SCIENCE OF

CERAMIC CHEMICAL PROCESSING

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Front row left to right: Dr. Ralph Iler, Keynote Awardee for inorganic chemistry; Prof. Paul Flory, Keynote Awardee for organic and polymer chemistry; Prof. Per-Olov Löwdin, Keynote Awardee for quantum chemistry. Second row left to right are presenters of Keynote Awards: Dr. George Parshall, Director of Chemistry Research, E. I. duPont de Nemours presenter of Dr. Iler's Keynote Award; Mr. Marshall Criser, President of the University of Florida, presenter of Prof. Löwdin's Keynote Award; Dr. Leo Young, Director, Research and Laboratory Management, Office of the Under Secretary of Defense, presenter of Prof. Flory's Keynote Award.

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In Memoriam

PAUL J. FLORY
Nobel Laureate
June 19, 1910–Sept. 8, 1985

RALPH K. ILER
July 12, 1909—November 9, 1985

PREFACE

This book contains the proceedings of the "Second International Conference on Ultrastructure Processing of Ceramics, Glasses, and Composites, held February 25–March 1, 1985 in Palm Coast, Florida. The conference was sponsored by the Department of Materials Science and College of Engineering, University of Florida and supported by the Directorate of Chemical and Atmospheric Sciences of the Air Force Office of Scientific Research. More than 250 scientists and engineers from university, industry, and government laboratories attended the conference, including researchers from the United States, Canada, England, France, Italy, Japan, and West Germany.

Three Keynote Award lectures were presented. Dr. Ralph Iler's Keynote Award was given for a lifetime's contribution to inorganic chemistry. His pioneering work in the study of silica polymerization and colloidal chemistry is the foundation of many of the concepts explored in Parts 1, 2, and 5 of this book.

Professor Paul Flory's Keynote Award was given for a lifetime's contribution to polymer chemistry. His developments in the theory of organic networks and structures provide the basis for interpreting many of the new materials developments discussed in Parts 1, 3, and 4 of this book.

Professor Per-Olov Löwdin's Keynote Award was given for a lifetime's contribution to quantum chemistry. His organization and chairmanship of the Sanibel Conference for 25 years have been a major influence on quantum calculations being directed toward practical applications such as the silicon-based systems discussed in Parts 3 and 4.

The concept of chemically based ultrastructure processing involves a synthesis of the fields of inorganic chemistry, organic chemistry, polymer chemistry, surface chemistry, and quantum chemistry, all oriented toward producing a new generation of high-performance materials. The three keynote awardees have provided much of the foundation for that synthesis.

In addition to the three keynote lectures, 34 of 36 oral presentations and 23 of 42 poster papers are included, selected after peer review by the conference review board. The resulting 60 chapters were organized into six parts: sol–gel science, applications of sol–gel processing, materials from organometallic precursors, ultrastructure in macromolecular materials, micromorphology (fine particulate) science, and quantum chemistry (a review).

Consequently, this book provides a comprehensive treatment of the broad scientific basis of producing ceramic, glass, and composite materials using chemistry-based processing methods.

It is the goal of ultrastructure processing to control the structure, surfaces, and interfaces of materials and devices at the molecular level in the earliest stages of production. The scientific understanding of molecular structure control of complex materials is beginning to emerge, as is evident in this volume. However, there is still much to be learned that will require multiple investigator efforts. The beginnings of such interdisciplinary efforts are evident herein. The long-term consequences of this new approach to creating complex materials from a molecular viewpoint are just beginning to emerge. The potential rewards are enormous.

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PART 1 SOL–GEL SCIENCE