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Book Reviews

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Book Reviews

ADHESIVE CHEMISTRY: DEVELOPMENTS AND TRENDS,
edited by Lieng-Huang Lee, Plenum Press, New York and London,
1984, 868 pp. (\$115.00)

This volume records the proceedings of the Symposium on Recent Developments in Adhesive Chemistry, sponsored by the ACS Division of Organic Coatings and Plastics Chemistry, held in Seattle during March, 1983. It contains 38 papers (some of them contributed after the Symposium itself), plus the introductory remarks of the session chairmen, a summary of the discussion from the floor, and both author and subject indexes. In addition, it contains brief biographies of the authors and session chairmen. It is very nicely printed and bound, in the manner we have come to expect from this series.

In keeping with the title of this symposium, the contents are strongly oriented toward the chemistry of newer adhesive systems, especially the relation between formulation and physical properties. However, the “plenary” papers include several detailed and useful reviews of physical topics, such as scanning electron microscopy (Buchanan), ESCA (Briggs), visco-elastic fracture mechanics (Maugis) and fracto-emission (Dickinson). Other “plenary” papers are an overview by the chairman, a discussion of newer high temperature adhesives (Hergenrother) and three summaries of various aspects of radiation-curable systems (Stueben, Crivello, McGinniss). The papers are divided into six sections, as follows:

- I. Chemistry of Adhesion—Importance of Interface.
- II. Physics of Adhesion—Characterization of Surface and Bulk of Adhesive Systems.
- III. Radiation—Curable Adhesives.
- IV. High Temperature Adhesives.
- V. Anaerobic and Structural Adhesives.
- VI. Trends in Adhesive Research.

As often happens, the section titles fall short of conveying an adequate idea of their contents, which range from detailed descriptions of research in specific areas, summaries of the behavior of certain adhesive systems, literature reviews of various topics, to one or two papers best described as "market reviews". Two papers were contributed by participants from the People's Republic of China, and the editor has included a summary of his tour of Chinese research institutes in 1983.

The diversity makes it seem likely that almost any reader with an interest in the field will find something worthwhile in this collection. However, few individuals will wish to read it through from cover to cover. It contains some good descriptions of the current status of a number of important subjects, plus information on several new developments, but notwithstanding the mention of "trends" in the title, those who seek an indication of the future of the subject will probably be disappointed.

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MOLECULAR CHARACTERIZATION OF COMPOSITE INTERFACES, edited by H. Ishida and G. Kumar, Plenum Press, New York, 1985. 453 pp. US\$79.00.

This book is a compilation of papers presented at the American Chemical Society Symposium on Polymer Composites held at the March 1983 meeting in Seattle, Washington, U.S.A. The papers included represent a cross-section of research results directed at delineating the complex events which occur and the complex structure which results from the interaction of a polymer with a substrate in composite materials. The purpose of the book was to attest to the existence of a complex interface and to show its relation to the physical and mechanical properties of composite materials.

The book is divided into five parts. The first section entitled General Overviews is required reading for anyone interested in polymeric interfaces. The introductory article by Kardos and the overview of silane coupling agents by Pleuddemann and Ishida contribute a great deal to increasing the reader's awareness of the state of the interfacial research.

Section II contains research reports directed at developing a linkage between the polymer-substrate interface and composite properties. Moisture and its deleterious effect on the interface, interfacial thermal mismatch caused by differences in fiber and matrix properties, fracto-emission from fiber-polymer interfaces and the influences of filler-polymer bonding on the melt-flow and mechanical properties of the interface are all clearly presented.

Section III is an in-depth discussion of research on the mechanism of operation and the structure of silanes at the substrate-polymer interface. The utility and complexity of silanes as a promotor of adhesion are adequately illustrated by the articles of this section.

Section IV contains papers which support the concept that the matrix itself is strongly influenced by the presence of the substrate surface. The definitive work that demonstrates quantitatively the variation in matrix properties as a function of distance from the substrate surface has not been done because of the lack of availability of a spatially resolved molecular probe. However, the papers included here graphically demonstrate that variations in matrix structure near the reinforcement surface are the most probable explanation for some of the observed interfacial phenomena.

Section V contains papers which not only report the latest work on the characterization of surfaces but also provide a good review of the latest surface analytical techniques and their application to the study of interfacial adhesion. As a result of reading this section, the reader will conclude that the classical physical chemical approaches for the characterization of surfaces provide a sensitive and valuable tool for surface studies that compliments the information from the recent expensive surface spectroscopies.

The publication of this book serves to provide the researcher entering the composites field a valuable broad perspective for the complexities and intricacies involved in developing an understand-

ing of composite interfaces or more properly – interphases. Interfacial structure-composite property relationships are not as yet available, but as researchers become more aware of the investigations such as the ones presented here, progress toward the establishment of those relationships will be made.

L. T. DRZAL

DURABILITY OF STRUCTURAL ADHESIVES, Edited by A. J. Kinloch. Applied Science Publishers, Barking, Essex, 1983 (US \$74.00).

The title of A. J. Kinloch's latest book implies a broader subject matter than is actually dealt with, but this is appropriate since by far the greatest effort has been put forth in the aviation and aerospace industries where such problems are paramount. The principles of investigation of durability and the mechanisms of joint strength degradation are sufficiently similar in other systems that the book provides valuable guidelines and insights for all structural adhesive technologists.

Kinloch starts with an "Introduction" to those modern views of adhesion science as apply particularly to the topics which follow. "Surface and Interfacial Analysis" by G. D. Davis and J. D. Venables provides a review of modern instrumental methods for examining the first few atomic layers of a surface, concentrating on XPS, AES and XSEM. The authors give a valuable bibliography on these techniques, and provide also a fine example of the reduction of data to useful generalizations, drawing almost entirely from their own work on aging changes in FPL etched and phosphoric acid anodized aluminum.

J. Comyn also discusses fundamental questions in "Kinetics and Mechanism of Environmental Attack," which is devoted entirely to water diffusion and how it affects adhesive joints. He starts with a development of diffusion theory and proceeds to show how experimental results generally bear out the theoretical predictions. The chapter gives an excellent review of the various mechanisms which have been proposed to account for observed joint weakening through combinations of water, geometry and stress. The lengthiest chapter is J. D. Minford's "Adhesives," which does not deal with

adhesive technology, but rather reviews a large volume of published data (303 references) on joint strength and durability. This will be valuable for many technologists, though the number of unpublished reports, government documents and private communications is somewhat annoying, since they are unavailable to most readers.

The next three chapters deal with "Aluminium Adherends" (D. M. Brewis), "Titanium Adherends" (A. Mahoon) and "Steel Adherends" (W. Brockmann). Brewis is somewhat trapped into reviewing material of earlier chapters, since the book is so thoroughly devoted to aluminum joints. He does provide an excellent critique on conditions for achieving maximum durability, and draws conclusions which were largely left to the reader in other chapters. Mahoon points out that the unique properties of titanium are responsible for its increasing use in new, high-performance applications, and that these often call for better performing (especially high temperature) adhesives. Titanium bonding is at once the newest technology developed in the book and that presenting the most challenges to the technologist. Earthbound structures such as bridges and automobiles are the actors in Brockmann's discussion on steel adherends. Though the nature of the oxide surface is again shown to be critical, the best methods of optimizing this are now mechanical rather than chemical.

The concluding chapter on "Aerospace Applications" is the shortest and most readable. P. Albericci brings all the technology of earlier chapters together in a delightful historical account of the use of adhesives in aircraft. He does this in clear, critical generalizations of data described elsewhere in the book. One of the key points of the book is that maximum initial joint strength is often not coincident with maximum durability, and Albericci shows how this historic realization influenced the subsequent development of both the aircraft industry and adhesive technology.

Overall, "Durability of Structural Adhesives" is must reading for the adhesives technologist, since it leads one at once to a comprehensive literature and a realization that the field is very new and undeveloped. The preponderance of references from non-refereed publications demonstrates this, as does the fact that the major effort so far has taken place in product development laboratories rather than academia. The science of adhesion still often stands aside in favor of cut-and-try methods, appearing only when the field of

investigation can be very narrowly restricted, as in the cases discussed by Davis and Venables and by Comyn. Kinloch has done an excellent job of bringing these points home through a useful selection of authors and topics, and he has made it conspicuously more readable by such editing ploys as the uniform presentation of numerical data in SI units.

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