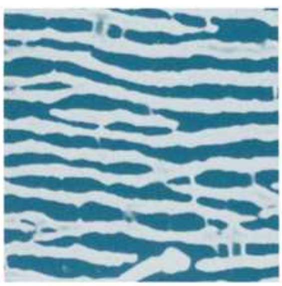
MICON 86

Optimization of Processing, Properties, and Service Performance Through Microstructural Control



Bramfitt/Benn/ Brinkman/Vander Voort
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MiCon 86: OPTIMIZATION OF PROCESSING, PROPERTIES, AND SERVICE PERFORMANCE THROUGH MICROSTRUCTURAL CONTROL

A symposium
sponsored by ASTM
Committee E-4 on Metallography
Philadelphia, Pa., 15–16 May 1986

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Foreword

The symposium on MiCon 86: Optimization of Processing, Properties, and Service Performance Through Microstructural Control was held in Philadelphia on 15–16 May 1986. Sponsored by ASTM Committee E-4 on Metallography, MiCon 86 was co-sponsored by The Metallurgical Society of the American Institute of Mining, Metallurgical and Petroleum Engineers, the International Metallographic Society, and the Philadelphia Chapter of ASM International. Bruce Bramfitt, Bethlehem Steel Corporation, served as symposium chairman. Charles Brinkman, Oak Ridge National Laboratories, Ray Benn, INCO Alloys International, and George Vander Voort, Carpenter Technology Corporation, served as session chairmen. All four have edited this publication.

The success of the first two MiCon symposia in 1978 and 1982 and the publications based upon them (*ASTM STP 672* and *ASTM STP 792*) was the result of the efforts of the MiCon Organizing Committees. The MiCon 86 Organizing Committee carried on the tradition and themes of the previous MiCon symposia, and the seeds of formation of the MiCon 90 Organizing Committee are now germinating. As in the two preceding symposia, the MiCon 86 symposium featured materials for energy applications—specifically, high-temperature and advanced materials for energy generation, aerospace, and ground transportation.

The MiCon Organizing Committee is deeply appreciative of the support of MiCon 86 by the following corporations:

- Carpenter Technology Corporation
- Ladish Company

MiCon ORGANIZING COMMITTEE

The MiCon Symposium is the responsibility of the MiCon Organizing Committee. The members of the committee for MiCon 86 and their responsibilities are:

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Related ASTM Publications

MiCon 82: Optimization of Processing, Properties, and Service Performance Through Microstructural Control, STP 792 (1983), 04-792000-28

MiCon 78: Optimization of Processing, Properties, and Service Performance Through Microstructural Control, STP 672 (1979), 04-672000-28

A Note of Appreciation to Reviewers

The quality of the papers that appear in this publication reflects not only the obvious efforts of the authors but also the unheralded, though essential, work of the reviewers. On behalf of ASTM we acknowledge with appreciation their dedication to high professional standards and their sacrifice of time and effort.

ASTM Committee on Publications

ASTM Editorial Staff

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Overview

This symposium, as with the previous two MiCon symposia, was organized under the aegis of ASTM Committee E-4 on Metallography. The MiCon 86 symposium was co-sponsored by the Philadelphia Chapter of ASM International, the International Metallographic Society, and The Metallurgical Society of the American Institute of Mining, Metallurgical and Petroleum Engineers.

The theme of all three MiCon symposia has been to emphasize the role of microstructure in the optimization of processing, properties, and service performance. The acronym MiCon stands for *mi*crostructural *con*trol. Every material engineer and metallurgist understands the important and fundamental interrelationship between the microstructure and properties of a material. MiCon 86 was designed to increase this understanding.

The specific focus of the symposium was advanced and high-temperature materials for the 1990's and beyond. All of the papers were invited by the MiCon 86 Organizing Committee and represent both present and future needs for a spectrum of materials. The symposium was divided into three sessions, each of which is highlighted briefly below.

High-Temperature Materials for Power Generation

No area is more important to this nation than the generation of electric power for private and industrial use. Materials engineers have been challenged in the present decade to provide an array of materials for the safe generation of electric power using fossil and nuclear fuels. *Marshall*, of the Central Electricity Generating Board in the United Kingdom, describes many of these materials' challenges in his very extensive review paper. The steelmaker's role in providing materials for power generation is described in the paper by *Bodnar and Cappellini*. The challenges presented here include providing clean steels for improved ductility, toughness, and uniformity of mechanical properties. The future steels include both ferritic and austenitic steels with properties tailored to a specific application within the power plant. *Todd et al* and *Maziasz* discuss these steels in respect to their high-temperature service performance. In all these papers the role of microstructure is emphasized.

High-Temperature Materials for Aerospace

The papers in this session focus on advanced high-temperature materials for the gas turbine engine. *Sprague and Smashey* give an overview of materials needs and challenges for the gas turbine engine for the year 2005. The success of meeting the challenges depends upon the establishment of well understood microstructure/property relationships in these materials. Advanced processing will be needed, particularly particle metallurgy as described by *Lawley* and directional solidification as described by *MacKay and Nathal*. The newer particle metallurgy processes that are now emerging, such as the Osprey process, will play an important role in processing advanced high-temperature materials. Oxide-dispersion strengthened alloys using special particle metallurgy processing are also being considered.

Benn describes the recent advances in this field. Although directional solidification is now a major processing method for the manufacture of gas turbine blades and disks, it will play an even larger role in the future. The microstructures of the directionally solidified alloys are unique and have a profound effect on the subsequent properties. New materials such as the nickel aluminides are now emerging. These intermetallic alloys have unique properties. *Liu* describes the development of nickel aluminides for high-temperature structural applications.

Advanced Materials for Ground Transportation

Alternatives are being considered for the conventional internal combustion engine for the automobile of the future. The Stirling engine described by *Stephens* of NASA may be one such alternative. However, the materials challenge is tremendous because of the vigorous requirements of the Stirling engine. Advanced materials in the form of composites will make up a fairly large portion of the structural materials in the future automobile. Special fiber architecture will be needed for high strength, elastic modulus, and toughness. Of particular interest regarding these applications are the composites described by *Ko et al.*

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