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Biomedical Materials

EDITORS
J. M. Williams
M. F. Nichols
W. Zingg

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Biomedical Materials

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EDITORS:

J. M. Williams
Oak Ridge National Laboratory, Solid State Division, Oak Ridge, Tennessee, U.S.A.

M. F. Nichols
University of Missouri, Dalton Research Center, Columbia, Missouri, U.S.A.

W. Zingg
University of Toronto, Institute of Biomedical Engineering, Toronto, Ontario, Canada

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Preface

This volume contains selected invited and contributed papers that were presented at the "Biomedical Materials Symposium", which comprised part of the Fall Meeting of the Materials Research Society, held in Boston, MA, December 2 through 7, 1985. The symposium was the first ever sponsored by the Society in the area of biomaterials, and as such it marked the first major interaction between the biomedical materials community and the rest of the Society. Therefore, to help make for creative exchange, program guidelines were designed to elicit responses concerning research in a broad range of materials problems, technologies, and analysis techniques pertinent to biomedical engineering. This goal accounts for the breadth of the subject matter that appears in these proceedings.

In proposing the symposium, the Program Committee and the organizers acted in the belief that these are favorable times for more interaction between the biomaterials community and others engaged in materials research. Biomedical engineering and basic materials research are both undergoing important changes. On the one hand basic research in materials science has become increasingly capital-intensive in recent years. An analysis technique such as neutron scattering, useful for example in development of polymer composites, is enormously expensive on the front end, and in this case, continued operation is also expensive. Materials analysis by synchrotron radiation provides another such example. Ion accelerator techniques for processing and analysis of materials are not nearly so expensive, but still remain relatively inaccessible to workers in many laboratories. Other techniques such as secondary ion mass spectroscopy (SIMS), transmission electron microscopy (TEM), or various coatings techniques, although less expensive still, are nevertheless often most fruitfully employed where results can be correlated with those from other techniques. The overall effect has been that a substantial amount of materials research has been concentrated in larger institutions. The primary purpose of the MRS is to bring together scientists from many different institutions and many different backgrounds to discuss materials problems of mutual interest. This interdisciplinary approach to materials research makes the symposia sponsored by the MRS unique. An aspect of the Society's programming format that should be of particular interest to the biomedical engineer, too, is that program topics are not restricted to presentations on just one type of material -- polymeric, ceramic, or metallic. Instead, topical symposia are designed to summarize developments in areas of materials research that are particularly active and fruitful at the time of scheduling, regardless of material or whether the topic is oriented toward technique, application, or basic science.

Expertise in use and development of biomaterials is distributed largely in a host of universities, private and public hospitals, smaller firms, and state and federal agencies. For other reasons, also -- scale of engineering operations and production, diversity in types of surgically implantable devices needed, and diversity in engineering approach -- biomedical engineering is a more diffuse discipline than many other areas of engineering. One central theme that has emerged, however, is the idea that bioengineering can include "custom tailoring" of the basic materials of construction. In the past construction materials for surgically implantable devices have been chosen largely from readily available, multi-purpose polymers, ceramics, and metal alloys that had been developed for commercial use. Differences between medical grades of materials and commercial grades have been related to impurity control, quality, cleanliness, uniformity of product, etc., but not to basic properties. Obviously, biocompatibility, together with the best optimization of other properties

that could be obtained for the purpose, consistent with biocompatibility, provided the criteria for selection. Now, instead of just shaping existing materials to form his devices, the innovator in biomedicine is seeking to modify surface and bulk properties of existing materials, or to originate entirely new materials (fibrous materials, new alloys, films, composites, etc.) to meet his needs. This theme enters fully half of the presentations in this volume. As this trend matures, biomedical engineers will increasingly require access to the most modern of information on processing techniques, analysis techniques, and on the relationship between structure and properties of materials. The organizers believe that the MRS programs provide a consolidated "market" in which the biomaterials engineer can efficiently learn about new general developments in materials science and technology and, at the same time, keep others in the field of materials informed of his own developments and anticipated requirements.

We trust that this volume will represent only the first in a succession of MRS symposia that feature topics in biomaterials.

J. M. Williams

M. F. Nichols

W. Zingg

Acknowledgments

We are indebted to the MRS Officers and Councillors and to the Program Committee for the 1985 Fall Meeting for the opportunity to organize the symposium. The advice and sustained support of the Committee, John E. E. Baglin, David K. Biegelsen, and John C. C. Fan, throughout all phases of the activity were particularly important to the success of the venture.

We express sincere gratitude to the expert staff at MRS headquarters, including especially, John B. Ballance, Mary E. Kaufold, Gail A. Oare, and Janice M. Dininny, for their professional contributions in publicizing, organization, and management of the event and for their further achievements in compilation and production of the present volume.

The accomplishments of Kathy C. Brunson (Oak Ridge National Laboratory) in organization, management, editorial assistance, and myriad other tasks, associated with the symposium and proceedings, were invaluable. Further thanks are due to Wanda Wells of Dalton Research Center for her contributions to organizational activities from that institution.

The efforts of those acknowledged above would have resulted in little of value were it not for the splendid cooperation of all participants -- invited speakers, session chairmen, other contributors and reviewers of papers. The time and care that the participants invested in the symposium were greatly appreciated. The papers from abroad were especially welcome. The symposium was noteworthy for its international character in that contributions were received from Canada, China, France, Germany, Sweden, Switzerland, and the United Kingdom.

J.M. Williams
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