PREFACE

HIGH TEMPERATURE AND ENERGY-RELATED MATERIALS CONFERENCE

The following seven papers are the plenary lectures from the Fourth International Conference on High Temperature and Energy-Related Materials. The conference, sponsored jointly by IUPAC through Commission II.3 on High Temperature and Solid-State Chemistry and by Los Alamos National Laboratory, was held in Santa Fe, New Mexico, USA, April 1984.

The conference was the fourth in a series (1977, 1979, 1981, 1984) of IUPAC conferences on high-temperature materials. Its objective was to review the present state of knowledge of the physico-chemical properties of materials for high-temperature processes and in energy production, and to serve as a guide for the direction of future research. There were sessions on thermodynamic measurements; chemical synthesis of new materials; thermodynamic calculations; properties of materials; techniques, instrumentation, and fabrication; lasers in investigation of high-temperature processes; and vaporization phenomena. In addition to the seven plenary lectures published here, there were 68 contributed papers, presented orally or as posters, which will be published in High Temperature Science. There were 133 participants from ten nations.

The plenary lectures and other conference papers and discussions illustrated current and emerging trends in high temperature science. Major experimental tools continue to be mass spectrometry; various kinds of spectroscopy, often coupled with matrix isolation of the high-temperature species; and a wide variety of techniques to characterize solids and surfaces. New tools which are having a major impact on high temperature work, just as they are in other fields of chemistry and physical science, are computers -- in both experiment and theoretical modeling -- and lasers -- both as heat sources and as diagnostic probes.

Perhaps the biggest and most exciting change seen in the conference is one predicted and hoped for by observers a half-decade ago: the fact that computers, lasers, other new tools, and application of multiple techniques now allow researchers to examine the complex, multi-element, multiphase systems of interest in technology rather than being forced to concentrate on prototypic binary interactions or isolated two-phase systems. A related development is that there appears to be emerging an implicit concensus concerning the approach to description and understanding of complex systems. The developing emphasis appears to be what one might call a pragmatic, "building-block" or "permutation theory," approach which reflects maturity and an acceptance of limitations. In this approach, thermodynamics, along with quasi-equilibrium descriptions and models, are used to the maximum degree possible. Detailed kinetics are then brought in to describe those aspects of the system where they are clearly necessary. For the thermodynamic descriptions, the tendency is to find clever ways to use ideal behavior and consideration of only binary and ternary interactions so that the number of parameters is minimized, even for very complex systems.

The last assessment of developments, as illustrated by this conference, which deserves comment is that, although the organizers tried to place an emphasis on synthesis, the use of molecular principles and synthetic chemical approaches to tailor-make materials is still as much a hope as a reality. There are hints of exciting developments just over the horizon.

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