book reviews

Adhesive Strength of Fibre–Polymer Systems

Yu. A. Gorbatkina
Ellis Horwood, Hemel Hempstead, 1992, 264 pages, £65.00
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This book is a translation from the Russian and is based on work undertaken over the last two decades at the Reinforced Plastics Laboratory of the Institute of Chemical Physics of the USSR Academy of Sciences. It is entirely devoted to a study of the adhesive strength of the fibre–polymer interface and the majority of data has been obtained by the 'pull-out' technique. Most results are for adhesives and fibres used in Russia for fabricating composite materials but the aim is to present principles and relationships of general validity and a large number of results are for epoxy-based polymer composites.

The shear strength of fibre–polymer joints is usually measured on specially prepared samples of fibres embedded in an adhesive layer. Clearly joint geometry depends on the length of the layer of adhesive in contact with the fibre as well as on the fibre diameter and accurate data depend, amongst other things, on good contact and on uniformity. Techniques have been developed at the Reinforced Plastics Laboratory for ensuring reproducible and reliable specimen production in sufficient quantities to produce statistically significant results. These techniques are detailed in the opening chapter which characterizes the book as a whole by being extremely thorough and including a lot of experimental detail based on years of experience. This is followed by an equally detailed chapter on the statistical treatment of results and the calculation of adhesive strength for competing adhesive and cohesive modes of fracture. This is extremely mathematical and results in a procedure for separating the effects of cohesive and adhesive fracture together with an algorithm for treating the data. The algorithm itself (although admirably detailed compared with the sketchy outlines so often given) is of enormous complexity and runs to thirty-nine steps over five pages of the Appendix. Whilst this may form the basis of a computer program to treat experimental data systematically, it will not be entered into lightly by any but the most dedicated specialists.

Following these foundation chapters on experimental techniques and data analysis the book continues with a systematic presentation of the effects of various factors on adhesive strength. Scale effects and local adhesive strength as a measure of interfacial interactions are considered in Chapter 3, although any application of fracture mechanics is explicitly excluded, which seems rather unfortunate. This is then followed by a systematic consideration of the effects of curing conditions, test temperature and loading rates in Chapters 4 and 5, and the effects of binders and surface modification in Chapter 6. High-strength and high-modulus fibres are considered in Chapter 7. Only in Chapter 8 does the treatment widen out to consider the relationship of the strength of composite materials to the strength and properties of the fibre–matrix interface. Finally, in Chapter 9, the adhesive strength of fibre–thermoplastic polymer joints is considered.

Overall the book gives a very thorough treatment of its chosen topic — the adhesive strength of fibre–polymer systems — but the specialization of subject matter may well limit its appeal. It will be of value as a reference text to those embarking on research in the adhesive strength of composites and to those needing to know the effects of experimental variables on such measurements. The claim on the back cover that the book will be useful to 'all involved in the production and utilization of fibre composites' seems a little ambitious. However the proposed readership — those involved in surface phenomena, adhesion physics and the strength of composites — will find it a comprehensive treatment of an important topic.

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Polymers for Electronic and Photonic Applications

C. P. Wong (Ed.)
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With the notable exception of one Japanese paper, all the other contributions to this text are of United States origin, though from a wide range of academic departments, manufacturing and user industries whose interests are embraced by its 'catch-all' title. The electronic and photonic applications of polymers are as diverse as the applications of wood in fabrication and construction, and it is this that inevitably lends the text the appearance of a collection of papers intended for selective reading. But, this is not a criticism, for whilst texts of a comparable size might be written on any one of the topics, this is an admirable compilation of information for anyone who is interested to delve into the structures and properties of the materials that underpin integrated circuit technology, without their being exhausted by the detail. The first chapter gives an overview of the subjects to be developed later and it makes ideal reading for the non-specialist. The subsequent chapters are comprehensively referenced with up-to-date papers and could well become essential reading for chemists, physicists and material scientists upon entry to one of the specialist areas.

For the last couple of decades we have seen the number of components on an integrated circuit chip, on average, double every 18 months. The objective of the book is to review and discuss the important applications of polymers that have facilitated this ongoing miniaturization of semiconductor, very large-scale integrated circuit (VLSI) devices, and which have also enabled the advent of optoelectronics. Typically, in the VLSI context, these are the polymers that are used in microlithograpy, as interlayer dielectrics, as passivating thin films and for electronic packaging and interconnects. In photonics they are the polymers with the potential for application as waveguides, as optical switches, and for data storage and retrieval.

In so far as it is possible to identify a natural order of presentation of the subject matter of the book, it has been achieved. The overview of the first chapter is followed by a paper devoted to the chemistry of resists for microlithography; this being the area that deals with the primary imaging of the circuit features of VLSI in a radiation-sensitive polymer, prior to the transfer of the pattern to an underlying substrate. These methods find use in the manipulation of other polymeric materials used in electronic devices, such as the polyimide and other resins that are used as interconnect dielectrics which are discussed in the next chapter. There follows a discussion of the processes of encapsulation, and the materials for use as encapsulants to protect integrated circuitry from an otherwise hostile environment. Polyimides and polyimide-siloxanes then get chapters of their own, even though they have featured regularly in the previous chapters. The justification