

## BOOK REVIEWS

### New Characterization Techniques for Thin Polymer Films

*Edited by H. M. Tong and L. T. Nguyen, Wiley Interscience Publication, New York, NY, 1990, 368 pp., \$65.00*

Polymers have found a wide range of applications in microelectronics and optoelectronics. As a result, techniques to characterize these polymers in a thin-film form have proliferated. This book assembles a great number of such specialized techniques and analyses, each in detail. The editors have grouped the chapters according to their relevance to either bulk (Chapters 1 through 10) or interface (Chapters 11 through 13).

Under bulk properties, the topics include microdielectrometry, bending-beam technique, X-ray diffraction, laser interferometry, ion-beam analysis, fluorescence redistribution after pattern bleaching, surface sensors, photothermal analysis, and thermally simulated discharge current technique. Under interface properties, X-ray photoelectron spectroscopy (XPS), secondary ion mass spectroscopy (SIM), Auger electron spectroscopy (AES), scanning tunneling and atomic force microscopes and adhesion studies by the indentation technique are discussed.

All of the chapters are authored or coauthored by individuals renowned for the development or current use of the associated techniques. Hence, the compiled information is up-to-date and comprehensive. Most chapters clearly demonstrate lucid writing and systematic organization. The level of the text is

suitable for graduate students or industrial researchers interested in an overview and review of the particular subject matter, the technique and its application to solving characterization problems found in polymer thin films. In short, each chapter is a unique capsule and can be read alone without reference to the rest. Therefore, the most distinctive contribution of this book is the very fact that such a large number of chapters have been assembled in one place, making the book itself a handy reference for those involved in using or developing polymers for the microelectronics industry.

Upon closer examination of the chapters, one can group the topics in a different manner. Microdielectrometry and thermally stimulated discharge current are somewhat related. The former gives the dielectric spectra as functions of temperature, frequency and time. It is useful for identification of transitions, monitoring of cure and moisture uptake, and detection of ionic impurities. The latter is particularly suited for detection of thermally induced changes in films. Bending beam, X-ray diffraction, and a major part of surface sensors deal with the issue of stress in thin films. These chapters are especially well organized. Laser interferometry and Piezo-electric resonators find many applications in kinetic studies of film swelling and dissolution. As tools *per se*, they are complementary. Generically, ion-beam analysis, XPS, SIMS, and AES are related in concept and experimental design. However, the ion-beam analysis chapter is nicely tied to the photo-

bleaching chapter via the common theme of diffusion (polymer-polymer and dopant-in-polymer). Both are then somewhat related to the subjects covered in the photothermal analysis chapter where laser-induced transient heat source, combined with acoustic and thermal detection schemes, enable the measurement of properties such as thermal conductivity of thin films. Perhaps the only two chapters that stand alone are the scanning tunneling and atomic force microscopes and adhesion by indentation technique. These, nevertheless, fall in the general domain of thin-film characterization, and their connection to the main body of the book does not appear tenuous.

The strengths of this book are the neatly-organized and lucidly-written packages of individual topics, with common interconnecting threads. The weaknesses of the book are to be found not in what is presented, but rather in what is missing. This volume could be greatly improved if a vibrational spectroscopy chapter (surface IR and Raman) were included. In addition, nonlinear optics (second harmonic generation) and angle-resolved laser light scattering could potentially be added to benefit the reader.

Despite these few misses, the editors and authors are to be commended for their excellent effort and contribution to the chemical/material science literature in polymer thin-film characterization.

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### Clathrate Hydrates of Natural Gases

*By E. Dendy Sloan, Jr., Marcel Dekker, Inc., New York, 1990, 664 pp., \$125.00 (U.S. and Canada), \$150.00 (other countries).*

It is a comprehensive monograph on gas hydrates. Publication of this book is appropriate and timely for two reasons.

First, significant research has been done on natural gas hydrates in the last several decades, which needed a compilation. Secondly, there is renewed interest in gas hydrates as a potential, future untapped resource for natural gas. This book is a valuable addition to the literature on hydrates and will serve as a single treatise

for both industrial practitioners and hydrate researchers. The book ties together fundamental, theoretical concepts, and experimental advances that have emerged (primarily) during the last half century. The book includes the compilation of most of the experimental data on hydrate thermodynamic and transport properties