Spectroscopy of Semiconductor Microstructures

Edited by Gerhard Fasol, Annalisa Fasolino, and Paolo Lugli
(Plenum Press, New York, 1989), 667 pages.
ISBN 0-306-43378-8

Spectroscopy of Semiconductor Microstructures provides reviews on the phononic, electronic, and optical properties of semiconductor quantum structures. Such structures include quantum wells, wires, and dots fabricated from group IV semiconductors, III-V semiconductors, and their alloys. The spectroscopies used include magneto-optic and electro-optic and time-resolved spectroscopies. Special emphasis is given to phonons in microstructures.

Each of the approximately 40 chapters is written by a different author or group of authors. Many of the authors are well-known specialists in their respective fields, with the result that the work presented is timely. This book should prove useful to young researchers and graduate students entering the field as well as to researchers who want to learn more about a field outside their own specialty.

I see two alternatives to becoming familiar with state-of-the-art research, knowledge, and understanding of semiconductor microstructures. The first and more difficult way is to do a literature search, spend hours in the library, copy many papers, study the papers, and finally spend even more time trying to extract the physics in them. The other alternative is to have *Spectroscopy of Semiconductor Microstructures* on the shelf in one's office and study it whenever needed. I believe this is the major advantage and the thrill of this publication. Furthermore, the chapters in the book give descriptions of entire areas that are more comprehensive than the original research articles.

This volume clearly emphasizes the physics rather than the technology of microstructures, not surprising since the editors come from academia. The editors do, however, also make an effort to include the technology (crystal growth, doping, etc.) in some introductory chapters. (The editors mention that the book is "biased toward the European way of working," whatever that means.)

The coverage of so many aspects gives the book a broad, if not too broad, range of topics, but this collection of contributions will make the book immensely valuable to many scientists who want to deepen their knowledge in the field and even to graduate students who want to become familiar with the field. Finally, the editors should be commended for providing an excellent index.

Reviewer: E. Fred Schubert, a member of the technical staff at AT&T Bell Laboratories, is responsible for research on the limitations of impurity distributions in semiconductor quantum devices.

Microbial Polyesters

Yoshiharu Doi
(VCH Publishers, New York, 1990), approx. 153 pages.
ISBN 0-89573-746-9

"Microbial polyesters" essentially means poly-3-hydroxybutyrate (PHB) and its close relatives. Many bacteria store this polymer when they are supplied with an abundant carbon source but too little nitrogen to allow them to multiply rapidly. In the same way, plants store starch for the winter and people store fat in their bodies for use in hungrier days. Like people, the bacteria can become quite plump, with PHB amounting to 80% of their dry weight.

During the last oil crisis ICI developed a commercial fermentation process to produce PHB from *Alcaligenes eutrophus*. The polymer has potential as an industrial thermoplastic since it is solvent soluble and melts at about 175°C, similar to polypropylene. Much effort went into modifying the bacterial genetics to allow a high production level. A major problem was the development of economic methods to separate the polymer granules from the rest of the "guts" of the bacteria. The other traditional problem with such biopolymers is that all polymer properties are very sensitive to molecular weight and this proves hard to control in fermentations. PHB is a real test of the viability of biotechnological routes to materials production. It is a major and simple cell product but, as a direct competitor to industrial polymers, it is at least an order of magnitude too expensive at the moment.

Over the last four years, Doi and a large group of co-workers have published extensively on PHB.

Doi's presentation is strong on polymer production by a wide range of bacterial genera and on the production of various copolymers. A crucial problem with the development of PHB was its rapid degradation at the melting point, which makes molding and extrusion difficult. This was solved by feeding selected bacterial strains with some of a hydrocarbon or fatty acid with an odd number of carbons. The result is a polyhydroxybutyrate-hydroxyvalerate copolymer, with a reduced melting point so that it can be molded. Doi has done extensive work on this "bio-copolymerization" and has also incorporated units of 4-hydroxybutyrate, longer chain 3-alkanoates and chloro- and fluoro-alkanoates. This does promise to become a real family of polymers.

A great deal of interesting work has been done on crystallization and nucleation, on degradation and on comparisons with synthetic PHB, which is not as stereoregular. Doi's presentation is much weaker on these aspects and also on applications. Biodegradability is the obvious selling point for PHB. The polymer has been used for surgical sutures and for drug delivery but the quantities needed for such applications are tiny. Recently it has been promoted as an environmentally friendly packaging for cosmetics, which may be the breakthrough to large-scale uses.

Microbial Polyesters is really a review rather than a definitive work. It is clearly written, contains a mass of data, and is recommended to anyone interested in whether biotechnology is going to seriously impact materials.

Reviewer: Paul Calvert, an associate professor at Arizona Materials Laboratories, part of the University of Arizona in Tucson, works on polymer-ceramic "biomimetic" composites.

There is no Calendar of upcoming meetings in this issue of the *MRS Bulletin*. Calendar entries from June 1, 1991 through December 31, 1992 are listed in the May issue. The next calendar will be published in the July issue and bimonthly afterward.

To list an event in the Calendar, contact: J. Dininny, Materials Research Society, 9800 McKnight Road, Pittsburgh, PA 15237; phone (412) 367-3003; fax (412) 367-4373.