapter is on the polymeric rather than the photophysical aspects. The second of these chapters is devoted to the more unfamiliar but very important subject of photodegradation and photoyellowing of wool. After outlining the gross effects of light on wool, the author (C. H. Nicholls) considers the chromophores which are active in photoprocesses and tries to identify the chemical processes which follow photolysis and cause structural breakdown (phototendering); evidence currently points to breakdown of tryptophan residues as the process which is most probably responsible for photoyellowing. The importance of excited oxygen and of non-radical reactions is discussed and a short account of processes in fluorescent whitened wool is included. The author also describes briefly attempts which have been made to protect wool from photodegradation.

Finally, in two chapters the behaviour of relatively small dye molecules in or on polymeric matrices is considered, namely "Photochemistry of azo dyes and related compounds" (J. Griffiths) and "Structural effects on photostability of anthraquinone dyes in synthetic polymers" (N. S. Allen and J. F. McKellar (the late)). In both chapters the photochemical aspects of the subject are emphasized although the influence of polymeric substrates is considered, particularly in the latter article in which the low light-fastness of anthraquinone dyes on nylon-6,6 and their variable light-fastness on polyethyleneterephthalate are considered. The former chapter is not restricted to the photochemistry of the diaryl azo dyes; a general discussion of the photochemistry of azo compounds in solution is included as background to mechanisms for photochemical fading and possible modifications due to the presence of polymeric substrates are considered.

It is unlikely that many individuals will feel motivated to purchase copies of this volume because the disparity of topics will limit the information of immediate interest to them. However, it will probably be a useful addition to libraries of institutions in which there is a general interest in photochemical processes in polymer systems. There could be a useful role for this series if it concentrates on important and advancing topics and avoids overlap of subject matter with other review series.

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